DECISION MAKING

in Plastic Surgery

Edited by

JEFFREY L. MARSH, MD
Clinical Professor of Plastic Surgery, St. Louis University School of Medicine; Director of Pediatric Plastic Surgery and Director of Cleft Lip/Palate and Craniofacial Deformities Center, St. John’s Mercy Children’s Hospital, St. Louis, Missouri

CHAD A. PERLYN, MD, PhD
Attending Physician, Division of Plastic Surgery, Miami Children’s Hospital; Clinical Associate Professor of Surgery, Department of Surgery, Florida International University College of Medicine, Miami, Florida
Important note: Medicine is an ever-changing science undergoing continual development. Research and clinical experience are continually expanding our knowledge, in particular our knowledge of proper treatment and drug therapy. Insofar as this book mentions any dosage or application, readers may rest assured that the authors, editors, and publishers have made every effort to ensure that such references are in accordance with the state of knowledge at the time of production of the book.

Nevertheless, this does not involve, imply, or express any guarantee or responsibility on the part of the publishers in respect to any dosage instructions and forms of applications stated in the book. Every user is requested to examine carefully the manufacturers’ leaflets accompanying each drug and to check, if necessary in consultation with a physician or specialist, whether the dosage schedules mentioned therein or the contraindications stated by the manufacturers differ from the statements made in the present book. Such examination is particularly important with drugs that are either rarely used or have been newly released on the market. Every dosage schedule or every form of application used is entirely at the user’s own risk and responsibility. The authors and publishers request every user to report to the publishers any discrepancies or inaccuracies noticed. If errors in this work are found after publication, errata will be posted at www.thieme.com on the product description page.

Some of the product names, patents, and registered designs referred to in this book are in fact registered trademarks or proprietary names even though specific reference to this fact is not always made in the text. Therefore, the appearance of a name without designation as proprietary is not to be construed as a representation by the publisher that it is in the public domain.
I dedicate this book to my late parents, Frieda and Harry Marsh, whose focus on task, tolerance of others, and quiet self-sacrifice made it possible for me to become educated and develop into the person I’ve become; to my wife, Rebecca Moyer Marsh, and daughter, Judith Kohli Flick, for their support, understanding, and love; to all of the medical students, residents, and fellows who stimulated my mind with their questions and often morphed from student to friend; to the women who so effectively managed my surgical practice (Karen Lask, Shannon Stamberger, and Kristen DeRousse), coordinated my cleft/craniofacial program (Virginia Knapp, Sibyl Scheve, and Dana Kiley), and provided special nursing service for my patients (Joan Barzilai and DeAnn Wilson); and finally to the admissions committee and faculty of the Johns Hopkins University School of Medicine, who saw promise in a young, aspiring physician and gave him the opportunity and tools to fulfill far more than his limited dream of 1965.

J.L.M.

I dedicate this book to my wife, Brooke, my best friend, who loves me and supports me every day, without question, and whose belief in me motivates me beyond all else; to my parents, Marilyn and Don, whose love, guidance, and teaching allowed me to follow my dreams, and who showed me, through their own example, that I could make a difference in the lives of those around me; to my in-laws, Gina and Richard, who have become my second parents and whose support and love have allowed us to build our professional and personal lives in such a wonderful way; to Dr. Bruce Bauer, who inspired me; to Dr. Seth Thaller, who educated me; to Dr. Susan Mackinnon, who believed in me; to Dr. Jeffrey Marsh, who molded me, and, most of all, to my dear son, Ethan: If I have one wish for you as a father, may it be that you find individuals in your life who will love you, mentor you, teach you, and inspire you, as I have found in mine.

C.A.P.
Contributors

Gary J. Alter, MD
Assistant Clinical Professor, Division of Plastic Surgery, University of California–Los Angeles School of Medicine, Los Angeles, California

Sherrell J. Aston MD, FACS
Chairman, Department of Plastic Surgery, Manhattan Eye, Ear, and Throat Hospital; Professor of Surgery (Plastic), New York University School of Medicine, New York, New York

Donald P. Baumann, MD
Assistant Professor, Department of Plastic Surgery, The University of Texas M. D. Anderson Cancer Center, Houston, Texas

Mark E. Beehner, DDS, MD
Assistant Clinical Professor of Surgery (Oral and Maxillofacial Surgery), Department of Surgery, Washington University School of Medicine, St. Louis, Missouri

Francesco Boccardo, MD, PhD
Assistant Professor of Surgery, Department of Surgery–Unit of Lymphatic Surgery, University of Genoa, Genoa, Italy

Kelly M. Bolden, MD
Chief Resident, Department of Plastic Surgery, University of Texas Southwestern, Dallas, Texas

Gregory H. Borschel, MD, FAAP, FACS
Assistant Professor, Division of Plastic and Reconstructive Surgery, The Hospital for Sick Children; Assistant Professor, Division of Plastic and Reconstructive Surgery, University of Toronto; Associate Scientist, Institute of Biomaterials and Biomedical Engineering, SickKids Research Institute, Toronto, Ontario, Canada

Adam G. Buchanan, MD
Instructor, Department of Ophthalmology and Visual Science, Washington University School of Medicine, St. Louis, Missouri

Charles E. Butler, MD
Professor, Department of Plastic Surgery, The University of Texas M. D. Anderson Cancer Center, Houston, Texas

Corradino Campisi, MD, PhD
Full Professor of Surgery, Department of Surgery, Section of Lymphology and Microsurgery, San Martino University Hospital, Genoa, Italy

Paul S. Cederna, MD
Associate Professor, Section of Plastic Surgery; Associate Chairman, Department of Surgery; Associate Chief of Staff, University of Michigan Health System, Ann Arbor, Michigan

James Chang, MD, FACS
Chief, Division of Plastic and Reconstructive Surgery; Professor, Departments of Surgery, Orthopaedic Surgery, Hand and Microsurgery, Stanford University Medical Center, Palo Alto, California

Yu-Ray Chen, MD
Professor, Department of Surgery, Chang Gung University; Attending Surgeon, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Taoyuan, Taiwan

Jonathan Cheng, MD
Assistant Professor, Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas
Contributors

Bong-Kyoon Choi, MD
Fellow, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Taipei, Taiwan

Frank S. Ciminello, MD
Director of Craniofacial Surgery, Department of Plastic and Reconstructive Surgery, University of Medicine and Dentistry of New Jersey, Newark, New Jersey

Howard M. Clarke, MD, PhD, FRCSC, FAAP, FACS
Professor of Surgery, Department of Surgery, University of Toronto; Division of Plastic Surgery, The Hospital for Sick Children, Toronto, Ontario, Canada

Randall A. Clary, MD
Pediatric Otolaryngologist, Private Practice, Department of Otolaryngology, St. John’s Mercy Children’s Hospital, St. Louis, Missouri

Christine G. Curtis, BScPT, MSc
Physiotherapist, Department of Rehabilitation Services, The Hospital for Sick Children, Toronto, Ontario, Canada

Philip L. Custer, MD
Professor, Department of Ophthalmology and Visual Sciences, Washington University School of Medicine, St. Louis, Missouri

Sean J. Darcy, MD
Resident Physician, Aesthetic and Plastic Surgery Institute, University of California–Irvine Medical Center, Orange, California

Jorge I. de la Torre, MD
Professor and Chief, Division of Plastic Surgery, University of Alabama at Birmingham, Birmingham, Alabama

A. Lee Dellon, MD, PhD
Professor of Plastic Surgery and Neurosurgery, Johns Hopkins University, Baltimore, Maryland

E. Gene Deune, MD, MBA
Associate Professor, Co-Director of Hand Surgery Division, Department of Orthopedic Surgery; Associate Professor, Director of Hand Surgery Section, Division of Plastic Surgery, Johns Hopkins University School of Medicine, Baltimore, Maryland

Joseph J. Disa, MD, FACS
Attending Surgeon, Plastic and Reconstructive Surgery Service, Memorial Sloan-Kettering Cancer Center; Professor of Surgery, Weill Cornell Medical College, New York, New York

Frederick J. Duffy, Jr., MD
Clinical Assistant Professor, Department of Plastic Surgery, University of Texas Southwestern Medical School; Attending Plastic Surgeon, Medical City Dallas Hospital, Dallas, Texas

Brent M. Egeland, MD
Resident, Section of Plastic Surgery, Department of Surgery, University of Michigan, Ann Arbor, Michigan

Maristella S. Evangelista, MD, MBA
Resident Physician, Aesthetic and Plastic Surgery Institute, University of California–Irvine Medical Center, Orange, California

Julius W. Few, MD
Clinical Associate, Division of Plastic Surgery, University of Chicago; Director, The Few Institute for Aesthetic Plastic Surgery, Chicago, Illinois

Lucian Fodor, MD
Chief, Department of Plastic and Reconstructive Surgery, Emergency District Hospital, Cluj-Napoca, Romania; Attending Surgeon, Department of Plastic Surgery, Rambam Health Care Campus, Haifa, Israel

Christian N. Ford, MD
Department of Plastic Surgery, University of Stanford, Stanford, California
Contributors

James W. Forsen, MD
Attending Otolaryngologist, Department of Otolaryngology, St. John’s Mercy Medical Center, St. Louis, Missouri

Thomas J. Francel, MD, FACS
Associate Clinical Professor, Department of Surgery, St. Louis University; Chief of Plastic Surgery, Department of Surgery, St. John’s Mercy Medical Center, St. Louis, Missouri

Francesco Gargano, MD, PhD
Resident Physician, Department of Plastic Surgery, Brown University, Providence, Rhode Island

David Gault, MB, ChB, FRCS
Consultant Plastic Surgeon, London Centre for Ear Reconstruction, The Portland Hospital, London, United Kingdom

Daron Geldwert, MD
Attending Physician, Department of Plastic Surgery, Southern California Permanente Medical Group, Fontana, California

Thomas Gifford, MD
Physician, Department of Otolaryngology–Head and Neck Surgery, University of Utah, Salt Lake City, Utah

Raymond C.W. Goh, MBBS(Hons), FRACS(Plast)
Consultant Plastic Surgeon, Craniofacial Center, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Taipei, Taiwan.

Aaron G. Grand, MD
Clinical Assistant Professor, Division of Plastic Surgery; Department of Orthopaedic Surgery, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania

Ronald P. Gruber, MD
Clinical Assistant Professor, Division of Plastic and Reconstructive Surgery, University of California–San Francisco, San Francisco; Adjunct Clinical Assistant Professor, Division of Plastic and Reconstructive Surgery, Stanford University, Stanford, California

Daniel A. Hatef, MD
Resident, Department of Plastic Surgery, Baylor College of Medicine, Houston, Texas

Erika Henkelman, MD
Resident Physician, Southern Illinois University School of Medicine, Division of Plastic Surgery, Springfield, Illinois

Ginard I. Henry, MD
Assistant Professor, Department of Surgery–Plastic Surgery, University of Chicago Medical Center; Assistant Professor, Department of Surgery–Plastic Surgery, Weiss Memorial Hospital, Chicago, Illinois

Dennis J. Hurwitz, MD, FACS
Clinical Professor of Surgery (Plastic), Department of Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania; Director, Hurwitz Center for Plastic Surgery, Pittsburgh, Pennsylvania, Brandywine, Pennsylvania, Beverly Hills, California

Ian T. Jackson, MB, ChB, MD(G)(Hon), DSc(Hon), FRCS(Ed), FRCS(G)(Hon), FRACS(Hon)
Director, Craniofacial Institute, Providence Hospital, Southfield, Michigan

Jeffrey E. Janis, MD, FACS
Associate Professor and Program Director, Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas

Ryan D. Katz, MD
Hand Surgery Fellow, Raymond M. Curtis Hand Center, Baltimore, Maryland

Daniel Kwan, MD
Resident, Department of Plastic Surgery, University of Chicago, Chicago, Illinois

Anthony N. LaBruna, MD, FACS
Director of Facial Plastic and Reconstructive Surgery, Department of Otolaryngology; Associate Professor of Clinical Surgery, Department of General Surgery, Division of Plastic Surgery, Weill Cornell Medical College, New York, New York

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
Contributors

W. Thomas Lawrence, MPH, MD
Professor and Chief of Plastic Surgery, University of Iowa Hospitals and Clinics, Iowa City, Iowa

W.P. Andrew Lee, MD
Professor of Surgery; Chief, Division of Plastic Surgery; University of Pittsburgh, Pittsburgh, Pennsylvania

Valerie Lemaine, MD, MPH, FRCSC
Fellow, Plastic and Reconstructive Surgery, Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, New York

Yu-Fang Liao, DDS, PhD
Assistant Professor, College of Medicine, Chang Gung University, Taoyuan; Attending Staff, Department of Craniofacial Orthodontics, Chang Gung Memorial Hospital, Taipei, Taiwan

Michael P. Lin, MD, MS
Resident Physician, Aesthetic and Plastic Surgery Institute, University of California–Irvine Medical Center, Orange, California

Lun-Jou Lo, MD
Professor, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Taipei, Taiwan

James N. Long, MD, FACS
Assistant Professor, Division of Plastic Surgery, University of Alabama at Birmingham, Birmingham, Alabama

Albert Losken, MD, FACS
Associate Professor of Surgery, Department of Surgery, Division of Plastic and Reconstructive Surgery, Emory University, Atlanta, Georgia

Daniel P. Luppens, MD
Atlantic Plastic Surgery, Salisbury, Maryland

Steven D. Macht, MD, DDS
Clinical Professor of Surgery, Division of Plastic Surgery, George Washington University, Washington, DC

Paul Manson, MD
Professor and Chief, Department of Plastic Surgery, Johns Hopkins School of Medicine; Professor, Department of Plastic Surgery, University of Maryland Shock Trauma Unit, Baltimore, Maryland

Jeffrey L. Marsh, MD
Clinical Professor of Plastic Surgery, St. Louis University School of Medicine; Director, Pediatric Plastic Surgery; Director, Cleft Lip/Palate and Craniofacial Deformities Center, St. John’s Mercy Children’s Hospital, St. Louis, Missouri

Jon A. Mathy, MD
Consultant Plastic Surgeon, Department of Plastic and Reconstructive Surgery, Middlemore Hospital, Auckland, New Zealand

Constantino G. Mendieta, MD, FACS
4 Beauty Aesthetic Institute, Miami, Florida

Frederick J. Menick, MD
Associate Clinical Professor, Division of Plastic Surgery, University of Arizona; Chief, Division of Plastic Surgery, St. Joseph’s Hospital, Tucson, Arizona

Steven Ross Mobley, MD
Associate Professor, Department of Surgery, Division of Otolaryngology–Head and Neck Surgery, University of Utah, Salt Lake City, Utah

Michael Morhart, MSc, MD, FRCSC
Associate Clinical Professor, Department of Surgery, Division of Plastic Surgery, University of Alberta, Edmonton, Alberta, Canada

Larry L. Myers, MD, FACS
Assistant Professor, Department of Otolaryngology–Head and Neck Surgery, University of Texas Southwestern Medical Center, Dallas, Texas

Farzad R. Nahai, MD
Assistant Clinical Professor, Division of Plastic and Reconstructive Surgery, Emory University; Private Practice, Paces Plastic Surgery, Atlanta, Georgia

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
Michael W. Neumeister, MD, FRCSC, FACS
Professor and Chairman, Southern Illinois University School of Medicine, Division of Plastic Surgery, Springfield, Illinois

Rei Ogawa, MD, PhD
Associate Professor, Department of Plastic, Reconstructive, and Aesthetic Surgery, Nippon Medical School, Tokyo, Japan

Chad A. Perlyn, MD, PhD
Attending Physician, Division of Plastic Surgery, Miami Children’s Hospital; Clinical Associate Professor of Surgery, Department of Surgery, Florida International University College of Medicine, Miami, Florida

Silvio Podda, MD
Director, Birth Defect Center, Regional Craniofacial Center, Department of Plastic Surgery, St. Joseph’s Children’s Hospital, Paterson; Faculty Member, Department of Maxillofacial Surgery, Seton Hall University, South Orange, New Jersey

Julian J. Pribaz, MD
Professor, Department of Surgery, Brigham and Women’s Hospital, Harvard Medical School, Boston, Massachusetts

Andrea L. Pusic, MD, MHS, FRCSC
Assistant Professor, Department of Plastic and Reconstructive Surgery, Memorial Sloan-Kettering Cancer Center, New York, New York

Timothy J. Reichert, MD
Clinical Professor, Department of Otolaryngology, St. Louis University, St. Louis, Missouri

Eduardo D. Rodriguez, MD, DDS
Chief of Plastic, Reconstructive, and Maxillofacial Surgery, R. Adams Cowley Shock Trauma Center; Associate Professor of Surgery, University of Maryland School of Medicine, Johns Hopkins School of Medicine, Baltimore, Maryland

Michelle C. Roughton, MD
Resident, Section of Plastic and Reconstructive Surgery, University of Chicago Medical Center, Chicago, Illinois

Shai M. Rozen, MD
Assistant Professor, Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, Texas

Arlene A. Rozzelle, MD, FACS, FAAP
Chief, Department of Plastic and Reconstructive Surgery; Director, Cleft/Craniofacial Team; Director, Vascular Anomalies Team, Children’s Hospital of Michigan; Associate Professor, Wayne State University School of Medicine, Detroit, Michigan

Peter M. Rumbolo, MD, FACS
Clinical Assistant Professor, Department of Surgery, Division of Plastic Surgery, St. Louis University School of Medicine; Associate Director, Burn Center, Department of Surgery, Division of Burn Surgery, St. Johns Mercy Medical Center, St. Louis, Missouri

Christian E. Sampson, MD
Assistant Professor, Department of Surgery, Harvard Medical School, Brigham and Women’s Hospital, Boston, Massachusetts

Subhro K. Sen, MD
Clinical Assistant Professor, Division of Plastic and Reconstructive Surgery, Stanford University Medical Center, Palo Alto, California

Jaimie T. Shores, MD
Assistant Professor of Surgery, Division of Plastic Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania

Meryl Singer, MD
Clinical Instructor, Department of Plastic Surgery, University of California–San Francisco, San Francisco, California
Contributors

Mark Sisco, MD  
Clinical Assistant Professor, Department of Surgery, Section of Plastic and Reconstructive Surgery, University of Chicago Pritzker School of Medicine, Chicago; Attending Physician, Division of Plastic Surgery, NorthShore University HealthSystem, Evanston, Illinois

David H. Song, MD, MBA, FACS  
Professor and Chief, Section of Plastic and Reconstructive Surgery; Vice-Chairman, Department of Surgery, University of Chicago Medical Center, Chicago, Illinois

Samuel Stal, MD  
Professor and Chairman, Department of Plastic Surgery, Baylor College of Medicine, Houston, Texas

W. Grant Stevens, MD, FACS  
Associate Clinical Professor of Plastic and Reconstructive Surgery, University of Southern California, Los Angeles, California

Anthony E. Sudekum, MD, FACS  
Chief of Surgery, Missouri Hand Center, O’Fallon, Missouri

Baran D. Sumer, MD  
Assistant Professor, Department of Otolaryngology–Head and Neck Surgery, University of Texas Southwestern Medical Center, Dallas, Texas

Dale M. Swift, MD  
Associate Clinical Professor, Department of Neurosurgery, University of Texas Southwestern Medical School, Dallas, Texas

Marissa J. Tenenbaum, MD  
Assistant Professor, Department of Plastic and Reconstructive Surgery, Washington University School of Medicine, St. Louis, Missouri

Puneet Tuli, MD, MBBS, MS, MCh Plastic Surgery  
Fellow, Craniofacial Institute, Providence Hospital, Southfield, Michigan

Yehuda Ullmann, MD  
Professor and Director, Department of Plastic Surgery, Rambam Health Care Campus, Haifa, Israel

Nicholas Vendemia, MD  
Chief Resident, Department of Plastic Surgery, New York Hospital–Weill Cornell Medical Center, New York, New York

Jennifer L. Walden, MD, FACS  
Attending Surgeon, Department of Plastic Surgery; Program Director, Department of Aesthetic Surgery, Manhattan Eye, Ear, and Throat Hospital, New York, New York

Joshua Waltzman, BS  
Medical Student, Aesthetic and Plastic Surgery Institute, University of California–Irvine Medical Center, Orange, California

Garrett A. Wirth, MD, MS, FACS  
Associate Clinical Professor of Plastic Surgery, Aesthetic and Plastic Surgery Institute, University of California–Irvine Medical Center, Orange; Medical Director, Wound Healing Center, Long Beach Memorial Medical Center, Long Beach, California

Peter D. Witt, MD  
Clinical Professor, Department of Surgery and Pediatrics, University of California–San Francisco, Fresno; Medical Director, Department of Pediatric Plastic Surgery, Children’s Hospital Central California, Madera, California

S. Anthony Wolfe, MD  
Chief, Division of Plastic Surgery, Miami Children’s Hospital, Miami, Florida

V. Leroy Young, MD  
President, BodyAesthetic Plastic Surgery & Skincare Center, BodyAesthetic Research Center, St. Louis, Missouri

Ronald M. Zuker, MD, FRCSC, FACS  
Professor of Surgery, Department of Surgery, Division of Plastic and Reconstructive Surgery, The Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada
Key to success in plastic surgery is the decision-making process that precedes any surgical intervention. Careful planning is essential for avoiding complications and achieving excellent outcomes. That is why this new book, Decision Making in Plastic Surgery, edited by Drs. Jeffrey Marsh and Chad Perlyn, is such a welcome addition to the literature. It supplies us with the tools for assessing a wide range of aesthetic and reconstructive problems. The unique format, composed of algorithms with supporting text, provides the reader with a virtual roadmap for navigating these frequently complex conditions and arriving at time-tested solutions.

This book is a follow-up to an earlier publication by Dr. Marsh that used this decision-tree approach. It is greatly expanded and improved, with an outstanding group of world-renowned contributors. The presentations are not only novel, but also extremely practical. They allow the reader to think through each problem, guided by the comments of the experts.

This book promises to be a great asset to both young surgeons new to practice as well as to more senior practitioners. It is a thrill to see the publication of this outstanding text. Drs. Marsh and Perlyn are to be congratulated on this major accomplishment.

Peter Randall MD, FACS
Emeritus Professor of Plastic Surgery
University of Pennsylvania School of Medicine
Preface

From generation to generation . . .

Three decades ago, a freshly minted, untried plastic surgeon rejected the invitation to stay on with his mentor for the opportunity to create a new program in craniofacial surgery. And now, that matured surgeon’s protégé has rejected the same invitation for the same opportunity, albeit at a different time and place.

Three decades ago, I was encouraged by my Chairman, Paul Weeks, to publish a book. He introduced me to his Editor at C.V. Mosby, Karen Berger, and, with her editorial assistance, my co-author, Michael Vannier, and I published Comprehensive Care for Craniofacial Deformities. Two decades ago, adopting a more editorial role, I indulged my passion for education and used the then-novel format of algorithms to produce Decision Making in Plastic Surgery. This book was favorably received by residents studying for plastic surgery boards, as well as by practicing plastic surgeons seeking guidance or brushing up for recertification.

In the Spring of 2008, anticipating his pediatric plastic/craniofacial surgery fellowship with me, Chad Perlyn suggested that he and I edit an updated, expanded second edition of Decision Making in Plastic Surgery. We approached Karen Berger, now the head of a well-established, St. Louis–based medical publishing house, Quality Medical Publishing, to produce the book. She was as enthusiastic as I recall she had been in the early 1980s, with my first book. And so for the past year, Chad and I have not only been student and teacher but also editorial colleagues: not Boswell and Johnson but collaborating friends. Chad solicited contributions from young, up-and-coming plastic surgeons while I worked the old-boys’-and-girls’ network. The lively discussions he and I have had about authors’ manuscript content—how it should be interpreted, what is too much, what is sufficient, and what is missing—has been invigorating for me.

I extend special thanks to our co-authors whom I know personally: those whom I knew before we were even plastic surgery residents, Sherrell Aston and A. Lee Dellen; my mentor, Ian Jackson; members of my study group, Steven Macht and Ronald Zuker; residents whom I helped train, Gary Alter, E. Gene Deune, Aaron Grand, W. Grant Stevens, and Leroy Young; my research fellow, Lun-Jou Lo; my craniofacial fellow, Arlene Rozelle; colleagues in St. Louis, Mark Beehner, Randall Clary, Philip Custer, James Forsen, Thomas Francel, Timothy Reichert, Peter Rumbolo, and Anthony Sudekum; pediatric plastic and craniofacial colleagues, Yu-Ray Chen, Dennis Hurwitz, Paul Manson, Samuel Stal, and S. Anthony Wolfe; and my long-time practice partner, Peter Witt.
I am grateful to Chad for stimulating me to undertake this opus and to Karen and all of the production staff at QMP for their encouragement and dedication to task. I also recognize the unselfish work of Kristen DeRousse, my Medical Assistant and so much more, who assumed the burden of manuscript communications on top of her regular clinical office duties. Last, but definitely not least, as with every book, peer-reviewed publication, presentation, and office personnel vacancy, I am indebted to my wife, Beki, for being there with me.

I believe there can be no greater reward for an educator than to have one’s student excel beyond and achieve more than the educator. My co-editor, Chad, has already surpassed me in many things, and I am confident he shall continue to do so.

Jeffrey L. Marsh, MD
# Contents

## 1 FUNDAMENTALS

### Wound Management

1. Upper Facial Lacerations, 2  
   **Chad A. Perlyn**

2. Lower Facial Lacerations, 4  
   **Chad A. Perlyn**

3. Acute Ear Trauma, 6  
   **Jon A. Mathy • Julian J. Pribaz**

4. Bites, 8  
   **Chad A. Perlyn**

5. Burns: Acute Management, 10  
   **Peter M. Rumbolo**

6. Acute Burns: Wound Management, 12  
   **Peter M. Rumbolo**

7. Chemical Burns, 14  
   **Chad A. Perlyn**

8. Frostbite, 16  
   **Chad A. Perlyn**

9. Hidradenitis Suppurativa, 18  
   **Chad A. Perlyn**
Contents

10 Pressure Sores, 20
   Chad A. Perlyn

11 Scars, 22
   W. Thomas Lawrence

12 Keloids, 24
   Rei Ogawa

RECONSTRUCTIVE SURGERY

Skin

13 Melanoma, 30
   Steven D. Macht

14 Non-melanoma Skin Cancer, 32
   Steven D. Macht

15 Blood Vessel Malformations: Infant, 34
   Jeffrey L. Marsh

16 Blood Vessel Malformations: Not Infant, 38
   Jeffrey L. Marsh

17 Lymphatic Malformations, 40
   Jeffrey L. Marsh

Head and Neck

Congenital Anomalies

18 Cleft Lip and Palate: Management, 44
   Jeffrey L. Marsh

19 Cleft Lip and Palate: Residual Deformities, 46
   Jeffrey L. Marsh
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Cleft Lip and Palate: Persistent Functional Impairments, 48</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>21</td>
<td>Cleft Lip and Palate: Fistulas, 50</td>
<td>Bong-Kyoon Choi • Lun-Jou Lo</td>
</tr>
<tr>
<td>22</td>
<td>Cleft Lip and/or Palate: Dentoskeletal Management, 52</td>
<td>Yu-Fang Liao • Lun-Jou Lo</td>
</tr>
<tr>
<td>23</td>
<td>Craniofacial Deformities: Initial Evaluation, 54</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>24</td>
<td>Craniofacial Deformities: Airway Management, 56</td>
<td>Arlene A. Rozzelle</td>
</tr>
<tr>
<td>25</td>
<td>Abnormal Calvarial Shape, 60</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>26</td>
<td>Abnormal Orbital Region, 62</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>27</td>
<td>Abnormal Midface, 64</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>28</td>
<td>Abnormal Lower Face, 66</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>29</td>
<td>Prominent Ears, 68</td>
<td>Samuel Stal • Daniel A. Hatef</td>
</tr>
<tr>
<td>30</td>
<td>Constricted Ears, 70</td>
<td>Samuel Stal • Daniel A. Hatef</td>
</tr>
<tr>
<td>31</td>
<td>Microtia, 72</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Authors/Editors</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>32</td>
<td>Midline Nasal Masses, 74</td>
<td>Jeffrey L. Marsh</td>
</tr>
<tr>
<td>33</td>
<td>Pediatric Neck Masses: Congenital, 76</td>
<td>James W. Forsen • Randall A. Clary • Timothy J. Reichert</td>
</tr>
<tr>
<td>34</td>
<td>Pediatric Neck Masses: Acquired, 78</td>
<td>James W. Forsen • Randall A. Clary • Timothy J. Reichert</td>
</tr>
<tr>
<td></td>
<td><strong>Dentoskeletal Malocclusion</strong></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Dentofacial Deformities: Evaluation, 80</td>
<td>Mark E. Beehner</td>
</tr>
<tr>
<td>36</td>
<td>Maxillary Deformities: Treatment Plan, 82</td>
<td>Mark E. Beehner</td>
</tr>
<tr>
<td>37</td>
<td>Mandibular Deformities: Treatment Plan, 84</td>
<td>Mark E. Beehner</td>
</tr>
<tr>
<td></td>
<td><strong>Craniofacial Trauma</strong></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Facial Bone Fractures: Evaluation, 86</td>
<td>Paul Manson • Eduardo D. Rodriguez</td>
</tr>
<tr>
<td>39</td>
<td>Frontal Bone and Frontal Sinus Fractures, 88</td>
<td>Paul Manson • Eduardo D. Rodriguez</td>
</tr>
<tr>
<td>40</td>
<td>Nasal Bone Fractures, 90</td>
<td>Paul Manson • Eduardo D. Rodriguez</td>
</tr>
<tr>
<td>41</td>
<td>Orbital Fractures, 92</td>
<td>Francesco Gargano • Frank S. Ciminello • S. Anthony Wolfe</td>
</tr>
<tr>
<td>42</td>
<td>Zygomaticomaxillary Complex Fractures, 94</td>
<td>Paul Manson • Eduardo D. Rodriguez</td>
</tr>
</tbody>
</table>
43 Nasoorbital-Ethmoid Fractures, 96
Paul Manson • Eduardo D. Rodriguez

44 Midface Fractures, 98
Paul Manson • Eduardo D. Rodriguez

45 Mandibular Fractures, 100
Paul Manson • Eduardo D. Rodriguez

Neoplasms and Reconstruction

46 Scalp Defects, 102
Puneet Tuli • Ian T. Jackson

47 Forehead Defects, 104
Chad A. Perlyn

48 Eyelid Defects, 106
Adam G. Buchanan • Philip L. Custer

49 Eyelid Ptosis, 108
Philip L. Custer • Adam G. Buchanan

50 Ear Defects, 110
David Gault

51 Nose Defects, 112
Frederick J. Menick

52 Cheek Defects, 114
Puneet Tuli • Ian T. Jackson

53 Lip Defects, 118
Puneet Tuli • Ian T. Jackson

54 Mandibular Defects, 120
Mark Sisco • Joseph J. Disa
Contents

55    Facial Paralysis, 124
      Ronald M. Zuker • Chad A. Perlyn

56    Parotid Masses, 128
      Shai M. Rozen • Larry L. Myers

57    Lip Cancer, 130
      Larry L. Myers • Shai M. Rozen

58    Oral Cavity Cancer, 132
      Baran D. Sumer • Larry L. Myers

59    Breast Reconstruction: Overview, 138
      Thomas J. Francel

60    Breast Reconstruction: Autologous, 140
      Frederick J. Duffy, Jr. • Thomas J. Francel

61    Partial Breast Reconstruction, 142
      Albert Losken

62    Gynecomastia, 144
      Thomas J. Francel

63    Sternal Wounds, 146
      Michelle C. Roughton • David H. Song

64    Abdominal Wall Wounds, 148
      Donald P. Baumann • Charles E. Butler

65    Groin Wounds, 150
      Brent M. Egeland • Paul S. Cederna

66    Male Genital Anomalies: Congenital, 154
      Gary J. Alter
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>Male Genital Anomalies: Acquired</td>
<td>Gary J. Alter</td>
</tr>
<tr>
<td>68</td>
<td>Female Genital Anomalies: Congenital</td>
<td>Gary J. Alter</td>
</tr>
<tr>
<td>69</td>
<td>Female Genital Anomalies: Acquired</td>
<td>Gary J. Alter</td>
</tr>
<tr>
<td>70</td>
<td>Vaginal Defects</td>
<td>Valerie Lemaine • Andrea L. Pusic</td>
</tr>
<tr>
<td>71</td>
<td>Myelomeningocele</td>
<td>Frederick J. Duffy, Jr. • Dale M. Swift</td>
</tr>
<tr>
<td></td>
<td><strong>Upper Extremity</strong></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Congenital Hand Anomalies: Evaluation</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>73</td>
<td>Polydactyly</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>74</td>
<td>Syndactyly</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>75</td>
<td>Camptodactyly and Clinodactyly</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>76</td>
<td>Thumb Anomalies</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>77</td>
<td>Forearm and Hand Anomalies</td>
<td>Peter D. Witt</td>
</tr>
<tr>
<td>78</td>
<td>Pediatric Brachial Plexus Injuries</td>
<td>Gregory H. Borschel • Christine G. Curtis • Howard M. Clarke</td>
</tr>
</tbody>
</table>
Contents

Acute Hand Trauma

79 Distal Phalanx Fractures, 184
Jaimie T. Shores • W.P. Andrew Lee

80 Middle and Proximal Phalanx Fractures, 186
Jaimie T. Shores • W.P. Andrew Lee

81 Metacarpal Fractures, 188
Jaimie T. Shores • W.P. Andrew Lee

82 Wrist Fractures, 190
Jaimie T. Shores • W.P. Andrew Lee

83 Extensor Tendon Injuries, 194
E. Gene Deune

84 Flexor Tendon Injuries, 196
E. Gene Deune

85 Acute Nerve Injuries: Open, 198
Ryan D. Katz • A. Lee Dellon

86 Acute Nerve Injuries: Closed, 200
Ryan D. Katz • A. Lee Dellon

87 Upper Extremity and Digit Amputations, 202
Aaron G. Grand

88 Upper Extremity Crush Injuries, 204
Jonathan Cheng

89 Extensive Tissue Loss, 206
Aaron G. Grand
90 Upper Extremity Injection Injuries, 208
Jonathan Cheng

91 Hand Infections, 210
Jaimie T. Shores • W.P. Andrew Lee

Special Problems

92 Bone and Joint Pain, 214
Erika Henkelman • Michael W. Neumeister

93 The Stiff Joint, 216
Erika Henkelman • Michael W. Neumeister

94 Thumb Reconstruction, 220
Anthony E. Sudekum

95 Scaphoid Nonunion, 224
Subhro K. Sen • James Chang

96 Impaired Vascularity, 226
Christian E. Sampson

97 Motor Deficits, 228
Aaron G. Grand

98 Delayed Flexor Tendon Injuries, 230
E. Gene Deune

99 Peripheral Nerve Compression, 232
Ryan D. Katz • A. Lee Dellon

100 Neuromas, 234
Ryan D. Katz • A. Lee Dellon

101 Dupuytren’s Contracture, 236
Michael Morhart
Lower Extremity

102 Lower Extremity Injuries: Evaluation, 240
Maristella S. Evangelista • Sean J. Darcy • Garrett A. Wirth

103 Proximal and Middle Third Lower Leg Defects, 242
Joshua Waltzman • Garrett A. Wirth

104 Distal Third Lower Leg Defects, 244
Michael P. Lin • Garrett A. Wirth

105 Heel and Ankle Defects, 246
Ginard I. Henry • David H. Song

106 Dorsal Foot Defects, 248
Ginard I. Henry • David H. Song

107 Plantar Defects, 250
Ginard I. Henry • David H. Song

108 Lower Extremity Osteomyelitis, 252
Yehuda Ullmann, Lucian Fodor

109 Lymphedema, 254
Corradino Campisi • Francesco Boccardo

3 AESTHETIC SURGERY

Skin

110 Lines, Texture, Dyschromias, and Scarring: Laser Therapy, 260
Marissa J. Tenenbaum • W. Grant Stevens

111 Rhytids, Hyperpigmentation, and Chloasma: Chemical Peels, 262
V. Leroy Young

112 Fine Rhytids: Fillers, 264
Daniel Kwan • Julius W. Few
Contents

Scalp, Brow, and Periorbital Area

113 Hair Loss of the Scalp, 268
   James N. Long • Jorge I. de la Torre

114 Forehead and Brow, 270
   Sherrell J. Aston • Jennifer L. Walden

115 Upper Eyelids, 272
   Farzad R. Nahai • Daniel P. Luppens

116 Lower Eyelids, 274
   Farzad R. Nahai • Daniel P. Luppens

Face

117 Midface and Lower Face, 278
   Jennifer L. Walden • Sherrell J. Aston

118 Perioral Area, 280
   Daniel Kwan • Julius W. Few

119 Chin, 282
   Francesco Gargano • Silvio Podda • S. Anthony Wolfe

120 Neck, 284
   Thomas J. Francel

121 Craniofacial Contouring, 286
   Raymond C.W. Goh • Yu-Ray Chen

Nose

122 Nasal Airway Obstruction, 290
   Thomas Gifford • Steven Ross Mobley

123 Nasal Deformities, 294
   Ronald P. Gruber • Christian N. Ford • Meryl Singer

124 The Crooked Nose, 296
   Nicholas Vendemia • Anthony N. LaBruna

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Breast

125 Micromastia, 300
Thomas J. Francel

126 Macromastia, 304
Thomas J. Francel

127 Breast Ptosis, 306
Marissa J. Tenenbaum • W. Grant Stevens

128 Breast Asymmetry I, 308
Breast Asymmetry II, 310
Kelly M. Bolden • Jeffrey E. Janis

129 Tuberous Breast Deformities, 312
Thomas J. Francel

Body Contouring

130 Abdominal Wall Excess, 316
Marissa J. Tenenbaum • W. Grant Stevens

131 Upper Arm Excess, 318
Daron Geldwert • Dennis J. Hurwitz

132 Thigh Laxity, 320
Daron Geldwert • Dennis J. Hurwitz

133 Gluteal Augmentation, 322
Constantino G. Mendieta
134
Anterior Body Wall Excess After Massive Weight Loss, 326
Daron Geldwert • Dennis J. Hurwitz

135
Posterior Body Wall Excess After Massive Weight Loss, 328
Daron Geldwert • Dennis J. Hurwitz

136
Breast Deformities After Massive Weight Loss, 330
Daron Geldwert • Dennis J. Hurwitz

137
Buttock Deformities After Massive Weight Loss, 332
Daron Geldwert • Dennis J. Hurwitz

Index, 335
PART 1

FUNDAMENTALS

Wound Management

Upper Facial Lacerations
Lower Facial Lacerations
Acute Ear Trauma
Bites
Burns: Acute Management
Acute Burns: Wound Management
Chemical Burns
Frostbite
Hidradenitis Suppurativa
Pressure Sores
Scars
Keloids

ALGORITHM KEY

- Problem
- Surgical Interventions and Surgical Endpoints
- Nonsurgical Interventions
- Surgical or Nonsurgical Options List
- Combination of Surgical and Nonsurgical Options List
- Hierarchy List

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1); copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
Facial lacerations should be assessed for location, depth of injury, extent of tissue loss, and degree of contamination. Because the face has an extensive blood supply, even subacute facial wounds should be closed primarily after irrigation. A complete head and neck examination should always be performed to detect any underlying facial bone fractures, cervical spine injuries, or other wounds.

The finding of orbital fat in an eyelid laceration indicates violation of the orbital septum. In the upper lid, this may be associated with injury to the levator muscle. Failure of the patient to elevate his or her lid indicates a potential injury to the levator muscle, and operative exploration is warranted.

Injury to the canalicular system is suspected if there is a laceration in the proximity of the upper or lower canaliculus. Transection of the underlying duct is suggested if the location of the punctum is significantly displaced. All potential duct injuries should be probed and, if necessary, repaired in the operating room over a stent.

If primary closure cannot be obtained because of tissue loss, reconstruction should be delayed until edema has lessened and adequate tissue mobility can be obtained. In the interim, care must be taken to protect the eye with lubricating ointments, patching, and/or tarsorrhaphy suture (see algorithm 48).

Septal hematomas must be drained to prevent septal necrosis, and large intranasal mucosal tears should be repaired to prevent synechiae.

There is no evidence for the routine use of antibiotic therapy for straightforward facial lacerations. The patient’s tetanus status should be assessed, and tetanus immunization guidelines should be strictly followed.

BIBLIOGRAPHY

PATIENT WITH UPPER FACIAL LACERATION

History and physical examination

A Assess location

Eyelid

Cornea or globe injury?

Yes

Ophthalmology consultation

No

Nose

Soft tissue loss

Extensive

See algorithm 51

None/minimal

Nasal fracture?

Yes No

Yes

E Septal hematoma or large mucosal tear?

No

Repair before closure of external wound

E Primary closure

No

Continued with wound closure (see algorithm 40)

Levator intact?

Yes

Tarsus intact?

No

To OR for exploration

No

C Canalicular system intact?

Yes

Consider primary closure

Extensive tissue loss?

Yes

D See algorithm 48

No

Primary closure

Long-term follow-up
CHAPTER 2  LOWER FACIAL LACERATIONS

Chad A. Perlyn

Facial lacerations should be assessed for location, depth of injury, extent of tissue loss, and degree of contamination. Because the face has an extensive blood supply, even subacute facial wounds should be closed primarily after irrigation. A complete head and neck examination should always be performed to detect any underlying facial bone fractures, cervical spine injuries, or other wounds.

Lacerations anterior to the lateral canthus may suggest an injury to the facial nerve; sequelae are rare, because of the redundancy of nerve branches medial to this line. Lacerations associated with facial muscle paralysis lateral to this line should be explored within 72 hours, and injured nerves repaired.

The parotid gland lies under the middle third of the line between the commissure of the lips and the tragus of the ear. Lacerations to the parotid gland may be associated with injuries to the facial nerve, Stensen’s duct, or other facial structures; because of this, lacerations through the parotid gland should be explored in the operating room. A severed duct is repaired over a small catheter that is externalized through the intraoral papilla.

If the patient has lip injuries with significant tissue loss, the repair should be delayed to allow the edema to resolve and to ensure adequate tissue mobility. Tissue viability should be preserved with appropriate dressings and wound care. A definitive reconstruction can then be planned and performed (see algorithm 53).

Attention must be paid to restoring anatomic alignment of the vermilion-cutaneous junction, also known as the white roll. Care must also be taken to restore the red line of the lip, which is the demarcation between wet and dry vermilion. The orbicularis oris muscle must be repaired before the skin closure to ensure normal lip function and to prevent a residual deformity such as notching.

There is no evidence for the routine use of antibiotic therapy for straightforward facial lacerations. The patient’s tetanus status should be assessed, and tetanus immunization guidelines should be strictly followed.

BIBLIOGRAPHY


PATIENT WITH LOWER FACIAL LACERATION

History and physical examination

A

Assess location

Cheek

Facial nerve injury?

Yes

B

Laceration anterior to lateral canthus?

No

Yes

C

Parotid gland or suspected duct injury?

No

To OR for exploration

Yes

Consider primary closure

Extensive tissue loss?

Yes

See algorithm 52

No

Primary closure

Lips

Dental injury?

No

Yes

Dental consultation

Extensive tissue loss?

Yes

Replantation possible?

No

Successful?

Yes

D See algorithm 53

No

E

Primary closure with attention to white roll and wet/dry vermillion

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 3  ACUTE EAR TRAUMA
Jon A. Mathy • Julian J. Pribaz

The majority of the external ear is composed of two opposing layers of skin that encase a convoluted sheet of form-giving cartilage. Blunt trauma can shear the perichondrium from the cartilage, leading to a dissecting hematoma between these layers. Drainage is indicated before the hematoma leads to permanent blunting of the ear’s normal architecture through disorganized cicatrisal conversion, as in the condition sometimes referred to as cauliflower ear.

Draining a hematoma can be performed with simple aspiration in early cases or through open incisions once the clot has matured. Drainage incisions placed on the lateral aspect of the ear typically heal with highly inconspicuous scars. It is also possible to approach lateral collections through a medial (mastoid) incision using a transcortilaginous approach. Subsequent to drainage, it is safest to place mattress sutures or a temporary compressive dressing over the area to prevent the blood from collecting further.

The treatment algorithm for ear injuries falling along the spectrum between simple laceration and total amputation is dictated mainly by the quality of residual tissue perfusion. Fortunately, the ear has a rich blood supply that is fed by multiple, interconnected branches of two named vessels: the superficial temporal artery, which runs anteriorly, and the posterior auricular artery, which runs on the medial surface, within the conchal-mastoid groove.

The ear’s rich vascularity means that even extensive lacerations, in which sections of the ear remain attached only by narrow segments, can sometimes be managed with simple reapproximation with excellent results. In such cases, the sturdy adherence of the skin to its underlying cartilage allows excellent approximation with only a single-layer closure at the skin level; a separate layer of closure at the cartilage level typically does not add appreciable strength or precision, and therefore can be omitted.

When perfusion of a nearly or totally amputated ear is inadequate, the treatment depends on whether anastomosable vessels can be identified. If possible, revascularization provides the best possible long-term result. Failure to identify a vein is not an absolute contraindication, because veins on the amputated part will become more apparent after the arterial anastomosis has been performed. Although at least one venous anastomosis is preferred, several case reports have shown that it is possible to substitute chemical or organic leeching for venous outflow until neovascularization takes place. This possibility should be discussed with the patient preoperatively, because leeching mandates several weeks of inpatient care, including volume replacement with an average of at least 6 units of packed red blood cells.

When performing microvascular replantation, it is also important to preserve secondary reconstructive options in case the replant fails. For example, if a patient’s periauricular skin has also been traumatized, or if the surgeon’s preference is to use a temporoparietal fascial flap with a delayed autologous or implant reconstruction, then an effort should be made to protect distal perfusion through the superficial temporal artery. This can be accomplished by performing the anastomosis to a side branch or to another donor pedicle, which may include a vein graft.

When microvascular replantation is not feasible, the surgeon should attempt to salvage underperfused ear tissue using the so-called pocket principle, an excellent reconstructive option. This technique capitalizes on the thin and metabolically undemanding nature of ear tissue, characteristics that allow it to temporarily survive as a composite graft within a postauricular tissue pocket until vascular integration takes place.

Before pocketing an ear segment, the skin must be completely deepithelialized (for example, using dermabrasion) and returned to its anatomic origin with sutures. The dermis should remain over the cartilaginous skeleton for maximal protection against warping and definition loss. The graft should be buried in a retroauricular pocket under closed-suction drainage, with antibiotic prophylaxis that includes treatment for Pseudomonas. The ear can usually be safely delivered after approximately 10 to 14 days and has been allowed to spontaneously reepithelialize, with a satisfactory long-term result.

BIBLIOGRAPHY
PATIENT WITH ACUTE EAR TRAUMA

History and physical examination

Assess nature of injury

A Hematoma/seroma
- Drain, quilting sutures/bolster
- Primary repair
- Long-term follow-up

B Laceration
- Adequate perfusion?
  - Yes: Primary repair
  - No: Salvageable tissue?
    - Yes: Vessels suitable for replantation?
      - Yes: Microvascular replantation
      - No: Delayed reconstruction
    - No: Delayed reconstruction

C Extended laceration/partial amputation
- Adequate perfusion?
  - Yes: Primary repair
  - No: Salvageable tissue?
    - Yes: Vessels suitable for replantation?
      - Yes: Microvascular replantation
      - No: Delayed reconstruction
    - No: Delayed reconstruction

D Total amputation
- Vessels suitable for replantation?
  - Yes: Microvascular replantation
  - No: Delayed reconstruction

E Utilize the pocket principle
- Deliver ear at 10-14 days
- Costochondral rib graft ± TPF flap
- Prosthesis
- Long-term follow-up
The patient’s tetanus status is of the utmost importance in all bite injuries. Current tetanus recommendations are listed in the following table.

### TETANUS IMMUNIZATION GUIDELINES

<table>
<thead>
<tr>
<th>Previously Immunized Patient</th>
<th>Patient Not Previously Immunized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean wound, immunization</td>
<td>Clean wound</td>
</tr>
<tr>
<td>&lt;10 years previous</td>
<td>Toxoid injection</td>
</tr>
<tr>
<td>Dirty wound, immunization</td>
<td>Dirty wound</td>
</tr>
<tr>
<td>&lt;5 years previous</td>
<td>Toxoid injection and</td>
</tr>
<tr>
<td></td>
<td>human tetanus immune globulin</td>
</tr>
<tr>
<td></td>
<td>(HTIG)</td>
</tr>
</tbody>
</table>

Human bite wounds are most commonly contaminated with *Streptococcus* and *Eikenella corrodens*. Approximately 10% to 15% of human bite wounds become infected, because saliva contains as many as 100,000,000 organisms per milliliter, representing as many as 190 different species. Bites can also transmit other communicable diseases, such as hepatitis. Amoxicillin derivatives are often the antibiotic agents of choice for human bites.

Bites to a clenched fist may cause soft tissue injuries, including extensor tendon laceration and joint capsule disruption. When the injured finger extends, bacteria may be carried proximally away from the skin wound into apparently uninjured tissue. Therefore such wounds are often treated in the operating room with open exploration, irrigation, and debridement.

If secondary healing may result in considerable loss of form or function, delayed primary closure can be performed after 48 hours of local wound care to decrease the bacterial load.

Fewer than 20% of dog bites become infected, compared with up to 80% of cat bites. Antibiotic therapy should cover common domestic mammalian oral flora, including *Pasteurella*, *Streptococcus*, and *Staphylococcus*. Amoxicillin with clavulanate is frequently prescribed for human, dog, cat, and wild animal bites.

The transmission of rabies must always be considered after any attack by a wild animal. If possible, the animal should be killed and analyzed. Domestic animals should be quarantined and observed for 10 days. Postexposure prophylaxis with human rabies immune globulin (HRIG) and human diploid cell vaccine (HDCV) should be started immediately in patients with bites from either wild or domestic animals that cannot be quarantined. If the animal can be quarantined, then treatment does not need to be empirically started in patients unless the animal shows signs of rabies during the 10-day quarantine period.

Local wound care for a bite from the *Loxosceles reclusa* spider (commonly called the *brown recluse* spider) should include cold compresses, because the spider’s toxin (sphingomyelinase D) is temperature dependent. Cooling has been shown to limit tissue damage.

Bites from black widow spiders (those from the genus *Latrodectus*) are systemically treated with antispasmodics (benzodiazepines), narcotics, and intravenous calcium gluconate. An antivenom is also available and appears effective—but it should only be used in patients who are at high risk for severe complications.

The initial care of patients with snakebites should include immobilization and elevation of the affected part. Vascular tourniquets should never be used, and although loose compression bands have been suggested to reduce lymphatic drainage, their use remains controversial. Ice should not be used, because it decreases blood flow and may worsen tissue necrosis. Initial care also includes maintaining the patient’s hemodynamic stability and crossmatching his or her blood for transfusion purposes, because hemolysis may occur as a result of phospholipase A activity.

### BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
PATIENT WITH BITE INJURY

History and physical examination

A. Check tetanus status

Nature of injury

B. Human

Facial location

Conservative debridement

Loose primary closure

Antibiotic therapy

Irrigation

C. Joint involved?

Yes

Delayed primary closure or closure by secondary intention

Debridement

Antibiotic therapy

Secondary repair of tendons/nerves

Irrigation

To OR for exploration

No

Debridement

Antibiotic therapy

Secondary reconstruction

Long-term follow-up

E. Nonhuman

Nonmammalian

Nonhuman

Facial location

Conservative debridement

Loose primary closure

Antibiotic therapy

Irrigation

F. Mammalian

Trunk/extremities

Joint involved?

Yes

Brown recluse

Systemic support

Consider antivenom

Consider fasciotomy if indicated on examination (not prophylactic)

No

Debridement of necrotic tissue

Secondary reconstruction

Debridement

Antibiotic therapy

Local wound care

Systemic therapy

G. Spider

Brown recluse

Local wound care

Debridement

Antibiotic therapy

Local wound care

Systemic therapy

H. Reptile

Local wound care

Local wound care

Debridement

Antibiotic therapy

Local wound care

Systemic support

Consider antivenom

Consider fasciotomy if indicated on examination (not prophylactic)

I. Initial care

Brown recluse

Local wound care

Debridement

Antibiotic therapy

Local wound care

Systemic support

Consider antivenom

Consider fasciotomy if indicated on examination (not prophylactic)
CHAPTER 5 BURNS: ACUTE MANAGEMENT

Peter M. Rumbolo

A Physiologic stabilization is the first line treatment for all patients with burns. This stabilization involves the use of the ABCDE principles of resuscitation—Airway, Breathing, Circulation, Disability/neurological damage, and Environment—as outlined by the Advanced Burn Life Support protocol.

B For patients with burns of any type, securing the airway is of the utmost importance. If there is evidence of or concern for airway compromise, the airway must be secured by endotracheal intubation or an emergent surgical airway, if necessary.

C If the burn is larger than 20% of the total body surface area (TBSA), fluid resuscitation using two large-bore intravenous lines is indicated. The patient is resuscitated to maintain his or her urine output at 0.5 ml/kg/hr (1 ml/kg/hr in children). The Parkland formula (lactated Ringer solution 4 ml x the patient’s weight [in kg] x percentage of the patient’s body with burns) can be a guide; half of the total fluid is given over the first 8 hours, and the rest is administered over the next 16 hours. Other monitoring devices are recommended, including a cardiac monitor, continuous pulse oximetry, and arterial line. The burn’s size and depth are formally calculated using guides such as the Rule of Nines or a Lund-Browder diagram. Tetanus prophylaxis should be given if the patient’s immunization status is either not current or unknown.

D Thermal burns are the most common type of burn injuries, whether they are caused by flames, scalds, or contact with a hot object. Initially covering the injured areas with dry, sterile sheets helps prevent hypothermia and aids in pain control.

E A thorough assessment of patients with electrical burns is necessary to evaluate the affected area for muscle necrosis. It is also essential to examine the extremities for compartment syndrome. Serial measurements of creatine phosphokinase (CPK) and lactate levels can be useful for following the trend of the laboratory findings, and it is essential that the patient’s urine be assessed by the laboratory for the presence of myoglobin until the kidneys clear the body of the protein. Resuscitation is altered by increasing the patient’s intravenous fluids to maintain his or her urine output at 75 to 100 ml/hr, by adding sodium bicarbonate to the resuscitative fluid to alkalize the urine, and by administering mannitol to promote diuresis of circulating myoglobin. The urgent amputation of cadaveric limbs is sometimes necessary.

F See algorithm 7 for additional details.

G The delayed presentation of patients is common, unless the initial exposure is excessive and causes systemic effects. Although rare, burn injuries may progress to the third-degree classification as a result of inadequate resuscitation.

H Treating toxic epidermal necrolysis (TEN) and Stevens-Johnson syndrome requires the superficial debridement of the affected epidermis and coverage with biologic dressings (for example, cadaver allograft or xenograft), Biobrane, or silver-impregnated dressings. Avoidance of the presumed causative agent of the process and other sulfa-containing topical antimicrobial agents is recommended.

I Emergency procedures may need to be performed to save the patient’s life or to salvage his or her limbs. These procedures include cricothyroidotomy or tracheostomy (if intubation is not possible), escharotomies (extremities, trunk, and neck), fasciotomies, debridement of necrotic muscle, and/or amputation.

J Blisters and nonviable loose skin should be debrided. Any charring should also be removed. Topical antimicrobial agents should be applied. Mafenide acetate penetrates eschar and cartilage; it is recommended for cartilage with deep tissue injuries (for example, as with electrical burns). Side effects of the topical agents need to be monitored.

K Supportive measures include tailoring the resuscitation to the patient, because certain patients may need more fluid than originally calculated (for example, because of inhalation or electrical injuries, an inaccurate calculation of the burn size, or premorbid factors). Nutritional support should begin as soon as possible with a feeding tube. Colloid resuscitation in the second 24 hours is recommended for burns larger than 20% of the TBSA. It is imperative that physical and occupational therapies be instituted early. For patients who meet the American Burn Association guidelines, a transfer to a burn center may be appropriate.

BIBLIOGRAPHY


See algorithm 7 for additional details.
PATIENT WITH ACUTE BURN (STABILIZATION)

History and physical examination

A Physiologic stabilization

B Airway management

C Fluid management

Tetanus prophylaxis

Injury-specific considerations

D Thermal burns

E Electrical burns

F Chemical burns

G Radiation burns

H TEN/Stevens-Johnson syndrome

I Emergency procedures if indicated

J Acute wound care

K Supportive care, nutrition

Wound management

Patient stable

Patient unstable

Treatment of burns (see algorithm 6)
Burns of the hands, feet, and perineum require special consideration. The burn depth must be precisely determined to dictate the appropriate timing for treatment, which directly affects the functional outcome. Superficial and intermediate-depth partial-thickness wounds can be safely treated with wound care and should heal within 21 days. Early burn excision and skin grafting (1 to 7 days after the burn) should be performed for deep partial- and full-thickness burns. The use of temporary coverage (for example, allograft) may be indicated. Aggressive therapy before and after surgery is essential for functional return. Splinting of the hands and feet is a key component of preoperative care, and it should be initiated as soon as the patient is stabilized. Thermoplastic splints are ideal, because they can be easily removed for dressing changes and range of motion exercises.

The majority of second-degree burns of the trunk and limbs heal within 3 weeks. Third-degree areas should be excised; skin grafts or temporary coverage (for example, allograft) should be placed within 10 to 14 days, if possible. Splinting of the neck and major joints should be initiated early, along with an aggressive therapy program before and after surgery.

Second-degree facial burns heal remarkably well, because of the excellent distribution of the blood supply in the head and neck region. Excision, skin grafts, or placement of a dermal substitute (for example, Integra) is usually required for the treatment of third-degree burns and should be performed within 2 weeks. Attention to maintaining aesthetic units is preferable. When lid burns are present, preventing globe exposure is critical. An ophthalmology consultation should be obtained, and lubricating drops/ointments and/or surgical procedures may be required to temporarily close the lid in cases of eyelid retraction caused by burn injury. Early excision and grafting should be performed if there is concern about the development of a lower lid ectropion. Lower lid support (for example, cartilage grafts) and/or canthal suspension procedures may also be necessary. Burns to the oral commissure also require special attention, and early splinting is recommended.

Any infected or fourth-degree burns may require multiple debridements and excisions until an adequate wound bed can be procured. Supporting a graft may require excising all nonviable tissues and using temporary coverage or open treatments with topical antimicrobial therapy until bacterial counts are at an acceptable level. Dermal substitutes (for example, Integra) may be indicated when wound beds allow.

Skin care and scar management are essential components of burn treatment, and an individualized program should be developed for each patient. Healed skin may be dry, prone to blistering, and sensitive to temperature changes. Moisturizing lotions and sunscreens should be used liberally. Compression garments, whether prefabricated or custom made, must be worn for 23 hours each day; they may be necessary for 6 months to 2 years after an injury. Hypertrophic scars and keloids may require additional management (see algorithms 11 and 12). Physical and psychological rehabilitation by specialized therapists is recommended.

Late reconstruction of burns focuses on the restitution of form and function. Multiple techniques may be used, including tissue expansion, dermal substitutes, and flap coverage. Key principles include replacing like tissue with like tissue, providing full-thickness skin coverage over joints and the neck, restoring hair-bearing areas, and maintaining adherence to aesthetic subunits.

**BIBLIOGRAPHY**


PATIENT WITH ACUTE BURN
(WOUND MANAGEMENT)

History and physical examination

Stabilize patient
(see algorithm 5)

Location of the burn

A Hands, feet, perineum
   - Superficial or intermediate second-degree
   - Deep second-degree or third-degree
   - Wound care 10 to 21 days
   - Healed or Not healed

B Trunk, extremity
   - Second-degree
   - Third-degree
   - Wound care 10 to 21 days
   - Healed or Not healed

C Face
   - Second-degree
   - Third-degree
   - Wound care 10 to 21 days
   - Healed or Not healed

D Fourth-degree (any location) or infected burn
   - Excision and temporary coverage
   - Infected or necrotic
   - Clean bed
   - Grafting (consider free flap or Integra)

Scar management

E
- Lotion
- Compression garments
- Sunscreen
- Physical/occupational therapy

F Late reconstruction

Long-term follow-up
Clothing should be removed immediately, excess liquid absorbed, and any powder brushed away and removed.

Information can be obtained about many products from the material safety data sheet (MSDS) found on the packaging. If no MSDS is available, the local poison control center or national data banks such as the Chemtrec HAZMAT Communications Center should be contacted for information and treatment recommendations.

Skin exposed to acids and bases should be treated with copious irrigation using low-flow running water. Neutralization should never be performed, because this may result in exacerbation of the injury. Irrigation should be performed for 2 to 3 hours for acid burns and for at least 12 hours for strong alkali burns.

Exothermic reactions occur when the elemental forms of lithium, potassium, sodium, and magnesium are exposed to water; therefore water irrigation must be avoided. Mineral or vegetable oil should be used instead, and the metallic fragments carefully removed and disposed of properly.

Hydrofluoric acid (HF) is one of the strongest inorganic acids; exposure can cause severe tissue damage and metabolic disturbances, including death. HF binds calcium, resulting in severe hypocalcemia that can cause cardiac dysrhythmias. Patients should have electrolyte laboratory studies and an electrocardiogram (ECG) performed on arrival. They should also undergo cardiac and electrolyte monitoring for at least 24 hours after the exposure to observe for prolonged QT intervals or other cardiac changes.

HF may penetrate skin and accumulate in blister fluid or beneath nail beds. The adequate removal of HF is essential to prevent prolonged tissue disturbances. Blisters should also be debrided, and nail beds removed promptly.

Calcium gluconate should be used to bind fluoride ions. Calcium gluconate (2.5%) gel is effective only for mild, superficial exposure. An occlusive cover or latex glove should be used to ensure adequate coverage. The endpoint of treatment is pain relief.

For more severe injuries, 5% to 10% calcium gluconate can be injected subcutaneously at a dose of 0.5 ml/cm² of skin. If a large surface area is exposed, or if injecting additional fluid into exposure sites is not warranted, then the intraarterial infusion of calcium gluconate can also be performed. The endpoint of treatment is pain relief.

White phosphorous ignites spontaneously in air. Submersion in water is the preferred means of irrigation. If this is not feasible, the area should be copiously irrigated, and petroleum jelly or wet towels should be used to cover any areas that may have embedded particles. For easier identification and removal, 3% copper sulfate can be used to turn the particles black; this solution also limits the tissue toxicity of the phosphorus particles. Because phosphorus burns may result in serum electrolyte changes and cardiac toxicity, the patient must be monitored.

Inadvertent phenol exposure can cause CNS and cardiac depression, electrolyte disturbances, and tissue necrosis. The offending substance is removed with polyethylene glycol (PEG) or isopropanol. If PEG cannot be found, most hospitals will have Golytely, which is a PEG-based bowel preparation solution. Alternatively, copious water irrigation at high volume can reduce surface-area spread and thus may be used for decontamination.

**BIBLIOGRAPHY**


PATIENT WITH CHEMICAL BURN

History and physical examination

Systemic support and ABCs
Toxicology consults

A Remove offending substance

Substance known?

Yes

B Review MSDS or contact local poison control or Chemtrec

No

C Acids/bases
Copious irrigation with water

D Elemental metal
Do not irrigate with water

E Hydrofluoric acid
Copious irrigation with water

F Debride blisters and remove nail plate, if affected

G Topical calcium gluconate gel

H Tissue infiltration or intraarterial infusion of calcium gluconate

Assess degree of exposure

Mild

G

Moderate/severe

H

Local wound care

Debride necrotic tissue

Secondary reconstruction

Long-term follow-up

I White phosphorous
Submerge affected part in running water

J Phenol
Rinse with PEG or isopropyl alcohol

Decontaminate with copious water irrigation if PEG or isopropyl alcohol is not available

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 8  FROSTBITE
Chad A. Perlyn

A  Tissue damage caused by prolonged exposure to cold occurs because of three mechanisms: ice crystallization (both intracellular and extracellular), tissue dehydration, and arterial insufficiency. Four degrees of frostbite injury exist:

• **First degree:** Nonsensate, central white plaque surrounded by a ring of hyperemia
• **Second degree:** Appearance of clear blisters with surrounding erythema
• **Third degree:** Hemorrhagic blisters, usually followed by eschar formation
• **Fourth degree:** Focal necrosis with visible tissue loss

All individuals with frostbite must be evaluated for hypothermia, possible traumatic injuries, or systemic illnesses that may have led to debilitation and subsequent prolonged exposure. A core temperature of at least 34° C should be maintained before treating the frostbite.

B  Rapid rewarming of the affected part should begin only when there is no risk of possible refreezing, because this will worsen any potential injury. Warming should be performed by immersing the affected part in warm water at 40° to 42° C until thawing is complete, as determined by clinical assessment. Rubbing or massaging the affected part can cause tissue trauma and must be avoided.

C  Debridement of clear blisters is recommended to reduce the tissue damage that thromboxane and prostaglandin can cause. Hemorrhagic blisters are indicative of deeper tissue damage, and these should not be debrided until the full extent of the injury is determined.

D  Initial local wound care should include the application of topical aloe vera cream to all affected areas every 6 hours to inhibit the synthesis of thromboxane and other components of the arachidonic inflammatory cascade. Some scientific studies also support antibacterial and antifungal effects of aloe vera.

E  Systemic treatment should include the antiinflammatory drug ibuprofen, because progressive necrosis may result from excessive thromboxane A2 production, which upsets the normal balance between prostacyclin (prostaglandin I2) and thromboxane A2. Recent research has also found that when used within 24 hours of injury, the intraarterial dosing of tissue plasminogen activator improves tissue perfusion and dramatically reduces amputation rates.

F  As with all wounds, the patient’s tetanus status should be determined and the tetanus booster given, if necessary. Benzyl penicillin has been used for infection prophylaxis. However, the treatment for frostbite is similar to that for burns: Many experts think there is no indication for prophylactic antibiotic therapy, and its use should be reserved for cases in which treatment of a documented infection is necessary.

G  Historically, debridement was not done until the tissues had fully demarcated, typically 1 to 3 months after the injury occurred. This remains an appropriate recommendation for patients with significant frostbite injuries. However, in individuals who need to have early intervention because of other factors (for example, a return to work is necessary; medical comorbidities), recent studies have shown that technetium scintigraphy or MRI performed early after injury can be used to adequately predicate the level of nonviable tissue and aid in determining the amputation level.

H  Long-term sequelae may include sensory deficits, hyperhidrosis or anhidrosis, chronic skin and nail problems, cold sensitivity, joint stiffness, muscle loss, and loss of fine motor movement. Premature closure of epiphyses in children may also occur.

BIBLIOGRAPHY
PATIENT WITH FROSTBITE

History and physical examination

A. ABCs and hypothermia treatment

B. Rapid rewarming

C. Blisters noted after rewarming

Clear blisters

Hemorrhagic blisters

Blister debridement

Avoid debridement

D. Local wound care

E. Systemic antiinflammatory treatment

F. Tetanus prophylaxis and antibiotic therapy, if indicated

Requirement for early intervention

No requirement for early intervention

Bone scan or MRI

Continue local wound care >4 weeks until demarcation clear

G. Debridement/amputation

Debridement/amputation

Secondary reconstruction

H. Sequelae management/prevention of future injury

Long-term follow-up

Algorithm 8
Acute flares of hidradenitis suppurativa should be treated with antibiotic therapy, and enlarged, tender lesions should be incised and drained. Cultures and sensitivity testing should be performed, and organism-specific antibiotic agents administered. Of note, methicillin-resistant Staphylococcus aureus (MRSA) infection is becoming increasingly common in patients with hidradenitis suppurativa.

Chronic hidradenitis suppurativa is characterized by multiple erythematous, hard, painful nodules with thickened skin; sinus tracts; and purulent, draining sinuses. Commonly affected areas included the axillas, groin, scalp and posterior neck, gluteal and inframammary folds, and perianal region.

No definitive cause of hidradenitis suppurativa has been established. The pathophysiology is likely follicular occlusion, which leads to apocrine gland occlusion and subsequent perifolliculitis. Cigarette smoking, obesity, poor hygiene, excessive perspiration, stress, and ingrown hairs may contribute to the disease process. Weight loss should be encouraged, as should proper hygiene and antiperspirant use. Botulinum toxin type A (Botox) has also been used to limit hyperhidrosis. Laser hair removal may be helpful in limiting the incidence of ingrown hairs, but it is not a treatment for the disease itself.

Patients with chronic hidradenitis suppurativa should be referred to a knowledgeable dermatologist for medical therapy before surgical treatment. Bacterial load suppression with long-term antibiotic therapy may be initiated. Isotretinoin (Accutane) is also used to decrease sebaceous gland size and sebum production. Recent studies have also reported success with infliximab (Remicade), which inhibits excess TNF-alpha activity. Hormone and radiation therapy have also been used to limit disease progression.

Laser ablation with CO$_2$ can be performed on small areas of hidradenitis suppurativa or in areas where function must be maintained (for example, the anal sphincter). Lesions are ablated using tissue vaporization until all macroscopically diseased tissue is removed. Local wound care is then performed to allow healing by secondary intention. Small areas with healthy adjacent tissue can also be treated with surgical excision and primary or secondary closure.

Larger areas, or those areas in which wound contracture could cause decreased mobility or interfere with function (for example, the neck, axilla, or anal sphincter), may require reconstruction with skin grafts or flaps.

Negative-pressure therapy is beneficial and can be used to maintain the position of split-thickness skin grafts (STSGs) in areas that are difficult to bolster because of contour or movement.

The pedicle thoracodorsal artery perforator (TAP) flap is becoming increasingly popular for coverage of axillary defects following hidradenitis suppurativa excision. The flap provides reliable soft tissue coverage, and the resulting function and appearance are better than those provided with STSGs or full-thickness skin grafts (FTSGs).

BIBLIOGRAPHY

CHAPTER 9  HIDRADENITIS SUPPURATIVA

Chad A. Perlyn

Organism-specific antibiotic therapy

PATIENT WITH HIDRADENITIS SUPPURATIVA

History and physical examination

- Acute flare
  - Incision and drainage with cultures and sensitivities
    - Organism-specific antibiotic therapy
      - Resolved
      - Persistent or recurrent
        - Patient instructed in preventive measures
  - Chronic
    - Limit contributing factors

- Dermatology consult for medical therapy
  - Resolution of chronic problem
  - Persistent debilitating disease
    - Surgical removal of affected tissue

- Small area
  - CO₂ laser ablation with healing by secondary intention
  - Excision with primary closure or healing by secondary intention
    - Long-term follow-up
    - Reconstruction
      - Only skin coverage needed
      - Skin coverage needed and concern for contracture formation
        - STSG
        - FTSG or perforator flap
          - Myocutaneous flap, perforator flap, or muscle flap with STSG
            - Long-term follow-up

- Large area or area with functional significance
  - Excision
CHAPTER 10 PRESSURE SORES
Chad A. Perlyn

The ischium, sacrum, greater trochanter, and heel are common sites of occurrence for pressure sores. The most important principle in treating pressure sores is to relieve the pressure. This must be addressed before wound reconstruction is attempted. Modern, pressure-alleviating mattresses and wheelchair cushions should be used to reduce pressure, and the patient should be turned every 2 hours when possible. Working with social workers, specialized wound care nurses, and therapists is encouraged, because these individuals can help identify and alleviate the causes of increased pressure.

For patients with acute pressure wounds, attention should be directed to determining the cause of the tissue breakdown. In addition to prolonged pressure caused by limited mobility and/or decreased sensory perception (for example, in an intubated, sedated patient), other factors such as moisture, friction, and shear must be addressed.

A plethora of local wound care options is available. No single product has proved to be more beneficial than the others. The dressing used must keep the wound moist, free of exudate, and clean with autolytic or mechanical debridement. For deeper wounds, negative pressure therapy can also be effective by increasing blood flow, increasing granulation tissue, and decreasing edema.

Chronic pressure sores are most commonly seen in patients with neurologic injuries and in debilitated, bedridden patients. Although fever and sepsis can be caused by a chronic pressure sore, the clinical examination of patients with clean wounds often reveals other sources of bacteremia, such as urinary or respiratory tract infections.

If the patient’s nutritional status is deficient as determined by the albumin level, supplementation is required, and a nutritionist should be consulted for maximizing benefit. The effects of supplementation can be assessed by the serum prealbumin level, which has a shorter half-life than albumin. Depending on the individual’s nutritional needs, supplementation with vitamin C and/or zinc may be warranted. Vitamin A should be prescribed to patients on systemic steroids. Muscle spasms and joint contractures must also be assessed and managed before successful pressure sore management.

When fever or sepsis occurs without an identifiable source, osteomyelitis must be considered. Osteomyelitis should also be considered in patients with nonhealing pressure sores. Osteomyelitis may be present in more than 80% of nonhealing grade IV pressure ulcers. MRI has been shown to be superior to bone scans for the detection of and clinical planning for the treatment of osteomyelitis. The diagnostic benchmark is a bone biopsy with pathologic diagnosis, because bone cultures cannot be used to differentiate osteomyelitis from infection or colonization of adjacent soft tissue.

Managing osteomyelitis in a patient with a chronic pressure sore requires an interdisciplinary approach. A consultation with an infectious disease expert is useful to determine the need for and duration of antibiotic therapy before wound coverage. Even with organism-specific antibiotic treatment, debridement of necrotic bone remains the principle treatment modality for osteomyelitis.

Many patients have multiple recurrences of their pressure sores. For some patients, chronic treatment of a clean, well-drained, open wound is an acceptable option.

The primary objective of surgical debridement is to create a clean tissue defect that is then closed with a flap. It is imperative to sharply excise the bursa of the ulcer and debride any exposed bone. It is also important to understand that the ulcer is not treated by the flap.

The specific flap used depends on the anatomic site of the ulcer, the patient’s ambulatory status, and the availability of the tissue (see the table below). The flap should obliterate the dead space and provide a tension-free closure. Given the high rate of pressure ulcer occurrence, the flap should also be designed to interfere as little as possible with the elevation of subsequent local flaps.

<table>
<thead>
<tr>
<th>FLAP COVERAGE FOR PRESSURE SORES OF THE TRUNK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Cord Function</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Ambulatory</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Nonambulatory</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

GM, Gluteus maximus; SGAP, superior gluteal artery perforator flap; TFL, tensor fascia lata.

BIBLIOGRAPHY

CHAPTER 10  PRESSURE SORES

Chad A. Perlyn

PATIENT WITH A PRESSURE SORE

History and physical examination

A Pressure relief

Acute pressure sore

B Eliminate causative risk factors

Assess sore quality

Clean

Exudate/necrotic debris

C Local wound care and/or negative pressure therapy

Successful healing?

Yes

Maintenance and prevention

No

Enzymatic, mechanical, or surgical debridement

B

Chronic pressure sore

D Eliminate causative risk factors

Treat systematic comorbidities (poor nutrition, spasticity, contractures)

E Concern for osteomyelitis?

No

Yes

MRI and/or bone biopsy

F

Soft tissue coverage desired?

No

Soft tissue coverage desired?

Yes

Negative for osteomyelitis

Positive for osteomyelitis

G Infectious disease consultation

Antibiotic therapy

H Local wound care

I Surgical debridement, wide excision of bursa, bony debridement, and flap coverage

J Surgical debridement

Maintenance and prevention

Yes

Osteomyelitis resolved?

No
CHAPTER 11  SCARS

W. Thomas Lawrence

A When considering scar management and possible revision, the first consideration is the age of the scar. It is also important to understand the original cause of the wound, and if any complications such as infection or mechanical disruption occurred during the healing process. If the scar is a result of a wound that occurred within the previous 6 months, efforts are initially directed at minimizing the development of unfavorable scar characteristics. Minimizing sun exposure may limit hyperpigmentation and is a universal recommendation. The injured area is often excessively dry, and moisturizing cream can make the skin look and feel more natural.

B Many agents have been used to optimize the appearance of scars. The modality that has the most scientific support is topical silicone, which can be applied as a sheet or gel that solidifies after application. Treatment should be initiated as soon as possible after wound closure and continued for at least 12 hours a day for 2 months. If silicone gel is not available, the simple application of paper tape may be useful at limiting unfavorable scars. It has been suggested that secondary modalities, including pressure, topical over-the-counter ointments and creams, and other agents may be valuable for improving the appearance of scars. However, definitive studies proving the efficacy of these agents are lacking. Intralossional injections with steroids (for example, Kenalog) can also be given if the scar is showing signs of becoming hypertrophic. Typical treatment includes up to three injections spaced 6 weeks apart.

C If the scar is older than 6 months and mature, the undesirable characteristics of the scar need to be assessed, including the wound that generated the scar. If the scar is aesthetically acceptable and does not impair function, no treatment is necessary.

