The Role of Fat Grafting in Buttock Augmentation

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Abstract

Autologous fat grafting is now considered the gold standard for buttock augmentation. Although a variety of techniques are currently being used by surgeons around the world, methods of fat grafting to the buttocks remain unsystematized, poorly understood, and controversial in terms of their safety and efficacy. Nonetheless, buttock augmentation by fat grafting has a satisfaction rate of 97.1%, and its mean complication rate has been estimated to be around 7 to 10%, with serious complications occurring in less than 1% of cases. Fat emboli are one such serious complication, with several reports in the literature discussing morbidity and mortality, specifically with intramuscular injection. With the increasing popularity of fat grafting for buttock augmentation, it is more important than ever to continue researching and learning to safeguard the satisfaction and safety of our patients.

Keywords

- fat grafting
- body contouring
- buttock augmentation

Fat grafting has become an increasingly popular procedure in recent years for soft tissue augmentation and volume replacement of various body features in both reconstructive and cosmetic settings. The procedure was initially used for facial rejuvenation until around 30 years ago, when it was first applied to body contouring, especially buttock augmentation.¹ First popularized in Brazil, fat grafting for buttock augmentation has slowly risen in popularity both internationally and within the United States. According to data published in 2018 by the American Society of Plastic Surgeons and the American Society for Aesthetic Plastic Surgery, the number of cases of gluteal augmentation with fat grafting has increased by 19% since 2017 and by 61% since 2014.^{2,3} Furthermore, 94% of buttock augmentation procedures in 2018 consisted of fat grafting rather than implant-based augmentation.³ Autologous fat grafting for buttock augmentation is now considered the gold standard.⁴

In 1987, Toledo presented one of the first studies investigating fat grafting in buttock augmentation in the United States.⁵ At the time, silicone implants were the only

accepted technique for buttock augmentation. The author was injecting up to 450 mL of fat into each buttock at a time when many surgeons were hesitant to inject more than 10 mL in one procedure.⁵ Unsurprisingly, he was heavily criticized over concerns for patient safety and aesthetic outcome following fat reabsorption. It was not until the 1990s that fat grafting would become widely popularized in body contouring, laying the foundation for its contemporary position as the standard of care within this field.^{1,5–7} Throughout this period of growth, many studies have been performed on the indications, techniques, results, and safety of fat grafting in body contouring and buttock augmentation. More recently, plastic surgeons have been reinvestigating the safety of fat grafting in buttock augmentation due to the feared risk of morbidity and mortality associated with fat emboli. With advances in research and paradigm shifts occurring quickly in this dynamic field, it is important for plastic surgeons to remain up to date with the newest information and the safest techniques for body contouring and buttock augmentation.

Indications

It has been described that an hourglass shape with a waist-to-hip ratio of approximately 0.7 is the optimally attractive figure for a woman.⁸ The waist-to-hip ratio is the measurement of the waist circumference at its narrowest compared with the measurement of the thigh circumference at the level of maximal gluteal projection.⁸ More recently, however, this “ideal ratio” may be evolving toward a more exaggerated ratio of 0.6 or 0.5, likely due to influences from the social media and celebrities. Fat grafting allows for contouring and reshaping of the buttocks and improvement of the overall body shape, with the simultaneous benefit of fat harvesting and donor-site contouring.⁹ The role of fat grafting in buttock augmentation is to augment and shape the buttocks in a way that cannot be accomplished with silicone implants, including the ability to attain more exaggerated waist-to-hip ratios, which have recently become popular.

Patient Selection

The most important first step of patient selection is a thorough history and physical examination, including personal or family histories of hematological coagulation disorders. According to the 2018 American Society for Aesthetic Plastic Surgery data, 99.2% of patients undergoing buttock augmentation with fat grafting were females, with 80% of patients between 18 and 50 years of age.³ While the majority of patients are able to undergo fat grafting for body contouring and buttock augmentation, the quality of results is determined by three main patient characteristics: fat presence, skin excess, and body shape.

