Thieme

The Art of Aesthetic Surgery

Principles and Techniques

Volume III

Breast Surgery • Body Contouring • Female Genital Rejuvenation • Gender-Affirming Surgery

Third Edition

Editor

Foad Nahai, MD, FACS, FRCS (Hon)
Professor of Surgery
The Maurice J. Jurkiewicz Endowed Chair in Plastic Surgery
Department of Surgery
Emory University
Atlanta, Georgia, USA

Associate Editor

Farzad R. Nahai, MD
Board Certified Plastic Surgeon
The Center for Plastic Surgery at MetroDerm
Atlanta, Georgia, USA

Section Editors

John G. Hunter, MD, MMM, FACS
Chief, Division of Plastic Surgery
Associate Chief and Director of Clinical Operations,
Department of Surgery
New York-Presbyterian Brooklyn Methodist Hospital
Brooklyn, New York, USA
Attending Plastic Surgeon
New York-Presbyterian Hospital (Weill Cornell Campus)
Professor of Clinical Surgery (Plastic Surgery)
Weill Cornell Medical College
New York, New York, USA

Jeffery M. Kenkel, MD
Professor and Chair
Department of Plastic Surgery
University of Texas Southwestern Medical Center
Dallas, Texas, USA

William P. Adams Jr., MD
Program Director
University of Texas Southwestern Aesthetic Surgery Fellowship
Associate Professor
Dept. of Plastic Surgery
University of Texas Southwestern
University Park, Texas, USA

W. Grant Stevens, MD, FACS
Clinical Professor of Plastic Surgery
University of Southern California Keck School of Medicine
Director
Aesthetic Surgery Fellowship
Marina del Rey, California, USA

2072 illustrations

Thieme
New York • Stuttgart • Delhi • Rio de Janeiro

Library of Congress Cataloging-in-Publication Data
is available from the publisher upon request.

Thieme Publishers New York
333 Seventh Avenue, New York, NY 10001 USA
+1 800 782 3488, customerservice@thieme.com

Thieme Publishers Stuttgart
Rüdigerstrasse 14, 70469 Stuttgart, Germany
+49 [0]711 8931 421, customerservice@thieme.de

Thieme Publishers Delhi
A-12, Second Floor, Sector-2, Noida-201301
Uttar Pradesh, India
+91 120 45 566 00, customerservice@thieme.in

Thieme Revinter Publicações Ltda.
Rua do Matoso, 170 – Tijuca
Rio de Janeiro RJ 20270-135 - Brasil
+55 21 2563-9702
www.thiemerevinter.com.br

Cover image: "The Three Graces" by Baron Jean-Baptiste Renault
(Paris, 1754–Paris, 1829).
Cover design: Thieme Publishing Group
Typesetting by Prairie Papers

Printed in India
by Replika Press Pvt. Ltd.

5 4 3 2 1

Three-volume set ISBN: 978-1-68420-034-4

Also available as an e-book: 978-1-68420-036-8

Volume III ISBN: 978-1-68420-040-5

Also available as an e-book: eISBN 978-1-68420-050-4

To Shahnaz

My best friend and partner of fifty years whose beauty is only surpassed by the loveliness that radiates from within.
You are an inspiration to us all, and your patience, understanding, sacrifices, and encouragement have made me who I am.
Thank you for enriching my life.

—Foad Nahai, MD, FACS, FRCS (Hon)

Contents

Preface . . . xiii

Acknowledgments . . . xv

Contributors . . . xvii

Video Contents . . . xxv

Volume I

Part I Fundamentals . . . **1**

Section Editors: Foad Nahai and Farzad R. Nahai

1 The Patient . . . 3
Foad Nahai

2 Psychological Considerations in Aesthetic Surgery . . . 15
David B. Sarwer and Jacqueline C. Spitzer

3 Photographic Essentials in Aesthetic Surgery . . . 21
Walter C. Lin, William Y. Hoffman, and Farzad R. Nahai

4 Patient Safety in Aesthetic Surgery . . . 39
Christopher A. Tokin, Christodoulos Kaoutzanis, Kent K. "Kye" Higdon, and James C. Grotting

5 Sedation and Anesthesia for Aesthetic Surgery . . . 51
Aaron M. Kearney, Sergey Y. Turin, and Sammy Sinno

Part II Business Basics . . . **61**

Section Editor: W. Grant Stevens

6 Why Offer Aesthetic Medicine in an Aesthetic Surgical Practice? . . . 63
Ali A. Qureshi, Renato Saltz, and W. Grant Stevens

7 Optimal Correction and Patient Retention: A Personal Philosophical and Practical Approach to Your Nonsurgical Practice . . . 67
A. Jay Burns

8 The Spa and the Law . . . 74
Michael S. Byrd

9 Social Media . . . 80
Anthony Youn

10 Hiring and Training a Superstar Patient-Care Coordinator . . . 85
Karen A. Zupko

11 Evidence-Based Pricing Strategies That Work . . . 95
Karen A. Zupko

Part III Nonsurgical Cosmetic Treatments . . . **101**

Section Editor: Jeffrey M. Kenkel

12 Clinical Decision Making for Nonsurgical Cosmetic Treatments . . . 103
Mikaela Kislevitz, Foad Nahai, and Jeffrey M. Kenkel

13 Over-the-Counter Skin Care and Nutraceutical Basics for the Aesthetic Surgeon . . . 111
Mary P. Lupo and Katharine Saussy

14 A Scientific Approach to Cosmeceuticals . . . 119
Leslie Baumann

15 Botulinum Toxin Injection for Facial Rejuvenation . . . 135
Sean Michael Devitt and Steven Fagien

16 Soft-Tissue Fillers 150
Vic A. Nanurkar

17 Non-Light-Based Skin Resurfacing 159
Christodoulos Kaoutzanis, Blair A. Wormer, and Galen Perdikis

18 Chemical Peels 173
Richard H. Bensimon and Foad Nahai

19 Lasers and Light-Based Devices in Plastic Surgery 196
Noelani E. González and David J. Goldberg

20 Sclerotherapy and Laser Vein Treatment 206
Gilly Munavalli, Mitchel P. Goldman, and Robert A. Weiss

21 Nonsurgical Treatment of the Face and Neck 222
Michael P. Ogilvie and Julius W. Few Jr.

Part IV Hair Transplantation 241
Section Editor: Jeffrey M. Kenkel

22 Applied Anatomy in Hair Transplantation 243
Alfonso Barrera

23 Clinical Decision Making in Hair Transplantation 248
Alfonso Barrera

24 Hair Transplantation: Follicular Unit Micrografting and Minigrafting—Current Techniques and Future Directions 259
Alfonso Barrera

25 Reoperation, Refinement, and Treatment of Complications after Hair Transplantation 270
Jack Fisher

Part V Brow Lift 281
Section Editors: Foad Nahai and Farzad R. Nahai

26 Clinical Decision Making in Brow Lift: Brow Rejuvenation 283
Foad Nahai

27 Temporal Brow Lift 291
Foad Nahai

28 Endoscopic Brow Lift 298
Foad Nahai

29 Endoscopic Brow Lift: My Personal Approach 317
H. Devon Graham III

30 Other Approaches to Brow Lift 334
Foad Nahai

Part VI Eyelid Surgery 341
Section Editors: Foad Nahai and Farzad R. Nahai

31 Eyelid and Periorbital Anatomy 343
Amy Patel and Guy G. Massry

32 Clinical Decision Making in Aesthetic Eyelid Surgery 357
Foad Nahai

33 Upper Eyelid Blepharoplasty 374
Ted Wojno

34 Upper Blepharoplasty in the Asian Patient 389
H. Joon Kim

35 Ptosis Surgery in the Blepharoplasty Patient 397
Ted Wojno

36 Lower Eyelid Blepharoplasty 410
Mark A. Codner and Juan Diego Mejia

37 Transconjunctival Blepharoplasty 425
Foad Nahai

38 The Lower Eyelid Pinch Blepharoplasty 439
Lorne King Rosenfield

39 Avoidance and Treatment of Complications of Aesthetic Eyelid Surgery 458
Ted Wojno

Index I-1

Volume II

Part VII Midface Rejuvenation 471

Section Editors: Foad Nahai and Farzad R. Nahai

40 Clinical Decision Making in the Midface 473
Foad Nahai

41 Midface Recontouring 478
Patrick Tonnard, Alexis Verpaele, and Adriana Cely

42 Endoscopic Rejuvenation of the Midface 505
Renato Saltz, Gabriele Miotto, and Carlos Casagrande

Part VIII Surgical Rejuvenation of the Face and Neck 517

Section Editors: Foad Nahai and Farzad R. Nahai

43 Clinical Anatomy of the Face and Neck: Visualizing the Face 519
Joel E. Pessa and Foad Nahai

44 Clinical Decision Making in Facelift and Neck Lift 529
Foad Nahai

45 Structural Fat Grafting: Basics and Clinical Applications in the Hand and Face 551
Michael J. Cammarata and Sydney R. Coleman

46 The MACS Lift Short-Scar Rhytidectomy with Fat Grafting 573
Patrick Tonnard, Alexis Verpaele, and Igor Pellegatta

47 Short-Scar Rhytidectomy 594
Daniel C. Baker

48 Extended SMAS Technique in Facial Rejuvenation 612
James M. Stuzin

49 Lamellar High-SMAS Facelift: Single-Flap Lifting of the Midface, Cheek, and Jawline 634
Timothy Marten and Dino Elyassnia

50 Simultaneous Facelift and Facial Fat Grafting 687
Timothy Marten and Dino Elyassnia

51 Facial Implant Augmentation 725
Imran Ratanshi and Michael J. Yaremchuk

52 Neck Lift 749
Foad Nahai

53 Secondary Neck Lift 771
Timothy Marten and Dino Elyassnia

54 Reoperative Rhytidectomy 817
James C. Grotting, Nirav B. Patel, and William J. Vinyard

55 Avoidance and Management of Complications in Facial Aesthetic Surgery 844
Foad Nahai

Part IX Rejuvenation of the Cheeks, Chin, Lips, and Ears . . . 861

Section Editors: Foad Nahai and Farzad R. Nahai

56 Rejuvenation of the Aging Mouth . . . 863
Christopher D. Knotts, Byron D. Poindexter, Robert K. Sigal, and George Weston

57 Refinements in Otoplasty Techniques . . . 871
Kayvan Shokrollahi and Jamie Barnes

58 Rejuvenation of the Chin . . . 882
Stephen E. Metzinger, Salvatore Lettieri, and Aldo B. Guerra

Part X Rhinoplasty . . . 895

Section Editor: Farzad R. Nahai

59 Applied Anatomy of the Nose . . . 897
Rod J. Rohrich, Paul N. Afrooz, William P. Adams Jr., and Joel E. Pessa (Dedicated to the memory of Jack P. Gunter)

60 Clinical Decision Making in Rhinoplasty . . . 905
Farzad R. Nahai

61 Primary Rhinoplasty . . . 913
Paul N. Afrooz and Rod J. Rohrich

62 Tip Grafting for Nasal Contouring . . . 953
Jeffrey T. Steitz and Dean M. Toriumi

63 Asian Rhinoplasty . . . 970
Jeffrey T. Steitz, Sheena Samra, and Dean M. Toriumi

64 Ethnic Rhinoplasty . . . 983
Ashkan Ghavami and Sean Y. Saadat

65 Revision Rhinoplasty . . . 1002
Jeffrey T. Steitz, Robert T. Cristel, and Dean M. Toriumi

Index . . . I-1

Volume III

Part XI Breast Surgery . . . 1021

Section Editor: William P. Adams Jr.

66 Applied Anatomy of the Breast . . . 1023
Kristin A. Boehm and Foad Nahai

67 The Process of Breast Augmentation: Optimizing Clinical Decisions and Outcomes in Breast Augmentation . . . 1036
William P. Adams Jr. and Foad Nahai

68 Choosing the Right Breast Implant . . . 1041
David A. Sieber

69 Breast Augmentation . . . 1051
Patrick Mallucci

70 Fat Grafting of the Breast . . . 1066
Emmanuel Delay and Andreea Carmen Meruta

71 Composite Primary and Revision Breast Augmentation . . . 1084
Michael Scheflan, Adi Maisel Lotan, and Bradley Bengtson

72 Capsular Contracture: Current Science, Prevention, and Management . . . 1098
Nicholas Lahar, Jason Roostaeian, and William P. Adams Jr.

73 Primary and Revision Augmentation Mastopexy: Techniques and Considerations . . . 1106
Robert Cohen

74 Clinical Decision Making in Breast Reduction and Mastopexy . . . 1134
Foad Nahai

75 Medial Pedicle Vertical Breast Reduction 1152
Elizabeth J. Hall-Findlay

76 Breast Reduction: The Lateral Pedicle Technique....1182
Moustapha Hamdi

77 Short-Scar Mammaplasty with a Pectoralis Loop 1195
Ruth Graf, Maria Cecília Closs Ono, and Thomas M. Biggs

78 Alternative Approaches to Breast Reduction 1209
Elizabeth J. Hall-Findlay, Niamh Corduff, Genevieve F. Caron, and Don Lalonde

79 Control and Precision in Mastopexy....1235
James C. Grotting and Stephen M. Chen

80 Mastopexy and Breast Reduction in Massive-Weight-Loss Patients....1258
J. Peter Rubin and Jonathan Toy

81 Management of Breast Asymmetry 1274
Glyn Jones

82 Treatment of Gynecomastia 1284
Alfredo Hoyos and David E. Guarin

Part XII Body Contouring 1291

Section Editor: Jeffrey M. Kenkel

83 Applied Anatomy in Body Contouring....1293
Alfredo Hoyos and Mauricio Perez

84 Clinical Decision Making in Body Contouring....1316
Mikaela Kislevitz and Jeffrey M. Kenkel

85 Noninvasive and Minimally Invasive Techniques for Body Contouring....1327
Lawrence S. Bass, Jason N. Pozner, and Barry E. DiBernardo

86 Liposuction and High Definition Liposculpture: Basic Techniques and Safety Considerations 1341
Alfredo Hoyos and Mauricio Perez

87 Screening and Safety Issues in the Massive-Weight-Loss Patient....1361
Christopher K. Patronella, Stephanie Nemir, and Olivier A. Deigni

88 Brachioplasty....1372
Sepehr Egrari

89 Decision Making in Upper Back Contouring....1387
Joseph P. Hunstad and Alexandra C. Schmidt

90 Body Lift 1396
Karen B. Lu and Jeffrey M. Kenkel

91 Abdominoplasty....1409
Dennis C. Hammond and Jonathan Nathan

92 Gluteal Augmentation with Fat Transfer....1444
Ashkan Ghavami and Vicky Kang

93 Evaluation and Treatment of Iatrogenic Deformities, Including Contour Deformities 1461
Jeffrey R. Claiborne and Simeon Wall Jr.

