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**PATIENT SAFETY: ULTRASOUND-ASSISTED
BUTTOCK FAT GRAFTING FOR THE
EFFECTIVENESS OF AESTHETIC RESULTS**

**SEGURIDAD DEL PACIENTE: INJERTO DE GRASA EN
GLÚTEOS ASISTIDO POR ULTRASONIDO PARA LA
EFICACIA DE LOS RESULTADOS ESTÉTICOS**

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Patient Safety: Ultrasound-Assisted Buttock Fat Grafting for the Effectiveness of Aesthetic Results

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ABSTRACT

A systematic review of the literature was carried out, whose basis is the structured and systematic integration of the information obtained in different research studies published in specialized journals, which was a search of records in the following databases: PubMed, SciELO and Science Direct of studies published in the last 10 years (2013-2023). The articles were searched in English and Spanish, Portuguese and once selected, they were read, with the due concentration of relevant information for this research. Two independent reviewers screened publications including those showing or not showing clinical evidence for "Ultrasound-assisted buttock fat grafting for the effectiveness of aesthetic outcomes ." We included 4 studies that met our selection criteria. We extracted data from: year of publication, author, country, population and outcomes. Conclusion: The use of real-time ultrasound allows injection into the subcutaneous plane of the skin, avoiding the deep plane where life-threatening complications such as fat embolism could occur.

Keywords: fat grafting, ultrasound, patient safety

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Seguridad del Paciente: Injerto de Grasa en Glúteos Asistido por Ultrasonido para la Eficacia de los Resultados Estéticos

RESUMEN

Se llevó a cabo una revisión sistemática de la literatura, cuya base es la integración estructurada y sistemática de la información obtenida en diferentes estudios de investigación publicados en revistas especializadas, que fue una búsqueda de registros en las siguientes bases de datos: PubMed, SciELO y Science Direct de estudios publicados en los últimos 10 años (2013-2023). Los artículos se buscaron en inglés, español y portugués y, una vez seleccionados, se leyeron, con la debida concentración de información relevante para esta investigación. Dos revisores independientes examinaron publicaciones que mostraban o no evidencia clínica para "Injerto de grasa en glúteos asistido por ultrasonido para la eficacia de los resultados estéticos". Incluimos 4 estudios que cumplieron con nuestros criterios de selección. Extraímos datos de: año de publicación, autor, país, población y resultados. Conclusión: El uso de ultrasonido en tiempo real permite la inyección en el plano subcutáneo de la piel, evitando el plano profundo donde podrían ocurrir complicaciones potencialmente mortales como el embolismo graso.

Palabras claves: injerto de grasa, ultrasonido, seguridad del paciente

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INTRODUCTION

The history of fat transfer or fat grafting in the buttocks is interspersed with the attempt to extract fatty tissue from the body and, therefore, the beginning of body remodeling through liposculpture. It seems that fat transplantation was first reported by Neuber in 1893, followed by reports by Czerny, Lexer, and Rehn. In 1911, Bruning was the first to inject autologous fat into the subcutaneous tissue to augment soft tissues. Still, Charles Dujarrier, a French surgeon general and head of the Department of Surgery at Saint Antoine Hospital, made the first recorded attempt to remove subcutaneous fat through a small incision in 1921. The procedure performed on dancer Folies Bergère resulted in necrosis and amputation, culminating in the first lawsuit in the history of plastic surgery. ⁽¹⁾

The purpose of this procedure is to achieve a redistribution of volume to change the proportions from the waist to the hips and modify the posterior projection, the upper and lateral fullness of the buttocks. Depending on the patient's body habit and goals, this is achieved by a combination of lumbosacral liposuction, flank, hip, inner and outer thigh and fat grafting on the upper buttocks, lateral gluteal depression, trochanter, ischium, and lateral and posterior thighs. ⁽²⁾

Female buttocks have been a ubiquitous symbol of femininity throughout history and as modern trends shift towards more dramatic curves, butt augmentation surgery continues to grow in popularity. ⁽³⁾