The first characteristic is the presence of fat, which may be determined by body fat percentage and body mass index (BMI).⁷ Patients with a body fat percentage between 20 and 30% or a BMI between 20 and 30 kg/m² are the ideal candidates for fat grafting, as excess fat may be harvested and transferred to the buttocks, enhancing the overall contour.^{7,9} Patients with body fat percentages under 20% or a BMI under 20 kg/m² are not good candidates for this procedure, as the amount of available donor fat is insufficient to significantly augment their buttocks.^{1,7} Likewise, patients with body fat percentage over 30% or a BMI over 30 kg/m² generally have too much fat to make a significant difference in the shape and appearance of their buttocks, making them poor candidates for the procedure.⁷

The second characteristic is skin excess. Mendieta and Sood have described several categories of buttock ptosis, including no-ptosis classes A to C, in which there is no skin or volume below the infragluteal fold, but there may be deficiencies in volume in the lower buttocks (►Table 1). Grade I ptosis occurs when there is minimal skin and volume below the fold, typically with the infragluteal fold in a horizontal line. Grade II ptosis includes moderate skin and volume below the fold, with a more angular infragluteal fold moving inferomedially from the lateral thigh. Grade III ptosis has the most skin and volume below the fold, with significant skin laxity and a more angular infragluteal fold.¹⁰ The Mendieta and Sood classification is demonstrated in ►Fig. 1. Patients with no ptosis or

Table 1 The Mendieta and Sood buttock ptosis classification

Grade	Skin below IF	Volume below IF	IF shape	Ideal technique
No	None	None	Horizontal	Fat grafting
I	Minimal	Minimal	Horizontal, longer	Fat grafting
II	Moderate	Moderate	Angular	Skin excision
III	Significant	Significant	More angular, rolls of skin	Skin excision

Abbreviation: IF, infragluteal fold.

grade I ptosis are the most ideal candidates for fat grafting because the procedure will allow for the reshaping and lifting of the buttocks.⁷ Patients with moderate-to-severe skin excess, such as patients with grade II/III ptosis are less than ideal candidates, as fat grafting alone will be insufficient to lift and redrape the excess skin. Patients with high levels of skin excess, especially massive weight loss patients, may require additional skin excision procedures before attempting augmentation with fat grafting.⁷

The final characteristic is body shape. Body shapes do not necessarily preclude patients from undergoing fat grafting for buttock augmentation but instead limit the quality of the result and are an important factor to appropriately manage patients' expectations.⁹ One common buttock classification system includes shapes—A, V, square (H), and round—which are determined by the relationship between the upper lateral hip, lateral thigh, and lateral midbuttocks (►Fig. 2).^{9,10} Patients with V-shaped or square bodies generally have inferior results, as it is more challenging to adequately recontour these body shapes the ideal waist-to-hip ratio of 0.7.^{7,10} Patients with A-shaped or round bodies may be better candidates because their natural curvature is easier to modify to create attractive buttocks with an ideal waist-to-hip ratio.⁷

In addition to proper patient selection, understanding patients' goals for fat grafting and setting reasonable expectations are necessary to increase the likelihood of satisfaction with the final outcome.^{10,11} For example, patients who desire significant buttock augmentation should be counseled that multiple fat grafting procedures may be required.

Preoperative Planning

Preoperative planning is vital for successful outcomes. There are three main factors that must be assessed during the preoperative stage: location of fat harvesting versus grafting, presence of asymmetries or irregularities, and ideal point of maximal buttock projection.⁶

Fat is typically harvested from areas of excess fat in the vicinity of the buttock, including the upper back, flanks, lumbar region, sacral region, and lateral and medial thighs (►Fig. 3).^{1,7,11} To obtain an attractive buttock, the fat is typically grafted superiorly and laterally in an oval shape to lift and complete the hourglass silhouette.^{7,11} It is important to identify areas of excess fat versus areas where augmentation is desired to create the overall effect of buttock augmentation with the ideal waist-to-hip ratio in mind.

Fig. 1 The Mendieta and Sood buttock ptosis classification.

Fig. 2 Different buttock shapes.

Asymmetries of the width, height, and projection of the buttocks are common among patients, as are irregularities caused by scars or previous injections.⁶ Identifying asymmetries and irregularities of the buttocks is crucial not only to ensure that these issues are properly addressed and corrected during surgery but also to point out to the patient preoperatively to appropriately manage their expectations. Patients should be aware that such asymmetries or irregularities may be reduced, but they are unlikely to be eliminated completely.⁶

Projection of the buttocks is another important factor during preoperative planning. Identifying the point of maximal projection allows the surgeon to plan how to augment the buttocks so that the point is in a more ideal location to successfully alter the buttocks' shape and attractiveness. Patients may present with buttocks that have maximal projection in the lower pole, giving a ptotic and aged appearance.¹¹ Instead, the ideal point of maximal projection should be located in the upper middle buttocks, usually between the ilium and the greater trochanter, at the height of the mons pubis.^{6,10-12}

Fig. 3 Common harvesting and grafting sites for buttock augmentation by fat grafting. Preoperative patient markings showing potential donor sites.