D Large, depressed scars will generally benefit from surgical revision, which may involve simple scar excision with advancement of the wound edge. Tissue deficits under the scarred area can be managed by deepithelializing the scar and advancing the wound edges over it. Alternatively, the advancement of deeper subcutaneous tissues can also be effective for supporting the cutaneous closure.

E Small, depressed scars (for example, acne scars) can benefit from using dermabrasion or a laser to smooth the edges. Fillers such as fat, collagen, or hyaluronic acid can be used to fill in the depth of the scars.

F If the scar is excessively erythematous and/or raised, it may respond to occlusion with silicone sheeting, if such a treatment has not already been used. Alternatively, intralossional injections of triamcinolone may minimize erythema and scar prominence. Treatment with a pulsed dye laser has also been effective at minimizing erythema. However, good comparative studies of the different therapeutic modalities have not been performed.

G The surgical revision of erythematous and/or raised scars is another alternative. The history of the wound and scar needs to be considered. If significant trauma and/or inflammation was associated with the original injury, these factors may have contributed to the development of a less favorable scar. A surgical scar revision in a controlled environment without these comorbidities may lead to an improved result. Adjunctive modalities such as intralesional steroids, topical silicone, pressure, or intralesional verapamil may minimize the recurrence of the erythema and induration. Raised scars may also benefit from dermabrasion, which will provide mechanical smoothing.

H Contracted scars near vital structures such as the eyelid or mouth can distort these structures, which can result in aesthetic disharmony and/or functional limitations. Contracted scars across the joints can impede the patient’s full range of motion. In either circumstance, scar release is required. If the tissue deficiency is limited, a local tissue rearrangement may be adequate to correct the problem. If the deficiency is more severe, however, additional tissue must be added in the form of a graft or a flap. If the scar crosses tension lines in the skin, stress on the scar can contribute to a raised, erythematous scar. Realigning the scar with Z-plasties or other forms of tissue rearrangement may be required to diminish the unfavorable scar characteristics.

BIBLIOGRAPHY


CHAPTER 11  SCARS

W. Thomas Lawrence

Sun avoidance protection and moisturizing cream

PATIENT DESIRING SCAR REVISION

History and physical examination

Determine nature of the injury and assess the scar

Wound less than 6 months old

A Sun avoidance protection and moisturizing cream

Scar is unfavorable

B Massage and topical scar management plus intralesional steroids if indicated

Scar is unfavorable

Reassess after 6 months

Scar is favorable

No treatment

Wound greater than 6 months old

C Wound greater than 6 months old

Scar is unfavorable

Assess nature of the scar

No treatment

Scar is favorable

D Depressed scar

Shallow

E Excise or fill (see algorithms 110 and 112)

Deep

F Intrallesional steroid ± laser therapy

Scar is unfavorable

G Surgical scar revision with perioperative steroid treatment and topical scar management

Scar is favorable

No treatment

H Scar contracture

Tissue deficiency

Limited deficiency

Add tissue (FTSG or flap)

Major deficiency

Z-plasty or other tissue arrangement

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 12  KELOIDS
Rei Ogawa

A It is necessary to consider the differential diagnosis of keloids and hypertrophic scars. Malignant or local destructive tumors such as dermatofibrosarcoma protuberans may be clinically misdiagnosed as keloids. A biopsy should be conducted in anomalous cases, and steroid injections should be performed only after careful consideration, because a malignancy or infection may be present. Many scars possess features of both keloids and hypertrophic scars; thus it may be difficult to distinguish between these two conditions on the basis of their horizontal growth patterns alone. For this reason, all such cases should be treated as keloids.

B Noninvasive measures, including silicone gel sheets, creams, taping, and compression garments, are frequently used for the initial treatment of keloids. Unfortunately, these modalities are often unsuccessful in resolving a patient's concern about a keloid. However, patients should be informed that performing invasive therapy to treat a keloid may induce additional scar formation; therefore a trial of conservative management may be warranted.

C Corticosteroids, including hydrocortisone, methylprednisolone, triamcinolone, and dexamethasone, have been widely used to treat keloids. Although they are efficient in reducing the size of excessive, accumulated scars, corticosteroids have a number of side effects, including pain during the injection, thinning and atrophy of the skin, capillary dilatation, and hypopigmentation. Because these complications sometimes hamper combination treatments, corticosteroid use should be considered and planned carefully. However, steroid injections—if used properly—may lead to significant improvements in the appearance and symptoms of the keloid.

D Single or small keloids can be treated radically if other measures fail; it may also be the primary treatment option for motivated patients who understand the limitations and risks. Because our understanding of postoperative radiation and steroid therapies has increased, these treatments can be used effectively as adjuvant therapies after primary surgery. Moreover, some therapies, including laser or cryotherapy treatments, may be effective as forms of monotherapy for the radical treatment of keloids. Adjuvant radiation therapy is typically reserved for larger keloids, or for patients who did not have a beneficial response to previous steroid treatments. Dose protocols for radiation therapy should be adjusted, depending on the keloid’s location and the patient’s race. To prevent carcinogenesis, dermatitis, and pigmentation, the total dose should not exceed 20 Gy.

E Multiple or large keloids are difficult to treat. Having a thorough discussion with the patient is essential; setting goals should be part of that conversation. In this dialog, patients usually express major complaints related to poor appearance, itching, pain, infection, and inclusion cysts. Thus mass-reduction surgery and symptomatic multimodal therapies should only be undertaken when the patient understands the full extent of the needed treatment, and the risk of a recurrent keloid.

F Mass-reduction surgery should be performed to remove excess amounts of collagen. This is effective for flattening and reducing the area covered by the keloid and for removing infected regions, including inclusion cysts. Serial excision is usually required; therefore, to prevent excessive radiation exposure, radiation therapy should not be used in mid course. Radiation therapy should only be performed after radical removal of the keloid. There are also occasions in which a keloid is removed in its entirety, leaving a large cutaneous defect. This defect can be covered with a skin graft or a local/regional/distant tissue transfer. The patient must be advised that he or she may develop keloids around the incision and/or donor sites. Therefore adjuvant therapies for both the excision and donor sites should be considered.

G Drugs that are normally reserved for the treatment of cancer and autoimmune diseases, including alpha-interferon, 5-fluorouracil, and bleomycin, have been successfully used to treat keloids. They may be beneficial when treating patients with large or multiple keloids. However, the mechanisms underlying the actions of these agents remain unknown.

H A key factor for the prevention of keloid recurrence postoperatively is patient self-management. Recent studies have revealed that mechanical force is the primary factor responsible for keloid generation and ingression. Thus every procedure that prevents the exertion of mechanical force, including skin stretching and friction, should be considered. Gel sheeting, taping, and pressure garments are useful for resting, fixation, and remodeling of the scar and should be used. External agents such as antiinflammatory ointments and scar-improvement compounds can also be used. Antiallergenic agents may be effective in treating subjective symptoms, including itching and pain, during the healing process.

BIBLIOGRAPHY
PATIENT WITH A CUTANEOUS KELOID

History and physical examination

A. Ensure that the keloid is not a misdiagnosed lesion (for example, dermatofibrosarcoma protuberans)

Single or small keloid

Has the patient tried noninvasive measures?

Yes

B. No

Does the patient prefer to attempt noninvasive measures despite unlikely improvement in the keloid?

No

C. Invasive treatment

Consider corticosteroid injections

Keloid improved after therapy?

No

D. No (or the patient prefers radical therapy)

Consider radical therapy

Surgical excision with adjuvant corticosteroid injection

Surgical excision with radiation therapy

Laser or cryotherapy ± adjuvant therapy

Postoperative management

Long-term follow-up

Yes

D. Yes

No further treatment

No

E. Establish mutual treatment goals and outcomes with the patient

Debulk the keloid or complete excision

Primary suture or wound coverage if indicated

F. Posttreatment management

Long-term follow-up

Yes

G. Consider antitumor/immunosuppressive agents

Steroid or radiation adjuvant therapy to the site of keloid excision and donor site, if tissue is harvested for wound coverage

No

H. Has the keloid improved?

No

Long-term follow-up

Yes

I. Continue with conservative measures

Silicone gel sheets

Taping

Compression therapy

External medications

Yes

J. Continue with therapy

No

K. Has the keloid improved?

No

Yes
RECONSTRUCTIVE SURGERY

Skin
Head and Neck
Breast and Trunk
Upper Extremity
Lower Extremity
Skin

Melanoma
Non-melanoma Skin Cancer
Blood Vessel Malformations: Infant
Blood Vessel Malformations: Not Infant
Lymphatic Malformations
CHAPTER 13 MELANOMA

Steven D. Macht

A general medical history is obtained for all patients suspected of having melanoma. In addition, specific inquiries should be made about his or her history of sun exposure, dysplastic nevus syndrome, and a personal and/or family history of melanoma. It should be determined whether more than 20 nevi are present. On examination, lesions should be evaluated based on the ABCDE criteria—asymmetry, border irregularity, color variation, a diameter larger than 6 mm, and changes within or evolution of a cutaneous lesion.

Suspicious lesions that have not been biopsied should undergo either an excisional or incisional biopsy, depending on the lesion size. Shave biopsies should never be performed for a suspected melanoma, because the depth-of-invasion measurements will not be valid.

In some cases, the pathology report may not give a conclusive diagnosis. This may be caused by either difficulty in the histopathologic analysis of the specimen or confusion in the terminology used to report the findings. If confusion exists, the sample should be sent to an experienced dermatopathologist for review before any extensive tissue resection takes place.

The depth of invasion of melanoma is referred to as Breslow’s depth, which is used for melanoma staging and to predict lymph node involvement. The depth of tumor invasion is classified in the following table.

### Breslow’s Depth of Invasion of Melanoma

<table>
<thead>
<tr>
<th>Breslow’s Depth</th>
<th>5-Year Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 mm</td>
<td>95-100</td>
</tr>
<tr>
<td>1-2 mm</td>
<td>80-96</td>
</tr>
<tr>
<td>2-4 mm</td>
<td>60-75</td>
</tr>
<tr>
<td>&gt;4 mm</td>
<td>50</td>
</tr>
</tbody>
</table>

The Clark level of invasion is also used to classify the depth of the melanoma: I, limited to the epidermis; II, into the underlying papillary dermis; III, to the junction of the papillary and reticular dermis; IV, into the reticular dermis; V, into the subcutaneous fat. However, because Clark’s level has a lower predictive value and is less reproducible, its usefulness is limited in the current (2010) American Joint Committee on Cancer (AJCC) staging system.

Asymptomatic patients should have chest radiographs and liver function tests, in addition to a physical examination, performed to screen for metastasis. Melanoma staging should be performed according to the most recent guidelines of the AJCC.

The biopsy site and any residual melanoma are excised according to the recommendations of the National Institutes of Health (NIH) and the World Health Organization (WHO) Melanoma Program:

- **0.5 cm margin**, for melanoma in situ (stage 0)
- **1 cm margin**, for tumors of 1 mm or less (stage I A and primary tumors associated with stage III disease, according to their thickness)
- **2 cm margin**, for tumors between 1.1 and 3.99 mm (stages IB, IIA, IIB, and primary tumors associated with stage III disease, according to their thickness)
- **2 to 4 cm margin**, for tumors larger than 4 mm (stage IIC and primary tumors associated with stage III disease, according to their thickness)

The patient is examined for regional lymphadenopathy. Palpable nodes require fine-needle aspiration. If this is positive, a formal lymph node dissection is indicated. If the patient does not have a palpable node, but the tumor is thicker than 1 mm, a sentinel node biopsy (SNB) is indicated. A positive SNB is followed by a formal lymph node dissection.

A long-term follow-up is essential for all patients with melanoma. Specific stage-based follow-up protocols are well established and should be strictly adhered to regarding the frequency and duration of visits and the need for additional diagnostic testing.

### BIBLIOGRAPHY


**PATIENT WITH SUSPECTED MALIGNANT MELANOMA**

A. History and physical examination

B. Has a biopsy of the lesion been performed?
   - Yes
   - No

   C. Is pathology diagnostic?
     - No
     - Yes
     - Send slides to a dermatopathology center for review

D. Histologic staging (Breslow thickness and Clark level)

E. Stage patient and complete an oncologic consultation for evaluation and additional treatment if indicated

F. Surgical resection of the lesion or biopsy scar

   - Tumor thickness < 1 mm
   - Tumor thickness ≥ 1-3.99 mm
   - Tumor thickness ≥ 4 mm
     - Excise with 1 cm margins
     - Excise with 2 cm margins
     - Excise with 2-4 cm margins

G. Lymphadenopathy present?
   - Yes
     - Fine-needle aspiration
     - Sentinel node biopsy
   - No
     - Lesion > 1 mm thick

H. Long-term follow-up
CHAPTER 14 NON-MELANOMA SKIN CANCER

Steven D. Macht

A complete history and physical examination are essential for all patients who may have non-melanoma skin cancer. In addition, specific inquiries should be made about the patient’s history of sun exposure, smoking, prior radiation therapy treatments, organ transplantation, arsenic ingestion, and exposure to toxic tars and oils, all of which can predispose individuals to develop skin carcinoma. A lesion-specific history should be obtained to ascertain how long the lesion has been present, if it has changed, if there is ulceration or bleeding, if the patient has any associated symptoms (for example, numbness or pain), and if any treatments have been attempted.

A lesion-specific history should be obtained to ascertain how long the lesion has been present, if it has changed, if there is ulceration or bleeding, if the patient has any associated symptoms (for example, numbness or pain), and if any treatments have been attempted.

Pathology results must be carefully reviewed to determine the proper course of treatment, because the margin of resection varies with each lesion. For patients in whom an unusual pathology is found (for example, a Merkel cell tumor), it is recommended that an experienced dermatopathologist review the slides before tumor resection. In addition, the surgeon must be familiar with lesions that have strong malignant potential (for example, keratoacanthoma or nevus sebaceous) to ensure that the appropriate treatment is provided.

For some patients, the most appropriate course of therapy may be medical management. Lesions can be treated with either topical medications such as 5-fluorouracil (5-FU) or imiquimod. These medications can be used to treat low-risk basal cell carcinoma (BCC) or premalignant or in situ squamous cell carcinoma (SCC). More aggressive treatments are required for high-risk basal cell tumors with specific histologic features (for example, morpheaform, sclerosing, infiltrative, micronodular, or mixed subtypes), perineural spread, and basosquamous features. Tumors are also considered high risk if they are recurrent, have poorly defined borders, are located on the H-zone of the face or on the hands, or are located at a site where radiation was previously used. Radiation therapy can be used successfully for primary tumors in patients who cannot tolerate surgery.

When a direct tumor excision is appropriate, the recommended surgical margin for BCC is 3 to 4 mm, whereas the margin for SCC is based on the nature of the lesion. Low-risk SCC (smaller than 2 cm; well-differentiated; without subcutaneous fat invasion; located on the trunk and extremities) requires a 4 mm margin. High-risk SCC (larger than 2 cm; poorly differentiated; invasive to fat; located in high-risk locations such as the central face, ears, scalp, genitalia, and hands/feet) requires 6 mm margins.

Patients with palpable adenopathy require fine-needle aspiration (FNA) of the suspicious node. If the FNA is positive, lymph node dissection is required, and an oncologist should be consulted regarding additional evaluations and treatments, if indicated.

Reconstruction after the excision of a cutaneous carcinoma depends on the anatomic location and should be delayed until the final pathology report indicates clear margins in all surgical planes.

Patients with BCC should be followed every 6 months for 5 years and examined at yearly intervals thereafter. Patients with SCC should be reexamined every 3 months for the first 2 years, then followed indefinitely every 6 to 12 months.

BIBLIOGRAPHY


PATIENT WITH SUSPECTED NON-MELANOMA SKIN MALIGNANCY

History and physical examination

A Has a biopsy been performed?

No

Excisional or incisional biopsy

Yes

B Is the pathology consistent with non-melanoma skin cancer?

No

Treat the lesion as indicated

Yes

Can the patient tolerate surgery?

C No

Nonsurgical management

• Medical therapy
• Radiation therapy

Yes

Excise lesion

D Is the lesion appropriate for Mohs surgery?

No

Yes

Mohs surgery

BCC

Excise with 3-4 mm margins

F Adenopathy present?

Yes

Excise with 6 mm margins

Negative

Lymph node dissection

No

Positive

Oncology consultation

H Long-term follow-up

E SCC

High-risk lesion

Low-risk lesion

Excise with 4 mm margins
CHAPTER 15  BLOOD VESSEL MALFORMATIONS: INFANT

Jeffrey L. Marsh

**A**  Vascular malformation is the encompassing term for congenital and acquired abnormalities of the peripheral blood vessel and lymphatic systems. Clinical differentiation among the types of vascular malformations is made on the basis of the patient’s history, physical examination, and diagnostic imaging. Hemangiomas are the most frequently occurring vascular malformation and the most common birth defect. They may be present at birth or appear within the first few weeks of life, as the maternal hormones that vasoconstricted the abnormal vessels in utero are metabolized postnatally.

**B**  Intradermal hemangiomas are present at birth, flat, and have a color spectrum from purple, through red, to light pink. The intensity of coloration and the anatomic locus are used to differentiate a stork bite from a portwine stain. Stork bites are usually light pink to red and involve the midline of the face. They are most commonly located on the forehead and nose, sometimes with extension onto the eyelids and upper lip. Stork bites fade over time and rarely require intervention. Portwine stains may occur anywhere in the body, persist throughout life, and often darken and develop a verrucoid surface with age. A portwine stain that involves the distribution of one or more of the sensory divisions of cranial nerve V may be associated with meningeal vascular malformations, which can precipitate seizures (Sturge-Weber syndrome). Laser therapy can lighten portwine stains, and make-up can be used to camouflage them. Treatment is usually deferred until the child can be empowered to participate in the decision-making process.

**C**  Hemangiomas that engorge postnatally are known by a number of names. Of greater clinical significance, however, are whether the hemangioma is still engorging when initially evaluated, whether the hemangioma is being slowly or rapidly engorged, and whether the lesion extends beyond the borders noted at presentation.

**D**  Hemangiomas can result in both local and systemic morbidity. For example, an ulcerated hemangioma will bleed and may become infected, thereby causing necrosis of the previously normal tissues adjacent to the hemangioma. Cauterization, antibiotic therapy, and surgical removal, if feasible, are indicated. A combination of topical Silvadene and systemic antibiotic therapy can control infection. Rarely, a hemangioma can induce consumption coagulopathy (Kasabach-Merritt syndrome), a potentially life-threatening condition that requires hospitalization with hematologic consultation for treatment.

*Continued*
INFANT WITH RED, PURPLE, OR BLUE LESION OF SKIN AND/OR SUBCUTANEOUS TISSUE

History and physical examination

A Present at birth or develops within first few months of life?

Yes

Flat (intradermal)

Remains flat?

Yes

B Anatomic site

Face midline (stork bite)

Observe

Face cranial nerve V sensory distribution

Consider MRI of head to rule out meningeal involvement (Sturge-Weber syndrome)

Meningeal involvement on MRI and/or seizure disorder?

Yes

Psychosocial concern to patient?

Yes

Nonsurgical management

• Camouflage with makeup
• Laser therapy

No

Still actively engorging?

Yes

C Complications?

Ulceration, bleeding, infection

Nonsurgical management

Consumption coagulopathy

Hematology consultation

• Pressure
• Cauterization
• Topical and systemic antibiotic therapy

No

Not flat (raised above skin and/or subcutaneous mass)

D Complications?

Yes

Observe

No

Continued
CHAPTER 15  BLOOD VESSEL MALFORMATIONS: INFANT

Jeffrey L. Marsh

The anatomic locus of an actively enlarging hemangioma determines the need for and timing of intervention. If a critical structure (for example, eyelid, airway, face, hand, or perineum) is involved, and if the hemangioma can be completely excised without producing unacceptable cosmetic and/or functional morbidity, then surgical excision is the most effective treatment. Conversely, if a critical structure is involved and the hemangioma cannot be completely excised without producing unacceptable cosmetic and/or functional morbidity, pharmacologic treatment with systemic propranolol, interferon, or a high-dose–alternate-day systemic steroid (prednisone) is initiated. Although some authors advocate laser therapy or intralesional steroid injections, I have not found these to be effective. Furthermore, these treatments may increase the morbidity of the hemangioma by causing surface breakdown with bleeding and infection (laser) or by delaying effective systemic steroid therapy. If a hemangioma does not involve a critical structure, is engorging slowly, or has stopped enlarging altogether, it can either be observed for natural involution or excised surgically.

Contrain to some publications, my experience has been that if a hemangioma is going to involute naturally, it will do so by the time the patient is 4 years old. Therefore I am willing to treat a residual hemangioma anytime the patient is older than 4. As with most elective pediatric surgeries, parents are informed that they can either decide to have the residual hemangioma treated, or wait until the child is old enough to be empowered to participate in the decision-making process. Residual skin discoloration is treated with the laser; surgical excision is used for dysplastic skin and residual bulk.

Pathologists diagnose the clinical entity of pyogenic granuloma as a hemorrhagic hemangioma. The lesion usually appears as a friable, raised, bright red mass that bleeds recurrently without known antecedent trauma. Excision and cautery of the base suffices.

Patients should be followed in the short term by the treating physician and in the long term by the primary care physician.

BIBLIOGRAPHY


CHAPTER 16  BLOOD VESSEL MALFORMATIONS: NOT INFANT

Jeffrey L. Marsh

For a child or adult with a red, purple, or blue lesion of the skin and/or subcutaneous tissue, it is important to distinguish between high-flow and low-flow vascular malformations. High-flow lesions are much more likely to have local and systemic comorbidities than low-flow lesions.

The maturation of interventional radiology has altered the management of many types of vascular malformations. For some patients, elective embolization of a discrete feeding vessel under direct visualization results in complete involution of the lesion. For others, it provides only a temporary marked reduction in blood flow, allowing surgical intervention without excessive blood loss.

Although localized vascular malformations can be excised surgically, their locations may make surgical resection undesirable because of unacceptable cosmetic and/or functional morbidity. This is especially true for the head, neck, and hands. In such cases, observation or limited surgical debulking may be the best approach.

Sclerotherapy under direct medical imaging is the treatment of choice for low-flow venous malformations that are not suitable for complete surgical excision.

The patient is followed in the short term by the treating physician and in the long term by the primary care physician.

BIBLIOGRAPHY


Algorithm 16

CHILD OR ADULT WITH RED, PURPLE, OR BLUE LESION OF SKIN AND/OR SUBCUTANEOUS TISSUE

History and physical examination

A. Clinical signs of high-flow vascular malformation (visible pulsation, thrill, bruit, overgrowth)?

Yes
Cardiac evaluation

Cardiac pathology?

Yes
Cardiology management in conjunction with vascular malformation management

B. Feeding vessel(s) suitable for embolization?

No

Abnormal arteriovenous communication (AVM) suitable for ligation?

Yes
Surgical ligation

Residual AVM?

No
Observe

No

Residual vascular malformation?

Yes

C. Can the vascular malformation be completely excised without unacceptable cosmetic or functional deficit?

No
Observe

Yes
Nonsurgical management

- Observe
- Consider partial resection

No

Observe

Yes
Surgical excision ± reconstruction

E. Follow-up

No

Observe

MR vascular imaging (arterial and venous phases)

Feeding vessel(s) suitable for embolization?

Yes

D. Venous lakes suitable for sclerotherapy?

No

Can the vascular malformation be excised without unacceptable cosmetic or functional deficit?

Yes
Surgical reconstruction

No
Observe

No

Residual anatomic deformity?

Yes
Observe

No

Surgical reconstruction

No
Observe

No

Yes

Observe

Yes
Surgical excision ± reconstruction

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 17  LYMPHATIC MALFORMATIONS
Jeffrey L. Marsh

A Lymphatic malformations of the extremities may be congenital, have a delayed onset, or result from trauma, surgery, or radiation. Regardless of the origin, these malformations tend to present as lymphedema—a diffuse process unlike that of lymphatic malformations of the head/neck or torso (that is, lymphangioma), which require different treatment. Head/neck and torso lymphatic malformations tend to be localized, at least regionally, and cystic: macrocystic, microcystic, or a combination. These lymphatic malformations often have a hemangiomatous component.

B Small, asymptomatic lymphatic malformations may be observed until they become either concerning to the patient or symptomatic.

C Recurrent infection caused by flow stasis within the lymphangioma that predisposes to seeding from otherwise innocuous bacteremias is a major cause of lymphangioma morbidity. The infection may resolve with oral antibiotic agents given as outpatient treatment. Alternatively, parenteral antibiotic therapy and even low-dose, long-term suppressive antibiotic therapy may be required as inpatient treatment. When there is a recurrent infection or prolonged need for suppressive antibiotic therapy, surgical extirpation should be considered.

D MRI should be used to evaluate the anatomic definition of the lymphangioma and to determine the feasibility of total surgical removal. Although lymphangiomas do not usually take up imaging contrast, different forms of MR images can be used to separate the lymphangioma from uninvolved tissue. Lymphangiomas that either compromise the upper aerodigestive system with pressure (cystic hygroma) or involve the oral cavity, tongue, and/or larynx often require more aggressive treatment.

E Several types of interventions, including surgical excision and drainage with or without sclerotherapy, are advocated for macrocystic lymphangiomas. Some authors report spontaneous resolution of cystic hygromas. The literature is not clear regarding which therapies are most effective for which types of lymphangioma; it seems as if the treatments used are largely dependent on the authors’ preference. However, microcystic lymphangiomas require surgical ablation for removal. Involvement of vital structures in the upper aerodigestive system or portions of the face may preclude total removal because of unacceptable cosmetic or functional morbidity. In such cases, performing a limited excision and preserving vital tissues and structures may be beneficial. Serial reexcisions may be necessary, because the residual lymphangioma may grow over time.

BIBLIOGRAPHY

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
PATIENT WITH LYMPHATIC MALFORMATION

History and physical examination

A Limb involvement?

No

Is the lymphatic malformation symptomatic?

No

B Is the lymphatic malformation of concern to patient or parents?

No

Observe

Yes

C Is there an active or recurrent infection?

Yes

Antibiotic therapy

No

D MRI to define anatomic extent

Involvement of deep vital structures?

No

Can lymphatic malformation be completely excised without unacceptable cosmetic or functional deficit?

Yes

Surgical resection ± reconstruction

Short-term follow-up with treating physician; long-term follow-up with primary care physician

Regrowth of lymphatic malformation with cosmetic, functional, or infectious morbidity

Yes

Observe

No

Consider:
- Partial resection
- Sclerotherapy

Yes

Is the residual lymphatic malformation stable?

No

Yes

E Is the lymphatic malformation of concern to patient or parents?
Head and Neck

Congenital Anomalies
Cleft Lip and Palate: Management
Cleft Lip and Palate: Residual Deformities
Cleft Lip and Palate: Persistent Functional Impairments
Cleft Lip and Palate: Fistulas
Cleft Lip and/or Palate: Dentoskeletal Management
Craniofacial Deformities: Initial Evaluation
Craniofacial Deformities: Airway Management
Abnormal Calvarial Shape
Abnormal Orbital Region
Abnormal Midface
Abnormal Lower Face
Prominent Ears
Constricted Ears
Microtia

Midline Nasal Masses
Pediatric Neck Masses: Congenital
Pediatric Neck Masses: Acquired

Dentoskeletal Malocclusion
Dentofacial Deformities: Evaluation
Maxillary Deformities: Treatment Plan
Mandibular Deformities: Treatment Plan

Craniofacial Trauma
Facial Bone Fractures: Evaluation
Frontal Bone and Frontal Sinus Fractures
Nasal Bone Fractures
Orbital Fractures
Zygomaticomaxillary Complex Fractures
Nasooribtal-Ethmoid Fractures
Midface Fractures
Mandibular Fractures

Neoplasms and Reconstruction
Scalp Defects
Forehead Defects
Eyelid Defects
Eyelid Ptosis
Ear Defects
Nose Defects
Cheek Defects
Lip Defects
Mandibular Defects
Facial Paralysis
Parotid Masses
Lip Cancer
Oral Cavity Cancer

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
A neonate with a cleft lip (with or without a cleft palate) presents a series of management decisions for care providers. The choice and sequence of specific interventions will affect the quality of outcome and the cost efficiency of the selected treatments. A longitudinal habilitation plan is discussed as part of the initial evaluation. This plan, which will be modified as time passes, is based on the child’s response to previous interventions and his or her growth and development.

Infants with an isolated cleft lip who have no breathing or feeding difficulties and no other dysmorphic features have traditionally been cared for by someone outside of the cleft palate team. However, increasing data documenting previously unrecognized hearing and speech impairments and genetic anomalies among patients with an isolated cleft lip suggest that they receive a multidisciplinary cleft team evaluation, as should all patients who have either a cleft lip with cleft palate or an isolated cleft palate. Multidisciplinary cleft team evaluations and care have improved the habilitation of cleft patients, because no single health care discipline incorporates all of the expertise necessary for the successful habilitation of cleft-associated problems.

A subgroup of neonates with cleft palates, with or without cleft lips, is at risk for airway problems caused by a small, posteriorly placed mandible (Pierre Robin sequence). The airway may occlude, producing apneic episodes regardless of positions, in certain positions only (for example, supine), or only during feeding. An airway history should be part of the evaluation of every neonate with a cleft.

Managing a neonate’s unstable airway involves a sequence of maneuvers beginning with position and culminating in tracheostomy. Neonatal mandibular distraction osteogenesis has eliminated the need for tracheostomy in most infants with Pierre Robin sequence. Thus tracheostomy is restricted to neonates who cannot be successfully extubated or those who have additional orofacial anomalies that compromise the airway, such as the absence of the mandibular condyle in hemifacial microsoma.

When evaluated by geneticists, almost 50% of patients with an isolated cleft palate and a smaller percentage of those with cleft lip, with or without cleft palate, have been found to have anomalies in addition to the cleft. Genetic screening, followed by a complete evaluation and counseling of parents, should be part of the care for all cleft patients. Patients with clefts and their parents should also receive reproductive risk counseling.

Failure to thrive is the second neonatal risk factor for infants with clefts. All neonates with clefts should receive a feeding and nutrition screening. If the neonate is not consuming adequate amounts of formula, is taking an excessively long time to feed, and/or is not gaining weight appropriately, a full evaluation—including a physical examination and a feeding demonstration by an experienced provider—is indicated.

The timing and specifics of cleft interventions remain controversial. This care protocol is based on the extent of the initial anatomic defect.

Infants with an isolated cleft lip are divided into two subsets: those with and those without an alveolar cleft. If there is no alveolar cleft, or if there is an alveolar cleft without deformity of the alveolus, a definitive Millard rotation-advancement cleftplasty with Noordhoff dry vermilion flap and nasal reconstruction are performed any time after 6 weeks of age for a healthy term infant. For the premature infant, the lip repair is delayed until at least 48 gestational weeks to avoid postanesthetic apnea. If the infant is not healthy, lip surgery is delayed until there is steady weight gain and no additional anesthetic risk. If the alveolus is deformed, with ventral protrusion of the premaxilla, a lip adhesion is performed at 6 weeks of age. Preoperative or perioperative alveolar and/or nasal moldings can be performed, but are not necessary. Definitive cheiloplasty is then performed 6 months later or synchronously with palatoplasty.

Following a full evaluation by a cleft palate team, infants with an isolated cleft palate undergo a one-stage repair of the hard and soft palates between 6 and 12 months of age.

Infants with cleft lip and palate are managed with a combination of the protocols used to treat an isolated cleft lip with alveolar deformity and an isolated cleft palate. Bilateral myringotomies and insertion of ear drum ventilation tubes are usually performed by an otolaryngologist (ENT) synchronously with the palatoplasty.

All cleft patients should undergo a full cleft team evaluation at 2 and 3 years of age. If the screenings for hearing, speech, and language are normal, patients with an isolated cleft lip are followed thereafter by the plastic surgeon. Patients with either an isolated cleft palate or a cleft lip with cleft palate undergo full cleft team evaluations at 4, 6, 8, 10, 12, 14, 17, and 20 years of age. Secondary problems are managed as they arise (see algorithms 19 through 22).

BIBLIOGRAPHY


INFANT WITH CLEFT LIP WITH OR WITHOUT CLEFT PALATE

History and physical examination

A Evaluation by a multidisciplinary cleft team

B Check airway

Unstable → Stabilize airway

C Stabilize airway

Position
- Nasopharyngeal tube
- Nasotracheal/orotracheal intubation
- Tongue/lip adhesion
- Mandibular distraction osteogenesis
- Tracheostomy

Stable

D Check for other anomalies

Present → Genetic evaluation and counseling

Absent → Manage noncleft anomalies as needed

E Feeding and nutrition screen

Failure to thrive → Feeding and nutrition evaluation and management

Satisfactory intake and growth

F Anatomic site of deformity

G Cleft lip

Alveolar cleft

Deformity of alveolar arch

Lip adhesion with nasal reconstruction or synchronous with palatoplasty at ≥6 weeks of age

+ 6 months

No alveolar cleft

No deformity of alveolar arch

H Cleft palate

Single-stage palatoplasty at 6-12 months of age

L Lip adhesion with nasal reconstruction or synchronous with palatoplasty at ≥6 weeks of age

I Cleft lip with cleft palate

Definitive cheiloplasty and single-stage palatoplasty at 6-12 months of age

Definitive lip repair with nasal reconstruction at ≥6 weeks of age

J Longitudinal cleft team care

Correct secondary deformities and dysfunctions as needed (see algorithms 19-22)
CHAPTER 19 CLEFT LIP AND PALATE: RESIDUAL DEFORMITIES

Jeffrey L. Marsh

A Longitudinal evaluation by a multidisciplinary cleft team is necessary from birth into early adulthood, because not all cleft-associated problems can be corrected in infancy. Furthermore, not all cleft interventions in infancy are successful. Thus the multidisciplinary approach is the most convenient and comprehensive means for conducting such a follow-up. When secondary deformities or dysfunctions are identified, they are evaluated and managed based on their functional and psychosocial impairments and the patient’s age.

B Residual lip deformity is much less common in children whose cleft lip was repaired within the past few decades than in patients who underwent cheiloplasty many decades ago. Adults with residual lip deformity should be managed if they desire lip revision, and if such a revision is possible. We evaluate children for overt lip deformities between 5 and 6 years of age, before they enter first grade. If such a deformity is present and symptomatic, lip revision is advised at that time. However, if there is minimal deformity and no psychosocial awareness on the part of the patient or his peers, then the revision is deferred until concern arises or until it is necessary to anesthetize the child for another procedure.

C Although some residual nasal deformity is seen in almost all cleft lip patients, primary nasal repair synchronous with lip repair has minimized its morbidity. Any adult with residual nasal deformity should be managed if he or she desires nasal revision, and if such a revision is possible. We evaluate children for overt nasal deformities between 5 and 6 years of age, before they enter first grade. If such a deformity is present and symptomatic, nasal tip revision is advised at that time. However, if there is minimal deformity and no psychosocial awareness on the part of the patient or his peers, then the revision is deferred until concern arises, the child is anesthetized for another procedure, or the adult nose has developed.

Nasal airway patency is an additional concern in the cleft patient. Nasal septal deflection is a consistent component of the unilateral cleft lip and palate condition. For a child about to begin school, Rees’s swinging-door technique can be used in conjunction with tip revision to centralize the caudal septum. True septoplasty and osteotomies are deferred until the middle teen years.

D Dentoskeletal deformities in patients with clefts can result from both the anomaly itself and from the types of intervention. Timing the correction of cleft-associated dentoskeletal deformities depends on the nature of the problem, the status of the dentition, and the physical maturation of the patient.

E The patient with a bilateral cleft lip and palate has a unique problem related to the premaxilla. Following lip repair in infancy, with or without the use of orthopedic devices, the premaxilla will ideally sit within the maxillary arch like a keystone. However, the premaxilla often protrudes ventral to the arch, and the mesial ends of the lateral segments collapse behind it. Because of the possibility of impairing maxillary anterior growth with early premaxillary surgery, we prefer to defer surgical repositioning and alveolar bone grafting until after the patient is 6 years old, usually after the eruption of the permanent maxillary incisors.

F Decreased maxillary width, or maxillary collapse, is seen in many patients with cleft lip and palate. Maxillary collapse is usually addressed around 8 years of age, after the eruption of the permanent maxillary central incisors and before the resorption of not more than one third of the primary canine root. At that time, orthodontic maxillary expansion is performed using a fixed appliance usually within 3 to 6 months. After the expansion is completed, autogenous iliac cancellous alveolar bone grafting is completed, and any residual alveolar-nasal fistulas are repaired. The expansion device is retained for 3 months, then replaced with a maxillary orthodontic retainer with replacements for any missing teeth; this should be used until the patient is ready for definitive orthodontics in the teen years.

G Maxillary retrusion is much less common today because certain palatoplasty procedures, which iatrogenically induced the condition, are no longer used. When maxillary retrusion is documented in a growing child, we wait until the patient seems to be within 2 years of the cessation of growth, which can be determined based on family history, growth patterns, and wrist radiographs. Presurgical orthodontics are then performed; these usually require 18 to 24 months of preparation, followed by maxillary advancement (LeFort I-type), with or without mandibular osteotomies and osseous genioplasty as indicated (see algorithm 120).

BIBLIOGRAPHY

PATIENT WHO HAS UNDERGONE CLEFT LIP AND/OR PALATE REPAIR

History and physical examination

A Longitudinal evaluation by multidisciplinary cleft team

Persistent deformity

B Lip deformity

Preschool child

Overt symptomatic deformity

Revise before child enters first grade

C Nose deformity

No overt or symptomatic deformity

Observe

No overt deformity or psychosocial concern

Dentoskeletal deformity (see algorithm 22)

D No persistent deformity

Continue longitudinal evaluation

E Protrusive or unstable premaxilla

Patient <4 years old

Orthodontic maxillary arch expansion

Orthodontic maxillary expansion

Patient >4 years old

Orthodontic retention

Maxillary alveolar bone grafting

Maxillary permanent incisors erupted

Orthognathic surgery

Maxillary permanent central incisors not erupted

Surgical maxillary repositioning with gingivoperioplasties

Surgical maxillary repositioning with alveolar bone grafting

F Decreased maxillary width

Permanent maxillary incisors not erupted

Defer until erupted

Permanent maxillary incisors erupted

Orthognathic surgery

Orthodontic retention

Orthognathic surgery

G Maxillary retrusion

Time before dentoskeletal maturation

<2 years

Defer intervention until 2 years before expected growth cessation

>2 years

Orthognathic surgery

Postoperative orthodontics

Presurgical orthodontics

Longitudinal follow-up with cleft lip/palate interdisciplinary team
CHAPTER 20  CLEFT LIP AND PALATE: PERSISTENT FUNCTIONAL IMPAIRMENTS

Jeffrey L. Marsh

A Longitudinal evaluation by a multidisciplinary cleft team is necessary from birth into early adulthood, because not all cleft-associated problems can be corrected in infancy. Furthermore, not all cleft interventions in infancy are successful. Thus the multidisciplinary approach is the most convenient and comprehensive means for conducting such a follow-up. When secondary deformities or dysfunctions are identified, they are evaluated and managed based on their severity and the patient’s age.

B A patient with cleft palate, with or without a cleft lip, may have impaired verbal communication caused by a variety of speech and/or language disorders. Velopharyngeal dysfunction (VPD)—evidenced by hypernasal resonance, nasal turbulence, and/or facial grimacing—is the specific disorder that relates to the cleft palate and adjacent structures. VPD can secondarily affect other components of speech, such as articulation and voice quality.

C The mechanism of VPD is determined before palatal management so that treatment may be specific for the type of dysfunction. Nasopharyngoscopy and fluoroscopy, both of which can be recorded digitally or on videotape for later review by care providers and archiving, are the most common means of establishing a differential diagnosis. Instrumental assessments of air flow and palatal movement may also be used.

D Prosthetic palatal management is used when the patient has documented obstructive sleep apnea, is not a surgical candidate (for example, he or she has uncorrectable cyanotic cardiac disease), or the parents refuse surgery. If sufficient velar tissue is present, a palatal lift is prescribed; if not, a pharyngeal obturator is prescribed. Palatal prostheses should be fit under nasopharyngoscopic control to optimize function and minimize time expended.

E The choice among surgical management options for VPD is based on the differential diagnosis of the etiologic factors. These routinely include muscle reconstruction with velopharyngeal flap, pharyngeal flap, sphincter pharyngoplasty, and occasionally soft palate lengthening (double-opposing Z-plasty) or posterior pharyngeal wall augmentation. All palatal management is preceded and followed (at 3 months postoperatively), with audiovideo-recorded perceptual speech evaluations by an experienced speech-language pathologist. If residual VPD is present, instrumental VP evaluation is repeated (nasopharyngoscopy and/or speech fluoroscopy).

F The timing for management of an alveolar-nasal fistula depends on the dental maturation of the child and the symptomatology of the fistula. A fistula affecting speech resonance is repaired as soon as it is identified, whereas an asymptomatic fistula, or one that causes minimal nasal regurgitation, is repaired in conjunction with alveolar bone grafting during the mixed dentition.

G The timing for management of a palatal fistula depends on the dental maturation of the child and the symptomatology of the fistula. If orthodontic palatal expansion is anticipated, palatal fistula repair is deferred until after the expansion, unless it is causing major symptomatology. A fistula that affects speech resonance or produces psychosocially significant nasal regurgitation is repaired as soon as it is identified. An asymptomatic fistula or one causing minimal nasal regurgitation is repaired only if desired by the patient or his or her family.

BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
PATIENT WHO HAS UNDERGONE CLEFT LIP AND/OR PALATE REPAIR

History and physical examination

A Longitudinal evaluation by multidisciplinary cleft team

Persistent functional impairment

No persistent functional impairment

Continue longitudinal evaluation

B Velopharyngeal dysfunction

Has there been an adequate trial of speech therapy?

Yes

Speech therapy

No

F Alveolar-nasal fistula

Permanent maxillary incisors erupted

Fistula affects speech resonance

Speech therapy

Permanent maxillary incisors not erupted

Fistula affects speech resonance

Palatal expansion not anticipated

G Palatal fistula (see algorithm 21)

Hearing loss

Failure to thrive

Refer to audiology and otolaryngology for evaluation and management

Refer to intramural or extramural services for counseling or therapy as indicated

H Hearing loss

Refer to audiology and otolaryngology for evaluation and management

I Imaging and/or instrumental documentation of velopharyngeal function

Patient has obstructive sleep apnea or is not a surgical candidate

Patient does not have obstructive sleep apnea and is a surgical candidate

J Prosthetic lift or obturator

Surgical palatal management

K Prosthetic lift or obturator

Repair fistula when speech disorder identified

Speech resonance affected

Psychosocially significant nasal regurgitation present

Repair fistula

Minimal nasal regurgitation present

Observe

Repair fistula

L Prosthetic lift or obturator

Speech resonance not affected

Minimal nasal regurgitation present

Observe

Repair fistula

M Prosthetic lift or obturator

Repair fistula

Defer repair until after expansion

N Prosthetic lift or obturator

Defer repair until after expansion

O Prosthetic lift or obturator

Defer repair until after expansion

Longitudinal follow-up with cleft lip/palate interdisciplinary team
When treating a patient with a palatal fistula, the first priority should be determining the presence or absence of symptoms. The most common symptoms that require surgical intervention are nasal regurgitation of food and problems related to speech caused by the escape of air through the nose. These conditions may contribute to velopharyngeal deficiency (VPD) and nasal hygiene problems.

Conservative treatment is indicated for the patient with an asymptomatic fistula. If the patient has a symptomatic fistula, a perceptual VP assessment is performed. If there are signs of hypernasality or nasal emissions, a further VP examination using videofluoroscopy (VFS) is performed as soon as the child can cooperate for the exam. Nasopharyngoscopy (NPS), a simple illumination test that uses a nasopharyngoscope, also helps to evaluate soft palate mobility and the competency of the VP closure. VP function is determined by using a combination of clinical perceptual speech assessment and the aforementioned objective methods. To examine the possible influences during speech, the fistula should be temporarily covered using dental wax or a palatal plate. Speech resonance is evaluated before and after coverage.

Hypernasal resonance diminishes after temporary fistula occlusion, the nasality is caused mainly by the fistula. The oronasal fistula can be repaired without an additional VP operation. The patient may require speech therapy postoperatively for the correction of articulation errors. If hypernasal resonance persists as the fistula occlusion test, VP surgery should be considered as a simultaneous or staged procedure.

The goal of fistula-closure surgery is to perform a two-layer (nasal and palatal side), tension-free closure. Depending on the location, the surgeon can treat a small fistula (for example, one that is 5 mm wide) by using adjacent tissue to make a regional flap. Turnover and transposition flaps from palatal, buccal, vestibular, or facial regions can be used, as can tissues taken from the nasal cavity, septum, or turbinate. The interpositioning of spacer materials such as crushed ear cartilage or acellular dermal matrices (autogenous or alloplastic) can be used for secure repairs. For some patients, a repeat two-flap palatoplasty can be used to close the fistula.

At times, large fistulas (for example, 10 mm wide) cannot be treated with local tissue. For these patients, a distally based tongue flap can be used to treat a fistula in the anterior part of the hard palate; a superiorly based pharyngeal flap can be used for fistulas in the middle or posterior portions of the hard palate. To prevent upper airway obstruction, tongue and pharyngeal flaps should not be performed simultaneously. VP function should be reevaluated after surgery.

If the patient has either a very large fistula or a recurrent fistula with severe scarring, local tissues will not be sufficient to close the defect. If the defect is in the anterior portion of the palate and there is also an alveolar defect, a temporalis muscle flap can be used. If the alveolar arch is intact, a facial artery myomucosal (FAMM) flap, which uses vascularized buccal mucosa, can be used. Rarely, microsurgical tissue transfers using a radial forearm, scalpula, or dorsalis pedis flap have been performed to close the palatal fistula. The VP function should be reassessed postoperatively to determine if a secondary VP surgery will be required.

BIBLIOGRAPHY


PATIENT WITH PALATAL FISTULA

History and physical examination

A Evaluation of symptoms

Absent

B Observation

Speech dysfunction present

C Perceptual VP assessment

VPD absent

D NPS/VFS plus fistula occlusion test

VPD present

E VP function improved

F Persistent VPD

Closure of palatal fistula

G Determine size of fistula

Small fistula

H Large fistula

I Very large fistula with severe scarring

Surgical repair with local or regional flaps or interpositional spacer (autogenous or alloplastic)

Follow-up in 3 months for wound and speech evaluation; longitudinal follow-up with a cleft lip/palate interdisciplinary team

Anterior hard palate

Posterior hard palate

Soft palate

Tongue or FAMM flap

Pharyngeal or FAMM flap

Pharyngeal flap

Reassess VP function if VP dysfunction was present

VP function intact

Persistent VPD

VPD management

Speech therapy, as indicated

See algorithm 20
All patients with a repaired cleft lip and/or cleft palate and dentoskeletal deformity should receive a complete evaluation by a multidisciplinary cleft team. Minimally, this team should include the patient’s orthodontist and surgeon. The evaluation should include clinical, photographic, and radiographic assessments; dental molds should also be evaluated. A medical history—including the patient’s chief complaint—is essential for developing a treatment plan.

A collapsed maxillary minor segment in association with a narrow alveolar cleft is not uncommon in patients with complete clefts. When the collapse is mild or moderate, simple orthodontic treatments are performed. When the collapse is severe, segmental distraction osteogenesis for anterolateral advancement of the maxillary minor segment can be performed. This is followed by the repair of any residual fistula and alveolar bone grafting between 8 and 10 years of age.

A collapsed maxillary minor segment in association with a wide alveolar cleft is seen in some patients with complete clefts. When there are marked symptoms (for example, a speech disorder or unilateral chewing), interdental distraction osteogenesis can be performed to advance the maxillary minor segment; this procedure creates new alveolar bone and gingival tissues and reduces the alveolar cleft. This is followed by the repair of any residual fistula and alveolar bone grafting between 8 and 10 years of age.

Diminished maxillary growth is common in individuals with a repaired cleft. The hypoplasia may involve the AP, vertical, and/or transverse dimensions.

When the maxillary hypoplasia is mild, simple orthodontic treatment is performed to align the dental arches and to correct jaw relations in AP, vertical, and/or transverse dimensions. Special consideration is necessary if the patient has an absent lateral incisor—the space can either be preserved for a future replacement or closed altogether.

If the patient has moderate maxillary hypoplasia, complex orthodontic treatment is required. This treatment aligns the dental arches and orthopedically protracts the maxilla, with or without maxillary expansion. Lowerarch dental extractions are sometimes necessary to relieve crowding and/or to secure a better anterior occlusion (for example, as with overjet and overbite).

Because deterioration of the class III skeletal pattern commonly occurs with pubertal growth, especially in males, longitudinal dental and jaw development is monitored through adolescence. Residual dentoskeletal deformity is managed with orthodontic therapy and orthognathic surgery procedures after growth is complete.

Some patients may have severe maxillary hypoplasia and no psychosocial awareness regarding the deformity; to optimize stability, orthodontic therapy and orthognathic surgery are deferred until growth is complete. When there is a psychosocial indication to correct severe maxillary hypoplasia in a growing patient, maxillary advancement is performed either by distraction osteogenesis or a traditional LeFort I osteotomy with rigid internal fixation. The patient and family must understand that additional orthodontic therapy and/or orthognathic surgery will likely be necessary after growth is complete.

**BIBLIOGRAPHY**


PATIENT WITH A CLEFT LIP AND/OR PALATE WITH DENTOSKELETAL DEFORMITY

History and physical examination

A. Evaluation by a multidisciplinary cleft team

B. Collapsed maxillary minor segment and narrow alveolar cleft
   - Mild/moderate
   - Severe
   - Orthodontic therapy
     - Segmental distraction osteogenesis
     - Alveolar bone grafting

C. Collapsed maxillary minor segment and wide alveolar cleft
   - Minor or no symptoms
   - Marked symptoms
   - Dental obturator
     - Orthodontic therapy followed by orthognathic surgery (postpubertal)
     - Interdental distraction osteogenesis
     - Significant alveolar cleft
     - Minimal or no alveolar cleft
     - Alveolar bone grafting
     - Gingivoperiosteoplasty

D. Maxillary hypoplasia
   - Mild
   - Moderate
   - Severe
   - Simple orthodontic therapy
   - Complex orthodontic therapy
   - Longitudinal evaluation of occlusion and jaw growth

E. Significant alveolar cleft
   - Deformity does not increase
   - No further therapy
   - Orthodontic therapy followed by orthognathic surgery (postpubertal)

F. Minimal or no alveolar cleft
   - Deformity increases
   - Orthodontic therapy and/or
     - Maxillary distraction osteogenesis or traditional LeFort I osteotomy with rigid fixation

G. Is there a psychosocial concern?
   - No
   - Yes
     - Minimal
     - Significant
     - Longitudinal follow-up with cleft lip/palate team

H. Yes
   - Orthodontic therapy
   - Orthognathic surgery (postpubertal)
   - See algorithm 36
Patients with a congenital craniofacial deformity usually require the services of a variety of health care providers, because no single health care discipline possesses all of the expertise necessary for the evaluation and management of craniofacial anomalies. The multidisciplinary craniofacial deformities team offers the most efficient means to provide comprehensive, integrated, and coordinated care for such patients.

Some deformities are easily recognizable as part of a described process or syndrome. Many craniofacial syndromes can also be identified by their associated DNA errors. Routine radiographs, cephalometry, and computer-assisted CT and MRI are used to facilitate a diagnosis, identify anomalous anatomy, plan surgery, and evaluate the results of intervention.

Definable etiologic factors can be identified for only a minority of craniofacial deformities—for example, chromosomal disorders, errors of metabolism, and effects of teratogens. Of these, a few are amenable to primary treatment, such as craniosynostosis secondary to rickets. Unfortunately, the causes for the majority of craniofacial anomalies remain both unknown and untreatable.

Segmentation of the head into craniofacial regions has proved to be a useful method of anomaly classification and management.

The longitudinal follow-up of patients with craniofacial anomalies is an essential part of care, because many sequelae of the anomalies and their management may not become overt until pubertal growth occurs, producing the definitive adult face. The multidisciplinary craniofacial deformities team is ideal for completing such a follow-up.

BIBLIOGRAPHY

PATIENT WITH CONGENITAL CRANIOFACIAL DEFORMITY

A Evaluation by multidisciplinary craniofacial deformities team

B Recognizable dysmorphology

Dysmorphology not recognizable

Medical genetics evaluation with DNA testing

C Definable etiologic factors

Etiologic factors unknown

Treatment possible

Treatment not possible

Manage cause

Anatomic region of deformity

Calvaria
(see algorithm 25)

Orbits
(see algorithm 26)

Midface
(see algorithm 27)

Lower face
(see algorithm 28)

Formulate treatment plan

Execute treatment plan

E Longitudinal follow-up with multidisciplinary craniofacial deformities team
CHAPTER 24  CRANIOFACIAL DEFORMITIES: AIRWAY MANAGEMENT
Arlene A. Rozzelle

The first step in evaluating the airway of an infant with an at-risk craniofacial anomaly is a careful clinical observation. The patient should be checked for noisy breathing, cyanosis, and retractions (intermittent pectus or suprasternal); his or her ability to feed without obstructing or demonstrating desaturations on the pulse oximeter should also be monitored. During the physical examination, the clinician should look for anomalies such as micrognathia, maxillary retraction, clefts of the primary and/or secondary palate, hypertrophy of tonsils and adenoids, choanal blockage, and position of the tongue within the mouth.

If there is no obvious upper airway obstruction, the baby is feeding well, and he or she is gaining weight, parents are educated about the signs and symptoms of airway obstruction.

If the airway is stable but there is failure to thrive, the infant should be evaluated by a pediatric feeding specialist and, if indicated, a pediatric gastroenterologist. Ancillary tests include a gastroesophageal reflux disease (GERD) study, echocardiogram, three-dimensional craniofacial CT to delineate occult anatomic abnormalities, and a routine sleep study.

If the patient has signs and symptoms of upper airway obstruction, acute management is necessary. A simple and often successful first maneuver, particularly in patients with Pierre Robin sequence, is prone positioning with pulse oximetry and apnea monitoring. If this improves the airway, a nasogastric tube (NGT) may be required for adequate nutrition.

If the baby desaturates with attempted bottle feedings, nutrition is maintained with tube feedings, or gastrostomy tube feedings.

If positioning does not open the airway, an oral airway or nasal trumpet is inserted. In rare cases, a traction tongue stitch may be placed at the bedside.

If the airway cannot be maintained by these measures, intubation is indicated. A comprehensive workup is then performed.

Once a stable airway is obtained, the cause of the airway compromise should be determined, and confounding factors should be ruled out with the following workup:

- An echocardiogram to rule out concomitant cardiac anomalies that may require treatment.
- A GERD study to detect and determine treatment for reflux, if indicated.
- A three-dimensional craniofacial CT study to evaluate choanal patency, maxillary retraction, and micrognathia. The sagittal reconstruction can help to visualize the nasooropharyngeal airway.
- MRI of the brain and brain stem to rule out CNS anomalies, including Chiari malformation or hydrocephalus, which may cause apnea and may require neurosurgical treatment.
- Nasoendoscopy is performed with the infant spontaneously breathing to visualize the position of the tongue in the airway and to evaluate improvement of the airway with mechanical changes in the jaw and tongue.
- Direct laryngobronchoscopy is performed to rule out laryngomalacia, tracheomalacia, and bronchial anomalies.
- Polysomnogram to evaluate severity and type of apnea (obstructive versus central)
- Other studies as indicated, including chest radiographs or MRI in patients with an abnormal direct laryngobronchoscopy or echocardiogram.

Continued
INFANT WITH A CRANIOFACIAL ANOMALY AT RISK FOR IMPAIRED UPPER AIRWAY

A History and physical examination

Is the upper airway stable?

Yes

Feeds well, with positive weight gain?

Yes

Position infant on side or prone

Did the condition improve?

Yes

Educate caregiver regarding airway obstruction and failure to thrive

No

Feeds well, with positive weight gain?

No

B

Keep infant in mechanical tongue displacement

D

No

Position infant on side or prone

Did the condition improve?

Yes

Is the patient able to feed orally?

Yes

Reassess supine breathing when the weight is steady

No

Intubation

F

Mechanical tongue displacement

No

Position infant on side or prone

Did the condition improve?

Yes

Mechanical tongue displacement

No

Intubation

G

Comprehensive workup

H

Continue side/prone position

Follow up to monitor airway and weight gain

continued
CHAPTER 24 CRANIOFACIAL DEFORMITIES: AIRWAY MANAGEMENT

Arlene A. Rozzelle

If a child will not tolerate extubation—or if the extubation is successful but a patient’s airway control remains marginal and there is failure to thrive—treatment is planned based on the anatomic abnormality.

Glossoptosis with an anatomically normal-sized jaw can be effectively treated with a tongue-lip adhesion.

Micrognathia is treated with mandibular distraction osteogenesis. The distraction vector (horizontal, vertical, or oblique) depends on the morphology of the mandible, as seen on three-dimensional craniofacial CT.

Choanal atresia usually requires surgical correction. Choanal stenosis may respond to dilation or require surgery. Septal deviation may respond to a nasal trumpet or a closed septal reduction.

Macroglossia (for example, in infants with Beckwith-Wiedemann syndrome, vascular malformation, lymphangioma, neurofibroma, or glycogen storage disease) can occasionally cause acute airway obstruction, which may require acute lingual reduction.

If the child is not a surgical candidate because of coexisting medical risks, lack of an effective surgical treatment, or age-related surgical/technical limitations, management with continuous positive airway pressure (CPAP) or high-flow nasal O₂ may be attempted. If all other treatments are unsuccessful, a tracheostomy may be performed.

The effectiveness of any treatment, whether conservative or surgical, is evaluated with a posttreatment sleep study. Most children are maintained at home with a pulse oximeter and a sleep apnea monitor; these evaluate the patient’s respiratory efficiency and inform parents or caregivers of life-threatening events. The patient’s airway and weight gain are monitored by the craniofacial surgeon and pediatrician. A longitudinal follow-up is performed by a cleft lip/palate or craniofacial deformities interdisciplinary team.

BIBLIOGRAPHY


INFANT WITH A CRANIOFACIAL ANOMALY AT RISK FOR IMPAIRED UPPER AIRWAY

1 Are anatomic etiologic factors present?
   - Yes
     - Normal mandible with glossoptosis
       - Tongue-lip adhesion
     - Micrognathia with glossoptosis
       - Mandibular distraction osteogenesis
     - Choanal atresia
       - Surgical lysis
   - No
     - Nasal airway obstruction
       - Choanal stenosis
         - Dilation
         - Surgical lysis
       - Nasal-septal deflection
         - Closed septal centering
       - Macroglossia
         - Tongue reduction

Lower airway anomaly or unsuccessful extubation?
   - Yes
     - Tracheostomy
   - No
     - No tracheostomy

Management of both tracheostomy and decannulation per pediatric ENT

Longitudinal follow-up
Most neonates who are born vaginally have some deformity of the head, which is caused by passage through the birth canal. This molding should disappear within the first few weeks of life. If an abnormal head shape persists past 6 weeks of age, or if the head shape seems pathologic to the obstetrician or pediatrician at birth, a referral to the craniofacial team is recommended for further evaluation and management as indicated.

The neck should be examined for torticollis, which can either produce cranial molding or be associated with cranial deformity. True torticollis—a restriction of the sternocleidomastoid muscle—must be distinguished from poor head control caused by muscle weakness or asymmetrical cranial mass. Torticollis is managed with physical therapy, pharmacologic measures (botulinum toxin A injection), or surgery, as indicated, whereas poor head control is managed with bracing and physical therapy.

Routine four-view skull radiographs can usually confirm the clinical impression of the presence or absence of craniosynostosis.

If the calvarial sutures are radiolucent on skull radiographs, the infant has positional calvarial deformity.

If the dysmorphism is overt and the infant is 1 year of age or younger, a calvarial molding helmet is used to allow the growing brain to reshape the head. If the dysmorphism is overt and the infant is older than 1 year, surgical calvarial reconstruction is necessary to normalize the head shape.

If the dysmorphism is not overt, the infant is observed longitudinally. If overt dysmorphism develops, it is managed; otherwise no treatment is indicated.

If one or more calvarial sutures are not visualized on skull radiographs, the infant is presumed to have craniosynostosis. The diagnosis is confirmed, and a head CT scan is used to screen for intracranial anomalies.

If the dysmorphism is not overt (for example, there is minimal frontal ridging with metopic synostosis or mild scaphocephaly with sagittal synostosis), observation is indicated. Surgery is recommended if the dysmorphism becomes overt.

If the dysmorphism is overt, surgery is recommended to remove the synostosed sutures and reshape the deformed calvaria. If there is any associated orbital deformity (for example, unicoronal, bicornal, metopic, or multiple synostosis), synchronous superolateral orbital rim repositioning is performed.

BIBLIOGRAPHY
INFANT WITH DYSMORPHIC CALVARIA

History and physical examination

Examine head and range of motion

**A** Torticollis

Physical therapy

No torticollis

**B** Skull films

No response

Positive response

- Botulinum toxin A injection

Surgical release of sternocleidomastoid muscle

**C** All sutures radiolucent

- Dysmorphism overt

Observe

Dysmorphism increases

- Infant <12 months old

Cranial molding helmet

Follow-up per positional head deformity clinic

- Infant >12 months old

Calvarial reconstruction

**D** Dysmorphism not overt

Observe

Dysmorphism does not increase

**E** One or more sutures not visualized

Confirm diagnosis with CT scan of head

**F** Dysmorphism not overt

Observe

Dysmorphism does not increase

**G** Dysmorphism overt

Observe

Dysmorphism increases

**H** Infarct deformity

No orbital deformity

- Suturectomy calvarial recontouring orbital rim repositioning

- Suturectomy calvarial recontouring

Longitudinal follow-up with craniofacial deformities interdisciplinary team

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 26  ABNORMAL ORBITAL REGION

Jeffrey L. Marsh

A Anomalies of the upper face are often associated with calvarial and intracranial anomalies. The examination of the infant with an orbital deformity should begin with an evaluation of the cranium and its contents. After the status of the cranium and its contents have been clarified, assessment and documentation of the visual status of the infant are obtained, preferably from a pediatric ophthalmologist versed in craniofacial anomalies.

B If abnormalities are identified during the ophthalmologic examination, the timing of their management is considered. If it is anticipated that skeletal craniofacial surgery might improve or alter the ophthalmologic abnormality, then ophthalmologic management is deferred until after the craniofacial procedure (for example, strabismus without amblyopia). If the patient’s vision is at risk and an ophthalmologic intervention before the craniofacial procedure might help preserve or restore vision, the ophthalmologic intervention takes priority (for example, eye patching for amblyopia resulting from disconjugate gaze in hypertelorism).

C The ocular globes may be malpositioned in the anteroposterior, horizontal, or cephalad-caudad planes of the face.

Retrusion of the globe behind the orbital rim is called enophthalmos. This condition is usually caused by trauma (see algorithm 41), but may also be seen with a congenitally small eye (microphthalmia). Protrusion of the globe ventral to the orbital rim is called proptosis or exorbitism; exophthalmos is acquired globe protrusion caused by hyperthyroidism or an intraorbital mass lesion. Exorbitism is associated with craniosynostosis syndromes (see algorithms 25 and 27).

Excessive width between the eyes (increased bony interorbital distance) is known as hypertelorism or hypotelorism, which can have multiple causes. Decreased width between the eyes is referred to as orbital dystopia, which may occur in association with craniosynostosis, encephaloceles, bony disorders, or sinus anomalies.

D Infants with widely spaced eyes (hypertelorism) are evaluated with CT scans and/or MRI to determine the cause of the orbital deformity, if possible. Hypertelorism may result from encephaloceles, craniosynostosis, facial clefts, or bone disorders.

E If an encephalocele is present, the risk of a CNS infection is determined. If the risk is thought to be high (for example, the patient has an intranasal encephalocele), an intracranial/extracranial repair of the encephalocele is performed in infancy. We prefer to defer correction of the hypertelorism until the orbit has consolidated. If the risk of infection is thought to be low (for example, the patient has an orbital or frontal encephalocele), consideration may be given to deferring its correction until the time of the hypertelorism correction. However, the timing for each patient is individualized.

F The orbital bones of an infant or toddler are loosely connected by fibrous sutures. Attempts to move the orbit before about 4 years of age, at which point the osseous orbit consolidates, often result in comminution and inadequate globe repositioning. For our patients’ psychosocial well-being, we therefore prefer to delay hypertelorism correction until after 4 years of age, but not beyond the start of first grade (at about 6 years of age). Occasionally a patient will have significant amblyopia problems unresponsive to patching caused by globe malposition. In such cases, we reposition the orbits when the patient is between 2 and 4 years old.

G Correction of strabismus and/or lacrimal dysfunction is deferred until after the orbital relocation surgery, because the surgery may alter or induce the strabismus or produce nasolacrimal duct obstruction.

H Unlike hypertelorism, hypotelorism produces neither ophthalmologic dysfunction nor psychosocial problems resulting from an abnormal appearance. Therefore we do not treat hypotelorism.

I Orbital dystopia is evaluated with CT scans and/or MRI to identify the etiologic factors of the orbital malposition, if possible, and to plan the surgical correction. The temporal considerations are the same as those for hypertelorism correction—that is, delaying the orbital repositioning until the patient is between 4 and 6 years old, unless visual impairment necessitates earlier intervention.

BIBLIOGRAPHY


Pinzer T, Gollogly J, Krishnan KR, et al. Telecanthus and hypertelorism from the obtained assessment of osseous orbit consolidates, often result in comminution


https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
INFANT WITH DYSMORPHIC UPPER FACE/ORBITAL REGION

History and physical examination

A Ophthalmologic evaluation

Normal

D Abnormal

Can nonsurgical management improve abnormality?

Yes

Manage nonsurgically

No

Might craniofacial surgery improve or alter abnormality?

Yes

Proceed with craniofacial surgery

No

Ophthalmologic management before or after craniofacial surgery

C Orbital deformity

D Eyes widely spaced (hypertelorism) with or without frontal, nasal, or orbital mass

CT scan and/or MRI

E Encephalocele present

Assess risk of CNS infection

High

Intracranial or extracranial repair of encephalocele in infancy

Low

No encephalocele

F Vision intact

Repair hypertelorism (4-6 years old)

Vision impaired

Repair hypertelorism (2-4 years old)

Secondary strabismus/lacrimal dysfunction surgery

G

H Eyes excessively close together (hypotelorism)

No treatment necessary

CT scan and/or MRI

I Eyes on different levels (orbital dystopia)

Hypotelorism (4-6 years old)

Repair dystopia (2-4 years old)

Longitudinal follow-up with craniofacial deformities interdisciplinary team

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 27 ABNORMAL MIDFACE

Jeffrey L. Marsh

The midface may be abnormal with respect to the anteroposterior and/or cephalad-caudad relationships with the base of the skull and the mandible. This chapter details midface retrusion, which most commonly occurs as a result of the craniosynostosis syndromes. Midface retrusion can affect a patient’s breathing, vision, feeding, and psychosocial adjustment.

Extreme cases of midface retrusion can present as perinatal respiratory difficulties, with occlusion of the upper airway caused by compression of the soft palate against the posterior pharynx, and glossoptosis resulting from a diminished oral cavity. Some authors have advocated frontofacial monobloc advancement for such cases; however, we prefer temporary orotracheal intubation and then, if necessary, tracheostomy.

The combination of craniosynostosis and midface retrusion reduces the volume of the orbits, producing proptosis or exorbitism. In the extreme case, the eyelids retract posterior to the ocular globes, causing corneal exposure and the potential for corneal scarring, ocular infection, and blindness. Corneal lubrication and humidification are provided until definitive management can be performed. Temporary lateral tarsorrhaphies, with or without medial tarsorrhaphies, are the first step for protecting patients from the effects of extreme exorbitism. Advancement of the superior orbital rims, in conjunction with calvarial suturectomies and frontal bone advancement between birth and 3 months of age, usually provides enough orbital enlargement for corneal protection.

Failure to thrive is often a consequence of severe midface retrusion with airway problems. The infant is unable to breathe and eat at the same time and becomes exhausted during feedings—before sufficient calories are consumed. I prefer to perform subcranial LeFort III distraction osteogenesis for patients between 2 and 4 years of age. If the frontoorbital region is retruded, a staged frontoorbital advancement precedes the midface advancement; a monobloc frontofacial advancement can also be performed. Tracheostomy decannulation, improved growth, and accelerated development have resulted from this approach in a number of my patients.

The timing of midface advancement, either with frontofacial monobloc or LeFort III, remains controversial. I choose to perform LeFort III advancement with distraction osteogenesis for patients with moderate to severe midface deformities with or without functional problems; the surgery should take place when the child is between 4 and 6 years of age. I expect that a second midface advancement will be required in the teen years. A single midface advancement is deferred until the teen years for patients who have mild to moderate deformity and no functional problems.

BIBLIOGRAPHY


INFANT WITH MIDFACE RETRUSION

History and physical examination

A Airway stable
  No corneal exposure
    Nutritional status good
    Failure to thrive
      Moderate to severe deformity with or without functional problems
        LeFort III distraction osteogenesis midface advancement (4-6 years old)
        Repeat LeFort III midface advancement (teen years if necessary)
      Mild to moderate deformity without functional problems
        LeFort III midface advancement (teen years)

B Corneal exposure
  Topical ointments
    Superior orbital rims retruded?
      Yes
        Superior orbital rims and frontal bone advancements
          Has corneal exposure resolved?
            Yes
              Tarsorrhaphies
            No
              Repeat LeFort III midface advancement (teen years if necessary)
      No
        Attempt decannulation

C Failure to thrive
  Longitudinal evaluation
    Subcranial LeFort III or frontofacial (monobloc) distraction osteogenesis advancement (2-4 years old)

Airway not stable
  Temporary intubation
    Tracheostomy
    LeFort III distraction osteogenesis midface advancement (4-6 years old)

Longitudinal follow-up with caniofacial deformities interdisciplinary team

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 28  ABNORMAL LOWER FACE

Jeffrey L. Marsh

The mandible may be abnormal with respect to anteroposterior, cephalad-caudad, and/or symmetry relationships with the base of the skull and the maxilla. This chapter details mandibular asymmetry, which is most commonly caused by hemifacial microsomia. Mandibular asymmetry can affect a patient’s breathing, feeding, temporomandibular joint function, facial growth, and psychosocial adjustment.

A neonate with an unstable or markedly retruded mandible may present with respiratory difficulties. This progressive series of interventions should be followed until a stable airway is established:

- Prone positioning
- Nasopharyngeal intubation
- Nasotracheal intubation
- Mandibular distraction osteogenesis
- Tracheostomy

Nutrition is maintained with oral feeding, if possible; gavage or gastrostomy may be used if other methods fail.

When breathing and nutrition have been stabilized, the infant is evaluated for occlusal cant. If none is present, the patient should be observed through childhood. If necessary, orthodontics and orthognathic surgery may be recommended in the teen years, when growth ceases.

The management of occlusal cant depends on the patient’s age at presentation.

If the patient is prepubertal, early reconstruction is advised, allowing maxillary growth to proceed unimpeded by the asymmetric mandible. We prefer to perform such interventions at 4 years of age. If the condyle is absent, a neocondyle is fabricated from an autogenous nonvascularized costochondral graft. If the condyle is present and, most important, if there is any lateral pterygoid function, a vertical mandibular ramus-leveling osteotomy is performed. Dental and jaw development are monitored throughout childhood and into adolescence. Residual dental deformity is managed orthodontically, and skeletal deformity with orthognathic surgery in the teens.

If the patient’s facial growth is complete or nearly complete, combined orthognathic surgical management is executed. The specifics of treatment depend on the extent of the deformity.

BIBLIOGRAPHY

INFANT WITH DYSMORPHIC LOWER FACE

History and physical examination

A Assess airway

Unstable
Stabilize airway

• Prone position
• Nasopharyngeal tube
• Nasotracheal tube

Airway remains stable
Is microgenia/retrogenia contributing to the airway condition?

Yes
Mandibular distraction osteogenesis

No
Tracheostomy

Airway stabilized

B Evaluate for occlusal cant

Stable

Significant
Evaluate for occlusal cant

None
Observe

Orthodontic management and orthognathic surgery (teen years)
(see algorithms 35-37)

Orthodontic management and orthognathic surgery (teen years)
(see algorithms 35-37)

C Age of patient

Prepubertal

D

Agenesis of mandibular condyle

Mandibular condyle present

Reconstruct condyle (>12 years old)

Vertical ramus-leveling osteotomy (4 years old)

Orthodontic management and reconstruct mandibular condyle contralateral mandibular osteotomy maxillary leveling osteotomy

Orthodontic management and maxillary osteotomies

Dentoskeletal deformity

Orthodontic management

Postoperative splint therapy

Evaluate occlusion and jaw growth in teens

Dental deformity

Orthodontic management

Longitudinal follow-up with craniofacial deformities interdisciplinary team

Postpubertal

E

Agenesis of mandibular condyle

Mandibular condyle present

Orthodontic management and orthognathic surgery (see algorithms 35-37)
The first step in the management of a patient with a prominent ear is screening for impaired hearing. If the patient fails the perinatal hearing exam or has a history consistent with impaired hearing, a referral to an audiologist and/or otologist is indicated.

The external auditory canal should be examined to ensure that no abnormalities exist. If the plastic surgeon finds or suspects an abnormality of the auditory canal, a referral to a pediatric otologist is indicated.

For a neonate with a prominent ear, taping the ear with an earmold may help avoid subsequent surgery.

There are four major anatomic defects of the prominent ear that must be addressed if present. These include (1) inadequate development of the antihelical fold; (2) a deep concha with a prominent posterior wall; (3) a prominent helical root; and (4) a prominent lobule after setback with concha-mastoid sutures. The ear’s vertical height and position on the head must also be evaluated and addressed if they contribute to a displeasing appearance.

Permanent mattress (Mustardé) sutures are used to construct the antihelical fold. When the cartilage is stiff, an otoabrader is used to disrupt the perichondrium before the mattress sutures are placed, minimizing the chance of relapse.

Mustardé sutures are not used for setback. Prominent ears with a deep concha require at least one conchomastoid suture, with or without conchal skin/cartilage resection to achieve an appropriate reduction of the conchoscaphal angle. Liberal undermining of the skin from the incision in the postauricular sulcus is important for relieving any tension caused by elasticity. Failure to do so may compromise the final result because of skin memory.

A lobule that remains prominent after setback must be addressed, or the patient will have a poor result that is often referred to as telephone deformity. Several methods can be used for lobule reduction.

A prominent helical root can be managed with a hitch suture that attaches the root to the deep temporal fascia.

The patient is instructed to follow up with the otoplastic surgeon in 1 week, or immediately if there is extreme pain, swelling, or bleeding. These can represent infection and/or hematoma, which are indications for immediate takeback. The patient is followed in the long term at 6 to 12 months.

**BIBLIOGRAPHY**

PATIENT WITH PROMINENT EAR

History and physical examination

A Assess hearing

Normal

Are other systemic anomalies present?

Yes

Refer to appropriate specialist

No

Abnormal

Refer to audiologist/otologist for evaluation

B Are there auditory canal anomalies?

Yes

Child <6 years of age

Defer correction until at least 6 years of age

No

≥6 years of age

D Assess for anatomic reason for prominent ear

G Inadequate antihelical fold

Posterior wall >2.5 cm deep

Anterior scoring with an otoabrader

Creation of a neoantihelical fold with permanent mattress sutures

Correction satisfactory

H Prominent helical root

Prominent helical tail

Yes

Hitch suture from helical root to deep temporal fascia

No

G Persistent lobule after setback

Posterior wall <2.5 cm deep

Excision of postauricular skin and cartilage

Concha-mastoid sutures

Correction not satisfactory

F Deep concha with prominent posterior wall

Soft cartilage

Stiff cartilage

Anterior scoring with an otoabrader

E Persistent prominence

D Stop

Stiff cartilage

Soft cartilage

Anterior scoring with an otoabrader

Creation of a neoantihelical fold with permanent mattress sutures

Depen

Correction satisfactory

Follow up

No additional treatment

E Follow up

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
The first step in the management of a patient with a constricted ear is screening for impaired hearing. If the patient fails the perinatal hearing examination or has a history consistent with impaired hearing, referral to an audiologist and/or otologist is indicated.

A thorough history should be obtained and a physical examination performed to rule out the presence of other anomalies. A consultation with an appropriate specialist is indicated if there is any possibility of another diagnosis.

An auricular examination should be performed to identify an auditory canal abnormality. If the surgeon is uncertain about the results or finds an abnormality, referral to a pediatric otologist is indicated.

Surgical management is dictated by the degree of deformity. If the ear has extreme constriction with severe cupping (Tanzer group III), then the ear should be managed as a microtia. If auricular elements are present and can contribute to reconstruction, they should be retained and used appropriately.