Unlike the use of implants to improve the buttock region, experimentation with fat transfer to the buttocks emerged. The Brazilian Butt Lift technique, first described in 1988 by Brazilian surgeon Luiz Toledo, involves the extraction of adipose tissue from the flanks, abdomen and thighs with subsequent injection into the buttocks. This technique has been widely employed in the regions of Mexico and Latin and South America and, in recent years in the United States, has become an increasingly popular means of improving the volume and contour of the buttocks without the use of an implant. ⁽⁴⁾

Butt augmentation through autologous fat grafting ("Brazilian Butt Lift") is a widely performed aesthetic procedure to shape and augment the buttock region, while also thinning adjacent regions. The goal of the procedure is to achieve a heart-shaped or A-shaped buttock, with anatomical features such as an infragluteal fold, a V-shaped fold, and lumbar hyperlordosis. ⁽⁵⁾ The transfer of large volume of fat to the buttock region has become increasingly popular due, in part, to more efficient liposuction and fat grafting techniques, as well as changing aesthetic ideals. ⁽⁶⁾

Autologous fat grafting is a versatile procedure that is gaining popularity for a variety of indications, including facial rejuvenation, breast contouring and augmentation, and buttock augmentation. In addition to being a minimally invasive procedure using tissue that is readily available in most patients, fat grafts are a living filler and contain stem cells with tissue-regenerating properties. The main obstacle to this technique has been long-term graft viability and retention, but virtually every step of the grafting process is now being optimized in search of the ideal protocol that maximizes graft survival. ⁽⁷⁾

Compared to other procedures to add volume to the buttocks, such as silicone implants and injection of permanent alloplastic materials, such as polymethylmethacrylate, fat grafting has a lower incidence of complications. However, gluteal fat grafting can also present serious complications in the attempt to inject large volumes due to the possibility of causing fat embolism and even death. To avoid them, the Foundation for Research and Education in Aesthetic Surgery (ASERF) emphasizes some precautions that must be respected, such as: avoid injecting fat into the muscle; use larger caliber cannulas when injecting, such as the 4 mm cannula with a single hole; Direct the cannula to the most superficial tissues and inject the fat with the cannula in motion. ⁽⁸⁾

The demand for butt augmentation with autologous fat has increased dramatically over the past five years. According to statistics from the American Society for Aesthetic Plastic Surgery (ASAPS), "primary physicians" (plastic surgeons, dermatologists, and facial plastic surgeons) performed 18,487 of these procedures in 2015 compared to 7,382 in 2011. For purposes of tabulation of procedure statistics, the number of cases performed by non-plastic surgeons is included in the estimates provided by ASAPS. It is estimated that up to 25% more of these procedures are performed by non-essential physicians, resulting in a total of approximately 23,108 procedures performed last year in the United States. ⁽⁹⁾

Although gluteal fat grafting only subcutaneously is safe, surgeons still need a technique to confirm subcutaneous placement of the fat graft in all cases. Intraoperative ultrasound filled this unmet clinical need by allowing surgeons to confirm subcutaneous placement of the fat graft. Ultrasound visualization also revealed 2 distinct subcutaneous fascial layers: the DGF (i.e. the fascia of the gluteal muscle) which lines the outer surface of the gluteus maximus muscle; and superficial gluteal fascia (SGF), which is analogous to Scarpa's fascia (i.e., the superficial fascial system [SFS]) and is located below the dermis

and above the DGF. There are also 2 distinct subcutaneous fat layers, the superficial fat subcutaneous space, which is below the dermis and above the SGF, and the deep fat subcutaneous space, which is below the SGF and above the DGF. ⁽¹⁰⁾