94 Aesthetic Abdominal Surgery in Men: BodyBanking with Autologous Fat Contouring and Silicone Six-Pack Implant Augmentation....1474
Jordan D. Frey and Douglas S. Steinbrech

95 Male Massive-Weight-Loss Chest Excision....1483
Omar E. Beidas and Jeffrey Gusenoff

96 Thighplasty 1490
Karan Chopra and Jeffrey M. Kenkel

Part XIII Female Genital Rejuvenation 1499

Section Editor: John G. Hunter

97 Applied Anatomy in Female Genital Rejuvenation. 1501
Franziska Huettner and John G. Hunter

98 Clinical Decision Making in Female Genital Rejuvenation 1506
John G. Hunter

99 Surgical and Nonsurgical Female Genital Rejuvenation: Patient Selection, Preoperative Considerations, Psychological Considerations, and Patient Satisfaction: Part 1—Patient Selection and Preoperative Considerations. 1509
Christine A. Hamori

100 Surgical and Nonsurgical Female Genital Rejuvenation: Patient Selection, Preoperative Considerations, Psychological Considerations, and Patient Satisfaction: Part 2—Psychological Considerations and Patient Satisfaction. 1518
Gemma Sharp

101 Surgical Alteration of the Labia Minora and Clitoral Hood: Part 1—Labia Minora Reduction Surgery Using Edge Excision Techniques and Nonwedge Flap Techniques. 1523
Ryan E. Austin, Frank Lista, and Jamil Ahmad

102 Surgical Alteration of the Labia Minora and Clitoral Hood: Part 2—Central Wedge Labiaplasty and Clitoral Hood Reduction 1536
Gary J. Alter

103 Surgical Alteration of the Labia Minora and Clitoral Hood: Part 3—Surgical Alteration of the Clitoral Hood 1544
Carlo M. Oranges

104 Surgical Alteration of the Labia Majora and Mons Pubis 1550
John G. Hunter and Yhelda Felicio

105 Vaginal Rejuvenation and Perineoplasty, Surgical Alteration and Minimally Invasive Procedures: Part 1—Vaginal Rejuvenation and Perineoplasty, Surgical Procedures. 1558
John R. Miklos and Robert D. Moore

106 Vaginal Rejuvenation and Perineoplasty, Surgical Alteration and Minimally Invasive Procedures: Part 2—Vaginal Tightening, Surgical and Nonsurgical Options. 1572
Lina Triana

107 Labiaplasty and Hood Reduction Complication Avoidance and Treatment 1579
Michael P. Goodman

108 Female Genital Rejuvenation: Labia Minora Revision Surgery. 1589
Michael P. Goodman

Part XIV Gender-Affirming Surgery 1605

Section Editor: John G. Hunter

109 Clinical Decision Making for Gender-Affirming Surgery 1607
Wilmina N. Landford, Paula M. Neira, and Devin O'Brien Coon

110 Gender-Affirming Surgery: Patient Selection and Preoperative Considerations. 1615
Ara A. Salibian, Steven Lamm, and Rachel Bluebond-Langner

111 Gender-Affirming Surgery: Facial Surgery 1620
Ara A. Salibian and Rachel Bluebond-Langner

112 Gender-Affirming Surgery: Top Surgery 1623
Tareq Ammari, Emily Sluiter, Katherine Gast, and William M. Kuzon Jr.

113 Gender-Affirming Surgery: Genital Surgery 1637
David M. Whitehead and Loren S. Schechter

Index I-1

Preface

It has been almost twenty years since my good friend and mentor John Bostwick, then chief of plastic surgery at Emory, and Karen Berger, another good friend who, at the time, was the CEO of Quality Medical Publishing, encouraged me to undertake the task of editing a textbook on aesthetic surgery. Their input and advice led to the publication of the first edition of *The Art of Aesthetic Surgery* in 2005. Six years later, in 2011, the second edition was published. The first two editions were an immense undertaking for me, but also rewarding and educational. Both editions were written to address the enormous demand for and interest in cosmetic surgery and the need for comprehensive information on that topic. I had not anticipated the warm reception both editions would receive from colleagues throughout the world, and I have been delighted, humbled, and gratified to witness its continued popularity and enthusiastic readership. Recent translations into Chinese, Korean, and Russian attest to the ongoing global need for education in aesthetic surgery. I never imagined, twenty years ago, that today I would be writing the preface for a third edition.

Why a third edition? Surely twice was enough for a project of this magnitude. The answer is obvious: this is a dynamic field continuing its rapid and significant growth, with numerous, exciting new developments. Interest in this topic has not abated over the years; in fact, it has grown stronger and more vibrant. While many of the procedures touted nine years ago are still being performed, others have been replaced by new, less-invasive approaches or techniques that emphasize volume replacement to enhance rejuvenation procedures. Furthermore, new technology, noninvasive techniques, and a number of new devices, fillers, and products have enhanced our ability to provide our patients a broader spectrum of options and improved outcomes. Clearly, after nine years there was a need for a revision of the book to reflect these dramatic and ongoing changes.

Today, nonsurgical cosmetic treatments, such as injectables, continue to gain in popularity, whereas the decline we had seen in some surgical approaches to facial rejuvenation seems to be reversing. Nowhere is this change more dramatic than in the area of brow rejuvenation. Another important trend has been the emphasis on volume enhancement in periorbital and facial rejuvenation, as well as surgery of the breast. In keeping with these trends, we have increased coverage of nonsurgical treatments and injectables and have added new sections and chapters dealing with volume and its role in facial rejuvenation and the role of fat grafting in breast surgery.

In contrast to the reduction in the number of invasive surgical procedures for facial rejuvenation being performed today, there has been a dramatic increase in breast and body-contouring procedures, in normal-weight patients, and in individuals who have lost massive amounts of weight. Accompanying this burgeoning interest and demand have been advances, the development of new procedures, and refinements of existing techniques. In keeping with advances and demand for genital rejuvenation, we have expanded that section and added a new section on gender-affirming surgery.

I did not approach the task of this revision lightly. As with the first two editions, it involved many late nights and weekends spent writing and editing. A busy practice, numerous academic and societal commitments, a journal editorship, and an effort to bring more balance into my own life were all forces working against such an undertaking. Why, then, did I feel this was the right time to take on the responsibilities and make the time commitment for editing a third edition? Obviously, there was more than one reason.

My commitment to learning and teaching was a primary motivator. From my earliest writings on muscle and musculocutaneous flaps, to the editing of two editions of this three-volume work on aesthetic surgery, I have always felt an obligation to contribute to the literature and to help advance our specialty. This book represents a continuation of my lifelong dedication to this process. It has been a wonderful way to reach out to young and experienced surgeons alike and to offer them insight into the remarkable contributions made by leading experts worldwide. During academic travels and interactions with plastic surgeons and trainees all over the world, I have witnessed their interest in aesthetic surgery and their desire to master the basics of aesthetic surgery and learn about the latest techniques. This new edition has been written to address that need and to provide information on current advances that emphasize safe and best practices to all aesthetic surgeons.

Recognizing my many commitments and the increasing scope of the specialty led to the decision to invite others to assist me; namely, my son, Farzad Nahai as coeditor and section editor; Dr. Jeffrey Kenkel and Dr. John Hunter as section editors, with each responsible for two sections; and Dr. William Adams and Grant Stevens as section editors. I felt this would not only lighten my load and speed up the time to publication but would allow the coeditors to add their expertise.

Every chapter has been revised with new material added. Twenty new chapters, reflecting the growth and diversity of our specialty, have been included. The amount of online material has also grown, with nineteen operative videos, fourteen of which are new, included in this edition. The entire book is also available online for quick and portable reference. It is with great pleasure that I welcome 105 new contributors who, along with our previous contributors, bring valuable insights and considerable expertise to this new edition. The contributors, drawn from all parts of the globe, represent several disciplines, including the four core specialties. These contributors, all of whom have distinguished themselves as educators and innovators, have graciously succumbed to my gentle arm-twisting and that of the section editors to provide us with outstanding chapters on a diverse range of topics.

The positive feedback we have received on the clinical decision-making chapters prompted the expansion of existing chapters and the inclusion of new ones. The additions reflect the increase in the number of options now available for each patient. These chapters reflect my own and the section editors' daily decision-making process, not only in the operating room but also in the clinic, where we evaluate new patients and care for them after the operation.

My personal interest and fascination with human anatomy dates back to my first year in medical school. I recall one of my teachers telling the class, "You will learn anatomy three times and forget it three times." He went on to say that unlike other knowledge we would acquire over the years, anatomy would never change. Of course, he was right; anatomy does not change. However, it is important to note that we change, and our understanding of anatomy evolves and deepens with experience.

Back then, I never imagined that one day as a practicing plastic surgeon not only would I remember all the anatomy I learned, but I would also learn intricate details that were unimaginable then. Little did I know that in some modest way I would even contribute to that knowledge base. Interest in anatomic detail as it applies to aesthetic surgery continues with further clarification of facial anatomy, such as the fat compartments and more detailed descriptions of anatomy of the trunk and breast relating to emerging body-contouring procedures. In keeping with these new findings, all anatomy chapters have been appropriately updated.

The topic of patient safety also assumes a more prominent position in this edition, with a major chapter on safety considerations in aesthetic surgery, as well as specific chapters on problems and complications in different anatomic regions.

All volumes have been significantly updated with new information—each chapter reflects the latest information presented by experts responsible for advancing our knowledge in those areas.

As the book progressed from first to third edition, the cover also changed. The first edition cover with a modern rendition of *The Three Graces* was replaced with an even more contemporary rendition of *The Three Graces*. The third edition carries the masters version of The Three Graces.

It is my wish that readers will receive this third edition with enthusiasm equal to that of the first two editions. I hope that it will provide a source of new information, stimulate thought, and foster innovation. As with any writing project, this book has been a major undertaking, but it has also been a labor of love. I have learned as much as I have taught, and I continue to marvel at the outstanding work being done by my colleagues around the world. I am gratified to be able to share our learning and work with you in these pages. My goal for this book is to provide trainees, as well as experienced practitioners, with a solid foundation for learning basic principles and techniques in aesthetic surgery in order to enable them to build on it and advance this specialty that we all love.

Foad Nahai, MD, FACS, FRCS (Hon)

Acknowledgments

This book is intended to serve as a testament to all the surgical pioneers who laid the foundation for modern aesthetic surgery, as well as a tribute to current contributors worldwide whose ingenuity and skill are paving the way for future developments. While acknowledging my mentors, I also credit the young surgeons in whose training I have been privileged to participate. Their enthusiasm and quest for knowledge continues to stimulate me.

This work would never have been completed without the support and encouragement of my family, my partners, those with whom I work on a daily basis at the Emory Aesthetic Center, and my friends at Thieme Publishers. I would be remiss if I didn't mention all of them by name.

My wife, Shahnaz, has been a support and a part of my professional life for fifty years. She, more than anyone, has put up with my unusual hours and weekends away from home. My son, Farzad, now associate editor of this work, and my daughter, Fariba, have always been interested in what I do and have encouraged me in my efforts. My partners at the Emory Aesthetic Center Grant Carson—Bert Losken, Monte Eaves, Gabi Miotto, and Vince Zubowicz—provided encouragement, advice, and most of all, support in looking after my patients while I was working on the book. Trina Walker, my patient care coordinator, has been my right hand for her hard work and support.

Farzad Nahai, in addition to his role as section editor, worked diligently, capably assisting me with all aspects of putting this work together. The section editors—W. Grant Stevens, Jeffrey M. Kenkel, William P. Adams, and John G. Hunter—all lightened my load and assured that this publication would be the best possible.

I am indebted to all at Thieme, notably my friend and adviser Sue Hodgson, who demonstrated her professionalism and talent as an editor in her willingness to work and rework with me until we both felt we had a superb, scholarly, and "aesthetically" appealing product. Judith Tomat not only encouraged but also managed to corral all the contributors and section editors (and the editor as well) into submitting their manuscripts and videos in a somewhat timely manner. Sarah Landis provided the follow-up to process content for publication, gathering missing elements and keeping all aspects of the book in order and on target. Illustrators Brenda L. Bunch, Amanda Behr, Graeme Chambers, Amanda Tomasikiewicz, and Bill Winn provided quality images to accompany the text.

I acknowledge the outstanding contributors to the book, not only the original contributors who updated and in some cases totally rewrote their chapters, but also the new authors whose contributions have filled in any deficiencies that may have existed in the second edition. I am most grateful to them for so generously and readily sharing their expertise with us.

Foad Nahai, MD, FACS, FRCS (Hon)

It is an honor for me to be included in the third edition of *The Art of Aesthetic Surgery*, for so long referred to by me as "dad's book." When my father approached me to assist with the organization, writing, and editing of this book, I was thrilled—thrilled for the opportunity to contribute to the project in a meaningful way, but especially to have the chance to share this experience with him, working closely together to learn the ins and out of putting together a book like this one. It has been a joy for us to collaborate, so I am most grateful to my father for inviting me to be a part of this project and for his continued guidance, mentorship, patience, and leadership. As special as it is for him to share a passion for plastic surgery with me and work together on the common goal of publishing this third edition, it is an equally special experience for me.

The support of my wife Dana and my children Marcelle and Andre has also been important. I especially appreciate their understanding when I have needed to leave the house in the morning before they are awake to work on the book before my clinical day starts.

I would like to also recognize my mentors and their influence on me as a surgeon. The influence of my dad on my career as a surgeon is immense and goes beyond the scope of this note to fully recount and detail. Stephen Mathes, whom I've been fortunate to know since I was a kid, was my chief during residency. He taught me the value of hard work and commitment to the patient. He was taken from us too soon, but I feel so fortunate to have had the time with him that I did. Bill Hoffman (who coauthored the photography chapter with me) was a big influence on me during my time as a resident. To this day I recall and still abide by many of his wise practices and anecdotes. David Young, Keith Denkler, Lorne Rosenfield, and Gil Gradinger were also major influences during my training and remain dear to me to this day.

I must make a special mention with regard to Ron Gruber. Ron was kind enough to allow residents who were interested in rhinoplasty to spend time with him in his private practice. I went to his office quite often, and Ron was always very welcoming and eager to teach me about rhinoplasty. Much of what I know about rhinoplasty and the success of my rhinoplasty practice I owe to Ron. Much of my chapter on rhinoplasty and my approach to rhinoplasty is based on his mentorship and the approach he taught me. Without Ron's gracious time and teaching, I would probably not be the rhinoplasty surgeon I am today.

I would also like to mention my staff and partners at The Center for Plastic Surgery at MetroDerm, who supported me in my clinical practice to where I could take the time needed to work on this book.

Lastly, none of this would be possible without the excellent team at Thieme, especially Judith Tomat and Sue Hodgson, who both put in a lot of time and hard work to help make this third edition become a reality.

Farzad R. Nahai, MD

Thank you to Suzanne, Matthew, and Ashley for the many sacrifices you have made to allow me to pursue my professional dreams. Your boundless support continues to be the backbone of my successes.

Thank you to the students, residents, and fellows who have allowed me the privilege of teaching. You have driven me to pursue excellence and allowed me to be a small part of your accomplishments.

To my patients, I am indebted to each of you for allowing me to care for you. It has been my pleasure and honor to do so.

Jeffrey M. Kenkel, MD

I thank Foad Nahai, MD, for conceiving of and first publishing in 2005 this internationally and critically regarded masterpiece in aesthetic plastic surgery. The impact of the initial text on the aesthetic surgery community, as well as its second edition in 2011, cannot be overstated. I am honored and humbled to be included by Dr. Nahai as a coeditor for this Third Edition, entrusted with the development of two new sections: female genital rejuvenation surgery and gender affirming surgery. Both additions reflect remarkable changes in aesthetic surgery that have occurred since publication of the second edition and illustrate just how state-of-the-art *The Art of Aesthetic Surgery* has been and continues to be.