Lidding of the helix is a hallmark of the constricted ear. It can be corrected by restoring the helix to a normal position by rotating it upward as a banner flap. Because the cartilage in this lidded portion is sometimes flimsy, a cartilage graft may be required to batten the helix in its new position. Occasionally the helix is short (Tanzer type II), and a rotation or advancement flap of lobule or postauricular skin may be required to fill in the defect left by the cranial rotation of the lidded portion.

If the scapha is flattened, an antihelical fold should be created manually. If the lidding correction is compromised, the fold should not be re-created.

In many cases, the constricted ear will protrude. Conchal protrusion can be managed with concha-mastoid sutures, antihelical fold re-creation, or cartilage excision.

If there is a third crus (Stahl’s ear), it is excised.

A caudal ear position is sometimes seen with constricted ears, and its severity is proportional to the overall deformity. A mastoid hitch suture may be used to fix the helix in a more cephalic location; however, the presence of an external auditory meatus and canal limits the amount of repositioning that can be achieved.

A severely constricted ear (Tanzer group III) is best treated as a microtia reconstruction with insertion of an autologous cartilage or alloplastic frame and rotation of existing auricular elements for reconstruction.

The patient is instructed to follow up with the otoplastic surgeon in 1 week, or immediately if there is extreme pain, swelling, or bleeding. These can represent infection and/or hematoma, which are indications for immediate takeback. The patient is followed in the long term at 6 to 12 months.

BIBLIOGRAPHY
PATIENT WITH A CONSTRICTED EAR

A Assess hearing

Normal

Abnormal

B History and physical examination to rule out other systemic anomalies

Refer to audiologist/otologist for full evaluation and management, as indicated

Other anomalies present

No other anomalies present

Refer to appropriate specialist

C Are there auditory canal abnormalities?

Yes

No

D Assess ear deformity

Tanzer group I or II

J Tanzer group III

Lidding of helix

E Helix

Adequate length

Short

Restore helical rim to normal position; rotate/advance flap for extra soft tissue

Sufficient cartilage support?

Yes

No

F Flattened scapha

Manually create antihelical fold

Does this compromise lidding correction?

Yes

No

G Protruding ear

Management

Excision of crus

Concha-mastoid sutures

Antihelical fold creation

Conchal cartilage excision

H Stahl’s ear (third crus)

Cephalic conchal suspension sutures if appropriate

I Low-set ears

Reconstruct as in microtia, using appropriate, existing elements for accurate lobule recreation (see algorithm 31)

K Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
CHAPTER 31  MICROTIA

Jeffrey L. Marsh

Microtia is the most severe congenital ear deformity. The degree of dysmorphology of the auricle is classified as grade I, II, or III (Meurman). Although grade I microtia may include an external auditory meatus, the meatus is absent in patients with grades II and III microtia. Patients with microtia usually have conductive hearing loss and may have sensorineural loss. A hearing evaluation should be conducted in infancy, followed by the prompt placement of hearing aids if indicated.

Microtia is often an apparently isolated anomaly. However, a careful evaluation of the craniofacial structures will often disclose subtle findings consistent with hemifacial microsomia. Microtia is also often a component of the dysmorphology of Treacher Collins syndrome.

Surgical construction of an auricle using autologous tissues requires creative utilization of the microtic remnants, non–hair-bearing skin coverage, a cartilaginous internal framework, and creation of the auriculocephalic sulcus. The auricle should be constructed in the mirror image location to the contralateral ear, assuming a normal ear is present.

If the region of the proposed auricular reconstruction is covered by hair-bearing scalp, an initial decision must be made regarding the scalp. The scalp can be managed in a number of ways: (1) before insertion of the cartilaginous framework with either tissue expansion or elevation (scalp roll) and skin grafting; (2) during framework insertion using a temporoparietal fascia flap and skin graft; or (3) after framework insertion with elevation (scalp roll) and skin grafting. Managing the reconstructed auricle after the framework insertion often yields the best aesthetic results.

Although sufficient glabrous skin may be available for the insertion of a cartilaginous framework in the desired location, recruitment of additional skin through preotoplasty or intraoperative tissue expansion seems to improve the aesthetic results of the reconstruction. Because of frequent complications with preotoplasty expansion, I prefer intraoperative expansion with a 30 ml Foley catheter; the option is economical and involves a disposable, readily available device.

Unless preotoplasty tissue expansion has been chosen, the insertion of a carved, layered, three-dimensional autologous costal cartilage framework is the first stage of the auricle construction.

The second stage of the auricle construction is performed no earlier than 3 months after the first stage has been completed. The second stage involves rotating the microtic remnants to create a lobule as well as tragus and helical take-off, if possible. If hair-bearing scalp covers the superior portion of the framework, the scalp is elevated, and a full-thickness skin graft (FTSG), harvested from the contralateral ear, is used to surface the auricle.

The third stage begins at a minimum of 3 months after the second stage. The auriculocephalic sulcus is created and lined with an FTSG harvested from the groin. Additional lobule adjustments and tragal construction can be done at this time if necessary.

After construction of the auricle, surgical restoration of air conduction hearing can be contemplated. If there is normal hearing in the contralateral ear, this consideration can be deferred until the teen years, when the patient will likely be able to participate in the discussion. The course of treatment is different if both ears have conductive hearing loss. If a CT scan shows a middle ear cavity and ossicles in at least one temporal bone, the otologist may discuss external canaloplasty and tympanoplasty with the family. An implantable hearing aid (for example, the Baha system) is becoming the hearing restoration device of choice.

Some parents of a child with microtia elect not to undergo surgical reconstruction of the auricle. In these cases, a prosthetic ear may be desired. A prosthetic ear may be a poor choice for a child or an active adult because of problems with dislodgement injury to and loss of the prosthesis. Osseointegrated auricular prostheses may be a better alternative.

BIBLIOGRAPHY


PATIENT WITH MICROTIA

History and physical examination

Hearing evaluation and management

A Examine for other craniofacial anomalies

Present

Absent

Manage other anomalies
(see algorithm 23)

B Autogenous reconstruction desired

Adequate glabrous skin not available

Tissue expansion not desired

Preotoplasty tissue expansion

Scalp roll and skin graft

Temporoparietal fascia flap and skin graft

Adequate glabrous skin available

D Tissue expansion desired

Preotoplasty tissue expansion

Intraoperative tissue expansion

Costal cartilage framework

Reconstruct surface soft tissue details

Reconstruct auriculocephalic sulcus

Evaluate for possible restoration of air conduction hearing

External prosthesis

Osseointegrated prosthesis

Longitudinal follow-up
CHAPTER 32 MIDLINE NASAL MASSES

Jeffrey L. Marsh

A A combined intracranial/extracranial mass may be a neural malformation (meningocele or encephalocele), a vascular malformation (intradural or extradural), or an extradural soft tissue tumor (for example, dermoid or lipoma). The magnitude of the intervention and the need for craniofacial reconstruction depend on both the cause of the mass and the extent of the dysmorphology.

B Some authors advise that computer-assisted imaging be obtained of every nasal midline mass. The probability of detecting intracranial extension of the mass on an individual without telecanthus (increased intermedial canthal distance) is so low as to have no clinical or cost-efficiency value.

C Most patients outgrow medial epicanthal folds as the nasal dorsum develops. If the folds persist until the patient is of primary school age, medial canthoplasties can be performed if desired by the parents or at a later date when desired by the patient.

D Nasal growth proceeds normally for the large majority of individuals who undergo excision of midline nasal masses in infancy or early childhood. In the rare case of residual nasal deformity, nasal reconstruction can be performed if and when it is of concern to the affected individual.

BIBLIOGRAPHY


PATIENT WITH A MIDLINE SUBCUTANEOUS NASAL MASS

History and physical examination

Is there overt craniofacial dysmorphology?

Yes

High-resolution CT scan of head

Does mass extend intracranially?

Yes

MRI of head with contrast and specific vascular imaging as indicated

Neurosurgical consultation

Intracranial/extracranial treatment depending on specific diagnosis

Longitudinal follow-up with neurologic and craniofacial surgeons

No

Measure intermedial canthal distance

Greater than normal for age

B

Normal or less than normal for age

Excisional biopsy of mass

Residual epicanthal folds

Yes

Neurosurgical consultation

Age?

<6 years

C

Observe

Epicanthal folds persist?

No

≥6 years

Medial canthoplasties

Instruct parents/patient to return if deformity persists into adolescent/adult life

No

Yes
Although they may present years after birth, certain lesions such as branchial cleft cysts and thyroglossal duct cysts are considered congenital (see algorithm 34).

The primary diagnostic modality for a congenital neck mass is some form of imaging, usually ultrasound, CT, or MRI. Ultrasound is noninvasive, inexpensive, and helpful in determining whether a lesion is cystic or solid. MRI is also noninvasive, but it is expensive and often requires sedation. However, MRI can provide excellent diagnostic information and is useful for surgical planning.

If the lesion is uniloculated and well encapsulated, the site of presentation on the neck can further aid in the diagnosis. Branchial cleft cysts (types 2 and 3) present along the anterior border of the sternocleidomastoid muscle, whereas thyroglossal duct cysts and dermoids usually present in the midline of the anterior neck. Regardless of the precise diagnosis, most unilocular cystic congenital lesions will require surgical excision, because they have a propensity for infection and enlargement and are unlikely to resolve spontaneously.

If the lesion is multiloculated, the lesion is most likely a lymphatic malformation (also known as a lymphangioma or cystic hygroma) or a venous malformation. Management is determined by the site and size of the lesion and whether the lesion consists of large cystic spaces (macrocystic) or small ones (microcystic). Macrocysts (either lymphatic or venous) can be treated with sclerotherapy or surgical excision. Microcystic lymphatic malformations can be difficult to manage; these lesions may be observed, excised, or debulked. See algorithm 17 for additional information.

Congenital solid lesions that do not lend themselves to definitive diagnosis after the examination and imaging will require either an incisional or excisional biopsy. The differential diagnosis is broad, including benign lesions such as teratoma, and malignant lesions such as neuroblastoma.

A common, solid congenital pediatric neck lesion is fibromatosis colli, also known as the sternocleidomastoid pseudotumor of infancy. This benign lesion presents as a firm mass within the central portion of the sternocleidomastoid muscle and is often associated with torticollis. The clinical presentation is usually sufficient for a diagnosis, which can be confirmed with ultrasound. Primary treatment includes massage and physical therapy. Surgery is reserved for masses that do not resolve and/or restrict the neck’s range of motion.

Hemangiomas located within the deeper structures of the neck and lower face are not uncommon. Most of these lesions require only observation as they progress along a clinical course of proliferation followed by involution. However, some lesions can impair function (for example, related to vision or airway); others may grow rapidly, causing a progressive deformity. Interventions such as steroids (intralesional or oral) or surgical excision may be required in these instances.

**BIBLIOGRAPHY**


CHILD WITH CONGENITAL NECK MASS

A History and physical examination

B Neck imaging

C Cystic lesion

Unilocular

Mass is at the border of sternocleidomastoid muscle

Mass is at the midline

Likely branchial cleft cyst

Likely thyroglossal duct cyst or dermoid

Microcystic

Sclerotherapy or excision

Mass is at the midline

Mass is at the border of sternocleidomastoid muscle

Macro cystic

Excision

Excisional biopsy

D Multilocular

Mass is at the midline

Likely thyroglossal duct cyst or dermoid

Excisional biopsy

E Solid lesion

Unilocular

Mass is at the border of sternocleidomastoid muscle

Mass is at the midline

Likely branchial cleft cyst

Likely thyroglossal duct cyst or dermoid

Fibromatosis colli

Physical therapy

Microcystic

Observation

Rapid growth with progressive deformity or impairment of function

Progression limited and concern for functional impairment resolved?

Yes

No

Steroid treatment

Observe

Surgical excision or debulking

Follow up in surgeon’s office

See algorithms 15 and 16

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
Acquired pediatric neck masses can usually be classified into two groups: inflammatory (usually lymphadenopathy) or noninflammatory (presumed neoplastic). The division is aided by the patient’s history (for example, prodrome, contact with ill individuals, constitutional signs and symptoms) and the physical examination (for example, the presence of erythema, tenderness, increased warmth).

Helpful laboratory studies include a complete blood cell count with differential, serologic testing for mononucleosis (Epstein-Barr virus titers), cytomegalovirus (CMV titers), and cat scratch disease (Bartonella titers), and skin testing for tuberculosis. Any suppuration should be cultured.

For inflammatory lesions, a primary concern is whether an abscess is present; imaging with ultrasound or a CT scan is usually definitive. If an abscess is present, incision and drainage with an organism-specific antibiotic therapy is indicated.

Parotitis and submandibular sialadenitis are examples of solid inflammatory lesions. They are usually diagnosed based on the swelling and tenderness of these glands in their respective sites. Imaging with ultrasound or CT may be useful. The cause is often infectious, although the lesion may also be caused by sialolithiasis. Treatment includes antibiotic therapy, hydration, massage, heat, sialogogues, and, rarely, excision.

Solid inflammatory neck masses are usually infected lymph nodes—the most common cause for neck masses in children. Often such masses have viral causes, and can simply be observed. However, if laboratory studies suggest a bacterial infection, then management with antibiotic therapy is indicated. Atypical mycobacterial infections of the cervical lymph nodes can be difficult to diagnose because of the fastidiousness of the organisms. However, the diagnosis can usually be made because of the typical presentation of neck swelling in the preauricular or submandibular region, painless skin erythema, and thinning with possible suppuration. Treatment includes excision or curettage, and, occasionally, antibiotic therapy.

An acquired neck mass that does not seem to be inflammatory based on the patient’s history, physical examination, and laboratory studies is likely to be a neoplastic lesion. The main concern is determining whether the lesion is benign or malignant. The next step in evaluation is imaging. If the lesion is solid and the imaging results are not diagnostic, a biopsy (either open or needle) may be useful. A lesion with a benign biopsy may be observed for a short period because of the possibility of spontaneous resolution. If the lesion does not resolve, excision is necessary. If the biopsy indicates malignancy, further management requires tumor-specific treatments.

**BIBLIOGRAPHY**


CHILD WITH ACQUIRED NECK MASS

A History and physical examination

E Laboratory studies

Inflammatory condition

Imaging

Abscess

C

D Salivary gland involved

Organism-specific antibiotic therapy

Antibiotic therapy and conservative treatment

Mass resolved?

Yes

Antibiotic therapy

Antibiotic therapy and curettage or excision

No

Consider excision (rare)

No further treatment

Lymphadenitis

E

F Presumed neoplastic condition

Imaging

Open or needle biopsy

Benign

Observe

Mass resolved?

Yes

Complete excision, if not done at time of biopsy

No

Tumor-specific treatment

Malignant

Long-term follow-up
The dentofacial deformity workup is a cooperative effort on the part of all participants in a patient’s treatment. During the initial interview, the surgeon should elicit the patient’s chief complaint, along with his or her treatment outcome goals and overall understanding of orthognathic surgery. Some patients are well informed, whereas others require extensive instruction about the benefits, risks, length of time, and other specifics of orthodontic/orthognathic surgical treatments. It should be explained to the patient and family that orthognathic surgery procedures are generally planned after growth has ceased to limit factors that could cause relapse and to optimize stability. When there are psychosocial reasons to perform the surgery in a growing patient, the patient and family must understand that further surgery may be needed after growth is complete. In general, the patient and family should be aware that the time span of an orthognathic surgery treatment plan is 2 years—preoperative orthodontic therapy requires 18 months, and postoperative orthodontic finishing requires 6 months.

During the physical examination, the surgeon should evaluate the soft tissue of the facial structures, positions of the facial bones, and positions of the teeth. The maxillary and mandibular positions relative to the cranial base, facial structures, and each other must also be assessed. Dental occlusion is described according to Angle’s classification. Documentation of overjet, overbite, open bite, crossbites, dental arch forms, and dental midlines is also necessary. The patient’s pretreatment temporomandibular joint function must also be noted.

Records for an orthognathic surgery case consist of facial and dental photographs, dental models with bite registration, and panoramic and lateral cephalometric radiographs. PA cephalometric radiographs and dental periapical and occlusal films are indicated in cases of asymmetry and during segmental surgery, respectively.

A dentoskeletal malocclusion can be corrected by advancing the jaw with the more posterior incisors and/or setback of the jaw with the more anterior incisors. Although each of these options will provide the same occlusal result, the effects on the patient’s facial appearance will be different for each. The final choice regarding which jaw or jaws to move, and in which direction, is based on cephalometric and facial aesthetic analyses.

Occlusal cant correction requires two-jaw surgery for occlusal plane leveling, centralization of midlines, and correction of AP dentoskeletal anomalies, when present.

**BIBLIOGRAPHY**


PATIENT WITH DENTOFACIAL DEFORMITY: INITIAL EVALUATION

A History and initial discussion

B Physical examination

C Obtain dental records and radiographs

Minimal dentofacial deformity and acceptable facial aesthetics

Teeth well aligned?

No

Orthodontic therapy

Yes

Dentofacial deformity with poor facial aesthetics

D Identify maxilla, mandible, or both as malpositioned

E Occlusal cant present?

No

Yes

Malpositioned maxilla

Surgical maxillary repositioning

See algorithm 36

Malpositioned mandible

Surgical mandibular repositioning

See algorithm 37

Both jaws malpositioned

Two-jaw surgery
CHAPTER 36  MAXILLARY DEFORMITIES: TREATMENT PLAN

Mark E. Beehner

A When the maxilla is prognathic and the mandible is retrognathic, two-jaw surgery (synchronous maxillary setback and mandibular advancement) will produce the most harmonious facial proportions.

B When the maxilla is excessively retrognathic, postoperative stability can be improved either by distraction osteogenesis for the maxilla alone or by splitting the occlusal normalization difference between a conventional LeFort I advancement and a mandibular setback. Mandibular setback is absolutely contraindicated if the patient has obstructive sleep apnea; it is relatively contraindicated if there is a poor cervicovestibular angle.

C Total vertical maxillary excess gives rise to long-face syndrome, which is characterized by excessive upper tooth show, lip incompetence, and mentalis strain. Mandibular retrognathia is often associated with the condition. By repositioning the jaws in more favorable positions, lip competency is attained, and the strain on the mentalis is relieved. The result is a more rounded and relaxed facial appearance. During maxillary impaction, adequate reduction of the nasal septum or palatal floor is necessary to avoid deviation of the septum.

D In a patient with an anterior open bite, the maxillary central incisors are often in the proper vertical position. Posterior vertical maxillary excess is present, producing premature molar occlusion, which prevents the anterior teeth from meeting. Orthodontic treatment is performed in two planes (anterior and posterior) to prepare for segmental maxillary surgery to level the plane of occlusion, with anterior segment rotation about the central incisor vertical position, and with posterior vertical impaction.

E Vertical augmentation of the maxilla remains a challenging procedure with regard to its long-term stability; historically, it has a high rate of relapse. However, bone grafts can be used interpositionally to maintain the new vertical position.

F When the maxillary arch is significantly constricted, the surgeon and orthodontist must decide whether to perform the needed expansion with maxillary corticotomies early in the treatment plan, or to expand the maxilla with segmental orthognathic surgery. If the maxilla is otherwise properly positioned, maxillary corticotomies can avoid a more involved maxillary procedure.

G Maxillary corticotomies involve cutting the maxillary buttresses surgically to allow rapid palatal expansion using a palatal expander. The result is a bony expansion of the maxilla in the palatal midline, not the dental tipping that can occur in adult patients who have not had the corrective procedure.

H An orthodontic surgery/orthodontic patient will require orthodontic brackets for approximately 2 years. The patient’s general dental health and periodontal condition are optimized before initiating orthodontic therapy. Indicated extractions are also performed to alleviate dental crowding and allow the teeth to be aligned over the skeletal basal bone of the jaws.

I On average, presurgical orthodontia requires 18 months to level and align the dental arches.

J After presurgical orthodontia is complete, new cephalometric radiographs and dental models should be obtained. When the teeth are properly aligned over the supporting basal bone, the decompensation caused by dental malpositioning can result in an altered dental and skeletal relationship that accentuates the pretreatment deformities. The surgical plan is updated to accommodate the postorthodontic positions of the teeth and jaws.

K The new case records are used to simulate surgery on plaster dental models, which are then used to fabricate an occlusal splint. The splint is used intraoperatively to guide jaw positioning.

L The postoperative orthodontic phase requires an average of 6 months following the orthognathic surgery.

BIBLIOGRAPHY


PATIENT WITH MAXILLARY DENTOFACIAL DEFORMITY

- History and physical examination
- Assess anteroposterior maxillary position
  - Prognathic
    - Plan maxillary setback
  - Normal
    - Assess vertical maxillary position
  - Retrognathic
    - Plan maxillary advancement

A. Mandible retrognathic?
   - Yes
     - Maxillary setback and mandibular sagittal split advancement
     - Follow up with lateral and/or AP cephalometric films
   - No
     - Maxillary LeFort I setback

B. Advancement distance ≥10 mm
   - Yes
     - Mandible prognathic?
       - Yes
         - Traditional LeFort I advancement
       - No
         - Follow up with lateral and/or AP cephalometric films
   - No
     - LeFort I osteotomy and distraction

C. Total vertical maxillary excess
   - Plan vertical impaction

D. Anterior open bite; posterior vertical maxillary excess
   - Plan orthodontic therapy in two planes; segmental LeFort osteotomy with posterior impaction

E. Total vertical deficiency
   - Plan vertical augmentation

F. Significant deficiency
   - Consider maxillary corticotomies with palatal expansion versus segmental LeFort I osteotomies

G. Orthodontic expansion
   - Minimal deficiency
     - Orthodontic constriction
   - Significant excess
     - Segmental LeFort I osteotomies

H. Presurgical dental restorations, extractions, and/or periodontal therapy

I. Presurgical orthodontic therapy

J. Obtain preoperative dental models, cephalometric radiographs

K. Surgery simulation and fabrication of surgical occlusion splint

L. Postoperative orthodontic therapy
   - Proceed with orthognathic surgery
   - Long-term follow-up
CHAPTER 37  MANDIBULAR DEFORMITIES: TREATMENT PLAN
Mark E. Beehner

A. The mandible is assessed using results from an extraoral and intraoral physical examination and radiographs. The facial profile is a guide—convexity suggests mandibular retrusion; concavity may be mandibular prognathism (or maxillary retrusion); a straight profile is often normal. A photograph of the patient biting on a tongue blade aids in evaluating occlusal cant. A PA cephalometric radiograph distinguishes mandibular from maxillary deformities and assists in the evaluation of asymmetry.

B. The mandible is set back, preferably using an intraoral sagittal split osteotomy. Vertical subcondylar osteotomy and other set-back techniques have also been used.

C. Mandibular advancement is performed using IOSS. Rigid fixation techniques allow patients to avoid intermaxillary fixation in the immediate postoperative period. Guiding elastics from the maxillary arch to the mandibular arch aid in training the mandible to occlude in the new surgically attained position.

D. In cases of asymmetry, occasionally a unilateral mandibular osteotomy is possible with rotation about the contralateral temporomandibular joint (TMJ). Multiple osteotomy and grafting techniques can be combined to augment the deficient side and/or reduce the hyperplastic side.

E. When the mandibular condyle is severely hypoplastic without a functional TMJ, or entirely absent, it is reconstructed with a nonvascularized chondroosseous rib graft, a vascularized bone graft, or a prosthesis. After the mandible has been stabilized, abnormalities of the AP relationship and occlusal cant are corrected.

F. The introduction of distraction osteogenesis for the mandible has fundamentally altered the management of congenital mandibular hypoplasia and asymmetry. Distraction is the procedure of choice in children with mandibular deficiencies and asymmetries. Either distraction or conventional mandibular osteotomies may be used in adults.

G. Mandibular wisdom teeth are extracted at least 6 months before the mandibular intraoral sagittal split osteotomy to decrease the possibility of an unfavorable split.

H. New dental models and a lateral cephalometric radiograph are evaluated to finalize the surgical treatment plan. After presurgical orthodontic therapy, corrected dental compensation can result in significant alteration in the dental arches, and the surgical plan may need to be adjusted accordingly.

BIBLIOGRAPHY
PATIENT WITH MANDIBULAR DENTOFACIAL DEFORMITY

A History and physical examination (see algorithm 35)

Mandibular prognathism

B Plan mandibular setback

Mandibular retrognathia

C Plan mandibular advancement

Asymmetry

D Plan correction of asymmetry

Is the mandibular condyle present?

Yes

E Condylar reconstruction

No

F Is the patient dentoskeletally mature?

Yes

G Perform necessary preoperative dental restorations, extractions, and periodontal therapy

Preoperative orthodontic therapy

H Obtain preoperative dental models and lateral cephalometric radiographs

Model surgery and splint fabrication

Is the chin deficient, asymmetric, or displaced from the facial midsagittal plane?

Yes

Consider osseous genioplasty synchronous with mandibular surgery

Mandibular orthognathic surgery

Postoperative orthodontic therapy

Long-term follow-up

No

Is there airway embarrassment and/or psychosocial concern?

Yes

Observe until dentoskeletal maturity

Monitor dentoskeletal development

No

Observe until dentoskeletal maturity

Mandibular advancement and/or leveling via distraction osteogenesis
Craniofacial Trauma

CHAPTER 38 FACIAL BONE FRACTURES: EVALUATION

Paul Manson • Eduardo D. Rodriguez

The presence of a significant facial injury implies that a simultaneous injury to adjacent areas such as the neck, brain, and skull may have occurred. Injuries in these areas often have more serious immediate consequences than the obvious facial injury itself. Therefore the clinician must exclude brain, skull, and/or cervical injuries or fractures.

Massive hemorrhage is best controlled by direct ligation, carefully avoiding the locations of branches of the facial nerve. Blunt contusion causes bleeding within facial soft tissue, which is usually tamponaded by the soft tissue pressure. The result is a hematoma that is either diffuse or localized. No treatment, except observation, is needed for a diffuse hematoma. A localized hematoma should be drained, because it may produce tissue necrosis. Cranial base, orbital, and midface fractures may produce hemorrhage from lacerations of arteries and veins within the sinus cavities. It is not possible to control cranial base bleeding by tamponade. Generally, bleeding from midface LeFort fractures can be controlled by (1) instituting AP nasal packing, (2) repositioning the maxilla by applying intermaxillary fixation, (3) selective arterial embolization for patients who do not respond to manual maxillary repositioning and AP nasal packing, and (4) rarely, simultaneous ligations of bilateral external carotid and superficial temporal arteries.

Aspiration is more likely with simultaneous midface and mandibular fractures, and is more common in patients with concomitant cerebral injuries. Simple intubation prevents aspiration and should be performed as soon as possible if there is evidence that the patient’s airway is not protected. A tracheostomy is an additional method used for airway control; it is indicated for patients who have chest injuries or for those who are comatose and are not expected to be able to control their own airway within a week. Cricothyroidotomy or emergency tracheostomy is the surgical option for urgent airway control when intubation is not possible.

All facial structures should be examined in sequence. A lateral-to-medial examination is performed in each of the four facial areas—the forehead, the orbits and nose, the maxilla, and the mandible. All bony surfaces, especially the superior and inferior orbital rims, zygomatic arches, and malar prominence, are palpated for tenderness, deformity, and abnormal mobility. An intraoral examination of the maxillary and mandibular dental arches is followed by an examination of the horizontal and vertical portions of the mandible. The movement of the mandible, its relationship to the maxilla, and its occlusion should all be noted. Fractures are suggested by irregularities in the dental arch form and abnormal relationships of the dentition. Avulsed or missing teeth and intraoral or gingival lacerations indicate the possibility of an underlying fracture of the alveolus or a more extensive fracture of the mandible or maxilla. Lacerations of the lips and chin, palate, and floor of the mouth often accompany fractures of the jaws and suggest the possibility of a bone injury. The search for occult lacerations includes the eyelids, ear canal, mouth, pharynx, floor of the mouth, and nose. Sensation is documented in the supraorbital, corneal, infraorbital, and mental nerve distributions. Facial nerve function is also assessed. The range of extraocular motion, the presence of a field defect, double vision, or any decrease in visual acuity is noted, as are the symmetry of the pupils, the presence of blood behind the cornea (hyphema), and the speed of pupillary reaction. At the end of the examination, any grossly displaced tissue or fractures can be manually repositioned. If desired, intermaxillary fixation can be applied to the jaws to temporarily stabilize any fracture involving the occlusion. Throughout this period, the airway must be protected.

The best radiographic evaluation of facial fractures consists of a CT scan with axial and coronal plane reformations. For the orbit, bone and soft tissue images are obtained to define the relationship of the extraocular muscles to the orbital fracture. If a patient cannot be positioned for direct coronal orbital imaging, these images can be reconstructed from axially formatted scans. All patients with facial trauma in whom an injury of the neck or head is suspected must also have a synchronous CT scan of the cervical spine and head.

BIBLIOGRAPHY

PATIENT WITH FACIAL INJURIES: ACUTE MANAGEMENT

History and physical examination
Assess airway, breathing, and circulation

Is a life-threatening emergency related to the facial trauma identified?

A Organ survey and neurologic examination

B Hemorrhage
Superficial (soft tissues)

Apply pressure
Suture ligation

Deep (bone, sinuses, cranial base)

Nasal packing
Repositioning displaced bones (for example, maxilla)
Selective embolization
External carotid artery ligation (rarely done)

Patient stabilized

C Aspiration

Intubate patient if concern for aspiration exists

Airway obstruction

Urgent airway control

Intubation
Cricothyroidotomy
Emergency tracheostomy

D Focused head and neck examination ± formal ophthalmologic consultation

Bone

Clinical examination for step-offs, bony instability, malocclusion

Acute fracture management indicated
Open reduction and internal fixation

Acute fracture management not indicated
Allow edema to decrease
Tetanus prophylaxis; antibiotic therapy if appropriate

Operative management as indicated

Soft tissue

Laceration
CT scan or plain films (for example, Panorex) as indicated

See algorithms 1 and 2

Hematoma

Diffuse
See

Localized
Drain

Tissue loss

Judicious debridement and partial skin closure

Serial “second look” examinations every 48 hours until wound is clean

Definitive reconstruction with local/regional flap or microvascular transfer

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
CHAPTER 39 FRONTAL BONE AND FRONTAL SINUS FRACTURES

Paul Manson • Eduardo D. Rodriguez

A. The anterior portion of the skull consists of the broad and sturdy frontal bone, with its external, diploic, and internal layers. The frontal sinus consists of two, usually asymmetric, cavities that are separated by one or more bony partitions. Frontal sinus fractures may be located in only the anterior wall, only the posterior wall, or in both the anterior and posterior walls; the latter is a combined fracture. Lacerations or bruises in the forehead or supraorbital region suggest that a CT scan is needed to rule out fracture of the frontal bone, frontal sinus, or superior orbital areas. In addition, the integrity of the nasal frontal duct is determined by evaluation of the CT scan.

B. Patients with fractures that involve the frontal skull may present with pneumocephalus or a cerebrospinal fluid (CSF) leak caused by dural laceration. CSF may exit from the nose (CSF rhinorrhea) or the ear (CSF otorrhea). These conditions allow the subdural space to communicate with the external environment, possibly leading to meningitis. Detecting and confirming CSF rhinorrhea or otorrhea can be difficult, because the CSF being secreted is often obscured by the presence of blood. However, the clinician can use a paper towel to absorb the bloody fluid—if there is a CSF leak, there will be a small, central ring of blood surrounded by a large ring of clearer fluid. This is known as the double-ring sign. A suspected CSF leak or pneumocephalus warrants a detailed CT evaluation of the cranial base. In the presence of displaced fractures, intracranial repair of the dura is indicated. The surgical procedure is generally accompanied by the use of prophylactic antibiotic agents intraoperatively and for several days thereafter.

C. Nondisplaced fractures of the anterior wall may require only observation, provided that patency of the nasofrontal duct is maintained. Depressed fractures of the anterior wall with patent nasofrontal ducts may be treated with simple elevation, which can be accomplished by using endoscopic techniques or by direct visualization through a coronal incision. An overlying laceration may be used for fracture reduction.

D. Posterior wall fractures imply the possibility of a dural laceration, especially when fragment displacement exceeds the thickness of the posterior table. Therefore displaced posterior wall fractures generally require intracranial surgical exploration and dural repair.

E. When the posterior table is nondisplaced and the nasofrontal ducts are assumed to be obstructed, the frontal sinus should be obliterated to prevent postoperative mucocele or other sequelae. Before obliteration, duct patency is confirmed by instilling methylene blue into the sinus cavity and watching its egress into the middle meatus. Failure of the dye to pass through the duct, or high clinical suspicion of duct injury but inability to perform the examination because of concomitant factors, warrants sinus obliteration. The sinus mucosa should be removed by stripping, and a shaping bit can be used to lightly abrade the sinus walls. The abrasion eliminates microscopic invaginations of mucus membrane into the bone, preventing mucosal regrowth. The nasofrontal ducts are plugged with bone grafts and, often, a pericranial flap. The remainder of the sinus cavity is then obliterated with bone shavings.

F. For patients with a displaced or comminuted posterior table fracture, a neurosurgical consultation is warranted to ensure that no injury to the brain or dura exists. With these types of injuries, sinus cranialization is also indicated. As with an obliteration procedure, the sinus mucosa should be removed by stripping, the sinus walls lightly abraded with a shaping bit, and the nasofrontal ducts plugged with bone grafts. The pericranium and the posterior wall can often be removed entirely, thereby converting the sinus into a portion of the intracranial cavity (cranialization).

BIBLIOGRAPHY


PATIENT WITH FRACTURE OF THE FRONTAL BONE OR FRONTAL SINUS

History and physical examination

Initial assessment (see algorithm 38)

A Determine areas of involvement by examination and CT scan

B Isolated frontal bone fracture

Open fracture

Nondisplaced fracture

- Irrigation, antibiotic therapy, and wound closure

Displaced fracture

- Neurosurgical evaluation for possible dural tear

Closed fracture

Nondepressed fracture

- CSF leak or pneumocephalus present?
  - Yes: Neurosurgical reduction
  - No: Observation

Depressed fracture ± epidural hematoma

Neurosurgical reduction

CSF leak or pneumocephalus present?

- Yes: Neurosurgical reduction
- No: Neurosurgical evaluation

Observation or neurosurgical treatment as indicated

If patient is <1 year old, observe for “growing skull” fracture

Anterior frontal sinus wall

C Nondisplaced

- Nasofrontal duct patent?
  - Yes: Observation
  - No: Sinus obliteration

Displaced fracture

- ORIF of anterior wall

Posterior frontal sinus wall

D Neurosurgery consultation

Nondisplaced fracture(s)

- Nasofrontal duct patent?
  - Yes: Sinus obliteration
  - No: Observation

Displaced fracture(s)

- Fluid in sinus or nasofrontal duct not patent
  - Yes: Exploration, dural repair, sinus cranialization
  - No: Observation

- No fluid in sinus and nasofrontal duct patent
  - Exploration, dural repair, sinus cranialization

Anterior and posterior frontal sinus walls

Neurosurgery consultation

Nondisplaced fracture(s)

- Nasofrontal duct patent?
  - Yes: Exploration, dural repair, sinus cranialization
  - No: Observation

Displaced fracture(s)

- Observation

Sinus obliteration

Sinus preservation

Sinus obliteration

Final determination

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
Fractures of the nose are the most common facial bone injury. They may be nondisplaced or dislocated laterally and/or posteriorly. The diagnosis of a nasal bone fracture is suggested by epistaxis, bruising, small lacerations and swelling over the nose, and distortion of the appearance of the nose (for example, lateral deviation or flattening). The intranasal inspection may show septal deviation or lacerations and nasal airway obstruction. A diffuse periorbital hematoma may also accompany a nasal bone fracture. For isolated nasal fractures, radiographic imaging is unnecessary. However, if there is a possibility that the injury involves a more complex facial fracture, a CT scan is obtained.

Fractures of the nasal bones are usually closed injuries. However, when a nasal bone fracture has an associated laceration, the wound can be used for fracture reduction. Depending on the degree of comminution and fracture stability, fixation may be required to maintain the reduction. This can be accomplished with a variety of techniques, including bioabsorbable fixation.

Nasal fractures are generally treated by closed reduction of the septum and nasal pyramid, preferably under general anesthesia instead of an external nasal field block. Nasal fractures are first completed by thoroughly mobilizing the nasal pyramid in both lateral directions and then restabilizing the bones in the midline. The nasal pyramid is then supported by an external nasal splint.

When there is a near-total or total loss of the nasal bone structure caused by severe posterior displacement, primary or delayed bone grafting is necessary to restore a normal-appearing radix and dorsal aesthetic lines. Depending on the degree of injury, cartilage grafts may also be required for tip shape and support. Ideally, reconstruction should be performed before the nasal soft tissue envelope and lining contract.

Injuries to the nose may also fracture the nasal cartilages; these injuries are typically complete or incomplete breaks in the cartilages. Failure to correct these fractures leads to functional and aesthetic deformities of the midvault, nasal tip, and external nasal valve. Open injuries should be repaired using direct visualization, whereas external manipulation can be attempted for closed injuries. The frequent need for secondary surgery should be discussed with these patients.

The septum must be examined in all patients with a nasal fracture. Septal lacerations are repaired to prevent synechiae, and hematomas are drained to prevent necrosis and subsequent septal perforation. If displaced, the septum is mobilized with an Asch forceps and is restabilized in the midline. The septum should be supported after the reduction or perforation/hematoma repair by internal nasal splints or quilting sutures.

If a patient is dissatisfied with the aesthetic appearance or functional capacity of the nose following acute management of a nasal fracture, then a delayed rhinoplasty can be performed to straighten the nose and improve the nasal airway.

**BIBLIOGRAPHY**


**CHAPTER 41 ORBITAL FRACTURES**

Francesco Gargano • Frank S. Ciminello • S. Anthony Wolfe

The treatment plan for orbital fractures depends largely on the extent and severity of the injury. The workup should include a thorough eye examination, with assessment of visual fields, the pupillary response, and range of extraocular muscle (EOM) movement, as well as visualization of the anterior chamber of the globe for injury. In unconscious or sedated patients, a forced duction test may be required to assess EOM movement and to rule out entrapment of the inferior oblique muscle. The face and periorbital areas should also be palpated for osseous displacement. The patient should also be screened for intracranial and cervical injuries and concomitant trauma elsewhere in the body.

Conventional radiographs are not helpful in evaluating fractures of the orbital floor. The routine use of CT scans has improved the evaluation of orbital fractures. Patients with suspected periorbital trauma should undergo a fine-cut CT scan of the head and maxillofacial region; with axial and coronal reformations and osseous surface images.

Small (less than 0.8 cm²) orbital floor fractures without evidence of muscle entrapment are treated with observation. Acute diplopia is common, but this typically resolves as the intraorbital traumatic edema decreases.

When evidence or suspicion of muscle entrapment exists because of an orbital floor defect, surgical exploration is indicated. When there is no involvement of the orbital rim, a transconjunctival approach, with or without a lateral canthotomy, is preferred. When the orbital contents have been released from the fracture site, a piece of interpositional material is placed to encourage favorable healing.

Large orbital floor defects (greater than 0.8 cm²) require reconstruction. As with smaller defects, the transconjunctival approach is preferred for defects that do not involve the orbital rim. We believe that the best material for orbital floor reconstruction is autogenous bone. However, several alloplastic options exist, including titanium mesh, Medpor (Porex), and bioabsorbable orbital floor plates.

Displaced fractures of the infraorbital rim require different surgical approaches, depending on the location of the fracture and the degree of comminution. If the fracture cannot be reduced, bone grafting is required to restore rim contour and height. When the rim has been realigned, the orbital floor is visualized again to ensure that a defect does not exist and that no muscle entrapment has occurred during the repair of the orbital rim.

For complex fractures with extensive disruption of the orbital floor, patients should be referred to a surgeon with experience in major orbital fracture reconstruction.

**BIBLIOGRAPHY**


PATIENT WITH ORBITAL FRACTURE

A History and clinical assessment

Ocular injury suspected?

Yes

Ophthalmology consultation and treatment as indicated

B Radiographic assessment of cranium, orbits, and facial bones

C Isolated small orbital floor defect (<0.8 cm²) without muscle entrapment

Observation

Transconjunctival approach ± canthotomy; muscle release and placement of interpositional material

D Isolated small orbital floor defect (<0.8 cm²) with muscle entrapment

Transconjunctival approach ± canthotomy; orbital floor reconstruction with autogenous or alloplastic implant

E Isolated large orbital floor defect (>0.8 cm²)

Subtarsal, buccal, and/or lateral blepharoplasty approach

Fracture reducible?

Yes

Bone graft to restore contour

No

Orbital floor defect present after reduction?

Yes

No

F Displaced infraorbital rim

G Complex orbital fracture

See algorithm 42

See algorithm 43

H Isolated large orbital floor defect (>0.8 cm²)

Displaced infraorbital rim

F

Subtarsal, buccal, and/or lateral blepharoplasty approach

Fracture reducible?

Yes

Bone graft to restore contour

No

Orbital floor defect present after reduction?

Yes

No

Long-term follow-up with ophthalmologist and orbital fracture surgeon
CHAPTER 42 ZYGOMATICOMAXILLARY COMPLEX FRACTURES

Paul Manson • Eduardo D. Rodriguez

A. The zygoma has five attachments to adjacent bones: laterally to the temporal bone, superiorly to the frontal bone, medially to the maxilla, inferiorly to the maxillary alveolus, and laterally and posteriorly in the orbit to the greater wing of the sphenoid. When the zygoma is completely dislocated at the zygomaticofrontal (ZF) suture, the lateral canthus may be inferiorly displaced, because its attachment to Whitnall’s tubercle is just inside the inferior surface of the lateral orbital rim. Depression of the malar eminence posteriorly or inferiorly and depression of the inferior orbital rim are common clinical signs of zygomatic fractures. A step-off or level discrepancy is commonly palpated at the inferior orbital rim and may occasionally be palpated at the ZF suture. When the body of the zygoma is posteriorly dislocated, or if the arch is medially dislocated, the bone may impinge the coronoid process of the mandible, creating malocclusion or a lateral open bite. The definitive radiographic examination of zygomatic fractures is an axial and coronal CT scan of the entire facial skeleton with bone and soft tissue windows.

B. A displaced fracture of the zygomatic arch may be accompanied by other associated fractures located in the rest of the zygoma. An isolated arch fracture produces a depression in the temporofacial skin and possible interference with mouth opening because of the compromised excursion of the coronoid process of the mandible. Isolated, displaced fractures of the zygomatic arch are treated either with Gillies (temporal) or Lothrop (intraoral) approach. With the Gillies approach, an incision in the temporal hairline permits the insertion of an elevator under the deep temporal fascia, between the fascia and the muscle, to elevate the zygomatic arch. The same procedure may be accomplished intraorally. Because of periosteal continuity, isolated arch fractures are generally stable following this closed reduction: a palpable “click” is often noticed when the segment is reduced properly.

C. Fractures that are nondisplaced at the ZF suture may be approached with an intraoral incision. In these cases, displacement is largely confined to the zygomaticomaxillary (ZM) buttress and inferior orbital rim, which are both exposed by an open approach, reduced, and stabilized with rigid fixation. The intraoral approach can simultaneously allow visualization of both areas. Reduction of a fracture at the ZM buttress also reduces and stabilizes the infraorbital rim. Decompression of the infraorbital nerve should also be confirmed. The degree of orbital floor discontinuity can be assessed by placing an endoscope within the maxillary antrum and noting the degree of discontinuity of the orbital floor. Significant discontinuity is an indication for either endoscopic intrasinus reduction of the orbital floor or reduction through a lower eyelid or conjunctival incision. If a significant defect remains, floor reconstruction is performed with autogenous bone graft or an alloplastic implant. Similarly, orbital rim displacement that cannot be corrected with the intraoral approach requires a lower eyelid or conjunctival incision for open reduction and internal fixation (ORIF). Nondisplaced fractures at the ZF suture do not require exposure and fixation.

D. The most common zygoma fracture is displacement at the ZF suture, inferior orbital rim, and ZM buttress. Accompanying zygomatic arch fractures usually have medial displacement. These fractures can be reduced by exposing the ZF suture through the lateral aspect of an upper lid blepharoplasty incision. Incisions in the lower eyelid (percutaneous or transconjunctival) and gingivobuccal sulcus complete the exposure. The medially displaced zygomatic arch is reduced “closed” using either a Gillies or Lothrop approach. The orbital floor is reconstituted using either autogenous bone or alloplastic material. Plating systems are used to fix the ZF suture, the inferior orbital rim, the ZM buttresses, and possibly the zygomatic arch (if closed reduction cannot be maintained).

E. In rare cases of extreme posterior displacement of the zygoma or lateral displacement of the zygomatic arch, upper fracture exposure is best achieved with an open reduction performed through a coronal incision, in addition to lower eyelid and gingivobuccal sulcus approaches for complete ORIF. This open reduction technique provides exposure of all major buttresses of the zygoma. It can also help the surgeon to align the orbital process of the zygoma with the greater wing of the sphenoid in the lateral orbit.

F. If an orbital defect persists after reduction of the zygomatic fracture, reconstruction of the orbital floor and lateral wall must be performed. Orbital floor defects can be repaired with alloplastic or autogenous material, whereas lateral orbital wall defects are best repaired with autogenous bone grafts.

BIBLIOGRAPHY


PATIENT WITH A ZYGOMATIC OR ZYGOMATICOORBITAL COMPLEX FRACTURE

A History and initial assessment (see algorithm 38)

Isolated arch

Nondisplaced

B Displaced

Complex zygomatic fracture

Nondisplaced

Displaced

Observation

Reduction without fixation using a temporal or intraoral approach

C Medial displacement of zygomatic arch without displacement at ZF suture

ORIF of ZM buttress and orbital rim fractures through gingivobuccal sulcus (lower eyelid incisions)

D Medial displacement of zygomatic arch with displacement at ZF suture

ORIF of ZM buttress and orbital rim fractures through gingivobuccal sulcus, lower eyelid, and lateral orbit (ZF) incisions with reduction of arch via temporal or intraoral approach

Is internal orbit disrupted?

Yes

E Lateral displacement of zygomatic arch or extreme posterior displacement of the zygoma

ORIF of ZF, ZM, and interior orbital rim fractures through coronal, gingivobuccal, and lower eyelid incisions

No

Is orbit integrity and architecture restored after fracture reduction?

Yes

Long-term follow-up

No

Restore integrity of orbit with autogenous bone graft or alloplastic implant
A nasoorbital-ethmoid (NOE) fracture isolates the lower two thirds of the medial orbital rim with the attached medial canthal ligament from adjacent bones. This fracture may result in canthal ligament migration. Patients with a NOE fracture commonly have bilateral periorbital and subconjunctival hematomas and depression of the nose. When the nasal dorsum depression is marked, the appearance of the nose is quite characteristic, with forehead shortening of the bridge and depression of the nasal dorsum. Pain and tenderness are present with direct finger pressure over the medial canthal ligament. Telecanthus, or widening of the intercanthal distance, is present because of the lateral displacement of one or both canthal ligament attachments. A cerebrospinal fluid leak, orbital emphysema, or pneumocephalus may also result. A physical test, the bimanual examination, may be performed, which involves an intranasal-extranasal examination. The pad of one index finger is placed externally on the side of the nose, deeply over the canthal ligament. A clamp is then placed internally in the nose, directly under the bone that provides the attachment of the medial canthal ligament. Movement of the medial orbital rim bone segment is easily detected, confirming the presence of a mobile fracture. The radiographic examination consists of axial and coronal CT scans of the orbit, nose, frontal bone, and maxillary areas.

A greenstick NOE fracture is displaced at the infraorbital rim and piriform aperture but is relatively nondisplaced at the internal angular process of the frontal bone. Treatment involves visualizing the entire lower end of the nasal maxillary buttress and open reduction and internal fixation (ORIF) through the gingival buccal sulcus and lower eyelid incisions. A CT scan documents the integrity of the internal orbit. If an orbital reduction is needed, a periorbital incision allows access to the medial wall and floor of the orbit. Patients with NOE fractures commonly present with the physical finding of unilateral nasal airway obstruction, which is relieved when the fracture is reduced. With these fractures, which are classified as type I, the nasal height and contour are reconstituted with a simple reduction of the displaced bones.

NOE fractures that involve dislocation of the central fragment, which carries the medial canthal ligament, are classified as type II. These fractures may require full exposure with coronal, bilateral lower eyelid, and gingivobuccal buccal sulcus incisions. All edges of the fracture are visualized, and the bone that attaches to the canthus is reduced and stabilized with transnasal wiring. The fracture is reduced and stabilized both posterior and superior to the ligament attachment. Bone grafts may be necessary to augment the height of the nose or restore the integrity of the internal orbit.

Patients with type III NOE fractures commonly present with skin lacerations over the medial canthus. If the bone to which the medial canthus is attached is highly comminuted, the canthal ligament may need to be stripped to achieve complete bone reduction. The canthal ligament must then be reattached to the bone with a separate set of transnasal canthopexy wires. Two sets of transnasal wires are necessary—one for the canthal attachment on each side and one for the internal bone reduction.

When a patient has a severe nasal injury and loss of dorsal support, primary bone grafting should be performed. Cartilage grafts such as a columellar strut may be necessary to prevent nasal shortening.

The internal orbit is evaluated radiographically with CT scans both preoperatively and intraoperatively to ensure that there is no disruption of the orbital cavity. Displaced fractures should be reduced, and the expanded orbit corrected with bone grafts to prevent increased orbital volume and subsequent enophthalmos.

BIBLIOGRAPHY


PATIENT WITH A NASOORBITAL-ETHMOID FRACTURE

History and physical examination

A Initial assessment (see algorithm 38)

B Incomplete greenstick fracture

Complete

Noncomminuted

Comminuted

Assess structures involved

Canthus mobile but attached to bone fragment

Canthus mobile caused by avulsion or severe comminution of bone

C ORIF

D Fracture reduction with transnasal wiring

E ORIF with primary bone and cartilage grafting

ORIF with primary bone grafting

NO

Yes

Is there loss of nasal bone height?

Is there nasal shortening?

Yes

No

Yes

No

ORIF

ORIF

Closed reduction if fractured

F Is the internal orbit fractured?

Nonexpanded

Expanded

Medial wall

Inferior wall

Bone graft to restore thickness and contour of ethmoid sinus

Bone graft or orbital floor plate to restore orbital floor

Long-term follow-up
Maxillary fractures are classified according to the general patterns originally described by René LeFort. A LeFort I fracture separates the entire maxillary alveolus from the upper midface. A LeFort II fracture separates a central, pyramid-shaped nasomaxillary segment, which contains the entire maxillary dentition, from the bilateral zygomatic and orbital portions of the facial skeleton. A LeFort III fracture is a craniofacial disjunction that separates the facial bones from the cranial skeleton, extending through the upper nose, the lateral and medial orbits, and the maxillary, palatine, and pterygoid articulations. LeFort III fractures consist of combinations of lesser LeFort patterns and are usually more extensive on one side than the other. In patients with LeFort fractures, 10% to 15% of them will also have fractures of the palate. The clinical diagnosis of a LeFort fracture depends on the demonstration of malocclusion, usually (but not always) involving the mobility of the maxillary segment containing the dentition. To detect this mobility, the head is stabilized with one hand, the maxillary alveolus is grasped with the other, and an attempt is made to move it, independent of the cranial. The radiographic examination of LeFort fractures consists of axial and coronal CT scans with three-dimensional reformations as needed.

Plate and screw fixation of the four anterior buttresses of the maxilla (the medial and lateral buttresses) is used for LeFort I fracture fixation. When a solid operative fixation is obtained, the intermaxillary fixation (IMF) may be released postoperatively; alternatively, light elastic traction in occlusion can be utilized. When the bone segments are highly comminuted and the fixation is not as stable as desired, the patient is kept in IMF for 3 to 4 weeks. He or she is then observed for another 4 weeks in light elastic traction to ensure complete bone healing and stable occlusion.

A LeFort II fracture requires gingivobuccal exposure at the LeFort I level supplemented by lower eyelid incisions; at times, a coronal incision to expose the nasofrontal junction may be necessary. The LeFort II fracture either separates the nasofrontal junction at the internal process of the frontal bone or travels over the lower portion of the nose. The latter does not require an open reduction at the nasal area, but only fracture treatment at the inferior orbital rim and LeFort I levels. The treatment of an upper LeFort fracture through the nasofrontal junction may require exposure with a coronal incision.

LeFort III fractures are generally comminuted and involve both zygomatic and LeFort I and/or LeFort II fracture components. The treatment of a zygoma fracture and its accompanying LeFort I or II fracture is integrated synchronously. Fractures involving the internal orbit require synchronous internal orbital fracture reconstruction.

BIBLIOGRAPHY

PATIENT WITH MIDFACE FRACTURE

History and physical examination

Initial assessment (see algorithm 38)

A Assess location of fracture(s)

Is the patient edentulous?

No

Does the patient have dentures?

No

Surgical splint to align maxillary and mandibular alveoli

Yes

Surgical splint to align maxillary and mandibular alveoli and use for IMF

No

Wire dentures to maxillary and mandibular alveoli

Align occlusion with either arch bars and elastic traction or perform LeFort I osteotomy and ORIF

B LeFort I fracture

Open reduction and internal fixation (ORIF) of medial and lateral maxillary buttresses

Is there a palatal fracture?

Yes

Synchronous closed nasal reduction

No

Is rigid transpalatal fixation possible?

No

IMF or palatal splint for 4-6 weeks

Yes

ORIF of palatal fracture

Follow up

C LeFort II fracture

ORIF of medial and lateral maxillary buttresses and orbital rim

Is the LeFort II at the level of the nasofrontal suture?

No

Synchronous ORIF at nasofrontal suture

Yes

Synchronous ORIF of each subunit fracture

D LeFort III fracture

Is rigid transpalatal fixation possible?

No

IMF or palatal splint for 4-6 weeks

Yes

ORIF of palatal fracture

Follow up

Check postoperative occlusion and temporomandibular joint function

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1); copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 45 MANDIBULAR FRACTURES
Paul Manson • Eduardo D. Rodriguez

The location of fractures of the mandible varies with the age of the patient and the state of the dentition. In the edentulous mandible, the proximal body area is a common site of fracture because of the presence of bone atrophy with tooth loss. In all states of dentition, the condylar and subcondylar areas are frequently involved. In the dentulous mandible, the angle and the symphysis and parasymphyss regions are frequently involved, as is the subcondylar area. In high-energy mandibular fractures, bilateral fractures of the subcondylar areas often accompany angle, symphysis, and parasymphysis fractures. Mandibular imaging consists of plain radiographs and a Panorex examination. However, patients who have multiple injuries may be unable to stand for a Panorex examination. A CT scan shows alignment of both dental cortices well and should be obtained routinely in mandible fractures. CT provides a definite plan for operative intervention, because it defines the length and type of fixation necessary. At times, radiographs of the teeth (for example, occlusal and apical dental films) are required. These can frequently be obtained after the initial injury has been treated.

If there is no malocclusion and the mandible functions normally, no operative intervention is necessary. The patient should be given a soft diet for 6 weeks to allow the fracture to heal.

Most subcondylar fractures can be treated conservatively by intermaxillary fixation (IMF) with wires or guiding elastics for control of the occlusion, followed by physical therapy. Indications for open reduction and internal fixation (ORIF) of subcondylar fractures include: (1) dislocation into the middle cranial fossa; (2) lateral extracapsular displacement; (3) inability to obtain occlusion, and (4) an open, contaminated temporomandibular joint. Many surgeons also consider bilateral subcondylar fractures as a relative indication for ORIF. Patients with an edentulous mandible may also require ORIF of subcondylar fractures if a splint is not available or possible because of alveolar ridge atrophy.

When a low subcondylar fracture requires an open reduction, a Risdon or retromandibular incision is appropriate. Higher fractures such as a condylar head dislocation may require the combination of preauricular and retromandibular approaches. In these cases, exposure and protection of the facial nerve may be necessary.

Loss of ramus height or complete destruction of the condyle requires condylar reconstruction. Although prosthetic condylar devices exist, it is ideal to use an autogenous costochondral graft to reconstruct the condyle.

Displaced angle fractures benefit from open reduction. In noncomminuted angle fractures, this may be accomplished intraorally by fixation along the mylohyoid ridge or at the angle. Impacted third molar teeth may not need to be removed at the time of the reduction, because this maneuver devascularizes bone and can compromise healing of the reduction. Complex fractures of the angle require external approaches through the neck skin. Intraoral exposures are preferred for the anterior portion of the horizontal segment of the mandible, especially in the symphysis and parasymphyss areas.

Patients with fractures of the edentulous mandible require a modified treatment regimen. When there is a horizontal segment defect, treatment should be determined based on the height of the mandible. If the mandible is atrophic (having a height less than 10 mm), large-plate fixation plus immediate bone grafting is indicated. An edentulous fractured mandible with a height of 10 to 20 mm should be treated with ORIF using a large plate. When the mandibular height is 20 to 30 mm, ORIF with upper and lower border plates is indicated. Simple fractures can be repaired intraorally; however, in the mandible with a reduced height, the neurovascular bundle may be located within the soft tissue, and the extraoral approaches provide improved access for the placement of larger plates and bone grafts.

BIBLIOGRAPHY
PATIENT WITH MANDIBULAR FRACTURE

Initial assessment (see algorithm 38)

A Assess location of fracture and occlusal pattern

Can the patient achieve his or her preinjury dental relationship?

Yes

B Soft diet for 6 weeks

No

Determine location of fracture

Alveolar fracture

Closed reduction with arch bar or splint stabilization

Follow up

Condylar/subcondylar fracture

C Are any absolute indications for ORIF present?

Yes

ORIF

No

D Are any relative indications for ORIF present?

Yes

IMF with guiding elastics

No

E Costochondral graft

At time of ORIF, is there loss of ramus height that cannot be restored or severe disruption of condyle?

Yes

No

Proceed with ORIF

Condylar fracture

Angle, body, symphysis/parasymphysis

F Is the mandible edentulous?

No

ORIF

Yes

G Is the mandible atrophic?

No

ORIF

Yes

ORIF + immediate bone grafting

Physical therapy if indicated

Long-term follow-up
The reconstructive goals and available local tissue options vary with the site, size, and causes of the defect. Evaluation of the defect, planning of local flaps, and assessment of the surrounding scalp are important, because the area may be inelastic or fibrotic as a result of radiation therapy or previous operations. Careful attention to the preservation or creation of the anterior, parietal, and posterior hairlines is important when planning local flaps.

Clinical, radiologic, and histologic assessments of the underlying bone and periosteum help to avoid postoperative complications such as a sinus discharging along the suture line or an abscess forming under the scalp. If the injury was caused by a third- or fourth-degree thermal burn or an electrical burn, or if the wound contains exposed bone, the bone should be debrided generously until punctate bleeding occurs.

When the status of the resected margins is uncertain, a temporary cover with a biologic dressing or negative pressure therapy can be used until definitive reconstruction is executed.

Scalp defects can be arbitrarily classified as small (less than 2 cm²), medium (2 to 25 cm²), or large (greater than 25 cm²). Small defects can be closed primarily without disturbing the hairline. In difficult situations, mobilization of the surrounding scalp, galeotomy (scoring), and use of external skin expansion devices or rapid intraoperative tissue expansion can facilitate closure. Gradual closure is an important technique that can be used to harvest the viscoelastic properties of skin—creep and stress relaxation. Often as many as three closures may be necessary to achieve the stretch to close the defect.

Medium-sized defects can be reconstructed with local flaps using transposition, rotation, or advancement. However, the designed flap must have dimensions bigger than the defect, because the scalp tissue is thick and inelastic. Unless the pedicle has an axial vascular supply, transposition flaps are most successful when the flap’s length/width ratio exceeds 4:1. When designing rotation flaps, the length of the curved incision should either be more than or equal to four times the greatest dimension of the defect, as measured along the curved incision and extending to the loose region of the scalp. Careful planning for the back cut and the relaxing incision is important, because these are important tools for closing difficult defects. In most circumstances, a small flap donor site defect can be closed primarily. If a split-thickness skin graft (STSG) is required for donor site closure, it should be placed so that the hair pattern can camouflage the graft.

For large defects, local flaps based on axial scalp vessels can be designed, but the donor site will often require an STSG for closure. The Ornicochea flap can typically cover a defect 50 cm² or larger. The operative technique involves using three flaps—two are based on each superficial temporal vessel and are used to reconstruct the defect; the third is based on the occipital vessel and is designed to cover the flap donor site. The disadvantage of this flap design is that the hair direction must be altered. The Juri flap, based on a superficial temporal vessel, can be used to re-create an anterior hairline and can also cover a defect up to 25 cm². Depending on the size and location of the defect, one or two Juri flaps can be designed to cover the defect and the flap donor site. If the clinical situation permits, the reconstruction of large defects can be staged. In the first stage, a split-skin graft is used to cover the defect. At a later stage, when the wound has healed, tissue expansion is performed.

When the defect is larger than 200 cm², local tissue is usually insufficient for wound closure, and microvascular tissue transfer offers a reasonably good option. Depending on the defect requirement, a variety of tissues—ranging from a thin fasciocutaneous flap to a bulky myocutaneous flap—can be considered. Procedures using the anterolateral thigh, rectus abdominis, and latissimus dorsi flaps, as well as the serratus anterior muscle flap with a vascularized rib, if required, are described in the literature. In patients who have an osseous defect of the skull, both autogenous (for example, nonvascularized bone sources such as calvarial bone, rib graft, or iliac bone graft) and nonautogenous materials (for example, titanium mesh) can be considered for reconstruction of the bony defect. If needed, vascularized rib with a serratus muscle flap can be used.

### Neoplasms and Reconstruction

**CHAPTER 46 SCALP DEFECTS**

Puneet Tuli • Ian T. Jackson

**A** The reconstructive goals and available local tissue options vary with the site, size, and causes of the defect. Evaluation of the defect, planning of local flaps, and assessment of the surrounding scalp are important, because the area may be inelastic or fibrotic as a result of radiation therapy or previous operations. Careful attention to the preservation or creation of the anterior, parietal, and posterior hairlines is important when planning local flaps.

**B** Clinical, radiologic, and histologic assessments of the underlying bone and periosteum help to avoid postoperative complications such as a sinus discharging along the suture line or an abscess forming under the scalp. If the injury was caused by a third- or fourth-degree thermal burn or an electrical burn, or if the wound contains exposed bone, the bone should be debrided generously until punctate bleeding occurs.

**C** When the status of the resected margins is uncertain, a temporary cover with a biologic dressing or negative pressure therapy can be used until definitive reconstruction is executed.

**D** Scalp defects can be arbitrarily classified as small (less than 2 cm²), medium (2 to 25 cm²), or large (greater than 25 cm²). Small defects can be closed primarily without disturbing the hairline. In difficult situations, mobilization of the surrounding scalp, galeotomy (scoring), and use of external skin expansion devices or rapid intraoperative tissue expansion can facilitate closure. Gradual closure is an important technique that can be used to harvest the viscoelastic properties of skin—creep and stress relaxation. Often as many as three closures may be necessary to achieve the stretch to close the defect.

**E** Medium-sized defects can be reconstructed with local flaps using transposition, rotation, or advancement. However, the designed flap must have dimensions bigger than the defect, because the scalp tissue is thick and inelastic. Unless the pedicle has an axial vascular supply, transposition flaps are most successful when the flap’s length/width ratio exceeds 4:1. When designing rotation flaps, the length of the curved incision should either be more than or equal to four times the greatest dimension of the defect, as measured along the curved incision and extending to the loose region of the scalp. Careful planning for the back cut and the relaxing incision is important, because these are important tools for closing difficult defects. In most circumstances, a small flap donor site defect can be closed primarily. If a split-thickness skin graft (STSG) is required for donor site closure, it should be placed so that the hair pattern can camouflage the graft.

**F** For large defects, local flaps based on axial scalp vessels can be designed, but the donor site will often require an STSG for closure. The Ornicochea flap can typically cover a defect 50 cm² or larger. The operative technique involves using three flaps—two are based on each superficial temporal vessel and are used to reconstruct the defect; the third is based on the occipital vessel and is designed to cover the flap donor site. The disadvantage of this flap design is that the hair direction must be altered. The Juri flap, based on a superficial temporal vessel, can be used to re-create an anterior hairline and can also cover a defect up to 25 cm². Depending on the size and location of the defect, one or two Juri flaps can be designed to cover the defect and the flap donor site. If the clinical situation permits, the reconstruction of large defects can be staged. In the first stage, a split-skin graft is used to cover the defect. At a later stage, when the wound has healed, tissue expansion is performed.

**G** When the defect is larger than 200 cm², local tissue is usually insufficient for wound closure, and microvascular tissue transfer offers a reasonably good option. Depending on the defect requirement, a variety of tissues—ranging from a thin fasciocutaneous flap to a bulky myocutaneous flap—can be considered. Procedures using the anterolateral thigh, rectus abdominis, and latissimus dorsi flaps, as well as the serratus anterior muscle flap with a vascularized rib, if required, are described in the literature. In patients who have an osseous defect of the skull, both autogenous (for example, nonvascularized bone sources such as calvarial bone, rib graft, or iliac bone graft) and nonautogenous materials (for example, titanium mesh) can be considered for reconstruction of the bony defect. If needed, vascularized rib with a serratus muscle flap can be used.

### BIBLIOGRAPHY


PATIENT WITH SOFT TISSUE DEFECT OF THE SCALP

A History and physical examination
- Would clean Wound necrotic
- Margins uncertain
- Debride

B Wound necrotic
- Debride
- Await final pathology

C Temporary coverage
- Await final pathology

D Assess size of defect
- <2 cm
  - Primary closure
- 2-25 cm²
  - Local flap closure
  - Transposition flap
  - Rotation flap
  - Multiple pinwheel flaps
  - V-Y advancement flap
  - Donor site closed primarily?
    - Yes
    - No
    - STSG
- 25 cm² to 200 cm²
  - Hair orientation important to patient?
    - Yes
    - Staged procedure with STSG to defect at first stage
    - Orticochea or Juri flap
    - Tissue expansion for second stage to excise STSG and close scalp
    - No
    - STSG
- >200 cm²
  - Granulation tissue present?
    - Yes
    - Microvascular tissue transfer
    - No
    - STSG

Long-term follow-up
CHAPTER 47 FOREHEAD DEFECTS

Chad A. Perlyn

A The skin of the forehead should be assessed for laxity in both the transverse and vertical dimensions. Tension lines and rhytids should be noted and used for incision placement when possible.

B The defect should be evaluated to determine if it can be closed primarily. Despite the perpendicular nature of the scar to the brow crease, a vertical closure of a central forehead defect will often yield a result superior to those of other techniques for forehead reconstruction. Scoring of the galea or frontalis muscle may help achieve primary closure.

C If a defect is closed vertically, and the scar will violate the center of the glabella, a W-plasty is indicated at the inferior aspect of the brow closure. This places the scars in existing vertical rhytids on either side of the glabella, thereby preserving the glabella itself.

D Small or medium-sized defects of the brow can heal well by secondary intention, provided that local wound care is performed and there is viable, intact periosteum (for example, the donor site defect left by a forehead flap). The appearance of these defects is far superior when they heal spontaneously and do not require skin grafts or flaps for definitive wound coverage. Larger defects, or those without intact periosteum, require flap coverage. A thin, split-thickness skin graft (STSG) can minimize the time required for wound care and, by contractions, recruit adjacent “expanded” skin for secondary graft excision and closure.

E There are limited indications for using a skin graft for a forehead defect, regardless of location. Matching skin color is difficult, and the operative time required to harvest, prepare, and inset a skin graft is often greater than if the wound had been covered by a local flap. If a skin graft will be used, full-thickness skin grafts (FTSGs) are preferred. A viable wound bed is necessary to ensure graft take.

F Closure of central brow defects is best accomplished using a local flap. Options include rotation flaps (uni- or bilateral), transverse advancement flaps, and single or multiple rhomboid flaps. Shutter flaps, which use the galea frontalis and skin, are transposed medially, much like the shutter of a camera. These can be used to close large defects. However, there is often a substantial donor site that must be allowed to heal either by secondary intention or by coverage with an FTSG. Rhomboid flaps are useful for glabellar reconstruction.

G Small, lateral brow and temporal defects are easily closed with single or double rhomboid flaps. Large defects, including lateral hemibrow flaps, can be closed with a Worthen flap, which involves incising the remaining forehead with the anterior hairline and rotating it into the defect.

H If primary closure of a forehead defect will distort the brow, then flap reconstruction above the eyebrow is necessary. The defect should be circumscribed, and the skin on either side of the defect can be mobilized either as a hatchet flap or as a laterally and medially based rotation flap. These flaps are a V-Y advancement flap that leaves behind a small skin bridge, or “hatchet handle,” as a skin pedicle. Island flaps are also useful, because they do not create additional scars at the site of the defect.

I If an extensive defect exists, it may be possible to perform tissue expansion to recruit residual normal brow skin. A local flap from the expanded skin is subsequently used for wound closure. Tissue expansion requires careful preoperative planning and attention to eyebrow and hairline positions.

J In cases of total or near-total forehead loss, a microvascular tissue transfer using a thin fasciocutaneous flap (for example, an anterior lateral thigh flap) is indicated.

K Long-term follow-up is beneficial to patients with forehead defects. Because most of the defects result from tumor ablation, a follow-up for oncologic monitoring is necessary. The shape of the eyebrow can be adjusted, and hair density can be corrected with grafting, if necessary. Postoperative brow asymmetry can be corrected with direct or indirect brow-lifting procedures.

BIBLIOGRAPHY


PATIENT WITH A DEFECT OF THE FOREHEAD

History and physical examination

A Assess skin laxity in transverse and vertical dimensions

B Can the defect be closed primarily?

Yes

Primary closure

C If closed vertically, does the scar cross the glabella?

Yes

Consider W-plasty at glabella

No

Straight line closure

No

Assess the patient’s goals and defect size

Patient does not desire reconstructive surgery

Patient desires/requires reconstructive surgery

Assess defect location

Assess relationship of hairline and eyebrows to defect

No

Assess defect location

Small/medium defect with intact periosteum

Large defect or defect without intact periosteum

Local wound care

Defect healed?

Yes

Wound coverage

• Thin STSG
• Local flap

No

Long-term follow-up

Central brow/glabellar region

Lateral brow/temporal region

Supraeyebrow region

Extensive defect

E FTSG

Local flap

• Rotation flap
• Bilateral transverse advancement flap
• Shutter flap
• Rhomboid flap (glabella or central defect)

F FTSG

Local flap

• Single rhomboid flap
• Double rhomboid flap
• Worthen flap

G FTSG

Local flap

• Double rotation flap
• Hatchet flap
• Island flap
• Bilateral advancement flap

H FTSG

Local flap

Tissue expansion and local flap

I

Microvascular tissue transfer

J

K Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 48 EYELID DEFECTS
Adam G. Buchanan • Philip L. Custer

Eyelid defects are typically classified as anterior lamellar (skin with or without the orbicularis oculi muscle) or full thickness. Repair techniques are generally independent of cause.

Defects involving the anterior lamella (skin with or without the orbicularis oculi muscle) are usually repaired with local advancement, rotation, or transposition flaps. When developing these flaps, it is essential to avoid vertical traction on the eyelid margin. Ideally, it is best to mobilize tissue of a similar consistency when repairing eyelid defects.

Skin grafts may be used to repair eyelid skin defects if adjacent tissue does not have the laxity required for the development of local flaps. Full-thickness grafts are preferred, because the contraction of split-thickness grafts often results in postoperative deformity. Preferred donor sites include the upper eyelid and retroauricular regions. The upper arm can be used if a large amount of tissue is needed.

The technique used to repair a full-thickness eyelid defect is determined based on the size of the defect and the degree of adjacent tissue laxity.

Small (less than 25%) marginal defects can often be closed primarily. A lateral canthotomy and cantholysis may facilitate closure of slightly larger wounds.

Moderately sized (25% to 50%) defects of either the upper or lower lid can be closed with a semicircular flap technique, which advances tissue from the lateral canthus. If the defect involves the lateral lid or canthus, a transposition periosteal flap can be used to reform the posterior lamella and reattach the lid temporally. This flap must be covered with either a skin graft or flap. A free tarsal graft (from the upper lid) underneath a vascularized skin flap can be used to repair somewhat larger defects of the lower eyelid. Moderate upper lid defects may be repaired with adjacent upper tarsal conjunctival advancement or transposition, with a skin graft. It is advisable to leave at least 3 mm of marginal tarsus in the donor lid when harvesting either a flap or graft of this tissue.

Large (greater than 50%) defects of the lower eyelid are typically repaired with a tarsal conjunctival flap advanced from the ipsilateral upper lid. The overlying skin can be provided by a free graft or, if the patient has adequate anterior lamellar laxity, an advancement. Large defects of the upper lid may necessitate the advancement of a full-thickness lower eyelid flap (Cutler-Beard procedure).

The majority of eyelid defects are best repaired with local flaps or grafts; however, extensive or deep defects occasionally require regional flaps such as midforehead or Mustardé cheek flaps.

All patients should be evaluated by both an ophthalmologist and eyelid surgeon postoperatively. The initial follow-up examination is performed 1 week postoperatively for suture or bolster removal. If there are no signs of infection or other complications, patients are reevaluated at 1 month. Lid-sharing tarsal conjunctival flaps are divided in a secondary procedure at 4 to 6 weeks.

BIBLIOGRAPHY
PATIENT WITH EYELID DEFECT

History and physical examination

Assess location and extent of defect

Anterior lamellar defect (skin ± orbicularis oculi muscle)

Assess defect size

Extensive periocular tissue loss

Repair defect

- Midforehead flap
- Mustardé cheek flap
- Free tissue transfer

Assess defect size

Small (<25%)

Moderate (25%-50%)

Large (>50%)

Primary closure ± canthotomy/canthalysis

Central or medial defect

Lateral defect

Lower eyelid

Upper eyelid

Semicircular flap ± lateral canthotomy

Periosteal flap with skin graft or local flap

Tarsocconjunctival flap and skin graft

Cutler-Beard flap

Tarsal graft for support

Tarsal flap for support

Repair defect

- Midforehead flap
- Mustardé cheek flap
- Free tissue transfer

Long-term follow-up with ophthalmologist and eyelid surgeon

Local flap

Full-thickness skin graft

Sufficient adjacent tissue

Insufficient adjacent tissue
Philip L. Custer • Adam G. Buchanan

CHAPTER 49 EYELID PTOSIS

Ptosis is defined as an abnormally low position of the upper eyelid margin when the eye is in primary gaze. Redundant upper eyelid skin, known as dermatochalasis, does not cause ptosis, and upper blepharoplasty is not typically performed to correct ptosis. The evaluation of a patient with ptosis should help determine the cause and associated conditions. Likewise, a detailed ocular examination is necessary for all ptosis patients. The physician must then ascertain whether relative contraindications to surgery are present. For patients found to be good surgical candidates, the office examination will help determine the type of procedure most likely to be successful. Preoperative photographs and visual field testing may document the need for functional surgery.

The presence of pupil changes, strabismus, proptosis, an abnormally full superior eyelid sulcus, and fatigability are among the findings that indicate the need for further evaluation. Imaging and detailed ophthalmologic or neurologic examinations may be required. Unique physical findings, including blepharophimosis and jaw-winking syndrome, are also present in certain types of congenital ptosis.

Ptosis can be classified according to the age of onset (congenital versus acquired) and mechanism (neurogenic, myogenic, aponeurotic, or mechanical). Simple myogenic ptosis is the most common form of congenital disease, whereas the majority of adult patients have acquired ptosis as a result of attenuation or dehiscence of the levator aponeurosis. It is also necessary to determine the duration and stability of the disorder. Ptosis of recent or sudden onset may indicate a significant underlying condition. A detailed review of past photographs can be very helpful in clarifying the duration of ptosis.

Ptosis surgery is often delayed in patients with progressive acquired myopathies such as myasthenia gravis, chronic progressive external ophthalmoplegia, myotonic dystrophy, and oculopharyngeal dystrophy. However, limited frontalis suspension may be necessary if the ptosis becomes visually disabling. Special or additional surgical procedures may be needed for patients with certain conditions, including jaw-winking syndrome and blepharoophimosis (medial canthal reconstruction and ectropion repair).

Not all patients with ptosis are good candidates for surgery. Patients with dry eye, poor Bell’s phenomenon, limited ocular motility, enlarged pupils, and reduced levator function are at higher risk for developing postoperative ocular complications. Furthermore, symptoms such as ocular irritation, blurred vision, double vision, and light sensitivity can all be exacerbated by ptosis surgery.

