

Alvaro Cansanção
Alexandra Condé-Green
Editors

Gluteal Fat Augmentation

Best Practices in Brazilian Butt Lift

Gluteal Fat Augmentation

Alvaro Cansanção • Alexandra Condé-Green
Editors

Gluteal Fat Augmentation

Best Practices in Brazilian Butt Lift

Editors

Alvaro Cansanção
Hospital da Plástica
Rio de Janeiro
RJ
Brazil

Alexandra Condé-Green
Private Practice
Delray Beach
FL
USA

Private Practice
Boca Raton
FL
USA

ISBN 978-3-030-58944-8 ISBN 978-3-030-58945-5 (eBook)
<https://doi.org/10.1007/978-3-030-58945-5>

© Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To my wife Georgia and my children Davi and Isa whose love, sacrifices, understanding, and unselfish support have made editing and writing this book possible.

To my father, Dr. Alvaro Cansanção, for being a great example of character and professionalism, responsible for awakening in me the passion for plastic surgery. He has taught me everything I know, from how to hold a scalpel to the most refined plastic surgery techniques. Even today, 20 years after plastic surgery residency, I continue to learn from him daily in the operating room and it is a great honor to be practicing by his side.

Alvaro Cansanção

To my best friend and husband Joseph Louis Hogan whose love and unselfish support has made my academic and clinical work as a plastic surgeon possible for many years. To my daughter Anne-Isabelle Hogan for being patient, calm and an angel while I spend hours working at the office and even at home.

To my worldwide friends and colleagues in plastic surgery who have made me achieve so much more than I could have ever imagined by learning and listening to them, as so many have made remarkable contributions to our specialty.

Alexandra Condé-Green

Foreword

Gluteal augmentation through fat grafting, popularly known as the Brazilian Butt Lift or BBL, continues to gain in popularity and dare I say notoriety? Notoriety based on safety concerns related to massive fatal fat embolism. This work, including the words “best practices” in its title, is dedicated to patient safety, promoting best practices proven to reduce morbidity and mortality of this procedure which is increasingly sought after worldwide.

Despite safety concerns, demand for BBL has and will continue to grow. The International Society of Aesthetic Plastic Surgery’s (ISAPS) international survey on aesthetic/cosmetic procedures reported over 45,000 such procedures for 2018, while the American Society for Aesthetic Plastic Surgery (ASAPS) Cosmetic (Aesthetic) Surgery National Data Bank Statistics for 2018 included over 25,000 cases of BBL in the United States, representing a 15% growth in the procedure from 2017 and 86% growth between 2014 and 2018 [1].

I commend Dr. Conde Green and Dr. Cansanco for this timely publication dedicated to the science and art of such a surgical technique and most importantly to the safety of BBL. Both have contributed to our understanding of fat grafting and body contouring. They have assembled an international group of authors each recognized as an expert on gluteal reshaping. Each of these experienced author surgeons has contributed to the safety and evolution of the procedures described.

The book is divided into four parts. Part I covers history and the basics including anatomy, aesthetics, and most notably three chapters on the art and science of fat grafting. Part II, comprising the major portion of the book, is dedicated to surgical technique, which includes a variety of fat harvesting, fat preparation, and fat grafting techniques. Parts III and IV are dedicated to alternate and ancillary procedures.

Each chapter is comprehensibly and beautifully illustrated with art work and clinical images outlining details of each technique, how to avoid pitfalls and complications including massive fat embolism. Clinical pre- and post-op images demonstrate the effectiveness of each technique.

This is a comprehensive work covering all aspects of buttock shaping which will be of great value not only to the novice just embarking on buttock contouring but also to the seasoned surgeon who will find valuable information to enhance results, reduce complications, and improve safety.

Foad Nahai, MD, FACS, FRCS (Hon)

Reference

1. The American Society for Aesthetic Plastic Surgery’s Cosmetic Surgery National Data Bank: statistics 2018. *Aesthet Surg J.* 2019;39(Suppl_4):1–27.

Preface

This book was written in order to inform and educate plastic surgeons who wish to perform gluteal fat augmentation in a safe manner, obtaining great long-term results. Even though gluteal fat augmentation has been performed since the early 1980s, it was somewhat marginalized. Thirty years later, the increase in demand and the popularity of the procedure have made it a hot topic in plastic surgery.

We first started to perform this procedure during our plastic surgery residency in Rio de Janeiro, Brazil, in the 2000s. There were two books on the subject at the time: *Buttocks Reshaping* from Raul Gonzalez and *The Art of Gluteal Sculpting* from Constantino Mendieta. However, these books described the personal techniques of each of these editors.

When Springer proposed to us to write this book because of our course at the annual meeting of the American Society of Plastic Surgeons, Plastic Surgery The Meeting, and our Best Cosmetic Surgery article awarded by *Plastic and Reconstructive Surgery* journal, we thought it would be interesting to not only show our concepts of gluteal fat augmentation but also share the techniques of several world-renowned plastic surgeons, so that the reader can appreciate the different techniques and apply the best to their practice and to their patients.

The book was carefully planned as we invited the masters of gluteal surgery from North America, Central America, South America, Europe, and Asia to share their extensive clinical and scientific experience. We are honored and grateful that the vast majority agreed to participate and contribute to our book.

The book contains 35 chapters divided into 4 parts: the basic concepts of gluteal fat grafting, the description of the procedure per se, other surgical techniques available for the treatment of the gluteal region, and ancillary techniques that can greatly improve the results of the procedure when used in conjunction with gluteoplasty.

This book was harder to write than we had imagined, especially with all the changes that came along since we started to write it: the cases of death from fat embolism, the identifying cause being intramuscular gluteal fat grafting that many plastic surgeons were doing previously; the statistics showing at some point that it was the plastic surgery procedure with the highest mortality rate; and the guidelines and restrictions to only inject fat in the subcutaneous plane. We were writing about a hot topic when all the concepts of this procedure were changing. Therefore, many chapters had to be rewritten and the information constantly updated. It took us more than 2 years to collect all the information and follow the new guidelines of the procedure. After all, we are offering our readers from around the world the most updated and current information in gluteal surgery, especially in gluteal fat augmentation. We hope to contribute to making gluteal fat augmentation a safer procedure, as education, dissemination, and sharing of knowledge are the best ways to increase patient safety, so that more plastic surgeons can perform the procedure safely with great long-lasting results.

Boa leitura – Bonne lecture

Rio de Janeiro, RJ, Brazil
Boca Raton, FL, USA

Alvaro Cansanção
Alexandra Condé-Green

Contents

Part I Basics of Gluteal Fat Grafting

- 1 History of Gluteal Fat Grafting** 3
Jose Abel de la Peña Salcedo and Guillermo J. Gallardo
- 2 Biology of Adipose Tissue** 9
Guy Magalon and Jeremy Magalon
- 3 Stromal Vascular Fraction Enriched Fat Grafting** 15
Katarina Andjelkov and Ramon Llull
- 4 Cryopreservation of Fat Grafts for Future Clinical Applications** 21
Shaili Gal and Lee L. Q. Pu
- 5 Anatomy of the Gluteal Region Applied to the Brazilian Butt Lift** 29
Alvaro Cansanção, Alexandra Condé-Green, and Mauricio S. S. Viaro
- 6 Aesthetics of the Gluteal Region** 37
Aditya Sood, Samuel Kogan, and Robert F. Centeno