I also thank my chapter coauthors and all the authors who generously contributed chapters to both sections that I edited. I also offer very special thanks to Ms. Judith Tomat of Thieme Medical Publishers for her constant assistance, support, and positivity throughout the editorial process.

John G. Hunter, MD, MMM, FACS

I would like to acknowledge Dr. Foad Nahai and all of the section editors for their tireless work in completing this edition of *The Art of Aesthetic Surgery*. I would also like to thank all of the authors who contributed to this landmark aesthetic surgery and medicine textbook.

W. Grant Stevens, MD, FACS

I acknowledge all surgeons who rise above the noise and seek to truly move the needle with advancement of the art and science of breast surgery.

William P. Adams Jr., MD

Contributors

William P. Adams Jr., MD
Program Director
University of Texas Southwestern Aesthetic Surgery Fellowship
Associate Professor
Dept. of Plastic Surgery
University of Texas Southwestern
University Park, Texas

Paul N. Afrooz, MD
Plastic Surgery
Private Practice
Miami, Florida, USA

Jamil Ahmad, MD, FRCSC
Director of Research and Education
The Plastic Surgery Clinic
Mississauga, Ontario, Canada

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

Tareq Ammari, MBBS, BSc (Hons), MRCSed
Specialty Doctor in Plastic Surgery
Department of Plastic Surgery
National Health Service
United Kingdom
Ann Arbor, Michigan, USA

Ryan E. Austin, MD, FRCSC
Plastic Surgeon
The Plastic Surgery Clinic
Mississauga, Ontario, Canada

Daniel C. Baker, MD
New York, New York, USA

Jamie Barnes, MBChB, MRes, MRCS, FRCS (Plast)
Specialty Registrar in Burns and Plastic Surgery
Whiston Hospital
Liverpool, United Kingdom

Alfonso Barrera, MD, FACS
Clinical Assistant Professor
Department of Plastic Surgery
Baylor College of Medicine
Houston, Texas, USA

Lawrence S. Bass, MD, FACS
Clinical Assistant Professor
Department of Plastic Surgery
Zucker School of Medicine at Hofstra/Northwell
New York, New York, USA

Leslie Baumann, MD
CEO Skin Type Solutions
Miami, Florida, USA

Omar E. Beidas, MD
Plastic Surgeon
Orlando Health Aesthetic and Reconstructive Surgery Institute
Orlando, Florida, USA

Bradley Bengtson, MD, FACS
Founder and CEO
Bengtson Center for Aesthetics and Plastic Surgery
Co-Founder, Plastic Surgery Imaging, LLC
Grand Rapids, Michigan, USA

Richard H. Bensimon, MD
Private Practice
Portland, Oregon, USA

Thomas M. Biggs, MD
Clinical Professor of Plastic Surgery
Baylor College of Medicine
ICON, American Association of Plastic Surgeons
Houston, Texas, USA

Rachel Bluebond-Langner, MD
Laura and Isaac Perlmutter Associate Professor of Plastic Surgery
Hansjörg Wyss Department of Plastic Surgery
New York University Langone Health
New York, New York, USA

Kristin A. Boehm, MD, FACS
Plastic Surgeon
Private Practice
Premier Image Cosmetic and Laser Surgery
Atlanta, Georgia, USA

A. Jay Burns, MD, FACS
Medical Director
EpiCenter Skin Care and Laser Center
Dallas Medical Skin Solutions
Dallas, Texas, USA

Michael S. Byrd, Esq.
Byrd Adatto, PLLC
Dallas, Texas, USA

Michael J. Cammarata, BS
University of California–San Francisco
San Francisco, California, USA

Genevieve F. Caron, MD, FRCSC
Plastic Surgeon
Department of Plastic Surgery
CIUSS Est-de-l'Ile-de-Montreal
Montreal, Quebec, Canada

Carlos Casagrande, MD
Director, Plastic Surgeon
Casagrande Clinic
Florianópolis, Brazil

Adriana Cely, MD
Plastic Surgeon
Department of Aesthetic Plastic Surgery
The Carolina Clinic
Bogotá DC, Colombia

Stephen M. Chen, MD
Private Practice
Richmond Plastic Surgeons
Richmond, Virginia, USA

Karan Chopra, MD
Plastic Surgeon
Twin Cities Cosmetic Surgery
Minneapolis, Minnesota, USA

Jeffrey R. Claiborne, MD
Private Practice
Plastic Surgeon
Northshore Plastic Surgery
Mandeville, Louisiana, USA

Mark A. Codner, MD, FACS
Clinical Assistant Professor of Plastic Surgery
Department of Surgery
Emory University
Atlanta, Georgia, USA

Robert Cohen, MD, FACS
Medical Director
Scottsdale Center for Plastic Surgery
Paradise Valley, Arizona, USA

Sydney R. Coleman, MD
Clinical Assistant Professor
Department of Plastic Surgery
University of Pittsburgh Medical Center
Pittsburgh, Pennsylvania, USA

Devin O'Brien Coon, MD, MSE
Assistant Professor of Plastic Surgery and Biomedical Engineering
Johns Hopkins University
Baltimore, Maryland, USA

Niamh Corduff, MB, BS, FRACS
Specialist Plastic Surgeon
Geelong, Victoria, Australia

Robert T. Cristel, MD
Department of Otolaryngology–Head and Neck Surgery
Division of Facial Plastic and Reconstructive Surgery
University of Illinois–Chicago
Chicago, Illinois, USA

Olivier A. Deigni, MD, MPH
Plastic Surgeon
Private Practice
Deigni Plastic Surgery
Houston, Texas, USA

Emmanuel Delay, MD, PhD
Plastic Surgeon
Lyon, France

Sean Michael Devitt, MD
Plastic and Reconstructive Surgeon
University of Texas Southwestern
Dallas, Texas, USA

Barry E. DiBernardo, MD
Plastic Surgeon
Medical Director
New Jersey Plastic Surgery
Montclair, New Jersey, USA

Sepehr Egrari, MD, FACS
Medical Director
Egrari Plastic Surgery Center
Bellevue, Washington, USA

Dino Elyassnia, MD, FACS
Marten Clinic of Plastic Surgery
San Francisco, California, USA

Steven Fagien, MD, FACS
Private Practice
Cosmetic Oculoplastic Surgery
Boca Raton, Florida, USA

Yhelda Felicio, MD
Department of Plastic Surgery
Health Secretary of the Ceará State of Brasil
Plastic Surgery Service
Fortaleza, Ceará, Brazil

Julius W. Few Jr., MD
Director
The Few Institute for Aesthetic Plastic Surgery
Clinical Professor
University of Chicago Pritzker School of Medicine
Plastic Surgery
Chicago, Illinois, USA

Jack Fisher, MD
Associate Clinical Professor
Department of Plastic Surgery
Vanderbilt University
Nashville, Tennessee, USA

Jordan D. Frey, MD
Hansjörg Wyss Department of Plastic Surgery
New York University Langone Health
New York, New York, USA

Katherine Gast, MD, MS
Assistant Professor of Surgery
Division of Plastic Surgery
University of Wisconsin
Madison, Wisconsin, USA

Ashkan Ghavami, MD
Assistant Clinical Professor
David Geffen UCLA School of Medicine
Division of Plastic Surgery
Los Angeles, California, USA
Private Practice
Ghavami Plastic Surgery, LLC
Beverly Hills, California, USA

David J. Goldberg, MD, JD
Skin Laser and Surgery Specialists of New York/New Jersey
Clinical Professor of Dermatology
Past Director of Mohs Surgery and Laser Research
Icahn School of Medicine at Mount Sinai
Clinical Professor of Dermatology
Chief, Dermatologic Surgery
UMDNJ–Rutgers Medical School
Adjunct Professor of Law
Fordham Law School
New York, New York, USA

Mitchel P. Goldman, MD
Volunteer Clinical Professor of Dermatology
University of California–San Diego
Medical Director, West Dermatology
San Diego, California, USA

Noelani E. González, MD
Instructor, Dermatology
The Mount Sinai Hospital
New York, New York, USA

Michael P. Goodman, MD
Medical Director
Caring for Women Wellness Center
Davis, California, USA

Ruth Graf, MD, PhD
Professor
Department of Plastic Surgery
Universidade Federal do Paraná
Curitiba, Paraná, Brazil

H. Devon Graham III, MD
Department of Otolaryngology–Head and Neck Surgery
Division of Facial Plastic and Reconstructive Surgery
Ochsner Medical Center
New Orleans, Louisiana, USA

James C. Grotting, MD
Clinical Professor
Division of Plastic Surgery
University of Alabama–Birmingham
Private Practice
Grotting Plastic Surgery
Birmingham, Alabama, USA

David E. Guarin, MD
Plastic Surgeon
Department of Plastic Surgery
Plastic UV Research Team
Universidad Del Valle
Cali-Valle del Cauca, Colombia

Aldo B. Guerra, MD, FACS
Guerra Plastic Surgery Center
Scottsdale, Arizona, USA

Jack P. Gunter, MD (deceased)
Founder of the Gunter Center for Aesthetics and Cosmetic Surgery
Founder of the Dallas Rhinoplasty Symposium
Dallas, Texas, USA

Jeffrey Gusenoff, MD
Professor of Plastic Surgery
Department of Plastic Surgery
University of Pittsburgh
Pittsburgh, Pennsylvania, USA

Elizabeth J. Hall-Findlay, MD, FRCSC
Private Practice
Banff Plastic Surgery
Banff, Alberta, Canada

Moustapha Hamdi, MD, PhD
Professor and Head of Plastic Surgery Department.
Brussels University Hospital
Vrij Universiteit Brussel
Brussels, Belgium

Dennis C. Hammond, MD
Partners in Plastic Surgery
Associate Program Director
Spectrum Health Integrated Plastic Surgery Residency
Grand Rapids, Michigan, USA

Christine A. Hamori MD
Director of the Cosmetic Surgery and Skin Spa
Duxbury, Massachusetts, USA

Kent K. "Kye" Higdon, MD, FACS
Associate Professor
Program Director
Department of Plastic Surgery
Vanderbilt University Medical Center
Nashville, Tennessee, USA

William Y. Hoffman, MD
Stephen J. Mathes Endowed Chair
Professor and Chief
Division of Plastic and Reconstructive Surgery
University of California–San Francisco
San Francisco, California, USA

Alfredo Hoyos, MD
Plastic Surgeon
Total Definer Medical
Bogota, Colombia

Franziska Huettner, MD, PhD, FACS
Plastic Surgeon
Lenox Hill Hospital Northwell Health
Manhattan Plastic Surgery
New York, New York, USA

Joseph P. Hunstad, MD, FACS
Associate Clinical Professor
Plastic Surgery Division
University of North Carolina–Chapel Hill
North Carolina
Director, the American Society for Aesthetic Plastic Surgery
President, HKB Cosmetic Surgery Center
Huntersville, North Carolina, USA

John G. Hunter, MD, MMM, FACS
Chief, Division of Plastic Surgery
Associate Chief and Director of Clinical Operations, Department of Surgery
New York-Presbyterian Brooklyn Methodist Hospital
Brooklyn, New York, USA
Attending Plastic Surgeon
New York-Presbyterian Hospital (Weill Cornell Campus)
Professor of Clinical Surgery (Plastic Surgery)
Weill Cornell Medical College
New York, New York

Glyn Jones, MD, FACS
Illinois Cosmetic and Plastic Surgery
Professor of Surgery (Plastic a Reconstructive)
University of Illinois College of Medicine at Peoria
Peoria, Illinois, USA

Vicky Kang, MD
Associate Medical Director
Myovant Sciences
Los Angeles, California, USA

Christodoulos Kaoutzanis, MD
Assistant Professor, Plastic and Reconstructive Surgery
Department of Surgery
University of Colorado, Anschutz Medical Campus
Aurora, Colorado, USA

Aaron M. Kearney, MD
Division of Plastic Surgery
Northwestern University
Chicago, Illinois, USA

Jeffrey M. Kenkel, MD
Professor and Chair
Department of Plastic Surgery
University of Texas Southwestern Medical Center
Dallas, Texas

H. Joon Kim, MD
Assistant Professor
Department of Ophthalmology
Emory Eye Center
Atlanta, Georgia, USA

Mikaela Kislevitz, BSN, RN
Department of Plastic Surgery
University of Texas Southwestern Medical Center
Dallas, Texas, USA

Christopher D. Knotts, MD, FACS
Plastic Surgeon
The Austin-Weston Center for Cosmetic Surgery
Reston, Virginia, USA

William M. Kuzon Jr., MD, PhD
Reed O. Dingman Collegiate Professor of Surgery
Section of Plastic Surgery
University of Michigan
Ann Arbor, Michigan, USA

Nicholas Lahar, MD
Plastic and Reconstructive Surgery
Lahar Plastic Surgery
Beverly Hills, California, USA

Don Lalonde, MD, FRCSC
Professor, Surgery
Dalhousie University
Division of Plastic Surgery
Saint John, Canada

Steven Lamm, MD
Clinical Professor of Medicine
Director of the Preston Robert Center for Men's Health
Department of Medicine
New York University
New York, New York, USA

Wilmina N. Landford, MD
Plastic and Reconstructive Surgery
Johns Hopkins Hospital
Baltimore, Maryland, USA

Salvatore Lettieri, MD, FACS
Assistant Professor
Division of Plastic Surgery
Mayo Clinic
Phoenix, Arizona, USA

Walter C. Lin, MD
Attending Surgeon
The Buncke Clinic
San Francisco, California, USA

Frank Lista, MD, FRCSC
Founder, Medical Director
The Plastic Surgery Clinic
Trillium Health Parnters
Assistant Professor
Division of Plastic and Reconstructive Surgery
University of Toronto
Toronto, Ontario, Canada

Adi Maisel Lotan, MD
Department of Plastic and Reconstructive Surgery
Shaare Zedek Medical Center
Jerusalem, Israel

Karen B. Lu, MD
Department of Plastic Surgery
University of Texas Southwestern Medical Center
Dallas, Texas, USA

Mary P. Lupo, MD, FAAD
Clinical Professor of Dermatology
Tulane Medical School
New Orleans, Louisiana, USA

Patrick Mallucci, MD, MBChB, FRCDS (Plast)
Malucci London
London, United Kingdom

Timothy Marten, MD, FACS
Founder and Director
Marten Clinic of Plastic Surgery
San Francisco, California, USA

Guy G. Massry, MD
Beverly Hills Ophthalmic Plastic Surgery
Beverly Hills, California, USA
Clinical Professor of Ophthalmology
University of Southern California
Los Angeles, California, USA

Juan Diego Mejia, MD
Plastic Surgeon
Private Practice
Medellin, Colombia

Andreea Carmen Meruta, MD
Surgeon
Plastic Surgery Department
Centre Leon Berard
Lyon, France
Breast Institute
Monza Hospital
Bucharest, Romania

Stephen E. Metzinger, MD, MSPH, FACS
Clinical Associate Professor
Tulane University School of Medicine
Department of Surgery
Division of Plastic and Reconstructive Surgery
Aesthetic Surgical Associates
New Orleans, Louisiana, USA

