



Gluteal Augmentation with Fat Grafting: Literature Review

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Abstract

Background The buttock is the second sex feature of the human body, and the graceful buttock curve gives people confidence. Although the safety of gluteal augmentation with autologous fat grafting is still controversial, the proportion of operations is increasing year by year.

Purpose To provide a comprehensive and detailed review of the literature on gluteal augmentation with fat grafting.

Methods A comprehensive review of the published literature through September of 2020 was performed in PubMed database, with the search terms “gluteal augmentation,” “buttock augmentation,” “Brazilian buttock lift,” “fat grafting,” “fat transfer,” “gluteal AND aesthetic,” “gluteal AND anatomy.”

Results A total of 64 articles were included. On the basis of the information obtained, surgical recommendations are proposed to achieve buttocks as close as possible to aesthetic standard and improve surgical safety.

Conclusion With a good grasp of the anatomical structure of the buttocks, complications can be reduced. At the same time, based on the theoretical basis of buttock aesthetics, better postoperative results can be obtained.

Level of evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings,

please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Gluteal augmentation · Fat grafting · Aesthetics · Anatomy · Complication

Introduction

Gluteal augmentation has become increasingly common worldwide over the past few decades and has become a widespread phenomenon in Central and South America [1]. In addition, adipose grafts have also become a research hot spot because they are relatively abundant, easy to obtain, and have low immunogenicity, making them ideal substitutes for soft tissue. According to the American Society of Plastic Surgeons, the number of gluteal augmentations with fat grafting, commonly known as the Brazilian buttock lift, doubled from 2014 to 2018 [2]. However, recent reports of high morbidity and mortality from fat transfer for gluteal augmentation have aroused the concern of the whole society.

Aesthetics

Although aesthetic standards are affected by subjective factors such as cultural differences and geographic environment, objective measurement is still the basis of aesthetic evaluation. Mendieta suggested that buttocks could be classified into four different shape types: square shape, A shape, V shape, and round shape (Fig. 1), accounting for 40%, 30%, 15%, and 15%, respectively [3]. In the aesthetically pleasing buttock, the A shape is the ideal shape. On the posterior view (Fig. 2), it has equal volumes above and below as well as to the left and right when we draw a

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horizontal and vertical lines in the middle of the buttock. Most of the buttock volume is centrally located, with fat evenly distributed over the upper and lower buttock zones. The infragluteal fold should stop in the midbuttock or slightly lateral, in which a short fold has a youthful appearance. Furthermore, the infragluteal fold should form a diamond-shaped space with the inner thigh. On the lateral view (Fig. 3), the buttock contour has a smooth C shape, without depression and ptosis. In the ideal proportion, the greater trochanter is twice as far from the point of maximal gluteal projection as it is from the point of maximal projection of the mons veneris (pubis) [4, 5].

It is worth noting that molding a beautiful buttock contour is not just a matter of adding volume and changing shape. The relationships between the areas surrounding the buttock may be very important [6]. Wong and colleagues proposed that the new ideal waist-to-hip ratio is 0.6 and 0.65 [7], but 93.5% of their respondents came from the USA. The following year, another study also evaluated waist-to-hip ratio preference. It was reiterated that the global consensus of waist-to-hip ratio preference, with participants from more than 40 different countries, was 0.7 [8].

Anatomy

The buttock has three groups of muscles, which are usually grouped as superficial, middle, and deep. The superficial muscles are the largest muscles and include the gluteus maximus and tensor fasciae latae. The middle muscles, from top to bottom, are the gluteus medius, piriformis, gemellus superior, obturator internus, gemellus inferior, and quadratus femoris. The deep muscles include the gluteus minimus and obturator externus.