The degree of levator function indicates which form of surgery is most likely to succeed for each patient. As a general rule, frontalis suspension is used for most patients with poor function and is most successful in patients who exhibit compensatory eyebrow elevation in response to the ptosis. External levator aponeurotic surgery is indicated in patients with fair or good function. An internal conjunctiva–Müller’s muscle resection can be performed in individuals with good levator function who respond well to the phenylephrine test.

Pediatric patients require general anesthesia, necessitating empirical adjustment of the eyelid’s position. Local anesthesia with minimal or no sedation is used in cooperative adult patients, allowing intraoperative adjustment of the eyelids.

After surgery, ptosis patients are followed closely to ensure they do not develop exposure keratopathy or other ocular disorders. Lagophthalmos, overcorrection, undercorrection, poor eyelid contour, and exposure keratitis are among the more common complications of surgery. Noticeable scarring, bleeding, and loss of vision can also occur. An immediate reoperation may be necessary for patients with overcorrection and/or significant keratitis.

BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book
PATIENT WITH UPPER EYELID PTOSIS

History and physical examination

A. Assess levator function

B. Ipsilateral miosis?
   - Yes
     - Horner's syndrome evaluation
       - Normal
       - Aponeurotic ptosis
   - No
     - Proptosis or full superior sulcus?
       - Yes
         - Myasthenia gravis evaluation
           - Normal
             - Evaluation for neurologic disease or myopathy
               - Absent
               - Present
                 - Neuromuscular treatment
       - No
         - Imaging to rule out orbital mass
           - No mass
           - Intraorbital mass
             - Treatment as needed

C. Onset
   - Acquired
     - Proptosis or full superior sulcus?
       - Yes
         - Myasthenia gravis evaluation
           - Normal
             - Evaluation for neurologic disease or myopathy
               - Absent
               - Present
                 - Neuromuscular treatment
       - No
     - Blepharophimosis present?
       - Yes
         - Blepharophimosis syndrome
       - No
         - Congenital

D. Treatment as needed

E. Ptosis surgery based on levator function

F. Levator function (mm)
   - Good
     - 16
   - Moderate
     - 12
   - Poor
     - 8
     - 4
     - 0

G. Follow-up evaluation
   - Postoperative complications?
     - No
     - Yes
       - Ocular exposure ± significant keratitis
         - Immediate reoperation if indicated

Levator aponeurotic repair or conjunctiva–Müller's muscle resection
Levator aponeurotic muscle resection
Frontalis suspension
Defects of the ear are common. Three-dimensional reconstruction is required to restore a normal appearance. Defects may be caused by trauma, burns, infections, or the resection of a malignancy. Before any definitive reconstruction can be performed, the ear and periauricular areas should be free of necrotic tissue, infectious debris, or malignancy.

Because of its superior tissue penetration, mafenide acetate cream can be used prophylactically as a topical antimicrobial therapy with Sulfamylon to treat burned or traumatized ears. However, mafenide acetate inhibits carbonic anhydrase, which may result in metabolic acidosis if the drug is used for a prolonged period.

Using the Antia-Buch technique, chondrocutaneous helical rim advancement flaps can be used to treat isolated helical rim defects smaller than 2 cm. Defects smaller than 1.5 cm can also be closed using a wedge technique, which involves converting a defect into a full-thickness triangular wedge that can be repaired in layers. Burow's triangles are often necessary to allow closure without distortion or cupping.

Large, isolated helical rim defects can be treated with a staged retroauricular tube flap technique. This technique allows a thin, aesthetic helical rim to be created, without requiring cartilage support.

Defects in the upper or middle third of the ear that also involve less than 25% of the ear require conchal cartilage support and soft tissue reconstruction. Conchal cartilage is recommended for these defects because of its structural characteristics and ease of harvest. A template of the opposite ear is used for symmetrical reconstruction.

Defects that involve more than 25% of the ear require significant structural support. Costal cartilage is used, in addition to skin coverage, because it can be carved into an accurate three-dimensional shape. It provides a greater source of donor material and is less pliable than conchal cartilage.

When the retroauricular mastoid skin is available and pliable, the cartilage framework is covered with a retroauricular mastoid skin flap.

When the retroauricular mastoid skin is not adequate, then the presence of the superficial temporal artery is determined. If the artery is present, then the cartilage is covered with a temporoparietal fascia flap and split-thickness skin graft (STSG). If the artery is not present, then tissue expansion is considered. If expansion is possible, the expanded skin is used to create a retroauricular flap. If expansion is not possible, or if the expansion fails, then soft tissue coverage is provided with microvascular tissue transfer using a thin, pliable flap.

At a second stage, the retroauricular flap is divided, and the ear is elevated and covered. The posterior auricular sulcus is then created with a full-thickness skin graft (FTSG).

Lobule loss is corrected by placing a cartilage graft under the cheek/retroauricular skin below the defect in a single stage and covering the posterior surface of this with a postauricular skin flap swung downward.

If the patient prefers, or if autologous reconstruction is not possible, a bone-anchored prosthesis can be used for total auricular loss.

BIBLIOGRAPHY


PATIENT WITH ACQUIRED EAR DEFORMITY

History and physical examination

A Assess nature of injury

Traumatic/burn

Infectious

Malignancy

Wound clean?

No

Yes

B Debridement plus antibiotic therapy

Assess defect size and location

Isolated helical rim

Upper or middle third

Lower third

Lobe only

Small (≤ 2 cm)

Large

Small defect (≤ 25%)

Large defect (> 25%)

Cartilage graft to cheek/retroauricular skin (first stage)

Conchal cartilage graft

Costal cartilage graft

Advancement of skin/cartilage to create lobule (second stage)

Cartilage graft disc between a cheek/neck flap (anteriorly) and a postauricular skin flap posteriorly

Assess retroauricular skin quality and quantity

Adequate

Inadequate

Is the superficial temporal artery intact?

Yes

No

Is tissue expansion possible?

Yes

No

Conchal cartilage graft

Cover cartilage with retroauricular skin flap

Second stage to elevate ear and re-create posterior auricular sulcus with FTSG

Tissue expansion

Microvascular tissue transfer

Bone-anchored prosthesis

Cover cartilage with temporoparietal flap and STSG

Cover cartilage with retroauricular skin flap

Long-term follow-up/refinement procedures

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 51  NOSE DEFECTS
Frederick J. Menick

When treating a patient with a nasal defect, the primary objective must be to establish a goal. Almost all wounds will heal with secondary intention or the approximation of cover to lining. Any skin graft or local, regional, or distant flap can be used to repair a hole. However, to optimize aesthetic and functional outcomes, nasal reconstruction requires reestablishing the correct tissue quality, two-dimensional border outline, and three-dimensional contour. The nose is usefully divided into subunits—the adjacent topographic areas of characteristic skin quality, two-dimensional border outline, and three-dimensional contour. The character of the overlying skin can also be divided into thin and thick zones. The skin over the dorsum and sidewall is thin, relatively mobile, and in slight excess (zone 1). Along the nostril margin and columella, the skin is thin, but adherent to the underlying tissues (zone 3). The skin over the tip and ala is highly sebaceous, thick, adherent, and without excess (zone 2). A small amount of excess skin is available within the superior nose. However, the tip and ala, which abut the highly mobile nostril margin, lack excess skin, limiting secondary healing, primary closure, or local tissue rearrangement in the thick skin zone. If left to granulate, small defects near the canthal region heal better than defects on the tip or columella. Except for those harvested from the forehead, most skin grafts appear as a patch within the thick-skinned zones.

The nose sits on the underlying cheek and lip platform in exact position and projection. If missing, a stable base must be reestablished before the nasal repair to prevent shifting caused by edema, tension, and gravity. If there is any doubt about the base, the nose repair should be delayed to allow the nasal platform to stabilize.

If the lining is lost because of a full-thickness injury, it must be replaced. A small rim defect is repaired with a composite skin graft. An isolated midvail lining defect is filled with a contralateral, dorsally based intranasal lining flap or skin graft. Distal unilateral defects smaller than 1 cm in height along the nostril margin are repaired with a Menick modified folded forehead flap, skin graft, or bipedicle lining flap within an ipsilateral septal intranasal lining flap. Lining defects longer than 1 cm in the nostril margin can be repaired with a folded forehead flap or a bipedicle vestibular flap with a contralateral septal flap. The heminose is repaired with ipsilateral and contralateral intranasal lining flaps. A free flap should be considered for large or irradiated wounds. Central lining loss is closed primarily by approximating the septal mucosa and lateral nasal lining, provided that there was minimal loss of dorsal height. More significant central losses of the dorsum and tip are repaired with an inferiorly or superiority based composite septal flap. Subtotal and total nasal defects are repaired with an inferiorly based composite septal flap and either a lateral alar hingover flap or nasolabial flap, or a free flap.

Missing cartilage must be replaced to support, shape, and brace the soft tissues against gravity, tension, and scar contracture. Although the ala contains no cartilage, if more than 10 mm of skin is missing, the reconstruction should be braced with cartilage support. Cartilage grafts are placed in a nonsubunit or subunit design, and, depending on the loss, over a vascularized, intact lining.

In addition to the conventional nasal subunits, the nose can be divided into three zones for reconstructive planning. Zone I includes the upper dorsum and sidewalls of the nose. Zone II begins 1.5 cm above the supratip area and comprises most of the alar lobules. Zone III consists of a 4 mm strip along the nostril margin, the soft triangles, the lower half of the intratip lobule, and the columella.

A defect smaller than 1.5 cm and more than 1 cm away from the mobile nostril margin or tip can be closed by secondary intention, a full-thickness skin graft (FTSG), or a local flap (for example, a single lobe within the thick-skinned zone, a bilobed flap, or a dorsal nasal flap within the thick-skinned zone). An FTSG or cheek advancement can be used to repair the sidewall, with or without a nasolabial single-stage extension for the ala.

Skin grafts in zone II typically appear waxy and patched unless they are harvested from the forehead, which may improve their appearance. Local flaps in this area provide better aesthetic coverage, although mobility of the flaps is often limited, because skin from the nose does not twist or transpose easily.

Multiple nasal subunits of complex contour are resurfaced with a three-stage forehead flap. This flap permits the creation of an ideal, thin, supple cover and detailed soft and hard tissue contours. The modified Menick folded forehead flap lining technique can also be used. To improve the final results and minimize the need for late revisions, each of these measures should be completed before pedicle division.

BIBLIOGRAPHY
PATIENT WITH A NASAL DEFECT

History and physical examination

A Establish goals for restoration

Nasal base absent

B Establish a stable nasal platform by restoring missing tissue volume and surface skin

Long-term follow-up

Nasal base intact

Assess internal lining

Internal lining intact

Assess cartilaginous support

Cartilage intact and ala intact

D Cartilage missing or ala violated

Restore with primary cartilage grafts or composite grafts for small alar rim defects <1.5 cm

E Assess external skin coverage

F Zone I injury

Defect <1.5 cm

Local flap or forehead or preauricular skin graft

Defect >1.5 cm

FTSG or forehead flap

G Zone II injury

Defect <1.5 cm

Bilobed flap or FTSG from forehead

Defect >1.5 cm

Two- or three-stage paramedian forehead flap or nasolabial flap (ala or sidewall)

H

Long-term follow-up

Composite ear graft or FTSG from forehead, two-stage helix, or preauricular skin

G Zone III injury

Defect <1.5 cm

Two-stage nasolabial flap or forehead flap

Long-term follow-up

• Residual vestibular lining
• Septal mucoperichondrial flaps
• Turnover of adjacent skin flaps
• Folded edge of a covering flap
• Skin-grafted portion of covering flap
• Facial artery musculomucosal flap
• Free flap

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
The cheek represents the largest area of the face, and it has been divided into various subunits by different authors. For the purposes of reconstruction, the principle of unit reconstruction does not hold true for the cheeks as it does for other areas of the face, including the nose. The best option for reconstructing a cheek defect can be determined both by assessing the relationship of the defect to its surroundings and by evaluating the area’s hair-bearing status, skin laxity, natural wrinkles, previous surgical scars, and relaxed skin tension lines.

The key aspect of a successful reconstructive procedure is a critical assessment of the size and location of the defect. To provide a better understanding of cheek reconstruction, I (I.T.J.) have divided the defects into five regions (areas C through G). Arbitrarily, the defects can also be classified as small, medium, and complex. All small defects are closed primarily, provided that excessive tension and distortion of the surrounding tissue can be avoided. This simple technique of primary closure varies from site to site and is largely dependent on the availability of the surrounding skin. When closing any defect primarily, dog-ears should be excised properly. A noncurvilinear scar in the direction of the wrinkles is preferred.

A small defect of the lower cheek region can be closed easily by undermining the surrounding neck or cheek skin and paying attention to the direction of the future scar. For a medium-sized defect, a variety of local flaps have been described, including the rhomboid, bilobed, modified bilobed, inferiorly based rotation, and transposition flaps. For a large superficial defect, a deltopectoral, nape-of-the-neck, or forehead flap can be used. Tissue expansion can also be considered.

Reconstruction of the superomedial cheek region needs thoughtful planning, because an inappropriate primary closure can lead to ectropion of the lower lid. When planning a flap in this region, attention should be paid to landmarks such as the medial canthus, punctum, and medial end of the lower lid. A variety of flaps have been described for medium-sized defects, but a horizontal or vertical triangular advancement flap offers the best option, because the scars will form in an ideal line. Once in its new position, the medially rotated flap should be carefully anchored to the underlying deep tissues or periosteum to hold the flap in place and prevent pulling on the eyelid. A lateral rotation or forehead flap can be used for larger defects. For situations in which the surrounding skin is not available, a frontogaleal flap with skin grafting is considered.

When reconstructing a malar defect, special consideration should be given to the design of the flap. Because the cheek’s contour is convex, scars are more obvious and can be highlighted by illumination. The surgeon can consider a number of local flaps, including rhomboid, bilobed, transposition, inferior, or lateral cheek rotation flaps, all of which can be used alone or in combination. Male sideburns are an important landmark, and special attention is required when moving flaps in this region. The flap should be fixed in its new position to underlying tissue to prevent drag on the lower lid.

Distortion of the alar base and nasolabial fold should be avoided when reconstructing any defect in this region. Advancement flaps (for example, perialar crescentic advancement, inferior advancement, or nasolabial triangular advancement flaps) may provide the best solutions, because the donor site can be closed in a V-to-Y manner, resulting in minimal cosmetic deformity.

Continued
PATIENT WITH A DEFECT OF THE CHEEK

A History and physical examination

B Assess defect's region and size

Lower region

C Lower cheek

Small defect

Primary closure

• Transposition flap
• Rhomboid flap
• Inferiorly based rotation flap

Medium defect

Closure

• Deltopectoral flap
• Forehead flap
• Tissue expansion

Large defect

Primary closure

• Advancement flap
• Perialar crescentic advancement flap
• Inferior advancement flap
• Nasolabial triangular advancement flap

G Alar base/nasolabial area

Small defect

Primary closure

• Advancement flap
• Perialar crescentic advancement flap
• Inferior advancement flap
• Nasolabial triangular advancement flap

Medium defect

Closure

• Cervicofacial rotation flap
• Tissue expansion

Large defect

Closure

Upper region

D Superomedial cheek

Small defect

Primary closure

• Lateral rotation flap
• Rhomboid flap
• Inferior rotation flap
• Advancement flap
  – Vertical triangular island advancement flap
  – Transverse triangular island advancement flap
  – Horizontal advancement flap
  – Nasolabial transposition flap

Medium defect

Closure

• Cervicopectoral flap
• Forehead flap
• Tissue expansion

Large defect

Primary closure

• Rhomboid flap
• Bilobed flap
• Transposition flap
• Rotation flap
• Advancement flap

Malar region

E

Small defect

Primary closure

• Cervicopectoral flap
• Forehead flap
• Tissue expansion

Medium defect

Closure

• Cervicopectoral flap
• Forehead flap
• Tissue expansion

Large defect

Closure

Continued
When reconstructing the lateral region, it is important to carefully note the position and shape of the tragus and sideburns. An inferiorly based rotation flap is one of the best options, because it allows primary closure of a triangular defect without altering the sideburn. For women, a preauricular transposition or rhomboid flap yields a cosmetically acceptable result.

Refer to p. 114.

Any defects that involve multiple subunits of the cheek or are full thickness need a distant flap. The deltopectoral, forehead, and pectoralis major myocutaneous flaps are among those that can be used alone or in combination with other flaps to reconstruct these complex defects. Likewise, free tissue transfer offers versatile, thin, and pliable tissue for reconstructing large defects. Thin or ultrathin flaps such as the anterolateral thigh, parascapular, lateral arm, or radial artery forearm flaps are preferred options.

Tissue expansion provides an excellent method for replacing the cheek skin with similar tissue. To achieve a cosmetically acceptable result, preoperative planning of flap design, movement, and expander placement is necessary.

BIBLIOGRAPHY
PATIENT WITH A DEFECT OF THE CHEEK

A History and physical examination

B Assess defect's region and size

E Lateral cheek

Small defect
- Primary closure

Medium defect
- Closure
  - Bilobed flap
  - Rhomboid flap
  - Preauricular transposition flap

Large defect
- Closure
  - Cervicofacial rotation flap
  - Forehead flap
  - Tissue expansion

Long-term follow-up

F Multiple subunits or full-thickness defect

- Closure
- Distant flaps
- Free tissue transfer
- Tissue expansion

Long-term follow-up
CHAPTER 53 LIP DEFECTS

Puneet Tuli • Ian T. Jackson

A A superficial defect of the lower lip that does not involve the underlying muscle can either be allowed to heal secondarily or may require reconstruction with a local myomucosal flap, depending on the size and position of the defect. A mucosal free graft may also be suitable for reconstruction. Wedge excision with primary closure is the simplest technique to use to repair a small defect, provided that the angle at the vertex of the wedge does not exceed 30 degrees and does not cross the mental crease. For circumstances in which neither of these conditions can be met, the inferior border can be modified as a W-plasty. In other difficult situations, a rectangular excision of the lesion can be performed, and bilateral advancement flaps with an inferior, horizontal incision in the shape of an arc around the mental prominence can be mobilized to close the defect.

B In cases in which the lip loss involves one to two thirds of the lip’s total width, local flaps mobilized by transposition, rotation, or advancement can be used for the repair. Reconstruction with a sensate flap (for example, a Karapandzic, depressor labii inferioris, anguli oris, or Nakajima Fujimori flap) requires tedious dissection, but it preserves the neurovascular bundle, resulting in a competent, sensitive lip. However, shortcomings such as microstomia and limited usage in a small central defect with preserved vermilion and mucosa restrict their role in lip reconstruction. Although easy to execute, insensate flaps (for example, the Gillies fan flap, bilateral flap, or stepladder skin, muscle, and mucosal flap in combination) result in an incompetent lip. In some long-term studies, it has been found that neurotization may increase the sensory function of the neolip over time.

C It is difficult to achieve an adequate stomal aperture with adequate control of lower lip continence. The Bernard–von Burrow, bilateral gate, or bilateral Gillies flap can be used alone or in combination with other flaps to reconstruct the complete lower lip. When local tissue is inadequate, reconstruction often results in microstomia, and a pedicle flap (for example, a deltopectoral flap), a bipedicled flap from the submental region, or a microvascular tissue transfer should also be considered. The radial artery forearm, gracilis, lateral arm, and free anterolateral thigh flap are other donor options. These flaps provide tissue bulk with only slight lip competence. Therefore slings using either the fascia lata or the palmaris longus tendon can be tunneled through the flap and fixed to the zygomatic peristeum, improving the sphincteric function of the lip.

D Reconstructing an upper lip defect is different in men and women because of the presence of hair-bearing skin in men. When planning and executing flaps for upper lip defects, landmarks such as the columella, philtral columns, and melolabial folds must be left undisturbed. The principle of excising the entire subunit and replacing it en bloc achieves the best possible result in upper lip reconstruction. When the defect is less than one third of the lip’s total width, primary closure is usually sufficient. However, if the defect is medially located, a perialar crescentic excision and release of the upper buccal sulcus allows medial advancement. This usually provides a significant amount of lip, thus allowing a good aesthetic result. When the defect is limited to skin and subcutaneous tissue, a nasolabial flap from the ipsilateral side can be used to reconstruct the defect with an inconspicuous donor site.

E For a centrally located defect, the combination of a perialar crescentic excision and an Abbé flap from the lower lip provides the best option. To maintain symmetry and similarity to the prolabium, the Abbé flap should be designed smaller than the defect. The Karapandzic flap, with a circumoral incision extending to the level of the commissure, offers an alternate solution, but may lead to microstomia and scarring. A laterally placed defect with commissure involvement can be reconstructed with an Estlander flap from the ipsilateral lower lip. If the defect extends to the philtral column, a perialar crescentic excision of the contralateral side may be used in combination with an Estlander flap to gain advancement of the remaining lip.

F Total and subtotal upper lip defects are associated with less functional morbidity than those affecting the lower lip. If sufficient tissue is available, Bernard’s procedure, with the excision of Burow’s triangles lateral to the lower lip, can be considered. When local tissue is inadequate or reconstruction results in microstomia, distant pedicle flaps from the scalp, deltopectoral, or cervical regions can be used. The principles for the free tissue transfer and the flap options are the same as those for the lower lip.

BIBLIOGRAPHY

PATIENT WITH A DEFECT OF THE LIP

History and physical examination

Assess location

Lower lip loss

Assess size of defect

Less than one third of lip width

Closure

• Primary closure
• V-plasty or W-plasty
• Bilateral advancement flaps

Medial side of lip

Local flap

• Abbé flap
• Karapandzic flap
• Staircase flap

Lateral side of lip

Local flap

• Estlander flap
• Karapandzic flap
• Gillies fan flap

More than two thirds of lip width

Bernard–von Burrow flap or multiple/bilateral local flaps (for example, bilateral Gillies flap)

Estlander flap or Karapandzic flap

Distant or microvascular flap with support

Long-term follow-up to ensure that oral competence remains and microstomia is absent

Upper lip loss

Assess size of defect

Less than one third of lip width

Closure

• Primary closure ± perialar crescent excision
• Nasolabial flap

Central

More than two thirds of lip width

Yes

No

Abbé flap and perialar crescent excision or Karapandzic flap

Bernard–von Burrow flap and contralateral perialar crescent excision

Distant flap or microvascular flap

Local tissue present?

Yes

No

Estlander flap or Karapandzic flap

Bernard–von Burrow flap and contralateral perialar crescent excision
Nonvascularized bone grafts (iliac crest or rib) may prove successful in small (less than 5 cm) lateral defects that have adequate soft tissue coverage and do not require radiation therapy (for example, fracture nonunions, trauma, and benign tumor extirpations). In patients who are not candidates for microvascular surgery, reconstruction of the mandible with a plate alone may be suitable for lateral defects. However, anterior mandibular defects reconstructed with plates alone demonstrate a high failure rate (up to 35%). Bone graft or plate reconstruction depends on adequate soft tissue coverage, which may be achieved by means of a pectoralis major, trapezius, or latissimus dorsi myocutaneous flap or other free soft tissue flaps (for example, radial forearm or anterolateral thigh).

Refer to p. 122.

Condylar defects may be managed in several ways. Reconstruction is not necessary in all cases; however, malocclusion, facial asymmetry, and a decrease in bite force may result. If the native condyle has been preserved, it may be grafted onto the bone flap using miniplates. If the condyle must be excised, the bone flap itself may be rounded to fit the glenoid fossa.

Patients with large lateral defects who are not good candidates for complex microsurgical procedures may be treated with soft tissue reconstruction alone. The vertical rectus myocutaneous free flap (VRAM) is a good choice for these patients. Functional results have been shown to be acceptable.

Anterolateral thigh flap (ALT). This perforator flap provides a useful soft tissue adjunct to bony reconstruction. It provides a large amount of relatively pliable tissue with minimal donor site morbidity. Its use is limited by the body habitus of the patient, which may render it too thick to be useful.

Fibula osseous flap (FO). The FO flap provides up to 25 cm of useful length. It has a consistent shape throughout and a segmental blood supply that allows multiple osteotomies.

Fibula osteocutaneous flap (FOC). The FOC flap is the workhorse for mandibular reconstruction at our institution. It can be harvested to include a moderately sized skin paddle based on septocutaneous perforators. A potential disadvantage to this flap is the reported unreliability of the skin paddle, which can fail in up to 10% of flaps. This can be mitigated by incorporating the flexor hallucis longus muscle into the flap.

Radial forearm fasciocutaneous flap (RFFC). The RFFC is a useful soft tissue adjunct to bony reconstruction of the mandible. It provides pliable, thin skin that is most appropriate to reconstitute the oral lining with minimal bulk. Drawbacks to the RFFC flap include the need for a conspicuous donor site.

Radial forearm osteocutaneous flap (RFOC). This flap provides up to 10 cm of unicortical bone. It is useful only for small, lateral bone deficits with large mucosal defects. The disadvantages of this flap are the inability to accommodate dental implants and the potential for fracture at the radius donor site.

Scapula osteocutaneous flap (SOC). This flap affords a large amount of soft tissue and permits closure of large external and full-thickness wounds. The bone, which can be up to 14 cm in length, does not tolerate osteotomies or osseointegration reliably. The skin island is not directly connected to the bone; this allows great flexibility during inset of the flap. Two islands may be used to reconstruct the mucosa and skin. Limitations to this flap include its location on the back, which requires intraoperative positioning changes, and the relative thickness of the skin island.

Vertical rectus myocutaneous flap (VRAM). This soft tissue flap is easily harvested and able to provide a large skin paddle and soft tissue bulk for reconstruction. It is useful as an adjunct to osseous reconstruction or when soft tissue reconstruction alone is considered for large body or hemimandible defects. Similar to the ALT, this flap is limited by the body habitus of the patient. Donor site complications include the potential for a bulge or hernia.

If the patient is able to swallow, he or she is advanced to a soft diet 7 to 10 days postoperatively. A regular diet is resumed at 6 weeks. Evidence of bony union is assessed radiographically at 6 to 12 months.
PATIENT WITH A DEFECT OF THE MANDIBLE

History and physical examination

Is there contaminated or devitalized tissue?

Yes

Debride nonviable tissue

Stabilize mandibular segments

No

Assess bone defect location and size

Lateral or combined defect

Condylar defect

Is there an indication for reconstruction?

No

Reconstruct condyle

Yes

Body or hemimandible defect

Assess soft tissue defect location and size

No defect

Closure

Small defect

FO flap

FOC flap

RFOC flap

Full-thickness defect

FOC flap and RFFC flap or ALT flap

Dual-island SOC flap

Consider soft tissue–only reconstruction

Large defect

FO or FOC flap and RFFC flap or ALT flap or VRAM flap

SOC flap

Consider soft tissue–only reconstruction

Large external defect

FO or FOC flap and RFFC flap or ALT flap or VRAM flap

SOC flap

Consider soft tissue–only reconstruction

Small defect

FO flap

Large internal defect

FO or FOC flap and RFFC flap or ALT flap or VRAM flap

SOC flap

Consider soft tissue–only reconstruction

Full-thickness defect

FOC flap and RFFC flap or ALT flap

Dual-island SOC flap

Consider soft tissue–only reconstruction

Continued

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 54  MANDIBULAR DEFECTS
Mark Sisco • Joseph J. Disa

Nonvascularized bone grafts (iliac crest or rib) may prove successful in small (less than 5 cm) lateral defects that have adequate soft tissue coverage and do not require radiation therapy (for example, fracture nonunions, trauma, and benign tumor extirpations). In patients who are not candidates for microvascular surgery, reconstruction of the mandible with a plate alone may be suitable for lateral defects. However, anterior mandibular defects reconstructed with plates alone demonstrate a high failure rate (up to 35%). Bone graft or plate reconstruction depends on adequate soft tissue coverage, which may be achieved by means of a pectoralis major, trapezius, or latissimus dorsi myocutaneous flap or other free soft tissue flaps (for example, radial forearm or anterolateral thigh).

The central segment of the mandible includes the canines and incisors. It sustains significantly greater force than the rest of the mandible during mastication. Reconstruction with vascularized bone of adequate thickness is recommended.

Refer to p. 120.

Refer to p. 120.

If the patient is able to swallow, he or she is advanced to a soft diet 7 to 10 days postoperatively. A regular diet is resumed at 6 weeks. Evidence of bony union is assessed radiographically at 6 to 12 months.

BIBLIOGRAPHY
**PATIENT WITH A DEFECT OF THE MANDIBLE**

- History and physical examination
- Is there contaminated or devitalized tissue?
  - Yes
    - Debride nonviable tissue
  - No
    - Stabilize mandibular segments

A Assess bone defect location and size

Continued

- Central or symphyseal defect
- Assess soft tissue defect
  - No defect
    - FO flap
  - Small defect
    - FOC flap
  - Large or full-thickness defect
    - Closure
      - FO flap and RFFC flap
      - SOC flap
      - FO flap and pedicle pectoralis flap

E Long-term follow-up
Facial paralysis is a complex disorder that may be congenital or acquired. The paralysis may be complete or incomplete, unilateral or bilateral. The time after onset is critical, because the facial musculature loses its ability to reinnervate 12 to 18 months after the insult.

The diagnosis of idiopathic facial paralysis (IFP; Bell palsy) may be made only after the exclusion of other causes. Slow onset of paralysis suggests an insidious process such as malignancy.

Routine laboratory tests include Lyme titers and blood, electrolyte, and C-reactive protein (CRP) levels. MRI is the preferred modality for radiographic evaluation of the facial nerve, though CT scan is more useful when temporal bone involvement is suspected. Electrodiagnostic studies (EMG) are useful for evaluating patients with total or worsening paralysis. All patients should undergo audiometry testing.

Medical treatment of IFP includes steroids and antiviral therapy. Nearly 75% of people with this condition fully recover. Surgical decompression of the facial nerve is indicated in patients with complete paralysis and those with a decrease in the electroneurography amplitude of 90% to 95% or more.

When the facial nerve is injured as a result of surgery or trauma, immediate reconstruction should be performed if possible. Direct coaptation, nerve graft, and nerve transfer are surgical options.

When the eyebrow droops significantly, an elliptical excision of skin and muscle is effective to restore symmetry. If the patient does not wish to have a scar on the brow, an endoscopic or distant brow lift can be performed.

Protection of the eye is of the utmost importance. The patient should be followed by an ophthalmologist and regularly use lubricating drops, taping, patching, and other protective measures.

Upper eyelid surgery should be deferred until symptoms of exposure keratitis or impending ulceration appear despite rigorous topical care. The upper lid loading procedure (gold weight) is the procedure of choice for most patients, because tarsorrhaphy can reduce lateral gaze and has a poor aesthetic result. Although dynamic procedures for functional restoration of the upper lid can be successfully performed, they are typically reserved to salvage lid function when simpler procedures have failed.

Patients with lower eyelid paralysis can develop ektopion, exposure keratitis, and troublesome tearing. The procedure of choice is a palmaris longus tendon sling. Lid shortening and lamellar support with grafting are utilized as necessary. As in the upper lid, functional tissue transfer is reserved to salvage lid function when simpler procedures have failed.

Continued
Algorithm 55

PATIENT WITH FACIAL PARALYSIS

A History and physical examination

B Onset without history of trauma or surgery

C Obtain laboratory studies and imaging (MRI versus CT scan)

D Obtain electrodiagnostic and audiometry testing

E Is immediate nerve reconstruction possible?

F Acquired secondary trauma or surgery

G Congenital

H Location of functional deficits

I Cause of paralysis detected (idiopathic facial paralysis)

J Medical therapy

K Paralysis resolved?

L Surgical decompression

M Nerve coaptation

N Nerve graft or nerve transfer

O Direct repair possible?

P Successful reconstruction of function?

Q Forehead/brow

R Balancing procedures

S Upper/lower eyelids

T Lips/oral commissure

U Protect cornea/globe

V Long-term follow-up

W Upper eyelid

X Lower eyelid

Y Static procedures

Z Dynamic procedures

AA Static procedures

BB Dynamic procedure
When discussing reconstruction of the upper lip and oral commissure, the patient and surgeon must decide between a static suspension and a dynamic functional procedure. Older patients often prefer the immediate effects of the static suspension. Most patients, however, benefit from a dynamic reconstruction that activates the oral commissure and upper lip. This addresses facial aesthetics (smile symmetry) as well as oral competence and speech.

Regional muscle or distant tissue obtained using a microvascular technique can be used for functional reconstruction. Advancements in microvascular transfer of functional muscle have reduced the utility of regional muscle transfers (for example, temporalis transfer). However, in a patient who is a poor candidate for a lengthy microvascular procedure, regional muscle is preferred as a shorter procedure without the risk of anastomotic thrombosis.

When a functional muscle transfer is elected, the motor nerve used to innervate the functional muscle must be selected. This can be (1) an ipsilateral branch of the facial nerve (if intact), (2) a buccal-zygomatic branch of the contralateral facial nerve using a two-stage cross-face nerve graft, or (3) another ipsilateral motor nerve such as the motor nerve to the masseter muscle.

Donor muscles commonly used for facial animation include the gracilis, pectoralis minor, and serratus muscle. In our experience, the gracilis is the most commonly used muscle for facial reanimation because of its size, neurovascular pedicle length, and ease of harvest.

Functional problems from lower lip paralysis are rare. Procedures can be performed to achieve balance by weakening through partial or total resection of the unaffected depressor labii inferioris muscle. The patient can preview the effects of this operation by blockade of muscle function using an injection of an anesthetic agent (short duration) or botulinum toxin A (3 to 6 months’ duration).

Follow-up should be provided until the condition and/or reconstruction has stabilized and no further management is required.

BIBLIOGRAPHY

Upper lip/oral commissure

Static procedures
- Tendon or fascial slings (lip/commissure)
- Rhytidectomy (lower face)

Dynamic procedures
- Microvascular functional muscle transfer

Regional muscle transfer
- Temporalis transfer
- Masseter transfer

Determine nerve to innervate functional muscle transfer
- Ipsilateral CN VII
- Contralateral CN VII
- Motor nerve to masseter muscle CN V

Requires staged cross-face nerve graft

Microvascular functional muscle transfer

Local anesthetic test successful?
- Yes
  - Inject botulinum toxin A into unaffected side
  - Does patient want a long-lasting solution?
    - Yes
      - Resect depressor labii inferioris on unaffected side
    - No
      - No further treatment

- No
  - Repeats botulinum injection every 4 months

Does patient want a long-lasting solution?
- Yes
  - Repeats botulinum injection every 4 months
  - Resect depressor labii inferioris on unaffected side
- No
  - No further treatment

Perform local anesthetic test to unaffected side

Lower lip

Long-term follow-up
CHAPTER 56 PAROTID MASSES
Shai M. Rozen • Larry L. Myers

A The history and physical examination are important initial steps in diagnosing parotid masses, though histologic confirmation is often needed. A history of any danger sign (such as facial paralysis, involuntary facial twitching, pain, rapid growth, or overlying skin changes) is highly suggestive of malignancy. Recurrent attacks of pain and swelling incited by eating generally indicate stone disease. Older age is associated with malignancy. Diffuse infiltration of the gland on examination suggests benign lymphoepithelial lesions, as found in patients with AIDS, Sjögren syndrome, sarcoidosis, or lymphoma. An intraoral examination is part of the parotid gland physical examination and includes inspection of the tonsillar fossa, soft palate, floor and roof of the mouth, and Stensen duct. The character and rate of saliva flow are documented. Positive clinical lymph nodes may occur in solid malignancies, lymphomas, or infectious processes. Twenty-five percent of parotid masses are nonneoplastic, consisting of cysts, inflammation, and other nonspecific infiltrative processes; the remaining 75% of the parotid masses are neoplasms, and 70% of these are benign.

B MRI is the most useful radiologic study for characterizing parotid masses. MRI is indicated in patients with malignant aspiration cytology, clinical suspicion of deep lobe involvement, facial paralysis, parotid mass fixation, and lymphadenopathy. Plain radiographic films may help in ruling out stone disease. Doppler ultrasonography may help in assessing the nature of more superficial lesions. Radionuclide scans may be helpful in assessing gland function, but otherwise are of limited diagnostic value.

C Fine-needle aspiration (FNA) is an important, simple, and cost-effective tool for diagnosis. There is a 90% correlation between diagnoses of aspirate material and final histologic diagnoses. The combination of MRI imaging, flow cytometric DNA analysis, and cytology has been reported to be 96% accurate in defining malignant neoplasms.

D A solid tumor, or a mass with an inconclusive diagnosis, requires excisional biopsy, typically performed as a parotidectomy (superficial versus total). Frozen section analysis during surgery is more than 93% accurate in differentiating between benign and malignant tumors and may be very useful with decisions regarding the facial nerve and extent of surgical resection. For patients with clinical nodal involvement, frozen section analysis of the lymph node is indicated. If lymphoma is diagnosed, further surgery is avoided, because it is treated medically.

E Partial parotidectomy or superficial parotidectomy is the treatment of choice for most benign tumors.

F When a definitive preoperative diagnosis is not made, upper jugular chain nodes should be biopsied early in the dissection.

G Stage I malignancies are treated with a superficial parotidectomy. Total parotidectomy is indicated for tumors extending into or originating from the deep lobe of the parotid gland; recurrent tumors; invasive tumors involving the skin, soft tissue, bone, or nerve; and metastatic or malignant lesions other than T1 or T2 low-grade tumors.

H Facial nerve resection is considered only after malignancy has been confirmed and is never performed for benign disease. The decision to sacrifice the facial nerve is made intraoperatively, based on the proximity of the tumor to the nerve. If no facial nerve symptoms were present preoperatively and the tumor may be peeled off the nerve, surgery may be followed by postoperative radiation therapy. If nerve resection is performed, a frozen section of the facial nerve should be analyzed to verify completeness of resection, and the nerve reconstructed immediately.

I Cervical lymphadenectomy is indicated in the event of clinically positive cervical nodes, high-grade malignant tumors, particularly larger than 4 cm, and/or direct invasion into the facial nerve. Lymphoscintigraphy may assist in mapping lymphatic drainage patterns of cutaneous lesions but does not predict the presence of disease.

J Postoperative radiation therapy is indicated for high-grade carcinomas, tumor invasion to adjacent structures (skin, muscle, and bone), regional lymph node metastasis, the presence of residual gross tumor after resection, and possible residual tumor close to the facial nerve. Chemotherapy has little role in the treatment for salivary gland cancer.

BIBLIOGRAPHY
PATIENT WITH MASS OF THE PAROTID GLAND

A History and physical examination
B Obtain diagnostic imaging

Hemangioma or vascular malformation
Solid or cystic mass
See algorithm 16

C Perform FNA

FNA benign
FNA inconclusive
FNA positive for malignancy

D Excisional biopsy (parotidectomy)

Inflammatory/infectious process
Solid tumor

E Benign tumor
F Unconfirmed diagnosis

G Malignant tumor (non-stage 1), recurrent tumor, or other indication

Malignant tumor (stage 1)

Partial or superficial parotidectomy
Partial or superficial parotidectomy with upper jugular chain node biopsy

H Can facial nerve be spared?

Yes
Facial nerve resection and immediate reconstruction

No

I Cervical lymphadenectomy if indicated

J Radiation therapy if indicated

Long-term follow-up
For patients suspected of having lip cancer, a biopsy must be performed to confirm and determine the cancer type. More than 95% of all cancers of the lips are squamous cell carcinomas (SCCA). The remaining 5% consist of basal cell carcinomas, melanomas, and, to a lesser degree, salivary gland cancers. This chapter focuses on the treatment of SCCA of the lip.

Proper classification is essential for appropriate treatment and prognosis. Cancer classification is defined by the American Joint Committee on Cancer (AJCC). T1 tumors measure less than 2 cm, T2 = 2.1 to 4 cm, T3 = 4.1 to 6 cm, and T4 tumors are greater than 6 cm; N0 = no neck nodes, N1 = single lymph node smaller than 3 cm, N2 = lymph node 3 to 6 cm, and N3 lymph nodes are greater than 6 cm.

Early-stage cancer (T1 or T2) can be treated with surgery alone or radiation alone. The treatment decision is based on any contraindications for surgery (poor surgical candidate) or radiation (prior radiation to this anatomic region). The outcomes are similar for early lip cancers treated with surgery or radiation therapy. Wide surgical excision is the most common treatment. Mohs microsurgery can be performed for premalignant or early lesions. For T1 lesions, margins of at least 4 mm are adequate to achieve 95% control. For T2 lesions, margins of 6 to 10 mm are required.

Late-stage cancer (T3 and T4) may have associated metastasis to neck nodes. If neck disease is present, then neck dissection is performed. If neck disease is absent, treatment is aimed at completely resecting the primary cancer. For T3 and T4 cancers, mucosa/skin margins of at least 2 cm are required. Intraoperative frozen sections of the surrounding mucosa/skin are obtained to assess a complete oncologic resection. If bone is involved in T4 cancers, then an oral composite resection with wide (2 cm or more) soft and bony margins is required. Advanced-stage cancers require postoperative irradiation for adequate treatment.

CT scanning or MRI with intravenous contrast of the neck (from skull base to clavicles) is indicated in the absence of palpable adenopathy in individuals with an obese or muscular neck and in those who are at high risk of having metastases (that is, the presence of perineural and/or perivascular invasion).

A patient’s prognosis depends on the extent of disease at the time of presentation. The 5-year cure rate for T1 and T2 lesions without cervical metastasis approaches 90% with either surgery or irradiation. For T3 and T4 lesions, the 5-year survival falls to 60% and 40%, respectively. If cervical disease is present, the 5-year survival rate falls to 50%. The follow-up is as follows: first year after treatment: 1 to 3 months; second year after treatment: 2 to 4 months; third year after treatment: 3 to 6 months; fourth and fifth years: 4 to 6 months; after 5 years: every 12 months.

BIBLIOGRAPHY


PATIENT WITH A LESION OF THE LIP

History and physical examination

A. Perform biopsy

Melanoma

See algorithm 13

SCCA

B. Stage lesion

C. Early stage (T1/T2)

T1

Are there comorbidities that would prevent surgery or does patient not wish to have surgery?

No

Excision of SCCA with 4 mm margins

Yes

Refer to radiation oncologist

T2

Are there comorbidities that would prevent surgery or does patient not wish to have surgery?

Yes

Excision of SCCA with 6-10 mm margins

No

D. Late stage (T3/T4)

Is this patient a high-risk patient?

Yes

Obtain CT/MRI of head and neck

No

Are there clinically or radiographically positive nodes?

Yes

Perform neck dissection

No

Does SCCA tumor invade bone?

Yes

Composite resection

No

Excision with 2 cm margins

Ensure tumor-free margins

Lip defects (see algorithm 53)

F. Long-term follow-up (physical examination with radiographs, depending on findings)

Radiation therapy if indicated

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 58 ORAL CAVITY CANCER

Baran D. Sumer • Larry L. Myers

A complete history and physical examination are important for all patients suspected of having oral cavity cancer. The history should include the presence of risk factors such as tobacco, alcohol, and betel nut use. The possibility of chronic trauma to the tongue from dentition should be explored. A history of previous oral cavity lesions such as leukoplakia, erythroplakia, and lichen planus should be considered. A complete examination of the head and neck includes the oral cavity, pharyngeal mucosa directly and with indirect laryngoscopy, and the neck. A biopsy must be performed to determine whether malignancy is present and, if so, the type. More than 95% of all cancers of the oral cavity are squamous cell carcinoma. A fine-needle aspiration biopsy of suspected metastatic disease in the neck may also be performed. Panendoscopy (direct laryngoscopy, esophagoscopy, and bronchoscopy) is used for accurate staging and to rule out secondary tumors in the upper aerodigestive tract.

Panoramic radiography of the mandible is necessary to assess the status of the patient’s dentition. Intraoral ultrasonography may be used to evaluate the thickness of the tumor. A CT or MR image of the head and neck is used to assess the extent of the tumor, and to assess possible mandibular involvement. A CT of the chest or PET/CT is used to rule out distant metastasis.

A radiation oncology consultation is obtained. A dental consultation is obtained to assess the status of the teeth, which may require treatment before radiation therapy begins. A prosthodontist may be consulted for palatal defects requiring an obturator. A medical oncologist should be consulted if the patient needs chemotherapy. An evaluation by a speech therapist should be initiated. In addition, a nutritionist should be consulted, because many patients are malnourished.

Treatment modalities include primary surgical excision or primary radiation therapy for patients unable or unwilling to undergo surgery. Chemotherapy is reserved for patients who have advanced disease with adverse features in the postoperative setting. Alternatively, it is used concurrently with radiation during primary nonsurgical therapy for patients with stage III or IV disease. The tumor is excised with adequate margins. Simultaneous or staged neck dissection can be performed for nodal disease or for N0 disease on the ipsilateral side for lateralized lesions, and on both sides for disease that approaches or crosses the midline. Neck levels 1 to 4 are routinely incorporated into the neck dissection for N0 disease, and a comprehensive neck dissection is performed for any nodal disease.

Reconstruction is site specific. Small defects of the buccal mucosa can also heal by secondary intent or be closed primarily. Larger defects that would lead to unacceptable contracture can be reconstructed with local flaps. Regional flaps such as a temporalis flap can provide greater coverage for large defects. For through-and-through defects, a regional flap or fasciocutaneous flap (through microvascular tissue transfer) is indicated. Superficial defects of the hard palate can usually be left to heal by secondary intent. Local flaps such as a palatal island flap, buccal flap, or buccal fat pad flap may also be used. Larger palatal defects, including through-and-through defects, may be reconstructed with regional flaps such as a temporals flap with or without the use of bone grafts, or may benefit from an obturator. If the defect is too large or dentition is not adequate for an obturator, microvascular tissue transfer is indicated. For tumors of the oral tongue and floor of mouth, healing by secondary intent or primary closure is preferred if it will not lead to tongue tethering or fistula. Local flaps, such as a submental island flap, or regional flaps can be used to reconstruct larger defects. Microvascular tissue transfer is used for larger defects that cannot be reliably covered with locoregional flaps. Options include thin fasciocutaneous flaps such as a radial forearm flap that will not provide excess bulk interfering with tongue mobility. For total glossectomy defects, free flaps with greater bulk such as a rectus or lattissimus dorsi flap can be used. For mandibular involvement, osteocutaneous free flaps can be used. Anterior mandible involvement requires osteocutaneous free flap reconstruction, whereas lateral mandibular defects can be plated without bone reconstruction if there is adequate tissue bulk medial to the plate. Resection of the condyle should be allowed to heal by fibrosis or reconstructed with an osteocutaneous flap. Plates or prostheses should not be used to reconstruct the condyle.

Postoperative radiation therapy is indicated for microscopically positive margins, larger tumors, if more than one node is histologically positive, and in the presence of perineural or intravascular invasion or extranodal tumor extension. Radiation therapy is initiated within a reasonable period after healing has occurred, usually within 6 weeks. Primary radiation therapy for treatment can consist of external beam radiation therapy or brachytherapy, or a combination of both, depending on the size, location, and extent of the tumor. External beam radiation is indicated for the treatment of the neck.

Chemotherapy is reserved for patients who have advanced disease with adverse features in the postoperative setting, including positive margins and extracapsular extension for nodal disease, or concurrently with radiation during primary nonsurgical therapy for advanced (stage III-IV) disease.

Continued
PATIENT WITH ORAL CAVITY CANCER

A History and physical examination

B Diagnostic imaging

C Consultation with relevant services

D Treatment of cancer

Patient is a candidate for surgical treatment

E Reconstruction

Continued

Buccal mucosa

Small defect: primary closure or healing by secondary intent

Larger defect: local flap or regional flap

Through-and-through defect: regional or free flap

<50% palate resected

Oroantral fistula?

Yes

Maxillary teeth present?

Yes

Flap

* Obturator flap
* Regional flap

No

Regional flap

No

Healing by secondary intent

Local flap

Hard palate

Continued

Continued

Continued

Continued

Continued

F G Postoperative radiation therapy for advanced disease or adverse features ± chemotherapy

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
A follow-up schedule for cancer surveillance is established—first year after treatment: every 1 to 3 months; second year after treatment: every 3 to 6 months; 3 to 5 years after treatment: every 4 to 6 months; after 5 years: every 6 to 12 months.

BIBLIOGRAPHY


PATIENT WITH ORAL CAVITY CANCER

A History and physical examination

Biopsy to confirm diagnosis

B Diagnostic imaging

C Consultation with relevant services

D Treatment of cancer

Continued

Patient is a candidate for surgical treatment

E Reconstruction

Continued

Hard palate

Continued

>50% palate resected

Maxillary teeth present?

Yes

Flap

• Obturator flap
• Regional flap
• Soft tissue free flap

No

Flap

• Regional flap
• Soft tissue free flap
• Composite microvascular tissue transfer

Entire palate resected

Orbital involvement?

Yes

Composite microvascular tissue transfer

• Soft tissue flap
• Composite microvascular tissue transfer for patients desiring dental implants

No

Flap

• Soft tissue flap
• Composite microvascular tissue transfer for patients desiring dental implants

Continued

Postoperative radiation therapy for advanced disease or adverse features ± chemotherapy

H Long-term follow-up for cancer surveillance

Patient is not a candidate for surgery or does not want surgery

Primary nonsurgical therapy

Stage I-II disease

Stage III-IV disease

F Primary external beam radiation or brachytherapy

G Primary chemotherapy and concurrent radiation therapy

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
Breast and Trunk

Breast Reconstruction: Overview
Breast Reconstruction: Autologous
Partial Breast Reconstruction
  Gynecomastia
  Sternal Wounds
Abdominal Wall Wounds
Groin Wounds
Male Genital Anomalies: Congenital
Male Genital Anomalies: Acquired
Female Genital Anomalies:
  Congenital
Female Genital Anomalies: Acquired
Vaginal Defects
Myelomeningocele

ALGORITHM KEY

<table>
<thead>
<tr>
<th>Problem</th>
<th>Surgical Interventions and Surgical Endpoints</th>
<th>Nonsurgical Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bold Text</td>
<td>Surgical or Nonsurgical Options List</td>
<td>Combination of Surgical and Nonsurgical Options List</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hierarchy List</td>
</tr>
</tbody>
</table>

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
Ideally, a patient with breast cancer will be seen by a plastic surgeon soon after the initial diagnosis. The proposed cancer treatments, including plans for either adjuvant chemotherapy or radiation therapy, need to be considered. The physical examination should include measuring the patient’s height, weight, bra size, and base diameter of the breast. In addition, the surgeon should also assess the soft tissues of the chest, evaluate the pectoralis major and latissimus dorsi muscles, and locate any previous biopsy sites on the involved breast or the abdomen. Typical measurements include the sternal notch-to-nipple distance and the breast diameter.

The type of mastectomy selected will affect reconstructive options. Patients at high risk for developing cancer in the opposite breast—those with a family history of breast cancer, positive gene testing, particularly dense breasts that may obscure the findings of cancer on a mammogram, and/or lobular carcinoma—may desire a prophylactic mastectomy of the unaffected breast. Patients may also choose a prophylactic mastectomy if they have significant concerns regarding cancer of the contralateral breast. The general surgeon must be informed of the type of surgery desired by the patient so that he or she can help the patient select the appropriate therapy for the unaffected breast.

If the patient is to receive radiation therapy after her mastectomy, a number of issues need to be addressed. Radiation will cause damage to the skin and subcutaneous tissues, thus delayed autologous tissue reconstruction is preferred. More recently, however, many surgeons have advocated placing a tissue expander at the time of mastectomy and attempting to maximize expansion before the onset of radiation therapy.

Delayed reconstruction is often performed after the patient has had a chance to heal, usually 3 to 6 months after surgery, and after the completion of adjuvant treatments such as chemotherapy and/or radiation therapy.

Autologous tissue reconstruction may be performed either as a pedicle flap (latissimus dorsi or transverse rectus abdominis [TRAM] flap) or a microvascular tissue transfer (see algorithm 60).

A breast expander can be placed at the time of the mastectomy, even if adjuvant treatments such as chemotherapy or radiation therapy are being considered. The benefits of placing the expander at the time of the initial mastectomy have been documented by multiple authors in the literature. The key step to this course of treatment is ensuring that the patient understands that she will have a much higher risk of wound-healing difficulties and capsular contracture if she receives radiation therapy after the mastectomy with the expander in place.

If the patient has adequate soft tissue after a mastectomy and no history of chest radiation, an expander can be placed, followed by the placement of a permanent implant. The expander may be placed either at the time of the mastectomy or about 3 months after the surgery; it is slowly expanded over time. In some cases, when adequate soft tissue is present in a small breast, single-stage reconstruction with a permanent implant can be performed.

The type of permanent breast implant used for definitive breast reconstruction is a decision that needs to be discussed with the patient. Implants can be anatomic or round, silicone or saline, textured or smooth. Silicone implants may be more appropriate for patients with less soft tissue, because the density of silicone more closely approximates that of normal breast tissue.

If the patient’s breasts are asymmetrical after breast reconstruction, surgical modification of the remaining breast is indicated. Options include breast reduction, mastopexy, or augmentation.

**BIBLIOGRAPHY**


PATIENT REQUIRING BREAST RECONSTRUCTION: OVERVIEW

A History and physical examination

B Determine type of mastectomy to be performed

Does patient desire autologous reconstruction?

Yes

C Is adjuvant radiation therapy anticipated?

Yes

D Delay reconstruction with autologous tissue until after radiation therapy completed

E Immediate reconstruction (see algorithm 60)

Radiation therapy not indicated

Radiation therapy

Delayed autologous reconstruction

No

Uncertain

F Preradiation expansion

Place expander

G Expansion

Replace with permanent implant

Adequate

Is adjuvant radiation therapy anticipated?

Yes

H Capsulectomy and placement of permanent implant after radiation therapy

I Management of uninvolved breast

- Breast reduction
- Mastopexy
- Augmentation

Nipple-areolar reconstruction

Inadequate

Recommend autologous breast reconstruction

Adequate

Assess soft tissue of breast

No

Yes

Place expander

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Autologous breast reconstruction can be performed in an immediate or secondary fashion and can be used for partial mastectomy or postlumpectomy defects. The autologous approach is especially useful in the setting of failed prior implant reconstructions, particularly after radiation therapy. Immediate reconstruction with autologous tissues in tandem with skin-sparing mastectomies can result in outstanding outcomes.

The type of approach selected for the patient is based on the consideration of many factors, including whether the approach would be immediate or delayed, the patient’s age and comorbid diseases, tobacco use, body weight and habitus, prior or anticipated radiation therapy, unilateral or bilateral reconstruction, contralateral breast size and shape in unilateral reconstruction, and the patient’s desires and expectations. Prior abdominal wall surgery such as abdominoplasty or liposuction in any potential perforator flap donor site may also affect the recommendation. Finally, oncologic considerations may affect the approach used or timing of the reconstruction.

The abdominal wall is the preferred donor site for autologous tissue harvest for a variety of reasons, including the following: (1) the donor scar is very favorable and body contour is improved, (2) there is typically enough fat to perform an all-autologous reconstruction without the need for an implant, and (3) there is no need to reposition the patient to harvest the flap, which facilitates two teams working simultaneously. Hartrampf introduced the pedicle TRAM flap in 1982. The donor site utilization has evolved into a microsurgical approach since that time, with attempts to lower the donor site morbidity through the development of the deep inferior epigastric perforator (DIEP) and the superficial inferior epigastric artery (SIEA) flaps. Controversy remains over the ideal method of harvesting and transferring the abdominal wall tissue to maximize flap survival and minimize donor site morbidity. Most surgeons agree that abdominal wall morbidity drops as the approach transitions from pedicle TRAM to free TRAM and DIEP flap, and finally to the SIEA flap (which does not involve incising the abdominal fascia). They also agree that the complexity of the reconstruction increases along with the skill required to transition from the pedicle TRAM to the SIEA flap.

When the latissimus flap is used for autologous reconstruction, it is typically in conjunction with a tissue expander or implant. The flap can be rotated with or without a skin island, depending on the reconstructive needs. A large skin paddle can be used to re-create breast ptosis and to import a platform for nipple-areolar reconstruction. Similar to other autologous options, this approach can be used to salvage failed implant reconstructions, particularly in the setting of prior radiation therapy.

A variety of other flap donor sites are available for microsurgical breast reconstruction. Each has advantages and disadvantages, and each has a learning curve associated with flap dissection and transfer. These approaches are often considered if the patient has a very thin abdominal wall or if she has had prior abdominal wall surgery such as an abdominoplasty. These flaps can also be used if the other breast has been reconstructed using the abdominal wall or if a free TRAM or DIEP flap has failed.

Secondary operations often involve contralateral symmetry procedures such as reduction or mastopexy as well as nipple-areolar reconstruction. Occasionally, implants are used to achieve contralateral symmetry or to increase the volume of the reconstructed breast by placing an implant behind the free flap.

Partial mastectomy defects can be addressed with a variety of local pedicle perforator flaps or free flaps. These defects are almost always subjected to prior radiation therapy and therefore are best corrected with autologous tissues. Fat grafting is currently being investigated for such defects and may become a useful technique for small defects.

The patient is followed in the long term as needed to assess results and symmetry, particularly if one side has been irradiated. Close communication is maintained with the oncologist or breast surgeon—whomever is providing the long-term oncologic follow-up.

BIBLIOGRAPHY

Nahabedian MY, Tsangaris T, Momen B. Breast reconstruction with the DIEP flap or the muscle sparing (MS-2) free TRAM flap: is there a difference? Plast Reconstr Surg 115:436-444, 2005.
PATIENT DESIRING AUTOLOGOUS BREAST RECONSTRUCTION

History and physical examination

A Nature of procedure

Immediate

Secondary

Salvage failed reconstruction

Partial mastectomy defect

B Assess procedure selection criteria

C Abdominal wall available?

Yes

Reconstruction using abdominal wall tissue

• Pedicle TRAM flap
• Free TRAM flap
• DIEP flap
• SIEA flap

No

D Reconstruction using latissimus dorsi flap (with or without implant)

E Reconstruction with other free flap options

• Superior gluteal artery perforator flap
• Inferior gluteal artery perforator flap
• Anterolateral thigh flap
• Rubens flap
• Myocutaneous gracilis flap

F Assess symmetry of both breasts

Symmetrical

Nipple-areolar reconstruction

Asymmetrical

Secondary operations

• Contralateral reduction
• Contralateral mastopexy
• Contralateral augmentation
• Ipsilateral augmentation

G Correction of partial mastectomy defects

• Thoracodorsal artery perforator flap
• Lateral thoracic flap
• Intercostal perforator flap
• DIEP or SIEA free flap
• Latissimus dorsi flap
• Fat grafting

H Follow-up
Partial breast reconstruction is typically performed at the time of tumor resection (immediate reconstruction). The reconstruction is easier and more options are available, because the breast is not irradiated or surgically scarred. The complication rates are lower, and cosmetic results are better when reconstruction is performed before radiation therapy. The main disadvantage of immediate reconstruction is the potential for positive margins. Strict intraoperative margin assessment (histologic, radiologic, and gross examination) will reduce the potential for positive margins. When the risk of positive margins is high (that is, patients 40 years old or younger, extensive DCIS, LCIS, and prior chemotherapy), then the reconstruction can be deferred 5 to 7 days until clear margins are confirmed on the final pathology examination (delayed immediate reconstruction). Extensive flap reconstruction is also often deferred until clear margins are confirmed. When cosmetic results are unfavorable following the completion of radiation therapy, partial reconstruction (delayed reconstruction) is still possible. Although the same options exist for reconstruction of the deformity after breast-conservation treatment, flap techniques are required more often, because the breast is irradiated.

The breast size, tumor size, and tumor location seem to be the major determinants of the type of partial breast reconstruction. Two options exist: (1) tissue replacement techniques (flaps) and (2) tissue displacement techniques (glandular rearrangement). In women with small breasts that require a moderate-sized resection, or when a quadrantectomy-type resection is performed, volume and/or skin is often required to maintain symmetry with the opposite breast. In women with larger breasts, it is possible to resorb the defect using reduction or mastopexy techniques.

If skin is resected outside the standard Wise pattern markings, even in women with moderate-sized or large breasts, then flap reconstruction is often required. Some surgeons believe that if a major flap is required to reconstruct a partial mastectomy defect, especially when nipple preservation is not possible, then a skin-sparing mastectomy and reconstruction are appropriate. If the partial mastectomy is too extensive and very little breast tissue remains, a decision needs to be made regarding completion mastectomy and breast reconstruction. This option must be discussed with the patient before the procedure. Otherwise, it should be performed at a later stage.

Tissue replacement techniques to reconstruct the defect involve bringing vascularized tissue in the form of flaps from distant or local “nonbreast” sites. This is best indicated in women with small breasts, quadrantectomy-type defects, or insufficient remaining breast tissue. Because the shape and size are preserved, a contralateral symmetry procedure is not necessary. When local flaps or potential breast reconstruction options are used, it becomes even more crucial to confirm clear margins before the reconstruction. The tumor location and size often dictate the most appropriate reconstruction. The thoracodorsal system and lateral chest wall provide many useful flap options for almost any defect location, except medial. The latissimus dorsi is the most versatile option because of its ability to replace both volume and skin and because of its excellent arc of rotation and reach almost anywhere within the breast. The use of abdominal flaps (superficial inferior epigastric artery and deep inferior epigastric perforator) to reconstruct partial mastectomy defects necessitates a serious discussion with the patient, because this would eliminate a major reconstructive option; skin-sparing mastectomy with immediate reconstruction might be a better choice in this situation.

Tissue displacement techniques are possible when sufficient tissue remains in relation to the nipple-areola complex to reshape the breast following tumor resection. Because this is an overall volume loss procedure, a contralateral reduction or mastopexy is often required. The tumor size and location, as well as breast size, shape, and degree of ptosis are used to determine the most appropriate tissue displacement technique.

Reduction or mastopexy techniques are very useful for women with macromastia or breast ptosis and sufficient breast tissue. The Wise pattern is often used and allows tumor resection in any location. Once the tumor has been resected, nipple viability is preserved (through the pedicle selection), additional tissue is removed if necessary, and the breast is reshaped. The pedicle technique is also selected based on the tumor location. The resection of central defects often includes the nipple-areola complex and subsequently requires nipple reconstruction either immediately or at a later stage.

Local dermoglandular breast flaps are a reasonable option in women with moderate-sized breasts in which shape can be preserved without much change in size and, therefore, symmetry. More options exist for lateral defects, including rhomboid flaps, thoracoepigastric flaps, and other local transposition flaps. Small medial defects can be reconstructed with a rhomboid-type flap; however, larger defects often require tissue replacement techniques.

Postoperative surveillance for potential tumor recurrence is best carried out by the multidisciplinary team. Because flaps have been performed and tissue has been rearranged, the altered breast architecture might interfere with appropriate screening. All members of the team must understand this approach and be involved in the development of protocols to best follow these patients after tumor resection and partial breast reconstruction.

BIBLIOGRAPHY


PATIENT REQUIRING PARTIAL BREAST RECONSTRUCTION

A History and physical examination

B Assess breast sizes

Small breasts

D Perform reconstruction with tissue replacement techniques using local or distant flaps

Assess location of tumor/defect

Lateral
- Latissimus dorsi flap
- Thoracodorsal artery perforator flap
- Lateral intercostal artery perforator flap
- Superior epigastric artery perforator flap

Medial
- Transverse rectus abdominis myocutaneous flap
- Superficial inferior epigastric artery flap
- Anterior intercostal artery perforator flap
- Superior epigastric artery perforator flap

Inferior

Superior
- Latissimus dorsi flap
- Thoracodorsal artery perforator flap
- Lateral intercostal artery perforator flap
- Superior epigastric artery perforator flap

Central
- Latissimus dorsi flap

Moderate/large breasts

C Will there be skin resection outside of the typical Wise pattern or insufficient remaining breast tissue after resection?

Yes

E Perform reconstruction with tissue displacement techniques

Assess breast characteristics

Medial
- Latissimus dorsi flap
- Thoracodorsal artery perforator flap
- Lateral intercostal artery perforator flap
- Superior epigastric artery perforator flap

Lateral
- Transverse rectus abdominis myocutaneous flap
- Superficial inferior epigastric artery flap
- Anterior intercostal artery perforator flap
- Superior epigastric artery perforator flap

Superior
- Latissimus dorsi flap
- Thoracodorsal artery perforator flap
- Lateral intercostal artery perforator flap
- Superior epigastric artery perforator flap

Central
- Latissimus dorsi flap

No

F Reduction mastopexy technique with pedicle selection based on tumor location

Assess location of tumor/defect

Reconstruction

Medial
- Rhomboid flap for small defects
- Tissue replacement techniques for larger defects

Latera
- Rhomboid flap
- Subaxillary flap
- Lateral thoracodorsal flap

Central
- Central
- Superior
- Inferior
- Lateral

Superior
- Central
- Superior
- Inferior
- Lateral

Inferior
- Central
- Superior
- Inferior
- Lateral

Long-term follow-up

Radiation therapy/chemotherapy if indicated
The history and physical examination are critical in evaluating a patient who presents with gynecomastia. The history includes the age of onset and the duration of the gynecomastia, the presence of pain or discharge from the nipples, the family history of gynecomastia, any history of testicular trauma or malignancy, and the use of alcohol or drugs. The patient should be questioned further regarding the history of sexual dysfunction or infertility. The physical examination should focus on the breasts. Their size and firmness and the presence of nipple discharge should be noted. Solitary nodules, skin dimpling or fixation, nipple retraction, adenopathy, or any other presentation that causes a concern for malignancy should also be noted.

The examination for secondary sexual characteristics helps to determine the need for further testing. The testicles must be examined to ensure that no masses exist. Signs of feminization, including hypogonadism, atypical body hair distribution, and body fat distribution, require additional workup. Conditions that result in hypogonadism leading to gynecomastia include Klinefelter syndrome, testicular trauma, testicular torsion, hyperthyroidism, and malignancies that increase human chorionic gonadotropin (HCG). In addition, the testis can be a site of atopic HCG production. Chronic liver disease and renal tumors can increase the peripheral conversion of androgens into estrogens. Ingested drugs that need to be considered are exogenous testosterone, androgens, and drugs that inhibit testosterone synthesis such as cimetidine, ketoconazole, metronidazole, and spironolactone. Some drugs act by unknown mechanisms, including tricyclic antidepressants, diazepam, phenothiazines, calcium channel blockers, alcohol, and marijuana.

Physiologic gynecomastia in adolescence resolves spontaneously in 90% of cases within 2 to 3 years after the onset of breast enlargement. However, when psychologic distress results from embarrassment or teasing, surgery is indicated. Based on the examination, the breast is placed into one of three classifications: grade I is small breast enlargement without excessive skin, grade II is moderate breast enlargement without excess skin, and grade III is severe breast enlargement with excess skin. It is important to differentiate between gynecomastia and pseudogynecomastia. In true gynecomastia, a ridge of glandular tissue is felt directly underneath the nipple-areola complex, whereas in pseudogynecomastia there is fat accumulation but no glandular hypertrophy.

Pseudogynecomastia is best treated with suction-assisted lipectomy or ultrasound-assisted lipectomy.

When the deformity is caused by excessive breast tissue, excision of the hypertrophied breast tissue can be accomplished through an infraareolar incision. It is necessary to leave a small amount of breast tissue directly underneath the nipple to ensure areolar/nipple survival and to prevent a concave soft tissue deformity after excision. When there is both excess fat and breast tissue, the treatment must also include lipectomy. Although this can be performed as a direct lipectomy, liposuction (either suction-assisted or ultrasound-assisted) is particularly useful in these cases and can be used for feathering the resection. Often there is enough skin retraction to obviate the need for skin excision.

When extra skin, fat, and breast tissue are present, all components must be addressed.

The patient should be reevaluated 6 months after surgery to determine if residual gynecomastia, skin excess, scarring, or areolar deformity exists. If so, surgical revision can be performed.

BIBLIOGRAPHY


PATIENT WITH GYNECOMASTIA

A History and physical examination

B Examination of secondary sexual characteristics

Gynecomastia appears physiologic

C Patient desires surgery?

No

Observation (≤3 years)

Gynecomastia resolved?

No

No treatment

Yes

D Assess extent of breast enlargement

Gynecomastia appears pathologic or concern for malignancy?

Refer to appropriate specialists for further evaluation and treatment

Gynecomastia resolved after treatment?

No

Yes

G Grade III gynecomastia

Direct breast tissue excision with suction lipectomy for contouring and skin excision

Reevaluate at 6 to 12 months

H Residual breast/areolar deformity present?

No

Unfavorable scarring

Persistent gynecomastia

Skin excess

F Grade II gynecomastia

Fat deposition present

Direct excision

Suction lipectomy

Yes

Persistent gynecomastia

Skin excess

Areolar widening

Liposuction

Hypertrophic breast tissue present

Direct excision

Suction lipectomy

Yes

G Grade I gynecomastia

Observation (≤3 years)

Gynecomastia resolved?

No

No treatment

Yes

Pseudogynecomastia

Observation (≤3 years)

Gynecomastia resolved?

No

No treatment

Yes

Patient desires surgery?

Gynecomastia resolved?
Median sternotomy in cardiac surgery is ubiquitous; unfortunately, sternal wound infection and dehiscence occurs in 0.25% to 5% of patients. Mediastinitis and deep sternal wound infections are diagnosed by isolating an organism from mediastinal fluid, tissue, or purulent wound discharge when a patient has sternal instability, chest pain, and/or fever. Preoperative risk factors for mediastinitis include: chronic obstructive pulmonary disease (COPD), smoking, end-stage renal disease (ESRD), diabetes mellitus, chronic steroid or immunosuppressive use, morbid obesity, prolonged ventilator support (longer than 24 hours), concurrent infection, and reoperative surgery. Other variables include off-midline sternotomies, osteoporosis, use of left or right internal mammary arteries (LIMA or RIMA, respectively), use of cardiopulmonary bypass for longer than 2 hours, and transverse sternal fractures. Sternal dehiscence is linked to mediastinitis and infection of the deeper soft tissues.

Quantitative tissue cultures facilitate thorough and adequate debridement. If the culture is positive (more than $10^5$ organisms per cm$^3$ of tissue), early debridement is encouraged and should be performed as soon as the patient is stabilized after the infection has been diagnosed. The original incision is opened, sternal wires are removed, and a sharp debridement of necrotic and/or purulent tissue is performed until the remaining tissue is healthy and bleeding. Topical antimicrobial agents such as silver sulfadiazine (Silvadene) and mafenide acetate (Sulfamylon) creams are used to gain and maintain bacteriologic control of the wound. A vacuum-assisted closure (VAC) device is applied to increase the blood flow and granulation tissue in the wound while also decreasing the bacterial count. Negative-pressure wound therapy decreases the number of days between operative debridement and definitive closure of sternal wounds. Occasionally, sternal dehiscence occurs early in the postoperative course and is secondary to mechanical failure (for example, the wire closure), not infection. These patients’ wounds are sterile, and plate fixation may be used to repair them.

Fixation of the remaining sternum is important for preventing further infection, chronic chest wall pain, paradoxic chest wall motion, future sternal instability (including sternal click), and preserving pulmonary function. The sternal edges are reapproximated, and osteosynthesis is performed with titanium locking plates.

If adequate soft tissue is available, primary closure is performed.

If the soft tissue adjacent to the sternal wound is inadequate to cover the plates, muscle flap coverage must be considered. Wounds that involve the upper two thirds of the sternum are commonly treated with either pectoralis major muscle advancement or turnover flaps, which are readily harvested and commonly used. However, when the lower sternal pole lacks coverage, the pectoralis is inadequate because of its limited arc of rotation and reach; the rectus abdominis muscle flap is a preferred choice. It may be used based on the eighth intercostal artery, its minor pedicle, despite LIMA or RIMA harvest. If the rectus abdominis is unavailable because of a previous surgery, a pedicle omental flap should be considered for soft tissue sternal coverage. Finally, if the omentum has been previously resected or if the patient has had multiple prior abdominal operations, the latissimus dorsi flap is an option. A skin island may be harvested from this muscle, allowing closure of the chest wound. Skin grafting, if required, may be used for either sternal wound or flap donor site closure.

BIBLIOGRAPHY


PATIENT WITH STERNAL WOUND

- History and physical examination
- Physical examination of sternum

A. Sternal instability/dehiscence noted

Obtain quantitative tissue cultures

Cultures with bacterial count >10^5

- Sternal debridement
- Topical antimicrobial agents and IV antibiotic therapy

Cultures with bacterial count <10^5

- Plate fixation of sternum (if feasible)

VAC therapy

Adequate soft tissue coverage?

D. Yes

- Primary closure

E. No

- Upper/midpole defect
  - Pectoralis major muscle flap
  - Rectus abdominis muscle available?
    - Yes
      - Rectus abdominis muscle flap
    - No
      - Omental flap
- Lower pole defect
  - Split-thickness skin graft if indicated

Long-term follow-up
CHAPTER 64  ABDOMINAL WALL WOUNDS

Donald P. Baumann • Charles E. Butler

The goals of abdominal wall reconstruction are to reestablish the integrity of the musculofascial layer and provide external cutaneous coverage. Surgical planning in abdominal wall reconstruction must include the potential loss of both skin and musculofascial tissue. Local wound conditions, including bacterial contamination, previous operations, and radiation therapy, can contribute to increased risks of compromised wound healing, surgical site infections, and reconstruction failure. Systemic patient factors such as advanced age, comorbidities, immunosuppression, poor nutritional status, and pulmonary disease increase the risk of complications and must be considered during the perioperative planning and management.

Abdominal wall defects require both reconstruction of the musculofascia and closure of the overlying skin. Musculofascial reconstruction is generally performed with component separation, with or without the use of implantable mesh. Commonly used implantable meshes include macroporous (polypropylene), microporous (extended polytetrafluoroethylene), composite (an antiadhesive layer laminated to macroporous mesh), and bioprosthetic (decellularized, processed human or animal dermis) varieties. Skin coverage is generally accomplished with local skin advancement and occasionally requires a local/regional flap or free flap.

The method of reconstruction is largely determined by several factors—the degree of bacterial contamination, the availability of vascularized hernia sac or omentum overlying the abdominal viscera, the quality and quantity of skin available for coverage, and the location of the abdominal defect. In patients with contaminated abdominal wounds, placing any permanent synthetic mesh is unfavorable and may be contraindicated, given the incidence of mesh-related infections. For these patients, surgeons generally prefer to use bioprosthetic mesh and/or component separation to prevent infectious complications resulting from musculofascial reconstruction.

Severely contaminated wounds may require a staged approach with serial debridements, dressing changes, negative pressure wound therapy, and delayed fascial closure with bioprosthetic mesh and/or component separation. Depending on the characteristics of the wound at the time of fascial closure, the cutaneous defect can be managed with a skin graft, primary skin closure over the drains, or healing by secondary intention. The most severe and complex abdominal wounds may require a traditional delayed closure strategy, which involves the placement of skin grafts, with or without resorbable mesh, directly over the granulated viscera to contain it temporarily. After several months, the skin graft is removed, the fascial defect is repaired, and the wound is closed.

Systemically ill patients with numerous comorbidities and contaminated fascial defects may require immediate reconstruction with bioprosthetic mesh and/or component separation. Skin closure is delayed because of the increased risk of infection. After a period of optimal wound care, cutaneous coverage can be achieved with delayed primary closure, secondary intention healing, or a skin graft.

For patients who have large cutaneous defects and insufficient local skin available for closure, wound coverage may require a locoregional flap or free flap. Superior and inferior pedicle rectus abdominis myocutaneous flaps can be used for some abdominal wall defects. However, because the rectus muscle, its fascia, and the overlying skin are usually adjacent to or involved in the primary defect, considerable donor site morbidity may occur; therefore these flaps are generally used to repair defects that are isolated to the superior or inferior aspects of the abdominal wall. Thigh-based flaps are useful options for the lower abdomen, because ample amounts of muscle, fascia, and skin can be harvested with them. Pedicle rectus femoris myocutaneous and anterolateral thigh fasciocutaneous flaps provide reliable options for coverage of lower abdominal wall defects. Alternatively, a thigh flap can be used as a free flap with vein grafts to either the femoral or axillary recipient vessels when covering an upper abdominal wall defect. Latissimus dorsi flaps can provide muscle, with or without skin, for abdominal wall reconstructions. Pedicle latissimus dorsi flaps can reach most superiorly located abdominal defects. Free flap reconstructions require suitable recipient vessels; depending on the location of the defect, there are various vessels available in the abdominal wall. Options include the superior and inferior epigastric vessels, superficial and deep circumflex iliac vessels, vein grafts to the femoral or axillary vessels, and intraperitoneal recipient vessels such as the gastroepiploic vessels.

BIBLIOGRAPHY

PATIENT WITH A DEFECT OF THE ABDOMINAL WALL

History and physical examination

A. Assess nature of wound

Clean wound
Is vascularized tissue available to cover viscera?