Part II Surgical Techniques of Gluteal Fat Augmentation

- 7 Strategy and Planning of Gluteal Reshaping** 47
Alvaro Cansanção and Alexandra Condé-Green
- 8 Liposuction: Clinical Management and Safety Protocol** 57
Alvaro Cansanção, Alexandra Condé-Green, Joshua A. David, and Bianca Ohana
- 9 Anesthesia for Liposuction and Gluteal Fat Grafting** 65
Marco Antonio Garambone Filho and Vanessa Leao Pedrozo Rajo
- 10 Clinical Principles of Autologous Fat Grafting** 69
Murillo Fraga, Bernardo Nogueira Batista, and Marcelo Sampaio
- 11 Liposuction Techniques** 73
Bárbara Helena Barcaro Machado
- 12 Fat Processing Techniques Used for Gluteal Fat Augmentation** 79
Pietro Gentile
- 13 Three Decades of Brazilian Buttock Lift** 83
Luiz S. Toledo
- 14 Strategy and Planning of Gluteal Augmentation with Lipotransfer** 91
Luiz Charles-de-Sá and Natale Ferreira Gontijo-de-Amorim

15	Gluteal Fat Augmentation with Vacuum-Assisted Liposuction	99
	Rodrigo G. Rosique and Marina J. F. Rosique	
16	Gluteal Fat Augmentation with Power-Assisted Liposuction	107
	Marwan H. Abboud, Hiba El Hajj, and Nicolas M. Abboud	
17	Gluteal Augmentation with Stromal Vascular Fraction-Enriched Fat	113
	Luiz Haroldo Pereira, Beatriz Nicaretta, and Aris Sterodimas	
18	Gluteal Fat Injection Standardization: The Gluteal Codes	119
	Alvaro Cansanção, Alexandra Condé-Green, Rafael A. Vidigal, and André Cervantes	
19	Ultrasound-Assisted Gluteal Fat Grafting	129
	Alvaro Cansanção, Alexandra Condé-Green, and Rafael A. Vidigal	
20	Postoperative Evaluation of Gluteal Fat Augmentation	135
	Eric Swanson	
 Part III Other Gluteal Augmentation Techniques		
21	Mortality Following Gluteal Fat Augmentation: Physiopathology of Fat Embolism	145
	Lázaro Cárdenas-Camarena, Héctor César Durán-Vega, Guillermo Ramos-Gallardo, and Jorge Enrique Bayter-Marin	
22	Complications of Gluteal Fat Augmentation	151
	Guillermo Ramos-Gallardo, Héctor César Durán-Vega, and Lázaro Cárdenas-Camarena	
23	Safety in Gluteal Fat Augmentation	157
	Alvaro Cansanção, Alexandra Condé-Green, and Amin Kalaaji	
24	Liposuction for High-Definition Gluteal Contour	161
	Alfredo Hoyos, David E. Guarin, and Mauricio Pérez	
25	Gluteal Augmentation with Implants	167
	Fernando Serra-Guimarães, Joao Henrique Spagolla Pontello, and José Horácio Aboudib	
26	Composite Gluteal Augmentation: Implant + Fat Grafting: Getting the Best of Both Worlds	175
	Héctor César Durán-Vega	
27	Gluteal Lift	181
	Michele A. Shermak	
28	Gluteal Augmentation with Injectable Fillers	191
	Denis Souto Valente	
29	Male Gluteal Augmentation with BodyBanking Lipocell Transfer and Silicone Implant	199
	Douglas S. Steinbrech and Eduardo Gonzalez	
30	Gluteal Augmentation in Patients with Lipodystrophy Due to the Use of Antiretroviral Therapy	213
	Eliane Hwang and Mario J. Warde Filho	
31	Gluteal Augmentation in Post-Massive Weight Loss Patients	223
	Flavio Henrique Mendes and Fausto Viterbo	

32	Nonaesthetic Gluteal Deformities	239
	Lydia Masako Ferreira and Felipe Contoli Isoldi	
33	Managing Complications of Non-approved Fillers	243
	Denis Souto Valente and José Ricardo Simões	
Part IV Ancillary Procedures for the Gluteal Region		
34	Subcision® for the Treatment of Cellulite	251
	Doris Hexsel, Taciana Dal’Forno Dini, and Camile L. Hexsel	
35	Management of Stretch Marks with Pigment Structuration	259
	Ana Paula Camargo Ferreira	
	Index	265

Contributors

Marwan H. Abboud Department of Plastic and Reconstructive Surgery, CHU Tivoli, Brussels, Belgium

Nicolas M. Abboud Department of Plastic and Reconstructive Surgery, CHU Tivoli, Brussels, Belgium

José Horácio Aboudib Departamento de Cirurgia da UERJ (Universidade do Estado do Rio de Janeiro), Hupe – Hospital Universitário Pedro Ernesto, Rio de Janeiro, RJ, Brazil

Katarina Andjelkov Department of Plastic Surgery, University of Belgrade, Belgrade Medical School and BelPrime Clinic, Belgrade, Serbia

Bernardo Nogueira Batista Department of Plastic Surgery, Hospital Sírio-Libanês, São Paulo, Brazil

Jorge Enrique Bayter-Marin Private Practice, Bucramanga, Colombia

Alvaro Cansanção Hospital da Plástica, Rio de Janeiro, RJ, Brazil

Lázaro Cárdenas-Camarena INNOVARE, Specialized Plastic Surgery, Division of Plastic Surgery at the Jalisco Institute of Reconstructive Surgery Dr. José Guerrerosantos, Zapopan, Jalisco, Mexico

Robert F. Centeno Columbus Institute of Plastic Surgery/The Ohio State University, Columbus, OH, USA

André Cervantes Private Practice, São Paulo, SP, Brazil

Luiz Charles-de-Sá Department of Plastic, Reconstructive and Aesthetic Surgery, Estate University of Rio de Janeiro – UERJ, Rio de Janeiro, Brazil

Alexandra Condé-Green Private Practice, Delray Beach, FL, USA
Private Practice, Boca Raton, FL, USA

Taciana Dal’Forno Dini Cosmetic Dermatology in the Dermatology Residence Program of Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, RS, Brazil
Department of Laser and Technologies, Brazilian Society of Dermatology, Rio de Janeiro, Brazil

Joshua A. David Department of Plastic Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Jose Abel de la Peña Salcedo Hospital Ángeles Lomas, Instituto De Cirugía Plástica, Huixquilucan, MX, Mexico

Héctor César Durán-Vega Private Practice, Merida, Yucatan, Mexico

Hiba El Hajj Department of Plastic and Reconstructive Surgery, CHU Tivoli, Brussels, Belgium

Ana Paula Camargo Ferreira Pigment Structuration in Breast Reconstruction, Hospital Sirio Libanes, Jundial, SP, Brazil

Lydia Masako Ferreira Universidade Federal de Sao Paulo, Department of Surgery, São Paulo, SP, Brazil

Marco Antonio Garambone Filho Department of Anesthesiology, Plastic Hospital of Rio de Janeiro, Rio de Janeiro, Brazil

Murillo Fraga Department of Plastic Surgery, Hospital Sírío-Libanês, São Paulo, Brazil

Guillermo J. Gallardo Hospital Ángeles Lomas, Instituto De Cirugía Plástica, Huixquilucan, MX, Mexico

Shaili Gal Division of Plastic Surgery, University of California Davis Medical Center, Sacramento, CA, USA

Pietro Gentile Department of Biomedicine and Prevention, University of Rome, Tor Vergata, Rome, Italy

Natale Ferreira Gontijo-de-Amorim Plastic Surgery, Verona University-Italia, Verone, Italy