The greater sciatic foramen is also an important anatomical structure, formed by the greater sciatic notch of the hip bone, the sacrospinous ligament, and the

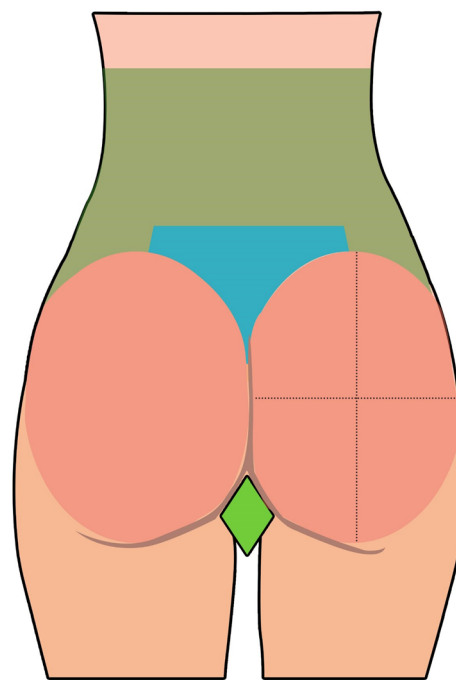


Fig. 2 On the posterior view, buttock has equal volumes above and below, as well as to the left and right. Most of the buttock volume is centrally located. The infragluteal fold stops in the midbuttock or slightly lateral and forms a diamond shaped space with the inner thigh.

sacrospinous ligament; passing through this structure are nerves, blood vessels, and a muscle [9].

The greater sciatic foramen above the piriformis contains the superior gluteal nerve, superior gluteal artery (SGA), and superior gluteal vein (SGV), from the outside to inside. The SGA is divided into two branches. The deep branch passes between the gluteus minimus and medius muscles, while the superficial branch enters the deep surface of the gluteus maximus muscle. The inferior gluteal artery (IGA), inferior gluteal vein (IGV), and inferior

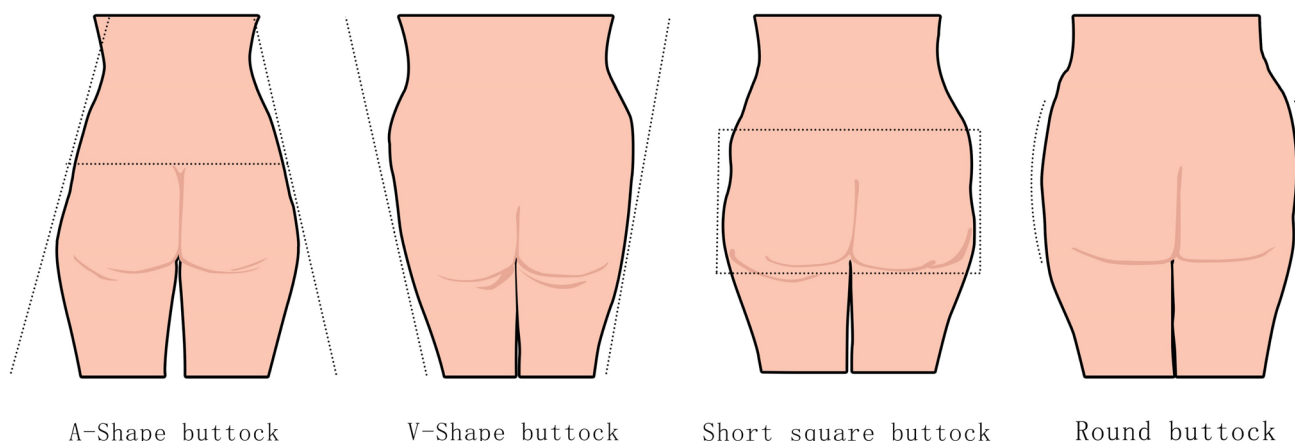


Fig. 1 The four buttock shapes

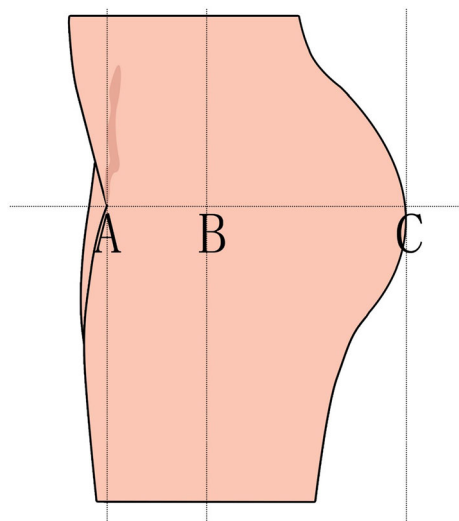


Fig. 3 On the lateral view, the buttock contour has a smooth C shape. **A** the maximal projection of the mons veneris (pubis). **B** the greater trochanter. **C** the maximal gluteal projection. ($2AB=BC$)

gluteal nerve leave the pelvic cavity through the greater sciatic foramen below the piriformis. The IGA mainly supplies the gluteus maximus and anastomoses with the SGA [10].