Operative Techniques

There are a variety of fat grafting techniques that are currently being used by surgeons across the world. While these techniques have been hot topics in the recent literature, they remain unsystematized, poorly understood, and controversial in terms of their safety and efficacy.^{4,10}

First, fat is harvested from the areas around the buttocks until a sufficient amount is collected. The fat is then injected into predetermined areas of the buttock to adequately create an hourglass figure with an augmented buttock. Anatomically, this encompasses the area between the lateral border of the sacrum, iliac wing, and femoral neck, the area overlying the gluteus maximus, and the region between the maximus, medius, and tensor fascia lata.⁷ The combination of fat harvesting from areas around the buttocks and fat grafting to the buttocks creates a synergistic effect and an overall greater emphasis on the hourglass figure and the buttock augmentation.^{1,6,11} In between these two areas is the transition zone, anatomically marked by the iliac crests and intergluteal cleft apex, which should be left untouched.^{7,9}

The “danger zone,” which is described as a triangle from the infragluteal cleft apex to the medial third of the inferior buttocks, should be avoided because it contains the major gluteal neurovascular structures (► **Fig. 4**).^{7,13,14} Additionally, this area contains the most dense fascial and ligamentous attachments, which require aggressive manipulation and can cause an increased risk of cannula misdirection into the deeper planes and toward major structures.¹⁵

Several incisions have been described for the use of fat grafting for body contouring and buttock augmentation. The incision location must be carefully considered. The ideal incision is inconspicuous, yet it is still able to provide

Fig. 4 The “danger zone.” This zone must be avoided as it contains major gluteal neurovascular structures.

adequate access to the areas of the buttocks that require the greatest amount of augmentation. Common incision locations that have been demonstrated to maximize both cosmesis and patient safety include the intergluteal cleft apex, area inferior to the iliac crest, and upper and lower

lateral buttocks.^{4,6,11,16} While the infragluteal fold approach has been deemed dangerous, studies questioning its safety were injecting fat into deep planes, at angles of -30° , 0° , and $+15^\circ$ degrees, and outside the recommended parallel-to-the-buttock direction.^{4,15,17} In the interest of patient safety and with inconclusive studies, the authors suggest that surgeons avoid the use of the infragluteal fold incisions.

Injection techniques vary by location and quantity of fat being grafted. The quantity that surgeons inject varies based on surgeons' preference as well as patient characteristics and outcome goals. Published ranges for injection quantity span from 28 to 1,880 mL, with many studies reporting an average of 400 to 550 mL of fat per buttock.^{1,5,7,11,12,18} Many surgeons describe injecting in a fanlike pattern to evenly spread the fat and recreate a natural shape without sharp transitions.^{7,9,19} It is also important to avoid pointing the cannula medially, which is associated with an increased risk for misdirection toward major structures present in the deeper planes.¹⁵

In addition to quantity, the location of injection also differs among surgeons. In the past, surgeons have injected fat both intramuscularly and subcutaneously, though many publications specifically recommend avoiding deep muscular planes.^{1,5-7} These techniques are influenced by the 1996 study by Guerrerosantos et al that showed decreased fat resorption following intramuscular fat injection.²⁰ Others have described their preferred fat injection technique for buttock augmentation as starting by injecting in the superficial muscular layer and moving superficially until the desired size has been achieved.^{9,11} To control the level of injection, it is imperative to keep the cannula angled superiorly and parallel to the gluteal muscle; this technique helps avoid unintentional injection of fat into the deep muscular layer, risking injection into the major gluteal vessels.^{9,12} In fact, Ramos-Gallardo performed a cadaver study showing that fat injection at a 30° -degree angle is safer regarding the deeper planes and vital structures versus a 45° -degree angle.¹³ Additionally, one systematic review showed that of the 19 studies reviewed, 46% reported injecting both intramuscularly and subcutaneously, 27% reported injecting intramuscularly only, and 27% reported injecting subcutaneously and/or subfascially only.¹⁸

More recently, many surgeons have been avoiding injecting fat intramuscularly due to the increased risk of fat emboli.²¹ Frank et al recently published two formulas—one for men and another for women—to estimate the thickness of gluteal subcutaneous fat in an effort to further reduce the chance of intramuscular injection. This study also showed statistically significant correlations of both high BMI and increased age with increased thickness of subcutaneous fat.²¹

According to one systematic review, fewer surgeons perform tunneling, a technique in which tunnels are created with the cannula prior to applying suction.¹⁸ While the majority of surgeons endorse injecting small aliquots of fat at a time, the quantities reported range from 0.3 to 20 mL, with multiple surgeons reporting 0.3 mL as their maximum aliquot per pass.^{1,4,9,11,18} Moreover, many surgeons only perform retrograde injections to ensure the safety of the blood vessels.^{1,4,13}