Eduardo Gonzalez Hansjörg Wyss Department of Plastic Surgery, New York University, New York, NY, USA

Raul Gonzalez, MD Clinica Raul Gonzalez, Ribeirão Preto, SP, Brazil

David E. Guarin Plastic and Reconstructive Surgery, Hospital Universitario del Valle/ Universidad Del Valle, Cali, Colombia

Camile L. Hexsel Department of Mohs Surgery, Madison Medical Affiliates, Glendale, WI, USA

Medical College of Wisconsin, Milwaukee, WI, USA

Brazilian Center for Studies in Dermatology, Porto, Alegre, Brazil

Doris Hexsel Brazilian Center for Studies in Dermatology, Hexsel Dermatologic Clinics, Porto Alegre, RS, Brazil

Alfredo Hoyos Private Practice, Bogotá, Colombia

Eliane Hwang Hospital Heliopolis-Sao Paulo, Department of Plastic Surgery, Sao Paulo, SP, Brazil

Felipe Contoli Isoldi Surgery Department, Translational Surgery Graduate Program, Plastic Surgery Division, Universidade Federal de São Paulo – UNIFESP, São Paulo, SP, Brazil

Amin Kalaaji Oslo Plastic Surgery Clinic, Oslo, Norway

Samuel Kogan Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, USA

Ramon Llull Department of Plastic and Reconstructive Surgery, Hospital Quironsalud Palmaplanas/Plastica Mallorca, Palma De Mallorca, Spain

Bárbara Helena Barcaro Machado Department of Plastic Surgery, Ivo Pitanguy Institute, Rio de Janeiro, Brazil

Guy Magalon Department of Plastic Surgery, Aix-Marseille University, Marseille, France

Jeremy Magalon Department of Cell Therapy, Hopital de la Conception, Marseille, France

Flavio Henrique Mendes Plastic Surgery Division, Botucatu Medical School Paulista State University, São Paulo, SP, Brazil

- Beatriz Nicaretta** Department of Plastic and Reconstructive Surgery, Metropolitan General Hospital, Athens, Greece
- Bianca Ohana** Department of Plastic and Reconstructive Surgery, Hospital Barata Ribeiro, Rio de Janeiro, RJ, Brazil
- Luiz Haroldo Pereira** Department of Plastic Surgery, Luiz Haroldo Clinic, Rio de Janeiro, Brazil
- Mauricio Pérez** Plastic Surgery, Private Practice, Jackson Heights, NY, USA
- Joao Henrique Spagolla Pontello** Private Practice, Maringa, PR, Brazil
- Lee L. Q. Pu** Division of Plastic Surgery, University of California Davis Medical Center, Sacramento, CA, USA
- Vanessa Leao Pedrozo Rajo** Department of Plastic Surgery, Hospital da Plástica, Rio de Janeiro, Brazil
- Guillermo Ramos-Gallardo** School of Medicine, Universidad de Guadalajara, Centro Universitario de la Costa, Puerto Vallarta, Jalisco, Mexico
- Marina J. F. Rosique** Department of Plastic Surgery, Junqueira Rosique Plastic Surgery, Ribeirão Preto, Brazil
- Rodrigo G. Rosique** Ribeirão Preto, Brazil
- Marcelo Sampaio** Department of Plastic Surgery, Hospital Sírio-Libanês, São Paulo, Brazil
- Fernando Serra-Guimarães** Pedro Ernesto University Hospital/University of Rio de Janeiro State, Plastic Surgery Division, Rio de Janeiro, RJ, Brazil
- Michele A. Shermak** Johns Hopkins Department of Plastic Surgery, Lutherville, MD, USA
- José Ricardo Simões, MD** Department of Plastic Surgery, Private Practice, Rio de Janeiro, RJ, Brazil
- Aditya Sood** Private Practice, Chicago, IL, USA
- Douglas S. Steinbrech** Gotham Plastic Surgery, New York, NY, USA
- Aris Sterodimas** Department of Plastic and Reconstructive Surgery, Metropolitan General Hospital, Athens, Greece
- Eric Swanson** Private Practice, Swanson Center, Leawood, KS, USA
- Luiz S. Toledo** Hospital Saint Louis, Lisbon, Portugal
- Denis Souto Valente, MD, PhD** Pontifical University Catholic of Rio Grande do Sul, School of Medicine, Graduate Program in Medicine and Health Sciences, Porto Alegre, RS, Brazil
- Mauricio S. S. Viaro** Private Practice, Santa Maria, RS, Brazil
- Rafael A. Vidigal** Hospital da Plástica, Rio de Janeiro, RJ, Brazil
- Fausto Viterbo** Plastic Surgery Division, Botucatu Medical School Paulista State University, São Paulo, SP, Brazil
- Mario J. Warde Filho** Department of Plastic Surgery, Instituto de Infectologia Emilio Ribas, São Paulo, SP, Brazil

Introduction

Gluteal Augmentation and Buttocks Reshaping: Two Different Concepts

Buttocks reshaping and gluteal augmentation are two slightly different concepts. The difference became apparent as gluteal contour surgery evolved. Reshaping aims at projecting the buttocks and making it rounder to achieve a nicer and more sensual shape that is in harmony with the rest of the body. For reshaping, some volume is added to selected areas of the buttocks that need more volume, or adipose tissue is removed from other areas such as the lower pole or close to the gluteal cleft, or large size buttocks can be reduced overall. It is, in principle, a very broad concept.

Augmentation is performed mostly to increase the volume of the current size of the gluteal region, based on the patient's request, without compromising the aesthetic aspect. It is of utmost importance to understand that it is not possible to use large filling volumes without losing the shape of selected areas of the buttocks. Also, when increasing the volume of the buttocks, the fine shape may be lost and the harmonious contour compromised.

Gluteal Augmentation or Reshaping? Or Gluteal Augmentation and Reshaping?

The indication of the procedure is based on the understanding of what the patient is looking for and what he or she is expecting. Asking them to bring pictures of gluteal contour that they like helps us understand what they want and which profile suits them best.

Many patients, especially Brazilians, are looking more for nicely shaped and contoured buttocks rather than for large sized buttocks. Small increases in selected areas, such as the trochanteric and ischiatic depressions, the superior aspect of the buttocks, will give the aspect of a lifted buttock. Patients who have lost projection due to sedentary life are looking to retrieve the shape that they had when they were young, and for those patients, selective reshaping or perhaps smaller gluteal implants may be preferred options instead of increasing the size of the buttocks.

Patients who are looking for a large increase in volume are usually more straightforward about what they want and most of the time they bring along pictures of their favorite models. Some of them are hard to please because they have high expectations and are often disappointed when the results fall short of what they had requested.

It is important not to confuse those two types of profiles and to identify exactly what patients are looking for. Successful indications and the right candidate result from clearly understanding those two different concepts.

Did Brazilian Surgeons Start Gluteal Contour Surgery by Reshaping or Augmenting the Buttocks?

Buttocks surgery started in the late 1980s and early 1990s in Brazil and Latin America. The first cases of fat grafting to the buttocks aimed at molding the buttocks were described in 1986, by this author, and were already popular in Brazil in the late 1990s. Raul Gonzalez, the pioneer, soon followed by Sergio Toledo, Paulo Matsudo, Luis Haroldo Pereira, Sergio Levy, and others were paramount in imparting fat grafting, first in Brazil and then abroad.