The SGV and IGV enter the pelvis along with their respective gluteal arteries, where they connect with the pelvic plexus of veins, eventually flowing into the femoral vein. The gluteal veins are always present in the submuscular plane approximately 6 cm deep to the skin, with a caliber on the order of 6 mm in the prone position. The vein caliber can be reduced by up to 27% in the “jackknife” or lateral decubitus positions, possibly reducing the risk of injury resulting from traction or direct impact of the cannula [10, 11]. In these circumstances, the skin is only 2–3 cm away from the underlying muscle; thus, excessive caution should be taken with the injecting cannula [12].

The sciatic nerve passes the gluteal region through the greater sciatic foramen below the piriformis muscle. It first passes through the posterior surface of the obturator internus and related gemellus muscles and then through the quadratus femoris muscle. It is at the midpoint between the ischial tuberosity and the greater trochanter, deep in the gluteal maximus [10]. The sciatic nerve is closely related to the piriformis. When the piriformis is injured, spasms, or hemorrhages and swells, it is easy to compress the sciatic nerve and cause low back and leg pain; this is called piriformis injury syndrome.

In the past, some scholars described the “danger areas” of gluteal augmentation, but the coverage area reached 40% or more of the gluteal surface, making the operation quite challenging. In 2019, Muresan et al. conducted a cadaveric dissection series study, which demonstrated that the SGV and IGV were on average 3.28 cm and 1.25 cm

away from the point one-third the distance from the mid-sacral edge to the greater trochanter, respectively [13]. Based on this research, surgeons could more accurately locate the gluteal veins, reducing the risk of vascular damage.

It is imperative for plastic surgeons to have a deep understanding of the gluteal anatomy, which contributes to reestablishing a beautiful buttock shape and avoiding incorrect injection planes and injury to neurovascular structures.

Research Status

To date, five gluteal augmentation procedures have been carried out comprehensively, including implants, autologous fat transfer, local flaps, hyaluronic acid gel injection, and local tissue rearrangement [14]. Statistics from Organes et al. showed that the incidences of complications in the first four procedures were 30.5%, 10.5%, 22%, and 39.1%, respectively. All six patients who underwent local tissue rearrangement had an uneventful postoperative course. After 6 months of follow-up, the contour, shape, and projection of the buttocks were improved [15].

The procedure of gluteal augmentation with implants dates back to 1969, when Bartels and colleagues used a Cronin breast implant to rebuild the buttock [16]. Soon after, there were reports of incision dehiscence and implant exposure after surgery, probably due to the greater mechanical force of the buttocks and the thin-shelled silicone breast implants [17]. It was not until 1973 that the first successful cosmetic surgery of gluteal augmentation, using a round implant specifically for the buttock region, was published by Cocke and colleagues [18]. According to recent studies, the implants are mainly placed in the subfascial, intramuscular, and submuscular regions of the gluteal region. The limitations of the subfascial procedure are visibility and significant seroma formation. The limitation of the submuscular procedure is that it can only successfully expand the upper third of the buttocks. If the implant pocket drops downward, the implant may come into contact with the sciatic nerve and will need to be repositioned or removed immediately. Although the intramuscular technique reduces the incidence of the above events, the operation is equivalent to operating blindly, which still poses a significant challenge for experienced plastic surgeons [19]. The technique of gluteal augmentation with implants is suitable for reshaping the medial two-thirds of the undesirable buttock and improving moderate ptosis [20]. In 2019, Mendes et al. proposed a new concept: gluteal implant-associated anaplastic large cell lymphoma (ALCL), the same disease as breast implant-associated ALCL but occurring in a new location, which produced a new international alert to the scientific community [21].

In 1999, Cárdenas-Camarena et al. first described a standardized technique of combining liposuction in the lumbosacral, lower buttocks, and trochanteric areas with lipoinjection in the upper middle buttock to improve the contour and the projection of the buttocks. According to the assessment of patients and surgeons, this technique achieved favorable results, with more than 90% improvement [22].