John R. Miklos, MD, MS, FPRMS, FACS
Director of Urogynecology and Cosmetic Vaginal Surgery
Miklos and Moore Urogynecology
Adjunct Professor of Obstetrics and Gynecology
Emory University
Atlanta Georgia, USA

Gabriele Miotto, MD, MEd
Assistant Professor
Division of Plastic and Reconstructive Surgery
Emory University School of Medicine
Associate Program Director
Aesthetic Fellowship at Emory Aesthetic Center
Atlanta, Georgia, USA

Robert D. Moore, DO, FACOG, FPMRS, FACS
Director, Cosmetic Vaginal Surgery
Beverly Hills Sunset Surgery Center International, Dubai UAE
Miklos and Moore Urogynecology and Aesthetic Vaginal Surgery
Atlanta, Georgia; Beverly Hills, California; Dubai, UAE

Gilly Munavalli, MD, MHS, FACMS
Medical Director, Founder
Dermatology, Laser, and Vein Specialists of the Carolinas, PLLC
Charlotte, North Carolina, USA

Farzad R. Nahai, MD
Board Certified Plastic Surgeon
The Center for Plastic Surgery at MetroDerm
Atlanta, Georgia

Foad Nahai, MD, FACS, FRCS (Hon)
Professor of Surgery
The Maurice J. Jurkiewicz Endowed Chair
Department of Surgery
Emory University
Atlanta, Georgia

Vic A. Nanurkar, MD, FAAD (deceased)
Director and Founder
Bay Area Laser Institute
Chairman, Dermatology
California Pacific Medical Center
San Francisco, California, USA

Jonathan Nathan, MD, MBA
Plastic Surgeon
Private Practice
Chicago, Illinois, USA

Paula M. Neira, JD, MSN, RN, CEN
Clinical Program Director
Johns Hopkins Center for Transgender Health
Johns Hopkins Medicine
Baltimore, Maryland, USA

Stephanie Nemir, MD, PhD
Assistant Professor and Director of Breast Reconstruction
Department of Surgery
Paul L. Foster School of Medicine
Texas Tech University Health Sciences Center–El Paso
El Paso, Texas, USA

Michael P. Ogilvie, MD, MBA
Associate Plastic and Reconstructive Surgeon
Division of Plastic and Reconstructive Surgery
Advocate Christ Medical Center
Oak Lawn, Illinois, USA

Maria Cecilia Closs Ono, MD, PhD
Plástica and Craniomaxillofacial Surgeon
Adjunct Professor
University Federal of Paraná
Department of Surgery
University Federal of Paraná
Curitiba, Paraná, Brazil

Carlo M. Oranges, MD, PhD
Department of Plastic, Reconstructive, Aesthetic, and Hand Surgery
Basel University Hospital
University of Basel
Basel, Switzerland

Amy Patel, MD
Department of Oculoplastics
Cedars-Sinai Medical Center
Los Angeles, California, USA

Nirav B. Patel, MD, MS, JD, FCLM
Associate Plastic Surgeon
Marietta Plastic Surgery
Marietta, Georgia, USA

Christopher K. Patronella, MD, FACS
Director, The Aesthetic Center for Plastic Surgery
Houston, Texas, USA
Clinical Professor of Surgery
Division of Plastic Surgery
University of Texas Medical Branch
Galveston, Texas, USA

Igor Pellegatta, MD
Plastic, Reconstructive and Aesthetic Surgeon
Private Practice
Milano, Lombardy, Italy

Galen Perdikis, MD
Professor and Chair
Department of Plastic Surgery
Vanderbilt University Medical Center
Nashville, Tennessee, USA

Mauricio Perez, MD
Medical Writer and Editor
Department of Plastic Surgery
Dhara Clinic
Bogota, Colombia

Joel E. Pessa, MD, FACS
Clinical Research
Department of Medicine and Oncology
Heldermon Lab
University of Florida School of Medicine
Gainesville, Florida, USA

Byron D. Poindexter, MD
Medical Director
The Austin-Weston Center for Cosmetic Surgery
Reston, Virginia, USA

Jason N. Pozner, MD, FACS
Sanctuary Plastic Surgery
Boca Raton, Florida, USA
Adjunct Clinical Faculty
Cleveland Clinic
Department of Plastic Surgery
Weston, Florida, USA

Ali A. Qureshi, MD
Private Practice
Irvine, California, USA

Imran Ratanshi, MD, MSc, FRCSC
Attending Surgeon
The Plastic Surgery Group at City Centre
Department of Surgery
Fraser Health Region
Surrey, British Columbia, Canada

Rod J. Rohrich, MD, FACS
Clinical Professor of Plastic Surgery
Baylor College of Medicine
Past Chair, Distinguished Teaching Professor of Plastic Surgery
Dallas, Texas, USA

Jason Roostaeian, MD
Associate Clinical Professor
Department of Plastic Surgery
David Geffen School of Medicine at UCLA
Los Angeles, California, USA

Lorne King Rosenfield, MD, FACS
Professor
University of California–San Francisco
Stanford University
Private Practice
Burlingame, California, USA

J. Peter Rubin, MD, FACS
Chair
Department of Plastic Surgery
UPMC Endowed Professor of Plastic Surgery
Professor of Bioengineering
University of Pittsburgh
Pittsburgh, Pennsylvania, USA

Sean Y. Saadat, MD
Plastic Surgeon
Plastic and Reconstructive Surgery
UCLA Health
Los Angeles, California, USA

Ara A. Salibian, MD
Hansjörg Wyss Department of Plastic Surgery
New York University Langone Health
New York, New York, USA

Renato Saltz, MD, FACS
Adjunct Professor
Division of Plastic Surgery
University of Utah
Salt Lake City, Utah, USA

Sheena Samra, MD
Surgeon
Facial, Plastic, and Reconstructive Surgery
Lasky Clinic
Beverly Hills, California, USA

David B. Sarwer, PhD
Associate Dean for Research
Director, Center for Obesity Research and Education
College of Public Health
Temple University
Philadelphia, Pennsylvania, USA

Katharine Saussy, MD
Tulane Dermatology
New Orleans, Louisiana, USA

Loren S. Schechter, MD, FACS
Plastic Surgeon
Clinical Professor of Surgery
University of Illinois at Chicago
Attending Surgeon
Rush University Medical Center
Weiss Memorial Hospital
Morton Grove, Illinois, USA

Michael Scheflan, MD
Plastic Surgeon
Scheflan Plastic Surgery
Tel Aviv, Israel

Alexandra C. Schmidt, MD
Plastic Surgeo
Private Practice
Blue Water Plastic Surgery Partners
Raleigh, North Carolina, USA

Gemma Sharp, PhD, MAPS, FCCLP
National Health and Medical Research Council Early Career Fellow
Head of the Body Image Research Group
Clinical Psychologist
Monash Alfred Psychiatry Research Centre
Monash University
Melbourne, Victoria, Australia

Kayvan Shokrollahi, BSc, MB, ChB, MSc, MRCS (Eng), LLM, FRCS (Plast)
Professor
Consultant Burns and Plastic Surgeon
Mersey Regional Centre for Burns and Plastic Surgery
Whiston Hospital
Merseyside, United Kingdom

David A. Sieber, MD
Private Practice
San Francisco, California, USA

Robert K. Sigal, MD
The Austin-Weston Center for Cosmetic Surgery
Reston, Virginia, USA

Sammy Sinno, MD
Private Practice
Chicago, Illinois, USA

Emily Sluiter, BS
Research Associate
Department of Surgery
Michigan Medicine
University of Michigan
Ann Arbor, Michigan, USA

Jacqueline C. Spitzer, MSEd
Senior Project Director
Temple University
Philadelphia, Pennsylvania, USA

Douglas S. Steinbrech, MD, FACS
Founder, New York Institute of Male Plastic Surgery
Co-Founder, Gotham Plastic Surgery
Attending Surgeon
Lenox Hill Hospital
New York, New York, USA

Jeffrey T. Steitz, MD
Facial Plastic and Reconstructive Surgery
St. Louis Facial Plastic Surgery
St. Louis, Missouri, USA

W. Grant Stevens, MD, FACS
Clinical Professor of Plastic Surgery
University of Southern California Keck School of Medicine
Director
Aesthetic Surgery Fellowship
Marina del Rey, California

James M. Stuzin, MD
Clinical Professor of Plastic Surgery (Voluntary)
University of Miami School of Medicine
Miami, Florida, USA

Christopher A. Tokin, MD
Breast Surgical Oncology
Plastic and Reconstructive Surgery
Hawaii Pacific Health
Honolulu, Hawaii, USA

Patrick Tonnard, MD, PhD
Medical Director
Coupure Center for Plastic surgery
Co-Director, Tonnard and Verpaele Associates
Ghent, Belgium

Dean M. Toriumi, MD
Professor
Department of Otolaryngology Head and Neck Surgery
Rush University
Chicago, Illinois, USA

Jonathan Toy, MD, FRCS(C)
Associate Clinical Professor
Division of Plastic Surgery
University of Alberta
Edmonton, Alberta, Canada

Lina Triana, MD
Corpus y Rostrum Surgery Center
Cali, Colombia

Sergey Y. Turin, MD
Division of Plastic and Reconstructive Surgery
Northwestern University Feinberg School of Medicine
Chicago, Illinois, USA

Alexis Verpaele, MD, PhD
Medical Director
Coupure Center for Plastic surgery
Co-Director
Tonnard and Verpaele Plastic Surgery Associates
Ghent, Belgium

William J. Vinyard, MD, FACS
Medical Director and Founder
Vinyard Institute of Plastic Surgery, LLC
Port St. Lucie, Florida, USA

Simeon Wall Jr., MD, FACS
Private Practice
The Wall Center
Shreveport, Louisiana, USA
Assistant Clinical Professor
Department of Plastic Surgery
University of Texas Southwestern Medical Center
Dallas, Texas, USA

Robert A. Weiss, MD
Assistant Clinical Professor
Department of Medcine, Gastroenterology
Mount Sinai Beth Israel
New York, New York, USA

George Weston, MD
Senior Partner
The Austin-Weston Center for Cosmetic Surgery
Reston, Virginia, USA

David M. Whitehead, MD, MS
Assistant Professor of Surgery
Division of Plastic Surgery
Department of Surgery
Donald and Barbara Zucker School of Medicine at Hofstra/Northwell
North New Hyde Park, New York, USA

Ted Wojno, MD
Director, Oculoplastic and Orbital Surgery
Department of Ophthalmology
The Emory Clinic
Emory University School of Medicine
Atlanta, Georgia, USA

Blair A. Wormer, MD
Plastic and Reconstructive Surgery
Novant Health Presbyterian Medical Center
Charlotte, North Carolina, USA

Michael J. Yaremchuk, MD
Clinical Professor of Surgery
Harvard Medical School
Director, Harvard Plastic Surgery Training Program
Chief of Craniofacial Surgery Massachusetts General Hospital
Boston, Massachusetts, USA

Anthony Youn, MD, FACS
Assistant Professor of Surgery
Oakland University William Beaumont School of Medicine
Youn Plastic Surgery, PLLC
Troy, Michigan, USA

Karen A. Zupko, BSJ
President
Karen Zupko and Associates, Inc.
Medical Management Consulting Firm
Chicago, Illinois, USA

Video Contents

Volume I

Video 17.1: Non-Light-Based Skin Resurfacing

Video 18.1: Croton Oil Peel

Video 24.1: Advances in Aesthetic and Reconstructive Hair Transplantation

Video 29.1: Endoscopic Brow Lift

Video 32.1: Upper and Lower Blepharoplasty and MidFace Cheek Lift

Video 33.1: Establishing Upper Eyelid Crease in Blepharoplasty

Video 34.1: Asian Blepharoplasty

Video 35.1: Ptosis Surgery in the Blepharoplasty Patient

Video 39.1: Canthotomy and Cantholysis

Volume II

Video 41.1: Midface Recontouring

Video 56.1: Rejuvenation of the Aging Mouth

Video 58.1: Genioplasty

Volume III

Video 73.1: Revision Augmentation Mastopexy

Video 75.1: Medial Pedicle Vertical Breast Reduction

Video 76.1: Septum-Based Lateral Mammoplasty

Video 77.1: Short Scar Mammoplasty with Pectoralis Loop

Video 80.1: Dermal Suspension Mastopexy

Video 86.1: Male High Definition Liposculpture

Video 89.1: Bra Line Back Lift

Video 90.1: Lower Body Lift

Video 91.1: Full Abdominoplasty: Basic Technique

Video 96.1: Medial Thighplasty

Video 101.1: Labia Minora Reduction: Edge Excision

85 Noninvasive and Minimally Invasive Techniques for Body Contouring

Lawrence S. Bass, Jason N. Pozner, and Barry E. DiBernardo

Abstract

A multitude of technologies are designed to contribute to improved outcomes in body contouring. The devices in one group are used as adjuncts to surgical procedures like liposuction to enhance or simplify fat removal or increase skin redraping, thereby broadening the scope of acceptable candidates for liposuction versus an open body contouring procedure like abdominoplasty. Devices in a second group are used in place of a surgical procedure in patients who require a smaller degree of improvement or who are unwilling or unable to undergo a surgical procedure. This latter circumstance is a compromise but one that an increasing proportion of patients are selecting. Realistic expectations on the part of patients and appropriate selection and application of technologies by surgeons are the keys to success in achieving patients' aesthetic goals. The role and capability of body contouring technologies will continue to grow as further refinements of existing technologies and combination therapies progress.

Keywords

fat, liposuction, cryolipolysis, laser lipolysis, HIFU, adipocytolysis

85.1 Introduction

There is an almost universal desire for body contouring in the population. Open surgical body contouring procedures have several inherent drawbacks, including the need for anesthesia, possible hospitalization, substantial cost, lengthy scars, pain, swelling, and prolonged recovery. Over the past four decades, body contouring has transitioned from the exclusive use of open procedures like abdominoplasty, thighlift, brachioplasty, and buttock lift to liposuction to noninvasive options. Today, noninvasive options are the most common, performed in large numbers that have grown in double digits annually for nearly the past decade. Liposuction remains one of the two most popular surgical procedures in aesthetic plastic surgery. The quality of results with liposuction has been amplified and refined with a number of energy-based devices that provide some advantages in many specific circumstances to enhance the completeness of fat removal; the evenness of the result, especially in reoperative cases; and as an aid in skin tightening and smoothing, which have always been the Achilles' heel of minimally invasive body contouring (liposuction). Major open surgical procedures continue to be an essential part of ideal body contouring and have evolved in ways that limit recovery time and enhance results but are the predominant choice only in major-weight-loss and postpartum circumstances. Body contouring through noninvasive means has become one of the most alluring areas in aesthetic surgery, with technologies that can consistently produce contour tailoring and subcutaneous fat reduction. Patient expectations and demands for no recovery, minimal discomfort, and increasingly efficacious noninvasive procedures will continue to drive industry development efforts to provide improvements and novel options for noninvasive body contouring.