Brazilian surgeons very quickly adopted fat grafting as a procedure for *RESHAPING* the buttocks. At first, small volumes of fat were used by most surgeons (150–300 ml) especially in the trochanteric depression and on the superior aspect of the buttocks, where most patients need some filling to correct depressions and give the effect of a higher buttock. These volumes of fat are small when compared to those described in “*Brazilian Butt Lift*” (*BBL*), clearly an *AUGMENTATION* procedure, especially by American authors. After several years, Brazilian surgeons also started transferring larger volumes of fat to the buttocks, although most do not exceed 500 ml per side.

Why Has the Brazilian Fat Grafting Reshaping Technique Been Successful?

The procedure’s success and popularity are based on two pillars: safety and good aesthetic outcomes. The fact that most Brazilian plastic surgeons inject fat in the subcutaneous layer, which is less vascularized than the muscular layer, has improved safety. When fat is injected in the intramuscular plane, it is placed in the superior aspect, the middle and thicker part of the muscle and not the lower aspect of the muscle and the tendinous part where it adheres to the sacrum. Injecting fat in these latter areas have a higher risk of injuring the gluteal vessels. This method of taking “*volume*” and “*area*” into account led to a low rate of complications of any nature such as infection, fat embolism, fibrosis, and retractions. As for the aesthetic results, experience has shown that using less volume in well-selected areas is more effective and achieves greater outcomes.

Creating a Market for Gluteal Reshaping in Brazil

One of the reasons why gluteal fat grafting became popular was the simplicity and the safety of the procedure, surgeons promptly began to offer it to patients who wished to have liposuction, as a means of “taking advantage of” and “reusing” the lipoaspirate to reshape the buttocks. Back in the mid-1990s, people assimilated this procedure as an “extra” advantage and part of the benefits of liposuction. This increased the demand for liposuction, since many patients knew that reshaping would be included “in the package” and it was easier for women who wished to have some improvement of the shape of their buttocks to take the decision to go forward with the procedure. To this date, the number of gluteal reshaping procedures with fat grafting is larger among patients whose main purpose is liposuction, but who are also looking for the reshaping that comes along with it, rather than the number of patients who specifically seek plastic surgeons to increase the size of their buttocks.

While buttocks reshaping with fat grafting grew in popularity, the use of gluteal implants also evolved, somewhat slower because of its complexity. On the other hand, thanks to the understanding of plastic surgeons of the superiority of the intramuscular techniques of gluteal implant placement and the need to respect the anatomical landmarks (XYZ) to achieve good results, in the year 2000, many gluteal implants were used in Brazil and became increasingly popular over the years.

Brazilian Buttocks Lifting Is Not Brazilian

It can be said that the Brazilian Butt Lift, as the term is used in United States, is not Brazilian. It is not properly a lifting procedure, but more of an augmentation procedure than a reshaping procedure. The true Brazilian way to improve gluteal contour was and has continuously been essentially a reshaping procedure. The demand for this type of procedure is continuously growing in this direction. Obviously, the concern with size exists also in Brazil and some patients are interested in larger buttocks. However, the interest for the majority of patients seeking this procedure is a great contour and shape of their buttocks rather than larger ones. Having perky and round buttocks is the most important request from Brazilian patients. On the other hand, BBL is the result of a market created for women who are looking for large-sized buttocks and an outstanding hourglass figure.

The Limit Between Buttocks Reshaping and Buttocks Augmentation Is Narrow

Both aspects are equally important and must be part of the armamentarium of every plastic surgeon that performs this procedure. To respond to the requests of some patients, some plastic surgeons obstinately give patients an hourglass figure, sometimes disproportionate to the waistline and hip measures. In order to achieve these results, aggressive liposuction is performed and large volumes of fat are transferred to the buttocks. On the other hand, the reshaping procedure is a delicate and thoroughly planned procedure with nice and more natural changes. Finding a balance between the two is important. The globalization of gluteal contour procedures has led to a fusion of local trends and cultures of the patients, with the experience of plastic surgeons around the world, each adapting to local preferences in order to obtain great outcomes.

Reshaping with Gluteal Implants

The major advantage of implants is that one can achieve projection at the center of the buttocks. Gluteal fat grafting provides a more scattered projection, which is not always desirable, and, therefore, gluteal implants in some patients is the only way to achieve the required remodeling. Nevertheless, the chosen technique is paramount to avoid two common problems with gluteal implants: asymmetry and visibility of the implants. The plane that will be used is of utmost importance to avoid such problems. The subcutaneous plane has shown to be impractical and should not be used. The sub-fascial plane in thin patients with saggy skin might make the implants more visible when the gluteal muscle contracts. Undoubtedly the best plane for gluteal implants is intramuscular as it provides more coverage in order to conceal the implants. The placement of the implant inside the muscle, as in a sandwich, leaves equivalent parts of the muscle in front and behind the implant and helps it stay in place when the muscle contracts, equally distributing the pressure exerted by the muscle onto the implant. During the undermining and split of the muscle, if one area is thinner than the other (this often happens on the lateral aspect of the muscle), with time, the continuous pressure on the implant by contraction of the larger and stronger (deeper) parts of the muscle on the smaller and weaker (more superficial) parts leads to gradual surfacing or even herniation of the implant. A guided technique such as the XYZ can help avoid this problem.

The Role of the Buttocks in Body Contouring

The buttocks are the center of the posterior part of the body and play a significant role in the beauty and harmony of the body. Their role in the posterior part of the body is similar to the one played by the breasts in the anterior part. The projection and round shape are common characteristics to both breasts and buttocks and are feminine features, undoubtedly important in the attraction between sexes.

Sexual attraction in most mammals is highlighted by the sense of smell, but for men sight and touch are more important. This explains the attraction that the visual differences in the male and female bodies cause. Undeniably, female buttocks play a significant role in sexual attraction. The posterior view, which represents three fourths of the posterior profile, is an alluring feature that intrigues and attracts the male sex. For all these reasons, the interest in improving techniques to value the shape of the buttocks is more than justifiable, and body contouring surgery is increasingly including the buttocks in its armamentarium.

The First Steps for Body and Gluteal Contouring

Before 1980, the posterior part of the body was rarely addressed. Surgeries involving the posterior contour such as trochanteric gluteal lifting, belt lipectomy among others, left extensive scars that were not attractive to patients. The term “Body Contouring” was introduced by John R. Lewis in 1980. The following year, Ivo Pitanguy, Bahaman Temourian and Bradford Fischer in different publications also used the term “Body Contouring.” All the procedures described during that period were procedures that would address excess skin laxity and there were no appropriate procedures for small lipodystrophies which would result in minimal or shorter scars.

Liposuction Enters the Picture: The Body Contouring Dream Comes True

Liposuction was described in the early 1980s, and by the end of the decade, it was the most prevailing aesthetic surgical procedure in many countries. Liposuction of the trochanteric area performed in the prone position became popular, giving surgeons the power to act nearly on the whole posterior contour, not to say on the whole body. Concomitantly, patients became bolder in their requests, asking for liposuction in different parts of their body, including the posterior contour which expanded body surgery to a true “*Body contouring*.” Later on, coinciding with the advent of liposuction and driven by it, the term “*body contouring*” became popular and turned out to be a key word to define a set of changes achieved through surgery, almost like sculpture, to attain beauty and harmony of the whole body, both front and back.

The Synergistic Effect of Liposuction and Gluteal Augmentation

Liposuction plays an important role in gluteal contour surgery. To perform a procedure on the gluteal region without completely and thoroughly evaluating the patient as a whole, especially the rear view, is to disregard the significant relationship between the buttocks and the posterior contour as a whole. Thus, liposuction of the area surrounding the buttocks, reducing the waist line, the fat deposits on the hips, and the saddlebag, achieves a synergistic effect that increases the buttocks’ projection with much better results than simply augmenting the volume of the buttocks.