In 2005, Sadir et al. suggested a new technique of creating a dermal fat flap as an autologous gluteal implant. The postoperative effect showed that the procedure obtained a more natural and delightful body contour and resulted in more satisfaction from surgeons and patients. Specifically, the flap successfully increased the projection, improved the buttock contour, and remained stable over time. Unfortunately, this technique is only suitable for patients with massive weight loss and abnormally loose skin [23].

In 2009, Hunstad et al. [24] first proposed the purse-string technology, that is, local tissue rearrangement, which uses the patient's own excess soft tissue in conjunction with the buttock lift to treat gluteal atrophy and ptosis caused by aging and massive weight loss. The ideal candidates for purse-string gluteoplasty are patients with excessive skin and soft tissues on the lower back and buttocks. The advantage of this technique is that it can significantly increase the buttock volume and projection. The most common complications are wound dehiscence and scar enlargement [25].

In 2013, Camenisch et al. performed a sub-study using magnetic resonance imaging to evaluate the postoperative effect of Macrolan (a hyaluronic acid-based gel of non-animal origin) injection for gluteal augmentation. At 6, 12, and 24 months of follow-up, 56%, 36%, and 24% of the gel remained mainly in the subcutaneous fat of the buttocks, respectively. The subjects and the investigators were satisfied with the postoperative results. This is a safe and effective method of temporary aesthetic gluteal augmentation but is limited by the huge amount required, in relation to the high injection cost [26].

In 2019, Aslani et al. proposed a composite gluteal augmentation technique, which aims to use implants to increase the core volume projection and use fat for transitional filling to create a natural appearance and feel of the buttocks. The overall postoperative complication rate was 11.6%. The most common complications were implant dislocation and palpability due to insufficient soft tissue coverage or muscular atrophy, followed by early postoperative infection. The study only had a small number of subjects and a short follow-up time; thus, the long-term clinical effects need to be further verified [27].

Gluteal Augmentation with Fat Grafting

The overall shape of the buttock is affected by the following anatomical factors: bony framework, gluteus maximus muscles, subcutaneous fat, and skin. However, because the skeletal shape is difficult to change, the volume and shape of the buttocks are mainly determined by the distribution of fat and, to a lesser extent, the distribution of muscles [28]. The proportion of gluteal augmentation with autologous fat grafting is increasing annually. The main advantages are the natural appearance, symmetry that is easy to achieve, and the absence of complications of implant ptosis, migration, palpability, and other issues. Furthermore, the combination of this surgery and liposuction can reshape the body and create an S-shaped curve, which produces a good aesthetic effect. However, the reports of high morbidity and mortality have also attracted the attention of the whole society. It should be emphasized that gluteal augmentation with fat transplantation should be performed by experienced plastic surgeons, who can reduce the occurrence of complications.

Methods

Preoperative

First, it is most important to determine the patient's goals, thoroughly discuss the extent of possible enhancement, and set realistic contour expectations based on the patient's anatomic morphology. Generally speaking, the projection and lateral fullness in terms of buttock shape should be considered [29]. Second, the attending doctor discusses with the patient related risk factors, including the presence of any underlying disease, intake of anticoagulant drugs, a history of hematologic disorders, and a family history of deep venous thrombosis or pulmonary embolism, among others. It is worth noting that herbal medicine is often overlooked; this may cause an increased risk of bleeding, hypoglycemia, immunosuppression, and hepatotoxicity. Herbs should be stopped at least 2–3 weeks before surgery. Third, the patient is asked whether he or she has any sciatic nerve symptom, which is regarded as a contraindication for the procedure. Surgery may aggravate the pain, and varicose veins in the sciatic nerve distribution in patients with these symptoms are often worse. Fourth, physical examination of the lower extremities to check for varicose veins should be performed, as this will increase the risk of venous damage [10, 20, 30–32]. Fifth, the donor sites are determined. Currently, studies have shown that there is no significant difference for different donor sites in terms of long-term clinical effects [33]. Care should be taken to avoid taking fat from areas where the patient does not need

correction because this may cause undesirable aesthetic effects on the donor area [34]. Finally, all patients are recommended to have a high-resolution ultrasound examination of the gluteal area, the purpose of which is to ascertain the thickness of the subcutaneous fat, map the vascular system of the area, and record the depth of the veins. Fat injection should not exceed twice the volume of the subcutaneous fat at one time [35]. Konstantin et al. measured the total thickness of the gluteal subcutaneous fat based on ultrasound, and the results showed the following: total thickness (mm) = $-56.997 + (\text{age} \times 0.1) + (\text{body mass index} \times 3.86)$ in women [36].