B. Component separation ± any mesh
Nonmacroporous mesh ± component separation to narrow defect

Assess amount of skin available for closure

C. Contaminated wound
Gross contamination or infection?

Yes

C. Serial debridement and local wound care

Yes

D. Heavy contamination of subcutaneous space or significant systemic comorbidities?

No

Yes

E. Serial dressing changes ± negative pressure therapy

Assess amount of skin available for closure

Yes

Defect of the epigastrium

• Latissimus dorsi flap
• Rectus abdominis flap
• Microvascular tissue transfer ± vein grafts

No

Defect of the hypogastrium

• Anterolateral thigh flap
• Rectus femoris flap
• Tensor fascia lata flap
• Microvascular tissue transfer ± vein grafts

F. Flap coverage

Skin advancement and primary closure over drains

• Latissimus dorsi flap
• Rectus abdominis flap
• Microvascular tissue transfer ± vein grafts

Delayed primary skin closure
• Split-thickness skin graft
• Locoregional flap

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
Groin wounds have many possible causes. These need to be addressed before reconstruction begins. Ensuring that each patient’s nutritional and physical status is optimal is an essential part of this process.

When the underlying etiologic factors of a groin wound have been addressed, all nonviable tissue is debrided before definitive closure. Serial debridement is preferred, because it minimizes the unnecessary tissue resection. Infected wounds require a complete workup, including tissue cultures and sensitivities to guide antimicrobial therapy. The surgeon should also consider a consultation with an infectious disease specialist. Infected wounds require incision, drainage, and/or serial debridement until the underlying infection is addressed. In patients with suspected necrotizing fasciitis, immediate wide debridement is indicated. Given the proximity of groin wounds to the pelvis, osteomyelitis must be considered, particularly if the patient has had recurrent infections.

Once the wound is clean, the quality of the tissue in the wound bed and surrounding areas is assessed. Irradiated tissues have impaired wound-healing characteristics and undergo progressive tissue fibrosis. Thus any injury to irradiated tissue requires substantially greater amounts of time to achieve wound closure than nonirradiated tissues. In patients with open wounds through irradiated tissue, more complex reconstructive interventions are typically required to achieve a stable, healed wound. Most reconstructive procedures in irradiated fields require flaps from regional or distant sites to ensure that healthy, viable, well-vascularized tissue is utilized for wound closure.

When healthy, nonirradiated tissue is present and no critical structures are exposed, the wound can be left to heal by secondary intention with either dressing changes or negative pressure therapy. Shallow wounds with healthy granulation tissue can be skin grafted. More extensive surgical reconstruction is indicated if the wound does not granulate successfully, or if the patient requires/desires immediate wound closure.

Continued
PATIENT WITH AN OPEN WOUND OF THE GROIN

History and physical examination

A Assess underlying cause

Exposed vascular graft or pseudoaneurysm
Vascular surgery consultation
Exposed vascular graft or pseudoaneurysm

Malignancy
Oncologic workup and treatment
Malignancy

Infection
Primary antibiotic therapy
Infection

Foreign body
Remove
Foreign body

Fistula
Repair
Fistula

Radiation therapy

B Wound clean?

Yes
No

Debride wound

C Wound bed/surrounding tissue healthy and no exposed structures/grafts?

Yes
No

D Does patient desire/require immediate wound coverage?

No
Yes

Secondary healing

Nonsurgical management

• Dressing changes
• Negative pressure therapy

Wound healed?

Yes
No

Surgical reconstruction

Continued
A superficial wound that cannot be treated with a skin graft can be closed with a skin or fasciocutaneous flap, provided that healthy local tissue is present.

When a deeper wound is present, additional tissue bulk is required for closure. In such cases, a muscle, myocutaneous, or omental flap is indicated. When a muscle or omental flap is used, a surfacing split-thickness skin graft (STSG) is performed synchronously.

Muscle flaps are commonly used to close wounds of the groin. When deciding which muscle to use, the patient’s intact vascular anatomy must be evaluated. If the medial or lateral circumflex femoral arteries are not intact, flaps supplied by these vessels may be compromised. Alternative flaps are those supplied by the superficial femoral or external iliac arteries.

Myocutaneous flaps have the advantage of providing both tissue bulk and skin coverage.

An omental flap, supplied by either the right or left gastroepiploic artery, can be used when a large surface area needs to be filled or when no suitable muscle flaps are available. This flap can be harvested during either an open or laparoscopic procedure.

**BIBLIOGRAPHY**


Surgical reconstruction

E. Shallow defect with healthy granulation tissue?
   - Yes
     - STSG
     - Random/axial skin or fasciocutaneous flap
       - Rotation flap
       - Advancement flap
       - Anterolateral thigh flap
       - Groin flap
       - Tensor fascia lata flap
   - No

F. Bulk and skin coverage needed
   - Yes
     - Muscle flap and STSG
     - Are branches of profunda femoris artery patent?
       - Yes
         - Transverse rectus abdominis myocutaneous flap
       - No
         - Vertical rectus abdominis myocutaneous flap
         - Gracilis flap
   - No

G. Is superficial femoral artery patent?
   - Yes
     - Gracilis flap
     - Rectus femoris flap
     - Vastus lateralis flap
     - Sartorius flap
   - No
     - Rectus abdominis flap

H. Myocutaneous flap
   - Omental flap

I. Omental flap and STSG

Long-term follow-up
CHAPTER 66  MALE GENITAL ANOMALIES: CONGENITAL

Gary J. Alter

A  Congenital deformities of the male genitalia may be overt and recognized at birth, or subtle and not discovered until some time later. If the genitalia are clearly male and the deformity is readily classified (for example, hypospadias), karyotyping is not necessary. However, if the genitalia are ambiguous, it is important to ascertain the chromosomal gender. An infant with ambiguous genitalia and an abnormal karyotype should receive a multidisciplinary evaluation for the purposes of gender assignment and formulation of a treatment plan.

B  Developmental errors involving the cloacal membrane may produce bladder, pelvis, and abdominal wall anomalies (for example, exstrophy with or without anorectal anomalies such as a cloacal or anal agenesis) in addition to epispadias. Management of the urinary and gastrointestinal tracts takes precedence over external genitalia reconstruction.

C  Because apparently isolated anomalies of the external genitalia can be associated with anomalies of the urethra or kidneys, the urinary tract should be evaluated using the history, urinalysis, urethroscopy, and ultrasonographic imaging, if indicated by history, before reconstruction of the genital anomaly.

D  The truly hypoplastic penis (that is, micropenis) must be differentiated from the hidden penis. Furthermore, patients with congenital androgen deficiency should be identified so that androgen stimulation or replacement can be instituted as soon as possible. Androgen-unresponsive patients may be considered for gender reassignment to females, because a phallus, which will grow and function normally for urination and sexual activity, cannot be normally constructed in an adult or child. However, such reassignment is now very controversial, because improved surgical techniques (free flap phalloplasty) are available and many reassigned patients have psychological sexual identity issues.

E  The urethral meatus may be located ventral (hypospadias) or dorsal (epispadias) to its normal position on the glans. The objectives of repair include: situating the meatus on the tip of the glans, allowing the patient to stand to void, the absence of penile curvature, and normal appearance of the penile glans and shaft. Today, most repairs are performed as one-stage procedures, but multistage procedures may be indicated for proximal or complicated anomalies.

F  An artificial erection is induced by various techniques before the hypospadias or epispadias repair to determine the extent of curvature.

G  Distal hypospadias of the glans or penile shaft may occur without chordee. If the meatus is on the glans, meatal advancement and glansplasty incorporated (MAGPI) is performed. If the meatus is at the corona or distal penile shaft, a flip-flap or Snodgrass repair is performed.

H  If chordee is present, it is released by excision of the tethering ventral dysgenetic bands and often by further straightening with a dorsal penile plication. The penis must be straight before the urethral reconstruction. Satisfactory release is confirmed with a repeat artificial erection. The specific type of hypospadias repair depends on the length of neourethra required, the availability of prepuce, and associated perineal anomalies.

I  Epispadias is repaired using more complex techniques that are somewhat similar to hypospadias repairs. If the epispadias meatus is at the bladder neck, consideration must be given to urinary continence. If exstrophy of the bladder is also present, management of the urinary tract takes precedence over the genital reconstruction. If possible, a functional penis is reconstructed by the age of 2 to 3 years.

J  Penile curvature downward (chordee), laterally, or upward can exist in the absence of an anomalous position of the urethral meatus. The curvature is caused by disproportionate development of one or both corporal bodies. These cases may not be discovered until young adulthood and are repaired using various plication techniques. The repair is confirmed during surgery with an artificial erection.

K  The testes must be identified shortly after birth and before the management of scrotal anomalies. If one or both testes cannot be palpated in the scrotum or inguinal canals, the patient should be referred for further evaluation and orchiopexy as indicated. A bifid scrotum may occur in association with proximal penile, scrotal, or perineal hypospadias or without a urethral meatal anomaly (rare). Reconstruction of the scrotum is a component of proximal hypospadias repairs. An isolated bifid scrotum is repaired after the testes are positioned extraabdominally, if that is possible. Testicle implants can be inserted in the pediatric or adult patient with an absent testicle.

BIBLIOGRAPHY


MALE WITH PERINEAL ANOMALIES

History and physical examination

A Obtain karyotype

46 XY

Not normal male

Multidisciplinary evaluation (genetics, endocrinology, urology, gynecology, plastic surgery) to determine assigned gender and management plan

B Anomaly not restricted to genitalia

Anomaly restricted to genitalia

Refer to urologist and/or pediatric surgeon as indicated

Refer to urologist as indicated

D Abnormal penis size

E Abnormal urethral meatus

J Penis curvature

K Abnormal scrotum

G Hypospadias without chordee

H Hypospadias with chordee

F Determine extent of chordee

I Epispadias

Long-term follow-up

Long-term follow-up

Long-term follow-up

Long-term follow-up

Long-term follow-up

Long-term follow-up

Urethroplasty

Androgen responsive

Androgen unresponsive

Consider gender reassignment

Suprapubic defatting/public and penoscrotal tacking

Long-term follow-up

Penile distortion

Distal penile

Distal penile

Penile

Scrotal/perineal

Glandular

MAGPI

Flip-flap urethroplasty or Snodgrass urethroplasty

Modified flip-flap or Snodgrass urethroplasty

Preputial island flap, skin graft, or buccal urethroplasty

Modified one-stage penile repair or two- or three-stage repair with scrotal reconstruction

https://t.me/Free_Plastic_Reconstruction_Book


All rights reserved. Usage subject to terms and conditions of license.
In a case of acute penile loss, replantation provides the best functional and aesthetic outcome. Revascularization of partial penile defects should also be attempted when the penis remains attached but has vascular compromise.

Functional penile reconstruction can be performed using a variety of techniques. Microvascular tissue transfer provides the best outcomes. The radial forearm fasciocutaneous flap is most commonly used.

A patient with an inadequate penis must be evaluated for penile size and length. The adequacy of the penile skin must be determined.

Skin deficiency can be caused by chronic inflammation (balanitis xerotica obliterans). In this condition, the corporal length is normal and palpable under the overlying skin and subcutaneous tissue, though the skin is raw, inflamed, and indurated. A trial of potent cortisone cream may improve a phimosis or allow increased elasticity of the skin. If medical therapy does not improve the condition, local flaps or a skin graft may be required. Skin deficiency may also be caused by radial circumcision, trauma, burn, or infection.

If a major skin deficiency is present, any residual penile skin is removed, and the entire shaft is covered with a full-thickness skin graft (FTSG) or thick split-thickness skin graft (STSG) if the man is potent. A thick graft allows the penis to fully stretch with erection and not contract during healing. Otherwise, a thin skin graft can be applied.

Continued
MALE WITH ACQUIRED GENITAL DEFORMITY

A History and physical examination

B Assess nature of deformity

Trauma or malignancy with total penile loss

Acute injury?

A Replantation possible?

Yes

Replant penis

No

Obtain urologic consultation

Stabilize wound

C Penile inadequacy resulting from skin deficiency

Skin deficiency resulting from inflammation

Medical therapy with cortisone cream

Skin quality and elasticity improved?

Yes

Microsurgical phallus construction with fasciocutaneous flap (for example, radial forearm)

Continue medical therapy

No

D Skin deficiency caused by radical circumcision, trauma, burn, infection

Is the man potent?

Yes

Penile resurfacing with FTSG or thick STSG

No

STSG

E

Continued
A buried or hidden penis describes a penile shaft buried below the surface of the prepubic skin. The penis may be partially or totally obscured by obesity, skin descent with aging, a radical circumcision, or chronic inflammation. The patient also lacks attachments from the Buck’s fascia to the dartos fascia and skin, which causes the corporal bodies to telescope proximally without the skin and dartos covering. Adequate skin coverage of the penis must be determined.

The presence of excessive pubic fat or redundant pubic skin is used to determine the treatment. If pubic skin has descended, elevation of the skin is indicated. Excess pubic fat must be removed and the pubic subcutaneous tissue tacked down to the rectus fascia. If no fat is present, then the penopubic skin needs to be tacked down to the dorsal corpora to prevent burying into the pubic region.

The ventral corpora are stabilized to the skin of the penis with tacking sutures to prevent them from becoming buried in the scrotum.

When a penoscrotal web is present, the web is corrected. If the web is large, skin is excised and the defect closed with a Z-plasty at the penoscrotal web. If the web is small, only a single or double Z-plasty at the penoscrotal junction is performed.

Some men have isolated stretching and elongation of the scrotal skin. The scrotum can also be enlarged from a variety of urologic causes. Evaluation and treatment are performed by a urologist. If the scrotum has persistent skin stretching after any abnormalities are corrected by a urologist, a scrotal skin reduction can be performed for aesthetic or functional reasons.

The scrotum can be very enlarged from lymphedema. If medical treatment fails, the skin and dartos of the entire scrotum are removed. The testicles, inside their tunica vaginalis, are sutured together and resurfaced with meshed STSG.

Necrotizing fasciitis or trauma may result in scrotal loss. The testicles are rarely involved. Thigh pouches are not necessary, because the testicles can be sutured together and grafted when granulation tissue develops. This technique allows a more aesthetic reconstruction and simulates the rugae of the normal scrotum.

BIBLIOGRAPHY
MALE WITH ACQUIRED GENITAL DEFORMITY

A History and physical examination

B Assess nature of deformity

C Hidden penis

Pubic skin descent

No pubic skin descent

D Is there excessive pubic fat?

Yes

Direct lipoectomy with liposuction and pubic tacking

No

Stabilize dorsal penile skin to corpora with penopubic tacking

E Scrotal enlargement

Skin only

Skin excision

Obtain urologic consultation

F Is scrotum still large after treatment?

Yes

Medical therapy

No

K Lymphedema

Moderate

Medical therapy

Severe

Excise skin and dartos fascia

L Scrotum loss

Major

Suture testes together

Partial

Primary closure

M Assess extent of penoscrotal web

Large/ moderate web

Skin excision and Z-plasty

Minimal web

Small Z-plasty

N Stabilize ventral corpora with penoscrotal tacking

I Assess extent of penoscrotal web

Large/ moderate web

Skin excision and Z-plasty

Minimal web

Small Z-plasty

Continued

Long-term follow-up

Continued

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 68  FEMALE GENITAL ANOMALIES: CONGENITAL

Gary J. Alter

A Congenital deformities of the female genitalia may be overt and recognized at birth, or subtle and not discovered until some time later. Ambiguous genitalia may resemble the male phenotype, so karyotyping is important to ascertain the chromosomal gender. An infant with ambiguous genitalia and an abnormal karyotype should receive a multidisciplinary evaluation to assign gender and formulate a treatment plan.

B Because of the interrelationship between the embryology of the urogenital system and the lower digestive system, anomalies of the urinary and terminal gastrointestinal tract may accompany anomalies of the external genitalia. The physical examination, urinalysis, urethrocystoscopy, abdominal ultrasonography, abdominal MR, and/or radiologic contrast studies are used as indicated to evaluate the urinary and lower gastrointestinal tracts.

C Developmental errors involving the cloacal membrane produce a wide spectrum of bladder, pelvic, vaginal, and abdominal wall anomalies (that is, exstrophy with or without an anorectal anomaly such as cloaca or anal agenesis). Management of the urinary and gastrointestinal tracts takes precedence over external genitalia reconstruction.

D Once excretory functions have been stabilized, attention can be directed to the anomalies of the perineum and vagina. Cloacal anomalies have diastases of the pubic rami with resulting flat, hypoplastic, scarred mons, even after pubic repair. The clitoris may be bifid and the anterior fourchette absent. The vagina can be short with an abnormal angle of penetration. Reconstruction of the clitoris and the rest of the vulva and vagina can be performed when desired by the parents. Reconstruction of the Mons after the pubic rami are united is usually delayed until after puberty so that a natural-appearing escutcheon can be created. V-Y advancement flaps are useful for pubic hair repositioning.

E Clitoral hypertrophy is usually the result of endocrine imbalance caused by adrenogenital syndrome. Before any surgery is performed, an endocrinologist should perform a complete evaluation to determine the need for and type of hormonal supplementation and electrolyte management. Clitoral reduction with nerve preservation is performed to reduce the shaft and usually the glans, and to reconstruct the labia minora. Because of the controversy of gender assignment for intersex patients, this surgery and possible gender choice are more frequently being delayed until puberty or later.

F Assessment of the internal female organs is an integral part of the management of anomalies of the external genitalia. High-resolution sonography is excellent for imaging ovaries; MRI is preferred for uterine anomalies. If a uterus is present, hematocolpos must be anticipated and managed if it occurs. If the ovaries are absent, female hormonal supplementation beginning at the time of puberty is necessary for the development of the secondary sexual characteristics. These uterine and ovarian concerns are best managed by an experienced gynecologist.

G Vaginal anomalies range from mild hypoplasia to agenesis. Vaginal anomalies are not treated until the patient is old enough to be interested in sexual intercourse and able to use vaginal dilators. Vaginal dilators or pressure appliances are rarely successful on patients with a dimple or a semblance of a vault. Instead, surgical vaginoplasty is performed. The modified McIndoe technique using full-thickness skin grafts or thick split-thickness skin grafts is commonly used, but a colon vaginoplasty is very popular.

H Postoperative maintenance of the neovagina is important until the patient begins regular sexual intercourse, especially if a skin graft is used. Medical dilating stents are used perioperatively to dilate the vagina. A commercial dildo may be psychologically preferable to an abstract dilator and is used thereafter as needed.

BIBLIOGRAPHY

FEMALE WITH PERINEAL ANOMALIES

History and physical examination

A Obtain karyotype

46 XX

B Evaluation of urinary and lower digestive tracts

Not normal female

Multidisciplinary evaluation (genetics, endocrinology, urology, gynecology, plastic surgery) to determine gender and management plan

C Abnormal

Refer to urologist, abdominal surgeon, and/or gynecologist as indicated for urinary and gastrointestinal tract management

D Age of patient

Prepubertal

Postpubertal

Reconstruct vulva

Reconstruct escutcheon

E Hypertrophic

Refer to endocrinologist to evaluate and manage adrenogenital syndrome

Normal

Hypertrophic clitoris

Clitoral reduction

F High-resolution sonography/MRI to evaluate ovaries and uterus

G Evaluate vagina (see algorithm 70)

Normal vagina

No further treatment

Vaginal hypoplasia

Enlarge with intermittent perineal pressure

Successful

No further treatment

Unsuccessful

Vaginal agenesis

Vaginoplasty

H Postoperative management
Pubic lipodystrophy can be treated with liposuction if neither skin excess nor descent of the mons pubis is present. When a patient has descent of pubic skin and fat, then a pubic lift with tacking is performed. Liposuction and direct lipectomy are both performed to eliminate pubic fat and contour the lower abdomen.

Enlarged labia minora may be a source of embarrassment for patients, particularly if asymmetry exists. Some women with enlargement of the labia minora also have discomfort during intercourse, exercise, or when wearing tight-fitting clothing. Labia minora reduction can be performed using various methods such as central wedge resection, longitudinal trimming, or lateral ellipses.

Enlarged labia majora can be reduced by medial excision of each labium, with or without excision of majora fat.

Labial atrophy can be caused by aging, weight loss, or heredity factors and can lead to loss of the youthful fullness of the labia majora. Treatment with autologous fat grafting can restore lost volume of the labia majora.

When evaluating the clitoris, it must be determined whether the patient has true clitoral enlargement or enlargement of only the clitoral hood. In cases of true clitoromegaly, referral to an endocrinologist should be made for evaluation and management of any endocrine abnormality. Multiple techniques are available for reduction of the clitoral hood when there is no clitoromegaly.

Women with minor stenosis of the vaginal canal can use dilators to stretch the vagina while using estrogen creams. With moderate stenosis, relaxing incisions are made to release the scar, and the raw areas are lined with skin grafts to prevent recurrent contracture. A severely stenosed, short vagina may require near-complete resurfacing with skin grafts or colon vaginoplasty.

BIBLIOGRAPHY
FEMALE WITH ACQUIRED GENITAL DEFORMITIES

History and physical examination

Assess location and patient’s aesthetic or functional concerns

A. Mons
   - Pubic fat present
     - No pubic skin descent → Liposuction
     - Skin descent → Mons lift with tacking, liposuction, and lipectomy

B. Labia minora enlargement
   - Reduction

C. Labia majora enlargement
   - Skin and/or fat reduction

D. Labial atrophy
   - Fat grafting

E. Clitoris
   - Large clitoral hood
     - No clitoromegaly → Clitoral hood reduction
     - Clitoromegaly → Reduce clitoris and hood

F. Vagina
   - Stenosis
     - Absent → See algorithm 70
     - Mild → Dilation, estrogens, and medical treatment
     - Moderate → Incisions and thick STSG
     - Severe → Vaginal reconstruction with thick STSG or colon vaginoplasty

https://tme/Free_Plastic_Reconstruction_Book
The most common cause of acquired vaginal defects is the surgical and medical treatment of colorectal, gynecologic, or urologic malignancies. Trauma, infectious processes, and burns represent less common causes of acquired vaginal distortion and defects, given the relatively protected position of the vagina. Small defects can usually be closed primarily without tension. Unlike congenital vaginal defects, skin grafting alone is rarely an acceptable reconstructive option for acquired vaginal defects, because a graftable bed seldom results after oncologic ablative procedures. Because multiple regional flaps are available, reconstruction with free tissue transfers is rarely needed. Acquired vaginal defects are classified based on their anatomic location. Type I are partial defects and are further divided into two subtypes. Type IA defects are partial and involve the anterior and/or lateral wall. Such defects result from resection of urinary tract or primary vaginal wall malignancies. Type IB defects are the most common. They are partial defects involving the posterior vaginal wall and are primarily encountered with extension of colorectal carcinomas.

The reconstruction of type IA defects requires little tissue bulk and small to moderate surface coverage. The use of a unilateral or bilateral modified Singapore fasciocutaneous flap is ideal in this setting. Posterior vaginal wall or type IB defects frequently require greater soft tissue bulk, which makes the pedicle rectus abdominis myocutaneous flap a highly reliable reconstructive option.

Type II defects are circumferential. Type IIA defects are circumferential and involve the upper two thirds of the vagina. They result from surgical treatment of uterine and cervical diseases. Type IIB defects are total circumferential vaginal defects generally resulting from pelvic exenteration. Similar to type IB defects, type IIA circumferential defects involving the upper two thirds of the vagina are usually reconstructed with a rolled pedicle rectus myocutaneous flap, providing sufficient skin and soft tissue bulk. A flap width of 12 to 15 cm provides a neovagina with a 4 cm diameter. In patients in whom the rectus abdominis flap cannot be used, the sigmoid colon flap can be used for reconstruction of type IIA defects. Excessive secretions and unpleasant odor are two significant disadvantages of this flap. For type IIB or total vaginal defects, bilateral gracilis myocutaneous flaps are a preferred choice.

The reconstruction of vaginal defects can usually be accomplished using the algorithm based on the type of defect, although there are a few exceptions. Rectus abdominis flap reconstruction in obese patients may not be a suitable choice, because it has been demonstrated that the skin paddle is less reliable. Therefore, in this situation, type IB defects may be reconstructed with bilateral Singapore flaps. Alternatively, for type IIA defects, a rectus abdominis muscle flap can be raised without its cutaneous portion, and a skin graft applied directly to the muscle over a vaginal stent. In irradiated tissues, the highly reliable rectus abdominis muscle flap may be a more suitable option even for small defects, providing additional pelvic vascularization. Elderly patients and patients with significant comorbidities who are unlikely to resume intercourse after reconstruction may not require reconstruction of the vaginal vault. In this situation, a rectus abdominis muscle flap without a cutaneous component can be used to fill the pelvic dead space.

BIBLIOGRAPHY
PATIENT WITH ACQUIRED VAGINAL DEFECT

History and physical examination

Assess nature of defect and anatomic location

A. Partial defects (type I)
   - Anterior and/or lateral wall (type IA)
     - Modified Singapore flap
   - Posterior wall (type IB)
     - Rectus abdominis flap

B. Posterior wall (type IB)
   - Rolled rectus abdominis flap

C. Circumferential defects (type II)
   - Upper two thirds (type IIA)
     - Rolled rectus abdominis flap
   - Total (type IIB)
     - Bilateral gracilis myocutaneous flaps

D. Exceptions to the use of this algorithm
   - Morbid obesity
   - Elderly
   - Significant comorbidities

Long-term follow-up
CHAPTER 71 MYELOMENINGOCELE
Frederick J. Duffy, Jr. • Dale M. Swift

The most common form of neural tube defect is the myelomeningocele, occurring in the United States at an approximate rate of 1 per 1000 live births. These defects develop during the fourth week of gestation, when the neural tube fails to close properly. The era of early closure of myelomeningoceles began in the sixties with the demonstration that these patients had a lower rate of mortality. The goals of early surgical closure are to (1) prevent infection, (2) eliminate cerebrospinal fluid leaks, (3) preserve neural function, and (4) diminish negative late sequelae such as pain over the closure site and possibly even tethered cord.

A prenatally diagnosis of myelomeningocele allows appropriate preparation of the obstetrician, pediatric neurosurgeon, pediatrician, and parents for the birth and subsequent care of the newborn. This care should be planned for a tertiary care facility. In addition, several trials of intrauterine repair of myelomeningoceles are ongoing. It is believed that intrauterine repair of these defects may improve the neurologic outcome. Protocols of the future may include routine intrauterine myelomeningocele repair, but at present there are not enough data to support this approach.

A neurosurgical evaluation should be performed immediately after birth to determine the functional level of the lesion. The head circumference should be assessed, and a baseline head ultrasound should be performed to determine if hydrocephalus is present. Fifteen percent of affected newborns have concurrent hydrocephalus at birth, and the vast majority of remaining patients develop it after closure of the defect. The entire spinal skeleton should be radiographed to document the extent of the dysraphism. A genitourinary evaluation should be performed, because the rate of neurogenic bladders in this population is quite high.

After the myelomeningocele is examined, a sterile dressing should be applied along with a plastic adhesive sheet to separate the anus and stool from the defect. Broad-spectrum antibiotic agents are administered, and surgical closure is scheduled as early as possible after birth. Surgical intervention should be performed as early as possible if there is a CSF leak, because this could lead to ascending meningitis and further degradation of neurologic function.

Neurosurgical operative management includes initial placode dissection, spinal cord reconstruction and closure, and dural elevation and closure. The majority of cutaneous defects can then be closed by simple skin flap elevation and minimal undermining by the pediatric neurosurgical team, but in a minority of patients with large skin defects or poor skin quality around the defect plastic surgical consultation is indicated.

Numerous procedures have been described for the closure of large myelomeningoceles. The approach used depends on the location and size of the defect. Previously described approaches for closure include skin grafts, delayed flaps, bipedicled flaps with and without relaxing incisions, rotation flaps, and composite muscle and skin flaps. The goal should be to cover the dural closure with well-vascularized tissue, regardless of the approach used.

Thoracic defects can easily be closed with bilateral latissimus flap elevation and advancement.

Larger lumbar defects can be more challenging because of the paucity of muscle in the region and can be associated with wound breakdown and infection. This can be a devastating complication, because infections have been shown to lead to further deterioration of neurologic function.

We have recently described a newer approach to lumbar myelomeningocele closure using a superior gluteal artery perforator (SGAP) flap. Although technically challenging, this flap avoids a suture line directly over the dural closure and does not require gluteus muscle elevation, which can be critical, because there are variable gluteal innervations in these patients.

We have some unpublished experiences with newer technologies for patients with defects that are more challenging to treat. We have had success with the use of dermal replacement (Integra) over the cord, the transient use of vacuum-assisted closure (VAC) to facilitate Integra incorporation, and then coverage with cultured allograft (Apligraf). These tools were useful on a very small premature infant (approximately 1500 g) with a large lumbosacral defect. Further use of these as bridging approaches in patients with more complicated defects will be explored.

The plastic surgeon may be called later in the child’s life to assist with scar or tethered cord release and coverage with local vascularized tissue. This is less challenging in older patients who are larger and have adequate subcutaneous fat and skin vascularity to provide healthy flaps for padding and coverage.

BIBLIOGRAPHY
PATIENT WITH MYELOMENINGOCELE

History and physical examination

Is there a prenatal diagnosis?

A Yes

Tertiary referral, if available, for intrauterine closure

Intrauterine closure performed?

Yes

B Neurosurgical evaluation and head ultrasound at birth

No

C Neurosurgical evaluation, head ultrasound, intravenous antibiotic therapy, and closure within 24 hours after birth if possible

D Assess soft tissue defect after neurosurgical repair of placode and dural closure

Small defect

Skin advancement flap

E Large defect

Can defect be closed with local or regional tissue?

Yes

F Thoracic defect

G Lumbosacral defect

Latissimus myocutaneous flap closure

H Closure with local flap

• Advancement flap
• Bipedicle flap
• Rotation flap or SGAP flap

Follow up

J Secondary surgery for unstable scars or tethered cord if necessary

Long-term follow-up typically provided by pediatric neurosurgeon with referral to plastic surgeon if indicated
Upper Extremity

Congenital and Acquired Pediatric Abnormalities
   Congenital Hand Anomalies:
      Evaluation
      Polydactyly
      Syndactyly
   Camptodactyly and Clinodactyly
      Thumb Anomalies
   Forearm and Hand Anomalies
   Pediatric Brachial Plexus Injuries

Acute Hand Trauma
   Distal Phalanx Fractures
   Middle and Proximal Phalanx Fractures
   Metacarpal Fractures
   Wrist Fractures
   Extensor Tendon Injuries

Surgical Interventions

ALGORITHM KEY

Problem

Surgical Interventions and Surgical Endpoints

Nonsurgical Interventions

Surgical or Nonsurgical Options List

Combination of Surgical and Nonsurgical Options List

Hierarchy List

Flexor Tendon Injuries
   Acute Nerve Injuries: Open
   Acute Nerve Injuries: Closed
   Upper Extremity and Digit Amputations
   Upper Extremity Crush Injuries
   Extensive Tissue Loss
   Upper Extremity Injection Injuries
   Hand Infections

Special Problems
   Bone and Joint Pain
      The Stiff Joint
   Thumb Reconstruction
   Scaphoid Nonunion
   Impaired Vascularity
      Motor Deficits
   Delayed Flexor Tendon Injuries
   Peripheral Nerve Compression
      Neuromas
   Dupuytren’s Contracture
CHAPTER 72 CONGENITAL HAND ANOMALIES: EVALUATION

Peter D. Witt

**A** Children with complex upper extremity differences should be managed at tertiary referral centers or by individuals who specialize in musculoskeletal disorders. The care providers at such institutions typically manage a large volume of affected patients, and they often have highly integrated and focused programs of basic and clinical scientific research. Subspecialists in genetics, cardiology, urology, and radiology are usually available, along with ancillary diagnostics and treatments (pediatric electromyography, hand therapy, and prosthetics). The operating rooms of these centers are frequently staffed with dedicated, full-time pediatric anesthesiologists.

**B** Congenital differences of the upper extremity are quite common, occurring in about 1 in 700 neonates. About 10% of affected babies have significant functional and cosmetic deformities. Many patients in this population have associated abnormalities involving the musculoskeletal, urogenital, and cardiac systems. Patients with radial dysplasia (radial club hand) may have hematologic abnormalities. Caucasian patients with ulnar polydactyly may have associated syndromes. These patients should be referred to a geneticist and other pediatric subspecialists as needed.

**C** The physical examination usually allows the surgeon to diagnose the hand anomaly. The surgeon observes the child’s pattern of hand use to determine which digit is primarily affected. Radiography is usually included, along with ancillary diagnostics and treatments (pediatric electromyography, hand therapy, and prosthetics). Radiographs may help to identify proximal metacarpal anomalies, extra digits within the soft tissue envelope of the central hand, and delta phalanges. These images are used to determine the diagnostic classification of radial polydactyly and may help guide treatment by providing clues about soft tissue involvement of the deformity. If the bones are close together, they may share soft tissue components such as tendons and nerves.

**D** Some pediatric hand conditions are diagnosed radiographically (for example, thumb polydactyly). Radiographs should be obtained for all but the simplest anomalies (for example, ulnar polydactyly and simple, nonsyndromic incomplete syndactyly). Radiographs may help to identify proximal metacarpal anomalies, extra digits within the soft tissue envelope of the central hand, and delta phalanges. These images are used to determine the diagnostic classification of radial polydactyly and may help guide treatment by providing clues about soft tissue involvement of the deformity. If the bones are close together, they may share soft tissue components such as tendons and nerves.

**E** A classification system for congenital hand anomalies is widely used by the international hand surgery community. Clinical features of upper extremity differences fall into one of seven categories: (1) failure of formation of parts, (2) failure of differentiation of parts, (3) overgrowth, (4) duplication, (5) undergrowth, (6) constriction ring, and (7) generalized skeletal abnormalities. The spectrum of congenital hand anomalies encountered usually includes the fingers (webbed, bent, crooked, extraneous, enlarged, and trigger), the thumbs (inadequate, absent, extraneous, and trigger), and the hand (radial dysplasia, ulnar dysplasia, cleft hand, and hypoplasia).

**F** The surgical consultant should be able to address the concerns of parents who are increasingly Internet literate. These questions pertain to the timing of intervention, expectation for the number of interventions required, and the ultimate usefulness of the hand and digits. Parents need to understand that when multiple digits are involved, the surgeon should operate on only one side of a digit at a time to avoid vascular compromise. For some complex conditions, the hand surgeon should schedule a second visit with parents to review the complexities of diagnosis and treatment. Some discussions with parents are lengthy and difficult, such as the need for digital amputation (often the case with macrodactyly), the outcome of a three-digit hand with pollicization, the aesthetic problems with symbrachydactyly, and Apert syndrome.

**G** The timing of intervention often relates to the complexity of the deformity and the size of anatomic structures. In general, I prefer to manage most congenital hand problems by age 1, the time at which handedness usually develops and children begin to position their hand in space to manipulate objects.

**H** Periodic follow-up of affected patients is important for longitudinal outcome assessment and recommendations for revisions, if needed. Secondary deformities that require additional surgical intervention occur in about 10% to 15% of treated patients. Types of secondary problems that may require additional intervention include a protuberant metacarpal head, tight metacarpophalangeal joint, tendon adherence, intrinsic muscle imbalance, rotation deformity, and flexion or extension contractures.

**BIBLIOGRAPHY**


CHILD WITH CONGENITAL HAND DIFFERENCE

A Referral to pediatric hand specialist
B History and physical examination
C Obtain necessary consultations
  - Genetics
  - Subspecialists (cardiology, urology, orthopedics)
  - Diagnostics
D Radiographs
E Classification
F Parental counsel second office visit
G By age 1 (severe constriction early)
  - Surgical treatment
  - Splinting
  - Steroid injection
H Long-term follow-up and revisions

Fingers
- Webbed (syndactyly)
- Bent (camptodactyly)
- Crooked (clinodactyly, delta phalanx)
- Extraneous (polydactyly)
- Enlarged (macrodactyly)
- Trigger (stenosing tenosynovitis)

Thumbs
- Inadequate (hypoplastic floating thumb)
- Absent
- Extraneous
- Trigger

Hand
- Radial dysplasia
- Ulnar dysplasia
- Cleft hand
- Hypoplasia

https://t.me/Free_Plastic_Reconstruction_Book
POLYDACTYLY

Peter D. Witt

A There is a wide range of digital duplications, from simple nubbins on the border of the hand to hands having seven or eight digits, all of which have the same approximate size. The most important part of treatment is deciding which digit is the most functional and has the greatest growth potential.

B Radiographs may show partial bony duplications or broad articular surfaces. Both conditions affect potential deviation of the digit remaining after treatment.

C Ulnar polydactyly occurs frequently and, in Caucasians, is associated with numerous syndromes. African-American patients do not need genetic evaluations. If the digital attachment is floppy, it may be excised in the nursery. However, if the pedicle base is broad, a formal operative amputation should be performed when anesthesia may be safely used. The practice of tying off the extra digit (so-called medical amputation) should be condemned, because this treatment results in an unsightly protuberance for which the patients, rather than their parents, seek treatment later in life.

D Central polydactyly is most often associated with syndactyly. Radiographs are important, because they may reveal an extra, hidden digit between the long and ring fingers and within the same skin envelope. Central polysyndactyly is anatomically complicated, because nerves and blood vessels may be anomalous, and there is often some variability in tendon attachments. Parents should be advised about postoperative deviation deformity of the digit left in situ. These cases should be managed by pediatric hand specialists.

E Radial polydactyly usually involves the thumb. Both duplicated digits are usually small, although often one digit is dominant and more obvious. When possible, it is best to preserve the ulnar collateral ligament, discarding the radialmost digit. Sometimes the distribution of duplicated tissue is equal, including that of the nail, so that a sharing procedure is indicated. The correction of radial polydactyly often employs principles of spare parts surgery in which parts of the bone, soft tissue, tendons, and ligaments of the discarded digit are used to reconstruct the preserved digit.

BIBLIOGRAPHY


PATIENT WITH EXTRA DIGITS (POLYDACTYLY)

A History and physical examination

B Radiographs if indicated

C Ulnar polydactyly
   Is the patient Caucasian?
      Yes
         Search for syndromes
         Surgical excision of digit
      No
         Surgical excision of digit

D Central polydactyly
   Is there coexisting syndactyly?
      Yes
         Synchronous syndactyly and polydactyly correction
      No
         Polydactyly correction with excision of extra digit
         Sharing procedure for thumb reconstruction

E Radial polydactyly
   Is the thumb involved?
      Yes
         Determine functional digit
         Reconstruction of functional digit with preservation of ulnar collateral ligament
      No
         Surgical excision of digit

Long-term follow-up
CHAPTER 74  SYNDACTYLY

Peter D. Witt

**A**  Syndactyly (webbed fingers) is a relatively common congenital hand anomaly of variable severity. Many children with syndactyly have additional birth defects, necessitating a genetics screening or referral to specialty services such as cardiology or urology.

**B**  Syndactyly is grouped, based on the physical examination, into four general categories: incomplete, complete, simple, and complex. Radiographs should be obtained for most varieties of syndactyly, except the simple, non-syndromic incomplete variety. Radiographs can be used to document extra appendages, delta phalanges, and the extent of bony fusion in complex forms.

**C**  Incomplete syndactyly refers to webbing that does not extend to the fingertips. Good results are usually achieved by completing the interdigital space with local cutaneous flaps and full-thickness skin grafts by 1 year of age.

**D**  Complete syndactyly refers to webbing that extends distally to the fingertips.

**E**  Simple syndactyly refers to webbing of soft tissue only. This usually occurs on the long–ring finger web and occasionally on the ring–little finger web. Surgical separation should take place by 1 year of age. If border digits are involved, correction should be undertaken earlier to prevent tethering of the longer digit and limitation of growth.

**F**  Complex syndactyly refers to webbing with osseous digital fusion.

**G**  Bony fusion complicates management, because once the digits are separated, the exposed bone must be covered with durable soft tissue, usually in the form of a small local transposition flap. A skin graft should not be placed over exposed bone because of its poor take, inherent instability (tendency for ulceration), and proclivity to result in deformity (creation of lateral deviation, thinning of the fingertip, and unnatural shape of the lateral nail groove). There are several varieties of complex syndactyly.

**H**  The Apert hand is a special case of complex syndactyly with symmetrical and bilateral hand and foot deformities, associated with typical facial features and craniosynostosis. Upton has described three types of Apert syndactyly based on the configuration of the thumb. Morphologically, type I resembles a spade hand, type II resembles a spoon hand, and type III resembles a rosebud (mitten deformity). Each type has complex union of the index, long, and ring finger distal phalanges, and there may be significant problems with bony rotational malalignment, anomalous pulley systems, bowstringing, symphalangism, brachydactyly, confluent nails, thumb clinodactyly, and metacarpal fusions. Occasionally, it is necessary to amputate a digit. Staged procedures over years are required, sometimes with a groin flap (controversial). The vascular supply to the digits is notoriously variable. These cases should be managed only by experienced surgeons.

**I**  Acrosyndactyly usually refers to syndactyly associated with amniotic banding. The distal digits are joined, and the proximal webs are intact. The hallmark of this condition is the presence of fully lined sinus tracts that pass through the digit proximal to the site of distal fusion.

**J**  There are treatment principles common to all cases of syndactyly, and it is important that parents understand this information preoperatively. A skin deficiency is always present with syndactyly, and skin grafts are necessary. The ipsilateral hypothenar eminence of the hand is often an excellent donor site. If the recipient defect is large, the harvest of skin may extend proximally, in a curvilinear fashion across the volar wrist crease.

**K**  When there are multiple webs on the same hand, each should be managed independently, at separate settings, to avoid vascular compromise. At our institution, we prefer to separate operations by 3 to 6 months, beginning the sequence of surgeries when the patient is 6 to 8 months old.

**L**  Border digits should be released first to avoid potential tethering of adjacent digits and possible growth disturbance. Operations should be performed under loupe magnification and tourniquet control for maximal visualization of the neurovascular bundles. Judicious defatting is undertaken only after neurovascular structures are isolated. Adequate defatting is important for optimal cosmetic results.

**M**  Parents should be informed that postoperative web creep occurs in about 10% of patients. Secondary revisions are usually managed with local V-to-M–plasties or occasionally repeat skin grafting, usually around age 5, before entry into school.

**BIBLIOGRAPHY**


https://t.me/Free_Plastic_Reconstruction_Book
PATIENT WITH HAND SYNDACUTLY

History and physical examination

A Check for other congenital anomalies

Present

Absent

Obtain genetics/specialty consultations

B Hand physical examination and radiographs

Assess extent of obliteration of web space

Assess for interdigital bony fusion

C Proximal to fingertips (incomplete)

D To fingertips (complete)

E Absent (simple)

F Present (complex)

Bony separation

Nail bed separation

Web space reconstruction

G Digital constriction bands

H Apert syndactyly

J One-stage correction with local flaps and skin grafts at 6 to 12 months of age

K Multiple web spaces involved

Border digits involved?

No

Reconstruct one web space at a time

L Yes

Reconstruct thumb–index finger web

Reconstruct ring–little finger web

Reconstruct central web

Annual follow-up with hand surgeon

Creep present?

M Yes

Reconstruct web space

No

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 75  CAMPTODACTYLY AND CLINODACTYLY

Peter D. Witt

Camptodactyly is a bending of the finger at the proximal interphalangeal (PIP) joint in the dorsopalmar plane. It is a fairly common deformity, although its treatment is controversial. Most frequently it involves the little and ring fingers. It is often more of an aesthetic than functional deformity. Many structures have been implicated as causes of camptodactyly. The physical examination should include assessment for tightness in the volar skin, subcutaneous fascial bands, short superficial flexor tendons, dysfunction between flexor and extensor tendons, intrinsic muscle (lumbrical) abnormality, and joint issues such as retraction of the collateral ligament and volar plate.

No surgical treatment is recommended for mild to moderate deformities. For severe deformities, treatment should be based on clinical testing.

In cases with significant deformation of the digit, mobility of the PIP joint should be assessed. If the PIP joint is supple and the deformity is passively correctable, a lasso procedure (described by Zancolli for ulnar palsy) is used to stabilize the metacarpophalangeal joint (MP).

If the joint is stiff, a trial of splinting should be instituted. Noncompliance with this conservative program would militate against surgical treatment, because postoperative therapy, including splinting, is essential.

When splinting results in improved passive motion, the MP joint flexion test (Bouvier maneuver, which is positive when there is active PIP extension possible with the MP joint in a neutral position) indicates the appropriate surgical intervention. If positive, the lasso procedure and/or resection or reinsertion of the lumbrical is recommended. If negative, then either the extensor tendon is hypoplastic or the central band is distended. In these cases, the flexor digitorum superficialis may be transferred to either the extensor hood or medial band, as appropriate, to augment digital extension.

Clinodactyly is a bending of the finger in the radioulnar plane, commonly of the little finger. As with many congenital hand differences, it is associated with many syndromes. It is caused by a shift or shortening and malalignment of the joint surface away from its usual 90 degrees to the long axis of the digit. It is usually more of a cosmetic than functional deformity. Surgical treatment with an opening or closing wedge osteotomy is reserved for patients whose fingers overlap on attempted fist-making and whose curvature is greater than 45 degrees.

Delta phalanx is an abnormal trapezoid-shaped bone with a longitudinally bracketed epiphysis. These extra bones are frequently found in patients with a triphalangeal thumb or polydactyly. Treatment involves excision of the bone, along with soft tissue procedures: contracture release, collateral ligament reconstruction, tendon rebalancing, and skin flap advancements.

BIBLIOGRAPHY


PATIENT WITH CONGENITALLY BENT FINGER (CAMPTODACTYLY)

A History and physical examination
- Perform clinical and radiographic examination

E Mild or moderate deformity
- Nonsurgical treatment
  - Splinting
  - Hand therapy
- PIP supple
  - Perform lasso procedure
- Long-term follow-up

C Severe deformity
- Assess PIP joint
- PIP stiff
  - Splint finger
  - Patient compliant
    - Patient noncompliant
    - Check PIP motion
  - Active motion improved
    - No further treatment
  - Passive motion improved
    - Perform MP joint flexion test
    - Positive: Perform lasso procedure
    - Negative: Perform flexor digitorum superficialis (FDS) or extensor hood rebalancing procedure
    - Long-term follow-up

PATIENT WITH CONGENITALLY CROOKED FINGER (CLINODACTYLY)

F Perform clinical and radiographic examination
- Assess functional impairment

G Delta phalanx present
- Thumb involved?
  - No
    - <45 degrees, no functional impairment
      - No treatment
    - >45 degrees, functional impairment present
      - Perform operative reconstruction with opening or closing wedge osteotomy
  - Yes
    - Operative reconstruction with wedge excision ± soft tissue procedures
- No treatment
- Long-term follow-up
The key elements of the physical examination of patients with a hypoplastic thumb include assessment of thenar musculature, the function of the carpometacarpal joint (stability), and the position of the thumb (closeness) relative to the central digital mass. The bony architecture shown on preoperative radiographs affects the choice of reconstruction. A surgeon must decide whether or not the small thumb is potentially useful, based on the supporting structures: intrinsic muscles and metacarpal and radiocarpal joints. The absence of a thumb is an indication for pollicization. Nonfunctional or inadequately functioning thumbs also managed by pollicization include floating thumbs (pouce flottant) and thumbs with unstable carpometacarpal joints. When the carpometacarpal joint is stable, function may be improved with opponensplasty, ulnar collateral ligament reconstruction, and Z-plasty of the first web space. Procedures to correct thumb hypoplasia should take place at 1 year of age, although pollicization can be undertaken at any time after 1 year with good results. Parents need to understand that revisions are necessary at least 10% to 15% of the time.

Clasped thumb has a variety of causes. The thumb is held close to the index finger and is placed more distally on the hand than usual. The more the thumb is adducted, the more the thenar musculature is abnormal. The recommended first treatment is serial casting. Surgical options include release of the first web space contracture and rebalancing the abnormal attachments of the flexor pollicis longus to the extensor mechanism of the thumb or to the radial side of the proximal phalanx. Weak or absent extensor muscles and abductors indicate the need to perform tendon transfers.

It is best to observe patients with trigger thumb for 2 to 3 years because of the known potential for spontaneous improvement. Surgical treatment consists of division of the A1 pulley and is reserved for patients with unsuccessful conservative management, usually at 3 years of age.

BIBLIOGRAPHY
INFANT WITH CONGENITAL THUMB ANOMALY

History and physical examination

Obtain consultation with appropriate specialists, including clinical geneticist, or evaluation and treatments as indicated

Other anomalies present?

Yes

No

Yes

No

Characterize nature of thumb anomaly

A Hypoplasia

Pouce flottant or absence of thumb

Thorn present

Assess thumb carpometacarpal joint

Pollicization at 1 year of age

B Clasped thumb

Splinting trial

Imprortment?

Yes

No

No surgical treatment

Normal thenar muscles?

Yes

No

Steroid injections

Improved?

Yes

No

No treatment

No surgical treatment

C Trigger thumb

Conservative management

Improved by age 2 to 3 years?

Yes

No

No treatment

Surgical release of A1 pulley

Unstable joint

Stable joint

Opponensplasty

Ulnar collateral ligament reconstruction

First web space deepening

Unstable joint

Stable joint

Tendon rebalancing procedures

Tendon transfers

Abnormal tendon attachments

Weak or absent extensors

First web space deepening

Long-term follow-up with additional procedures for functional improvement as indicated
CHAPTER 77  FOREARM AND HAND ANOMALIES
Peter D. Witt

Ulnar dysplasia is an uncommon problem. Patients with ulnar dysplasia present with a severe forearm deficiency, with diminished stability at the wrist in pronation and supination, and progressive ulnar deviation of the hand. The treatment is controversial with regard to excising the distal ulnar anlage.

There are two varieties of cleft hand: true cleft hand and symbrachydactyly (atypical cleft). These conditions may be differentiated clinically. The true cleft hand has an absent or deficient third finger ray, creating a V-shaped central defect. It is usually bilateral and familial, with syndactyly, foot involvement, and associated anomalies. Operations are designed to separate syndactylies and narrow the cleft. In contrast, symbrachydactyly has several central rays deficient. It is unilateral, non-familial, there is no foot involvement, and there are no associated anomalies. Often small nubbins of the three central fingers are present with vestigial nails. Pinch and power grip functions are intact. Operations are designed to deepen the cleft, if doing so would improve grasp across the central defect, and to remove the nubbins.

A Constrictions rings, presumably the result of an intrauterine disruption of the amnion, have a range of severity in presentation. These may cause mild deformities, such as circumferential grooves, to severe constriction with compromise of distal vascularity and autoamputation. A constriction ring may be associated with acro-syndactyly. When viability of the digit is threatened, surgical release should be undertaken early. Otherwise, staged release procedures, with multiple Z-plasties, are performed when the patient is 3 to 6 months old.

B Radial dysplasia may be one of the most severe and complicated forms of congenital hand anomalies. The presentation is variable but may include absence of the thumb, scaphoid, trapezium, and radius. It is essential that the patient be screened by a pediatrician for other malformations. Blood dyscrasias and cardiac anomalies are common. Conditions known to be linked to radial dysplasia include Fanconi anemia (thumb absent); thrombocytopenia–absent radius (TAR) syndrome (the thumb is present); Holt–Oram syndrome (congenital heart disease); and VATER association, which is characterized by vertebral anomalies, imperforate anus, tracheoesophageal fistula, and renal anomalies. Hands with radial dysplasia have aberrations in anatomy of the blood vessels, bones, muscles, and nerves. The ulnar two digits are usually normal. Management principles include improvement of function and appearance. Serial splinting and casting is appropriate treatment for minor deformities. Surgery is necessary when the wrist is unstable. Generally, this means that the hand should be positioned on the single remaining forearm bone to maximize function, growth, and appearance. A prerequisite for surgery is motion at the elbow. Patients may be candidates for pollicization if improvement in hand function is expected.

C BIBLIOGRAPHY
PATIENT WITH CONGENITAL FOREARM AND HAND ANOMALIES

History and physical examination

Assess specific extremity anomaly

A. Constriction ring
   - Is there vascular compromise?
     - Yes
       - Early release of ring with multiple Z-plasties
     - No
       - Release ring with multiple Z-plasties at 3 to 6 months

B. Radial dysplasia
   - Obtain consultations with specialists as necessary (hematology, cardiology, genetics)
   - Perform serial splinting/stretching
   - Is elbow function intact?
     - Yes
       - Perform centralization ± pollicization
     - No
       - No additional treatment

C. Ulnar dysplasia
   - Excision of distal ulnar anlage

D. Cleft hand
   - True cleft
     - Check for associated anomalies
   - Symbrachydactyly (atypical cleft)
     - Is grasp adequate?
       - Yes
         - Surgical narrowing of cleft and correction of syndactyly
       - No
         - No treatment
       - Surgical deepening of cleft at age 2 to 3 years

Hand therapy

Long-term follow-up
Patients diagnosed with obstetrical brachial plexus palsy are evaluated by a multidisciplinary team that includes surgeons and physical or occupational therapists.

Nonsurgical therapy is initially directed at maintaining passive range of motion of the elbow, wrist, and hand. Therapy on the shoulder may begin the first week. There is usually no need to immobilize the affected limb. Torticollis is addressed with therapy. The infant’s sleeping position is varied. The majority of infants do not require operative management for their brachial plexus lesion.

Primary nerve surgery at 3 months of age or earlier is recommended for all patients with Horner syndrome or flail arms (total plexus injuries, with clinical evidence of T1 avulsion).

The Toronto Test Score has proved valid in assessing the need for operative intervention. A Test Score is determined when the patient is 3 months old. A score of less than 3.5 is strongly predictive of poor recovery without surgical intervention, and operative management is recommended. Conversely, if the 3-month Toronto Test Score is higher than 3.5, the patient does not have Horner syndrome, and T1 is clinically intact, we recommend observation with reassessment when the patient is 6 months old.

In highly selected cases, a child will pass the Test Score (score 3.5 or higher) at 3 months of age, but will fail to show substantial improvement in elbow flexion by 6 months of age. If the child’s exam leads us to believe that he or she is unlikely to improve sufficiently, we recommend surgery at 6 months. It is uncommon to recommend surgery at 6 months for patients who have passed the Test Score.

The cookie test is performed when patients are 9 months old. This test is carried out by placing a lightweight cookie in the child’s hand, holding the humerus at the child’s side, and allowing the child to attempt elbow flexion sufficient to place the cookie into the mouth without flexing the neck beyond 45 degrees. If the child is unsuccessful in placing the cookie in his or her mouth, then operative management is recommended.

Primary operative nerve management may include brachial plexus neurona excision, sural nerve grafting, and nerve transfers. Preoperative CT myelography is helpful in determining the availability of proximal stumps. Preoperative ultrasound of the diaphragm is useful in determining the status of the phrenic nerve. The neurona does not contribute meaningfully to limb function; therefore it is excised and grafted through a supraclavicular approach. Neurolysis alone does not improve long-term function. It is important to obtain stumps free of neurona. Intraoperative frozen sections can help in verifying the suitability of the proximal and distal stumps. Nerve grafts are coapted with fibrin glue under zero-tension conditions. The infant’s limb is immobilized for 3 weeks using a soft shoulder immobilizer garment or Velpeau sling. Therapy on the hand and wrist may continue during this time, with resumption of shoulder therapy 5 weeks postoperatively.

Families are counseled preoperatively that the goal is not to achieve perfect symmetry with the unaffected limb. A realistic goal is to achieve limb function that allows the child to participate in most everyday activities.

Follow-up examinations are performed by the multidisciplinary team until maturity. Patients with residual motor deficits may be candidates for secondary procedures, including secondary nerve transfers, tendon transfers, and osteotomies.

BIBLIOGRAPHY
PATIENT WITH OBSTETRICAL BRACHIAL PLEXUS PALSY

History and physical examination

A Refer to multidisciplinary team

B Initiate early nonsurgical therapy

Assess degree of neurologic impairment

C T1 avulsion, Horner syndrome, or both

D T1 functioning without Horner syndrome

G Primary nerve operation

- Neuroma excision
- Nerve grafting
- Nerve transfers

H Shoulder immobilization for 3 weeks with wrist and hand physical therapy

Shoulder physical therapy 5 weeks after nerve surgery

I Follow-up examinations and secondary procedures if indicated

D 1. Obtain Toronto Test Score when patient is 3 months old

2. Score <3.5/fail

3. Score >3.5/pass

4. Reevaluate when patient is 6 months old

E No progress

F Progress

P Perform cookie test when patient is 9 months old

- Fail
- Pass
An evaluation of suspected hand and/or wrist fractures begins with a thorough history and physical examination. Details related to the mechanism of injury, timing of injury, previous injuries, and the patient’s profession, handedness, activities, and comorbidities may be helpful in directing the workup and treatment. The physical examination should be used to note deformities, tenderness to palpation and with motion, neurosensory abnormalities, and vascular compromise.

Plain radiographs should be ordered as indicated to include multiple views of the wrist, hand, or individual digits. It may be beneficial to perform radiographs of the contralateral side at times to help differentiate injuries from normal variants. Special views are indicated for many carpal injuries, and CT scans may be helpful when radiographs are equivocal.

Splinting is the mainstay of treatment for tuft fractures. For large segments, pinning may be indicated to help maintain reduction and reduce pain. This can frequently be performed in the emergency department.

Subungual hematomas indicate a nail bed injury. Hematomas that involve more than 50% of the nail bed and those that cause severe pain may require nail plate removal and repair of the nail matrix after reduction of the tuft fracture.

Operative treatment for intraarticular distal phalanx fractures may be reserved for fracture-subluxations, open injuries, flexor digitorum profundus (FDP) avulsion injuries, and open mallet deformities with avulsed or lost tendon substance and soft tissues.

**BIBLIOGRAPHY**


PATIENT WITH A DISTAL PHALANX FRACTURE

A History and physical examination

B Plain radiographs

Determine nature of fracture

Is there a subungual hematoma or nail bed injury?

No

Yes

D Does the hematoma involve >50% of the nail bed?

No

Yes

Is the hematoma causing severe pain?

No

Yes

Needle drainage or remove nail plate and perform nail bed repair if a nail bed injury exists

Assess site of fracture

C Tuft

Splint fracture

Long-term follow-up

E Intraarticular

Is there tendon disruption?

No

Yes

1 mm displacement or any subluxation/dislocation?

No

Yes

Splint and repeat radiographs in 1 to 2 weeks

CRPP versus ORIF

Hand therapy

Long-term follow-up

Mallet finger

Is there significant disruption of the articular surface?

No

Yes

CRPP versus ORIF

Hand therapy

Long-term follow-up

Jersey finger

ORIF with repair of FDP avulsion fracture

Nondisplaced

Displaced

CRPP versus ORIF

Hand therapy

Long-term follow-up

Extraarticular

Shaft/base

1 mm displacement or any subluxation/dislocation?

No

Yes

Crpp versus ORIF

Hand therapy

Long-term follow-up

Crpp versus ORIF

Hand therapy

Long-term follow-up

Crpp versus ORIF

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 80  MIDDLE AND PROXIMAL PHALANX FRACTURES

Jaimie T. Shores  •  W.P. Andrew Lee

**A** All open fractures require irrigation and debridement, tetanus prophylaxis, and antibiotic agents. Open fractures of the proximal and middle phalanges, metacarpals, and carpus require operative fixation in addition to thorough washout. The choice among multiple fixation techniques depends on the fracture location and type. K-wires, tension band techniques, condylar plates, and lag screws are useful in the phalanges.

**B** In all cases, the soft tissue envelope may not tolerate extensive exposure of fractures for rigid fixation. In these patients, percutaneous pinning and/or external fixation may temporize these injuries until they are more amenable to definitive fixation.

**C** Proximal and middle phalangeal fractures involving joints benefit from early fixation and early protected-motion hand therapy. Even for extraarticular fractures, proximal interphalangeal (PIP) joint stiffness may occur quickly, and early protected motion is beneficial in all cases, with splinting of nondisplaced fractures after initial callus formation and after fixation of all unstable or displaced fractures.

**D** Hand therapy is an integral part of all hand/wrist fracture care. Functional results will be poor after even the best fracture reduction and healing if appropriate therapy instituted as early as possible within the postoperative course is not performed. Therapy should begin as early as possible after all operative fractures have been stabilized. Patients with nonoperative fractures should begin therapy as soon as stability from callus formation allows limited and protected motion under the direct guidance of experienced therapists.

**BIBLIOGRAPHY**


PATIENT WITH A FRACTURE OF THE MIDDLE OR PROXIMAL PHALANX

History and physical examination

Assess nature of fracture

A Open fracture

B Operative fixation

- ORIF
  - K-wire
  - Lag screws
  - Miniplates
- External fixator
  - Static
  - Dynamic

C Closed fracture

Intraarticular fracture

- Operative fixation
  - CRPP
  - ORIF
    - Lag screw
    - Tension band
    - Miniplates
  - External fixator
    - Static
    - Dynamic

Extraarticular fracture

- Splint digit and repeat weekly radiographs
  - Fracture displacement seen on radiographs?
    - Yes
    - Continue immobilization
    - Hand therapy
    - Long-term follow-up
    - No
    - Weekly follow-up and radiographs

Displaced or unstable fracture

Nondisplaced, stable fracture

Non-displaced, stable fracture

Displaced or unstable fracture

Hand therapy

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
A  Metacarpal head fractures. Comminuted fractures or noncomminuted fractures involving more than 25% of the articular surface or fractures with a 1 mm or greater step-off should be treated operatively. Severely comminuted head fractures may require external fixation and may progress to eventual arthrodesis or alloplastic arthroplasty. Soft tissue defects overlying metacarpal heads deserve exploration to determine intraarticular communication. Fight bites or human bite wounds to the metacarpophalangeal (MP) joint sustained with a clenched fist may be misleading, because the skin defect may not be directly over the joint. Any possible penetration of the joint should be treated operatively with thorough irrigation and debridement.

B  Metacarpal neck fractures. Many metacarpal neck fractures are amenable to closed reduction and splinting. Although thresholds for nonoperative treatment vary, we prefer operative treatment for any neck fractures that cannot be adequately reduced to angulations of less than 15 degrees for index and long fingers, less than 30 to 40 degrees for ring fingers, and less than 45 degrees for small finger metacarpal neck fractures. Rotational deformities that cannot be corrected or have significant comminution and/or shortening are treated operatively.

C  Metacarpal shaft fractures. Closed reduction of closed shaft fractures with splinting is preferred for fractures that can be reduced to anatomic positions for the index and long finger metacarpals, to less than 20 degrees for the ring metacarpals, and to less than 30 degrees for the small finger metacarpals. Rotational deformities that are nonreducible and have shortening of more than 3 to 5 mm require operative fixation.

D  Metacarpal base fractures. The majority of these fractures affect the thumb metacarpal base. Intraarticular fractures of the thumb metacarpal base usually require operative fixation with percutaneous fixation; open fixation is necessary only if closed techniques are unsuccessful or for carpometacarpal (CMC) fracture dislocations. Metacarpal base fractures of the index and long metacarpals may require operative fixation if avulsion fractures involving the extensor carpi radialis longus (ECRL) or extensor carpi radialis brevis (ECRB) are involved, or for a displaced fracture involving the articular surface. Small finger metacarpal base fractures may be more complex, because forces exerted by the flexor carpi ulnaris (FCU), extensor carpi ulnaris (ECU), and abductor digiti minimi (ADM) may displace the fragments. We prefer initial attempts at closed reduction, reserving percutaneous fixation with open techniques for more complex fractures that cannot be reduced by closed techniques.

E  Indications for operative fixation of metacarpal fractures include all open injuries and certain closed injuries.

F  Hand therapy is an integral part of all hand/wrist fracture care. Functional results will be poor after even the best fracture reduction and healing if appropriate therapy instituted as early as possible within the postoperative course is not performed. Therapy should begin as early as possible after all operative fractures have been stabilized. Patients with nonoperative fractures should begin therapy as soon as stability from callus formation enables limited and protected motion under the direct guidance of experienced therapists.

BIBLIOGRAPHY


PATIENT WITH A METACARPAL FRACTURE

History and physical examination

Single fracture
Assess location of fracture

Multiple fractures

E Operative fixation
  • CRPP
  • ORIF
  • External fixation

Hand therapy
Long-term follow-up

A Metacarpal head
Closed fracture
Open fracture
  Is the fracture noncomminuted, involving <25% of articular surface, with <1 mm step-off?
  Yes
  No
  Splint hand in intrinsic-plus position
  Weekly follow-up with radiographs
  Fracture displacement seen on repeat radiographs?
  No
  Yes
  Continue immobilization
  Hand therapy
  Long-term follow-up

B Metacarpal neck
Open fracture
Closed fracture
Acceptable closed reduction obtained?
Yes
No
Splint hand
Hand therapy
Weekly follow-up with radiographs
Fracture displacement seen on repeat radiographs?
No
Yes
Continue immobilization
Hand therapy
Long-term follow-up

C Metacarpal shaft
Closed fracture
Open fracture or significant comminution or shortening
  Is there acceptable angulation, no rotation, and no shortening >3-5 mm?
  Yes
  No
  Splint hand
  Weekly follow-up with radiographs
  Fracture displacement seen on repeat radiographs?
  No
  Yes
  Continue immobilization
  Hand therapy
  Long-term follow-up

D Metacarpal base
Intraarticular fracture
Extraarticular fracture
Is there significant displacement?
Yes
No
Splint hand
Weekly follow-up with radiographs
Fracture displacement seen on repeat radiographs?
No
Yes
Continue immobilization
Hand therapy
Long-term follow-up

F Hand therapy
Long-term follow-up
Distal radius fractures with intraarticular step-offs, comminution, a dorsal tilt of 10 degrees or more, shortening of greater than 3 mm, or distal radioulnar joint (DRUJ) instability should be treated operatively. In addition, operative fixation should be considered for patients with nondisplaced and stable fractures. Operative fixation should also be considered for patients who have a high risk for nonunion and for high-demand patients. High-demand patients are those who require a limited period of immobilization and a much faster return to activity. Examples include athletes and other patients whose profession requires the use of their hands. In addition, individuals with multiple injuries may be considered high-demand patients if they would benefit from a shorter duration of immobilization or rigid fixation so that the repaired limb may be used to assist in the rehabilitation or wound care of other injuries. We prefer volar plate fixation for the majority of distal radius fractures and reserve dorsal plate fixation and fracture-specific plating techniques for more complex cases with significant articular and metaphyseal comminution. External fixation is the least commonly used method and is reserved for severely comminuted and shortened fractures and those with contraindications for more invasive techniques because of soft tissue injury or comorbidity.

Patients with suspected scaphoid fractures have traditionally been treated with casting and repeat radiographs 1 to 2 weeks after presentation, with possible MRI, CT scans, or bone scans for later detection. With the availability of high-resolution CT scanning at most trauma centers, we prefer to obtain CT scans immediately for any suspected scaphoid fracture with indeterminate plain radiographic results or any complex carpal injury. If these are indeterminate, the patient may still be splinted with thumb spica immobilization and repeat radiographs, and possible MRI.

Hand therapy is an integral part of all hand/wrist fracture care. Functional results will be poor after even the best fracture reduction and healing if appropriate therapy is not instituted as early as possible within the postoperative course. Therapy should begin as early as possible after all operative fractures have been stabilized. Patients with nonoperative fractures should begin therapy as soon as stability from callus formation enables limited and protected motion under the direct guidance of experienced therapists.

Continued
PATIENT WITH A WRIST FRACTURE

History and physical examination

Assess location of fracture

A Distal radius

Nondisplaced

Splint/cast for 4-6 weeks

ORIF in high-demand patient

Repeat weekly radiographs for closed reduction/immobilization

Reduction acceptable?

Yes

Continue immobilization for 4-6 weeks total

No

ORIF

>2 mm articular step-off, significant comminution, DRUJ instability, >10-degree dorsal tilt, or radial shortening

Consider CT scan to evaluate articular surface

B Suspected scaphoid fracture

Splint

Repeat radiographs at 1-2 weeks or obtain CT or MRI

Is a scaphoid fracture present?

No

Place removable splint for comfort

Yes

ORIF

E Hand therapy

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
Perilunate/lunate dislocation injuries are treated with open reduction internal fixation (ORIF) in almost all instances. Open carpal tunnel release should be given serious consideration in all of these injuries. Relocation of the lunate should be attempted in the emergency department if availability of the operating room is delayed. Greater arc injuries may require repair or excision of the radial styloid, compression fixation of the scaphoid, and screw or K-wire fixation of any other involved carpal bones. Lesser arc injuries with scapholunate and lunotriquetral ligament injuries should be repaired if possible.

Confirmed scaphoid fractures involving the proximal pole require operative compression fixation, because nonunion rates approach 100% with nonoperative treatment. Other scaphoid fractures with less than 1 mm of displacement may be treated nonoperatively with 9 to 12 weeks of thumb spica casting (initially long arm, then short arm after 4 to 6 weeks). Alternatively, for patients who require faster returns to work or activities or cannot tolerate extended immobilization, percutaneous or open compression screw placement may also be performed. All displaced scaphoid fractures receive ORIF with compression screw fixation.

Hand therapy is an integral part of all hand/wrist fracture care. Functional results will be poor after even the best fracture reduction and healing if appropriate therapy is not instituted as early as possible within the postoperative course. Therapy should begin as early as possible after all operative fractures have been stabilized. Patients with nonoperative fractures should begin therapy as soon as stability from callus formation enables limited and protected motion under the direct guidance of experienced therapists.

BIBLIOGRAPHY


PATIENT WITH A WRIST FRACTURE

History and physical examination

Assess location of fracture

Carpal fracture

C Perilunate/lunate dislocation injury

D Scaphoid fracture

ORIF with ligament repairs ± carpal tunnel release

Proximal pole fracture

Waist/distal pole fracture

Is there >1 mm displacement?

Yes

ORIF or percutaneous cannulated screw

Closed reduction and percutaneous pinning or ORIF

No

Cast for 9-12 weeks

ORIF versus percutaneous pinning in high-demand patient

E Hand therapy

Long-term follow-up

ORIF or percutaneous cannulated screw

Closed reduction and percutaneous pinning or ORIF

Cast

ORIF versus percutaneous pinning in high-demand patient

Displaced fracture?

Yes

No

Other carpal fractures

Fracture?

Yes

No

Scaphoid fracture

Perilunate/lunate dislocation injury

Proximal pole fracture

Waist/distal pole fracture

Is there >1 mm displacement?

Yes

ORIF or percutaneous cannulated screw

Closed reduction and percutaneous pinning or ORIF

No

Cast for 9-12 weeks

ORIF versus percutaneous pinning in high-demand patient

Displaced fracture?

Yes

No

Other carpal fractures

Proximal pole fracture

Waist/distal pole fracture

Is there >1 mm displacement?

Yes

ORIF or percutaneous cannulated screw

Closed reduction and percutaneous pinning or ORIF

No

Cast for 9-12 weeks

ORIF versus percutaneous pinning in high-demand patient

Displaced fracture?

Yes

No
CHAPTER 83  EXTENSOR TENDON INJURIES

E. Gene Deune

A  A patient with a closed finger injury can have an extensor tendon rupture. This rupture typically occurs either in the distal phalanx, resulting in a mallet deformity, or at the proximal interphalangeal (PIP) joint, resulting in a boutonniere deformity. Radiographs are obtained to identify bone fragmentation. Loss of extensor function with an open wound suggests tendon laceration rather than disruption.

B  An open laceration over the dorsal distal interphalangeal (DIP) joint with an extensor tendon laceration can be closed by repairing both the wound and the tendon laceration simultaneously with a continuous cutaneous suture, which is removed about 10 to 14 days later. This is followed by 6 to 8 weeks of splinting to keep the DIP joint in extension.

C  A single distal extensor tendon laceration over the DIP joint can be satisfactorily repaired in the emergency department. The ideal place to repair more complex extensor tendon lacerations is within a controlled environment with appropriate sterility, equipment, lighting, anesthesia, and nursing help.

D  Avulsion of the extensor tendon from the distal phalanx produces a mallet deformity. This is treated by splinting the affected digit in extension for 6 weeks, followed by a gradual reduction in the use of the splint over the next 2 to 4 weeks. If a sizeable bone fragment has been avulsed from the distal phalanx (more than 50% of the articular surface) or if palmar subluxation of the distal phalanx is present, operative intervention for correction of the mallet deformity is indicated. Closed disruption of the central slip into the base of the middle phalanx occurs where there is forced flexion of the digit or volar dislocation of the PIP joint. If there is slight extension lag and tenderness of the digit after such an injury, treatment with splinting the PIP joint in extension for 6 to 8 weeks is indicated, along with appropriate hand therapy.

BIBLIOGRAPHY


PATIENT WITH EXTENSOR TENDON LACERATION

History and physical examination

A Is the extensor tendon injury associated with an open injury?

No

D Consider possible extensor tendon avulsion from distal phalanx (mallet) or central slip injury (boutonnière deformity)

Is a mallet finger present on exam?

No

Consider central slip injury

Yes

B Is the extensor tendon laceration over the DIP joint (extensor zone 1)?

No

Closed treatment of mallet finger with 6-10 weeks of splinting

Yes

Formal exploration with repair of lacerated tendon

Is it an isolated injury?

No

Consider open reduction internal fixation

Yes

Repair with composite suturing of skin and tendon

Postoperative splinting, hand therapy, and long-term follow-up with hand surgeon
CHAPTER 84  FLEXOR TENDON INJURIES

E. Gene Deune

Key components of the physical examination of the traumatized hand include evaluating the rest of the patient as well as looking at the natural cascade of the fingers. In the uninjured hand, the small finger should be more flexed than the ring finger and adjacent fingers. The index finger is the least flexed of the fingers in the natural resting state. When this natural cascade is broken, it is very likely that there has been a flexor tendon laceration.

Flexor tendon lacerations should be suspected if lacerations are present on the palmar surface of the hand. With an associated loss of the flexion cascade without a laceration, it is likely that there is a closed rupture of the flexor digitorum profundus (FDP) tendon from the distal phalanx, with or without a bony attachment.

The patient is asked to flex the finger of interest to determine if the flexor digitorum superficialis (FDS) or FDP tendon or both are lacerated. To determine whether the flexor tendons are in continuity in an uncooperative patient, the distal one third of the patient’s forearm is squeezed or the wrist is passively flexed and extended (tenodesis effect). If the examination is inconclusive, the wounds are sutured closed and reevaluated a few days later for finger flexion, when the patient is more cooperative. Alternatively, the patient can undergo surgical exploration for a presumptive diagnosis of a flexor tendon laceration, especially if he or she will be under anesthesia for the management of other injuries.

Pain with active finger flexion usually indicates a partial tendon laceration. There is disagreement as to when a partial tendon laceration requires repair, with some surgeons advocating only repairing lacerations that involve more than 50% to 60% of the tendon. It has been my practice to repair all incomplete flexor tendon lacerations. The inability to flex the finger at all indicates a complete tendon disruption.

A nerve and/or digital artery laceration may be associated with the flexor tendon injury. This type of injury may require repair with the operative microscope.

After surgical repair, an initial postoperative splint is applied with the wrist flexed 20 to 30 degrees, the metacarpophalangeal (MP) joints at 60 to 90 degrees, and the interphalangeal (IP) joints at 0 degrees. The patient is reevaluated in 1 week and referred to a hand therapist for early controlled finger and hand motion.

At the 6-month postoperative assessment, if there is inadequate finger flexion, further surgery may be needed, with either a tenolysis or tendon graft if the repair ruptured. If the finger range of motion is acceptable, the patient is discharged.

If the natural cascade is present, the repair should be intact and surgical revision may be considered.

One of the principles of flexor tendon tenolysis is that passive range of motion at the joints should be full to increase the success rate of tenolysis. If passive range of motion is not full, then more hand therapy is necessary before exploring the finger and performing secondary flexor tendon reconstruction.

During the tenolysis, it is important to preserve the A2 and the A4 pulleys. Therapy is resumed in the very early postoperative period.

BIBLIOGRAPHY


PATIENT WITH ACUTE FLEXOR TENDON INJURY

History and physical examination

A Are the fingers in a natural cascade?

Yes No

Unlikely that there is a flexor tendon laceration

There is an open laceration on palmar surface

Assess patient’s ability to flex fingers

C Is the patient cooperative with active flexion?

Yes No

Evaluate flexor tendons by squeezing the patient’s distal forearm or by passive wrist flexion/extension

D Is there loss of active flexion?

No Yes

Check for finger sensation and vascularity

E Exploration and repair of flexor tendon laceration in OR

F Postoperative splint and early controlled finger motion with hand therapy

G Reassess motion at 6 months

H Is natural cascade present?

Yes No

Consider exploration and delayed repair (see algorithm 98)

I Is passive range of motion > active range of motion?

Yes No

J Tenolysis

Hand therapy

Postoperative therapy

Long-term follow-up

Is there loss of passive finger flexion?