The Future of BBL and Gluteal Contour Surgery

The Brazilian Butt Lift opens new horizons on buttocks remodeling. All surgeons working with the body and the gluteal contour should learn the different methods, open their minds to these new concepts, and most of all understand the safety guidelines and use them. Nowadays, because of globalization, the preferences and beauty stereotypes created by social media are different and are influenced by race, culture, and many others factors. The concept of beauty is unique to each patient; therefore, plastic surgeons have to adapt to the different trends, and an individual approach needs to be used for each patient. These techniques helped broaden the reach of gluteal contour surgery and joined the other aesthetic procedures that are increasingly being carried out worldwide. Gluteal retractions, ptotic buttocks, extreme sagginess, and flat buttocks have now found a solution. BBL will not be the last procedure aiming at beautiful buttocks or to bring satisfaction to women and men in search of enhancing their body contour. Nevertheless, BBL is a recent, still evolving technique and it must be quickly taught to those who wish to use it.

At the right time, the editors of this magnificent book are conveying excellent information provided by an outstanding group of experienced plastic surgeons to guide the steps of those who wish to perform a great procedure with high rates of satisfaction while employing patient safety.

Clinica Raul Gonzalez
Ribeirão Preto, SP, Brazil

Raul Gonzalez, MD

Part I

Basics of Gluteal Fat Grafting

Jose Abel de la Peña Salcedo and Guillermo J. Gallardo

1.1 The Female Figure in Art

There is no universal ideal female figure for each culture. The concept of female beauty has evolved with time; however the form and size of the breasts and the gluteal region have remained constant symbols of maximum femininity. In Art, the origins of human aesthetics go back to antiquity. Sculptures, paintings, and drawings show feminine figures that are voluminous, often to the point of deformity, and reflect human history's interest in fertility. Among the oldest discoveries that allude to the ancient ideal of feminine beauty is a painting found near Oslo, Norway, that reproduces the figure of a woman being daubed with reindeer fat. The well-known Venus of Willendorf (Fig. 1.1) was discovered in Austria, and it is perhaps one of the first sculpted female forms. It is the most famous of the “stetopygic” (i.e., fat in the gluteal area) type of Venuses. The Venus of Grimaldi found in the French Blue Coast area—with her protuberant breasts, prominent stomach, and plump gluteal area—is a symbol of fertility. In ancient Egypt, the refinement of the aesthetic ideal for women led to the images of Nefertiti, the beautiful queen who gained mythic stature.

The perception of beauty from ancient Greece has influenced many cultures. The Greeks initiated the concept of female aesthetics that spread throughout Europe (Fig. 1.2), and their beauty standards did not tolerate accumulation of fat in the trunk, but rather in the gluteal area.

The Middle Ages were characterized by little to no expression of the human body and physical aesthetics in Art. With a burst of artistic activity and understanding of human aesthetics, the Renaissance period in Europe made beauty



Fig. 1.1 The Venus of Willendorf is perhaps the earliest female form sculpted in history that still survives. (From: De la Peña de et al. [1])—Fig. 1)

J. A. de la Peña Salcedo (✉) · G. J. Gallardo
Hospital Ángeles Lomas, Instituto De Cirugía Plástica,
Huixquilucan, MX, Mexico
e-mail: doc@institutodecirugiaplastica.mx; ggallardo@institutodecirugiaplastica.mx



Fig. 1.2 The Venus de Milo (or Aphrodite of Melos) represents the ultimate beauty among the ancient Greeks. Although excess fat in the waist and trunk was not tolerated, we get a sense of plump buttocks beneath her drape. (Original collection of pictures from Alexandra Condé-Green, Le Louvre, Paris 2018)

embrace everything and be embraced by everyone. A clear example that the standards of beauty vary with the epoch and culture is the small feet held as a characteristic of feminine beauty by the Chinese, which would never appeal the eyes of an African. Instead, steatopygia and a narrow neck have been ideals in the model of beauty of many African cultures. Even with such differences within and between cultures, studies have demonstrated the presence of certain similar patterns of what humans find physically appealing, which could suggest universality for the appreciation of an aesthetic ideal. The standards of harmony, balance, and proportion have been used by artists, philosophers, and mathematicians of Western cultures for at least 2500 years.

The plastic surgeon and the sculptor both work in three dimensions and are accustomed to perceiving three-dimensional figures with the purpose of “sculpting” forms, sizes, and planes that are well balanced and harmoniously proportioned. The analysis of human beauty—harmony, form, balance, symmetry, proportion, tension, movement, force, color, and mass—has been studied via lines, axes,

planes, and curves for centuries. In this day and age, we possess newer tools like holograms and radiology, combined with geometric, mathematical, and logarithmic models, as well as knowledge of the physiology and psychology of vision and perception. Such tools give us more resources for quantifying the aesthetics of the human form as our patients seek more harmonious proportions [1].

1.2 History of Gluteal Augmentation

Women innately understand the necessity of balance between the volume and the form of the thorax, breasts, waist, hips, and buttocks. Modification of the body to achieve balance and improve an individual’s physical image may be accomplished by a number of methods, such as clothing, hairstyle, makeup, exercise, and surgery. The perception of the aesthetic ideal is undoubtedly influenced by trends in the mainstream media and marketing. Our modern lifestyle demands a harmonious figure from everyone so keenly that a lack of balance in proportions could have undesirable deleterious psychological implications, and its restoration can improve self-perception and self-confidence. However, judgement of harmony, beauty, and proportion is dictated by human perception [2].

Throughout history, special focus has been given to the female buttocks and breasts, which have served as a source of inspiration to many artistic disciplines: literature, painting, sculpture, and dance, among other expressions of the human form. In earlier times and different cultures, the concept of beauty of the gluteal region often involved a disproportionately large volume that—to our modern eyes—is now regarded as a lack of balance between the trunk and the extremities. It probably violates the golden ratio. Our current ideal of the female buttocks is composed of a small waist and an appealing buttock posterior projection, with a proportionate width. This is the exact opposite of the pre-Columbian beauty concept, which valued a large buttock width and small posterior projection. Today, we greatly prefer an athletic build, where the gluteal silhouette acquires a firm and round form that is in balance with the rest of the body.

Today’s body-contouring surgery is directed at improvement of the aesthetic characteristics of the extremities, breasts, abdomen, flanks, upper and lower back, and gluteal region. The different procedures available for contouring these regions include augmentation, reduction, fixation and lifting (pexy), and skin resection. For cases of lipodystrophy or gluteal ptosis, the buttocks can be re-contoured in much the same way as the breasts, specifically augmenting or reducing the volume and lifting the skin and subcutaneous tissue.