The frame (fat, bone, skin) and aesthetic units of the buttocks

The subpiriform and suprapiriform fossa delimits the anatomical compartments containing the inferior gluteal vessels and the superior gluteal vessels, respectively. The piriformis muscle originates from the anterior part of the sacrum and inserts into the superomedial aspect of the greater trochanter of the femur. The superior gluteal vessels enter the sciatic foramen above the piriformis and run between the gluteus minimus and medius. The inferior gluteal vessels enter the sciatic foramen below the piriformis muscle and innervate the gluteus maximus muscle and are joined below by the sacrospinous ligament. The sacrospinous ligament can serve as an easily recognizable landmark, as it can be palpated from its point of insertion into the ischial spine. The gluteal veins drain into the iliac veins. The plastic and reconstructive surgery literature discusses the "danger zone" with respect to the pyramidal area of the tissue with the apex of the pyramid at the top point above the gluteal cleft and the base covering the medial 2/3 of the gluteal fold. This "danger zone" should be avoided as the larger inferior gluteal vessel runs through this space and can be injured when performing liposculpture procedures such as autologous fat transfer. In the horizontal plane, an imaginary line can be drawn from top 1 inch and parallel to the ischial tuberosities when the person is seated to mark the horizontal axis of the piriformis muscle and therefore the subpiriformis fossa. ⁽¹¹⁾

With the muscle out of the way, the surgeon must understand how the variables that make up the frame (bone, skin, and fat) interact to create a particular shape and affect the aesthetic units of the buttocks.

The underlying bony framework influences the shape; However, because this structure cannot be changed surgically, it does not play a major role in the classification system, other than referring to it as upper, low, or intermediate pelvic height.

The skin plays a role in determining whether an upper butt lift, an excision of the lower gluteal fold, or an excision of the internal gluteal fold is necessary.

Thick topography is the most important component of the frame and the easiest to modify. Subcutaneous fat has the greatest impact on establishing the overall shape of the frame on which the gluteal muscle rests.

The aesthetic units of the buttocks are most useful when addressing this component of the form. Understanding the aesthetic units of the buttocks and their relationship to the frame is of utmost importance before undertaking butt augmentation. Butt units are used to orient and determine which areas may benefit from liposuction versus fat transfer, which undoubtedly affects the discussion of the overall framework. Previously published works have described 10 aesthetic units for the posterior region, and another has described 8 gluteal aesthetic units: 2 symmetrical flank units, 1 sacral triangle unit, 2 symmetrical buttock units, 1 infragluteal diamond unit and 2 symmetrical thigh units. ⁽¹²⁾

Selection of patients for fat transfer

The most important first step in patient selection is a thorough medical history and physical examination, including a personal or family history of hematologic bleeding disorders. While most patients can undergo fat grafting for body contouring and buttock augmentation, the quality of the results is determined by three main patient characteristics: presence of fat, excess skin, and body shape.

The first characteristic is the presence of fat, which can be determined by the percentage of body fat and body mass index (BMI). Patients with a body fat percentage between 20 and 30% or a BMI between 20 and 30 kg/m² are ideal candidates for fat grafting, as excess fat can be collected and transferred to the buttocks, improving the overall contour.

The second characteristic is excess skin. Mendieta and Sood have described several categories of gluteal ptosis. Patients without ptosis or grade I ptosis are the most ideal candidates for fat grafting because the procedure will allow reshaping and lifting the buttocks. Patients with moderate to severe excess skin, such as patients with grade II/III ptosis, are less than ideal candidates, as fat grafting alone will be insufficient to lift and re-cover excess skin.

The final characteristic is the shape of the body. Body shapes do not necessarily prevent patients from undergoing fat grafting for buttock augmentation, but limit the quality of the result and are an important factor in properly managing patients' expectations. ⁽¹³⁾

Marking

The patient should be marked in the standing position. Liposuction areas should be marked in the standard way with an understanding of how areas adjacent to the buttocks will affect the shape of the buttocks. For example, the flank region is almost always markedly reduced and can be one of the best donor sites. Areas that require release of ligamentous attachments (fascial adhesion zones) and that have different abilities to accept fat should be identified. The brands are based on several factors, including skin laxity, fat and muscle distribution, and bone structure. The identification and evaluation of the lateral trochanteric region and the need for augmentation at this location are important during this evaluation because they contribute significantly to the lateral contour of the gluteal profile and waist:hip ratio. As with all plastic surgeries, the inherent morphology of soft, muscle, and bone tissues will determine the prioritization of available donor fat. The iliac crest should also be identified because it is a transition zone that serves as the deepest and lowest point of liposuction and the upper edge of the gluteal region. Laterally, the height, width, shape and distance of the iliac crest from the lower rib will determine the defining potential of the waist on the flanks. ⁽¹⁴⁾