Intraoperative

There is currently no uniform standard for fat acquisition and processing, and studies have not shown which method is significantly better than the other. The choice of methods in clinical practice often depends on the doctor's personal experience and habits. The postoperative effect is closely related to the doctor's procedure. This article only focuses on the special precautions for the buttocks.

After positioning for liposuction, the patient is placed prone with the buttocks bent into a "jackknife" position. Meanwhile, keeping the knees straight can avoid venous stasis in the lower extremities and reduce the risk of deep vein thrombosis [10]. Protecting the eyes with goggles may be more effective than sealing them with tape because the goggles do not slip off easily. The use of chest rolls to protect the shoulder joints, knees, and feet is important to prevent pressure sores or nerve injuries [37].

The surgeon should use a single-hole injection non-flexible cannula with a diameter of ≥ 4.1 mm from the natal cleft for injection. It is currently believed that the cannula insertion from the natal cleft approach is safer than the inferior gluteal crease incision because it is easier for the cannula to penetrate the submuscular space or damage the deep vein with the latter approach, which is traditionally also called the "direct hit" paradigm. During the injection, the cannula is parallel to the buttock surface as far as possible and cannot be tilted or angulated downward, avoiding injection into the muscle layer. The adipose tissues can only be injected into the subfascial plane when the cannula is in motion. It is necessary to maintain a constant three-dimensional awareness of the cannula tip [10, 38, 39]. It is important to note that the intramuscular and submuscular spaces are rich in blood vessels and nerve structures. If the cannula is inserted into this area, adipose tissue can readily enter the blood vessels directly or indirectly, causing fat embolism, which may be life-threatening in severe cases. Gluteal lipoinjection has the highest mortality rate among all aesthetic surgeries [40].

Del Vecchio et al. proposed the "deep intramuscular migration," theory by studying cadaver donors. The superficial surface of the gluteal muscle is attached to a dense superficial fascial layer, while the undersurface lacks a deep fascial layer. When there is plenty of fat in the muscle, the pressure will cause the fat to migrate into the submuscular plane along the path with less resistance. At the same time, the superficial fascia can prevent fat from egressing in the opposite direction into the superficial subcutaneous space [38]. Some specialists have shown that the gluteal veins are very large, but the subcutaneous tributaries are so narrow that they cannot be used as an entry point for fat embolism [41, 42].

The performance of expansion vibration lipofilling (EVL), which creates the intraoperative expansion of the subcutaneous area through mechanical disruption with reciprocating cannulas, has been reported. EVL can potentially increase the volume of the subcutaneous receptor site and obtain effective buttock lipofilling [43]. The patient's vital signs should be closely monitored throughout the operation.

It is difficult to determine the optimal amount of fat filling for a patient before surgery. When determining the final volume of the lipofilling, the patient's expected effect, the aesthetic standards for the buttocks, and intraoperative tissue compliance should be considered. However, when the skin changes color to white or the fat overflows from the incision, it indicates that the subcutaneous pressure is high, and the injection should be stopped. Thomas et al. suggested that the maximum volume of grafting in each gluteal region is 450 cc. Any requirement exceeding this amount should be reconsidered with regard to safety and predictability, as it may be accompanied by higher chances of embolization and avascular necrosis of transferred fat [35].

Postoperative

After surgery, the patient is placed into a compression garment for 6 weeks. The patient's condition, including the development of signs and symptoms such as dyspnea, fever or purpura, should be closely observed within the first 72 hours after the operation. Postoperative analgesia and anti-inflammatory treatment last an average of 1 week [44]. Sufficient hydration needs to be maintained in order to facilitate the excretion of free fatty acids in the body, thereby decreasing the risk of fat embolism. The patient is encouraged to get out of bed as soon as possible to prevent deep vein thrombosis. It should be emphasized that the compression of the transplant sites are not allowed within the first 2 weeks [10]. Smoking is prohibited for 3–6 months after surgery because smoking causes vasospasm and reduces the caliber of vessels. This has been

confirmed in prospective trials, in which smokers have more wound healing problems and seromas than non-smokers [30].