Overcorrection, or the injection of extra fat to account for inevitable fat resorption, remains an area of debate with no clear consensus. While some surgeons advocate for overcorrection by as much as 50 to 100%, other surgeons avoid it out of concern for decreased graft viability as the pressure within the buttocks increases.^{1,9}

Postoperative Care

A widely agreed upon postoperative plan for patients following fat grafting to the buttocks has yet to be developed, mainly due to the uncertainty surrounding fat resorption. Specifically, debate exists regarding the use of compression garments, whether patients should be allowed to sit, and the functionality of massage. According to a 2016 review by Condé-Green et al, 78% of surgeons recommend the use of compression garments for a variable period of 4 to 8 weeks postoperatively.¹⁸ Those against the use of postoperative compression garments argue that the additional compression may lead to an increased risk of fat necrosis.^{6,9} For the same reason, 44% of surgeons recommend prohibiting sitting for 2 weeks following surgery.¹⁸ Surgeons who do not enforce position restrictions, however, cite that the fat is not grafted into the ischial areas that bear the brunt of the weight with sitting, and that, if worn, the compression garment may distribute the forces generated by sitting.^{5,7,12,19} Finally, postoperative massaging was recommended in 21% of cases, according to the review by Condé-Green et al, in an effort to decrease "lumps" of fat and thereby theoretically decrease the chance of fat necrosis.^{9,18} Overall, a patient's postoperative care plan is largely based on surgeon preference and experience.

Results

A standardized system does not yet exist for the evaluation of buttock augmentation through fat grafting.^{10,22} The majority of surgeons either use pre- and postoperative photos (► **Figs. 5** and **6**) or patient satisfaction surveys as an evaluation method.¹⁸ Importantly, buttock augmentation with fat grafting has a satisfaction rate of 97.1% per patient satisfaction surveys.²³ Additionally, 6 to 10% of patients request an additional fat grafting procedure to achieve their desired level of augmentation.^{1,18} In addition to these popular evaluation methods, a small number of surgeons use physical measurements, ultrasound, and magnetic resonance imaging (MRI), all of which have been shown to have similar accuracy and sensitivity of detecting gluteal changes.^{18,24} Evaluation following fat grafting is an important discussion topic due to the concern for fat resorption.

The amount of resorbed fat following buttock augmentation has been theorized to fall between 20 and 50% of the total grafted fat, primarily based on clinical assessment.^{1,5,11} Based on MRI studies, Murillo suggested that the majority of resorption occurs in the first 4 months postoperatively.¹⁹ It is currently unclear if the plane of injection affects the rate of fat resorption. Clinically, intramuscular injections have an estimated resorption rate of 20 to 40%, whereas subcutaneous injections have an average resorption rate of 33%.⁷

Fig. 5 Safe and unsafe planes of injection for fat grafting to the buttocks.

Interestingly, ultrasound evaluation of subcutaneous fat injection demonstrated a resorption rate of 18% after 1 year.¹² Nonetheless, many surgeons cite Guerrero-Santos et al' animal study as evidence in support of intramuscular injections, as he demonstrated decreased resorption when the fat was injected into rats' muscles.²⁰ However, this study and many others that influence current techniques were based on animal studies, limiting the applications to humans.¹³

Complications/Safety

One of the major points of discussion regarding fat grafting for buttock augmentation has been the risk of fat emboli. Microemboli occur when a small number of fat cells enter the bloodstream, potentially causing pulmonary fat emboli or fat embolism syndrome, which is characterized by microscopic inflammatory events initiated in response to tiny fat emboli that cause a systemic inflammatory response.^{6,9} Macroembolism occurs when large fat particles enter the bloodstream and lodge in the right side of the heart, causing acute mechanical heart failure.²⁵ Micro and macro fat emboli can be differentiated by the time of symptom onset, as the former typically occur in the first few days following surgery, whereas the latter occur during or almost immediately after lipoinjection.²⁵ A recent survey study by the Aesthetic Surgery Education and Research Foundation Task Force investigated 692 surgeons who performed a total of 198,857 gluteal fat grafting cases and reported only 135 cases of pulmonary fat emboli, of which 32 resulted in fatalities.²⁶ The Task Force calculated the rate of

pulmonary fat emboli after gluteal fat grafting as 1 in 1,030 cases ($< 0.08\%$), with fatal cases as 1 in 3,448 and nonfatal cases as 1 in 1,449 ($< 0.03\%$).²⁶ Additionally, deaths following gluteal fat grafting have been reported globally, with 13 deaths in Mexico over 10 years and 9 deaths in Colombia over 15 years, all of which were related to fat emboli.²⁷ Recently, Cárdenas-Camarena et al reported 22 mortalities from fat embolism following fat grafting for buttock augmentation, all of which were confirmed by autopsy findings of macroscopic fat emboli in the setting of damaged gluteal vessels.²⁷ The rate of fatal complications for gluteal fat grafting is higher than that of any other cosmetic procedures, which have a rate of approximately 1 in 55,000.²⁸ Moreover, it is likely that these reported rates are an underestimation of the actual risk of fat emboli after gluteal fat grafting, partly due to the reluctance of reporting serious complications and the including only board-certified plastics surgeons this study's survey population.²⁹