Several factors have led not only to a dramatic increase in the number of patients seeking buttock enhancement but also to an increase in the volume they request:

- The greatest influence has been the media. With our increasing acceptance of cultural diversity, the popularity of Latina star Jennifer Lopez, African American singer Beyonce, and tennis star Serena Williams, these celebrities' ample derrières have become the goal of many young women of all ethnic groups. These are among the most frequent photographs that patients bring in to illustrate the buttocks' shape they would like.
- Clothing styles: Low-cut jeans and bare midriffs call attention to the buttocks. Thong style underwear and bathing suits have increased in popularity; they uniquely expose and draw attention to the "gluteal aesthetic unit."
- The widespread circulation of upscale intimate apparel catalogs and the appearance of the bare or almost-bare buttocks in the popular media and advertising industry use models with a flawless gluteal shape.
- The Internet: By simply typing in a phrase such as "buttock augmentation," a wealth of information is available (and misinformation) on various types of surgeries and patients' descriptions of their own experiences.
- An early influence was the exercise/physical fitness movements, which called attention to the development and shaping of the buttocks. A tight-fitting attire with compression technologies has kept the gym as a main gathering place for those trying to tone up their gluteal muscles.
- The gradually increasing awareness by today's society that buttock augmentation using the patient's own fat is possible bypasses concerns about foreign implant material. The huge surge of "reality" television shows on plastic surgery has been a prime factor here.

1.3 Gluteal Augmentation with Alloplastic Implants

Gluteal augmentation in clinical practice began with Bartels and colleagues [3] in 1969 to correct asymmetry caused by atrophy of the left gluteal muscle with a Cronin-style breast implant. The implant was inserted through the infragluteal fold with an impressive aesthetic result.

Four years later, in 1973, Cocke and Ricketson [4] used breast implants in the subcutaneous plane to correct lateral gluteal depressions. Dacron patches were initially placed on the base of these implants for better fixation, but other implants such as the Lise style were also used. Still, aesthetic results with these alloplastic implants did not achieve

the best contouring of the buttocks. In 1977, González-Ulloa [5] designed an anatomic gluteal implant with fixation extensions to correct hypotrophic and ptotic buttocks. He also described placement of the implant in the subcutaneous plane; the supragluteal incision from both sides of the coccyx, which has thinner fatty tissue; the infragluteal fold incision, which facilitates drainage and helps hide the scars; and the intergluteal crease incision to avoid evident scars. Subcutaneous placement of gluteal implants has serious disadvantages, which were learned over time. The aponeurotic expansions that fix the skin to the deep tissues are incised, which lead to skin laxity; therefore, implants are prone to migration over time. In addition, the implants usually are more visible due to a lack of thickness in tissue coverage, and the complications include implant exposure, infection, and inferior displacement.

The second generation of implants had Dacron fixation patches at their base intended to keep the implants properly positioned postoperatively; however, implant migration still occurred. The next generation of implants was designed with an area that could be sutured to the deep tissues, similar to the 1977 implant description of González-Ulloa, but the results obtained did not look natural, and the implants were still visible. Because of all of these complications, this plane is rarely used today [5].

In 1984, Robles et al. [6], from Argentina, described placement of gluteal implants in a submuscular pocket beneath the gluteus maximus and medius muscles. Hidalgo presented his submuscular modification of the Robles' technique in 1992 along with the use of solid round elastomer gluteal implants [7]. This plane preserves the aponeurotic system of fixation between the skin and deep tissues and has the advantage of reducing capsular contracture. The submuscular position, however, has the disadvantage of being a small space limiting the use of large implants and carries the potential risk of impinging the sciatic nerve that emerges near the area of pocket dissection just below the inferior border of the piriformis muscle. Consequently, implants should not be placed below this level.

In 1996, Vergara and Marcos [8] described the placement of gluteal implants in an intramuscular space. The incision is made in the intergluteal cleft, the gluteus maximus aponeurosis is identified, and the muscle fibers are then separated to create a pocket. The pocket should be padded with 2–3 cm muscle thickness beneath the superior gluteal aponeurosis. Vergara also designed his own almond-shaped implants.

The reported advantages of this intramuscular position include avoidance of dissection around the sciatic nerve, coverage of the implant with a thick layer of muscle that maintains the implant in position, and prevention of ptosis and skin irregularities. The primary complication is seroma, which develops because of the extensive disruption of muscle

fibers. Another disadvantage is the difficulty of knowing the precise thickness of the muscle overlying the implant. Since there still is debate on which plane is best for implant placement to create a reproducible intermuscular geometric plane, González published his XYZ method for augmentation gluteoplasty, which is a more precise dissection. The following three points, X (an imaginary point that corresponds to half the thickness of the gluteus maximus muscle at the level of its incision site), Y (an imaginary point within the gluteus maximus at its superior origin attachment, normally on the iliac crest 4–5 cm lateral to the posterior superior iliac spine), and Z (an imaginary point within the gluteus maximus muscle where it covers the trochanter), form a triangular plane which delimits a safe zone for implant placement [9].

As surgeons strived for better results, different anatomical planes for implant placement were developed, i.e., the subcutaneous, submuscular, intramuscular, and subfascial planes; but little was published. Also, gluteal implant design evolved similarly to that of breast implants to include anatomical shapes and textured shells. Gluteal implants are currently designed specifically for the gluteal region and come in round, oval, and anatomical shapes with a variety of dimensions, textures, densities, and profiles. They can be filled with cohesive silicone gel or made from a soft solid silicone elastomer to prevent silicone extravasation in case of rupture.

At the 1995 International Society of Aesthetic Plastic Surgery (ISAPS) meeting in New York, the primary author, from Mexico, described the subfascial plane for gluteal augmentation with implants in order to solve the complications and difficulties found in the subcutaneous, submuscular, and intramuscular planes (Fig. 1.3). He also developed a system for gluteal augmentation that included templates,

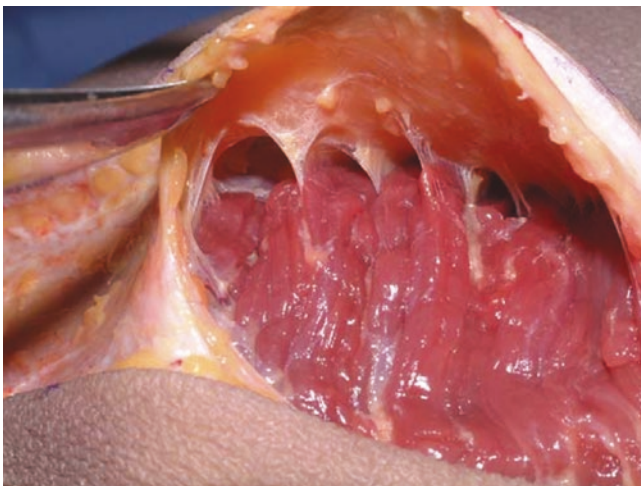


Fig. 1.3 The subfascial plane developed by De la Peña. The aponeurotic expansions are visible in this image. (From de la Peña [10]—Fig. 23)

sizers, and an anatomically shaped implant designed specifically for subfascial placement. His experience was originally published in 2004 [10]. Through diverse preoperative care and postoperative follow-up instructions, and surgical technique modifications, the complication rate has dropped dramatically.

In 2019, the first case of gluteal implant-associated anaplastic large cell lymphoma (GIA-ALCL) was published. This is an alert to physicians and patients alike, but definitive information is still lacking, and further investigation is warranted [11].

1.4 Gluteal Augmentation with Autologous Adipose Tissue

The history of fat tissue transfer or fat grafting to the buttocks is intermingled with the attempt to extract fat tissue from the body, and, therefore, the beginning of body sculpting through liposculpture. It appears that fat transplantation was first reported by Neuber [12] in 1893, followed by reports by Czerny [13], Lexer [14], and Rehn [15]. In 1911, Bruning [16] was the first to inject autologous fat into the subcutaneous tissue for the purpose of soft-tissue augmentation. Still, Charles Dujarrier, a French general surgeon and Chief of the Department of Surgery at Saint Antoine Hospital, performed the first recorded attempt to remove subcutaneous fat through a small incision in 1921. The procedure practiced on the dancer Folies Bergère resulted in necrosis and amputation, which culminated in the first lawsuit in the history of plastic surgery [17].