Positioning

The positioning is somewhat controversial since some authors recommend the prone position to contour the posterior flanks and back, while others prefer the lateral decubitus position. The prone position is more convenient as it only requires the patient to be repositioned twice on the operating table (supine-prone-supine). In addition, this position allows visual evaluation of both sides simultaneously. The lateral decubitus position requires the patient to be repositioned three times on the operating table (supine-right lateral decubitus position-left lateral decubitus position-supine). Despite the slightly longer surgical times associated with lateral decubitus positions, several experienced body contouring surgeons frequently use the lateral decubitus position when contouring the waist. The posterior triangle, an important component of the aesthetic waist, cannot be adequately approached from the prone position. ⁽¹⁵⁾

After positioning for liposuction, possibly supine position if fat is removed from the abdomen, the patient is placed in prone position when a buttock augmentation is to be performed. While patients are placed in this position, bending the patient's knees should be avoided to avoid venous stasis of the lower

extremities, which increases the risk of deep vein thrombosis. This prone position allows greater control and safety, with the use of graft cannulas from supragluteal and lateral incisions to a more subcutaneous plane. Straight cannulas are used to better control the direction of the graft. ⁽¹⁶⁾

Intraoperative positioning for butt augmentation procedures presents many inadvertent opportunities to injure patients. The prone and lateral decubitus positions common in butt procedures are fraught with risks for patients, including pressure ulcers, corneal abrasions, peripheral nerve compression, and traction injuries. Although the entire surgical team is responsible for being alert and preventing these types of injuries, the surgeon possesses the most specialized knowledge of the impact that an incorrect intraoperative position can have on a patient. ⁽¹⁷⁾

Fat harvesting

Donor site selections should match the sites that best require liposuction due to excess adipose tissue. It has previously been shown that there is no significant difference in fat cell viability when donor sites include the abdomen, flank, thighs or knees, especially when higher volume fat augmentation (>100 cc) is performed. In addition, studies have also shown that the donor site had no effect on fat graft volume or graft survival duration. Standard moisturizing liposuction techniques using larger diameter cannulas and low-pressure suction minimize blood loss and improve the viability of adipocytes. Several fat processing techniques have been described; However, there is no significant peer-reviewed evidence to show that one method is superior to others. It is recommended to use a closed system in which the liposuction is not exposed to the environment to minimize possible outdoor contamination. Simultaneous separation and tumescence of fat, first described by Khouri and Del Vecchio, is the recommended technique for preparing the donor site prior to liposuction.

The fat is collected online using large sterile containers. Once the fat is separated from the blood and crystalloid, the unwanted blood and crystalloid are decanted, and the donor fat is transferred through a peristaltic pump system. ⁽¹⁸⁾

Injection

Deep muscle injection exposes fat to larger volume veins capable of accepting clinically significant fat boluses. Fat can enter these veins either by direct trauma or by increased pressure. Placing large volumes of fat naturally increases the pressure and probably the risk of fat embolism with fat injections into the

muscular plane. Fat injected into too deep a plane can increase pressure on other structures such as the sciatic nerve and its branches. Some surgeons may believe that placing fat in muscle is associated with increased graft longevity or results in lower rates of fat necrosis or other complications. However, there is no data to support these conclusions. Fat is routinely transferred to other sites (face, breasts, and subcutaneous tissue to treat boundary defects) where injection into the muscle is impractical. Fat grafts have good longevity when placed in these places, and there is little reason to believe that transfer to the subcutaneous space of the buttocks is any different. ⁽¹⁹⁾