This chapter describes the technologies currently available to perform body contouring noninvasively or minimally invasively in lieu of surgical approaches or as a modification of traditional surgical procedures with some potential advantage or improvement in outcome. Several broad classes of technologies are available. Detailed outcomes data are not available for most of these, although some technologies have very specific outcome data that exceed the kind of data available for surgery, with its broad individual variability based on patient and surgeon attributes. Comments about potential benefits of technologies will be based on the subjective experience of the authors as well as an understanding of the tissue effects and mechanism of action of the technology.

Where the authors have some specific techniques for applying these technologies that they consider particularly useful, these will be delineated. However, each manufacturer generally provides a variety of instructional experiences to allow surgeons to become familiar with preferred techniques, such as webinars, preceptorships, and written materials. This chapter does not attempt to reproduce such teaching. In addition, even with three authors, it is impossible to have extensive hands-on experience with all available technologies. Finally, we caution that exposure parameters cannot be readily transferred from one device to another, even if the fundamental mechanism or energy modality is the same or seemingly identical. In most devices produced today, energy parameter regimes are unique and proprietary to the device. Settings that may be safe on one device could produce serious tissue damage with a roughly comparable device. Specific training and familiarity with appropriate settings is essential for safe operation of devices.

Efficacy also relies on multiple factors intrinsic to the individual technology and the treatment technique. Selection of proper energy settings in terms of both intensity and total dose is essential to place the treatment over the threshold of efficacy. To some extent, these issues are known or have been adequately developed by the equipment manufacturer in clinical trials. For other devices, few clinical data exist, and clinicians are required to develop their own effective approach to treating patients. In all cases, the individual patient areas requiring treatment and assessment of severity and appropriateness of a minimally invasive or noninvasive option require the judgment of an experienced clinician.

85.2 Energy-Assisted Liposuction

Although liposuction has performed admirably for contour reduction, the technique can require significant labor on the part of the surgeon. Fibrous areas such as the male chest, the flanks, the bra strap, or reoperative sites with fibrosis and scar can be particularly challenging.

Devices using laser, ultrasound, water, and radiofrequency energy have been employed as adjuncts to tumescent liposuction in order to facilitate adequate fat removal and contouring with reduced surgeon effort, improve contour smoothness, and enhance the natural tailoring of skin laxity that occurs during healing.

85.2.1 Laser-Assisted Liposuction

Laser-assisted liposuction uses a small fiber delivered through a narrow cannula of approximately 1 mm or smaller to deliver energy to tissues. This allows delivery of large amounts of energy directly to subcutaneous adipose and connective tissue elements without the concern for skin safety that is intrinsic to transcutaneous laser delivery. More energy can be placed directly at the target instead of passing through the epidermis and dermis, with the requirement for concomitant cooling mechanisms for protection of the surface from intense heat. The principle advantage is the enhancement of skin laxity correction compared to conventional tumescent liposuction due to laser exposure of both the deep surface of the dermis and the fibrous septa running between the dermis and the muscular fascia. In addition, laser exposure to fat creates a loosening of tissues, which allows aspiration with greater ease and smaller cannulas. Thus laser-assisted liposuction can more easily be used to treat scarring, dimpling, and cellulite in the superficial layers with the small cannula. This reduces the risk of contour irregularities seen with larger cannulas. Some disadvantages include the higher cost of equipment, the need for exact temperature measurement, and the potential for burns or blisters without this monitoring. Previous disadvantages were related to duration of the procedure; however, as technology progresses, exposure to multiple wavelengths allows shorter treatment times with comparable energy exposure and fat disruption while maintaining a similar cannula size.

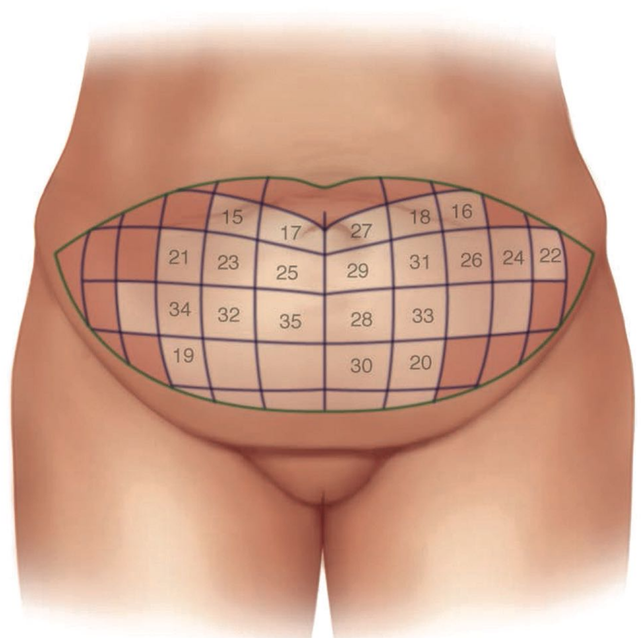

Fig. 85.1 Marking grid used to subdivide the area to be treated in order to control energy delivery to each area.

Preoperative Planning

Patients are evaluated for potential fat reduction and skin laxity improvement. When treating specific areas, these areas of adiposity are marked in a standard fashion, in addition to 5 × 5 cm squares representing the areas of skin laxity targeted for energy application (**Fig. 85.1**). Approximately 50 to 100 mL of tumescent fluid is administered per 5 × 5 cm^2 sector. This procedure is routinely performed with oral and local anesthesia only but may be supplemented with intravenous sedation, epidural block, or general anesthesia.

It is essential to manage patient expectations during the initial consultation. Patients must understand that the skin-tightening effect hinges on several variables, including age, genetics, and skin condition from environmental factors, such as smoking and sun exposure. The effect is highly variable and takes several months to fully manifest.

Operative Technique

Various laser systems are available from different manufacturers, offering different laser wavelengths and combinations of these wavelengths. It is beyond the scope of this chapter to discuss the attributes and provide comparisons of the systems. The most used laser-assisted liposuction system is the Triplex (Cynosure Triplex). It allows individual as well as sequential emission of 1,064-nm, 1,320-nm, and 1,440-nm wavelengths (**Fig. 85.2**). Energy is delivered to the subdermal tissue through a 600- or 1,000-μm fiber threaded through a 1-mm microcannula that extends 2 to 3 mm beyond the distal end of the microcannula. When the microcannula is inserted into the tissue, the laser is activated and the microcannula is moved slowly and evenly through the deep fat layer with a 1,064- to 1,440-nm combination or through the superficial subdermal layer with a 1,064- to 1,320-nm combination. For ideal absorption and performance, wavelength combinations are used for preferential target affinity of fat and water, respectively.

Sciton manufactures a competing device, Allura, which is a laser liposuction device using blended 1,064- and 1,319-nm wavelengths. The device is similar in use to the Cynosure device but lacks an accelerometer and differs in its skin temperature monitoring. Its clinical use and postoperative management are similar to those of the Cynosure laser.

Using the biplanar technique, adipose cells are disrupted, resulting in a more liquefied material that can be removed through a smaller cannula. This refines the removal, particularly close to the surface, thereby reducing potential contour irregularity that can be seen with larger instrumentation. To achieve increased skin elasticity and tightening, surface temperature goals of 40 to 42°C superficially and deep temperature goals of 47 to 52°C are delineated. Achieving and uniformly maintaining these temperature goals are paramount to achieving optimal efficacy.

Safe energy delivery is monitored via an accelerometer delivery system attached to the laser handpiece, used to minimize the occurrence of localized thermal damage during treatment. The handpiece contains a motion-sensing feedback chip that provides constant information of cannula movement to the laser device. Slower movement of the handpiece triggers a reduction in laser power. If the handpiece stops, energy delivery ceases within 0.2 seconds. This safety feature prevents excess accumulation of energy in a given area. Temperature safety is measured with an embedded thermistor probe at the tip of the cannula, which is

Fig. 85.2 Laser lipolysis devices can have temperature and motion feedback to ensure adequate and safe energy exposure.

set for a safe range according to the aforementioned parameters. When the threshold is reached, the laser automatically stops firing.

A two-layer/two-step technique is used in which the deep fat layers (1–3 cm below the epidermis) within the premarked squares are treated first. Insertion of the microcannula is facilitated with the use of 1-mm incisions made with a No. 11 blade for appropriate access to the treatment area. The superficial subdermal layer (0.5 cm below the epidermis) is treated in the second step of the two-layer technique. Aspiration is then performed with a standard 3-mm suction cannula to remove any remaining fat, disrupted cells, and free fat oils.

Optimization of this procedure hinges on proper delivery of energy while maintaining an appropriate safety margin. Inadequate tightening can often be the result of insufficient temperature attainment necessary to achieve the desired effect. Too much energy applied in one area can result in excessive heat buildup and fat necrosis, which manifest as protracted induration and palpable nodules. If too much heat is applied superficially, the result will be skin blistering, burns, or pigmentation changes. If used properly, the built-in safety mechanisms will help control temperature and avoid a harmful buildup of heat.

Another device on the market is the LipoFlow, a laser liposuction system (Alma Lasers). The LipoFlow uses a 1,470-nm laser fiber that is encased in a liposuction cannula. The laser helps break up the fat and makes fat removal easier, but this device differs from other laser liposuction devices in that the fat has been shown to be over 97% viable. Alma Lasers includes a fat collection device with this system and markets the device as a fat-grafting system. Further studies with this device are ongoing.

Postoperative Care

Firm pressure dressings are applied to the wounds upon completion of the aspiration, and compression garments are worn for 3 to 4 weeks postoperatively. Dependent incisions may be left open for drainage or closed, depending on surgeon preference, and oral antibiotic prophylaxis is administered. Garments are used as in traditional liposuction cases and use varies among surgeons.

Skin and tissue firmness is examined during the healing period. Excessive swelling or dense edema may be treated with the use of the Triactive Device (Cynosure) or some other external radiofrequency or equivalent massage, edema reduction, or lymphatic drainage system. Patients are reminded of the time necessary for skin changes to occur during the dynamic fibroblast stimulation period (90 days). If further enhancement of skin is desired after 3 months, acceptable external skin devices can be applied, and additional treatments in adjacent areas can be performed after tissue effects have subsided.

Outcomes

Ecchymosis tends to be less pronounced with laser lipolysis, but edema and induration may be greater or take longer to resolve. With healing and tissue remodeling, an amplification of skin tightening and smoothness, variable in amount, is typically observed (**Fig. 85.3**). Complications of laser-assisted liposuction include blisters, end hits, burns, blowholes, prolonged edema, heat/pressure problems, neuropraxia, permanent nerve damage, contour irregularity, palpable or visible nodules or induration, skin tethering, minor asymmetries, and insufficient effect. These complications are rare in procedures that are properly performed.

Laser-assisted liposuction has evolved over the past decade with improvements in the laser hardware and delivery systems, including more power and greater feedback control for enhanced safety and efficacy. At the same time, clinical study has provided more information about adequate dosing, and demonstration of outcome advantages in laxity reduction.

85.2.2 Ultrasound-Assisted Liposuction

Systems to deliver therapeutic levels of ultrasonic energy are decades old but have undergone development and refinement

Fig. 85.3 Smart lipo **(a)** before and **(b)** after.

to provide predictable effects safely and without excess energy exposure. The third-generation VASER system (Sound Surgical Technologies) was introduced in 2001 and is currently the most commonly used ultrasound-assisted liposuction (UAL) technology.

Ultrasound interacts with tissue by three basic mechanisms: thermal, mechanical, and cavitation. Cavitation is the tissue interaction most responsible for causing fat emulsification with current UAL devices. *Noninvasive* ultrasound devices that will be discussed here create tissue effects thermally or with cavitation. Wetting solution delivered into the target tissues is essential to create the cavitation effects of UAL, separating fat cells within the fat tissue matrix, which subsequently mix with the tumescent solution by means of acoustic streaming to create an emulsion. This emulsion is subsequently harvested by means of a suction cannula.

Preoperative Planning

Even though UAL has expanded the parameters for selecting liposuction patients, one criterion that remains unchanged is the patient's candidacy to undergo an elective surgical procedure. Once this has been established, preoperative preparation may proceed.

Preoperative markings are performed in the standing position. There are five distinct anatomical areas that should be avoided in patients undergoing UAL. These areas—termed the zones of adherence—include the gluteal crease, the lower lateral thigh area of the iliotibial tract, the posterior distal thigh above the popliteal crease, the midmedial thigh area, and the lateral gluteal depression area. Violation of these areas often leads to iatrogenic contour deformities. During the preoperative marking process, it is essential to carefully plan the placement of access incisions. UAL requires a greater number of slightly longer access incisions to accommodate the skin protectors and avoid placing torque on the ultrasonic probe over curved anatomical areas.

VASER probe selection must consider the characteristics of localized fat in the region to be treated. The characteristics of fat cells in different regions of the body differ with respect to collagen structure and conjunctive septi among the fat cells, as described by de Souza Pinto. Knowledge of these differences is essential for probe selection in order to achieve optimal outcomes.

Penetration of various tissue is influenced by the probe diameter and the number of grooves at the tip. For a probe of a given diameter, more grooves emulsify fat tissue more efficiently. However, they do not penetrate fibrous tissues easily due to vibratory energy that is transferred to the sides of the probe as opposed to the front surface. Fibrous tissues are better addressed with probes with fewer grooves. Smaller-diameter probes also penetrate fibrous tissue more easily. The 3.7-mm probes achieve rapid debulking and contouring of medium to large volumes of soft to fibrous tissues. The number of grooves at the tip of the probe will vary according to the fibrous nature of the anatomical area. For treating smaller, soft to extremely fibrous localized fat deposits in sensitive areas, fine contouring is achieved with 2.9-mm probes.

In general, the continuous mode should be used for fibrous tissue, for faster fragmentation, and when tissue emulsification is not readily achieved in the VASER mode. The VASER or pulsed ultrasonic mode is more suited for delicate work, finer sculpting, or softer tissues. The device must be adjusted such that the probe moves smoothly through tissue.

Experience and practice have delineated application times. In general, 1 minute of application time may be used per 100 mL of infused solution in the VASER or continuous mode. Loss of resistance to probe movement in all intended areas can be considered the surgical end point. Following emulsification, aspiration can be performed with suction-assisted or power-assisted liposuction.

Surgical Technique

The prone position provides good access to the back, flanks, lateral thighs, and superior posterior thighs. General endotracheal anesthesia is preferred for patients requiring prone positioning and for large-volume aspirations. Many surgeons also prefer the lateral decubitus position, which requires one additional patient repositioning. Despite additional repositioning, some authors maintain that the lateral decubitus position offers better access with less trauma and is particularly helpful for evacuating large volumes from the flanks and back with the goal of creating more aesthetic waistlines. Supine positioning offers access to the abdomen, anterior and medial thighs, knees, calves, arms ankles, breasts, and face.

Maintaining core body temperature is best accomplished by running intravenous fluids through a fluid warmer in addition to the use of forced warm air by means of a Bair Hugger (Arizent). The access incisions are placed in previously marked areas using a No. 11 blade and must be long enough to accommodate the fluid-infiltrating cannula. The rate of flow is controlled on the infusion pump according to the anatomical area. Generally, a wetting solution is prepared with 1 mL of epinephrine added to 1 L Ringer's lactate at room temperature (1:1,000,000 dilution). In cases not utilizing general anesthesia, lidocaine may be added to the wetting solution. The dose of lidocaine should not exceed 35 mg/kg, although some authors routinely use doses exceeding 50 mg/kg while maintaining a safety margin.