Yes No

Flexor tendons may be intact

Surgically explore based on clinical suspicion

Reevaluate at a later date

Surgically explore based on clinical suspicion

Reevaluate at a later date

Postoperative splint and early controlled finger motion with hand therapy

Long-term follow-up

There is no open laceration on palmar surface

Is the loss of the cascade at the DIP joint?

Yes No

Consider closed flexor tendon rupture

Obtain radiograph to evaluate possible bony fragment

Surgical exploration for presumed closed tendon rupture

Surgical exploration for presumed FDP rupture

https://t.me/Free_Plastic_Reconstruction_Book

197

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 85  ACUTE NERVE INJURIES: OPEN
Ryan D. Katz • A. Lee Dellon

A. After open trauma to an extremity, injury to a peripheral nerve is assumed when a patient has pain, numbness, weakness, or is unable to move certain parts of an extremity. It is essential to evaluate the extremity for the presence of a vascular injury, compartment syndrome, and fracture/dislocation.

B. In a conscious patient, the results of a detailed examination are documented for each sensory and motor function of that nerve. For each fingertip or toe pulp innervated by that nerve, at a minimum, two-point discrimination must be measured. If possible, the perception of vibration (any frequency) should be obtained and compared with that of the contralateral side. Abnormal vibratory perception in the acute setting is an indication for decompression of the compartment and nerve.

C. Surgical exploration is indicated in a patient with an open wound that results in peripheral nerve injury.

D. When the peripheral nerve is intact, external neurolysis is performed proximal and distal to the site of injury.

E. If the epineurium is hemorrhagic, it should be opened to release any hematoma compressing the nerve.

F. When the peripheral nerve is grossly intact but preoperatively lacked motor function, intraoperative electrical stimulation is performed. This may require deflating the tourniquet. If the nerve has a firm area within it and no motor function results from electrical stimulation, the epineurium should be opened. If no function exists after epineurotomy, conservative management is indicated. If there is no function or EMG activity to suggest return of function by 3 months, nerve reconstruction using a conduit or graft is performed.

G. When the nerve is not intact grossly, resection of the proximal and distal ends is necessary to remove the damaged edges before reconstruction to optimize recovery.

H. For the reconstruction of nerve gaps less than 3 cm, clinical studies have shown success with a bioabsorbable nerve conduit, compared with primary repair or nerve grafting.

BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book
Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
PATIENT WITH OPEN PERIPHERAL NERVE INJURY

History and physical examination

A. Examine extremity for contributing injuries and treat as necessary

B. Document degree of sensory and motor impairment of affected peripheral nerves

Motor and/or sensory deficit present

C. Surgical exploration

Is the nerve intact?

D. Yes

External neurolysis

E. Is hemorrhagic epineurium present?

No

Open epineurium

Yes

Release tourniquet if still inflated

Function present with stimulation?

Yes

No

Follow-up evaluation

Nerve function intact?

Yes

No further treatment

No

G. No

Resect nerve proximally and distally until healthy nerve encountered

Nerve reconstruction

Nerve defect ≥3 cm

Concern for nerve viability present?

Yes

No

H. Place bioabsorbable nerve conduit

Nerve defect ≤3 cm

Reexplore at 3 weeks

Tension-free nerve graft

Nerve ends viable?

No

Yes

May observe patient for ≤3 months to monitor recovery before nerve grafting
CHAPTER 86  ACUTE NERVE INJURIES: CLOSED

Ryan D. Katz • A. Lee Dellon

A  After blunt trauma, a closed injury to a peripheral nerve is assumed when a patient has pain, numbness, weakness, or is unable to move certain parts of an extremity. It is essential to evaluate the extremity for the presence of a vascular injury, compartment syndrome, and fracture/dislocation. Any of these conditions may require open treatment. For these patients, the management of the peripheral nerve injury converts to the management of an open nerve injury.

B  To determine the management of the closed peripheral nerve injury, each sensory and motor function of that nerve is assessed and documented. For each fingertip or toe pulp innervated by that nerve, at a minimum, two-point discrimination is measured. If possible, the perception of vibration (any frequency) should be obtained and compared with that of the contralateral side. Abnormal vibratory perception in the acute setting can be compared with a compartment pressure of 30 mm Hg or more, which is an indication for decompression of the compartment and nerve.

C  Patients with motor palsy are observed to determine if surgical intervention is indicated. If sensory symptoms ameliorate, no intervention is required. Motor function dominates decision making. Electrodiagnostic testing will not show positive denervation for 3 to 6 weeks. If a pattern of nerve regeneration is present, it is most likely that the nerve will regenerate without decompression. If there is no evidence of nerve regeneration, surgical decompression must be performed at 3 months to provide the optimum chance for motor recovery.

D  When motor function improves, but then plateaus, decompression of the affected nerve may allow continued recovery.

E  When sensory symptoms persist for 6 months after the injury, surgical decompression is justified.

BIBLIOGRAPHY


**PATIENT WITH CLOSED PERIPHERAL NERVE INJURY**

History and physical examination

A Examine extremity for contributing injuries and treat as necessary

B Document degree of sensory and motor impairment of affected peripheral nerves

Motor palsy present?

No Yes

Associated problems do not require open surgical approach

C Clinical observation and neurosensory testing

Motor palsy improving

No improvement

Electrodiagnostic testing at 6 weeks after injury

D Improvement of motor palsy plateaus on examination/EMG

Nerve regeneration pattern present

Nerve regeneration pattern absent

Surgical decompression/exploration of affected nerve at 3 months

Motor palsy improved?

No Yes

Surgical decompression/exploration of affected nerve

Sensory symptoms present?

No Yes

Additional procedures as indicated

- Nerve transfers
- Tendon transfers
- Joint fusion

Long-term follow-up

E Sensory symptoms improving?

No Yes

Surgical decompression at 6 months

No treatment

No Yes

Long-term follow-up
CHAPTER 87  UPPER EXTREMITY AND DIGIT AMPUTATIONS

Aaron G. Grand

A The assessment of patients with injury and amputation of an upper extremity or digit includes evaluation for other injuries. Radiographs of the injured limb and amputated part are reviewed. The patient’s age, medical history, medication use, smoking history, handedness, and occupation should be obtained.

B The location of the injury is important, because certain digits are more important for adequate function than others. The thumb is critical for proper hand use. Additionally, amputations within zone II of the hand (proximal to the flexor digitorum superficialis tendon insertion) are associated with poor postoperative function.

C Clean, sharp injuries are more favorable for replantation than are crush or avulsion-type injuries. When evaluating an avulsion, the vessels should be inspected for intimal damage (ribbon sign) or blood extravasation along the vessel wall (red line sign). These are both poor prognostic factors for successful replantation.

D The duration of ischemia, which begins at the moment of injury, is critical in deciding whether a replantation may be successful. Muscle necroses after 6 hours of warm ischemia or 12 hours of cold ischemia. Skin can tolerate approximately 8 to 12 hours of warm ischemia and as long as 24 hours of cold ischemia. Tendon and bone have ischemia rates similar to that of skin. Although replantations have been performed on digits with prolonged ischemia times, common practice suggests maximum warm ischemia times of 12 hours for digits and 6 hours for major amputations; cold ischemia times are 24 hours for digits and 12 hours for major amputations.

E Grossly contaminated wounds have a higher rate of replantation failure. Wounds with specific types of contamination, such as lake or sea water, soil, or fecal matter require pathogen-specific antibiotic coverage.

F Regardless of the status of the limb and amputated part, the most important decision to make regarding replantation is whether the patient will survive the procedure. Replantation should not be attempted on any patient who is deemed too unstable to undergo a prolonged surgical procedure.

G When discussing replantation with a patient, the upper extremity surgeon must use his or her best judgment to determine the likelihood of limb or digit survival after replantation. Its function must be given equal consideration. A well-perfused but stiff and insensate digit or limb is rarely used by the patient and becomes a hindrance. In most cases, there are no absolute indications or contraindications for replantation. Therefore, the surgeon must ultimately use his or her judgement to answer the following question: Will the net result of replantation, despite the involved risks, be sufficiently better than that of revision amputation?

H Informed consent must be provided to the patient and family if possible. A realistic discussion is needed regarding the benefits of replantation versus costs, time off from work, rehabilitation needed, and postoperative sequelae. For many patients, revision amputation is the preferred option.

I When performing a replantation, skeletal stability is achieved first, followed by vascular repair. Nerves and tendons are repaired, and soft tissue coverage is accomplished. Fasciotomies are often needed, and carpal tunnel release should be considered. If the limb is congested because of limited vascular outflow, leech therapy may be required. The use of leeches is associated with Aeromonas hydrophila infection and should be treated with prophylactic trimethoprim/sulfa or a third-generation cephalosporin. Postoperative care generally involves continuous vascular monitoring, room warming to prevent vasoconstriction, avoidance of vasoconstricting medications, maintenance of adequate hydration, and an anticoagulation agent such as aspirin. Hand therapy should be initiated early in the postoperative course.

J When revision amputation is performed, the vascular structures must be ligated, nerves resected and buried, bone edges smoothed, and soft tissue coverage achieved. In addition, as much as possible of the retained part’s length should be maintained to help with function, stability, and the fitting of a prosthesis.

K All patients should have routine long-term follow-up, because many will require additional procedures to improve function. Postoperative problems associated with replantation, such as chronic pain or cold intolerance, need to be managed.

BIBLIOGRAPHY


PATIENT WITH UPPER EXTREMITY/DIGIT AMPUTATION

A History and physical examination
Treat/stabilize other injuries and evaluate injured structure and amputated part
Assess radiographs of injured and amputated parts

B Assess location of injury

C Assess nature of injury

D Assess time elapsed since injury occurred

E Assess degree of wound contamination

F Can the patient tolerate prolonged operation for replantation?

Yes

Does the amputated part have a reasonable chance of survival if replanted?

Yes

G Will the anticipated function outcome of the replanted part be sufficiently superior to amputation to warrant the risks, costs, and rehabilitation time?

Yes

H Does the patient want replantation after informed consent is discussed?

Yes (or unable to assess)

I Replant amputated part

K Long-term follow-up and revisions if indicated

No

J Revision amputation

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 88  UPPER EXTREMITY CRUSH INJURIES

Jonathan Cheng

The management of patients with a crushed upper extremity requires a systematic evaluation of all involved structures, including skin, muscle, tendon, nerve, bone, joints, and vasculature. The integrity of the elbow, shoulder, and neck should be evaluated and documented, because high-energy crush injuries may cause damage to more proximal structures. Extensive crush injuries may cause hypotension, renal failure, and hyperkalemia. A urinalysis and routine blood analysis should be obtained, including serum creatine kinase (CK) to assess for rhabdomyolysis. Urinary catheterization is essential to monitor renal function and fluid status and to direct resuscitation. The patient is resuscitated and stabilized while attention is directed to the injured part. Acute compartment syndrome can occur after minor trauma. Crush injuries can even occur in limbs subject to prolonged compression, as in obtunded or severely intoxicated patients, without evidence of major trauma.

Hypotension and/or myoglobinemia can cause renal damage and should be monitored closely. Serum CK and urine myoglobin should be tracked serially to assess the progression and clearance of by-products of myonecrosis. Cola-colored urine can indicate the presence of free myoglobin and should be emergently addressed with aggressive intravenous hydration, with consideration of urine alkalinization and osmotic versus loop diuresis. Patients with renal failure may require dialysis.

Compartment syndrome is a frequent sequela of crush injuries. An impending ischemic compartment syndrome is indicated by a globally tense hand and/or forearm on visual and manual inspection and by rapidly evolving findings on examination. Findings also include pain that is not proportional to the examination, pain on passive stretching of muscles, and paresthesia. Paralysis and pulselessness are end-stage findings. The clinical signs of compartment syndrome are not always conclusive. Compartment pressures can be monitored: when the pressure is greater than 30 mm Hg, or greater than diastolic blood pressure minus 20 mm Hg in hypotensive patients, a fasciotomy should be performed. When clinical suspicion is exceedingly high, a conservative approach is compartment release, despite quantitative compartment pressures that do not strictly meet the criteria provided previously. After decompression, reassessment may be required in 24 to 36 hours to determine the need to debride necrotic muscle.

Once confirmed, compartment decompression should be undertaken immediately. Early compartment decompression can prevent the late sequelae of ischemic necrosis.

The renal status is monitored until it is stable. The patient is splinted in an intrinsic-plus position, with the thumb in functional abduction for comfort and maintenance. Aggressive hand therapy is initiated early.

BIBLIOGRAPHY

PATIENT WITH CRUSH INJURY OF THE UPPER EXTREMITY

A History and trauma examination

Laboratory studies, including serum CK and urinalysis

B IV fluids

Focused physical examination

C Measure compartment pressure

Compartment pressure low

Low clinical suspicion for compartment syndrome

Observe

Compartment pressure high

High clinical suspicion for compartment syndrome

D Decompression fasciotomy

E Splint after injury

Hand therapy

Long-term follow-up
A patient with open wounds of the hand and upper extremity requires a thorough examination to determine the extent of the wound, the tissues that have been lost, and the presence of necrotic or infected tissue. The neurovascular status of the limb must be assessed and documented.

Before any procedure to definitively close the wound is performed, tissue equilibrium must be established. Necrotic or infected tissue is debrided with serial procedures if necessary. Bony stability is achieved. Intraoperative joint manipulation and/or capsulectomy may be required. Edema management and temporary coverage can be provided using negative pressure therapy devices.

In a patient with exposed nonvascularized structures in the hand or arm, flap coverage is necessary for adequate wound closure. Skin grafts will not adhere to tendon without peritenon, or to bone without viable periosteum. In some cases, local wound care and/or vacuum-assisted closure devices may be used to allow sufficient wound granulation so that skin grafting can be performed.

One of the key considerations when deciding how to provide tissue coverage to an injured upper extremity is the quality of sensory feedback from the injured part. This is used to determine the need for sensate versus nonsensate tissue transfers.

Distant pedicle flaps are generally considered the treatment of last resort for open wounds of the upper extremity. The groin flap is traditionally used in these cases. It is a very reliable flap, with minimal donor site morbidity. However, it requires two operations, keeps the hand in a dependent position, prevents mobility of the entire upper extremity, and, despite debulking efforts at division and inset, is always significantly thicker than the normal tissues of the hand.

When a sensate flap is required to optimize function, the availability of local tissue should be assessed. If no local or regional flaps are available, neurotized microvascular tissue transfer is indicated.

When the wound bed is vascularized and sensate tissue is not necessary, coverage with a skin graft may be possible. When there is concern for contracture, a full-thickness skin graft (FTSG) is indicated. Recently, the use of artificial dermal replacement substitutes has become popular. For large defects or those requiring padding, a local or regional flap or free tissue transfer may be required.

BIBLIOGRAPHY


PATIENT WITH OPEN WOUND OF THE HAND

History and physical examination

A. Determine degree of tissue loss and associated injuries

B. Repair critical structures and achieve tissue equilibrium

C. Nonvascularized structures exposed

- Assess sensory importance of injured area

D. Critical sensory area

- Sensate flap needed

E. Is local tissue available?

- Yes: Sensate local flap
- No: Neurotized free tissue transfer

F. Wound coverage

- FTSG
- Dermal substitute with staged STSG
- Local or regional flap
- Free tissue transfer

G. Will STSG impair function?

- Yes: Neurotized free tissue transfer
- No: Sensate local flap

Splinting/hand therapy

Long-term follow-up
CHAPTER 90  UPPER EXTREMITY INJECTION INJURIES

Jonathan Cheng

To determine the optimal treatment for patients with upper extremity injection injuries, historical information of importance includes when and how the injury occurred and what agent was injected. Details of the injected agent include: type, amount, temperature, and pressure. The site of injection, vascular status of the hand, active range of motion, and sensory loss should be noted during the physical examination. Radiographs are essential and help to determine the extent of the injection for radiopaque agents. The carpal tunnel and forearm should be investigated to determine proximal tracking of the injected substance.

Petroleum and paint products cause marked inflammatory reactions, which can rapidly compress critical structures. Immediate surgical treatment is required.

Injections of air or water may be less damaging and treated with close observation. Prophylactic antibiotic agents should be administered, because the injectate may be contaminated.

Debridement and decompression require extensive exposure of the injection site. Material injected into the hand can frequently track into the forearm. All foreign material is removed using irrigation, and mechanical debridement should be attempted. Nonviable tissue is debrided.

Compartmental decompression requires division of the interosseous compartments of the hand. Injection into the hand requires decompression of the carpal tunnel and frequently the forearm.

Open wounds are irrigated. A pulsatile lavage device may be used, with careful consideration given to avoid iatrogenic injury from overly aggressive mechanical action. Drains are inserted and the wound is left open.

Postoperatively, antibiotic agents are administered and the extremity elevated. The wounds are inspected frequently to detect infection and/or necrotic tissue. Further debridement is performed as needed. The wounds are closed when they are free of infection and necrotic tissue. The wound is closed directly, with a skin graft, or with a flap as necessary.

Hand therapy is started early, often before wound closure. Splints should be applied early in the treatment phase to place the hand in an intrinsic-plus position, with the thumb in functional abduction.

BIBLIOGRAPHY


PATIENT WITH UPPER EXTREMITY INJECTION INJURY

A  History and physical examination
  Obtain radiographs
  Determine substance injected

B  Petroleum or paint product

C  Air or water
  Impaired sensation or vascularity, compartment syndrome
  Observation
  Antibiotic therapy
  No impaired sensation or vascularity, soft compartments
  Observation

D  Debride

E  Decompress compartments

F  Irrigate wound and leave open

G  Antibiotic therapy
  Extremity elevation
  Observation
  Persistent infection and/or necrotic tissue
  Serial debridement

H  Hand therapy/splinting
  Residual functional deficit?
  Yes
  See algorithms 83-86
  No
  No therapy indicated
When evaluating a patient with a potential hand infection, the history is extremely important and helps direct treatment. Patients with known diabetes, renal failure, immunosuppression, or organ transplantation are at high risk for invasive and aggressive infections by standard organisms, as well as less commonly encountered bacterial and fungal organisms.

The physical examination should include the patient’s vital signs and overall appearance to evaluate for systemic signs of sepsis or distress. The following should be recorded: the patient’s appearance, the position and amount of guarding of the affected part, swelling, erythema, striae, warmth, tenderness, crepitus, fluctuance, pain with movement, vesicles, pustules, wounds or defects, vascularity, sensory deficits, gangrene or necrosis, and any other notable characteristics.

Plain radiographs can be used to document foreign bodies, osteomyelitis, increased or decreased joint space, fractures, gas, and soft tissue swelling.

Fingertip infections are usually felon or paronychias. Felons and acute paronychias are usually staphylococcal infections; chronic paronychias are most frequently candidal in origin.

Any fluid-filled vesicle or shallow ulcer on the digit should receive consideration for herpetic whitlow, which is best treated with local wound care. A history of occupational exposure to herpetic lesions (such as dentists/oral hygienists/health care workers) or previous history of other herpetic lesions or recurrent digital infections suggests the diagnosis. A Tzanck smear and cultures should be performed.

All digital infections should be evaluated for flexor tenosynovitis. Young, sexually active patients without a history of inoculation or trauma may occasionally harbor Neisseria gonorrhoeae infections, which rarely require surgical debridement and can usually be treated with intravenous antibiotic agents. The most common organism of finger infections is Staphylococcus aureus. It may be treated with intravenous antibiotic agents if detected within the first 24 hours and the patient’s progression appears very early.

The flexor sheath may be aspirated to obtain a culture specimen. For fulminant tenosynovitis or cases older than 24 hours, we prefer operative debridement with cultures and intravenous antibiotic therapy. Cellulitis requires observation and empiric antibiotic agents, because it may progress to abscess or more serious infections. Most cases of cellulitis are caused by S. aureus or beta-hemolytic streptococci. Cellulitis that does not respond early to intravenous antibiotic therapy in immunosuppressed or high-risk patients may require biopsy and culture to direct antibiotic therapy and wide local debridement to prevent progression of the infection.

Continued
PATIENT WITH INFECTION OF THE HAND OR DIGITS

A History and physical examination

B Hand radiographs

Assess location of infection

Continued

C Fingertip

Are Kanavel signs present?

No

Yes

D Is there a fluid-filled vesicle or shallow ulcer?

No

Abscess at finger pad

Incision and drainage

Antibiotic therapy

Incision and drainage

Antibiotic therapy

Incision and drainage or marsupialization

Antibiotic therapy and/or fungal therapy

Abscess at nail complex

Acute condition

Chronic condition

Medical management

Antibiotic therapy

Finger

E Are Kanavel signs present?

No

Yes

Symptoms present <24 hours and mild

Perform Tzanck smear to rule out herpetic whitlow

Antibiotic therapy

Improved?

Yes

No

Fluctuant abscess present?

Yes

No

Incision and drainage

Antibiotic therapy

Incision and drainage

Incision and drainage with exploration of flexor sheath ± irrigation

Incision and drainage

Antibiotic therapy

Improved?

No

Yes

Hand therapy

Antibiotic therapy

Incision and drainage

Long-term follow-up

Continued
Patients on active immunosuppressive chemotherapy and organ transplant patients are at higher risk for infection and crystalline arthropathy. Patients may present with underwhelming pain levels (that is, pain that is less severe than one would anticipate with a septic joint) but may have serious infections present. Joint aspiration and consultation with a rheumatologist may be necessary. Gout should always be ruled out.

Necrotizing soft tissue infections of the hand are uncommon but can be life threatening. Operative debridement is the definitive therapy. The history may also help direct therapy (for example, waterborne injuries may be associated with *Vibrio* infection).

**NOTE:** All patients with hand infections should receive protective splinting, with the hand in the safe (intrinsic-plus) position when possible. Therapy with a qualified hand therapist should begin as soon as the infection is controlled and the patient is able to cooperate. Continued therapy for range of motion is essential.

**BIBLIOGRAPHY**

PATIENT WITH INFECTION OF THE HAND OR DIGITS

A History and physical examination

B Hand radiographs

Assess location of infection

Continued

Joint pain or swelling

History of crystalline arthropathy or rheumatoid disease?

Yes

Aspirate joint for fluid analysis, cell count, Gram stain, and culture

Evidence of infection?

No

Rheumatology consult

Follow up

No

Yes

Incision and drainage ± hand fasciotomies if compartment syndrome is present

Antibiotic therapy

Hand therapy

Follow up

No

Yes

G History of recent bite, puncture, immuno-suppression, distant infection (pneumonia, STD, endocarditis, or other infection)? Patient appears septic/toxic?

Antibiotic therapy

Hand therapy

Follow up

H Hand

Evaluate dorsal and volar surfaces to ensure that no collar button abscess exists

Incision and drainage

Antibiotic therapy

Hand therapy

Follow up

Evidence of infection?

No

Yes

Antibiotic therapy

Hand therapy

Follow up
CHAPTER 92  BONE AND JOINT PAIN

Erika Henkelman • Michael W. Neumeister

A Hand pain may be the result of numerous conditions. Although bone and joint pain may frequently be the source of hand pain, a comprehensive physical examination that encompasses soft tissue (tendons, nerves, vessels, skin, and subcutaneous tissues) as well as bones and joints are warranted to help delineate the nature and extent of the pain. The history should include patient factors such as hand dominance, occupation, hobbies, and cigarette use; medical conditions such as gout, pseudogout, arthritis, psoriasis, autoimmune disorders, or Raynaud’s disease; inciting events such as trauma or prior surgery; exacerbating and alleviating factors; and associated symptoms such as edema or erythema. The physical examination should include a visual assessment of deformities, edema, erythema or skin changes; palpation for nodules or masses, joint stability, crepitance within or around the joint, and localization of pain; active and passive range of motion; and strength. The patient’s vascular status is also assessed.

B Plain film radiographs are used to evaluate bony contour, fractures, nonunions, malunions, joint instability, tumors, foreign bodies, and degenerative processes. Three radiographic views (PA, lateral, and oblique) are required for a complete assessment of bones and joints. Each bone and joint is thoroughly assessed to identify intraarticular and nonarticular fractures, dislocations, irregularities of the joint surface, osteophytes, sclerosis, and joint space narrowing or widening. Tumors such as enchondromas, aneurysmal bone cysts, or giant cell tumors may show as lytic lesions within the medullary canal. Periosteal reactions may be seen in association with malignant tumors.

C Occasionally patients have bone and joint pain, even though radiographs appear normal. Specific tumors such as glomus tumors or conditions such as septic arthritis, osteomyelitis, and synovitis often cannot be visualized on radiographs and may require further investigation with another imaging modality such as MRI or CT scans. Further investigations may include bone scans, angiography, or arthroscopy, based on the findings of the history and physical examination, coupled with negative radiographic and MRI findings.

D Hand pain with negative imaging is often the result of ligamentous strain or synovitis and is treated with nonsteroidal antiinflammatory drugs (NSAIDs) or steroid injections combined with splinting, offloading the joint, and possibly subsequent therapy. Serum evaluation for autoimmune arthritis may also be considered.

E An unstable joint can be caused by collateral ligament disruption. The volar plate or central slip may also be involved, resulting in a swan neck or boutonnière deformity.

F Splinting is the initial treatment for joint instability unless there is a notable complete tear of a ligament.

G The most common site for complete tears is the ulnar collateral ligament of the thumb. This is found on physical examination of the thumb by radial deviation without a distinct endpoint. The collateral ligament can become displaced superficial to the abductor aponeurosis (Stener lesion), which prevents healing despite splinting. Surgery is required to correct the completely unstable joint. Reconstruction may involve direct repair of the ligament, tendon grafts, or fusion of the joint, depending on the patient’s occupation, the joint involved, the clinical examination, and the intraoperative findings.

H An abnormal articular surface of a joint may be the result of an obvious or occult intraarticular fracture, autoimmune arthritis, or degenerative changes. Patients may have physical examination findings such as a visible deformity, swelling around the joint, an effusion within the joint itself, a positive grind test, or significant discomfort with or limitation of active and passive range of motion.

I Serum evaluation for arthritic conditions using tests including antinuclear antibodies, sedimentation rate, CBC, and rheumatoid factor may be warranted to rule out rheumatoid arthritis or other autoimmune arthritidies such as psoriasis, Sjögren’s syndrome, or lupus.

J Osteoarthritis is very common at the interphalangeal joints, whereas rheumatoid arthritis more frequently manifests at the wrist and metacarpophalangeal joints. Osteoarthritis can be treated with NSAIDs, steroid injections, or, ultimately, arthroplasty or fusion.

K Abnormal radiographs of the bone may be the result of a fracture, tumor, or osteomyelitis. Lytic lesions such as enchondromas, aneurysmal bone cysts, or giant cell tumors are often treated with curettage and bone grafting. Osteoid osteoma characteristically causes night pain that is relieved with NSAIDs. It has a central nidus and a target-like appearance on radiographs. Treatment requires curettage of the nidus and bone grafting.

BIBLIOGRAPHY


PATIENT WITH BONE OR JOINT PAIN

A History and physical examination

B Hand plain films

Radiographs normal

C Consider additional imaging based on complaint

• CT
• MRI
• Angiography
• Arthroscopy

Imaging normal?

Yes

No

D Medical consultation for serologic evaluation

• NSAIDs
• Steroid injections
• Splinting
• Therapy

Treat specific condition as indicated

Radiographs demonstrate abnormal joint

E Joint is unstable

F Partial ligament tear

Splint

G Complete ligament tear

Joint reconstruction

H Joint is stable

I Intraarticular fracture

Arthritis

Treat as indicated

J Serum evaluation

Serum evaluation negative

Osteoarthritis

Treatment

Serum evaluation positive

Autoimmune arthritis

Treatment

Condition improved?

Yes

No

K Radiographs demonstrate osseous abnormality

Examination suggests septic arthritis

L Joint aspiration

Positive for infection

 Positive for gout or medical issue

Formal incision and drainage

Medical consultation

Long-term follow-up

Treat as indicated

Long-term follow-up

Medical consultation

Treat specific condition

Arthroplasty

Condition improved?

Yes

No

Physical therapy

Long-term follow-up

Joint fusion

Ch 072-101_Marsh pt 02s4_169-238_r8b.qxd:Marsh set up 3/6/10 1:17 PM Page 215

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 93  THE STIFF JOINT
Erika Henkelman  •  Michael W. Neumeister

A. The maximum active and passive flexion and extension of each joint should be documented for patients with stiff joints so that the progression or regression of composite motion may be assessed over time.

B. The rheumatoid hand may have joint stiffness resulting from pain, swelling, intrinsic tightness, swan neck deformity, boutonniere deformity, ulnar drift, or joint deformity. Ulnar drift is often associated with subluxation of the proximal phalanx off the metacarpal head, and chronic subluxation predisposes the joint to degeneration and contracture. Medical management of rheumatoid arthritis, lupus, gout, and other polyarthropathies can slow the progress of the disease and joint destruction. Patients with pain and stiffness resulting from osteoarthritis may benefit from intraarticular steroid injection. Those with heterotopic ossification may benefit from indomethacin treatment or radiation therapy.

C. Severe joint degeneration may require arthroplasty or arthrodesis. Arthrodesis is an excellent procedure for eliminating pain and should be considered in patients with poor bone stock, severely damaged or unbalanced soft tissues or tendons, and those who prefer single surgery. The proximal interphalangeal (PIP) or metacarpophalangeal (MP) joints should be fused, with increased degrees of flexion of radial compared with ulnar digits to give a more functional position. It is important to consider that both arthrodesis and arthroplasty can relieve pain. When choosing arthrodesis versus arthroplasty, the patient’s profession, handedness, extent of joint destruction, bony support, ability to tolerate a lengthy surgery, and the duration of rehabilitation are all important considerations in the decision-making process.

D. Tendon injury, edema, adhesions, volar plate or capsular contracture, and collateral ligament contracture can diminish the range of motion in the distal interphalangeal (DIP), PIP, or MP joints.

E. A contracture of the DIP joint is usually not functionally significant unless there is a fixed flexion or hyperextension deformity. Any underlying cause such as a swan neck or boutonniere deformity should be addressed. Fusion in a slightly flexed position of 20 to 30 degrees gives excellent function, and contracture release may have limited functional value.

Continued
PATIENT WITH A STIFF JOINT

History and physical examination

Evaluate active range of motion versus passive range of motion

Active = passive range of motion

Obtain radiographs

Joints not preserved

Rheumatology consult if indicated

Initial management

- Oral analgesics
- Intrarticular steroids
- Splinting
- Physical therapy

Is the patient a candidate for surgical reconstruction?

No

Yes

Continue with conservative management

Arthrodesis or arthroplasty

Hand therapy if indicated

Long-term follow-up

Joints preserved

Identify joints and structures involved

DIP joint

Nonoperative therapy

- Static splinting
- Dynamic splinting
- Hand therapy

Stiffness improved?

Yes

No

Long-term follow-up

Flexor tenolysis or extensor tendon repair as indicated

Division of dorsolateral fibers of extensor tendon

Joint mobile?

Yes

No

Hand therapy

Arthrodesis

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Nonoperative treatment of PIP and MP joint contractures with dynamic splinting in the daytime and static progressive splinting at night may be required until progress plateaus over several weeks to months. Edema should be controlled and hand therapy undertaken. Nonoperative management of joint contractures leads to adequate functional outcomes in most patients, without the need for surgical intervention. Surgical release should not be attempted unless the contracture is functionally disabling and the patient is diligent with therapy. Wide awake surgery is often beneficial. It allows assessment of active and passive range of motion after the release of each sequential structure.

Outcomes of PIP contracture release surgery are unpredictable with a high rate of recurrence. Gains seen in the operating theater overestimate the final outcome. In general, the more structures requiring release, the poorer the outcome.

MP flexion contractures typically have extraarticular causes such as intrinsic muscle tightness. Functional MP flexion is 75 degrees in the index and long fingers and 80 to 85 degrees in the ring and small fingers. If the interphalangeal (IP) joints are supple, 60 degrees of flexion (with less in the radial digits) signifies that the patient is unlikely to benefit from surgical release.

If passive range of motion exceeds active range of motion in a chronically stiff joint, the neuromusculotendinous unit and superficial scarring should be considered as sources of stiffness.

Nerve conduction studies or EMGs may be useful to assess muscle innervation in the setting of nerve injury, because these injuries can lead to joint stiffness. A low ulnar or median nerve injury results in loss of intrinsic muscle function with preservation of function of the long finger flexors and extensors. The lumbricals fail to extend the PIP joints and flex the MP joints. The unopposed forces of the FDP tendons pull the IP joints into flexion, and the unopposed actions of the extensor tendons draw the MP joints into hyperextension. This results in a claw deformity. Early antclaw splinting is essential to prevent joint contractures and stiffness.

Chronic regional pain syndrome is a combination of hyperesthesia and allodynia, sympathetic dysfunction, edema, trophic changes, and motor dysfunction. Joints have variable degrees of stiffness and swelling. A high index of suspicion allows early clinical diagnosis, with bone scan a useful ancillary diagnostic test. Treatment options include sympatholytic drugs, nerve blocks, splinting, and hand therapy.

BIBLIOGRAPHY


PATIENT WITH A STIFF JOINT

History and physical examination

Evaluate active range of motion versus passive range of motion

Passive > active range of motion

Identify cause of joint stiffness

Surgical release of flexion contracture

Surgical release of extension contracture

Nonoperative therapy

Skin/fascia

Tendon

Release contractures

Inject with steroids

A1 pulley release

 Consider EMG/nerve conduction study

Nerve or functional reconstruction

Consider bone scan

Nonoperative management

Complex regional pain syndrome

Hand therapy

Splinting

Nerve blocks

Medical therapy

Splints/hand therapy

Patient improved?

Yes

No

Surgical release of flexion contracture

Surgical release of extension contracture

Check reins

Lateral bands

Volar plate complex

Accessory collateral ligaments

Collateral ligaments ± Flexor tenolysis

Transverse fibers of retinacular ligaments

Dorsal fibers of collateral ligaments

All collateral ligaments of proximal phalanx ± Extensor tenolysis

± Flexor tenolysis

± Intrinsic release

± Balancing procedures

Dorsal capsule

Dorsal half of collateral ligaments

All of collateral ligaments from MP (ulnar → radial)

Volar plate

Accessory collateral ligaments ± Extensor tenolysis

Dorsal capsule

Dorsal half of collateral ligaments

All of collateral ligaments from MP (ulnar → radial)

Volar plate

Accessory collateral ligaments ± Extensor tenolysis

Splints/hand therapy

Patient improved?

Yes

No

Arthrodesis or arthroplasty

Hand therapy

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 94  THUMB RECONSTRUCTION

Anthony E. Sudekum

All significant thumb injuries should be evaluated and treated by a qualified hand surgeon as early as possible after the injury. Greater emphasis is placed on preservation and reconstruction of the thumb than the other digits because of its relative importance to hand function. Every reasonable effort should be made to repair and/or reconstruct the injured thumb. Not all patients are candidates for microvascular replantation or staged, complex reconstruction. In general, older, less healthy individuals and smokers are relatively poorer candidates for complex reconstruction, compared with younger, healthier patients. It is imperative that both the surgeon and patient (or patient’s family in the case of a child) understand the risks, benefits, and burdens of various treatment options.

If avulsed or amputated skin is available and in good condition, it should be aggressively defatted, resized, and replaced as a free graft. Replaced distal tip skin must first be thinned and stretched tightly to facilitate graft take. This tissue is an ideal match, and its use eliminates potential autograft donor site morbidity. Skin can be successfully replaced during the first 24 hours of warm ischemia and during the first 48 hours of cold ischemia. Most soft tissue defects distal to the interphalangeal (IP) joint can be treated with primary closure using local flaps and/or skin grafts. Full-thickness skin defects less than 1 cm² can be treated with daily dressing changes and allowed to heal by secondary intention.

Preservation of thumb length is an important consideration, but modest shortening of the distal phalanx tuft (up to 1 cm) is well tolerated. Minimal bone shortening can often make the difference between a one-stage procedure performed in the emergency room and a more complex and costly secondary procedure such as a dorsal kite flap or volar Moberg flap.

It is important to preserve or restore thumb sensation on the distal phalanx. Local flaps that utilize the dorsal sensory radial nerve branches to the index finger are well suited for this purpose. The dorsal sensory kite flap can extend distally to the level of the nail bed. The radial innervated dorsal index cross-finger flap can be used to reconstruct the palmar pad distal to the IP flexion crease. The ring finger neurosensory island flap can provide excellent sensate soft tissue for thumb reconstruction, but the donor site morbidity with this procedure is considerable, and meticulous dissection of the ring finger neurovascular pedicle is critical.

Continued
PATIENT REQUIRING POSTTRAUMATIC THUMB RECONSTRUCTION

A History and physical examination

Assess location of defect

Defect distal to IP joint

D No exposed bone/tendon

E Exposed bone/tendon

Soft tissue defect <1 cm²

Soft tissue defect >1 cm²

FTSG

G Dressing changes and healing by secondary intention

Bone shortening and closure with local flaps

H No length preservation required

I Length preservation and sensation restoration desired

Dorsal defect

Wound closure

Volar defect

Wound closure

• Index cross-finger flap
• Kite flap
• Microvascular reconstruction (partial toe wrap around flap, toe pulp free flap)

• Moberg flap
• Index radial sensory flap
• Microvascular reconstruction (partial toe wrap around flap, toe pulp free flap)

Long-term follow-up
E An attempt at replantation of the acutely severed thumb should always be considered as long as the available tissue is suitable, the patient is a candidate for microvascular surgery, and he or she wishes to proceed. In multiple-digit injuries with an unsalvageable thumb, an amputated finger in better condition can be transplanted in its place. Similar to replantation, toe-to-thumb transfer is a significant commitment for the patient and family. The donor site morbidity, recovery time, and financial considerations should not be underestimated. When a significant deficiency of palmar soft tissue exists, the usual approach is to first perform a groin flap, followed by a microvascular toe-to-thumb transfer as a secondary procedure. Careful preoperative planning and meticulous tissue handling will optimize results.

F Index or middle finger pollicization should always be performed as a secondary procedure. This is an excellent option for patients who desire reconstruction but are not candidates for microvascular toe-to-thumb transplantation. In patients who have sustained multiple-digit injuries, including partial finger amputations, pollicization using one of the shortened fingers should be considered.

G If replantation is not feasible or successful, then a groin or abdominal flap can be used to provide good quality soft tissue coverage, which can also serve as a base for later thumb reconstruction. In patients with less than half of the proximal phalanx remaining, consideration is given to secondary procedures that add bone length to improve pinch and prehension. Successful distraction-lengthening requires the presence of at least three fourths of the first metacarpal, an adequate soft tissue envelope, and a compliant, healthy patient.

H The first web space should always be evaluated as part of thumb reconstruction. Small procedures to deepen the web space can often lead to large gains in thumb function.

I Occupational therapy by a certified hand therapist (CHT) should be an essential part of the postoperative protocol for patients who undergo significant thumb reconstruction.

BIBLIOGRAPHY
PATIENT REQUIRING POSTTRAUMATIC THUMB RECONSTRUCTION

A. History and physical examination

Continued

Assess location of defect

Defect proximal to IP joint

Is patient a candidate for complex thumb reconstruction?

Yes

Inadequate palmar/thenar soft tissue base

Provide durable soft tissue coverage

- Groin flap
- Reverse radial forearm flap
- Microvascular tissue transfer

No

Debride/revise amputation site and close with local tissue groin flap and/or skin grafts

H. Is the first web space adequate?

Yes

Occupational/physical therapy

F. Distraction osteogenesis to lengthen first metacarpal
- Iliac crest or toe phalanx bone graft

No

Is local tissue available for web space reconstruction?

Yes

- FTSG
- Two-stage pedicle flap (chest flap)
- Reverse radial forearm flap
- Microvascular tissue transfer

Occupational/physical therapy

No

- Four-flap Z-plasty
- First dorsal metacarpal artery flap

I. Occupational/physical therapy

Long-term follow-up

Defect proximal to MP joint

E. Toe-to-thumb transplant

- Great toe
- Second toe
- Partial toe wraparound

Defect between MP and IP joint

Index or middle finger pollicization

C. No

Adequate thenar/palmar soft tissue base

Is patient a candidate for microvascular reconstruction?

Yes

Index or middle finger pollicization

G. No

Inadequate palmar/thenar soft tissue base

Provide durable soft tissue coverage

- Groin flap
- Reverse radial forearm flap
- Microvascular tissue transfer

No

Debride/revise amputation site and close with local tissue groin flap and/or skin grafts

H. Is the first web space adequate?

Yes

Occupational/physical therapy

F. Distraction osteogenesis to lengthen first metacarpal
- Iliac crest or toe phalanx bone graft

No

Is local tissue available for web space reconstruction?

Yes

- FTSG
- Two-stage pedicle flap (chest flap)
- Reverse radial forearm flap
- Microvascular tissue transfer

Occupational/physical therapy

No

- Four-flap Z-plasty
- First dorsal metacarpal artery flap

I. Occupational/physical therapy

Long-term follow-up

Defect proximal to IP joint

Is patient a candidate for microvascular reconstruction?

Yes

Index or middle finger pollicization

G. No

Adequate thenar/palmar soft tissue base

Is patient a candidate for microvascular reconstruction?

Yes

Index or middle finger pollicization

E. Toe-to-thumb transplant

- Great toe
- Second toe
- Partial toe wraparound

Defect between MP and IP joint

Index or middle finger pollicization

C. No

Inadequate palmar/thenar soft tissue base

Provide durable soft tissue coverage

- Groin flap
- Reverse radial forearm flap
- Microvascular tissue transfer

No

Debride/revise amputation site and close with local tissue groin flap and/or skin grafts

H. Is the first web space adequate?

Yes

Occupational/physical therapy

F. Distraction osteogenesis to lengthen first metacarpal
- Iliac crest or toe phalanx bone graft

No

Is local tissue available for web space reconstruction?

Yes

- FTSG
- Two-stage pedicle flap (chest flap)
- Reverse radial forearm flap
- Microvascular tissue transfer

Occupational/physical therapy

No

- Four-flap Z-plasty
- First dorsal metacarpal artery flap

I. Occupational/physical therapy

Long-term follow-up
CHAPTER 95  SCAPHOID NONUNION

Subhro K. Sen • James Chang

A. The incidence of scaphoid nonunion is estimated to be 5% to 15% of all scaphoid fractures. Factors contributing to the nonunion of scaphoid fractures include delay in diagnosis and/or treatment, fracture displacement, fracture comminution, proximal location, inadequate immobilization, avascular necrosis, associated carpal instability, and poor patient compliance. Avascular necrosis most commonly involves the proximal pole because of limited vascularity. MRI is a reliable tool used to assess avascular necrosis. CT imaging can be used to assess bony alignment. Long-term progression of scaphoid nonunion has been shown to lead to carpal collapse and marked disability from degenerative arthritis, known as scaphoid nonunion advanced collapse (SNAC). The management of scaphoid nonunion greatly depends on the presence or absence of carpal arthritis.

B. In the absence of significant arthritis, open reduction and internal fixation can restore length to the scaphoid and correct carpal deformity. The surgical technique involves debridement of fibrous tissue, reduction of bony fragments, bone grafting, and cannulated compression screw fixation.

C. Bone grafting addresses the need to fill bony defects created after debridement. A number of techniques have been described. Depending on the need, the bone graft may consist of cancellous or corticocancellous pieces. Some surgeons now advocate vascularized bone grafting for all cases of nonunion.

D. Vascularized bone grafting has been shown to have union rates as high as 88% for proximal pole nonunions, compared with 47% with conventional bone grafting. Several sources of vascularized bone grafts are available, but the most reliable graft is harvested from the dorsoradial aspect of the radius. Adjunct bone stimulation is a noninvasive technique of promoting bone growth in problematic fractures by application of a low electrical current or ultrasound to the fracture. Bone stimulation is a controversial modality.

E. Several salvage procedures are possible when nonunion persists. Radial styloidectomy relieves both pain and restriction of movement associated with impingement of the scaphoid on the radius. Wrist denervation with posterior and anterior interosseous neurectomy is an effective method of providing relief in patients with chronic wrist pain. Distal scaphoid resection also provides pain relief and is a motion-preserving procedure that requires only a short period of immobilization.

F. Proximal row carpectomy (PRC) and scaphoid excision with four-corner fusion are two standard salvage procedures. In the setting of radiocarpal arthritis, the proximal carpal row (scaphoid, lunate, and triquetrum) can be removed in the PRC procedure. The capitate then articulates with the lunate facet of the radius. Most series show maintenance of about 50% of wrist motion and 50% or more of hand strength, compared with the opposite side. Alternatively, in patients with midcarpal degeneration, the scaphoid can be excised and four-corner fusion (lunate, capitate, hamate, and triquetrum) can be performed. This maintains the full length of the hand and the lunate in the lunate facet of the radius. Some series have shown better strength but less mobility with this technique, and others have shown results equivalent to those obtained with the PRC. The four-corner fusion does appear to be more durable for younger patients and for those who perform heavy labor.

G. If a patient presents with pancarpal arthritis or motion-sparing measures have not alleviated pain, total wrist fusion is the final surgical option. The distal radius is fused through the proximal and distal carpal rows to the third metacarpal, typically with a dorsal plate. Multiple long-term studies have shown excellent pain relief and durability; this comes at the exchange of total loss of wrist motion. Wrist fusion is surprisingly well tolerated in most patients, especially if the other hand/wrist is unaffected.

BIBLIOGRAPHY


PATIENT WITH SCAPHOID NONUNION

A History and physical examination

Are there signs and symptoms of arthritis or carpal collapse (scaphoid nonunion advanced collapse [SNAC] wrist)?

B No

Assess location of scaphoid nonunion

Proximal one third of scaphoid

D Internal fixation with vascularized bone graft = bone stimulation

Treatment successful?

Yes

Hand therapy  Long-term follow-up

No

Consider salvage procedure

E Does the patient or surgeon feel a more conservative approach is indicated based on symptoms and examination?

Yes

Salvage procedure

radial styloidectomy
wrist denervation
partial scaphoid excision

Treatment successful?

No

Salvage procedure

proximal row carpectomy
scaphoid excision and four-corner fusion

Treatment successful?

F

Yes

Hand therapy  Total wrist arthrodesis

Long-term follow-up

No

Hand therapy  Long-term follow-up

Yes
CHAPTER 96  IMPAIRED VASCULARITY

Christian E. Sampson

For patients with impaired vascularity, a thorough history and physical examination should be directed toward identifying cold intolerance, pain at rest, color changes, and tissue loss/ulceration. A careful neurovascular examination must be performed for each digit. The occupation of the patient is important to determine possible work-related risk factors. Manual laborers are at risk of vascular disease involving the larger vessels in the hand (hypotenar hammer syndrome) as well as small vessel/vasospastic disorders (hand-arm vibration syndrome). The use of tobacco, caffeine, and vasoactive medications should be documented. Comorbidities should be determined, especially diabetes, peripheral arterial disease, end-stage renal disease, coronary artery disease, and hypertension. There are four primary mechanisms of disease that produce hand ischemia: embolization, thrombosis, arterial disease, and vasospasm.

A continuous wave Doppler ultrasound examination and a physical examination with an Allen test (including a digital artery Allen test) help determine whether the level of vascular pathology is proximal or distal to the wrist crease.

Proximal or unilateral conditions usually represent large-vessel disease and generally require evaluation with arteriography or magnetic resonance angiography (MRA).

Diffuse, distal disease is typically seen in patients with autoimmune or connective tissue diseases predisposing them to vasospasm, or in patients with end-stage peripheral arterial disease or thromboangiitis obliterans. Scleroderma is the most common connective tissue disease seen in patients with diffuse, distal ischemia.

Segmental disease involving only one or two digits warrants more accurate evaluation with an arteriogram. This type of disease can occur as the result of proximal lesions producing distal microemboli. Although lesions of the radial or ulnar arteries can produce distal embolization, most emboli to the upper extremity are of cardiac origin.

Arteriography remains the benchmark for assessing vascular pathology in the hand. MRA is useful for assessment of the vascular tree proximal to the the wrist. Because the quality of resolution of the digital vessels with an MRA is often poor, standard arteriography is preferable when disease is suspected beyond the palmar arches.

Diffuse vascular compromise in the digits should be evaluated with digital plethysmography (pulse volume recordings [PVRs]). This test provides quantitative data regarding digital blood flow. Patients who demonstrate a positive response with provocative testing may have compliant vessels, indicating the potential for a positive response to medical or surgical therapy.

Medical therapy consists of behavior modification, biofeedback, and medication. The use of alpha-2 blockers, calcium channel blockers, rheologic agents, acetylsalicylic acid (ASA), topical nitrates, and/or sildenafil citrate (Viagra) has been advocated. If oral therapy does not control symptoms of pain and ulceration, parental administration of the prostaglandin E2 analogue, iloprost, has been effective for temporary relief.

Surgical revascularization should be considered in any patient with a discrete vascular lesion amenable to reconstruction and/or bypass. However, vascular reconstructions distal to the brachial artery have only a 35% long-term patency rate. Salvage procedures include free omental microvascular transfer and arteriovenous reversal. These surgical procedures should be considered in patients with limb-threatening ischemia who are not candidates for traditional bypass surgical procedures. All patients who undergo surgical intervention, and especially those who undergo vein graft bypass surgery, should be considered for periarterial sympathectomy (PAS) as adjuvant therapy.

PAS is a procedure in which the sympathetic nerves attached to an artery are surgically removed to allow the vessel to maximally dilate, thereby improving blood flow. At least 2 cm of vessel adventitia should be cleared.

The off-label use of botulinum toxin A in patients with digital ischemic ulcerations and pain has been reported to be of benefit when traditional medical therapy has failed, and as an alternative to PAS. However, controlled randomized trials have yet to be completed to scientifically validate the use of botulinum toxin A as an effective treatment modality.

When all nonsurgical and surgical treatment modalities are unsuccessful and a patient has worsening pain and ulceration, amputation may be required. In the absence of infection or uncontrollable pain, allowing distal parts of the digit to autoamputate is acceptable.

All patients require long-term follow-up. Smoking cessation and behavioral/lifestyle modifications must be followed for success.

BIBLIOGRAPHY


PATIENT WITH IMPAIRED VASCULARITY OF THE HAND

A History and physical examination

B Doppler ultrasound examination

C Proximal or unilateral disease

D Distal disease

C1 Obtain arteriogram or MRA

C2 Discrete vascular lesion present?

Yes

No

D1 Segmental/single digit

D2 Diffuse

E Digital plethysmography ± nerve block and warming

F Initiate medical therapy

F1 Successful resolution?

Yes

No

H Surgical revascularization

H1 Symptoms improved?

Yes

No

J Surgical or chemical (Botox) sympathectomy

J1 Symptoms improved?

Yes

No

K Tissue loss present?

Yes

No

L Long-term follow-up, medical therapy, and behavioral/lifestyle modifications

L1 No

L2 Yes

https://t.me/Free_Plastic_Reconstruction_Book
Patients with motor deficits of the hand are assessed to determine the likelihood of functional return without surgery. If functional return can be reasonably expected, surgical intervention is contraindicated. If functional return is uncertain, serial examination with or without nerve conduction studies and electromyograms is indicated. A number of nonsurgical options are available either as the patient recovers or before surgery. These include occupational and physical therapies as well as dynamic and static splints.

A comprehensive assessment of hand and proximal upper extremity function and strength should be documented. This assessment should include the patient’s age, motivation, intelligence, and comorbidities. Not all patients are good candidates for tendon transfer surgery.

Matching donors to deficits is the most critical part of functional restoration. Ideally, tendon transfers should match power, amplitude, and line of pull as closely as possible. A synergistic, rather than antagonistic, functional match of the donor to the deficit is preferred. One motor only should be used to power one deficit. In the absence of available motor donors, microvascular free functional muscle transfer should be considered.

Additional procedures may need to be performed before tendon transfer, including restoration of sensation, passive range of motion, or improvement of the soft tissue envelope. Irretrievable paralysis may be needed to improve proximal and distal function (for example, wrist fusion may allow additional transfers to improve forearm and finger function).

In both low and high median nerve injuries, thumb opposition is lost. Patients with complete high median nerve injuries also lose flexion of the thumb, index, and long fingers. (Some long finger movement may be provided by the ulnar nerve.)

With a low medial nerve injury, thumb opposition may be restored using the ring finger flexor digitorum superficialis (FDS), extensor indicis proprius (EIP), palmaris longus (PL), extensor digiti minimi (EDM), or abductor digiti quinti (ADQ).

With a high medial nerve injury, thumb flexion and opposition can be provided by transfer of the brachioradialis (BR) muscle. Index and long finger flexion can be provided by transfer of the extensor carpi radialis longus (ECRL). Alternatively, tenodesis of the index and long finger tendons to the ring and little finger profundus tendons can be performed. However, this does not give good grip strength.

In ulnar nerve injury, loss of intrinsic motor activity severely affects hand function. Loss of intrinsic function with preservation of extrinsic function produces the classic claw deformity. The long and ring index fingers are less affected than the ring and small fingers, because the long and index lumbricals are innervated by the median nerve. High ulnar lesions also render the flexor carpi ulnaris (FCU) and the flexor digitorum profundus (FDP) to the ring and little fingers nonfunctional. The loss of adductor pollicis weakens pinch between the thumb and index finger.

The ulnar claw deformity can be corrected with either static procedures to block hyperextension or dynamic procedures.

With high ulnar nerve lesions, ulnar deviation of the wrist may be lost. This can be improved by transferring the flexor carpi radialis (FCR) to the FCU. Flexion of the ring and little finger profundus can be improved by suturing their tendons to the long finger FDP tendon.

With radial nerve injury, wrist and finger extension are impaired or lost. Thumb extension is restored with the PL or FDS of the ring or long finger routed through the interosseous membrane. Finger extension is restored by transfer of the FDS of the long finger. Wrist extension is achieved by transfer of the pronator teres (PT) to the extensor carpi radialis brevis (ECRB). Thumb metacarpal stabilization may be obtained by transfer of the FCR to the abductor pollicis longus.

**BIBLIOGRAPHY**

PATIENT WITH MOTOR DEFICIT OF THE HAND

History and physical examination

A Assess nature and timing of injury

Paralysis with secondary nerve injury

B Assess functional deficits

Disrupted tendons

C Assess available donors

Match donors and deficits

D Additional procedures as necessary

Tendon transfers

E Median nerve injury

Low

Restore thumb opposition

F FDS (ring) transfer

• EIP transfer

• PL transfer

• EDM transfer

• ADQ transfer

High

Restore thumb opposition

Restore thumb flexion

Restore finger flexion

BR transfer

ECRL transfer

Long-term follow-up with hand surgeon and hand therapist

H Ulnar nerve injury

K Radial nerve injury

Low

Restore thumb extension

• PL transfer

• FDS transfer

• FCR transfer

High

Restore finger extension

• FDS (ring/long) transfer

• FCU transfer

• PT transfer

• FCR transfer

Stabilize thumb metacarpal

Long-term follow-up with hand surgeon and hand therapist

Clawing

I Static splinting

Dynamic treatment

J

Restore key pinch

Finger adduction

• FDS transfer

• BR transfer

• EDM transfer

Long-term follow-up with hand surgeon and hand therapist

Clawing

Static splinting

Dynamic treatment

Finger flexion

• FCR transfer

• FDP transfer

Long-term follow-up with hand surgeon and hand therapist
CHAPTER 98  DELAYED FLEXOR TENDON INJURIES
E. Gene Deune

Delayed repair of a flexor tendon laceration is necessary when the diagnosis was missed or the patient’s presentation to the hand surgeon was delayed. This often occurs when concurrent vital injuries require immediate attention.

According to most hand surgeons, after 3 weeks the two ends of a lacerated tendon can no longer be brought together without either marked flexion at the proximal interphalangeal (PIP) joint or undue tension at the site of repair.

If the tendon bed is smooth and unscarred, then the lacerated flexor tendon can be repaired with a one-stage tendon graft.

If severe scarring is present from either a concomitant injury, such as a bone fracture, or previous attempts at tendon laceration repair, primary tendon grafting is contraindicated. A silicone rod is inserted first to achieve a smooth bed for the tendon graft, which is performed 2 or 3 months later. The flexor digitorum superficialis (FDS) tendon is resected to provide room for the single tendon graft for flexor digitorum profundus (FDP) reconstruction.

BIBLIOGRAPHY
PATIENT WITH FLEXOR TENDON INJURY REQUIRING DELAYED OR SECONDARY TREATMENT

History and physical examination

A Did the flexor tendon injury occur more than 3 weeks ago?

No

B Exploratory surgery of finger/hand in OR

Can ruptured/lacerated tendon ends be approximated without tension or marked PIP joint flexion?

Yes

Primary end-to-end repair

No

C Is there severe scarring in the flexor tendon bed?

Yes

Repair with a one-stage tendon graft

No

Resect FDS and insert a silicone rod within the path of flexor tendon

Postoperative therapy

D Return to OR in 2-3 months to remove silicone rod and repair tendon with tendon graft

Postoperative splinting, hand therapy, and follow-up with hand surgeon

Evaluate for nerve injury

Yes

No

Perform primary flexor tendon repair in OR (see algorithm 84)

Long-term follow-up
CHAPTER 99  PERIPHERAL NERVE COMPRESSION

Ryan D. Katz • A. Lee Dellon

A Compression of a peripheral nerve results in symptoms related to the composition of sensory and/or motor fascicles in that nerve. Sensory symptoms most often include numbness and paresthesias. These may be intermittent or persistent, and, though disturbing, they are rarely painful. Acute nerve compression is painful. Symptoms are in the skin territory of that peripheral nerve. Motor symptoms begin as weakness, progress to loss of bulk, and may manifest as clumsiness. When performing the physical examination, provocative testing such as the Phalen test can be used to help localize a specific nerve compression syndrome.

B The most important physical finding is the presence of a Tinel sign over a known site of anatomic narrowing of the suspected peripheral nerve. The Tinel sign is a tingling sensation or paresthesia elicited by lightly tapping over the affected nerve. This sensation will not be present with a “pure” motor compression, as with anterior interosseous nerve syndrome.

C Traditional electrodiagnostic testing is indicated for patients with symptoms similar to those of cervical or lumbosacral spine disease or nerve compression, and for patients who have undergone previous surgery. Positive results of an electrodiagnostic study are not required to diagnose chronic nerve entrapment, particularly if the history and physical examination are consistent with the diagnosis. In our experience, neurosensory testing provides one of the best means of documenting peripheral nerve compression.

D If the degree of compression is mild, symptoms can often be improved by nonoperative measures such as splinting and modification of daily activities.

E If the degree of compression is moderate or severe, it is unlikely that the patient will improve without surgical decompression of the nerve.

BIBLIOGRAPHY

PATIENT WITH SUSPECTED COMPRESSION OF PERIPHERAL NERVE

A History and physical examination

B Is Tinel sign positive?

Yes

Consider peripheral nerve compression syndrome

No

Consider isolated motor nerve compression or spinal cord pathology

C Diagnostic testing with nerve conduction velocities (NCV), electromyogram (EMG), and neurosensory testing

NCV/EMG is positive for compression, and neurosensory testing is positive for compression

Peripheral nerve compression confirmed

Assess degree of compression

D Mild

Splinting and modification of daily activities

Symptoms improved?

Yes

Nonoperative treatment

No

E Moderate/severe

Surgical decompression

NCV/EMG is negative for compression, and neurosensory testing is positive for compression

NCV/EMG is negative for compression, and neurosensory testing is negative for compression

Neurologic workup for spinal cord pathology

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Whenever a peripheral nerve is completely or partly transected, nerve regeneration occurs, guided by the surviving sensory nuclei in the dorsal root ganglia. If the distally growing axon sprouts become entrapped in collagen during wound healing, a painful mass called a neuroma may result. Although the pain is not proportional to the size of the mass, pain is related to the stress/strain imparted on this mass by joint or tendon movement and by direct physical contact with the mass. The initial treatment is directed at freeing the axon sprouts from the scar with conservative management for up to 6 months. This includes desensitization, ultrasound therapy, steroid injection, and the use of neuropathic pain medication.

Persistent pain must have a proven neural origin before a neuroma is resected. The peripheral nerve is identified according to the location of the neuroma and the skin territory that is the perceived site of pain. More than one nerve can be involved in the pain mechanism. A positive diagnosis of the involved nerve is confirmed with a nerve block. If a nerve block cannot relieve the pain, the patient should be referred for pain management, because there may be a fixed central mechanism for the pain.

If the sensation of the skin territory involved is of critical importance (for example, the pulp of the thumb or index finger) and the nerve block relieves the pain, then neuroma resection and reconstruction of the affected nerve, with a nerve conduit or nerve graft, are indicated.

If the nerve block is successful and the patient is willing to have an insensate rather than painful symptomatic area, then neuroma resection is indicated. Although axonal sprouting cannot be prevented, it is possible to control where that sprouting occurs. Implantation of the proximal nerve into a muscle can prevent the formation of a classic end-bulb neuroma. The muscle chosen for implantation should be reasonably bulky and have minimal excursion. When a painful digital neuroma results within an amputation stump, the nerve can be implanted into bone when there is no muscle remaining within the stump.

BIBLIOGRAPHY
PATIENT WITH PAINFUL NEUROMA

History and physical examination

A Nonoperative management for 6 months

Not improved

Perform nerve block at appropriate site

C Sensation not critical (for example, forearm)

Resect neuroma

Implant proximal end of cut nerve into muscle

No further therapy needed

Improved

Pain improved

Assess importance of sensation within affected skin territory

D Sensation critical (for example, thumb pulp)

Resect neuroma

Reconstruct nerve with nerve graft or conduit

Follow-up evaluation

No improvement

Pain not improved

Consider another nerve as source of pain

No improvement

Fixed central mechanism of pain

Refer to pain management specialist
CHAPTER 101 DUPUYTREN’S CONTRACTURE

Michael Morhart

A Dupuytren’s disease typically occurs in Caucasian men in their sixth decade of life. Women usually present in their seventh decade. These patients are commonly of northern European descent. The clinical presentation is most common in the ring finger, followed by the fifth, third, thumb, and index finger. The most common patient complaint is the inability to place hands in pockets and wear gloves. Dupuytren’s diathesis refers to a predisposition and aggressiveness of the disease. Men usually present before age 40, with ectopic disease in the feet (Lederhose disease), penis (Peyronie disease), and hands bilaterally. Patients may also present with knuckle pads and almost always have a family history of Dupuytren’s disease.

B Bands refer to normal anatomy, and cords refer to the pathologic involvement of normal bands. Pretendinous cords (index, middle, and long fingers) develop from the longitudinally oriented bands, which bifurcate distally at the palmar digital junction, and involve three layers: superficial (insertion into dermis), middle (spiral), and deep (pass from volar to dorsal). These cords are primarily responsible for metacarpophalangeal (MCP) joint contracture. Spiral cords involve pathologic spiral bands, pretendinous bands, the lateral digital sheath, and Grayson’s ligament. These cords are primarily responsible for proximal interphalangeal (PIP) joint contracture and, more significantly, for the superficial and midline displacement of the neurovascular structures as the cord shortens. The lateral digital cord is responsible for PIP and distal interphalangeal (DIP) joint contractures. Natatory cords are responsible for second to fourth web space contracture. Commissural cords cause first web space contractures.

C Direct injection of triamcinolone may be beneficial for symptomatic nodules and in the early (proliferative) phase of Dupuytren’s disease.Phase III clinical trials for collagenase injections are underway and have shown some promise.

D The tabletop test is given to patients with symptomatic involvement of the fingers or web spaces. In this test, the patient is asked to place the volar surface of the hand and fingers flat on a hard surface. The inability to do so indicates a positive test. The MCP/PIP contractures that prevent flattening of the hand/digits are identified and evaluated.

E Absolute indications for surgery include any contracture of a PIP joint and 30 degrees or more of MCP joint contracture.

F Regional fasciectomy is the usual surgical intervention. Many incisions have been described, but the most common is a longitudinal midline (centered over the cord) incision with secondary Z-plasties. Needle aponeurotomy is gaining clinical acceptance because of lower complication rates and reduced recovery times compared with open surgery.

G For patients with significant skin involvement in addition to joint contractures, dermatofasciectomy and full-thickness skin grafting (FTSG) are indicated. The open palm technique, in which no skin graft or wound closure is performed, is also popular, particularly for MCP joint contractures.

H Severe contractures of the PIP joints are difficult to correct. In some cases, joint fixation provides improved functional outcome compared with attempted release of the contracture.

I For patients with residual PIP joint contracture after fasciectomy, attention is directed toward PIP joint-specific factors such as check rein ligaments, volar plate, volar capsule, and collateral ligaments. Formal joint release is often necessary.

J Recurrence is reported in 40% to 50% of cases at 5 years. Variables affecting outcome include a patient’s age, the number of digits/joints involved, duration of disease, and presence of Dupuytren’s diathesis.

BIBLIOGRAPHY


PATIENT WITH DUPUYTREN’S DISEASE

A B History and physical examination

Isolated nodules or in early phase of disease

Finger/web space involvement

Is the patient symptomatic?

Yes No

Positive Negative

Perform tabletop test

Observation Observation

C Steroid injection

>30 degrees of MCP flexion

Is skin involved?

No Yes

Release procedure Release procedure

F Regional fasciectomy with Z-plasty

Needle aponeurectomy

G Dermatofasciectomy and FTSG

Open palm technique

E Assess degree of joint involvement

>70 degrees PIP flexion

Skin involved?

No Yes

Release procedure ± joint fixation

Drainage procedure

Residual PIP contracture

Resneed aponeurectomy

H Formal PIP joint release

Postoperative splinting and physical therapy

I Long-term follow-up to monitor for disease recurrence

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Lower Extremity

Lower Extremity Injuries: Evaluation
Proximal and Middle Third
Lower Leg Defects
Distal Third Lower Leg Defects
Heel and Ankle Defects
Dorsal Foot Defects
Plantar Defects
Lower Extremity Osteomyelitis
Lymphedema

ALGORITHM KEY

- Problem
- Surgical Interventions and Surgical Endpoints
- Nonsurgical Interventions
- Surgical or Nonsurgical Options List
- Combination of Surgical and Nonsurgical Options List
- Hierarchy List
CHAPTER 102 LOWER EXTREMITY INJURIES: EVALUATION

Maristella S. Evangelista • Sean J. Darcy • Garrett A. Wirth

A As with any trauma patient, the evaluation of a patient with an injured lower extremity must begin with primary assessment of the airway, breathing, circulation, disability, and exposure. Prompt resuscitation can prevent severe consequences of ischemia and hypovolemia.

B Other associated injuries must be assessed and treated once the patient is stabilized. The timing, mechanism, and nature of the injury should be described. Diseases and habits related to nutritional, vascular, or immunologic status are important to note, because they may affect future management decisions.

C The Gustillo classification describes soft tissue injury associated with open tibial fractures. Grade I injuries have wounds smaller than 1 cm, with minimal soft tissue injury. Grade II wounds have more fracture comminution, greater wound contamination, and wounds larger than 1 cm, with moderate soft tissue injury. Grade IIIa wounds are larger than 10 cm and have extensive tissue and bone injury, but local soft tissue coverage is possible. With grade IIIb wounds, local tissue coverage may not be possible and microvascular transfer would be needed. Grade IIIc wounds are similar to grade IIIb wounds, and also have a major vascular injury that requires operative intervention.

D Medically unstable patients who are unable to tolerate surgery are stabilized, bleeding is controlled, and amputation is planned. Other relative indications for amputation include: extensive damage in three or more fascial compartments; two or more injured arterial vessels; failed vascular reconstruction; severe crush injury; and/or posterior tibial nerve injury. These indications are not absolute and must be assessed in the context of the patient’s age, health, and functional status.

E The evaluation of the injured lower extremity should focus on the neurovascular examination, nature of the injury (for example, crush versus cut), and general soft tissue status. The presence of distal pulses and cutaneou s sensation of the plantar foot, in particular, are key factors that suggest a positive outcome. Judicious assessment of soft tissue and bony defects can be performed immediately; however, thorough examination of the injury and its severity is often better suited for the operating room.

F Vascular evaluation with angiography or duplex ultrasonography is generally recommended for any person with one or more absent or weak distal pulses. It is also indicated in any patients with neurologic deficit. In young patients with at least one palpable pulse, some surgeons defer instrumental vascular evaluation because of the low risk of coexisting vascular disease. Intraoperative angiography may be performed to expedite treatment of a devascularized limb.

G In conscious patients, sensory examination of the distal lower extremity should be performed and distribution of neurologic deficit noted. Pain or numbness may indicate vascular and/or neural injury or compartment syndrome. The loss of plantar sensation portends a poor prognosis, because sensation in this area is critical for function.

H Orthopedic stabilization of fractures is urgently performed, unless distal vascular compromise dictates revascularization or temporary shunting before bony fixation. Reduction of fractures and dislocations may restore blood flow to ischemic limbs.

I The lower leg is at significant risk for compartment syndrome resulting from the swelling of ischemic or injured muscle. This is an operative emergency and should be treated with emergent fasciotomy of all four compartments of the leg. Signs include tenseness, pain out of proportion to the injury, pain with passive movement, and, in late stages, loss of sensation. Only rarely are pulses absent. Patients with pressure measurements of 30 mm Hg or higher should be treated. However, an accurate pressure reading is not necessary to make the diagnosis. Though generally believed that skeletal muscle can withstand 3 to 6 hours of ischemia before muscle necrosis occurs, permanent damage can occur in shorter time periods.

J Radiographic imaging should be performed preoperatively. However, the reduction of grossly deformed limbs should not be delayed to obtain imaging. All tibial and femoral fractures, even when nondisplaced, require immobilization, splinting, and prompt orthopedic evaluation.

BIBLIOGRAPHY


PATIENT WITH ACUTE INJURY OF THE LOWER EXTREMITY

A Primary survey/acute resuscitation

B History, physical examination, and treatment of concomitant injuries as indicated

C Assess injured lower extremity

D Is attempted limb salvage reasonable?

No

Amputation

Is knee functional?

Yes

No

B Below-knee amputation

Above-knee amputation

Yes

Pulses absent

Vascular evaluation

Able to restore perfusion?

No

Yes

Pulses present

E Neurovascular examination of injured lower extremity

F Vascular evaluation

G Assess sensation

H Orthopedic surgery consultation for acute fracture reduction/stabilization if indicated

I Rule out compartment syndrome

J Bony imaging

K Fracture present

L Fracture absent

M Orthopedic evaluation

N Definitive bony reduction/fixation

O Assess soft tissue damage

Devitalized tissue present?

No

Yes

P Debride

Q Temporary wound coverage using negative pressure therapy

R Definitive soft tissue reconstruction

See algorithms 103-105
Stabilization of the patient and preservation of limb viability are the foremost priorities in treating patients with lower extremity wounds (see algorithm 102). The proximal third of the lower leg extends from the knee to the inferior bellies of the gastrocnemius muscle; the middle third of the lower leg extends from the inferior bellies of the gastrocnemius muscle to the inferior belly of the soleus muscle.

If primary closure of the skin is not possible for wounds of the proximal or middle third of the lower leg, there may be enough muscle or soft tissue present to allow placement of a split-thickness skin graft (STSG). This is particularly true in low-energy injuries. However, debridement is required for skin graft acceptance in higher-energy injuries and injuries without a viable wound.

If the injury or subsequent debridement results in exposure of a bone or other critical structure, the location of the defect must be reassessed, because the primary choice of wound coverage may vary. Defects of the proximal third of the lower leg (at or below the knee) are best covered with a gastrocnemius muscle flap. The medial gastrocnemius flap is most frequently used because of its longer length and greater arc of rotation. However, the lateral gastrocnemius muscle can also be used in isolation or together with a medial gastrocnemius flap.

Defects of the middle third of the lower leg are best treated with a soleus muscle flap.

The use of local fasciocutaneous or muscle flaps other than the gastrocnemius or soleus flap has been described for coverage of small to moderate-sized defects. Large flaps must be taken, even for small defects, to accommodate the necessary arc of rotation. One of the main disadvantages of using local flaps is that they are usually in the zone of injury of major defects. In our experience, these flaps are often of limited value if tissue trauma precludes the use of the gastrocnemius or soleus muscle.

Microvascular free tissue transfer is required for large wounds of the proximal and middle thirds of the lower leg with exposed bone when no local tissue is available for coverage. The rectus abdominis and the latissimus dorsi muscles are frequently used flaps in this area. The choice of free flap is based on a patient’s overall status, outcome expectations, donor sites/material available, and recipient vessels.

BIBLIOGRAPHY
PATIENT WITH SOFT TISSUE DEFECT OF THE PROXIMAL/MIDDLE LOWER LEG

History and physical examination

A Initial evaluation and treatment (see algorithm 102)

Patient stabilized and limb viable?

No

Osseous defect present

Defect repair

Bone graft
Distraction osteogenesis
Vascularized bone transport

Yes

Osseous defect not present

Wound closure required?

No

Viable wound bed?

Yes

Exposed bone or structures?

No

Primary closure possible

Primary or delayed primary closure

STSG

Debridement

Exposed bone or structures?

No

Yes

C Proximal third of lower leg

Gastrocnemius muscle viable?

Yes

Other local flap available?

No

Yes

Soleus muscle flaps with STSG

No

Other local flap available?

Yes

No

Soleus muscle flap with STSG

D Middle third of lower leg

Gastrocnemius muscle viable?

Yes

Other local flap available?

No

Yes

Soleus muscle flaps with STSG

No

Other local flap available?

Yes

No

STSG

Local flap with STSG

Microvascular free flap

E

F

Bone and/or vital structures exposed?

Yes

Lower extremity physical therapy as indicated

Long-term follow-up

STSG

Debridement

Exposed bone or structures?

No

Yes

Long-term follow-up

Primary closure not possible

https://t.me/Free_Plastic_Reconstruction_Book
CHAPTER 104 DISTAL THIRD LOWER LEG DEFECTS

Michael P. Lin • Garrett A. Wirth

Soft tissue coverage on the distal third of the lower leg, which extends from the inferior belly of the soleus muscle to the ankle, is a common problem in trauma patients, and vascularized coverage of exposed structures is often required. In the acute trauma setting, there is a high likelihood of damage to structures proximal and distal to the defect, including proximal vasculature. Preoperative angiography through the opposite groin is frequently indicated to evaluate the integrity of lower extremity vessels and to determine the location of appropriate recipient vessels. This is especially true in older patients and in patients with risk factors for peripheral vascular disease.

Smaller wounds (approximately 50 cm² or less) may be amenable to closure with rotation flaps if viable tissue is available. Fasciocutaneous and fascial flaps with skin grafting can be used when thin coverage is desired and the wound is not grossly contaminated or infected. These are based off of pedicled perforators from the distal tibial, peroneal, or sural vessels. The reverse sural artery flap is often described for reconstruction of the distal third of the lower leg. The pedicles of these types of flaps have the disadvantages of potentially being located within the zone of injury or compromised in patients with peripheral vascular disease and thus inadequately perfused. Also, problems of insufficient perforator length may occur if this technique is attempted for defects that are too distal or large. Flap options for smaller wounds are provided in the table below.

The successful use of artificial dermal substitutes, such as Integra, has been reported for coverage of small wounds with exposed bone. The process involves applying a bilayer dermal substitute consisting of a deep neodermis composed of a collagen-glycosaminoglycan biodegradable matrix and a superficial semipermeable layer of silicone. The dermal replacement is often used in combination with negative pressure therapy to accelerate tissue ingrowth. After incorporation occurs, in which the cross-linked bovine collagen and glycosaminoglycan act as a scaffold for infiltration of recipient fibroblasts, the silicone sheet is removed and a thin split-thickness skin (STSG) graft is applied.

Larger wounds (approximately 50 cm² or more) require a greater volume of soft tissue coverage, necessitating the use of microvascular free flaps. Contaminated wounds, or wounds with exposed vital structures such as bone, tendon, or nerves, also benefit from muscular flaps that provide a vigorous blood supply. Long donor pedicles are preferred to allow anastomosis to recipient vessels outside of the zone of injury. Venous anastomosis is preferentially performed to the deep venous system, avoiding the superficial saphenous system. Muscular free flaps are usually taken without overlying skin and subcutaneous tissue to reduce bulk and allow better contouring. Flaps are then skin grafted after inset. When choosing a donor site, the following must be considered: the desired volume and shape, the donor site available, the resulting donor site defect, and the patient’s preference. Flap options for larger wounds are provided in the table below.