Despite the existing contradictory evidence in the literature, some surgeons maintain that injecting into the superficial muscle is safe since the major neurovascular structures are contained in only the deeper muscle planes (—Fig. 7). Additionally, others contend that superficial intramuscular injection is safe based on the relative lack of fat emboli complications observed among their patients. These anecdotal arguments cannot stand in the face of evidence-based medical practice; the morbidity and mortality related to fat grafting to the buttocks have been documented in the literature by numerous surgeons in several countries, including the United States.

The risk of fat emboli is directly related to intramuscular injections.¹⁷ Several theories have emerged to explain the

Fig. 6 Preoperative and immediate postoperative on-table results of buttock augmentation.

mechanism behind macroscopic fat embolization. The first is the “direct hit” theory, in which the cannula directly traumatizes the nearby blood vessels, and fat is then injected into the bloodstream.^{4,12,14} Other studies have suggested passive embolization, where fat may passively migrate into an injured vessel due to the negative pressure of the venous system, to be the culprit. However, many surgeons who encountered fat emboli complications insist that the fat was not injected into the deep muscular planes, refuting the possibility of a direct hit or passive emboli.¹⁷ This question led to the third and most recently developed phenomenon of deep intramuscular migration, which suggests that intramuscular fat injection increases the pressure within the compartment and that with enough pressure the fat will be forced to follow the path of least resistance, which, due to the presence of superficial muscle

fascia and the lack of deep muscle fascia, is toward the deeper planes.¹⁷ The presence of fat in the deeper planes may then cause traction-induced venous tears, which, in turn, may allow for passive fat embolization. These observations were made following superficial fat injection into cadavers; no fat was injected directly into the deep neurovascular bundle-containing planes. Importantly, the theory of deep intramuscular migration suggests that no injection into the muscle, no matter how superficial, can be considered safe.¹⁷ To the authors’ best knowledge, there has been no reported case of fat embolism when the fat was only injected subcutaneously, and there was no component of intramuscular fat injection.^{17,29}

Fat embolism may be the most serious complication associated with fat grafting for buttock augmentation, but there are myriads of other complications that surgeons

Fig. 7 Preoperative and 8-month postoperative results of buttock augmentation.

encounter following this procedure. These risks, however, occur at lower rates than those associated with buttock augmentation with gluteal implants, which have been reported to have complications in approximately 30% of cases.^{1,23,30} The mean complication rate for fat grafting for buttock augmentation has been estimated to be around 7 to 10%, with serious complications occurring in fewer than 1% of cases.^{18,23} Common minor complications include seroma, erythema, pain, contour irregularities or asymmetries, fat necrosis, transient sacral numbness, and cellulitis.^{1,6,18,19,23} Fat necrosis may be particularly problematic if it calcifies and is mistaken for a malignancy, potentially exposing the patient to unnecessary or invasive procedures.^{16,31} The most common major reported complications include fat embolism, anemia, symptomatic hypovolemia, and septic shock.^{18,23} Sciatic nerve injuries have also been reported and range from transient symptoms to consistent bilateral foot drop requiring a wheelchair.^{23,32} Rare cases of mycobacterial infections and granulomatous reactions have also been described.^{9,33}

Complications occur most frequently following intramuscular fat grafting, with one review showing a complication rate of 4% for subcutaneous fat grafting compared with 28.7% for fat grafting involving intramuscular injections.¹⁸ Complication rates also increase with increasing volumes of injected fat, with a complication rate of 19% with fat injection of more than 1,000 mL intramuscularly and subcutaneously per buttocks.¹¹ Increasing BMI also increases the complication rate.²⁹

Safety recommendations include proper patient selection, avoiding intramuscular injections and the “danger zone,” using a blunt cannula, injecting parallel to the buttocks in a retrograde fashion and, and having a strong understanding of the gluteal anatomy.^{7,14,34} Most importantly, fat grafting for buttock augmentation should only be performed by experienced, board-certified plastic surgeons.

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Conflicts of Interest

The authors have nothing to disclose.

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