Treatment Recommendations

Posterior Trunk

- The 3.7-mm two-ring probe is used at 80% energy level in continuous mode for most of the back.
- The 3.7-mm one-ring probe is used at 80% energy level in continuous mode for tight fibrous back rolls.
- Posterior trunk areas require slightly longer ultrasound application, usually between 12 to 14 minutes on average.
- Aspiration is accomplished with a small-diameter cannula.

Abdomen

- The 3.7-mm three-ring ultrasonic probe is used at an energy setting of 80% in VASER mode.
- Continuous mode is used for the area above the costal margin.
- Average ultrasound time is 8 to 9 minutes.
- Aspiration is accomplished with a small-diameter cannula.

Extremities and Buttocks

- The 3.7-mm three-ring ultrasonic probe is used at an energy setting of 70% in VASER mode for the superior medial thigh.
- Around the knees and superior posterior thigh, a short 3-mm three-ring probe is used in 80% VASER mode.
- Depending on how fibrous the subcutaneous layer may be, the 3.7-mm three-ring probe is used in 80% VASER or continuous mode for the anterior and lateral thigh areas.
- Average ultrasound time is approximately 3 minutes for both knees, 5 minutes for both superior medial thighs, 8 minutes for both anterior thighs, 6 to 7 minutes for both lateral thighs, and 4 minutes for both superior posterior thighs.
- For the axillary area, a 3-mm three-ring probe is inserted into the subcutaneous space through a small access incision in the axillary fold.
- The energy setting is 70% VASER mode, applied for approximately 2 minutes per arm.
- Aspiration is performed through a small-diameter cannula.

Gynecomastia

- The 3.7-mm one-ring probe or the gynecomastia arrow probe can be used efficiently in this area.
- Energy levels are set at 80 to 90% at continuous mode at an average of 3 to 4 minutes per breast.
- Aspiration is performed through a small-diameter cannula.

HIV-Associated Cervicodorsal Lipodystrophy

- The 3.7-mm one- or two-ring probe is used depending on the fibrous nature of the area.
- The energy setting is 80% continuous mode, and the time will vary according to the volume of fat being treated.
- Aspiration is performed with a fine cannula.

Optimizing Outcomes

- Apply the least amount of ultrasound energy necessary to obtain fat emulsification.
- The clinical end point of ultrasound application is loss of tissue resistance against the probe.
- Incision placement must be planned appropriately to facilitate access to the treatment area while avoiding torque on the ultrasonic probe.
- Small-diameter cannulae provide the greatest precision, particularly in the aspiration of superficial fat.
- Liberal use of wetting solution dispersed evenly through the fat maximizes efficiency of ultrasonic cavitation, minimizes blood loss, and provides added protection against thermal effects of UAL.
- Circumferential contouring provides a more harmonious result than local fat extraction.
- Postoperative use of foam compression garments, lymphatic drainage massage, and skin-moisturizing regimens can optimize UAL outcomes and decrease recovery times.

Postoperative Care

Following large-volume UAL procedures, close monitoring of fluid replacement and urine output is required. Postoperatively, most patients with large-volume aspirations continue to leak fluid through the incisions for 24 to 36 hours. A significant volume of the infiltrating solution does get absorbed during the first 12 hours following major UAL, and this must be considered when planning fluid replacement. Oral intake of fluids is permitted upon waking, early ambulation is encouraged, and patients are discharged on the first postoperative day. Foam and compression garments can be applied to most UAL patients in the immediate postoperative period. Lymphatic drainage and skin-moisturizing regimens are helpful as soon as the patient can tolerate them.

Outcomes

The most common complications of liposuction procedures are underextraction, overextraction, or irregular contour. In general, these complications are prevented by the use of intraoperative flow sheets documenting infusion and aspiration volumes for each anatomical area. Underextraction is usually corrected by revisionary extraction while overcorrection may require fat grafting. Paresthesias, edema, and ecchymosis are usually self-limiting. The vibrating ultrasonic probe generates heat, which could lead to thermal injury, particularly around the incision site. The use of skin protectors is essential, along with the use of a wet towel adjacent to the incision to provide added protection. The most important factor in preventing skin burns is avoiding torque on the probes.

Seromas are the result of too much ultrasonic energy applied to the tissues either as a result of increased generator settings or prolonged application. It is seldom necessary to use energy settings above 80% applied for 1 to 1.5 min/100 mL of wetting solution to a particular area in order to achieve proper tissue fragmentation and emulsification.

Water-based liposuction (Bodyjet, Human Med) is a device that provides pressurized water to help break up fat deposits. This device is also marketed for simultaneous fat removal and harvest as the water pressure is gentle enough to enhance liposuction but not destroy the fat cells. Pre- and postoperative care with this device is similar to traditional liposuction.

Internal fiber–delivered radiofrequency devices have supplanted laser liposuction devices in many practices. The first device to gain U.S. Food and Drug Administration (FDA) approval and clinical acceptance was the Thermi device (Thermigen). Use of this device was very similar to that of laser lipo except that an internal radiofrequency probe was used rather than a laser fiber. Tumescent anesthesia was used, and the device was grounded using an external pad. The monopolar probe was then used under the skin, and thermistors at the tip measured temperature and the device also measured impedance. An external forward-looking infrared camera is used to measure external skin temperature. The goal of treatment was to achieve confluent skin temperatures between 42 and 47°C. Liposuction was then used to remove dead fat cells as well as for contouring similarly to that with laser lipo devices. The device works very well for neck and small-volume body tightening but was very slow for larger areas. A newer version called Arvati was introduced by the same company late in 2018. This device offered much higher power and solved the larger-area issues.

A Thermi/Arvati competitor was FDA-approved in late 2016 but had been used outside the United States since 2009. This radiofrequency device, Bodytite (Inmode), is a bipolar device with internal and external electrodes. A grounding pad is not required, and internal and external thermistors provide real-time temperature feedback. Goals are similar to those with the Thermi/Arvati, with achieved skin temperatures optimized at 40 to 42°C. Pre- and postoperative care with the radiofrequency devices is very similar to the care provided with laser liposuction devices (**Fig. 85.4**).

85.3 Noninvasive Modalities

85.3.1 Cryolipolysis

Cryolipolysis is a noninvasive technology that takes advantage of the higher freezing point of lipids and greater sensitivity of adipocytes to cold injury compared with surrounding skin or muscle tissues. Fat can be selectively targeted and eliminated. Cryolipolysis is performed as part of the CoolSculpting procedure (Zeltiq Aesthetics). Adipocytes respond differently to cooling than other cell types. Precisely controlled cooling causes lipid crystallization (freezing) above the temperature at which water would freeze and triggers apoptosis in adipocytes, while non-lipid-storing cells are left undamaged. Lipids released by apoptotic fat cells are removed gradually through the lymphatic system, thereby reducing tissue volume.

Planning

The areas to be treated must be evaluated for size and shape, after which the appropriate applicators are selected that best match the area to be treated in the fewest cycles (**Fig. 85.5**). For thicker areas or if a greater degree of correction is required, a second series of cycles or a complementary pattern of cycles should be planned. Manufacturer-provided templates aid in marking the application areas and anticipating how much tissue will be drawn into the applicator. The original cup-shaped applicators with parallel-facing flat cooling plates and a 60-minute cycle length have largely been replaced by cup-shaped applicators with a curved cooling surface. The newer applicators have a 35-minute cycle length and improved patient comfort. A flat applicator is available typically for upper abdominal and outer thigh areas. A small overlap between applicator placement is typically used in adjacent cycles.

A gel pad provides thermal contact between the patient's skin and the applicator and should be placed over the center of the treatment site.

Technique

The treatment regimen is selected from the instrument's touch screen console. Some regimens include a short massage session, which enhances the selective injury to the adipocytes.

Once the applicator is properly placed and the patient is comfortably positioned, the clinician may begin the cooling cycle. Vacuum pressure is used to draw the target tissue into the applicator for optimal cooling.

Aftercare

Following the procedure, the treated areas may feel cold and firm with a red and raised appearance. These effects are transient and usually resolve within a few minutes to hours. Massage of the

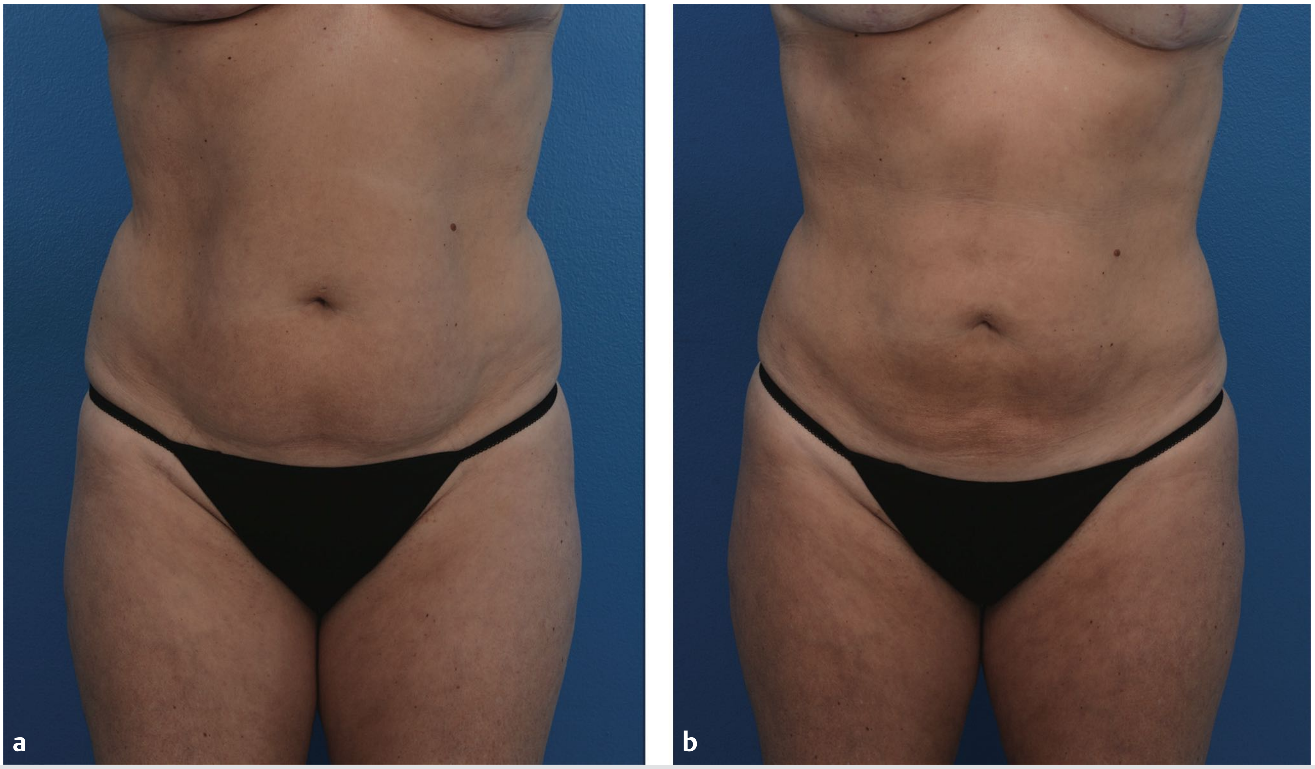

Fig. 85.4 Abdominal liposuction with InMode Bodytite radiofrequency treatment. **(a)** Before and **(b)** 6 months after.

Courtesy Zeltiq, Pleasanton, CA

Fig. 85.5 The cryolipolysis applicator provides hands-free treatment once applied but must be used in a pattern of cycles that covers the intended area of treatment.

frozen mass for several minutes or treatment with shockwave generators have shown enhanced clearance of fat compared with control patients undergoing cryolipolysis alone. Numbness in the treated area is expected for several weeks. Bruising, soreness, tenderness, cramping, and tingling occasionally occur but usually resolve within a few days to weeks.

Outcomes

Proper patient selection for cryolipolysis is essential to achieving successful outcomes. For optimal results, patients should be at or near their ideal body weight with good skin tone and minimal laxity. Ideal candidates have distinct pockets of fat that are resistant to diet and exercise.

A visible reduction in the thickness of the fat layer is typically achieved with each treatment. Though results are visible with a single procedure, multiple procedures may be recommended to achieve the aesthetic goals (**Fig. 85.6**). Although results may be observed as early as 3 weeks following treatment, final results are visible in 2 to 4 months. Some have reported skin tightening or smoothing after cryolipolysis, but these results have not been consistently demonstrated. Patients with visible skin laxity are particularly poor candidates for cryolipolysis and should be directed to other modalities.

Some patients may experience significant pain following cryolipolysis. This seems to be associated with abdominal area and inner thigh treatments, is self-limiting, and usually resolves within a few days to 2 to 3 weeks. Paradoxical fat hyperplasia is also rarely seen. This can be treated with some difficulty as the fat mass tends to be fibrous and resistant to the suction lipectomy, which is required to treat it. The zone of fat hyperplasia does not respond to repeat cryolipolysis.

Cryolipolysis is a novel, safe, and effective option for patients who desire a noninvasive procedure to reduce distinct areas of adiposity, such as fat in bulges, rolls, or other small areas that are resistant to diet and exercise. While reduction in local adiposity can be achieved, cryolipolysis should not be relied on to consistently produce tightening in the skin or deeper layers.