BIBLIOGRAPHY


Flap Options for Small Wounds (Approximately 50 cm² or Less)

<table>
<thead>
<tr>
<th>Location</th>
<th>Medial</th>
<th>Fasciocutaneous</th>
<th>Lateral</th>
<th>Fasciocutaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flap</td>
<td>Muscle</td>
<td>Fasciocutaneous</td>
<td>Muscle</td>
<td>Fasciocutaneous</td>
</tr>
<tr>
<td>Flexor hallucis longus</td>
<td>Fasciocutaneous rotation</td>
<td>Peroneus brevis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexor digitorum longus</td>
<td>(pedicled perforator from tibial, peroneal, or sural artery)</td>
<td>Peroneus tertius</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abductor hallucis</td>
<td>Extensor digitorum longus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soleus/medial hemisoleus</td>
<td>Extensor hallucis longus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial gastrocnemius</td>
<td>Lateral gastrocnemius</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flap Options for Large Wounds (Approximately 50 cm² or More) or Exposed Vital Structures

<table>
<thead>
<tr>
<th>Location</th>
<th>Microvascular Muscle</th>
<th>Microvascular Fascia</th>
<th>Microvascular Fasciocutaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flap</td>
<td>Gracilis</td>
<td>Temporoparietal</td>
<td>Radial forearm</td>
</tr>
<tr>
<td>Serratus anterior</td>
<td>Thoracodorsal</td>
<td>Scapular</td>
<td></td>
</tr>
<tr>
<td>Tensor fascia lata</td>
<td>Forearm</td>
<td>Parascapular</td>
<td></td>
</tr>
<tr>
<td>Rectus abdominis</td>
<td>Posterior calf</td>
<td>Lateral arm</td>
<td></td>
</tr>
<tr>
<td>Latissimus dorsi</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PATIENT WITH SOFT TISSUE DEFECT OF THE DISTAL THIRD OF THE LOWER LEG

History and physical examination

A. Initial evaluation and treatment (see algorithm 102)

Determine size of wound and presence of exposed structures after debridement

B. Small defect (<50 cm²) that cannot be closed primarily

D. Large defect (>50 cm²)

No exposed bone

Exposed bone

Conservative treatment preferred (local wound care ± negative pressure therapy)

Operative treatment preferred

Healthy wound bed/viable paratenon

Limited wound bed/paratenon

Local tissue available?

Yes

No

STSG

Local flap

STSG

Microvascular free flap

C. Consider dermal substitute

Successful treatment

Unsuccessful treatment (see algorithm 108)

Long-term follow-up
CHAPTER 105  HEEL AND ANKLE DEFECTS

Ginard I. Henry • David H. Song

The vascular status must be assessed in all patients undergoing foot wound reconstruction. If absent or diminished pulses are noted, the ankle-brachial index (ABI; normal 0.9 to 1) is determined and used to assess the overall limb vascular status. Digital toe pressures and transcutaneous oxygen tension can also be used to evaluate distal perfusion. Toe pressures are regarded as a more sensitive study, because digital arteries are less likely to become calcified. Toe pressures of 30 mm Hg or less and/or tissue oxygen pressures of 40 mm Hg or less indicate insufficient blood flow.

Ankle wounds that are potentially contaminated need excisional debridement until they are devoid of any infected or necrotic tissue. Serial debridement may be necessary. A wound should not be reconstructed until it is uninfected and stable. Regional vascularity should be optimized to facilitate wound healing. This can be achieved by a proximal vascular inflow procedure if indicated.

Skin grafts can be used over intact epitenon or well-vascularized, unviolated subcutaneous tissue. However, these grafts undergo more breakdown from footwear shear forces than flap reconstruction.

Vacuum-assisted wound closure has allowed significant changes in the management of lower extremity wounds through the development of a stable layer of granulation tissue over exposed tendons and/or bone. For the open, clean, well-vascularized wound, vacuum-assisted therapy can also be used in conjunction with acellular dermis. This treatment option is associated with low patient morbidity and, if unsuccessful, the need for microvascular flap reconstruction is confirmed. Once granulation tissue has developed sufficiently, a skin graft may be applied for definitive closure. Contraindications to vacuum-assisted therapy include wounds with exposed vascular structures or nerves and infected wounds.

Acellular dermal products provide a simple reconstructive option with minimal morbidity for dermal reconstruction over wounds, even with exposed tendon and bone. The product is a bilaminar sheet with a porous matrix of cross-linked bovine tendon collagen and glycosaminoglycan, with a superficial silicone layer. The dermal ingrowth is aided by the application of a wound vacuum. When dermal ingrowth is complete (5 to 14 days), the top-most silicone layer is removed and a split-thickness skin graft (STSG) is placed for definitive wound coverage.

For patients who desire immediate reconstruction or who have poor tissue quality, thus making successful use of negative pressure therapy unlikely, coverage is best achieved with tissue transfer.

Local flaps are occasionally possible for heel and ankle defects. However, the ankle region has minimal skin laxity, and therefore local skin flaps are less feasible. The bilobed flap may be possible with skin grafting of the donor site. Pedicle fasciocutaneous flaps are indicated for larger wounds. Pedicle muscle flaps, such as the extensor digitorum brevis flap, are useful for small wounds (4 cm or smaller) on the lateral and medial aspects of the foot, the dorsum, and the anterior ankle. The flexor hallucis brevis and abductor hallucis brevis muscle flaps can also be used for wound coverage.

For large defects and those with inadequate healthy regional tissue, microvascular tissue transfer is required for wound coverage. When free flap reconstruction is planned and absent or diminished pulses are noted on examination, a CT angiogram, MR angiogram, or traditional fluoroscopic angiogram should be obtained to assess vascular adequacy.

BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
PATIENT WITH WOUND OF THE ANKLE/HEEL

History and physical examination

A Assess lower extremity vascular status

Inadequate perfusion
  → Revascularization procedure

Adequate perfusion
  → B Clean/stable wound?
    ∨ Yes
    ▶ Wound bed with healthy tissue
    ▶ Wound bed with unhealthy tissue
    ∨ No
    ▶ Viable subcutaneous tissue or exposed tendon with intact epitenon
    ▶ Exposed tendon with no viable epitenon or exposed deep structures

B Clean/stable wound?
  ∨ Yes
  ▶ Debride
  ∨ No
  ▶ STSG

C Viable subcutaneous tissue or exposed tendon with intact epitenon
  ▶ STSG

Wound bed with healthy tissue
  ▶ D Negative pressure therapy ± acellular dermis
  ▶ E Flap reconstruction

D Negative pressure therapy ± acellular dermis
  ∨ Yes
  ▶ Adequate granulation tissue?
    ∨ Yes
    ▶ STSG
    ∨ No
    ▶ F Flap reconstruction

E Flap reconstruction
  ∨ Assess local tissue quality
  ∨ Sufficient viable, pliable tissue present
    ▶ Local/regional flap
  ∨ Inadequate local and regional tissue
    ▶ Peripheral pulses present?
      ∨ No
      ▶ Microvascular tissue transfer
      ∨ Yes
      ▶ Vascular imaging

H Inadequate local and regional tissue

G Local/regional flap

Posterior ankle
  • Bilobed cutaneous flap
  • Reverse sural artery flap
  • Reverse peroneal artery flap

Anterior ankle
  • Extensor digitorum brevis flap
  • Dorsalis pedis flap
  • Reverse sural artery flap
  • Reverse peroneal artery flap

Medial ankle
  • Flexor hallucis brevis flap
  • Abductor hallucis brevis flap
  • Reverse sural artery flap
  • Reverse peroneal artery flap

Lateral ankle
  • Bilobed cutaneous flap
  • Abductor digiti minimi flap
  • Reverse sural or peroneal artery flap

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
CHAPTER 106  DORSAL FOOT DEFECTS
Ginard I. Henry • David H. Song

Knowledge of the causes of dorsal foot wounds optimizes the ability to achieve a stable, well-vascularized wound. Some wounds require serial debridement with topical antimicrobial treatment and repeat quantification tissue cultures to document control of infection. The wound bed must be completely devoid of infected, necrotic, or neoplastic tissue before any surgical reconstruction.

The vascular status must be assessed in all patients undergoing foot wound reconstruction. When absent or diminished pulses are noted, the ankle-brachial index (ABI) is determined to assess the overall limb vascular status. Digital toe pressures and transcutaneous oxygen tension can also be used to evaluate distal perfusion. Toe pressures are regarded as a more sensitive study, because digital arteries are less likely to become calcified. Limb revascularization, if indicated, should precede wound reconstruction.

The presence of viable subcutaneous tissue or extensor tendon with intact epitenon within a dorsal foot wound facilitates the decision-making process, because these wounds can be covered with a split-thickness skin graft (STSG). If a wound bed is not adequate, tissue rearrangement with a flap transfer is often necessary.

When healthy local tissue is available and the wound involves 40% or less of the dorsal surface, reconstruction with local or pedicle flaps can be performed when immediate reconstruction is desired.

A smaller wound (20% or less) of the dorsal surface is treated with random flaps (rotation, bilobed, rhomboid, or V-Y flaps), provided the dorsum is adequately perfused, the tissue is pliable and noninfected, and enough laxity is present to close the donor area.

Larger wounds (20% to 40%) of the dorsal surface of the foot require more tissue and are treated with pedicle fasciocutaneous or muscle flaps.

Microvascular tissue transfer is indicated for a wound that involves 40% or more of the dorsal surface of the foot. This can be performed as a muscle or fascial flap covered with a skin graft, or as a fasciocutaneous flap.

When reasonably healthy tissue is available and immediate reconstruction is not desired or would not be tolerated by the patient, treatment of the wound with negative pressure therapy may allow the development of a viable wound bed that can be skin grafted. Recent studies have demonstrated successful wound closure using artificial dermal substitutes such as Integra synchronously with negative pressure therapy. After a period of time to allow incorporation of the neodermis, the protective superficial silicone sheet is removed from the dermis and a thin split-thickness skin graft (STSG) is applied.

When the tissue surrounding a dorsal foot wound is unhealthy and local tissue is not available for reconstruction, microvascular tissue transfer is indicated.

BIBLIOGRAPHY
PATIENT WITH A DORSAL FOOT WOUND

History and physical examination

A Wound clean?

No Debride

Yes

Evaluate vascular status of foot

Insufficient vascular status

Sufficient vascular status

Vascular surgery intervention as indicated

Assess characteristics of wound

Viable subcutaneous tissue or exposed extensor tendons with intact criterion

Exposed deep structures or denuded extensor tendons

Assess characteristics of surrounding tissue

Long-term follow-up

D Good tissue quality and immediate reconstruction desired

Assess wound size

E <20% of dorsal surface

Random/local flap reconstruction

F 20%-40% of foot dorsal surface

• V-Y flap
  • Rotation flap
  • Rhomboid flap
  • Bilobed flap

Pedicled flap

• Retrograde dorsalis pedis flap
  • Retrograde peroneal artery flap
  • Retrograde sural artery flap

Fasciocutaneous flap

• Extensor digitorum brevis flap
  • Retrograde extensor digitorum brevis flap (distal dorsal foot wounds)

Muscle flap

G ≥40% of foot dorsal surface

Microvascular tissue transfer

• Muscle flap and STSG
  • Fascial flap and STSG
  • Fasciocutaneous flap

H Good/moderate tissue quality and immediate reconstruction not desired/needed

I Microvascular tissue transfer

Poor tissue quality

J Negative pressure therapy or dermal substitute

K Adequate granulation tissue or take of dermal substitute?

Yes

STSG

Long-term follow-up

No

L Retrograde dorsalis pedis flap

M Retrograde peroneal artery flap

N Retrograde sural artery flap

O Retrograde extensor digitorum brevis flap

P Distal dorsal foot wounds

Q Long-term follow-up

R

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 107 PLANTAR DEFECTS
Ginard I. Henry • David H. Song

A Adequate plantar pressure sensation and proprioception are critical for functional ambulation. Patients with absent pressure sensation are candidates for a below-knee amputation, because their ability to maintain their balance and ambulate properly is severely compromised. A lack of cutaneous sensation may lead to future ulcers but is not an absolute prerequisite for amputation.

B The vascular status must be assessed in all patients undergoing foot wound reconstruction. If absent or diminished pulses are noted, the ankle-brachial index (ABI) is determined to help assess the overall limb vascular status. Digital toe pressures and transcutaneous oxygen tension can also be used to evaluate distal perfusion. Toe pressures are regarded as a more sensitive study, because digital arteries are less likely to become calcified.

C Once adequate vascular inflow is ensured or optimized, wound stabilization can begin. Knowledge of the cause of the wound helps to achieve a stable, well-vascularized wound. Some wounds require serial debridement with topical antimicrobial treatment and repeat quantification tissue cultures to document control of infection.

D The location and size of the wound, the local tissue quality, arterial perfusion, and venous outflow must all be considered when choosing a reconstruction option. The wound bed must be completely devoid of infected, necrotic, or necrotic-like tissue before any reconstruction is performed.

E The distinction between non–weight-bearing areas of the plantar surface of the foot (instep and toes) from the weight-bearing areas (heel and metatarsal heads) is critical. The heel overlying the weight-bearing calcaneus supports 80% of body weight, and the distal sole and transmetatarsal heads transmit 20%. Weight-bearing areas must be reconstructed with durable soft tissue coverage that can withstand the pressure of a patient’s weight and will resist the shear forces produced by gait and footwear. The reconstruction should mimic as much as possible the durability of plantar glabrous skin. Non-weight-bearing areas have less compression and shear forces acting on them and therefore can be reconstructed with less durable options such as skin grafts.

F Small wounds on the non–weight-bearing areas (instep and toes) can be treated with either a skin graft or flap, depending on the wound bed and quality of surrounding soft tissue. A local muscle flap such as the abductor digiti minimi (ADM) flap or the abductor hallucis brevis (AHB) flap is indicated when a small tissue defect needs to be filled. When a large tissue defect is present, microvascular free tissue transfer is indicated.

G In the metatarsal head/forefoot area, flap reconstruction is required to ensure coverage with durable tissue. Toe fillet flaps and toe island flaps can be used. As in the instep, ADM and AHB flaps can be used. For small metatarsal head defects, these flaps can be used as myocutaneous V-Y advancement flaps. Larger defects require a reverse medial plantar artery flap or microvascular tissue transfer.

H For the weight-bearing heel, small defects can be closed with a V-Y flap. For larger defects, the medial plantar artery flap is the first choice for reconstruction, because it utilizes durable, fixed glabrous skin. The lateral plantar artery flap and reverse sural artery flap are also potential reconstructive options. Total loss of the heel pad often requires microvascular tissue transfer.

I Loss of the entire plantar surface requires microvascular tissue transfer. Debate exists over the best choice of donor flap. A fasciocutaneous or musculocutaneous flap provides a sturdy dermal bed but excessive tangential movement, whereas a muscle flap plus skin graft reconstruction has less lateral movement, but the dermal element is less durable. Commonly used fasciocutaneous flaps include the radial forearm, anterolateral thigh, scapular/parascapular, and the lateral arm flap.

J Education in proper foot care is essential for long-term success and includes self-examination techniques, hygiene, and appropriate footwear.

BIBLIOGRAPHY
PATIENT WITH NONHEALING WOUND ON PLANTAR ASPECT OF FOOT

History and physical examination

A. Assess plantar proprioception/pressure sensation
   - Adequate
   - Inadequate

B. Assess vascular status
   - Consider below-knee amputation

Vascular surgery consultation

Acute ischemia

Chronic ischemia (peripheral vascular disease, venous stasis disease, diabetic)

Functional and anatomic evaluation of lower extremity perfusion

Inadequate perfusion

Adequate perfusion

C. Wound debridement/stabilization

D. Wound bed optimization

Critical structures exposed and/or patient desires surgical reconstruction

E. Assess location of wound

F. Non-weight-bearing areas (toes, instep)
   - Small defect with good wound bed
     - Skin graft
   - Small defect with poor wound bed
     - Flap
   - Large defect
     - Microvascular tissue transfer
       - Local flap
       - ADM flap
       - AHB flap

G. Metatarsal weight-bearing area
   - Flap
     - Local flap
     - Toe fillet flap
     - Reverse medial plantar artery flap
     - Microvascular tissue transfer (large defect)

H. Weight-bearing heel
   - Wound coverage
     - V-Y flap
     - Medial plantar artery flap
     - Microvascular tissue transfer
       (large defect)

I. Entire plantar surface
   - Microvascular tissue transfer
   - Delayed flap revision/thinning if needed

J. Proper foot care
   - Negative pressure therapy
   - Wound not closed
   - Wound closed

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 108  LOWER EXTREMITY OSTEOMYELITIS

Yehuda Ullmann • Lucian Fodor

Patients with lower extremity osteomyelitis may have pain, a draining sinus, or an open wound. Local swelling, redness, or tenderness may be noted during the clinical examination.

Laboratory and imaging studies are helpful to establish the diagnosis. Studies have shown that the increased sensitivity and specificity of MRI can replace technetium 99m–labeled scintigraphy and reduce plain film investigations. Bone biopsy with histologic and microbiologic study is the most accurate method to confirm the diagnosis. When clinical signs strongly support osteomyelitis, the histology and culture of the bone can be performed at the same time as the surgical debridement.

Treatment goals for osteomyelitis include organism-specific antibiotic therapy, meticulous debridement of all necrotic and infected tissue (bone and soft tissue), obliteration of dead spaces, and bone and soft tissue reconstruction. Systemic administration of antibiotic agents is common, and the recommended period is at least 6 weeks.

Hyperbaric oxygen treatment may be considered as an adjuvant method in the treatment of osteomyelitis. The amount of bone that must be debrided is estimated preoperatively based on radiographic and clinical data. However, the final amount of bone to be excised can only be determined intraoperatively. Previous internal fixation devices should be removed from the infected bone. The reconstructive options for the bone should be explained to the patient. Doppler ultrasound and vascular studies are recommended after trauma and in patients with a history of previous lower extremity surgery when vascular reconstruction or a microsurgical procedure is anticipated.

Bone and soft tissue debridement should be radical. For diffuse osteomyelitis, the so-called paprika sign is not sufficient to complete the debridement. Vacuum-assisted closure may be considered as an intermediate procedure before the final reconstruction.

The strategy of skeletal reconstruction depends on the amount of remaining healthy bone, the gap size, and the status of the surrounding soft tissue. Antibiotic-impregnated beads or cement may be used temporarily as spacers in wounds that have the potential for residual infection. If enough remaining bone is present, there is no need for external fixation, and soft tissue reconstruction can be accomplished. When less than 70% of the previous cortical volume remains following debridement, the risk of iatrogenic fracture is high. An external fixator or Ilizarov appliance should be used to increase stabilization.

When segmental bone resection is performed, the bone gap can be closed by autogenous bone grafts, bone transport, or vascularized bone graft. For small defects, cancellous and corticocancellous bone can be used, though it is not the optimal donor material in a previously infected area. For larger defects, bone transport or vascularized bone should be utilized. Vascularized bone grafts have the advantage of bringing a bone segment with its own blood supply to enhance the osseous union. When performing soft tissue reconstruction, significant wounds of the distal lower extremity are best covered by free flaps. Occasionally, a composite flap (osteocutaneous) can be used to replace the missing bone and soft tissue.

In the case of recurrent treatment failure, amputation should be considered when a patient’s quality of life and social activities are significantly negatively affected by the disease.

BIBLIOGRAPHY


PATIENT WITH SUSPECTED LOWER EXTREMITY OSTEOMYELITIS

History and physical examination

A Clinical assessment of lower extremity

• Wound culture
• Radiographs
• MRI or bone scans

Is the diagnosis strongly supported and an organism identified?

Yes

B Confirm diagnosis with bone biopsy

No

C Treatment

Initiate antibiotic therapy

Consider infectious disease consultation

D Radical bone and soft tissue debridement

Assess extent of bone and soft tissue loss

E Nonsegmental bone defect

Is the bone stable? (>70% of cortical volume remains)

Yes

Soft tissue coverage with local or microvascular tissue transfer (see algorithm 102)

Successful treatment

No

Consider amputation if recurrent treatment fails

F Segmental bone defect

External fixation

Assess size of bone gap

<6 cm

External fixation

Nonvascularized bone graft

>6 cm

Vascularized bone graft

G Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
CHAPTER 109 LYMPHEDEMA

Corradino Campisi • Francesco Boccardo

An accurate diagnosis of lymphedema is essential for appropriate therapy. In most patients, the diagnosis of lymphedema can be readily determined from the clinical history and physical examination: generalized edema with increased thickness, depending on its higher or lower fibrosclerotic tissue component; no pitting, even in early disease stages; Stemmer sign (that is, lack of skin plication at the root of the second toe); dystrophic skin lesions (for example, postlymphangitic sequelae, lymphostatic verrucosis, and lymphorrhrea, chylorrhrea); and frequent dermatolympangioadenitis (DLA) complications. Further, the lymph node examination is also useful to detect any associated acute or chronic lymphadenopathy. Moreover, in considering the basis of unilateral or bilateral extremity lymphedema, especially in adults, an occult tumor needs to be considered. For these reasons, a thorough and integrated medical evaluation is essential before initiating lymphedema treatment. If the diagnosis of lymphedema requires better definition for prognostic considerations, consultation with a clinical lymphologist or referral to a lymphologic center is recommended.

Lymphangioscintigraphy is the first choice to diagnose edema, confirm the nature of lymph stasis and identify its cause (either obstacle or reflux), evaluate the extension of disease (dermal backflow), determine any higher or lower damage to deep versus surface lymphatic circulation, and assess drainage through the lymph nodes. Therefore lymph and superficial lymph circulation is useful through proper tracer injection into specific drainage sites of both systems. This is a noninvasive, easily repeatable procedure, even in newborn babies. This investigative technique is also useful in following patients after various lymphedema treatments and, in particular, lymphatic microsurgery. The investigation of venous circulation with duplex scanning is commonly used for the instrumental assessment of an edematous limb.

Lymphedemas are generally categorized as primary or congenital, and acquired or secondary. Primary lymphedema is further distinguished as connatal (congenital) if present at birth, early onset (precox) if it develops before age 35, or late onset (tarda) if it develops after age 35. In the connatal group of lymphedemas, a further distinction is made between sporadic and heredofamilial forms to describe more or less complex malformation syndromes that may be associated with genetic anomalies. The phrase lymphatic dysplasia includes agenesis, hypoplasia, hyperplasia, fibrosis, lymphangiomatosis, hamartomatosis, and valvular insufficiency. Secondary lymphedema may be classified as postsurgical, posttraumatic, postlymphangitis, or parasitic.

The therapy for peripheral lymphedema is divided into conservative (nonoperative) and operative methods. The best results are achieved with a complete lymphedema functional therapy program involving the combination of three therapeutic phases, including two physical treatments (one preoperatively and one postoperatively) and a lymphatic microsurgical operation between them.

Nonoperative treatment includes skin care, manual lymph drainage, multilayer bandages, pneumatic compression, and physical exercises, combined according to each patient’s requirements.

Operative treatment involves microsurgical techniques, representing functional and causal therapeutic solutions for lymphedema. These procedures are aimed at draining the lymph flow or reconstructing the lymphatic pathways where they are obstructed or not present. Microsurgery techniques have yielded positive and long-lasting results in the treatment of primary lymphedemas—including those in children—as well as secondary lymphedemas following cancer treatment after lymph node dissection. The essence of these procedures is the use of multiple lymphatic-venous anastomoses to reconstitute lymphatic flow. The indications for microsurgical reconstruction depend on the presence of a viable lymphatic-venous pressure gradient in the affected limb. It is essential to consider that microvascular lymphatic-venous shunting procedures may not be indicated for lymphostatic disease combined with venous disorders (often observed in the lower limbs when associated with varices, venous hypertension, postphlebitic sequelae, and/or valvular incompetence). For these cases, lymphatic-venous-lymphatic shunting (that is, autologous interpositioned venous bypass between lymph collectors above and below the obstacle at the iliac-inguinal region) is required in our experience.

Debulking procedures may be performed in cases of refractory lymphedema that has failed three-phase functional therapy and has a significant negative impact on a patient’s quality of life. These procedures range from debulking subcutaneous tissue beneath elevated skin flaps to radical debridement of skin and soft tissue, followed by coverage with split-thickness skin grafts.

BIBLIOGRAPHY

**PATIENT WITH EDEMATOUS EXTREMITY**

History and clinical evaluation

**A** Physical examination
- Stemmer sign
  - Yes
  - No
- Pitting sign
  - Yes
  - No

Likely venous edema

Likely lymphatic edema

**B** Instrumental assessment
- Lymphangioscintigraphy
  - Positive
  - Negative
- Duplex scan
  - Positive
  - Negative

Assess and treat DVT

**C** Lymphedema

Congenital

Acquired

- Postsurgery or trauma
- Cause unknown

- Infectious disease and oncologic workup

Treat infectious or oncologic disease, or those with other causes

**D** Three-phase lymphedema functional therapy (all three phases required)

**E** Complex physical therapy

**F** Lymphatic microsurgery

Rehabilitation program

Unsuccessful management

Successful management

**G** Consider debulking procedure
AESTHETIC SURGERY

Skin

Scalp, Brow, and Periorbital Area

Face

Nose

Breast

Body Contouring

Massive Weight Loss
Lines, Texture, Dyschromias, and Scarring: Laser Therapy
Rhytids, Hyperpigmentation, and Chloasma: Chemical Peels
Fine Rhytids: Fillers
When considering laser therapy, it is important to determine a patient’s aesthetic goals, because many concerns may be better addressed with filler, botulinum toxin, or surgery. Problems that can be treated with laser therapy include fine lines, skin texture problems, dyschromias, and some effects of scarring. Deeper rhytids and significant skin laxity can be partially addressed with laser therapy, but this treatment is not a substitution for surgical procedures.

It is important to obtain a thorough history regarding the use of skin care products and medications, particularly isotretinoin. If a patient is using isotretinoin, it is prudent to delay laser resurfacing treatment for 12 to 18 months to significantly decrease the risk of hypertrophic scarring.

For most laser treatments, it is beneficial to pretreat patients with a topical retinoid and hydroquinone, ideally for 6 to 8 weeks. Pretreatment with an oral antiviral medication and an oral antibiotic agent 24 hours before treatment is recommended. These medications are continued for 3 to 5 days after treatment.

For fine facial rhytids, ablative therapy works best. Fractionated or unfractionated CO₂, erbium, or yttrium-scandium-gallium garnet (YSGG) lasers work well for this purpose. These lasers can cause hypopigmentation, and patients should be cautioned about this. Ablative lasers also have the benefit of decreasing age spots or the dyschromias present in the more superficial layers of the skin.

For patients with deeper rhytids, fillers or surgical procedures may give a more optimal result. However, laser therapy for deeper resurfacing can stimulate new collagen production with subsequent tightening of the skin.

Many patients can benefit from full facial resurfacing to improve overall skin texture, decrease fine lines, decrease superficial dyschromias, and obtain some skin tightening. For these patients, a combination of technologies is performed during one visit, with two passes of the face, each with a different setting.

Certain scars can be addressed with laser therapy. For slightly erythematous scars, intense pulsed light (IPL) therapy is indicated. The settings are generally in the 540 to 615 nm range, depending on a patient’s skin type and response. Therapy typically requires several treatments, spaced 4 to 8 weeks apart. For more severe red scars, pulsed dye laser (PDL) can be used alone or in combination with IPL.

Facial skin dyschromias can also be treated with laser therapy. Suspicious lesions must be biopsied to rule out malignancy before treatment.

The treatment for generalized redness or rosacea is similar to that used for red scars. IPL at 515 to 640 nm, depending on a patient’s skin type, alone or combined with PDL, has been effective to decrease redness. Multiple treatments are required, spaced 4 to 8 weeks apart. Treatment is tailored according to each patient’s response.

Brown spots or age spots can also be treated with IPL. Typically, the 515 to 540 nm range is most effective, and multiple treatments are often needed. More ablative lasers can also be used for these lesions and may be more effective for patients who can tolerate the additional downtime.

Postlaser therapy skin care depends on the therapy used. For IPL treatments, patients generally continue their current skin care regimen. They may use makeup to cover purpura that arises after treatment for redness or the darkening of brown spots that temporarily occurs after treatment. For resurfacing procedures, occlusive tape or dressing (petrolatum) is used until peeling begins. Gentle soap is then used with the application of an intense moisturizer several times per day. After peeling is complete, patients should resume hydroquinone therapy and apply a broad-spectrum sunscreen. Lifelong use of sunscreen is ideal after a resurfacing procedure.

**BIBLIOGRAPHY**


PATIENT DESIRING SKIN RESURFACING: LASER THERAPY

History and physical examination

A Assess patient’s aesthetic concerns

B Has the patient recently taken isotretinoin?

No

Delay resurfacing procedure 12-18 months

Yes

C Prelaser skin care

Facial rhytids

D Isolated fine rhytids (for example, crow’s feet)

Superficial ablative procedure with fractionated or unfractionated CO₂ erbium, or YSGG laser

E Deep rhytids (for example, perioral rhytids)

Deeper ablative procedure with fractionated CO₂ erbium, or YSGG using smaller spot and deeper penetration

F Full-face resurfacing

Combination of superficial and deep procedures, with varying spot size and number of passes

Treat with IPL at 540-615 nm, PDL, or combination therapy

G Erythematous scars

H Biopsy if suspicious

Assess color and characteristic

I Generalized redness or redness of rosacea

Telangiectasia

J Brown

IPL at 515-640 nm or ablative resurfacing

K Facial dyschromias

Treat with IPL at 540-615 nm, PDL, or combination therapy

Lips or combination therapy

IPL at 515-615 nm or Nd:YAG

K Postlaser skin care

Long-term follow-up
CHAPTER 111  RHYTIDS, HYPERPIGMENTATION, AND CHLOASMA: CHEMICAL PEELS

V. Leroy Young

When evaluating patients for a chemical peel, a general medical history must be obtained, including any history of cardiac disease, because phenol can induce cardiac arrhythmias. Each patient’s goals and expectations should be reviewed. The unpleasant appearance that results during the early postoperative period should be discussed. During the physical examination, the condition of the skin, including regional differences and laxity, and the distribution and character (fine or deep) of facial rhytids are noted. The patient’s complexion should be evaluated and documented. Any suspicious lesions should be biopsied before a facial peel.

If a patient has a history of herpes infection, treatment with acyclovir is indicated before and after the chemical peel.

If a patient is taking isotretinoin, the chemical peel must be delayed at least 12 to 18 months once the drug has been discontinued to prevent delayed epithelization and possible hypertrophic scarring.

When the laxity in the cheeks or neck is sufficient to warrant a rhytidectomy, a face lift should be performed before the chemical peel. This is done to prevent injury to the undermined skin, possible necrosis, and extensive scarring. However, if only perioral or periorcular wrinkles are present, they can be treated at the time of the face lift. A chemical peel that is part of a staged procedure is usually performed 2 to 3 months after the face lift, when the edema has resolved and the skin vascularity has improved.

If a patient has blotchy hyperpigmentation but no excess of skin or wrinkling, a trichloroacetic acid (TCA) peel or phenol peel can be used to improve the complexion. Because a TCA peel generally has a lower risk and morbidity, this is the recommended first line therapy. Chloasma, often seen after pregnancy or with the use of birth control pills, can be corrected with serial TCA peels.

With minimal skin laxity, fine wrinkles can be eliminated and the skin rejuvenated with one or more TCA peels. It is best to begin with a 35% or 30% TCA peel and then increase the concentration to 40%, if necessary, to achieve a satisfactory result; concentrations higher than 50% greatly increase the risk of complications.

Deep facial wrinkles can be treated with either a TCA or phenol peel. In general, a phenol peel requires additional recovery time, and this may be a key factor for many patients. In addition, a phenol peel has a higher risk of hypopigmentation and scarring and must be performed using cardiac monitoring. Furthermore, phenol should not be used below the mandibular border, whereas TCA can be carried onto the neck.

A patient’s complexion is an important factor in choosing the chemical peel technique. Fair-skinned patients tolerate either a phenol or TCA peel. Freckled patients also can be given either peel, though they must be warned before the procedure that the peel may permanently eliminate their freckles. Olive- or dark-skinned individuals can be safely treated with TCA peels, but should not have phenol peels because of the risk of hypopigmentation and the often noticeable demarcation between treated and untreated areas.

BIBLIOGRAPHY

PATIENT DESIRING SKIN RESURFACING: CHEMICAL PEELS

A History and physical examination

B History of herpes infection

Yes

Pretreat with acyclovir or similar medication

No

C History of isotretinoin use?

Yes

Delay resurfacing procedure for 12-18 months

No

Assess aesthetic concerns

D Marked skin excess

Staged surgical procedure (for example, rhytidectomy)

Little skin excess

Consider patient preference regarding recovery time

E No skin excess, but hyperpigmentation present

TCA peel

Long-term follow-up

F Fine facial rhytids

TCA peel

G Deep facial rhytids

Consider patient preference regarding recovery time

Limited recovery time available

TCA peel

Extended recovery time available

Assess complexion

H

Fair

Phenol or TCA peel

Freckled/medium

Phenol or TCA peel

Olive- or dark-skinned

TCA peel

Long-term follow-up
CHAPTER 112 FINE RHYTIDS: FILLERS

Daniel Kwan • Julius W. Few

Facial rhytids often require a combined approach, addressing both dynamic and static components. Each patient’s aesthetic concerns should be ascertained, as well as his or her preference for nonpermanent versus permanent facial filler. Although the permanent fillers offer a theoretical advantage in the duration of the product, this can present a challenge in cases with complications or undesired aesthetic change. Multiple forms of fillers are available. Hyaluronic acid (HA) is a large molecule that is recommended for subdermis/subcutaneous injection. Examples include Perlane and Juvederm Ultra Plus. Medium HA, such as Juvederm Ultra, Restylane, Prevelle, or Elevess, is used for mid to deep dermal placement. Small HA particles are ideal for patients with thin skin in the perioral and periorbital regions. Calcium hydroxyapatite, Radiesse, and other semipermanent fillers have been increasingly useful in deeper rhytids and facial depressions. Recently, Artefill was approved by the FDA as a nonabsorbable filler for the treatment of rhytids.

It is important to distinguish dynamic from static rhytids. This can be done by observing the patient at rest and during animation. Dynamic rhytids are best treated with chemodenervation, whereas static rhytids can be effaced with an injectable material. A combination of these techniques is often used to achieve the best correction.

Botulinum toxin A is used to produce a chemical denervation of specific facial musculature that is causing a given series of rhytids, such as the frontalis and corrugators for the forehead. Botulinum toxin A blocks the release of acetylcholine at the neuromuscular junction, thereby preventing muscle contraction and subsequent rhytids formation. Care must be taken when injecting the forehead and brow region so that overcorrection does not occur, resulting in complete loss of frontalis tone and subsequent brow or upper lid ptosis. Should upper lid ptosis occur, treatment with an alpha-2 adrenergic agonist eye drop such as apraclonidine causes contraction of the Muller muscle, elevating the upper eyelid 1 to 3 mm.

Caution is advised when injecting fillers in the glabellar region, because glabellar necrosis has been reported in some cases. We prefer to use nonpermanent fillers in this region and to inject vertical glabellar rhytids using superficial serial punctures. In this technique, multiple injections are made in proximity to one another until the rhytid is smooth. Care is taken to ensure that the skin does not blanch. If there is concern that the overlying skin may be compromised, it is best to remove the implant at that time and use hyaluronidase injections as needed.

In patients with static transverse rhytids of the brow, we have found it useful to determine the patient’s Fitzpatrick skin type. We recommend both nonpermanent and permanent fillers, based on each patient’s skin type and the surgeon’s preference. Nonpermanent fillers are injected using a superficial serial puncture technique, and longer-lasting fillers are injected using deep linear threading. In this technique, the length of the needle is inserted into the rhytid, and the filler can be injected in an antegrade or retrograde fashion. For patients with darker skin types (Fitzpatrick skin types 4 to 6), care is taken to minimize the number of skin perforations and to place injections in the deeper dermis to minimize adverse events and enhance results.

Rhytids in the periorbital areas can be treated with both chemodenervation and effacement using fillers. As in the brow, it is important to distinguish between static and dynamic rhytids. Crow’s feet that do not fully resolve after Botox injection can be treated with superficial injection of nonpermanent filler such as Restylane or Juvederm. We use fillers in the crow’s feet region for only the most severe residual rhytids. For fine residual lines, it is better to consider resurfacing the skin as opposed to filler injection. Treatment of the tear trough area with volume replacement is becoming increasingly popular. A variety of fillers and autologous fat have been used successfully in this area. The injection must be deep to the orbicularis muscle or directly on the periosteum, and care should be taken to inject when withdrawing the needle to prevent inadvertent intraarterial embolization.

The treatment of rhytids in the malar area depends on the specific subunit that is affected. All filler types can be used in this area. In the malar region, we prefer either a deep serial puncture or a fanning technique in which serial linear threading is performed, with progressive changes in the angles of the needle through one puncture site. In the submalar region, the injection is slightly more superficial, with the filler placed in a deep dermal to subcutaneous plane. The nasolabial fold is best treated with deep linear threading in patients with darker skin, and linear threading and/or serial puncture in patients with Fitzpatrick skin types 1 to 3. For very severe and/or resistant nasolabial folds, limited botulinum toxin A injection may be considered for the zygomaticus, with the understanding that this is a much more advanced technique that requires careful titration.

BIBLIOGRAPHY


https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
PATIENT DESIRING NONSURGICAL MANAGEMENT OF FINE RHYTIDS

History and physical examination

A. Assess location of rhytids and patient’s aesthetic concerns

Forehead/brow region

B. Treat with botulinum toxin A

- Dynamic rhytids
- Static rhytids

- Vertical glabellar rhytids
  - Treat with nonpermanent filler
  - Inject using superficial serial puncture technique

- Transverse rhytids

- Assess Fitzpatrick skin type

Midface region

F. Can treat with all filler types

- Malar region

- Submalar region

- Nasolabial fold

- Submalar region

G. Can treat with all filler types

- Treat with nonpermanent filler

- Treat with superficial serial puncture technique

- Treat with semipermanent and nonpermanent fillers

- Inject using deep linear threading technique

- Inject using a deep dermal to subcutaneous plane with massage

- Inject using a deep serial puncture or fanning technique in subcutaneous plane

- Inject using a deep serial puncture or fanning technique

- Inject using a mid to deep linear threading technique
  
  ± botulinum toxin A treatment to zygomaticus muscles

Type 1-3

Type 4-6

Resurfacing procedure

Midface region

Tear trough

- Can treat with all filler types

- Inject using superficial serial puncture technique

- Inject using serial puncture technique

- Injectable fillers

Long-term follow-up

Type 1-3

Type 4-6

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers. All rights reserved. Usage subject to terms and conditions of license.
Scalp, Brow, and Periorbital Area

Hair Loss of the Scalp
Forehead and Brow
Upper Eyelids
Lower Eyelids

ALGORITHM KEY

- Problem
- Surgical Interventions and Surgical Endpoints
- Nonsurgical Interventions
- Surgical or Nonsurgical Options List
- Combination of Surgical and Nonsurgical Options List
- Hierarchy List

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 113  HAIR LOSS OF THE SCALP

James N. Long  •  Jorge I. de la Torre

A  Hair loss is caused by the interaction of heredity, age, circulating hormones, and end receptor (for example, hair follicle) sensitivity. The mechanism of androgenic loss is through the action of dihydrotestosterone (DHT) on sensitized hair follicles, which induces follicular atresia. Circulating androgens and proandrogens are converted by 5-alpha-reductase to DHT, which is then free to act on the follicle. Other factors involved in hair loss include trauma, surgery, systemic (for example, sarcoidosis) or local (for example, tinea capitis) illness, endocrinopathies (for example, hypothyroidism), and certain medical therapies. Patients should also be evaluated for alopecia areata, alopecia totalis, fungal infections, dermatologic conditions, and parasitic infestations. When any of these diagnoses are present, they should be considered as potential causes of hair loss and treated appropriately. The history should also help to determine whether hair loss is stable. The condition of the scalp is examined. Prior interventions to treat hair loss should be documented. Other factors to be considered are the quality of the anticipated graft bed, the presence of scars on the scalp, and the density of hair in the donor area (approximately 16 hairs per 4.5 mm will be needed for transplantation).

B  Putative treatments for hair loss include vitamin, amino acid, and antioxidant supplements, purported transcutaneous inhibitors of (DHT), and herbal supplements such as saw palmetto. However, minoxidil (Rogaine) and finasteride (Propecia) are the only pharmaceutical treatments recognized by the FDA as effective in treating hair loss. Both of these drugs have been proven to cause visible regrowth of hair and halt further hair loss.

C  Surgical follicular micrografts (single follicular graft unit) and minigrafts (two to three follicles per graft unit) provide the most effective method for augmenting the frontal hairline, especially in younger men. Donor follicles are typically harvested from the parietal and occipital regions and transplanted to the frontal area. Multiple sessions are often required to achieve a normal-appearing hairline. Grafts have a high survival rate; however, they enter a temporary phase (telogen) during which the hairs are lost, and a transient dormant period ensues. Within 6 months, hair begins to regrow and then grows as it would in the area from which the grafts were harvested. Grafts, although initially costly, have the advantage of being less expensive over the long term, because the expense of maintenance pharmaceutical therapies (for example, Rogaine and Propecia) is eliminated. When performed improperly, grafting may result in a sodded orrowned appearance.

D  Scalp reduction can produce a very good aesthetic result in properly selected patients. When hair loss affects an area of the crown and vertex that is 4 cm or less in coronal width, scalp reduction can adequately replace the missing hair. When the coronal width is greater than 4 cm, serial excisions or tissue expansion is required. The disadvantages of scalp reduction are that it leaves a scar and can be used only to reduce relatively small areas of baldness.

E  Either serial scalp reductions or tissue expansion can be used to reduce larger areas of hair loss in the crown and vertex regions. Serial scalp reductions offer the advantage of eliminating the period of visible deformity that accompanies tissue expansion. With scalp reduction, the bald area is reduced in stages through the excision of 4 cm or less of the area’s width. Areas that are more than 4 cm wide should not be excised at one time. With tissue expansion, areas wider than 4 cm, and up to as much as 10 or 12 cm, can be excised at one time. At least two operations are required, with the tissue expander inserted initially. When the expander is removed, the bald area is excised and the hair-bearing scalp is advanced. When used to facilitate excision of anterior baldness, tissue expansion can distort the anterior hairline, which may necessitate either additional treatment plugs or transposition of a hair-bearing flap.

F  For patients with marked frontal hair loss, the transposition of hair-bearing scalp flaps creates a realistic-appearing frontal hairline. The temporoparietal flap is an excellent choice. However, when the flap is continued posteriorly into the occipital scalp for additional length, a delay is required. In addition, this technique reverses the normal direction of hair growth. The procedure is usually performed in two stages, because only one delayed long flap or two short flaps can be transposed during a single operation. When the bald area is large, two or three flaps may be needed to achieve satisfactory coverage. Transposition flaps produce a scar at the frontal margin of the hairline, but this can be hidden by hair grooming.

G  In patients who have a large area of baldness that involves the crown, vertex, and frontal area, a combination of treatments is usually necessary. For these individuals, effective hair replacement can include tissue expansion, transposition flaps, and hair grafting.

BIBLIOGRAPHY


PATIENT WITH HAIR LOSS OF THE SCALP

A History and physical examination
Assess areas of balding and extent of hair loss

B Pharmacologic management
Response to pharmacologic therapy satisfactory?
  No
  Yes
  Continue with pharmacologic therapy
  Long-term follow-up

Surgical management

Limited hair loss in frontal area
C Combination of minigrafts/micrografts
  Scalp reduction

Crown and vertex area
D Area of hair loss < 4 cm²
   Serial scalp reduction
E Area of hair loss > 4 cm²
   Tissue expansion
   Scalp reduction

Marked hair loss in frontal area
F Transposition flap(s)

Marked hair loss in crown, vertex, and frontal areas
G Combination treatment
   - Scalp reduction
   - Tissue expansion
   - Transposition flap(s)

Treat/augment scar alopecia with minigrafts/micrografts

Long-term follow-up
CHAPTER 114  FOREHEAD AND BROW
Sherrell J. Aston • Jennifer L. Walden

A Complete medical history must be obtained for all patients who are evaluated for facial aesthetic surgery. This history includes previous surgeries, medical conditions, medications, and allergies. A complete physical examination should be performed before a surgical procedure. When performed before periorbital surgery, visual acuity and ocular mobility should be assessed. Visual field testing is necessary if a patient has upper eyelid ptosis or skin folds that interfere with the lateral visual field. Photographic documentation of a patient's preoperative status must be obtained. The eyebrows are evaluated for position, symmetry, and the relationship between the medial and lateral brows. This examination is performed with the patient relaxed and without animation of the corrugator, procerus, and frontalis muscles.

B In women, the youthful eyebrow arches above the supraorbital rim and has a peak above the lateral limbus, although many women alter this by shaping their eyebrows. In men, the brow should be more horizontal. When the eyebrow is at a normal position above the orbital rim and glabella, creases are present. A heavy appearance of the upper eyelid can be improved with an upper lid blepharoplasty. Some patients desire an eyebrow that is situated higher than the normal position above the orbital rim. A brow-lift procedure can achieve this goal, but each patient’s aesthetic goals must be carefully and thoroughly discussed before surgery.

C When glabellar creases are present and the eyebrow is in the normal supraorbital rim position, an upper lid blepharoplasty with transpalpebral corrugator and depressor supercili muscles resection will improve upper lid heaviness and reduce glabellar creases. Likewise, Botulinum toxin can be used for temporary improvement of the glabellar creases if a transpalpebral corrugator resection is not performed.

D Transverse forehead lines are the result of frequent contraction of the frontalis muscle. For some people, this is purely an unconscious movement. Others do this because of the unconscious feeling of heaviness on the upper eyelid. For many patients, correction of the upper eyelid heaviness significantly reduces the frontalis contraction. When there are very deep forehead lines and the eyebrow is in the correct position above the orbital rim, an incision can be made in the hairline, a bicoronal flap developed, and the frontalis muscle partially resected. A transient improvement of transverse forehead lines can be achieved with botulinum toxin A injections. In either case, if the frontalis muscle is resected or paralyzed and the corrugator and procerus muscles remain intact, the eyebrow will drift inferiorly, because the brow elevator has been eliminated.

E When the eyebrow is below the orbital rim, it can only be corrected with a brow-lift procedure. When deep glabellar creases are present, the medial head of the eyebrow is usually low as a result of the contraction of the corrugator and procerus muscles. If the anterior hairline is less that 6 cm from the eyebrow margin, an endoscopic brow lift with corrugator and procerus resection and dissection in the subperiosteal plane along the orbital rim will allow repositioning of the eyebrow to a supraorbital rim position. Care must be taken to not over-elevate the brow position and attempt to achieve brow symmetry. A bicoronal incision forehead lift can also achieve brow elevation, but this procedure can be reserved for the extremely low forehead and eyebrow. When the anterior hairline is more than 6 cm from the upper brow margin, an anterior hairline incision that curves into the temporal hairline laterally can be used to elevate the brow, resect the corrugator and procerus muscles, and not raise the already-high hairline.

F When neither the glabellar creases nor a transverse nasal root crease is present, the medial head of the eyebrow is usually in a less depressed position, and lateral brow ptosis may be more significant. If the anterior hairline position is less than 6 cm from the upper edge of the eyebrow, an endoscopic brow lift can be performed with dissection in the subperiosteal plane along the orbital rim, but the corrugator and procerus muscles are not resected to prevent excessive medial brow elevation. If the anterior hairline is greater than 6 cm from the brow, an anterior hairline incision that curves into the temporal areas laterally is used to reposition the eyebrow, with dissection in the subperiosteal plane along the orbital rim. Patients with only lateral brow ptosis can be treated with a lateral brow lift using only a temporal area incision, with dissection in the subperiosteal plane along the orbital rim and in the subcutaneous plane above the temporalis fascia. The temporal fusion line is released to permit brow elevation.

BIBLIOGRAPHY
PATIENT DESIRING REJUVENATION OF FOREHEAD AND BROW

A History and physical examination

Visual/ophthalmologic examination as indicated

Correlate patient’s anatomy and aesthetic concerns

B Eyebrows situated above supraorbital rim

No glabellar crease(s) present

Upper lid blepharoplasty

Does patient desire surgery?

Botulinum toxin A injections to glabella

C Glabellar crease(s) present

Does patient desire surgery?

Frontalis resection

D Transverse forehead lines

Eyebrows below orbital rim

Does patient desire surgery?

E Glabellar crease(s) present

Assess anterior hairline position

No

Yes

F No glabellar creases present

Assess anterior hairline position

Hairline <6 cm from upper edge of eyebrow

Hairline >6 cm from upper edge of eyebrow

Extremely low forehead/brow

Hairline <6 cm from upper edge of eyebrow

Hairline >6 cm from upper edge of eyebrow

Is there lateral brow ptosis only?

Upper lid blepharoplasty with transpalpebral corrugator/depresseor supercilii resection

Anterior hairline incision brow lift

Bicoronal incision forehead lift

Endoscopic brow lift

Endoscopic brow lift with corrugator and procerus resection

Anterior hairline incision brow lift

Temporal incision lateral brow lift

Anterior hairline incision brow lift

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
When evaluating a patient who is interested in upper lid rejuvenation, a complete history, thorough periorbital examination, and the development of an operative plan are essential for a safe and successful procedure. The functional aspect of the upper eyelid is to protect and moisten the cornea and must be considered during the assessment, examination, and execution of any upper lid procedure. Previous eye or lid procedures, the use of corrective lenses, dry eye, eye diseases, and visual field deficits are documented. Patients with dry eye or visual field deficits are referred to an ophthalmologist who can assess and treat dry eyes and test visual fields to determine the contribution of the eyelids to any field deficit. If dry eye is suspected, a Schirmer test can be performed to confirm the diagnosis. Visual acuity is also measured and recorded before any eyelid procedure. If LASIK has been performed, aesthetic eyelid surgery should be delayed 6 months to allow the cornea to regain sensibility following keratotomy.

Once a patient has been assessed and treated by an ophthalmologist or if he or she does not meet any criteria necessitating ophthalmologic evaluation, the forehead and brows are evaluated. Often the first indicator of dermatochalasis or upper lid ptosis is forehead wrinkling and brow strain. These are easily identified during the physical examination. If the condition is long standing, a patient may not be aware of it.

When brow strain is present, lid ptosis must be ruled out. To check for ptosis, the examiner physically depresses the brow to neutralize the effect of the frontalis muscle on the lid position. If this maneuver results in the lid position covering more than 1 to 2 mm of the upper corneoscleral limbus during straightforward gaze, upper lid ptosis is confirmed and repair becomes part of the blepharoplasty. If the lid position is normal with no ptosis, then the cause of brow strain may be dermatochalasis, and a concomitant brow lift is indicated. When a brow lift is planned, it should be performed before the blepharoplasty because of its secondary lifting effect on the upper lid skin. In this manner, overresection of upper lid skin and possible iatrogenic lagophthalmus are avoided.

Excess skin should be resected. Skin resection medial to the midpupillary line is conservatively planned to avoid lid closure problems and the A-frame deformity. The skin, underlying muscle, and orbital septum can be removed en bloc or sequentially, based on the surgeon’s preference.

The fat in the upper eyelid consists of medial and middle fat pads. If excess medial fat is identified, it is resected conservatively. Fat is either not resected or only minimally resected immediately lateral to the medial fat pad to avoid the A-frame deformity. If present, excess retroorbicularis oculi fat is also resected.

The position of the lid crease may need to be corrected in patients with asymmetry or levator disinsertion associated with ptosis. Patients of Asian ethnicity may desire an occidental crease.

BIBLIOGRAPHY

PATIENT DESIRING UPPER EYELID REJUVENATION

A History and physical examination

Dry eye, visual defect, or other ocular problem noted?

Yes
Refer to ophthalmologist

No
Recent LASIK procedure?

Yes
Defer any aesthetic procedures until issues resolve

No
Satisfactory resolution of abnormal findings?

Yes
Full assessment of brow and eyelids

No
Defer lid rejuvenation for 6 months

Brow strain present?

Yes
Evaluate for ptosis versus dermatochalasis

Brow strain secondary to upper lid ptosis?

See algorithm 49

Brow strain secondary to dermatochalasis?

Consider concomitant brow lift

Assess components of upper lid

No
Brow strain present?

Low brow position

Normal brow position

D Excess skin on pinch test

Perform skin resection

E Excess fat

Judicious removal of upper lid fat pads

F Upper lid crease

Adjust per patient goals/ethnicity

Long-term follow-up
CHAPTER 116  LOWER EYELIDS

Farzad R. Nahai • Daniel P. Luppens

Before considering aesthetic surgery on a patient’s lower lids, a thorough history specific to the eyes is documented. This includes previous surgery, dry eyes, the use of corrective lenses, difficulty with vision, recent LASIK surgery, the use of ophthalmic medications, and a history of hyperthyroidism.

Any report of dry eyes, difficulty with vision, or other periorbital problem requires consultation with an ophthalmologist for an appropriate workup and treatment. If dry eye is suspected, a Schirmer test is performed.

If LASIK has been performed, aesthetic eyelid surgery should be delayed 6 months to allow the cornea to regain sensibility following keratotomy.

The evaluation of the lower eyelids includes an assessment of the upper eyelids and brows as part of a global assessment of the periorbital region. An examination of the lower lids starts with an assessment of the canthal tilt, the lid position relative to the lower corneoscleral limbus (that is, the presence of scleral show), excess skin, protruding periorbital fat, the tear trough, orbital rim sulcus, and the position of the cheek.

Eye prominence is measured with a Hertel exophthalmometer; 14 mm or less is considered enophthalmic, 15 to 20 mm is normal, and 21 mm or greater is exophthalmic.

Lid laxity is assessed using a lid distraction snap test. The maximum amount of lid distraction is recorded, and the ability of the lid to snap back to the globe is noted. In lax lids, the distraction is more than 8 mm from the globe, and the lid does not snap back to the globe until the patient blinks it back into place.

The presence of periorbital fat can be elicited by gently applying pressure to the globe after the patient closes his or her eyes.

For patients with excess fat and minimal excess skin, transconjunctival blepharoplasty is the procedure of choice. Redundant fat is removed from the three lower lid fat pads, using caution not to skeletonize the orbit. This is particularly applicable to young patients who desire reduction of the fullness caused by the excess fat in their lower lids.

When a small amount of lower lid skin needs to be removed, a subciliary skin pinch blepharoplasty is used in conjunction with the transconjunctival approach for fat removal. Conservative chemical peels or laser treatments are also useful options to address minor skin excess or sun damage present in a lower lid. Before performing any procedure to address excess skin, any lower lid laxity is noted. If lid laxity exists, even conservative resurfacing procedures may lead to lower lid malposition or ectropion in the absence of lower lid anchoring.

With more advanced lower lid changes, a transcutaneous blepharoplasty is indicated.

When a patient has a tear trough deformity, deep orbital rim sulcus, or significant malar descent (all indicators of a demarcation between the lid-cheek junction), release of the orbitomalar ligament should be performed to blend the lid-cheek junction. When cheek descent is significant, a subperiosteal cheek lift is useful to rejuvenate the lid-cheek junction.

For patients with significant excess lower lid fat, the fat should be resected until it is flush with the orbital rim. Alternatively, the fat can be repositioned below the lid-cheek junction to blend that junction and treat the tear trough deformity, provided an adequate release in the tear trough is performed.

When the lateral canthus is lax, the lower lid margin should be reset at the level of 1 to 2 mm above the inferior corneal limbus, with the lateral canthus set at the level of the midpupil. During this repositioning maneuver, lower lid tension is checked by distracting the lower lid away from the globe to determine the specific procedure. If the lid can be distracted so that a 2 to 3 mm gap results, adequate lid anchoring can be achieved with a canthopexy. If the lid is still lax (that is, distraction results in a gap of 3 mm or more), a canthoplasty is performed to achieve adequate lid anchoring.

The case of the prominent eye deserves special attention. With a Hertel measurement of 21 mm or more, it can be difficult to achieve the proper lid position. At a minimum, the lower lid retractors should be released. If this is not effective in correcting the lid position, a primary lower lid spacer graft is indicated.

BIBLIOGRAPHY

PATIENT DESIRING REJUVENATION OF THE LOWER EYELIDS

A History and physical examination

Dry eye, visual defect, or other ocular problems noted?

Yes

B Refer to ophthalmologist

Satisfactory resolution of abnormal findings?

No

Defer any aesthetic procedures until issues resolve

Yes

D Assess lower eyelid characteristics

E Globe position

F Lower lid position

G Cheek position

H Lower lid appears aged primarily because of prominent fat pads

Transconjunctival approach to remove excess fat from lower lid fat pads

I Residual skin excess

Concurrent subciliary skin pinch resection

J Transcutaneous approach

K Deep rim sulcus or malar descent

Release orbitor-malar ligament ± subperiosteal cheek lift

L Excess periorbital fat

Reposition fat to below lower lid-cheek junction

M Canthal laxity

Lid-globe gap >3 mm with distraction?

No

Canthopexy

Yes

Canthoplasty

N Exophthalmus

Lower lid retractor release ± lower lid spacer

Judicious skin resection if excess skin present

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book


All rights reserved. Usage subject to terms and conditions of license.
**Face**

Midface and Lower Face
Perioral Area
Chin
Neck
Craniofacial Contouring

**ALGORITHM KEY**

- Problem
- Surgical Interventions and Surgical Endpoints
- Nonsurgical Interventions
- Surgical or Nonsurgical Options List
- Combination of Surgical and Nonsurgical Options List
- Hierarchy List

https://t.me/Free_Plastic_Reconstruction_Book
When evaluating a patient for facial aesthetic surgery, a complete medical history is obtained, including medical conditions, medications, and allergies. A comprehensive physical evaluation should also be performed before any surgical procedure. An extensive analysis of the face and neck, with photographic documentation of a patient’s preoperative status, must be obtained for decision making, intraoperative review, and postoperative evaluation.

For patients with no midface descent (mostly young patients) and prominent nasolabial folds, a soft tissue filler or autologous fat can provide temporary improvement. The patient must be advised of the potential for lumps, bumps, and irregularities, as well as the transient nature of the treatment.

For patients who have little to moderate midface descent, with early jowling and no significant neck laxity, a short-incision face lift is indicated. If neck laxity exists, a full-incision face lift, including a neck lift, will be required (see algorithm 120).

Short-incision face lifts may be used for various facial contours. In patients who have a volume-deficient thin face, SMAS imbrication can reposition the volume to a desired area and correct laxity. Patients with normal facial volume benefit from an SMAS flap, which improves the lower two thirds of the nasolabial fold and the labiomandibular fold. Fat, round faces can be significantly improved with lateral SMASectomy to remove some facial volume and tighten the underlying foundation.

Moderate to severe midface descent with prominent NLFs and no neck laxity can be corrected with a short-incision face lift with the extended SMAS flap to reposition the midface volume and eliminate jowl. This also allows elevation and suspension of the malar fat pad. Typically, malar fat pad suspension is indicated if the malar fat pad is thick and ptotic. Otherwise, a standard or extended SMAS flap may be performed without a separate maneuver for fat pad elevation.

Midface descent with prominent nasolabial folds, jowling, and neck laxity requires a full-incision face lift. Malar fat pad elevation and extended SMAS flap repositioning are also indicated for this degree of facial aging and soft tissue descent in patients with a thick malar fat pad. If the malar fat pad is thin or insubstantial, an extended SMAS alone will suffice.

**BIBLIOGRAPHY**

PATIENT DESIRING REJUVENATION OF THE MIDFACE/LOWER FACE

A History and physical examination
Assess patient’s aesthetic concerns and correlate with facial analysis

B No midface descent, but prominent nasolabial folds present
Soft tissue filler (see algorithm 112)

C Little to moderate midface descent, but lower face jowling present
Is there laxity of the neck tissue?

D Full-incision face and neck lift
Facial volume deficient (thin face)
SMAS imbrication

E Moderate to severe midface descent with prominent nasolabial folds, jowling, and no neck laxity
Short-incision face lift
Facial volume sufficient (normal face)
SMAS flap
Facial volume excessive (heavy face)
Lateral SMASectomy

F Midface descent with prominent nasolabial folds, jowling, and neck laxity
Full-incision face lift
Patient has a thick malar fat pad
Malar fat pad elevation/suspension and extended SMAS flap
Patient has a thin malar fat pad
Extended SMAS flap alone

Long-term follow-up
CHAPTER 118  PERIORAL AREA

Daniel Kwan • Julius W. Few

A Patients requesting facial rejuvenation are frequently concerned about the appearance of their lips, mouth, and surrounding soft tissues. Concerns about lip volume and shape change, fine rhytids above the upper lip vermilion border, marionette lines, and the presence of a labiomiolar crease are common. These areas can be rejuvenated in isolation or as part of a more extensive procedure such as rhytidectomy.

B Several options exist for treating vertical lip rhytids. The decision as to which technique to use often depends on the patient’s tolerance of postprocedure discomfort and downtime. For patients willing to undergo a more invasive procedure requiring a longer recovery time, dermabrasion, laser resurfacing, or chemical peel can produce excellent aesthetic results. The choice of which technique to use is based on the surgeon’s experience and patient’s desires. The activation of herpes simplex has been reported after all three types of procedures, and patients should be treated prophylactically with oral acyclovir before the procedure. In addition, nonablative resurfacing procedures should not be performed on patients taking isotretinoin until the drug has been discontinued for 12 to 18 months. This limits the possibility of isotretinoin-induced hypertrophic scarring.

C For patients who must minimize postprocedure recovery time, vertical lip rhytids can be treated with injection of nonpermanent filler using a superficial serial puncture technique. Caution must be exercised when botulinum toxin A is used periorally, because overinjections interfere with the function of the orbicularis oris muscle, leading to a lengthened lip with compromised function.

D The labiomental crease is best treated with a filler injection. Successful treatment can be obtained with all filler types. A linear threading technique in the deep dermal or subdermal plane is used.

E With aging, a decrease in collagen, hyaluronic acid, and elastin within the upper and lower lips leads to loss of lip volume and definition. Younger patients may be interested in increasing lip pout.

F For patients interested in lip augmentation, autologous implants should be discussed. This could be a piece of SMAS harvested during a synchronous face lift, a piece of deepithelialized dermis, or fat grafts. Cadaveric tissues also have been used with success to augment the lips. Although non–tissue-type alloplastic lip implants have been used, high complication rates have been reported.

G For patients who do not want autologous tissue placed into the lip, nonsurgical management with nonpermanent fillers can provide excellent results.

H In augmenting the upper lip, it is important to consider proportions. For Caucasian patients, the upper lip makes up one third of the total lip volume, whereas for many patients of African descent, the upper lip makes up one half of the total lip volume. When injecting the upper lip, serial threading can be used between the mucosa and orbicularis. When injecting in the correct plane, it is common to see fasciculations. The lip volume is restored first, and definition is added to the Cupid’s bow and philtrum as needed.

I In augmenting the lips, the central raphe should not be overfilled. Once acceptable volume is achieved, the vermilion border can be enhanced as needed. As with the upper lip, it is important to avoid overfill of the lower lip, causing loss of the normal ridges found on the vermilion mucosa.

J Marionette lines are treated using a combination of effacement of the rhytid with filler and chemodenervation of the depressor anguli oris muscle using botulinum toxin A. All filler types can be used in this area. A deep dermal to subcutaneous linear threading technique for placement of the chosen filler is indicated in this area.

BIBLIOGRAPHY


PATIENT DESIRING REJUVENATION OF THE PERIORAL AREA

History and physical examination

A Assess patient’s aesthetic concerns

Vertical lip rhytids

D Labiomental crease

E Decreased lip volume/inadequate lip pout

Can patient tolerate postprocedure downtime?

B Yes

C No

Resurfacing procedure

Treat with nonpermanent filler using superficial serial puncture technique

F Is patient willing to accept an autologous implant?

G Nonsurgical management

H Upper lip

I Lower Lip

J Marionette lines

Can treat with all filler types using a deep linear threading technique

Botulinum toxin A treatment of depressor anguli oris muscle

Long-term follow-up

SMAS graft

Deepithelialized dermis graft

Fat graft

Implant

Long-term follow-up

Upper lip Vermilion

Treat with nonpermanent filler using deep injection with attention to filling the central tubercle

Treat with nonpermanent filler using superficial linear threading to highlight Cupid’s bow and philtral columns

Lower Lip Vermilion

Treat with nonpermanent filler using deep injection to preserve or create a midline raphe

Treat with nonpermanent filler using superficial linear dermal injections to create definition

Long-term follow-up
CHAPTER 119  CHIN
Francesco Gargano • Silvio Podda • S. Anthony Wolfe

A Chin abnormalities may be restricted to the chin, or they may be part of a more extensive dentoskeletal deformity.

B The intraoral examination is of paramount importance in the evaluation of occlusion planes and the shape of maxillary-mandibular arch to plan adjustments in the chin osteotomy. Patients with an Angle class II or III malocclusion pattern may require orthognathic surgery in addition to or instead of genioplasty.

C The clinical evaluation includes frontal, lateral, and occlusal views of the entire face. The AP view defines vertical dimension with horizontal lines (hairline, glabella, subnasal, and menton) and divides the face into three anatomic portions. Horizontal dimensions are best detected in profile. In the normal chin projection, the upper lip is at the level of the lower lip or slightly anterior to it. The soft tissue evaluation includes lip competence, cervicomental angle excess of skin, subplatysmal/supraplatysmal fat, platysmal bands, submandibular glands, and the hyoid bone.

D Patients with microgenia have a small chin with an overall deficiency of bone in the horizontal or vertical plane, or both.

E Horizontal chin deficiency is treated with horizontal osteotomy with advancement of the caudal segment. Sliding horizontal osteotomy advances the osteotomized segment, reducing the anterior length (indicated in retrohorizontal microgenia). Two-tiered or step osteotomy is indicated in more severe cases of retromicrogenia and in patients with a short, wide-angled mandible and a steep mandibular plane. Vertical microgenia is corrected with osteotomy and interpositional bone graft. Vertical excess with horizontal deficiency is better corrected using a jumping technique to advance the caudal excess toward the deficient horizontal plane.

F Patients with macrogenia have a large chin with either normal occlusion or mandibular prognathism, depending on the horizontal, vertical, or combined excess. Mild forms can be treated with burr reduction. More severe cases of horizontal and vertical excess should be treated with setback osteotomies tailored to the type of deformity.

G An asymmetrical chin can be the result of a combined microgenia and macrogenia (vertical excess and horizontal deficiency or vice versa) or displacement of the chin on the horizontal or rotational planes. Asymmetry with normal anterior lower facial height is treated with a leveling osteotomy and wedge augmentation.

H Staged genioplasties combined with orthognathic surgical procedures are a useful tactic in patients with very severe microgenia and retrogenia. When a patient has undergone as many genioplasties as possible and still has a perceived chin deficiency, an autogenous costal cartilage graft can be useful. When all techniques have been unsuccessful, healthy vascularized bone and soft tissue can be transferred as an osteocutaneous free flap.

BIBLIOGRAPHY
PATIENT WITH CHIN ABNORMALITY

History and physical examination

Prior chin surgery

Yes

Problematic alloplastic chin implant?

Remove implant

One- or two-stage osseous genioplasty

No

Evaluate occlusion

Insufficient prior osseous genioplasty

Revision

- Staged osseous genioplasty
- Autogenous cartilage graft
- Microvascular bone graft

Normal/near normal

B Abnormal

Patient does not want dentoskeletal correction

See algorithm 35

Patient does want dentoskeletal correction

C Physical examination of chin

Chin smaller than normal (microgenia)

Assess degree of horizontal deficiency

Mild

Alloplastic genioplasty

Moderate

Autogenous osseous genioplasty

Severe

Augmentation

- Staged genioplasties
- Autogenous cartilage graft
- Microvascular bone graft

H Chin larger than normal (macrogenia)

Assess magnitude of excess

Mild

Burr reduction

G Chin asymmetrical

Moderate to severe

Oblique osteotomies and setback

Centering ± leveling genioplasty

D Chin larger than normal (macrogenia)

Assess degree of horizontal deficiency

E Assess osseous chin volume

Deficient

Horizontal

Sliding two-tiered genioplasty

Vertical

Interpositional bone graft

Jumping genioplasty

Chin asymmetrical

F Chin smaller than normal (microgenia)

Assess degree of horizontal deficiency

Mild

Alloplastic genioplasty

Moderate

Autogenous osseous genioplasty

Severe

Augmentation

- Staged genioplasties
- Autogenous cartilage graft
- Microvascular bone graft

Jumps

Chin asymmetrical

Revision

One- or two-stage osseous genioplasty

- Staged osseous genioplasty
- Autogenous cartilage graft
- Microvascular bone graft

Long-term follow-up

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 120 NECK

Thomas J. Francel

A A complete history should be obtained for all patients who are considering surgery of the neck. It should include the patient’s overall health and medication use, any history of smoking, Accutane use, current topical skin care, laser therapy or radiation treatment to the neck, prior neck surgery, and the use of anticoagulant or antiplatelet medication. On physical examination, the aesthetic units of the neck are addressed: chin, jawline, ear, muscular mandibular triangle, submental zone, midline strip, middle neck, and lateral neck. It is also necessary to assess the amount of subcutaneous (preplatysmal) and subplatysmal fat. The jawline is examined for a prejowl notch, because this will require a more extensive release in this area. In addition, platysmal banding, the cervicomenatal angle, lower neck folds, and visible or palpable submandibular glands are assessed.

B The quality of the skin and its elasticity, determined using the pinch test for recoil, are evaluated. In patients with good skin tone, skin redundancy can often be addressed by redistributing the skin over an improved cervicomenatal angle, and no skin excision may be necessary. In patients with poor skin tone, lateral neck skin is excised through a postauricular skin incision.

C To improve the cervicomenatal angle, the tissue planes of the submental region must be assessed and treated individually. In patients with excess fat in the preplatysmal plane, removal of the fat with liposuction using minimal incisions is indicated. This may also be performed using scissors or electrocautery under direct visualization. However, fat removal may reveal secondary deformities, including prominent submandibular glands or platysmal banding.

D If a subplatysmal fat pad is present, direct lipectomy of the pad is performed using a submental incision. This also allows visualization of the platysma for decussation, and of the fat pad for mobilization and resection.

E Once the subplatysmal fat pad has been removed, the digastic muscles can be assessed. Tangential shaving is indicated when hypertrophic muscle produces a noticeable bulge. Plication of divergent muscles may also be performed, though care must be taken, because this maneuver can pull the submandibular glands out of their nests and create a bulge.

F A small, noticeable bulge from a submandibular gland can be corrected by oversewing the portion of the platysma muscle lying directly above the muscle. Larger bulges, created by more prominent glands, can be treated by first performing an intracapsular gland release, followed by platysmal reinforcement, suspension of the gland to the mandibular border, or partial gland resection.

G Static platysmal bands can be treated through a submental incision. A limited midline plication or corset platysmaplasty is indicated for decussation of the platysma. Partial transection of the platysma, below the level of plication, helps to prevent recurrent platysmal banding. When a postauricular incision is used, a posterior platysmal pullback may be performed.

H In patients with dynamic platysmal bands, injection of the platysma on either side of the midline edges with botulinum toxin A can relax the muscle, allowing it to redrape around the neck cylinder for a more defined cervicomenatal angle. This is most effective in a younger patient in whom the presence of platysmal laxity has not affected the elastic properties of the neck.

I The chin should be assessed preoperatively in all neck rejuvenation patients to determine whether the chin is hypoplastic, excessive, or pseudoptotic, or if dental malocclusion is present.

J Correction of a witch’s chin deformity requires addressing the skin and soft tissue, including periosteal attachments that cause a deep submental crease. Simply releasing the subcutaneous tethering of the crease may be enough to correct the skin ptosis, but skin and fat excision is often required. Mentalis release may also be necessary.

BIBLIOGRAPHY


PATIENT WITH AN AGING NECK

A History and physical examination
Consider patient’s aesthetic concerns
Static and dynamic examination of neck

B Excess skin
Assess skin tone
Good tone
Skin redistribution (no skin excision)
Lateral neck skin excision through postauricular skin incision
Long-term follow-up
Poor tone

C Subcutaneous fat
Suction lipectomy

D Subplatysmal fat
Direct lipectomy

E Anterior digastric muscle divergence or hypertrophy
Digastric muscle modification
Assess lateral submandibular area
Small bulge from submandibular gland
Platysmal reinforcement over gland
Long-term follow-up
Large bulge from submandibular gland
Intracapsular gland release

F Submental incision followed by midline platysmaplasty = platysmal division
Platysmal reinforcement over gland
Gland suspension to mandible
Partial resection of superficial lobe

G Platy smal bands
Static
Postauricular incision followed by posterior platysmal pullback with fixation

H Dynamic
Botulinum toxin A

I Chin deformity
Hypoplastic
Genioplasty (see algorithm 119)

J Ptotic chin
Correction of witch’s chin

Long-term follow-up
A thorough evaluation of the patient's perceived deformity is vital to a successful outcome. Bony pathology such as fibrous dysplasia needs to be excluded. Dentofacial deformities and malocclusion may occur concomitantly and need to be addressed.

Facial proportion and symmetry should be evaluated. Correction of asymmetry should be incorporated into the operative plan. Photographic documentation and radiologic studies may assist with surgical planning. Three-dimensional CT is especially helpful in analyzing cases of facial asymmetry.

Plain radiographs and CT are helpful in establishing the nature of frontal bossing or irregularities. Surgical access is usually through a coronal incision. When the frontal sinuses and overlying bone quality are normal, contouring with a burr is adequate. Hyperpneumatic frontal sinuses may be associated with thin overlying bone, in which case osteotomy and bone grafting may be necessary to restore aesthetic contour. When remodeling of the in situ bone is not a suitable option, a split of calvarial bone graft can be used.

Depression of the zygoma can be augmented transorally using either autogenous tissue or alloplastic implants.

Zygomatic prominence can be caused by a prominent zygomatic body, a wide arch, or both. Asymmetries, irregularities, and prominence of the zygomatic body alone can be improved by burring. A wide midface can be caused by arch prominence. This can be narrowed while maintaining a natural malar contour by performing osteotomies of the body and arch, followed by positioning of the prominent area medially, with rigid fixation using intraoral or sideburn incisions. Variations to this technique include L-shaped and inverted-L-shaped medial osteotomies with resection of a segment of bone.

Both soft tissue and bony contributions to the patient's lower facial contour must be assessed.

Patients with prominent mandibular angles usually present with hypertrophic masseteric muscles. Botulinum toxin is an effective alternative for contouring of the lower facial profile by reducing the bulkiness of masseteric muscles. Skeletal contouring and soft tissue reduction may need to be performed concurrently to achieve the desired result.

The morphology of the prominent bony mandibular angle needs to be determined. When the mandibular width is acceptable, and the prominent angle is caused predominantly by a posterior projection of the angle, an angle resection is sufficient to elevate and soften the appearance of the gonial angle. In contrast, when the mandibular angle and part of the mandibular body anterior to it are protuberant laterally, an angle-splitting osteotomy is used to narrow the width of the lower face by removing the lateral cortex of the protuberant area. Prominences, irregularities, and asymmetries of the mandibular body, as well as any chin deformities, should be addressed concurrently with mandibular angle reduction to obtain harmonious lower facial contours. Angle reduction surgery can be performed solely transorally or combined with an extraoral approach. Care must be taken to preserve the inferior alveolar nerve.

BIBLIOGRAPHY

PATIENT DESIRING A CHANGE IN FACIAL CONTOUR

History and physical examination

A Evaluate for bony pathology and/or dentofacial deformities

Present?

No

B Assess patient’s concerns and anatomic site of deformity with photographic and radiologic imaging

Yes

Manage bony pathology

See algorithm 35

Long-term follow-up

Frontal bossing or irregularity

Normal frontal sinus

Bone shaving

Hyperpneumatic frontal sinus

Osteotomy and bone grafting

Zygomatic contour

Zygomatic depression

Malar augmentation

• Autologous augmentation
• Alloplastic augmentation

Osteotomy and medial displacement/fixation

Zygomatic prominence

Arch

Bone shaving

Body

Bone shaving and osteotomy with medial displacement/fixation

Prominent mandibular angle

Assess anatomic cause

G Masseteric hypertrophy

Treat with botulinum toxin A

Satisfactory improvement

Soft tissue reduction ± bony reduction

Unsatisfactory improvement

Angle resection

Angle-splitting osteotomy

Associated body and chin deformities

Bony shaving and genioplasty as required (see algorithm 119)

Long-term follow-up
Nasal Airway Obstruction
Nasal Deformities
The Crooked Nose

ALGORITHM KEY

- Problem
- Surgical Interventions and Surgical Endpoints
- Nonsurgical Interventions
- Surgical or Nonsurgical Options List
- Combination of Surgical and Nonsurgical Options List
- Hierarchy List
The challenge of improving nasal obstruction begins by determining the various contributions of many separate components and then formulating an appropriate plan. It is helpful to divide the causes of nasal obstruction into two categories: those that are static in nature and those that are dynamic.

Patients with static obstruction of the nasal airway usually describe constant and persistent obstruction. This can be unilateral or bilateral. Unlike dynamic forms of obstruction, symptomatology from static causes is less likely to fluctuate over time.