Complications

The postoperative satisfaction of patients is high, but surgery is not without risks. Indeed, it has the highest mortality rate compared with other aesthetic procedures: 1/3448 [34]. In 1999, Cárdenas-Camarena et al. published a survey on the complications of gluteal fat transplantation, which resulted in the reconsideration of its safety [22]. In general, the reported incidence of complications ranges from 7% to 10.5%, of which 95.5% are minor complications. The most common minor complications include seroma, infection, fat necrosis, sciatica, and irregular contours. The major complication of gluteal augmentation is fat embolism [22, 45, 46, 20]. Recently, owing to the reports of death by fat embolism, gluteal fat grafting has become the focus of social attention.

Seroma

To form an aesthetically pleasing frame from the lower back to the upper buttocks, it is often necessary to perform aggressive liposuction in the lumbosacral area. However, seroma usually develops at the fat harvest site, especially the sacral triangle. As previously described in the literature, the formation of seroma depends on the amount of fat left behind and the amount of fascia removed and may be connected to lymphatic trauma, lipolysis, or tumescent fluid retention. Some postulate that the use of closed drainage or two drainage tubes can help reduce the chances of seroma formation [47, 48].

Infection

Genitalia usually has a lot of bacteria, which increases the risk of infection at the gluteal injection site. Prophylactic use of antibiotics preoperatively, strict aseptic procedure intraoperatively, and anti-bacterial treatment in the postoperative period can greatly reduce the chances of infection. For this reason, it is critical to rinse the buttock with 4% chlorhexidine gluconate the night prior and 5 days after the operation [49]. The most common bacteria are gram-negative, such as *Escherichia coli*, Microaerophilic streptococci, *Bacteroides fragilis*, Enterococci, and *Pseudomonas aeruginosa*. *Staphylococcus aureus*, meanwhile, has one of the lowest incidences [47]. In a meta-analysis by Oranges et al., the incidence of sepsis was found to be 0.4%. There are only a few reports on sepsis in previous studies, which may be due to the small numbers of patients [15]. As we know, patients with a weakened immune

system are at a higher risk of infection or sepsis after surgery.

Other Minor Complications

Avoiding excessive liposuction and choosing the appropriate depth during volume reduction are important aspects in preventing postoperative contour irregularities. The surgeon should keep at least 1–2 cm of fat under the skin to prevent dimpling and skin damage. Attention must be given to starting the lipoplasty deep before proceeding superficially [50]. If there are still irregular contours 3–6 months after the operation, when the grafted fat tissue has stabilized, fat injection or liposuction can be performed again according to the specific situation to improve the appearance.

The sciatic nerve is vulnerable to direct trauma and compression injury at the level of the gluteus, presenting with radiating pain from the posterior thigh to the calf. Mastering the anatomical landmarks of the sciatic nerve, avoiding fat injections into the muscle layer, and closely observing the clinical manifestations of compartment syndrome are essential to prevent sciatic nerve damage [51].

Fat necrosis is a common complication related to inadequate surgical techniques after fat transplantation. The main reason for necrosis is that the amount of injected fat is too large in a certain area, which leads to central hypoperfusion and devitalization of the graft core, eventually leading to tissue death. In some cases, the saponified sterile fat cells form the cystic cavity or firm areas of fat necrosis [52]. Small areas of fat necrosis, less than 2 cm in diameter, may subside over time and should be observed. Large areas of fat necrosis may require surgical removal [29].

Fat Embolism

In 2015, a retrospective study that was published by Cárdenas-Camarena et al. aroused widespread attention. The study documented 22 deaths that were attributed to pulmonary fat embolism (PFE) after gluteal fat grafting in Mexico and Colombia over a 15-year period [53]. A study by The Aesthetic Surgery Education and Research Foundation Task Force published that the annual mortality ratio of PFE ranges from a low of 1:6214 to a high of 1:2351, while the total rate of both fatal and non-fatal PFE is 1:1030. Considering that surgeons may overestimate the total number of cases throughout their careers and are unwilling to report complications, the mortality rate may be higher than what the survey showed. Unfortunately, patients with non-fatal PFE in some cases may require long-term intensive care unit stays and suffer from chronic or even permanent pulmonary diseases [54].