85.3.2 High-Intensity Focused Ultrasound

High-intensity focused ultrasound (HIFU) body contouring devices UltraShape (Louisville, KY) and Liposonix (Solta Medical, Hayward, CA) are novel technologies that result in noninvasive adipocyte death, creating a reduction in the fat layer and body contouring. A low-energy-density beam of sound energy is transcutaneously applied, focusing down to a smaller spot size and consequently higher energy density at a defined depth, creating a therapeutic effect. UltraShape operates at 0.2 MHz, creating cavitation rupturing the

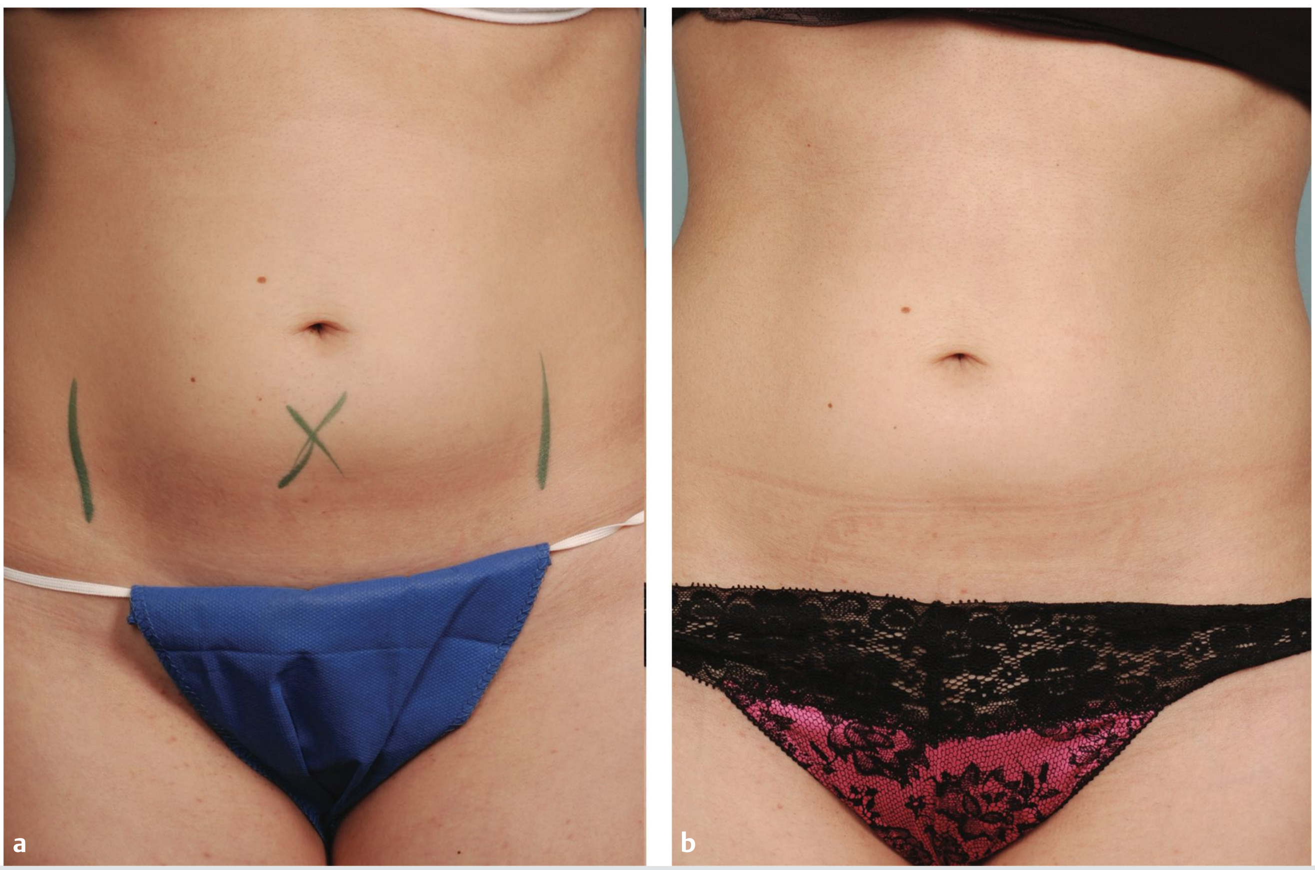

Fig. 85.6 Coolsculpting treatment of the abdomen **(a)** before and **(b)** 3 months after treatment.

cell membrane of adipocytes in the target zone. Lipsonix operates at 2 MHz, creating tissue heating to the point of adipocyte necrosis. Lipids subsequently released are removed gradually through the lymphatic system, thereby reducing tissue volume.

Planning

Patient assessment should be performed in the standing position so that the fat is subject to gravity. The clinician should assess the fat thickness; a minimum of 1.5 cm of fat is generally needed for efficacy, although advances in this technology may allow smaller volumes to be treated. The areas to be treated are marked in a standard fashion.

Technique

Most patients are able to undergo treatment without the need for analgesics or sedation. The transducer is placed on the skin, which is lubricated with oil to enhance conduction. The operator follows a pattern on the device screen, which ensures that the target area receives even treatment without overlap. The transducer dwells for a specific time per area while delivering the ultrasonic energy, and the tracking system keeps track of the area treated. The protocol for UltraShape calls for three sessions, 2 weeks apart, with radiofrequency treatments at the same time and during the untreated weeks, whereas the Liposonix device requires only one treatment per area.

Aftercare

There are no posttreatment limitations following HIFU, and patients may resume all activities immediately. The treated areas may be slightly ecchymotic and edematous, but these changes resolve within a few days. Sensory changes may also occur but usually resolve in a few days to weeks.

Outcomes

Patient expectations must be addressed preoperatively, and there must be an understanding that these devices are less efficacious than liposuction. In rare cases a burn may occur with treatment. The majority of patients will see results, but results are highly variable. Results may be observed as early as 3 weeks posttreatment, but final outcomes are visible in 2 to 4 months.

85.3.3 Noninvasive Laser Lipolysis

A noninvasive approach to laser lipolysis is available that applies 1,060-nm laser light transcutaneously (SculpSure, Cynosure). Simultaneous skin cooling from the faceplate of the applicator prevents injury to the skin even in dark-skinned individuals. This is one of the few laser treatments that is colorblind. Four applicator heads can expose multiple areas during a single cycle, which lasts 25 minutes. The laser wavelength is selected for preferential absorption in fat-bearing tissues compared with water-bearing tissues, although this is only a relative selectivity. During the 25-minute cycle, the laser is on continuously during a warm-up phase designed to bring the tissue to a target temperature of 43 to 47°C. This temperature is known to cause apoptosis in adipocytes after a few minutes. The laser cycles on and off for seconds at a time during the remainder of the treatment in a preset algorithm designed to maintain the target temperature in the fat while avoiding heating of the skin.

Indications

Patient selection for laser body contouring is similar to that for other noninvasive fat reduction or body contouring treatments. Patients who need only a small size reduction, have an isolated area of excess contour, or cannot be considered for a surgical procedure due to medical history or patient preference are typically the most suitable candidates. Skin laxity does not prevent treatment but often masquerades as contour excess, reducing the appearance of improvement despite success at destroying some of the fat depot. Additionally, patients with scarcely any excess fat may paradoxically also be poor candidates due to the minimal fatty substrate to target with the energy. Counseling the patient about the expected degree of contour reduction with a single treatment and the number of treatments required to meet the patient's individual aesthetic goals is essential to appropriate treatment selection and patient satisfaction. Treatment over the umbilicus, surgical or traumatic scars, or bony prominences must be avoided. Cooling cannot be directly applied to the skin at the depth of the umbilicus, creating a high risk for skin burn. Scars may conduct cooling and heating differently than normal tissues, again risking a burn. Bony prominences such as the iliac crest seem to preferentially absorb laser light, possibly at the level of the periosteum, with pronounced sensitivity for patients, although treatment over the ribs in the bra strap areas is well tolerated.

Planning

As an applicator-driven technology, planning involves selection of the contours to be treated and matching the smallest collection of applicators to cover this area in an efficient fashion. The size and shape of each applicator-driven treatment are somewhat different, making the process unique to each technology. The 1,060 nm laser system can be expected to expose fat over the entire zone of contact with the applicator and to the edges of the framing system used to hold the applicators in place. As a practical issue, various frames are typically held in place against the areas selected for treatment to see which will give the best fit. The variety of frames and orientations gives a greater degree of flexibility than other applicator-driven systems. With the patient in a standing position, a small ink mark is made at each strap attachment point on the frames to delineate proper positioning for all cycles planned at that sitting.

Technique

The selected frames and retaining straps are applied and snugged into position while the patient is standing. The patient then assumes the position to be maintained during treatment. Abdominal and inner thigh areas are usually treated in the supine position. Flank and bra strap areas may be treated in the sitting position with the patient facing away from the machine to allow treatment of both sides simultaneously, or in the lateral position if this allows better contact or if more than two applicators are being used on each side. Outer thigh areas are typically treated in the lateral position. An oil-based lotion is applied to the skin once the frames are in place to facilitate conduction of light into the skin. The applicators are then snapped into the frames and stable positioning is insured. The starting energy density (fluence) is set on the machine, typically in the middle of the available range, and the cycle is initiated. After the warm-up phase, fluence is adjusted to match patient sensation. The treatment should feel hot but not painful (typically a 3–4 out of 10). Usually, fluence is increased to the point where pain is experienced and then slightly reduced. This ensures that the tissue temperatures are in the middle of the therapeutic range. A small reduction in fluence often produces a significant improvement in comfort. Alternatively, some operators start at a high fluence during warm-up and reduce the energy as needed for tolerability during the cycling phase of the treatment. The operator may leave the patient unattended.

Aftercare

Immediately after the cycle, the straps and frames are removed, and any remaining lotion is wiped from the skin. The patient can dress and immediately resume full activities. A faint bruised feeling accompanied by minimal edema is typical for 1 to 2 days after treatment.

Outcomes

Contour reduction occurs over approximately 3 months. Assessment at 6 weeks is made to determine if further treatment should be planned. Patients approaching the desired contour by 6 weeks will probably have reached their goal by 3 months. If there is still a desire for significant additional contour reduction, more treatments should be planned (**Fig. 85.7**). Treatment is often repeated at

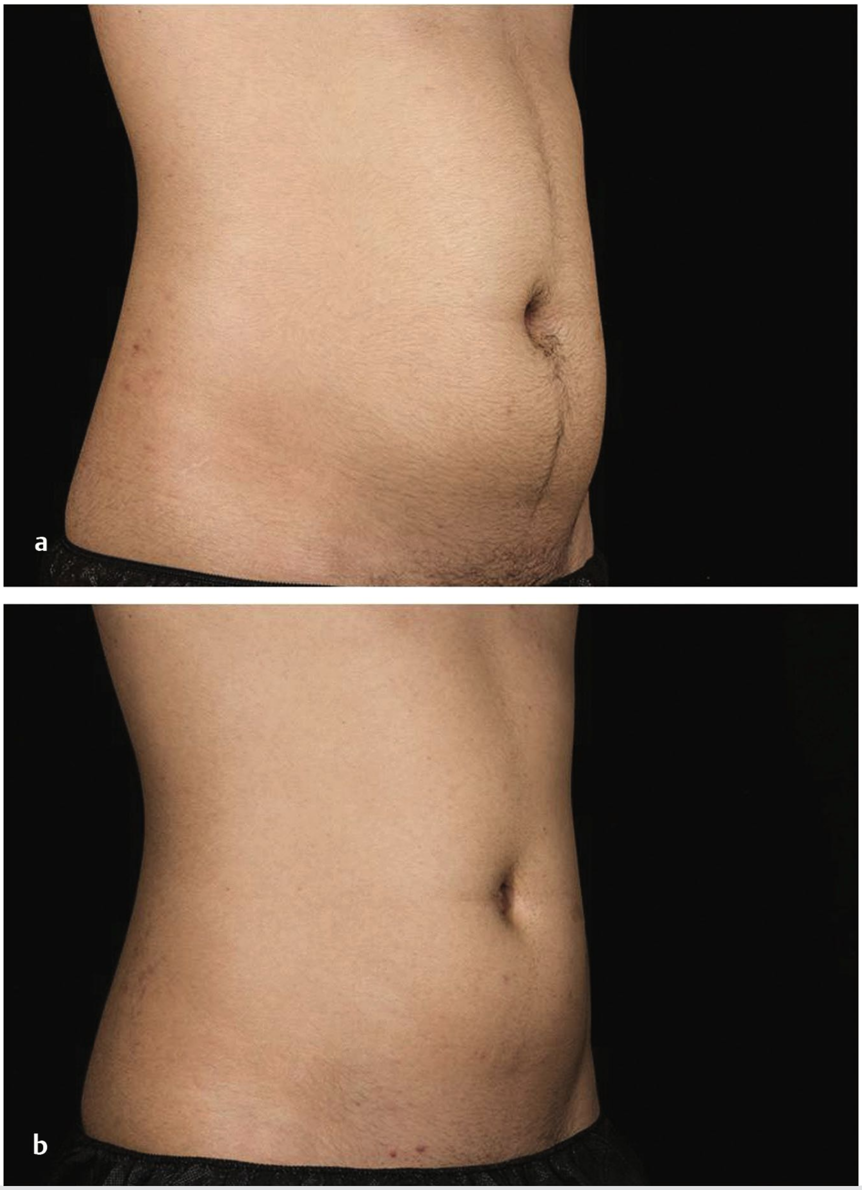

Fig. 85.7 A 26-year-old man treating the abdominal area with noninvasive laser lipolysis. **(a)** Before treatment. **(b)** Twelve weeks after three treatments, weight change of 3 lbs.

the 6-week point for patients who are not yet close to their contour goals. Complications are infrequent, but an occasional nodule in the subcutaneous fat can be seen, probably representative of fat necrosis, which resolves over a few weeks to a few months. Skin burns are possible but again infrequent with a properly functioning machine with working sensors on the applicator heads. Treatment in contraindicated areas can produce a skin burn, which heals in a fashion similar to most laser cutaneous burns.

Contour reduction is stable in the absence of weight gain, having been confirmed in studies out to a year and congruent with the histological observation of apoptosis, adipocyte death, and removal by macrophages. Multiple treatment applications are associated with modest skin tightening or smoothing (**Fig. 85.8**). This is more likely due to thermal effects creating remodeling and neocollagenesis in the fibrous septae transiting through the exposed fat than to any direct effect on the dermis, which experiences minimal tissue heating during treatment.

85.3.4 Multipolar Radiofrequency

Radiofrequency has been used transcutaneously in a number of fashions as well as being delivered into or beneath the skin using electrodes in a minimally invasive fashion. The coupling of the energy into the skin varies with the impedance of the tissues, which vary widely from patient to patient based on multiple factors. A technology has been developed (Vanquish, BTL Industries) that houses an array of electrodes in a treatment bay that is

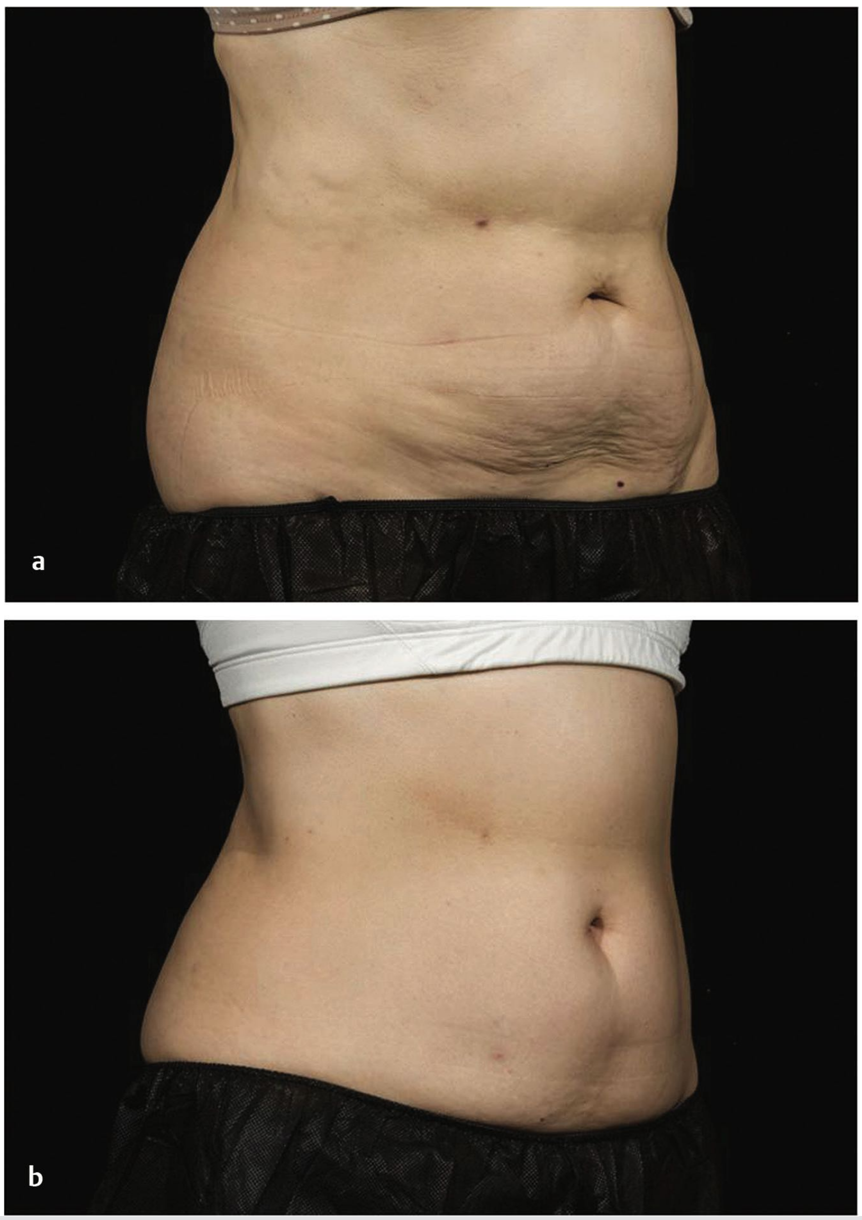

Fig. 85.8 A 66-year-old woman treating the infraumbilical abdomen with noninvasive laser lipolysis. **(a)** Before treatment. **(b)** Twelve weeks after three treatments, weight change of 1 lb. In addition to contour reduction some skin smoothing has occurred.

lowered over the patient's torso or extremity. The device transmits energy into the tissue from electrodes on one side of the bay with absorption on the other side. The device has impedance-matching capabilities to help produce a uniform field effect. This allows exposure of most of the anterior abdomen, or waist area posteriorly, or extremity (arm, thigh) nearly circumferentially in a single treatment. Multiple treatment sessions are needed to obtain a result comparable to cryolipolysis or laser lipolysis.