Septal deviation is determined based on external and internal nasal examination. In traditional endonasal septoplasty, a 1 cm strut of cartilage is maintained both dorsally and caudally for long-term structural and functional stability. When areas of deflection or obstruction occur within this 1 cm boundary, other techniques are indicated. When the septum has an extreme deviation (more than a 30- to 45-degree angulation) or for a considerable tortuous curvature to the septum, extracorporeal septoplasty is performed.

Internal nasal valve collapse is assessed using the Cottle maneuver. In patients with a unilateral internal nasal valve collapse with a visible indentation in the cartilaginous middle third of the nose, an ipsilateral spreader graft is inserted. If there is unilateral internal nasal valve collapse without visible indentation in the middle third of the nose, then bilateral spreader grafts are recommended to avoid postoperative middle third cartilaginous asymmetry. Bilateral spreader grafts are used if bilateral internal nasal valve collapse is diagnosed. In a select group of patients who have particularly severe types of nasal obstruction (and/or may be burdened by other pathology such as sleep apnea), a second spreader graft is placed lateral to a traditionally sized and shaped spreader graft.

Vestibular stenosis is a difficult problem to correct, often requiring complex flaps, composite grafts, and prolonged stenting to achieve an adequate nasal airway. Staged procedures are performed, first to stiffen the fibromuscular-fatty tissues of the alae and then to remove vestibular scar tissue, followed by full-thickness skin grafting (FTSG). Vestibular splinting with a custom-molded thermoplastic splint may be necessary.
PATIENT WITH NASAL AIRWAY OBSTRUCTION

History and physical examination

A. Assess nature of obstruction

B. Static

C. Deviated septum
   - Spares dorsal and caudal 1 cm
   - Involves dorsal or caudal 1 cm
   - >30 degrees or tortuous
   - Endonasal septoplasty
   - Open septoplasty
   - Extracorporeal septoplasty

D. Internal nasal valve collapse
   - Assess for visible identification at middle third of nose
   - Present
   - Ipsilateral spreader graft
   - Bilateral spreader grafts
   - Absent
   - No additional treatment
   - Double width of spreader grafts

E. Vestibular stenosis
   - Correction
   - • Composite grafts
   - • Z-plasty
   - • Alar batten grafts ± FTSG
   - • Stenting

Are exacerbating factors (obstructive sleep apnea, severe blockage) present?

- No
  - No additional treatment

- Yes
  - Double width of spreader grafts

Long-term follow-up
Patients with dynamic nasal obstruction present more of a diagnostic challenge because of the intermittent nature of the obstruction. The patient may or may not have obvious triggers or conditions that aggravate the nasal obstruction. The examination may disclose boggy, edematous turbinates or external nasal valve collapse.

Significant inferior turbinate hypertrophy may improve with topical medications. When medical management fails, submucosal resection can be performed. If the turbinates are large without significant soft tissue hypertrophy, large bony lamellae may require outfracture or resection.

When the nostril collapses with brisk inspiration, an auricular conchal cartilage graft is inserted into the fibro-muscular-fatty tissues of the ala. Dynamic collapse of the piriform aperture soft tissues is a difficult anatomic condition to correct surgically. Alar batten grafts and ipsilateral internal valve repair are traditional procedures. If a patient is a poor surgical candidate, nasal valve suspension performed under local anesthesia should be considered.

### BIBLIOGRAPHY


PATIENT WITH NASAL AIRWAY OBSTRUCTION

History and physical examination

A. Assess nature of obstruction

F. Dynamic

G. Inferior turbinate hypertrophy

- Fleshy tissue

Medical management

- Obstruction resolved?
  - Yes
    - No further treatment
  - No
    - Surgical reduction

H. External nasal valve collapse

- Locate site of collapse
  - Ala
    - Alar rim graft
  - Piriform aperture
    - Patient able to tolerate anesthesia?
      - Yes
        - Batten graft
          - Internal valve repair
      - No
        - Nasal valve suspension

Long-term follow-up

Continued
The medical and aesthetic concerns of patients with nasal deformities should be discussed when considering surgical treatment. Are there associated airway obstruction symptoms? Will functional surgery (septum, turbinates, internal valve, and external valve) be required in conjunction with the aesthetic rhinoplasty? Is the patient’s request reasonable?

Analysis of the anatomy is the key element for a successful result. Each component of the nose should be evaluated in isolation and in its relationship to other nasal units. A thorough intranasal examination with consideration given to function should also be performed. The distinction between male and female anatomy is important, because the male dorsum is usually a straight line with a 90-degree nasolabial angle, whereas the female dorsum has a slight supratip break, a 100- to 110-degree nasolabial angle, and sometimes a slight concavity to the dorsum.

We prefer to address the dorsum first. Commonly, patients complain of a hump. This can be removed by rasping or direct excision of cartilage. Removal may lead to an open roof deformity, and the middle one third of the nose then needs to be reconstructed with spreader grafts or spreader flaps, or osteotomies if bone is removed.

A low radix is augmented with either cartilage or fascial grafts. If it is high, it is rasped or shaved with a sharp osteotome.

The nasal tip is generally considered to be the most difficult part of the nose to change. Suture techniques have made tip refinement more achievable. It is often necessary to first resect the cephalic part of the lateral crus. This removes some of the unwanted convexity that causes a broad, boxy, or bulging nasal tip. A 6 mm rim of lateral crus should remain to ensure that collapse will not occur. In addition, sutures can be applied to remove convexity. Other tip suture techniques include the transdomal suture to reduce the width of the nasal dome and the interdomal suture to bring the dome together to provide symmetry and tip strength. In many cases of tip deficiency, a columellar strut (made of autogenous donor cartilage) can increase projection by propping up the tip in a tent pole fashion. If necessary, as in very hypoplastic tips, a tip graft is added to the domes of the nasal tip.

The length of the nose is dictated by the location of the columella. If retruded, a septal extension graft can lengthen the nose. If the nose is excessively long, shortening the caudal septum can address the issue.

After removal of a dorsal hump, the nose appears wider, and osteotomies may be required to reduce the dorsal width of the nasal bones. A medial oblique osteotomy (often combined with lateral osteotomy) can accomplish this task. A low-to-low osteotomy reduces the width of the base of the nasal bones.

The length of the nose can be reduced by shortening the septum. The nasolabial angle is frequently changed at the same time by adjusting the angle of that resection. When the nose appears foreshortened (as in some Asian or African noses), septal extension grafts are added to the side of the septum to lengthen it. The graft is often obtained from the existing septum by resecting its central portion.

The nasal base may be very wide and unaesthetic, particularly in some ethnic noses. When flared, the sides of the alae are resected. Otherwise, only the alar base is excised. If the nostrils are large, the excision extends into the nostrils.

**BIBLIOGRAPHY**


PATIENT DESIRING AESTHETIC RHINOPLASTY

A History and physical examination

Assess aesthetic concerns

Inspect subunits

B Dorsum
- Overprojected hump → Reduce
- Ideal
- Underprojected → Augment

C Radix
- Low → Augment
- Normal
- High → Reduce

D Tip
- Underprojected → Columellar strut tip graft
- Overprojected
- Wide → Divide cartilage
- Cephalic trim and tip sutures

E Columella
- Retruded → Septal extension graft
- Ideal
- Protruded → Resect

F Nasal bones
- Broad dorsum → Medial oblique osteotomy
- Broad base → Lateral osteotomy
- Broad dorsum and base → Medial oblique and lateral osteotomy

G Septum
- Long nose → Shorten
- Ideal
- Short nose → Septal extension graft

H Nasal base
- Flared alae → Excise alar side
- Broad sill → Excise sill
- Broad columellar base → Reduce foot plates
- Broad alar base → Excise alar base

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book
Nicholas Vendemia • Anthony B. LaBruna

CHAPTER 124 THE CROOKED NOSE

When considering surgery in a patient with a crooked nose, knowledge of previous trauma or nasal surgery, breathing problems, nasal disease, and intranasal drug use will help guide the physical examination and analysis of the deformity. After obtaining a thorough history, the face and nose are examined. The overall symmetry of the face and cranial vault, including an assessment of facial width and height, should be evaluated. Visualization of a horizontal line passing through the radix of the nose and a vertical line passing through the midpoint between the medial canthus is helpful in assessing facial and nasal symmetry. The face should be equally balanced in vertical thirds: the upper third between the top of the head and the brow, the middle third between the brow and the upper lip, and the lower third between the upper lip and the chin. Any disproportion should be noted, but particularly a disproportional midface. Maxillary retrusion, vertical maxillary excess, vertical maxillary deficiency, or other bony abnormalities of the midface may be independently related to asymmetry of the face or nose. Dental occlusion and the relationship of the upper lip to the maxillary incisors can be useful in determining such conditions.

When looking at the patient’s nose straight on, attention is focused on the dorsal aesthetic lines, which run in smooth, symmetrical curves from the medial eyebrows through the radix, and then in straight lines along either side of the nasal dorsum. Disruptions of the dorsal aesthetic lines may indicate fractures of the orbital or nasal bones, or dislocations/defor- mities of the upper lateral cartilages. Restoring disrupted dorsal aesthetic lines is crucial to the successful correction of the crooked nose.

In the lateral view, the aesthetically pleasing nose has a relatively straight dorsal line from the radix to the tip—a supratip break, and a tip whose size and shape are in proportion to the rest of the nose. A large dorsal hump, or a saddle-nose deformity, may cause visual interruption of the dorsal line and/or the supratip break.

Examining the nose from an overhead view allows further assessment of the dorsal aesthetic lines, the width of the nose, and the symmetry of the lower lateral cartilages, which are partially responsible for the shape of the nasal tip. Lower lateral cartilages that are too large, too small, or grossly asymmetrical may lead to significant tip asymmetry.

From the worm’s-eye view, the examiner assesses the external nasal valves and nostril apertures, caudal septum, internal nasal valve, and crura and domes of the lower lateral cartilages. Deformities of any of these structures are further examined with an internal nasal speculum.

Once the nasal deformities are noted, the surgeon formulates a treatment plan. This may mean restoring normal anatomy or using procedures to camouflage defects to give the appearance of a straight nose.

Nasal bone fractures must be relocated if they are displaced. If the fractures are old and have begun to heal, osteotomies may be necessary to restore their original position. If the fractures are severely comminuted, or if the entire bony nasal pyramid is depressed in association with a nasoorbital-ethmoid (NOE) fracture, dorsal onlay grafting with autogenous bone may be necessary to reconstruct the nasal bridge.

Dislocated or asymmetrical upper lateral cartilages may be relocated to their natural position or repaired with augmentation grafts. The dorsal edges of these cartilages may be resected if they contribute to a dorsal hump, but bony osteotomies may then be necessary to correct the resulting open roof deformity and increased nasal width.

A deviated septum may be corrected by resecting the deformed portion, using batten grafts to straighten it, or repositioning it within the vomerine groove. When resecting a portion of deformed septum, a 1 cm margin of cartilage must be left intact caudally and dorsally to prevent collapse of the nasal midvault. Spreader grafts can be used to help support a corrected deviated septum and straighten distorted dorsal aesthetic lines.

A deviated or fractured caudal septum can create a significant deforming force on the nasal tip. A curved septum can be straightened using batten grafts that counteract the undesirable curve of the cartilage. Overriding edges of a septal fracture can be resected to restore a normal contour, and the fracture line can be reinforced with a graft if necessary. A dislocated septum can be relocated to its normal position within the vomerine groove. In certain instances of long-standing dislocation, it can actually be placed on the opposite side of the groove to counteract the effects of long-term displacement. Rarely, a caudal septum that is too deformed or lacks enough structural integrity to be useful is replaced by an autogenous graft.

After underlying septal deformity is ruled out or corrected, asymmetries of the lower lateral cartilages can be corrected by the techniques of cephalic trimming, augmentation grafting, columellar strut grafting, interdomal/intradomal suturing, or intercrural/intracrural suturing. These techniques are often used in conjunction to produce an aesthetically pleasing tip.

A nasal spine that is either naturally deviated or malpositioned from fracture can be corrected with an osteotomy and relocation of the spine to the midline. If the nasal spine is retruded or absent, or if the occlusal plane or mandibular occlusion is abnormal, referral to an orthognathic surgeon is indicated.

BIBLIOGRAPHY

PATIENT WITH A CROOKED NOSE DEFORMITY

A History and physical examination

B Detailed nasal analysis

C Consider anatomic reconstruction versus camouflage techniques

No

Yes

See algorithm 24

Upper third of nose

D Deviated bony pyramid

Nasal bones prominent

Osteotomies and bony pyramid repositioning

Nasal bones depressed

Autologous augmentation of pyramid/dorsum

Middle third of nose

E Dislocated or asymmetrical upper lateral cartilages

Relocation or repair

Mild

Septal repositioning

Severe

Septal cartilage resection

Support with cartilage grafts if necessary

Lower third of nose

F Deviated septum

G Deviated caudal septum

Relocation or repair

H Asymmetrical lower lateral cartilages

Correction

I Malpositioned nasal spine

Maximal normal with normal occlusion

Nasal spine osteotomy and repositioning

Abnormal maxilla or occlusion

Orthognathic evaluation (see algorithm 36)

Long-term follow-up

• Suture fixation of cartilage into normal position
• Augmentation grafts for symmetry

• Repositioning
• Resection
• Cartilage graft reinforcement

• Cephalic trim
• Augmentation cartilage grafts
• Lower lateral cartilage sutures
• Intercural strut

Maxilla normal with normal occlusion

Support with cartilage grafts if necessary
Breast

Micromastia
Macromastia
Breast Ptosis
Breast Asymmetry
Tuberous Breast Deformities
The American Society of Plastic Surgeons has stated that breast augmentation for breast hypoplasia without congenital deformity should be offered only to patients who are at least 18 years old. Surgeons and patients must also be aware that according to current FDA restrictions, silicone gel–filled breast implants are only available to patients who are at least 22 years old.

In addition to obtaining a general history for patients with micromastia, a detailed breast health history must be taken. A family or personal history of breast cancer is significant, because breast implants obscure some of the breast tissue and may compromise routine mammography. In addition, a preoperative baseline mammogram should be obtained as indicated by the patient’s age and breast health history.

The physical examination should include the present bra size and a thorough examination of the breast to detect any masses and previous scars. Measurements of the sternal notch-to-nipple distance as well as the nipple-to-inframammary crease distance and the base diameter of the breast should be obtained. The examination should also include a ptosis evaluation: grade I (nipple above the inframammary fold [IMF]), grade II (below the IMF), and grade III (the nipple points inferiorly).

Correction of breast hypoplasia with grade I ptosis only requires an augmentation. A constricted inferior pole of the breast, when present, requires surgical release.

Breast hypoplasia with grade II ptosis in which the nipple is just below the fold is best treated as a grade I ptosis, with an augmentation. A grade II ptosis in which the nipple is significantly below the IMF is best treated with an augmentation and mastopexy. Occasionally, mastopexy is not required if a large enough implant is selected to fill the skin laxity.

Breast hypoplasia with grade III ptosis requires a mastopexy and an augmentation. It is controversial whether the two procedures should be performed at the same time or separately.

The implant characteristics from which to choose include the filling (saline or silicone), surface (smooth or textured), and shape (round or anatomic). The decisions are made by the physician and the patient. A significant part of the initial consultation should be devoted to these options.

The incision for pocket dissection and implant placement can be made in several areas: transaxillary, periareolar, inframammary, and transumbilical. If a silicone gel implant is placed, then the manufacturer recommends an inframammary incision of approximately 5 cm or more.

Patients should be followed after breast augmentation to ensure that the final aesthetic result is optimized. Patients may need to be instructed in implant massage, the use of breast straps, and proper bra usage. Patients should be instructed regarding the signs of implant deflation, and all patients receiving silicone implants must be advised of the FDA recommendation to have a breast MRI 3 years after surgery and every 2 years thereafter. Patients should also be instructed to have their routine breast cancer screening examinations performed at a center with the capacity to perform imaging techniques necessary to best visualize the parenchyma in augmented breasts.

Continued
PATIENT WITH MICROMASTIA

A. Age ≥ 18 years
   - No
     - Defer breast augmentation until ≥ 18 years of age (22 years if patient requests silicone implants)
   - Yes
     - B. History and physical examination
       - C. Assess breast characteristics

D. No ptosis or grade I ptosis
   - Alloplastic breast augmentation

E. Grade II ptosis
   - Nipple slightly below IMF

F. Grade III ptosis
   - Nipple well below IMF
   - Augmentation and mastopexy (see algorithm 127)

G. Determine type of implant
   - Filling
     - Silicone
     - Saline
   - Surface
     - Smooth
     - Textured
   - Shape
     - Round
     - Anatomic

H. Determine location of incision
   - Periareolar
   - Inframammary
   - Transaxillary
   - Transumbilical

J. Follow-up examinations and MRI 3 years after surgery and every 2 years thereafter are recommended for patients with silicone implants
The implant location depends on the patient’s anatomy as well as the patient’s and/or physician’s preference. When the subcutaneous tissue and breast tissue are deficient, a submuscular implant is most appropriate. Placement of a submuscular implant can be either completely submuscular or in dual planes, with superior coverage of the implant with muscle and inferior coverage with breast tissue. When the subcutaneous tissue and breast tissue are adequate, a subglandular implant may be used. Many surgeons prefer submuscular placement even when the subcutaneous tissue and breast tissue are adequate. Submuscular placement may reduce the rate of capsular contracture, facilitate mammography, and provide extra upper pole fullness.

Patients should be followed after breast augmentation to ensure that the final aesthetic result is optimized. Patients may need to be instructed in implant massage, the use of breast straps, and proper bra usage. Patients should be instructed regarding the signs of implant deflation, and all patients receiving silicone implants must be advised of the FDA recommendation to have a breast MRI 3 years after surgery and every 2 years thereafter. Patients should also be instructed to have their routine breast cancer screening examinations performed at a center with the capacity to perform imaging techniques necessary to best visualize the parenchyma in augmented breasts.

BIBLIOGRAPHY

PATIENT WITH MICROMASTIA

A. Age ≥18 years
   - No
     - Defer breast augmentation until ≥18 years of age (22 years if patient requests silicone implants)
   - Yes
     - History and physical examination
       - Assess breast characteristics

D. No ptosis or grade I ptosis
   - Alloplastic breast augmentation

E. Grade II ptosis
   - Nipple slightly below IMF

F. Grade III ptosis
   - Augmentation and mastopexy (see algorithm 127)
     - Nipple well below IMF

I. Determine implant location
   - Assess thickness of subcutaneous and breast parenchymal tissue
     - Tissue adequate
       - Implant placement
         - Subglandular
         - Submuscular or dual plane
     - Tissue deficient
       - Implant placement
         - Submuscular or dual plane

J. Follow-up examinations and MRI 3 years after surgery and every 2 years thereafter are recommended for patients with silicone implants

Continued
CHAPTER 126  MACROMASTIA

Thomas J. Francel

When evaluating a patient for surgical correction of macromastia, a standard breast history must be obtained and a physical examination performed. In addition, specific symptoms need to be documented to justify the medical necessity for surgery. These include back pain, neck pain, shoulder pain or grooving, rash or hygiene problems, and difficulty exercising. The physical examination specifically includes measuring the distance from the sternal notch to the nipple and from the inframammary fold to the nipple. The breast examination helps to detect masses or other abnormalities. Preoperative mammograms should be obtained in accordance with the National Cancer Institute guidelines.

The sternal notch-to-nipple distance helps determine the most appropriate procedure. A sternal notch-to-nipple distance greater than 40 cm in a high-risk patient is an indication for a free nipple-areolar graft. High-risk patients include those with heart disease, diabetes, collagen vascular disease, or a history of smoking. These comorbidities place the nipple at an increased risk for necrosis when moved superiorly. An inferior pedicle technique is typically performed for patients with a sternal notch-to-nipple distance less than 40 cm. In a healthy patient with a sternal notch-to-nipple distance greater than 40 cm, an inferior pedicle reduction mammoplasty may be considered.

Another important measurement affecting the choice of operation performed is the inframammary fold-to-nipple distance. A fold-to-nipple distance of 17 cm or less is most appropriate for an inferior pedicle, because the folding of the inferior pedicle is not excessive and therefore should not cause ischemia. When the inframammary fold-to-nipple distance is greater than 17 cm, folding of an inferior pedicle may constrict the vessels supplying the nipple-areola, adding increased risk for necrosis.

The inferior pedicle technique is recommended for patients who have a sternal notch-to-nipple distance of 40 cm or less and an inframammary fold-to-nipple distance of 17 cm or less. An inferior pedicle technique can be used when the sternal notch-to-nipple distance is greater than 40 cm, as long as the inframammary fold-to-nipple distance is 17 cm or less and no comorbidities predispose to nipple-areolar necrosis.

When the inframammary fold-to-nipple distance is greater than 17 cm, movement of the nipple-areola complex (NAC) is less pronounced. When the NAC does not need to be moved extensively, superomedial pedicle advancement with resection of inferior pole tissue is indicated.

Vertical reduction mammoplasty can be considered for smaller reductions. This avoids the horizontal scar associated with the inverted-T or Wise pattern resections. Either a superior or superomedial pedicle can be used. With a vertical mammoplasty, the central portion is resected inferiorly, and the lateral parenchymal pillars are brought to the midline. This tends to centralize the breast and prevent bottoming-out.

Free nipple-areolar grafting should be considered if extensive movement of the NAC is needed and in patients with comorbidities for nipple-areolar necrosis.

BIBLIOGRAPHY


PATIENT WITH MACROMASTIA

A History and physical examination
Assess breast characteristics

B Sternal notch-to-nipple distance
>40 cm High-risk patient?
  Yes Free nipple-areolar graft
  No ≤40 cm

C Inframammary fold-to-nipple distance
≤17 cm
  No Extensive NAC movement required; comorbidities present for NAC necrosis?
  No
  Yes ≥17 cm

D Superior pedicle

E Superomedial pedicle

F Consider vertical pattern excision

G Free nipple-areolar graft

Estimated size of reduction (per breast)

>1500 g Wise pattern excision
≤1500 g

Long-term follow-up
When evaluating a patient for treatment of breast ptosis, a careful history of her breast health, future lactation desires, and goals is obtained. A preoperative baseline mammogram should also be obtained, based on the patient’s age and risk factors. The degree of ptosis is classified. In pseudoptotic breasts, the nipple is in an appropriate position above the fold, but the majority of the gland lies below the inframammary fold (IMF). In grade I ptosis, the nipple lies at or slightly below the fold. In grade II ptosis, the nipple lies lower than the fold, but it is not at the lowest portion of the breast. In grade III ptosis, the nipple lies at the lowest portion of the breast.

The patient’s desired volume is considered. Often, a woman with breast ptosis may request an augmentation, assuming that this will correct what she finds displeasing about her breasts. It is important to discuss this with the patient to distinguish breast fullness from nipple descent.

In patients with pseudoptosis who desire larger breasts, a biplanar breast augmentation can be performed. A biplanar approach allows partial implant coverage by the pectoralis muscle superiorly and breast tissue inferiorly. With adequate redraping of the parenchyma, no breast tissue excision is needed. This provides more superior fullness to better match the inferior fullness.

In patients with pseudoptosis who desire smaller breasts, an inframammary wedge excision allows the lower pole fullness to be reduced and repositioned superiorly. When the patient desires to maintain the same size, a small resection can be performed and a small implant placed. The implant is preferentially placed in a biplanar fashion to allow redraping of the parenchyma.

In patients with grade I ptosis the nipple needs to be elevated no more than 2 cm. For patients who desire larger breasts, an augmentation can be performed with a synchronous circumareolar mastopexy. If a large implant is placed in a subglandular plane to correct the ptosis, the patient should be cautioned that this may lead to more rapid descent of breast tissue and an earlier need for revision surgery. Because of this, we prefer to place implants in a biplanar fashion, allowing muscle coverage superiorly. This has the added benefit of a softer superior pole take-off, avoiding the look of an implant.

An augmentation-mastopexy should be performed for patients with grade II ptosis who desire increased breast volume. This can be a concomitant augmentation-mastopexy or staged procedure based on the surgeon’s preference and experience. Depending on the size of the breast, a vertical mastopexy may be useful.

When the patient has had significant weight loss and breast tissue quality is poor, then a staged Wise pattern mastopexy and breast augmentation is performed. When there has been no significant weight loss and the patient’s tissue quality is good, then a Wise pattern mastopexy along with breast augmentation can be performed satisfactorily.

BIBLIOGRAPHY

PATIENT WITH BREAST PTOSIS

A. Assess degree of ptosis

Pseudoptosis

Grade I ptosis (nipple < 2 cm below IMF)

B. Assess patient’s desired breast volume

C. Larger

Biplanar breast augmentation

D. Smaller

Inframammary fold wedge excision

E. Same

Inframammary fold wedge excision ± implant

F. Biplanar breast augmentation and circumareolar mastopexy

G. Mastopexy-augmentation

H. History of significant weight loss

Yes

Staged Wise pattern mastopexy and augmentation

No

Combined Wise pattern mastopexy-augmentation

I. History of significant weight loss

Yes

Wise pattern mastopexy

No

Vertical or Wise pattern breast reduction

J. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

K. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

L. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

M. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

N. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

O. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

P. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

Q. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

R. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

S. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

T. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

U. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

V. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

W. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

X. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

Y. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

Z. History of significant weight loss

Yes

Wise pattern breast reduction

No

Vertical or Wise pattern breast reduction

Long-term follow-up
CHAPTER 128: BREAST ASYMMETRY I: VOLUME AND SHAPE

Kelly M. Bolden • Jeffrey E. Janis

The breasts are an integral part of the feminine form, and natural asymmetry is present in all women. However, marked asymmetry can have profound effects on the psychosocial development of a young woman, particularly an adolescent. Significant asymmetry can develop from embryologic, hormonal, traumatic, or iatrogenic sources, and surgical intervention is often required for treatment. Successful treatment can be complex, and requires not only detailed operative planning, but also artistry, compassion, and patience to obtain the best aesthetic, social, and psychological results. Each patient is unique and must be addressed individually. Input from the patient as well as the surgeon is needed to achieve a successful result.

Several systems have been developed to classify and treat breast asymmetries, but all incorporate four key components in the decision-making algorithm. Whether the cause of the asymmetry or disease is unilateral or bilateral, the key factors in determining operative management are the breast volume, including the parenchyma and skin envelope, the breast shape, the location of the inframammary fold (IMF), and the nipple-areola complex (NAC).

When assessing breast volume, the quality and quantity of the parenchyma, as well as the skin envelope, must be evaluated. In a female with a hypoplastic breast and an adequate skin envelope, lipofilling may be more useful than implant. However, in a patient with a hypoplastic breast and a moderate or severely constricted skin envelope, the use of tissue expansion followed by implant augmentation may be necessary. In a patient whose skin envelope is inadequate from trauma or an iatrogenic cause, autologous tissue reconstruction is often required in the form of a flap, such as the latissimus dorsi myocutaneous (TRAM) flap, superficial glutal artery perforator (SGAP) flap, or transverse upper gracilis (TUG) flap.

Lipofilling, or fat grafting, to the breast has historical roots dating back to the late 1800s, but it has regained interest in the last decade. With increased interest have come improved surgical techniques. Although these techniques are very promising, and acceptable results have been demonstrated by plastic surgeons, specific guidelines about indications, technique, and preoperative and postoperative imaging have yet to be determined in controlled clinical trials. These techniques undoubtedly have a role in breast reconstruction and augmentation, but should be performed by a skilled and informed practitioner with appropriate surgical training.

In a female with a hypertrophic breast, the obvious solution is a reduction mammoplasty. In a patient with grade 1 ptosis and an elastic skin envelope, liposuction is an acceptable option. For a patient with a lax skin envelope or grade 2 or 3 ptosis, more traditional reduction mammoplasty techniques should be used. This is most commonly an inverted-T (Wise pattern) technique or a vertical scar technique.

Evaluating the shape of the breast is critical when correcting breast asymmetry. In a ptotic breast, traditional mastopexy techniques can be used to obtain symmetry. However, when considering a patient with grade 1 ptosis and an elastic skin envelope, implant augmentation is a consideration to fill the skin envelope of the diseased breast. Lipofilling is also a consideration. This may require a contralateral matching procedure (either augmentation or reduction) to ensure symmetry. In a patient with grade 1 ptosis but a lax skin envelope, a circumareolar or crescentic mastopexy may be all that is required. For patients with grade 2 or 3 ptosis, traditional mastopexy techniques, such as the circumareolar, Wise pattern, or short-scar periareolar inferior pedicle reduction (SPAIR) techniques, are used.

Identifying a tuberous or constricted breast is critical, because the appropriate management is multimodal. For these patients, the approach involves a periareolar incision, radial scoring to release the constricted parenchyma, and lowering of the IMF. Once an adequate breast pocket has been achieved, the breast can be reconstructed with an implant in the setting of mild or moderate constriction; lipofilling may be another alternative. A breast that is severely constricted is best approached in two stages: tissue expansion is performed first, followed by delayed implant reconstruction or possibly lipofilling.

**BIBLIOGRAPHY**


PATIENT WITH BREAST ASYMMETRY: VOLUME AND SHAPE DIFFERENCES

History and physical examination

A Identify reason for asymmetry

Difference in breast volume

B Patient concerned about unilateral hypoplasia

Is the skin envelope adequate?

Yes

implant

Tissue expansion followed by implant and/or lipofilling or autologous tissue (locoregional or free flap)

No

Lipofilling

C

D Patient concerned about unilateral hypertrophy

Assess degree of ptosis

Grade I ptosis

Tissue expansion followed by implant and/or lipofilling or autologous tissue (locoregional or free flap)

Grade II or III ptosis

Liposuction

Reduction mammaplasty

Difference in breast shape

E Affected breast is ptotic

Grade I ptosis

Good skin elasticity

Implant

Lipofilling

Circumareolar mastopexy

Grade II or III ptosis

Mild

Moderate

Significant

Circum-vertical mastopexy

Wise pattern/inverted-T mastopexy or circum-vertical with J extension

F Affected breast is constricted

Periareolar incision

Radial scoring

Reposition IMF

Mild/moderate constriction

Implant

Tissue expansion

Severe constriction

Implant

Lipofilling

Mastopexy depending on degree of skin excess

Long-term follow-up

Long-term follow-up
In addition to volume and shape differences, breast asymmetry can be caused by differences in the inframammary fold (IMF) and nipple-areola complex (NAC). The NAC can pose several challenges; many women exhibit asymmetry in areolar size, nipple size, and the location of the complex. Asymmetry in the areolar size can be corrected by reducing the larger areola to match the smaller areola using a circumareolar or donut reduction technique. Similarly, nipple hypertrophy can be treated by reducing the larger nipple to match the smaller nipple, either by simple amputation or sleeve excision techniques. Nipple inversion can be treated by suture techniques, dermal flaps, allogenic implants, or autologous tissue (lipofilling, dermal fat graft, and cartilage grafts) to provide projection and support.

Repositioning a low IMF is typically less challenging than lowering a high IMF. A low IMF can be elevated by suture suspension to the chest wall at a level comparable to that of the contralateral breast. If the patient has had a prior implant or expander placed, this elevation can often be achieved by performing a capsulorraphy to recreate the fold. This is most commonly achieved with suture plication of the capsule. Alternative techniques include using strip capsulectomy with a layered closure, marionette sutures to secure the edge of the pectoralis to the overlying skin, or even a low thoracic advancement flap (Ryan flap) in the case of breast reconstruction after mastectomy.

Lowering the IMF can be a bit more challenging. If the breast shape is normal, this can be achieved by subfascial dissection down to the newly identified IMF. However, if the breast is constricted, a sequence is required, as discussed in Breast Asymmetry Part I, including a periareolar incision, radial scoring, and dissection down to the newly determined inframammary crease.

The location of the NAC can be corrected with various techniques. An NAC that is too low can frequently be corrected using mastopexy techniques. If the nipple needs to be elevated 3 cm or less, a periareolar technique is often adequate. If the nipple needs to be elevated 3 cm or more, either a circumvertical or Wise pattern technique should be employed, depending on the skin quality.

Lowering an NAC that is too high poses a significant challenge. This is a problem particularly after previous breast surgery. Several techniques have been described with variable success. In a patient with mild to moderate elevation, inferior pole skin excision with remodeling can be used to lower the NAC. In more severe cases, the use of upper pole tissue expansion has been described with reasonable results.

Helpful adjuncts to the algorithm for patients requiring bilateral asymmetry correction include the following:
- Consulting with the patient to decide which breast she considers to be more aesthetically pleasing.
- Operating on the more challenging and/or larger breast first.
- Using different profile and/or different sized implants to augment asymmetrical breasts.
- Using similar procedures on each breast, if possible, for more consistent and long-lasting results.

BIBLIOGRAPHY

PATIENT WITH BREAST ASYMMETRY: IMF AND NAC DIFFERENCES

History and physical examination

A Identify reason for asymmetry

Difference in position of the IMF

B IMF is low on affected breast

Has the patient had a previous breast implant?

No

Suture suspension to chest wall at newly determined IMF

Yes

Capsulorrhaphy

Difference in position of the NAC

C IMF is high on affected breast

Is the breast constricted?

No

Subfascial dissection to newly determined IMF + suture suspension

Yes

See Breast Asymmetry Part I

D NAC is too low on affected breast

Determine how much elevation of NAC is needed

<3 cm

Periareolar mastopexy

>3 cm with excess elastic skin

Circumareolar mastopexy

>3 cm with lax skin

Inverted-T/Wise pattern mastopexy or circumvertical with J extension

E NAC is too high on affected breast

Mild to moderate asymmetry

Skin excision with inferior pole mammoplasty

Severe asymmetry

Tissue expander in upper pole

Consider adjuncts for patients requiring bilateral correction

Long-term follow-up
When planning surgery for patients with tuberous breast deformity, pertinent history includes age, height, weight, bra size, and any personal or family history of breast disease. The physical examination should include a complete breast examination to screen for masses and axillary adenopathy. The sternal notch-to-nipple distance, the inframammary fold-to-nipple distance, and the base diameter of each breast should be measured and recorded. Characteristics of the tuberous breast should also be documented. These include constriction of the base of the breast, glandular and skin hypoplasia (particularly in the lower pole), malposition of the inframammary fold, and herniation of breast tissue into the areola.

The assessment of ptosis may be difficult. Although the sternal notch-to-nipple distance may be appropriate, the inframammary fold may be elevated, resulting in a grade III ptosis. It is more important to assess the degree of ptosis with regard to the location of the inframammary fold of the constricted breast.

Grade I ptosis is corrected with release of the inferior pole and lowering of the inframammary fold. The proposed new inframammary fold level is determined before surgery, with consideration of the diameter of the intended breast implant.

Typically, the inferior pole of the breast requires increased volume, which is achieved by insertion of an implant or, in cases of significant tissue hypoplasia, an expander. When an expander is used, expansion is followed by release of the inferior pole of the capsule and breast tissue.

In patients with grade II ptosis, it is very important to estimate the hypoplasia of the inferior pole skin. If the distance from the inferior margin of the areola to the inframammary fold appears short, then the breast is considered to have grade I ptosis, and treatment involves release of the inferior pole tissue, lowering of the inframammary fold, and placement of an expander or implant. If the distance from the inferior margin of the areola to the inframammary fold is long, then there is extended skin in that area with an elevated inframammary fold. In this case, the breast is considered to have grade III ptosis and requires a mammary lift and release.

Grade III ptosis causes the inframammary fold to be above the level of the nipple. This is a very difficult situation and requires a periareolar lift combined with release of the breast tissue, lowering of the inframammary fold, and expansion of the lower pole.

A periareolar lift is indicated for patients with a long areola-to-inframammary fold distance and for grade III ptosis. The periareolar incision combined with the lift has the advantage of completely dividing the breast tissue along its horizontal axis during dissection through the breast tissue to place the implant, thereby achieving a complete release of the breast tissue. Vertical cuts may be made into the remaining breast tissue to release the inferior pole.

Grade III ptosis is characterized by a high inframammary fold. Correction involves release of the breast tissue along with release and extensive lowering of the inframammary fold. Care must be taken to adequately release the area of the original inframammary fold, because it can serve as a site of secondary constriction with a subsequent double-bubble deformity. In severe cases, a tissue expander may be placed to overexpand the lower pole; secondary corrections are performed during permanent implant placement.

Breast herniation through the areola can be corrected either at the initial correction or secondarily, especially if the blood supply to the nipple-areola complex is compromised. Deferring surgical correction of areolar herniation until after pregnancies may allow the patient to breast feed and retain more normal sensation.

BIBLIOGRAPHY


PATIENT WITH TUBEROUS BREAST DEFORMITY

A. History and physical examination
B. Assess degree of breast ptosis

C. Grade I ptosis
   - Release inferior pole and lower inframammary fold

D. Augmentation ± tissue expansion

E. Grade II ptosis
   - Measure areola-to-inframammary fold distance
   - Short
   - Long
   - Periareolar lift

F. Grade III ptosis
   - Radial release of breast tissue and lower inferior pole
   - Augmentation ± tissue expansion

G. Correction of areolar breast herniation

Long-term follow-up
Body Contouring

Abdominal Wall Excess
Upper Arm Excess
Thigh Laxity
Gluteal Augmentation
CHAPTER 130  ABDOMINAL WALL EXCESS

Marissa J. Tenenbaum  •  W. Grant Stevens

A  The initial evaluation of patients with abdominal wall excess should be directed toward the amount and quality of abdominal, flank, and hip liposis. Patients can be classified as having minimal, moderate, or severe abdominal liposis. This distinction will alter the surgical options available. Patients should also be examined for abdominal scars, hernias, and abdominal wall muscular tone.

B  For patients with minimal abdominal liposis, the quality and quantity of skin are evaluated. Patients with no excess skin and firm skin tone can be considered for liposuction only. A young, nulliparous woman with a small abdominal pouch is an ideal candidate for this procedure. The amount of skin retraction is variable, but is often satisfactory to these individuals.

C  Patients with a small excess of lower abdominal skin and/or abdominal striae may benefit from skin excision with an isolated lower abdominoplasty. This procedure involves resection of redundant lower abdominal skin using a limited incision without translocation of the umbilicus or extensive subcutaneous undermining.

D  The majority of patients seeking abdominal contouring have moderate to severe skin excess. These patients benefit from a larger skin and fat excision, as with a full or extended (flank areas) abdominoplasty. In these patients, the abdominal flap is elevated to the subxiphoid region with translocation of the umbilicus. Some patients have a severe amount of skin excess in the horizontal as well as vertical direction and/or a preexisting vertical scar. These patients should be considered for fleur-de-lis-type skin and fat excision.

E  If the majority of the skin and fat is in the lower abdomen, it is described as a pannus. These patients can be managed with full or extended abdominoplasty with translocation of the umbilicus. This is often a fairly significant resection. In patients with a large overhanging pannus that interferes with activities of daily living (for example, ambulation) and affects hygiene (for example, intertrigo), a wedge resection of the pannus without abdominal skin flap elevation can be performed.

F  Some patients have diffuse abdominal liposis extending from the subxiphoid area to the pubic region. These patients have poor skin tone and/or abdominal striae and benefit from skin excision. However, abdominoplasty alone leaves an unattractive contour. Abdominoplasty should be performed with liposuction of the subxiphoid area to obtain a more reasonable contour. Translocation of the umbilicus should be performed. Liposuction is not carried out below the level of the umbilicus to protect flap viability.

G  Following an appropriate diet and exercise program, it is reasonable to attempt liposuction of the entire abdomen. Often, the outcome is good to excellent. However, a subset of these patients will not have adequate skin retraction and may benefit from an abdominoplasty as a second stage.

H  The abdominal wall must always be evaluated when considering aesthetic abdominal contouring. A rectus diastasis, hernia, or simply a lax abdominal wall may be present, especially in patients who have been pregnant. In these patients, plication of the abdominal wall should be added to the abdominoplasty procedure.

BIBLIOGRAPHY

PATIENT DESIRING AESTHETIC ABDOMINAL CONTOURING

A History and physical examination to assess amount/location of abdominal liposis

Minimal abdominal liposis

Assess skin redundancy

Moderate/severe abdominal liposis

Assess location of liposis

B Good tone, no excess skin

Mild skin excess and/or lower abdominal striae

Moderate to severe excess

E Predominantly lower abdomen

Diffuse liposis

Assess skin quality

Poor tone/presence of striae

F Liposuction of abdomen in subxiphoid and flank areas followed by concurrent abdominoplasty

Liposuction of entire abdomen

Corrected?

Yes

No

Consider staged abdominoplasty

G

Assess for rectus muscle diastasis or laxity of abdominal wall

Yes

No

Add rectus plication

Skin and fat excision only

Long-term follow-up

H

Liposuction

Lower (mini) abdominoplasty

Full abdominoplasty (with fleur-de-lis pattern for excess vertical laxity)

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 131 UPPER ARM EXCESS
Daron Geldwert • Dennis J. Hurwitz

A The examination of the upper extremity includes the range of motion, neurovascular status, and grip strength. This information is important to document preoperatively, because there have been reports of injury to the medial and lateral antebrachial cutaneous nerves along with ulnar nerve neuropathy during brachioplasty procedures.

B Any history of chronic lymphedema of the upper extremity, especially after axillary lymph node dissection, and severe neurologic and/or vascular disorder should be obtained, because affected individuals are poor candidates for brachioplasty. Relative contraindications for brachioplasty include connective tissue disorders, symptomatic Raynaud’s disease, and advanced rheumatoid arthritis.

C Upper body deformities usually consist of loose upper arm skin, an oversized axilla, descent of the posterior axillary fold, and flattening and elongation of the anterior axillary fold with extension onto the lateral chest wall. A detailed assessment of the combination of excess skin and adiposity should be undertaken. The ratio of skin to fat can be tested using a pinch test in which the patient flexes his or her arm 90 degrees at the elbow while the shoulder remains abducted.

D For patients with skin laxity and a limited amount of adiposity, limited brachioplasty is indicated. This can be converted to an L-type brachioplasty for extended tissue resection if needed. Often, in patients with massive weight loss, the chest wall excision is coordinated with the removal of a back roll and deepithelialized as a lateral spiral flap. This can be rotated into the breast and upper body lift. The key aspect of resection brachioplasty procedures involves anchoring the superficial fascial system of the arm to the dense axillary and clavicular fascia and/or deltopectoral groove.

E For patients with a combination of moderate to severe excess skin and fat, limited or L brachioplasty can be performed. Judicious use of liposuction can be performed synchronously.

F Liposuction is indicated for the treatment of patients with predominately excess fat in the upper arm and good skin tone. If skin laxity is a concern following liposuction, a staged brachioplasty can be performed.

BIBLIOGRAPHY
**PATIENT WITH UPPER ARM LIPODYSTROPHY**

A. History and physical examination

B. History of chronic lymphedema, neurologic/vascular disorder of the upper extremity?
   - No
   - Yes
     - C. Assess arm for skin laxity and adiposity
       - D. Primarily skin laxity
         - Assess location: Proximal upper arm, Entire upper arm, Arm and lateral chest
           - Limited (crescent) brachioplasty
           - L. brachioplasty with lateral thoracoplasty
       - E. Skin laxity and fat excess
         - Assess location: Proximal upper arm, Entire upper arm, Arm and lateral chest
           - Limited (crescent) brachioplasty
           - L. brachioplasty ± excision site lipoplasty
           - L. brachioplasty with lateral thoracoplasty ± liposuction
     - F. Fat excess
       - Deflate arms with liposuction
       - Second-stage L. brachioplasty if excess skin present after liposuction

Long-term follow-up
CHAPTER 132  THIGH LAXITY
Daron Geldwert • Dennis J. Hurwitz

A Thighplasty can alter lymphatic drainage in the lower extremity and exacerbate any preexisting condition. All patients considered for thigh rejuvenation should be evaluated to obtain any history of chronic lymphedema, lower extremity deep venous thrombosis (DVT), and the presence of venous insufficiency (for example, varicose veins). The presence of any of these conditions necessitates further workup.

B Thigh fat needs to be evaluated in the context of the entire thigh and lower body. The relationship of the skin to the underlying fat is noted. The overall thigh skin drape, excess, bulges, and tension are observed while the patient is standing. Most weight-loss patients have the greatest excess of skin in the proximal medial thigh. The lateral thighs are usually continuous with the bulging saddlebags, abruptly stopping at the midthigh. When a concomitant abdominoplasty is to be considered, the patient suspends his or her abdominal pannus in the cephalad direction to simulate the actual tension on the thigh.

C Medial thigh lipodystrophy can be treated with liposuction and/or direct excision depending on the quality and quantity of excess skin.

D A staged procedure can be performed with liposuction followed by an L thighplasty. At the time of thighplasty, the Colles fascia should be identified and the superficial fascia of the medial thigh skin anchored to it. The risk of thigh ptosis is great without a lasting fixation method. Some surgeons do not favor horizontal thigh excision, because it is thought to cause labial spreading.

E A medial thighplasty may be limited to an upper thigh crescent excision adjacent to the labia majora (or scrotum) when the deformity is primarily in the proximal thigh. Often, a posterior dog-ear results, which can be resected locally or in conjunction with a lower body lift.

F The lateral thigh is often addressed in conjunction with a lower body lift or circumferential belt lipectomy. The lateral thigh usually is ptotic and continuous with the lower torso, creating a poorly defined waistline. The lateral thigh is structurally supported by a zone of adherence at the level of the lower trunk. Therefore laxity of the lateral thighs and lower trunk needs to be corrected at the same time.

G Thighs that are exceptionally heavy with minimal to mild skin laxity do not respond well to thighplasty. Its management should be staged with preliminary liposuction followed by a thighplasty or lower body lift.

H An upper medial thighplasty, a lower body lift, and high lateral tension abdominoplasty are often performed together, because these procedures are synergistic and provide suspension of both the proximal anterior and lateral thighs. The lateral thigh superficial fascial system should be secured to the deep fascia during closure.

BIBLIOGRAPHY
PATIENT WITH THIGH LIPODYSTROPHY

History and physical examination

A. History of chronic lymphedema, DVT, or venous insufficiency
   - Yes
   - Refer for additional evaluation and treatment before considering thigh recontouring
   - No
   - B. Assess patient’s aesthetic concerns and areas of lipodystrophy

C. Medial thigh
   - Minimal adiposity and good skin tone
     - Lipoplasty
   - Significant adiposity and good skin tone
     - Preliminary liposuction
     - Staged medial and vertical thighplasty
   - Significant adiposity and poor skin tone
     - Upper medial thigh
     - Complete medial thigh
     - Horizontal and vertical thighplasty

D. Medial thighplasty

E. Lateral thigh
   - Primarily excess adipose tissue (saddlebags)
     - Liposuction
   - Adiposity and excess skin/ptosis
     - Lower body lift
     - F. Liposuction
     - G. No residual deformity
     - Residual deformity

H. Perform together if deformity exists in both regions

Long-term follow-up
CHAPTER 133  GLUTEAL AUGMENTATION

Constantino G. Mendieta

A  Fat grafting is the primary choice for gluteal augmentation. Some patients may not have enough fat for transfers. Gluteal augmentation with fat transfers requires 500 to 1000 cc of supernatant fat per buttock, depending on the patient size and gluteal dimension. Only 35% to 40% of the total aspirate (fat, tumescent, blood, and destroyed fat) is good, transferable fat; therefore 4 to 6 liters must be aspirated to obtain 1.5 to 2 liters of supernatant fat.

B  The greatest challenge in using autologous fat is determining whether a patient has adequate donor fat. If the surgeon is uncertain, the patient is asked to gain weight. Some patients simply cannot do this or plateau with their weight gain. These patients are given the options of combining fat grafting with implants or undergoing fat transfers at their current weight; however, they must be informed that a significant augmentation may not be achieved. If after 6 months the patient desires more volume, he or she can either attempt to gain weight again (commonly done), or an implant can be placed for further volume (rarely done).

C  Three key decisions need to be made in implant augmentation: incision location, implant selection, and the appropriate plane for implant placement (intramuscular or subfascial). Patients who are ideal for subfascial implants are usually great candidates for fat transfers, so most implants performed today are intramuscular. Implants carry an inherent, immediate risk of wound dehiscence, implant exposure, seroma, and infection; long-term risks include rotation, capsular contracture, seroma, extrusion, and displacement. These problems are non-existent with autologous fat augmentation.

BIBLIOGRAPHY


PATIENT DESIRING INCREASED BUTTOCK SIZE

History and physical examination

A. Assess patient's body habitus and amount of available adipose tissue

B. Does the patient have enough fat for transfers?

- Yes
  - Autologous fat transfer to buttocks
    - Patient satisfied?
      - Yes
        - No further treatment
      - No
        - Additional fat grafting or implant placement 6 months later
  - No
    - Is the patient willing to gain weight?
      - Yes
        - Patient able to gain 15-30 pounds?
          - Yes
            - Implant augmentation combined with fat transfer for supplemental volume
          - No
            - Implant augmentation
      - No
        - Patient able to gain 5-15 pounds?
          - Yes
            - Implant augmentation
          - No
            - No further treatment

Long-term follow-up
Massive Weight Loss

Anterior Body Wall Excess After Massive Weight Loss
Posterior Body Wall Excess After Massive Weight Loss
Breast Deformities After Massive Weight Loss
Buttock Deformities After Massive Weight Loss

ALGORITHM KEY

<table>
<thead>
<tr>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Interventions and Surgical Endpoints</td>
</tr>
<tr>
<td>Nonsurgical Interventions</td>
</tr>
<tr>
<td>Surgical or Nonsurgical Options List</td>
</tr>
<tr>
<td>Combination of Surgical and Nonsurgical Options List</td>
</tr>
<tr>
<td>Hierarchy List</td>
</tr>
</tbody>
</table>

https://t.me/Free_Plastic_Reconstruction_Book
Massive-weight-loss patients who desire body-contouring surgery need to be at a stable weight for at least 6 months. A detailed history of each patient’s weight loss and current nutritional regimen is necessary before beginning surgery. Patients who have not met their weight-loss goal should consider undergoing revision of the gastric bypass procedure or lifestyle changes.

All weight-loss patients require a full medical preoperative evaluation, including comorbidities (for example, diabetes, hypertension, ischemic heart disease, and sleep apnea). Psychosocial issues need to be stable, and the patient’s expectations should be reasonable. A nutritional evaluation is imperative. Knowledge of how the patient lost weight (exercise versus gastric banding versus Roux-en-Y bypass) can provide a clue to nutritional deficiencies. Common nutritional deficiencies include iron, vitamins B1 and B12, folate, fat soluble vitamins (A, D, E, and K), calcium, and protein. We obtain complete blood counts as well as electrolyte, albumin, prealbumin, iron, and micronutrient levels for all of our patients. Protein intake of at least 50 g per day is required before any surgery to ensure a positive nitrogen balance for adequate wound-healing potential.

Patients who have not met the goal weight but have significant morbidity from a large pannus may benefit from a panniculectomy.

Incisional hernias are common in patients who have undergone an open gastric bypass procedure. The repair can be performed at the time of abdominal wall contouring, if appropriate, based on the size of the hernia and the patient’s health status. Previous abdominal scars, especially subcostal scars, may increase the risk of flap loss inferior to the scar.

The mons pubis should be addressed in all cases of anterior body-contouring procedures. Patients with some fullness but minimal ptosis can benefit from a judicious lipoplasty. Patients with more severe ptosis can benefit from careful defatting of the mons with redundant skin excision. Undermining of the mons is not advocated, because it can negatively affect lymphatic drainage.

Often, patients with anterior body wall skin and fat excess also have back rolls and excess fat in the posterior hip region. These areas can only be addressed with a circumferential body lift. These patients need to be informed of the limitation of an anterior-based procedure. Patients with a BMI of greater than 35 have a higher risk of complication following a lower body lift and might benefit from a staged procedure.

Massive-weight-loss patients are more willing to trade contour for scars than are non–massive-weight-loss patients who undergo abdominal contouring. Excess skin and fat in the upper abdomen often necessitate a vertical midline scar to achieve optimal contour. Previously, many massive-weight-loss patients had a midline abdominal scar. With the current popularity of laparoscopic procedures, most patients do not have a laparotomy scar. They should be informed of the redundancy in the superior abdomen that might remain if a vertical resection with a resultant scar is not performed.

**BIBLIOGRAPHY**


PATIENT WITH ANTERIOR BODY WALL EXCESS AFTER MASSIVE WEIGHT LOSS

History and physical examination

A. Weight loss plateaued?
   - No
   - Patient without functional or hygiene issues caused by body habitus?
     - No
     - Reevaluate after 6 months of weight stabilization
     - Infraumbilical region
       - Limited abdominoplasty ± liposuction
         - Long-term follow-up
           - Vertical excess present
             - Previous laparotomy scar
               - Abdominoplasty ± liposuction
               - Yes
                 - Patient willing to accept vertical scar?
                   - Yes
                     - Fleur-de-lis abdominoplasty ± liposuction
                       - Long-term follow-up
                   - No
                     - Abdominoplasty ± liposuction
                       - Long-term follow-up
               - No
                 - Abdomino-plasty
               - No
                 - Liposuction
               - No
                 - Treatment
       - Limited to anterior body wall
         - Abdomen
           - Supraumbilical and infraumbilical regions
             - Assess for vertical tissue excess
               - Vertical excess present
                 - Previous laparotomy scar
                   - Abdominoplasty ± liposuction
                   - Yes
                     - Patient willing to accept vertical scar?
                       - Yes
                         - Fleur-de-lis abdominoplasty ± liposuction
                           - Long-term follow-up
                       - No
                         - Abdominoplasty ± liposuction
                           - Long-term follow-up
               - No
                 - Minimal vertical excess
                 - Abdominoplasty ± liposuction
       - Supraumbilical and infraumbilical regions
         - Normal mons
         - Mild ptosis and lipodystrophy
         - Moderate to severe ptosis and lipodystrophy
         - Liposuction
         - No treatment
         - Abdomino-plasty with excisional reduction of mons
         - Refer for evaluation and treatment of health/psychological issues

B. Perform medical, psychological, and nutritional screening
   - Good nutritional, psychological, and medical status
   - Physical examination to assess extent of deformity and presence or absence of incisional hernia
   - Poor nutritional, psychological, and/or medical status
   - Refer for evaluation and treatment of health/psychological issues

C. Panniculectomy

D. Physical examination to assess extent of deformity and presence or absence of incisional hernia
   - Limited to anterior body wall
   - Abdomen
     - Supraumbilical and infraumbilical regions
       - Assess for vertical tissue excess
         - Vertical excess present
           - Previous laparotomy scar
             - Abdominoplasty ± liposuction
             - Yes
               - Patient willing to accept vertical scar?
                 - Yes
                   - Fleur-de-lis abdominoplasty ± liposuction
                     - Long-term follow-up
                 - No
                   - Abdominoplasty ± liposuction
                     - Long-term follow-up
             - No
               - Liposuction
               - No
                 - Treatment
       - Supraumbilical and infraumbilical regions
         - Normal mons
         - Mild ptosis and lipodystrophy
         - Moderate to severe ptosis and lipodystrophy
         - Liposuction
         - No treatment
         - Abdomino-plasty with excisional reduction of mons
         - Refer for evaluation and treatment of health/psychological issues

E. Mons pubis
   - See algorithm 135

F. Circumferential anterior and posterior trunk

G. Abdominoplasty

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 135 POSTERIOR BODY WALL EXCESS AFTER MASSIVE WEIGHT LOSS

Daron Geldwert  •  Dennis J. Hurwitz

Massive weight loss affects the soft tissues of the back, buttocks, posterior and lateral thighs, flanks, and hips. It can lead to upper and lower back rolls. Zones of adherence over the posterior spine cause an inverted-V deformity, with excess skin and fat hanging off these attachments laterally and inferiorly. The posterior regions should be assessed in relation to the total body.

An assessment of the relationship between the upper back rolls, the lateral inframammary crease, and the lateral breast rolls is necessary. In men and women with mild upper back rolls, a transverse excision of the back rolls is performed.

In women, an extension of the back rolls onto the lateral breast can be preserved as a deepithelialized fasciocutaneous flap and used to autoaugment the breast in conjunction with a mastopexy procedure. It is imperative to correct the breast deformity first, because any vertical pull on the thorax at the time of the thoracoplasty can lateralize the breast.

In men, the upper back roll excess is often addressed in conjunction with a brachioplasty and its lateral thoracic extension. A boomerang-pattern excision can be used for synchronous correction of gynecomastia.

The lower back rolls are approached separately from the upper back rolls.

The lower body lift scars need to be well planned. The final scars should be below the level of anterior superior iliac spine posteriorly, because most garments are at that level. When a gluteal autoaugmentation is planned, only a minimal skin resection excision is performed, and the remainder of the tissue is deepithelialized and used as an augmentation fat flap.

Massive weight loss often leads to poor waist and hip definition. This lack of definition is caused by vertical descent of the abdomen, lateral thighs, and buttocks. Waist definition is created by a combination of body lift and lipectomy, with selective liposuction for contouring.

BIBLIOGRAPHY

PATIENT WITH POSTERIOR BODY WALL EXCESS AFTER MASSIVE WEIGHT LOSS

Refer to algorithm 134 if anterior body wall is also involved

A Assess anatomic site of deformity

Upper back

Minimal skin and fat excess
Direct horizontal excision ± liposuction

Long-term follow-up

Upper back

Moderate to severe skin and fat excess
B Is excess tissue continuous with lateral breast roll?

Yes

Direct horizontal excision ± liposuction

Long-term follow-up

Male

Breast volume is not adequate

D Is gynecomastia present?

No

No treatment of breast

Yes

Direct excision of breast and back rolls ± liposuction

Lower body lift ± gluteal augmentation (see algorithms 133 and 137)

G

Synchronous procedures

Presence of buttock ptosis?

No

Yes

H Circumferential belt lipectomy ± liposuction

Staged procedure

Lower back

Concurrent thigh ± abdominal reduction indicated?

E

No

Yes

Comorbidities present?

No

Synchronous procedures

Yes

Staged procedure

Female

Breast volume is adequate

Direct horizontal excision with thoracoplasty

C

Direct horizontal excision with thoracoplasty

Autoaugment breast with back flap ± mastopexy

D

Direct excision of breast and back rolls ± liposuction

Lower body lift ± gluteal augmentation (see algorithms 133 and 137)

G

C Circumferential belt lipectomy ± liposuction

Long-term follow-up

E

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1); copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
Breast shape varies after massive weight loss, with deformities that differ from those that result from typical mastopexy. After massive weight loss, the breast is usually very deflated with a flattened appearance, and the nipples are medially displaced. Skin elasticity is usually very poor, with redundancy relative to breast parenchyma. Additionally, the breast is typically continuous with the lateral chest wall.

As with any elective breast surgery, a thorough breast history and examination should be undertaken. According to the American Cancer Society, women older than 40 should have a mammogram performed within the past year. Women with a strong family history are deemed high risk should have a mammogram and/or MRI starting at age 30.

As with any breast-reshaping procedure, the degree of ptosis and residual parenchymal tissue are evaluated. Most weight-loss patients have significant breast deflation with loss of superior pole fullness and projection. Additionally, they have skin redundancy that is not amenable to short-scar skin resection patterns. Rarely, a weight-loss patient has a mild degree of ptosis and deflation. The classic approach to mastopexy is performed for these patients.

The treatment of grade III ptosis, which occurs in the majority of weight-loss patients, requires a Wise pattern skin resection. Skin resection alone is usually insufficient to support the breast parenchyma, leading to bottoming-out and recurrent ptosis. Newer techniques employ both parenchymal reshaping and dermal suspension techniques to avoid these problems.

Women who also desire increased breast volume can be evaluated for autogenous augmentation. For patients without extension of their breast rolls onto the upper back, a Wise pattern skin resection with placement of a permanent implant is indicated. This is performed either as a primary or secondary procedure. Significant upper back rolls that extend onto the breast can be used for autoaugmentation. A spiral flap that makes use of the redundant upper back rolls to augment the superior pole of the breast can be used for this purpose. The flap is elevated as a lateral thoracic, medially based fasciocutaneous flap. This flap is advanced into a tunnel under the superior breast and spiraled around the existing breast parenchyma to augment the breast volume.

BIBLIOGRAPHY

PATIENT WITH BREAST DEFORMITIES AFTER MASSIVE WEIGHT LOSS

General history and physical examination

A Assess breast shape and skin elasticity

B Focused breast health history and examination

C Breast diagnostic imaging if indicated by general or focused history and physical examination

Concern for malignancy based on breast examination or imaging?

Yes

No

Refer for evaluation/treatment

E Assess degree of ptosis

Grade I ptosis

Circumareolar mastopexy

Grade II ptosis

Vertical or short-scar mastopexy

Grade III ptosis

Skin resection mastopexy with parenchymal reshaping

Assess degree of breast volume

Adequate volume

Mastopexy only

Deficient volume

Does lateral breast roll extend to back roll?

No

Alloplastic implant

Yes

Autologous autoaugmentation

Long-term follow-up

https://t.me/Free_Plastic_Reconstruction_Book

Marsh and Perlyn, Decision Making in Plastic Surgery (ISBN 978-1-62623-937-1), copyright © 2010 Thieme Medical Publishers All rights reserved. Usage subject to terms and conditions of license.
CHAPTER 137  BUTTOCK DEFORMITIES AFTER MASSIVE WEIGHT LOSS
Daron Geldwert • Dennis J. Hurwitz

The placement of autologus fat grafts taken from low-pressure liposuction can be used as a primary procedure in patients who have sufficient donor stores, or as an adjunct to refine an autologous autoaugmentation flap. Buttock ptosis is corrected by elevating the buttocks, usually with a lower body lift. Careful attention should be given to placing the final lower body lift scars along the iliac crest, which is the superior border of the buttocks. This placement provides a clearer definition between the back and buttocks. Gluteal augmentation is often needed to improve the deflated look and improve projection, particularly in patients who undergo a lower body lift. Performing the lift procedure alone may acutely worsen the gluteal deformity.

BIBLIOGRAPHY

Although some surgeons advocate the use of alloplastic gluteal implants in massive-weight-loss patients, they usually lack tissue volume and fat necessary for successful coverage of the implant.
PATIENT WITH BUTTOCK DEFORMITIES AFTER MASSIVE WEIGHT LOSS

A History and physical examination
Are the buttocks ptotic?

Yes

Is there gluteal hypoplasia?

Yes

Is concomitant liposuction being performed elsewhere?

No

B

Lower body lift

Long-term follow-up

Yes

Is the patient interested in improving the thigh area?

No

Is there laxity of the thigh?

Yes

C

Buttock flap for augmentation ± alloplastic implant

Fat grafting ± buttock flap for autoaugmentation

No

Assess excess skin at inferior gluteal fold

Present

Perform concomitant posterior thigh lift

Absent

No

Will a lower body lift affect gluteal contour?

Yes

E

Liposuction of the buttocks ± lumbosacral region

No

Long-term follow-up

No

Is there significant lipodystrophy of the buttocks?

Yes

Long-term follow-up

No
Index

A
Abdominal contouring, 316-317
Abdominal liposis, 316-317
Abdominal wall
  excess skin of, 316-317
  wounds to, 148-149
Abdominoplasty, 316-317
Acellular dermal products, 246-247
Acrosyndactyly, 174-175
Acute ear trauma, 6-7
Acute nerve injuries
  closed, 200-201
  open, 198-199
Airway management, 56-59
Airway obstruction, nasal, 290-293
Alveolar cleft, 44-45
Alveolar-nasal fistula, 48-49
Ambiguous genitalia, 160
Amputations, of upper extremity, 202-203
Androgens, 268-269
Ankle-brachial index, 248-251
Anterior body wall excess, 326-327
Anterior frontal sinus wall fracture, 88-89
Anterior open bite, 82-83
Antia-Buch technique, 110-111
Antihelical fold, 68-69
Apert hand, 174
Areola; see Nipple-areola complex
Arthrodexis, 216-217
Aspiration, 86
Augmentation
  breast, 300-303
  gluteal, 322-323, 328-329
  upper lip, 280-281
Augmentation-mastopexy, 306-307
Auricular reconstruction, 72-73
Autologous breast reconstruction, 140-141
Avulsion
  of extensor tendon, 194-195
  of teeth, 86
B
Balanitis xerotica obliterans, 156
Baldness, 268-269
Basal cell carcinoma, 32-33
Bec...
Cleft hand, 180-181
Cleft lip and palate
with alveolar cleft, 44-45
bilateral, 46-47
dentoskeletal management of, 52-53
fistulas associated with, 48-51
management of, 44-45
persistent functional impairments associated with, 48-49
residual deformities, 46-47
velopharyngeal dysfunction associated with, 48-51
Clinodactyly, 176-177
Clitoral hypertrophy, 160-161
Clitoral reconstruction, 160-161
Cloacal membrane
anomalies of, 154-155
developmental errors of, 160-161
Columellar strut, 294-295
Compartment syndrome, 204-205, 240-241
Complete syndactyly, 174-175
Compression, of peripheral nerves, 232-233
Computed tomography
airway compromise evaluations, 56
facial bone fracture evaluations, 86-87
orbital dystopia evaluations, 62-63
Condylar fracture, 100-101
Condylar hypoplasia, 84
Constricted ears, 70-71
Constriction rings, 180-181
Continuous positive airway pressure, 58
Contouring; see Body contouring
Contracted scars, 22-23
Cottle maneuver, 290-291
Craniofacial contouring, 286-287
Craniofacial deformities
airway management, 56-59
initial evaluation of, 54-55
Craniosynostosis, 54, 64-65
Creatine phosphokinase, 10
Crooked nose, 296-297
Crush injuries of upper extremity, 204-205
Cystic hygroma, 40, 76-77

D
Delayed flexor tendon injuries, 230-231
Delta phalanx, 176-177
Dentofacial deformities
evaluation of, 80-81
mandible, 84-85
maxilla, 82-83
Dentoskeletal malocclusion, 80-81
Depressed scars, 22-23
Dermatochalasis, 108, 272
Dermatolymphangioadenitis, 254-255
Dermoids, 76-77
Digits; see also Thumb
amputation of, 202-203
fracture of, 184-187
infection of, 210-211
Dihydrotestosterone, 268-269
Direct laryngobronchoscopy, 56
Distal interphalangeal joint contracture, 216-217
Distal phalanx fractures, 184-185
Distal third of lower leg, 244-245
Distraction osteogenesis, 44-45, 64-65, 84
Dog bites, 8-9
Dorsal foot defects, 248-249
Double-ring sign, 88
Dupuytren’s contracture, 236-237
Dupuytren’s diathesis, 236-237
Dysmorphic calvaria, 60-61

E
Ear
acute trauma to, 6-7
caudal position of, 70
constricted, 70-71
defects of, 110-111
microtia of, 72-73
microvascular replantation of, 6-7
Electromyography, 218-219
Encephalocele, 62-63
Enophthalmos, 62
Erythematous scars, 22-23, 260-261
Exorbitism, 62
Exophthalmos, 62
Eyebrow; see Brow
Eyelids
aesthetic surgery of, 272-275
blepharoplasty of, 270-271
defects of, 106-107
laxity of, 272-273
lower, 124-125
paralysis of, 124-125
ptosis of, 108-109, 272-273
upper, 272-273
Facial skin dyschromias, 260-261
Failure to thrive
cleft lip and palate, 44-45
midface retraction as cause of, 64-65
Fasciocutaneous flaps
for heel defects, 246-247
for plantar defects, 250-251
for proximal and middle third of lower leg defects, 242-243
Fat grafting, 140-141, 162-163, 280-281, 308, 322-323, 332-333
Felon, 210-211
Female genital anomalies
acquired, 162-163
congenital, 160-161
Fibromatosis coli, 76-77
Fillers 22, 260, 264-265, 278, 280
Fine-needle aspiration
melanoma evaluations, 30
oral cavity cancer, 132
parotid mass evaluations, 128-129
Fingertip infections, 210-211
Fistula
alveolar-oral, 48-49
closure surgery for, 50
oronasal, 50
palatal, 48-51
Flaps
Abbé, 118-119
abductor digit minimi, 250-251
abductor hallucis brevis, 250-251
ankle defects, 246-247
anterolateral thigh, 120-121, 148
deep inferior epigastric perforator, 140-141
dermoglandular breast, 142-143
distal third of lower leg defects, 244-245
distant pedicle, 206-207
Estlander, 118-119
facial artery myomucosal, 50-51
fasciocutaneous, 242-243
fibula osteocutaneous, 120-121
fibula osseous, 120-121
groin, 206-207
latissimus dorsi, 102, 120, 122, 138, 140-143, 146, 148, 166, 242
omentum, 152-153
pedicle rectus femoris myocutaneous, 148
pharyngeal, 50-51
pressure sore coverage with, 20-21
radial forearm fasciocutaneous, 120-121
radial forearm osteocutaneous, 120-121
retroauricular skin, 110-111
sensate, 206-207
superficial inferior epigastric artery, 140-141
index
Mandible
Malignant melanoma, 30-31
Malformations
Male genital anomalies
Magnetic resonance angiography, 226-
Macromastia, 142-143, 304-305
Macroglossia, 58-59
Macrognathia, 58-59
Microcytic lymphangiomas, 40
Lymphedema, 40-41, 254-255, 318-319
Lymphatic malformations, 40-41
Lymphangioscintigraphy, 254-255
Lymphangioma, 40, 76-77
Lunate dislocation, 192-193
L-type brachioplasty, 318-319
Lothrop approach, 94-95
Lipodystrophy
Lip(s)
defects of, 120-123
defor-ments of, 84-85
distraction osteogenesis of, 44-45, 66-
decreases of, 84-85
orthognathic surgery, 80, 85
prognathism of, 84-85
retragnathia of, 82-85
setback procedure, 82
wisdom teeth extraction, 84
Mandibular angle, 286-287
Marionette lines, 280-281
Mass-reduction surgery, for keloids, 24-
Massive weight loss
Maxilla
Midface
cleft lip and palate residual deformi-
Methicillin-resistant Staphylococcus au-
Microcytic lymphangiomas, 40
Microgenia, 282-283
Micrognathia, 58-59
Micromastia, 300-303
Microtia, 72-73
Microvascular free tissue transfer
for dorsal foot defects, 248-249
for proximal and middle third of
lower leg defects, 242-243
Middle phalanx fractures, 186-187
Middle third of lower leg, 242-243
Midface
aesthetic surgery of, 278-279
fractures of, 98-99
retrusion of, 64-65
Midline nasal masses, 74-75
Millard rotation-advancement chemo-
Mohs surgery, 32-33
Motor deficits, of hand, 228-229
Muscle flaps, for groin defects, 152-153
Mustardé sutures, 68-69
Myelomingingocele, 166-167
N
Nasal airway obstruction, 290-293
Nasal deformities, 294-295
Nasal septum
defection of, 46-47
deviation of, 290-291, 296-297
dislocated, 296-297
lacerations of, 90-91
Nasal tip, 294-295
Nasoendoscopy, 56
Nasogastric tube, 56
Nasolabial angle, 294-295
Nasolabial angle, 294-295
Nasopharyngoscopy, 50-51
Nasal airway obstruction, 290-293
Nasal deformities, 294-295
Nasal septum
defection of, 46-47
deviation of, 290-291, 296-297
dislocated, 296-297
lacerations of, 90-91
Nasal tip, 294-295
Nasoendoscopy, 56
Nasogastric tube, 56
Nasolabial angle, 294-295
Nasopharyngoscopy, 50-51
Neck
aesthetic surgery of, 284-285
dissection of, for oral cavity cancer,
132-133
Neck masses, pediatric
acquired, 78-79
genital, 76-77
Necrotizing fasciitis, 158-159
Necrotizing soft tissue infections, 212-
Neck masses, pediatric
acquired, 78-79
genital, 76-77
Necrotizing fasciitis, 158-159
Necrotizing soft tissue infections, 212-
Neural tube defects, 166-167
Ner vous; see also Peripheral nerves
closed, 200-201
median, 228-229
open, 198-199
ulnar, 228-229
Neural tube defects, 166-167
Neuromas, 182-183, 234-235
Nipple-areola complex
asymmetries of, 310-313
description of, 304-305
Nipple hypertrophy, 310
Nipple inversion, 310
Non-melanoma skin cancer, 32-33
Nonunions, scaphoid, 224-225
Nose; see also specific nasal entries
cleft lip and palate defects, 46-47
crooked, 296-297
defects of, 112-113
defor-ments of, 294-295
fractures of, 90-91
midline masses, 74-75
septum of; see Nasal septum

https://t.me/Free_Plastic_Reconstruction_Book
All rights reserved. Usage subject to terms and conditions of license.
Palatal fistula, 48-51; Pain
Osteomyelitis, 20-21, 252-253
Osteoid osteoma, 214-215
Osteoarthritis, 214-216
Orticochea flap, 102-103
Orthognathic surgery, 80, 85
Orthodontic surgery, 82-83
Oronasal fistula, 50
Orbit
Oral cavity cancer, 132-135
Open wounds, of upper extremity, 206-207
Open reduction and internal fixation
Open bite, anterior, 82-83
Ocular burns, 12
Occlusal cant, 80-81
Peripheral nerves
neuromas, 234-235
open injuries of, 198-199
Phalangeal fractures, 184-187
Phenol, 14-15
Pierre Robin syndrome, 44
Plantar defects, 250-251
Platysmal bands, 284-285
Pocket principle, 6-7
Polydactyly, 170, 172-173
Polyethylene glycol, 14-15
Polysomnogram, 56
Portwine stain, 34-35
Posterior auricular artery, 6
Posterior body wall excess, 328-329
Posterior frontal sinus wall fracture, 88-89
Pretooplasty, 72-73
Pressure sores, 20-21
Pretendinous cords, 236-237
Prominent ears, 68-69
Proximal interphalangeal joint contracture, 219-219, 236-237
Proximal row carpectomy, 224-225
Proximal third of lower leg, 242-243
Pseudogynecomastia, 144-145
Pseudoptosis, 306-307
Pits of
breasts, 306-308, 312-313, 330-331
of brow, 270-271
of buttocks, 332-333
of eyelids, 108-109, 272-273
Pubic hip dysplasia, 162
Pyogenic granuloma, 36-37
Rule of Nines, 10
Superficial temporal artery, 6
Subungual hematomas, 184-185
Subplatysmal fat pad, 284-285
Subungual hematomas, 184-185
Superficial temporal artery, 6

https://t.me/Free_Plastic_Reconstruction_Book

All rights reserved. Usage subject to terms and conditions of license.
Index

Swan neck deformity, 216-217
Symbrachydactyly, 180-181
Sympathectomy, periartrial, 226-227
Syndactyly, 174-175

T
Teeth
avulsed, 86
extraction of, 84-85
Telecanthus, 96
Telephone deformity, 68
Tenosynovitis, 210-211
Testicular anomalies, 154-155
Tetanus immunization, 8-9, 16-17
Thigh laxity, 320-321
Thighplasty, 320-321
Third-degree burns, 12-13
Thromboxane A2, 16-17
Thumb; see also Digits; Hand
anomalies of, 178-179
extension of, 228-229
reconstruction of, 220-223
ulnar collateral ligament tears, 214-215
Thyroglossal duct cysts, 76-77
Tinel sign, 232-233
Torticollis, 60-61
Total body surface area, 10
Toxic epidermal necrolysis, 10-11
Tracheostomy, 44-45, 66-67, 86
Transconjunctival blepharoplasty, 274-275
Treacher Collins syndrome, 72
Trichloroacetic acid peel, 262-263
Tuberous breast deformity, 308-309, 312-313

U
Ulnar claw deformity, 228-229
Ulnar collateral ligament tears, 214-215
Ulnar drift, 216-217
Ulnar dysplasia, 180-181
Ulnar nerve injuries, 228-229
Ulnar polydactyly, 172-173
Upper airway obstruction, 56
Upper arm excess, 318-319
Upper extremity
amputations, 202-203
crush injuries of, 204-205
extensive tissue loss of, 206-207
hand; see Hand anomalies; Hand trauma
injection injuries of, 208-209
open wounds of, 206-207
Upper eyelid rejuvenation, 272-273
Upper lip augmentation, 280-281

V
Vacuum-assisted closure, 146, 166, 246-247, 252-253
Vagina
anomalies of, 160-161
defects of, 164-165
stenosis of, 162-163
Vascular malformations, 34-35, 38-39
Vascularized bone grafts, 252-253
Velopharyngeal dysfunction, 48-51
Vertical maxillary excess, 82-83
Vestibular stenosis, 290-291

W
Weight loss; see Massive weight loss
Wet/dry vermilion, 4-5
White phosphorous, 14-15
White roll, 4-5
Wisdom teeth extraction, 84
Witch’s chin deformity, 284-285
Wrinkles; see Rhytids

Z
Zygomatic prominence, 286-287
Zygomaticomaxillary complex fractures, 94-95