Adipose tissue extraction by curettage was carried out by the German physician Joseph Schrudde. He reported on practicing “lipexheresis” at the 1972 meeting of ISAPS in Brazil, which he then published in 1980 [18]. Arpad and George Fisher were pioneers in incorporating suction for adipose tissue extraction in 1977 [19]. Unfortunately, the complication rate was high. That same year, Illouz reported the removal of a large lipoma with a blunt cannula preserving the neurovascular bundles and using a hypotonic solution to decreased blood loss. He presented his technique in 1980 at the Shirakabe Clinic in Osaka, Japan [20]. Hetter then described the addition of epinephrine to the infiltration solution in 1984 further reducing blood loss to 4–8% of the lipoaspirate [21]. Illouz’s technique is currently the most accepted liposuction method around the globe [22].

Brazilian plastic surgeons were introduced to liposuction by Illouz in 1980 and to liposculpture in 1983 by Fournier. Since then they began developing body sculpting with adipose tissue transfer. In 1984, Raul Gonzalez started to perform fat grafting to sculpt and augment the gluteal region, which he published in 1986, along with the development of the first sterile device to accumulate fat for transfer [23, 24]. He then started to use

intramuscular implants since he did not achieve the results he expected [25]. In 1985, Luiz Toledo started injecting larger quantities of fat to the face and body, up to 450 mL to each buttock. He revealed his 18-month experience in 218 patients at the ISAPS congress in New York City in 1987 and published the results 1 year later [26, 27]. Toledo had developed a gluteal augmentation technique, which consisted on liposuction of the flanks, abdomen, and thighs with fat injection to the buttocks and trochanteric regions. He was injecting up to 500 mL of fat to each buttock intramuscularly and subcutaneously. Fat absorption was estimated by clinical evaluation to be between 20% and 50% of the transferred volume [28].

In the 1990s, Chajchir et al. [29] published their experience with gluteal fat augmentation, and other important contributions to the art of gluteal shaping through liposculpture have come from Guerrero Santos [30], Cárdenas-Camarena et al. [31], Peren et al. [32], and Pedroza [33] who have reported injecting 100–300 cc of fat per buttock. Toledo [34] in 1991 published his “syringe liposculpture” technique where he described some cases of buttock augmentation. He then performed surgical demonstrations of his technique at the University of Southern California (USC) in 1995, and the results were transmitted 6 months later at the Teleplast video-conference in the USA [35]. Fat grafting to the buttocks was initially met with skepticism in part due to Peer’s theory of 50% cell survival rate [36], but slowly was adopted by the rest of the world.

In 2003, Mendieta published a classification of the gluteal shape which combined with Centeno’s 2006 classification of the gluteal aesthetic units changed the way plastic surgeons understood the shape, anatomy, and surgical goals of the procedure [37, 38] as gluteal fat augmentation became a three-dimensional body contouring technique and not merely a buttock augmentation procedure. It is uncertain when and who coined the term “Brazilian Butt-lift (BBL)” to describe this technique, as it has been popularized in the English-speaking world. It has been deemed a mere marketing strategy by a plastic surgeon in California, USA, in 2006 [39, 40], but claims to this are still debated.

BBL as a body contouring technique including a circumferential lipoplasty of the whole region continued its evolution through modifications of Mendieta’s technique [41]. Del Vecchio used “expansion vibration lipofilling” which decreased operating time and increased the volume of fat transferred to the gluteal region [42].

Gluteal fat augmentation was initially described to have the best outcome when fat was grafted into the intramuscular plane; unfortunately, an alarming number of complications arose, questioning this practice [43, 44]. This led to the establishment of recommendations from the multi-society gluteal fat grafting task force and other techniques in order to reduce the risks of related fat embolism [45–47].

Even with the changes in cultural perception, the advances in the analysis of gluteal aesthetics and the increased use of technology in everyday surgical practice have led to an increase in the amount of fat injected into the gluteal region, an overall shift toward safer infiltration planes, and improvements in patient selection and follow-up methods in order to achieve better long-term surgical outcomes.

Disclosure The authors have no financial interest in relation to the content of this article.

References

1. De la Peña de JA, Rubio OV, Cano JP, et al. History of gluteal augmentation. *Clin Plast Surg*. 2006;33:307–19.
2. Tolleth I. Harmony and proportion in the female form. In: Hetter GP, editor. *Lipoplasty: the theory and practice of blunt suction lipectomy*. 2nd ed. Boston: Little, Brown; 1990.
3. Bartels RJ, O’Malley JE, Douglas WM, et al. An unusual use of Cronin breast prosthesis. Case report. *Plast Reconstr Surg*. 1969;44:500.
4. Cocke WM, Ricketson G. Gluteal augmentation. *Plast Reconstr Surg*. 1973;52:93.
5. González-Ulloa M. Gluteoplasty: a ten year report. *Aesthet Plast Surg*. 1991;5:85–91.
6. Robles J, Tagliapietra J, Grandi M. Gluteoplastia de aumento: implante submuscular. *Cir Plast IberoLatinoamericana*. 1984;10:365–9.
7. Hidalgo JE. Submuscular gluteal augmentation: 17 years of experience with gel and elastomer silicone implants. *Clin Plast Surg*. 2006;33:435–47.
8. Vergara R, Marcos M. Intramuscular gluteal implants. *Aesthet Plast Surg*. 1996;20:259–62.
9. Gonzalez R. Augmentation gluteoplasty: the XYZ method. *Aesthet Plast Surg*. 2000;28:417–25.
10. De la Peña JA. Subfascial technique for gluteal augmentation. *Aesthet Surg J*. 2004;24:265–73.
11. Shauly O, Gould DJ, Siddiqi I, et al. The first reported case of gluteal implant-associated anaplastic large cell lymphoma (ALCL). *Aesthet Surg J*. 2019;39(7).
12. Neuber GA. Fettransplantation. *Verh Dtsch Ges Chir*. 1893;22:66.
13. Czerny A. Plastischer ersatz der brustdrose durch ein lipoma. *Chir Kongr Verhandl*. 1895;216:2.
14. Lexer E. Freire fettgewebstranplantation. *Dtsch Med Wochenschr*. 1910;36:46.
15. Rehn E. Die fettransplantation. *Arch Klin Chir*. 1912;98:1.
16. Bruning P [cited by Broeckaert TJ]. Contribution a l’étude des greffes adipeuses. *Buli Acad R Med Belg*. 1919;28:440.
17. Flynn TC, Coleman WP 2nd, Field LM, et al. History of liposuction. *Dermatol Surg*. 2000;26:515–20.
18. Schrudde J. Lipexeresis as a means of eliminating local adiposity. *Aesthet Plast Surg*. 1980;4:215.
19. Hetter GP, Fodor PB. Aspirative lipoplasty. In: Georgiade GS, Riefkohl R, Levin SL, editors. *Georgiade plastic, maxillofacial, and reconstructive surgery*. 3rd ed. Philadelphia: Williams & Wilkins; 1998. p. 685–703.
20. Illouz YG. Body contouring by lipolysis: a 5-year experience with over 3000 cases. *Plast Reconstr Surg*. 1983;72:591–7.
21. Hetter G, editor. *Lipoplasty: the theory and practice of blunt suction lipectomy*. Boston: Little, Brown & Co; 1984.