There are two main mechanisms for PFE: The first is the mechanical blockage of the pulmonary vasculature through macroscopic fat particles; the second is systemic and pulmonary inflammation caused by the fatty acids produced by lipase hydrolyzing the microemboli, which leads to reactive airway compromise with hemorrhage and edema. The fat enters the blood stream when the cannula is inserted directly into the gluteal vein or when it transects the gluteal vein traumatically, which is followed by a pressure gradient [47, 55, 56].

Based on medical records and autopsy reports of 16 patients with fat embolism who underwent gluteal augmentation with fat grafting, Bayter-Mari et al. found that all patients had symptoms of bradycardia, hypotension, and hypoxemia [57]. Given that fat embolism is one of the most challenging complications of gluteal fat grafting, prevention is best. The most important precaution is to avoid injecting adipose tissue into the deep muscle plane and into highly vascularized areas.

Fat embolism syndrome (FES) refers to a series of clinical symptoms caused by fat droplets and lipid globules entering the vascular system, blocking blood vessels, organs, and tissues [56]. It usually occurs 12–72 hours postoperatively and is related to the process of obtaining adipose tissue. The typical clinical manifestations are respiratory distress, altered mental status, and petechial rash [58]. Mortality reported is as high as 20% [59].

According to the report, the successful management of patients with fat embolism includes early detection, aggressive cardiorespiratory support, and rapid transfer to an intensive care unit, which can significantly improve disease progression and patient prognosis. If there are already suspicious clinical manifestations in the intraoperative period, the operation should be terminated immediately [60]. Treatment requires the use of appropriate fluid resuscitation therapy and a period of mechanical ventilation. Low molecular weight dextran potentially reduces platelet aggregation and prevents thrombocytopenia. Albumin is generally believed to not only maintain volume but also to bind free fatty acids and reduce inflammation. Unfortunately, albumin can also accumulate in the interstitial lung compartment and cause respiratory failure. The study showed that the use of ciclesonide can be a safe and effective preventive treatment for posttraumatic microscopic fat embolism and help prevent severe hypoxia [61].

Discussion

Given the changes in the concept of aesthetics, the star effect, and the rapid spread of the Internet, people are paying more and more attention to the posture, which increases the demand for buttocks plastic surgery. In this

day and age, the “peach buttock” has become the goal pursued by many beauty seekers. The most commonly utilized techniques for gluteal augmentation are the use of implants and autologous fat transfer, according to the United States cosmetic surgery statistics [62].

Prosthesis implantation has a history of more than half a century and was originally used in the breast. Indeed, gluteal augmentation is different from breast augmentation; anatomically, the gluteal region naturally undergoes more stress than does the breast in daily life. The normal sleep time everyone needs is from 7–8 hours every day, and the supine or lateral position will cause extra pressure on the buttocks, which will dramatically reduce the useful life of the implant. Moreover, the buttock is more likely to be injured than is the breast. For gluteal augmentation with autologous fat grafting, surgeons and patients do not need to worry about implant displacement, palpability, rupture, and removal. It can also address irregular transitions and depressive trochanters and provide lateral expansion and roundness, all of which are not possible with implants alone. The combination of this technique and liposuction technology achieves the desired results in reshaping the body.

Thus far, some plastic surgeons are still reluctant to do the operation of gluteoplasty because it has a high morbidity and mortality, mostly attributed to fat embolism. However, with the improvements in the gluteoplasty method, the operation has become safer than before. According to the 2019 American Society for Aesthetic Plastic Surgery gluteal fat grafting survey, the mortality rate has been significantly reduced compared with the 2017 survey, and the present mortality rate is lower than that of abdominoplasty [63].

The danger in gluteal augmentation with fat grafting cannot be ignored. This operation is performed by a professional plastic surgeon who has expertly mastered the anatomical structure of the buttocks and the fat grafting process, in order to achieve better postoperative results and avoid serious complications.

Professor Senderoff declared, “I do not advocate one surgical technique over another for gluteal augmentation. It is up to each individual surgeon and patient to determine which strategy for success is best.” [64] I strongly agree with this. In my opinion, gluteal fat transplantation is a better prospect because it has the unique advantage of giving the buttocks a more natural shape, although problems with the procedure still exist. At present, it is imperative to reduce the mortality related to gluteal fat transplantation. In the future, there will be a need to conduct large numbers of basic research and clinical case studies consistent with evidence-based medicine to guide clinical practice.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent For this type of study, informed consent is not required.

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