Indications

As for similar noninvasive devices, the ideal patient requires a modest contour reduction. The ability to expose most of the abdomen or waist in a single treatment makes the technology more suitable for patients who want a small but global size reduction in the torso or an extremity compared with applicator-driven treatments and stamping treatments. Because of the use of radiofrequency energy, patients with metal prostheses in the zone of treatment or an implanted pacemaker or defibrillator may not be treated.

Planning

The treatment area must be selected in conjunction with the patient. Areas amenable to this therapy include the upper abdomen, lower abdomen, flanks, bra strap, extremity, or chest along with the upper thigh or arm. Three 45-minute treatment sessions are planned at weekly intervals for each zone being treated.

Technique

The coupling of energy into the tissue is critically affected by the treatment bay's positioning relative to the surface of the patient's skin. The patient must be in a position that can be comfortably maintained during the treatment. The treatment bay is lowered to the appropriate distance from the skin surface, and the lateral arms of the treatment bay are adjusted to bring them to an appropriate distance from the skin surface. The patient should not be wearing any metal objects and must be careful not to touch the treatment bay during exposure. The operator monitors the energy coupling during the treatment, and the power is adjusted to maximize energy coupling. The patient experiences a feeling of warmth and tissue heating, which is generally pleasant. Hot spots or pain should be promptly reported and responded to by repositioning the applicator or adjusting the power.

Aftercare

At the conclusion of the treatment the patient may immediately dress and resume all normal activities. Slow contour reduction occurs over a period of about 90 days after the final treatment.

Outcomes

Invested time is greater than with other contouring treatments, but a larger area is exposed in each treatment. Efficacy is dependent on meticulous positioning and energy monitoring during treatment. This is a much easier treatment for patients to undergo, the only restriction being the need to stay in one position with minimal motion for the duration of the treatment. The safety profile of the treatment is very high, but occasional nodules are seen from hot spots and the resultant fat necrosis.

85.3.5 Low-level Laser Therapy

Low-level laser therapy (LLLT) is characterized as treatment with a dose rate that causes no immediate detectable rise in tissue temperature and no macroscopically visible changes in tissue structure. The Zerona (Erchonia), a low-level laser device that emits a wavelength at 635 nm, has shown efficacy as a therapeutic strategy for circumferential reduction of the waist, hips, and thighs.

The mechanism of action of LLLT remains somewhat controversial, but it is thought that in body sculpting, the 635 nm LLT Zerona laser penetrates the first few millimeters of fat and creates a temporary pore in the adipocyte cell membrane through which lipids are released. Lipids are subsequently released into the interstitial space and gradually removed by the lymphatic system, and tissue volume is subsequently reduced.

The Zerona laser is a device with five rotating, independent diode laser heads, each emitting 17 mW of 635 nm of laser light. It was the first noninvasive aesthetic device to receive FDA market clearance in the United States for circumferential reduction of the waist, hips, and thighs following completion of a placebo-controlled, randomized, double-blind, multisite clinical investigation evaluating 67 participants. Results of this study showed an average reduction of 3.51 inches across the patient's waist, hips, and thighs in as little as 2 weeks.

Planning

Patient assessment should be performed in the standing position so that the fat is subject to gravity. The areas to be treated are marked.

Between treatments, patients are asked to walk 30 minutes per day, drink 1 L of water, and take a supplement called Curva that contains niacin among other homeopathic substances, which are designed to increase lymphatic flow. Cessation of smoking and alcohol consumption should be encouraged.

Technique

The commercial Zerona unit has an array of diodes, which are adjusted to within 6 inches of the patient's body. The patient is treated for 20 minutes in the waist, hips, and thighs in both the supine and the prone positions. The center diode is positioned 4 to 12 inches above the abdomen, centered in the midline, and the four remaining diodes are positioned above the lateral abdomen and thigh regions. The diodes are repositioned in a similar fashion in the prone position. In order to optimize the transitory pore, it is important that treatments are conducted 48 hours apart.

The current Zerona protocol calls for 6 to 12 treatments, depending on the habitus of the patient. On average, patients undergoing Zerona treatment receive a total of 9 treatments every 48 hours over a period of 2 weeks. It is possible to combine Zerona with other more focal, ablative, fat reduction technologies to enhance general slimming and local fat reduction.

Outcomes

Complications with LLLT can include thermal skin injury. However, complications are rare and mainly include patient dissatisfaction due to unrealistic expectations.

85.3.6 Muscle Bulking with Electromagnetic Pulsed Energy

A recent development in body contouring is the addition of treatments with electromagnetic pulsed energy (Emsculpt, BTL Industries), causing muscular contraction and a training or bulking effect. Unlike electrical muscle stimulation, electromagnetic stimulation is much more comfortable, allowing 20,000 contractions in the targeted muscle in 30 minutes. After four treatments spaced out by 2 to 3 days each, the muscle shows more definition. Some fat reduction in the overlying or adjacent area has also been demonstrated in early studies. The durability of the effect has not been defined, but this technology is rapidly becoming one of the mainstay treatments in noninvasive body contouring and is likely to be employed in concert with various noninvasive fat reducing technologies going forward. The main areas treated include the abdominal wall musculature and buttocks.

85.3.7 Pharmacologic Adipocytolysis Injection Therapy

Mesotherapy is the injection of various agents into the subcutaneous tissue to promote adipose tissue reduction. Agents can include a combination of homeopathic and pharmaceutical medications, plant extracts, and vitamins that are injected into the mesoderm layer targeting the adipose fat cells, dermal vasculature, and connective tissue septae. The selection of medications and herbal extracts is generally at the discretion of the practitioner. It is important to choose medication based on treatment goals, and the formula for each patient will differ based on these goals. Historically, theophylline tends to be the drug of choice for lipolysis in Europe, whereas in the Americas it is usually phosphatidylcholine.

More recently, investigation of mesotherapy cocktails has identified deoxycholic acid, a bile salt, as a major active ingredient responsible for adipocytolysis and fat reduction. A synthetic form of this compound has been FDA-approved for submental fat reduction, with off-label use taking place elsewhere on the body. There are significant limitations with using this medication for body applications. Treatment is dose-limited to 100 mg or 50 injections. The high cost of the medication also limits use to small contour issues, such as residual contour asymmetry or a small bump of retained fat after liposuction.

Planning

Proper selection of patients for mesotherapy is paramount for successful treatment and patient satisfaction. Patients with a body mass index greater than 30 are not ideal candidates for mesotherapy and will likely be dissatisfied with inadequate results.

Technique

Use of the formulation as delivered (10 mg/mL) is essential to produce maximum efficacy. Proper spacing is also essential to maintain efficacy and minimize risk. After marking the area to be treated, an injection grid is placed over the marked area and transferred onto the skin by moistening. The requisite amount of medication is drawn up and injected using a 30-gauge needle. The needle should be directed in at each grid-marked injection point to the midpoint of the fat layer thickness, and 0.2 mL of solution (2 mg) is injected at each point. Local anesthesia is often infiltrated prior to injection to minimize treatment discomfort. Cool compresses are applied after treatment to minimize discomfort and edema. Treatments are repeated at intervals of 4 to 8 weeks. Several treatments are typically required to achieve contour reduction. Various injectors have used dilution or threading techniques with this product, but the dosing and spacing are difficult to control in this fashion, creating unpredictability in the treatment.

Outcomes

The initial reaction to injection is typically a burning and itching sensation associated with flushing and swelling. After 1 to 2 hours this gives way to mild tenderness and edema, which can be pronounced. Numbness in the skin overlying the treated area typically lasts for several weeks. During healing, induration slowly dissipates, producing a flatter contour with reduced fat compared with pretreatment. Skin smoothing and tightening have been postulated given the inflammatory nature of the healing process, with the removal of necrotic fat in the area, but there are no data on this in other body areas. The compound is not exclusively selective for adipocytes and can create tissue injury if injected into skin or deeper structures. Neuropraxia occurs if a nerve is infiltrated with the medication.

85.4 Concluding Thoughts

The strong patient demand for safer, less invasive body contouring procedures will inevitably drive technology toward more effective modalities that minimize downtime and recovery while improving results. The future of body contouring will likely stratify patients into more distinct categories, such as those requiring aggressive surgical excision, minimally invasive liposuction techniques with adjunctive energy-delivering modalities or mesotherapy, and noninvasive techniques achieving volume reduction and skin tightening through additional energy-delivering modalities.

With proven safety and efficacy, the future of minimally invasive and noninvasive body contouring is very promising. However, judicious patient selection cannot be overemphasized, and these procedures should not be overpromoted. Currently, the most ideal candidates for these types of procedures are those who are accepting of a mild to moderate result.

These technologies, incorporated into a plastic surgery practice, provide a multifaceted approach to body contouring that will ultimately lead to greater patient and physician satisfaction. This is undoubtedly an emerging model of minimally invasive and noninvasive body contouring surgery given that body contouring is a recurrent or perhaps even continuing process for most patients; thus major surgery cannot be the only available option.

The future of body contouring will most likely involve entirely noninvasive procedures for mild cases and minimally invasive procedures for moderate cases, with invasive procedures reserved for massive-weight-loss and larger patients. Acquisition of noninvasive technologies is designed not to supplant surgical procedures but rather to offer a broader range of patients an appropriate option for their needs. Patient expectations must be based on the realistic capabilities of the available technologies, which is key to patient satisfaction and achievement of their aesthetic goals.

Clinical Caveats

- Patients must be stratified into candidates for surgical contouring, nonsurgical contouring, and medical weight loss.
- Realistic patient expectations for each option must be established at the outset.
- Noninvasive contouring technologies will require multiple rounds of treatment for significant results.
- Noninvasive contouring technologies will cost more and produce less than liposuction procedures but avoid anesthesia and recovery time and have a very low complication risk profile.
- Although many noninvasive technologies can be provided by nonprofessional staff in your office (subject to regulations in your state), careful planning by an experienced aesthetic plastic surgeon is essential to optimizing results.
- A detailed understanding of the energy–tissue interactions and outcomes data is essential to selecting technologies that will work in your practice.
- Manufacturer-provided training and coaching from experienced users substantially enhances deployment of a new technology in your practice.
- Minimally invasive energy application devices contribute to enhanced outcomes but have a variable response based on the individual patient's remodeling ability.

Suggested Reading

[1] Ascher B. Safety and efficacy of UltraShape Contour I treatments to improve the appearance of body contours: multiple treatments in shorter intervals. *Aesthet Surg J* 2010;*30*(2):217–224

[2] Avci P, Nyame TT, Gupta GK, Sadasivam M, Hamblin MR. Low-level laser therapy for fat layer reduction: a comprehensive review. *Lasers Surg Med* 2013;*45*(6):349–357

[3] Bass LS, Doherty ST. Safety and efficacy of a non-invasive 1060 nm diode laser for fat reduction of the abdomen. *J Drugs Dermatol* 2018;*17*(1):106–112

[4] DiBernardo BE. Randomized, blinded split abdomen study evaluating skin shrinkage and skin tightening in laser-assisted liposuction versus liposuction control. *Aesthet Surg J* 2010;*30*(4):593–602

[5] DiBernardo BE, Reyes J. Evaluation of skin tightening after laser-assisted liposuction. *Aesthet Surg J* 2009;*29*(5):400–407

[6] Duncan D, Rotunda AM. Injectable therapies for localized fat loss: state of the art. *Clin Plast Surg* 2011;*38*(3):489–501, vii

[7] Garibyan L, Sipprell WH III, Jalian HR, Sakamoto FH, Avram M, Anderson RR. Three-dimensional volumetric quantification of fat loss following cryolipolysis. *Lasers Surg Med* 2014;*46*(2):75–80

[8] Jewell ML, Baxter RA, Cox SE, et al. Randomized sham-controlled trial to evaluate the safety and effectiveness of a high-intensity focused ultrasound device for noninvasive body sculpting. *Plast Reconstr Surg* 2011;*128*(1):253–262

[9] Jewell ML, Weiss RA, Baxter RA, et al. Safety and tolerability of high-intensity focused ultrasonography for noninvasive body sculpting: 24-week data from a randomized, sham-controlled study. *Aesthet Surg J* 2012;*32*(7):868–876

[10] Jones DH, Carruthers J, Joseph JH, et al. REFINE-1, a multicenter, randomized, double-blind, placebo-controlled, phase 3 trial with ATX-101, an injectable drug for submental fat reduction. *Dermatol Surg* 2016;*42*(1):38–49

[11] McRae E, Boris J. Independent evaluation of low-level laser therapy at 635 nm for non-invasive body contouring of the waist, hips, and thighs. *Lasers Surg Med* 2013;*45*(1):1–7

[12] Nassab R. The evidence behind noninvasive body contouring devices. *Aesthet Surg J* 2015;*35*(3):279–293

[13] Robinson DM, Kaminer MS, Baumann L, et al. High-intensity focused ultrasound for the reduction of subcutaneous adipose tissue using multiple treatment techniques. *Dermatol Surg* 2014;*40*(6):641–651

[14] Schilling L, Saedi N, Weiss R. 1060 nm Diode hyperthermic laser lipolysis: the latest in non-invasive body contouring. *J Drugs Dermatol* 2017;*16*(1):48–52

[15] Solish N, Lin X, Axford-Gatley RA, Strangman NM, Kane M. A randomized, single-blind, postmarketing study of multiple energy levels of high-intensity focused ultrasound for noninvasive body sculpting. *Dermatol Surg* 2012;*38*(1):58–67