22. Newman J. Liposuction surgery: past-present-future. *Am J Cosmet Surg.* 1984;1:19–20.
23. Gonzalez R, Spina L. Grafting of fat obtained by liposuction. *Rev Bras Cir.* 1986;76:243.
24. Gonzalez R. Lipograft in the trochanteric depression. *Recent advances in plastic surgery.* São Paulo: Souza Pinto e Toledo; 1989. p. 192–8.
25. Gonzalez R. Augmentation gluteoplasty: the XYZ method. *Aesthet Plast Surg.* 2004;28:417–25.
26. Matsudo PK, Toledo LS. Experience of injected fat grafting. *Aesthet Plast Surg.* 1988;12:35–8.
27. Toledo LS. Gluteal augmentation with fat grafting the Brazilian buttock technique: 30 years' experience. *Clin Plast Surg.* 2015;42:253–61.
28. Toledo LS. Syringe liposculpture. *Clin Plast Surg.* 1996;23:683–93.
29. Chajchir A, Benzaquen I, Wexler E, et al. Fat injection. *Aesthet Plast Surg.* 1990;14:127–36.
30. Guerrerosantos J. Autologous fat grafting for body contouring. *Clin Plast Surg.* 1996;23:619–31.
31. Cárdenas-Camarena L, Lacouture AM, Tobar-Losada A. Combined gluteoplasty: liposuction and lipoinjection. *Plast Reconstr Surg.* 1999;104:1524–31; discussion 1532–3.
32. Perén PA, Gómez JB, Guerrerosantos J, et al. Gluteus augmentation with fat grafting. *Aesthet Plast Surg.* 2000;24:412–7.
33. Pedroza LV. Fat transplantation to the buttocks and legs for aesthetic enhancement or correction of deformities: long-term results of large volumes of fat transplant. *Dermatol Surg.* 2000;26:1145–9.
34. Toledo LS. Syringe liposculpture: a two-year experience. *Aesthet Plast Surg.* 1991;15:321–6.
35. Toledo LS. Syringe aspiration liposculpture, Tele-plast. *ASPRS/PSEF;* 1995.
36. Peer LA. Loss of weight and volume in human fat grafts: with postulation of a cell survival theory. *Plast Reconstr Surg.* 1950;5:217–30.
37. Mendieta CG. Gluteoplasty. *Aesthet Surg J.* 2003;23:441–55.
38. Centeno R. Gluteal aesthetic unit classification: a tool to improve outcomes in body contouring. *Aesthet Surg J.* 2006;26:200–8.
39. Chia CT, Theodorou SJ, Dayan E, et al. "Brazilian butt lift" under local anesthesia. *Plast Reconstr Surg.* 2018;142:1468.
40. Rhone N, Cox News Service. Society's singing a new tune: the derriere is where it's at. *Chicago Tribune.* July 5, 2006.
41. Mendieta C, Stuzin JM. Gluteal augmentation and enhancement of the female silhouette. *Plast Reconstr Surg.* 2018;141:306–11.
42. Del Vecchio D, Wall S. Expansion vibration lipofilling. *Plast Reconstr Surg.* 2018;141:639e–49e.
43. Cardenas-Camarena L, Bayter JE, Aguirre-Serrano H, et al. Deaths caused by gluteal lipoinjection: what are we doing wrong? *Plast Reconstr Surg.* 2015;136:58–66.
44. Condé-Green A, Kotamarti V, Nini KT, et al. Fat grafting for gluteal augmentation: a systematic review of the literature and meta-analysis. *Plast Reconstr Surg.* 2016;138:437e–46e.
45. Mofid MM, Teitelbaum S, Suissa D, et al. Report on mortality from gluteal fat grafting: recommendations from the ASERF task force. *Aesthet Surg J.* 2017;37:796–806.
46. Del Vecchio D. Common sense for the common good: staying subcutaneous during fat transplantation to the gluteal region. *Plast Reconstr Surg.* 2018;142:286–8.
47. Cansanco AL, Condé-Green A, Vidigal RA, et al. Real-time ultrasound-assisted gluteal fat augmentation. *Plast Reconstr Surg.* 2018;142:372–6.



Biology of Adipose Tissue

2

Guy Magalon and Jeremy Magalon

2.1 Adipose Tissue

2.1.1 Human Adipose Tissue

Adipose tissue, present in large quantity in mammals, is best known for surviving episodes of limited caloric intake by storing excess energy in the form of lipids during periods of abundance. Adipocytes, the main cells that make up adipose tissue, are the only cells that are specialized and perfectly adapted to accumulate lipids without compromising their functional integrity, due to their appropriate enzymatic machinery [1]. There are two types of adipose tissues that are fundamentally different in their distribution, function, and histology: brown adipose tissue and white adipose tissue.

Brown adipose tissue plays an important role in the regulation of thermogenesis, due to its large amount of uncoupling protein-1 (UCP-1) or thermogenin. This protein, located in the mitochondria's inner membrane, acts as a proton channel. It eliminates the potential difference in the membrane, thus preventing the production of adenosine triphosphate (ATP) by ATPase. The residual energy is then released as heat. The large amount of mitochondria in the cell may be responsible for its brownish color. The adipocytes that make up the brown adipose tissue contain an abundant cytoplasm with lipid droplets of various sizes and have a 30–40 μm diameter [1].

White adipose tissue is the predominant adipose tissue in mammals. It represents 9–18% of the body weight in healthy men and 14–28% in healthy women with a body mass index (BMI) of less than 25 kg/m^2 . It exceeds 22% in overweight men and 32% in overweight women. The distribution of white adipose tissue varies by species. In mammals,

it is mainly found in two layers: subcutaneous (abdominal, gluteal, and femoral) or visceral (mesenteric, omental, and retroperitoneal) (Fig. 2.1). Although white adipose tissue does not actively participate in thermogenesis, its insulating effect and its distribution throughout the body help conserve body heat. Although there are only subtle differences in gene expression, there are significant variations between the different white adipose tissue deposits in terms of their structure, composition, and metabolism, as well as their impact on the surrounding organs. For example, morphological studies reveal the presence of more blood vessels and nerve fibers in omental fat than in subcutaneous fat, suggesting greater metabolic activity in the latter.

2.1.2 The Adipocytes

Adipose tissue is a loose connective tissue composed of several cell types and extracellular matrix (ECM) composed of collagen fibers, among others. Mature adipocytes comprise one third of the adipose tissue. They are surrounded by an enriched vascularized stroma with several distinct cell populations, including nerve fibers, lymph nodes, immune cells (leucocytes and macrophages), pericytes, fibroblasts, and pre-adipocytes (undifferentiated fat cells). Adipocytes of white adipose tissue are differentiated cells that possess the cellular machinery necessary for lipid accumulation. Their size vary from 60 to 100 microns on average and can reach up to 120 microns in obese individuals. The lipid droplets contained in the cell represent 85–90% of the cell mass, repelling the other components of the cytosol (organelles, nucleus) at the periphery of the cell.

Adipogenesis consists of two main phases:

- The first phase, called determination, consists of the proliferation of adipose mesenchymal stem cells (MSCs) and their commitment to the adipocyte differentiation pathway to form adipocyte precursors (pre-adipocytes). The cell phenotype changes during this step and pre-adipocytes

G. Magalon (✉)
Department of Plastic Surgery, Aix-Marseille University,
Marseille, France

J. Magalon
Department of Cell Therapy, Hopital de la Conception,
Marseille, France
e-mail: Jeremy.magalon@ap-hm.fr