Security Results

It has been estimated that the complication rate of fat grafting for buttock augmentation ranges from 7% to 10%, with the vast majority (95%) minor complications. Serious complications occur in less than 1% of cases. Plications, both major and minor, occur more frequently with intramuscular fat grafting, as demonstrated by Conde-Green et al., who identified a 4% complication rate for subcutaneous-only fat grafting compared to 28.7% with any intramuscular injection, although this result did not achieve statistical significance. The risks also increased with higher volumes of fat injected, with a complication rate of 19% when more than 1000ml of fat was injected into each buttock. A higher BMI also leads to a higher rate of complications. ⁽²⁰⁾

Complications

Fat transfer to the buttocks is an extension of liposuction and therefore all the risks of liposuction are present. More specific additional risks for fat transfer are also present, including nerve compression, pulmonary embolism, fat embolism, and death. These complications may be technique-dependent and there are few data on the safety and efficacy of high-volume transfer procedures. ⁽¹⁹⁾

According to the study by Oranges et al. after complications include seroma of the donor site (3.1%), hyperemia/erythema (1.6%), liponecrosis (0.7%), major/minor irregularities (0.7%), cellulite (0.5%) and asymmetry (0.4%). The unpredictability of volume maintenance is also a concern related to this procedure, however, a study by Roberts et al in 556 patients reported long-term fat grafting survival ranging from approximately 50% to 75%. ⁽²¹⁾

Seroma

In a recent meta-analysis of all studies to date, the seroma rate was 3.5%. A seroma after buttock augmentation with fat grafting usually occurs at the site of fat collection: the lumbosacral area. Specifically, the sacral triangle is the most prone. Another literature review study by Oranges and colleagues found that the rate was 3.1%. None of these studies provided details on the use of suction drains or how aggressive liposuction was performed on the lumbosacral area. To create an aesthetically pleasing platform from the lower back to the upper buttocks, aggressive liposuction should be performed on the lumbosacral area. From liposuction, it is known that seroma formation depends on the amount of fat left and the amount of bare fascia. This is similar to the high seroma rates of latissimus dorsi muscle flaps, which are already familiar. To help decrease and manage the impending seroma, some surgeons use a closed suction drain in this area. Drainage also helps define the transition between the lower back and upper buttocks by decreasing the amount of fluid that builds up in that area, which then appears to turn into fibrosis. ⁽²²⁾

Fat embolism

There are two main mechanisms for pulmonary fat embolism: the first is mechanical blockage of the pulmonary vasculature through macroscopic fat particles; the second is systemic and pulmonary inflammation caused by fatty acids produced by lipase that hydrolyzes the microemboli, leading to reactive airway compromise with hemorrhage and edema. Fat enters the bloodstream when the cannula is inserted directly into the gluteal vein or when it passes through the gluteal vein traumatically, which is followed by a pressure gradient.

Based on medical records and autopsy reports from 16 fat embolism patients who underwent buttock augmentation with fat grafting, Bayter-Mari et al. found that all patients had symptoms of bradycardia, hypotension, and hypoxemia. Since fat embolism is one of the most challenging complications of fat grafting into the buttocks, prevention is best. The most important precaution is to avoid injecting adipose tissue into the deep muscular plane and into highly vascularized areas. ⁽²³⁾

Real-time ultrasound

There are several reports in the literature on techniques that include fat grafting in the subcutaneous plane, the intramuscular plane, or a combination of both. However, there is a strong correlation with

intramuscular fat grafting and fat embolism. Technical details in cannula size, injection angle or path, and injection plane are critical to avoid morbidity and mortality. ⁽²⁴⁾

The use of real-time ultrasound-guided cannula visualization has been described as a technique for fat transplantation. In a series of 15 patients using awake epidural anesthesia, a 2-surgeon approach was needed: one injecting and the other holding the ultrasound probe. following the cannula. An average total transplanted volume of 528 cc was grafted and an additional 25 minutes were reported to the "usual fat injection time". Total operative time was not reported. The authors suggest that this technique "may avoid injuring the deep vessels, further decreasing the risks of major complications." Although radiological imaging of the cannula location may have theoretical merit, the impracticability of a 2-operator run would likely not achieve widespread clinical adoption in its current form. ⁽²⁵⁾

A recent publication described the use of real-time ultrasound to follow the cannula and confirm that the cannula remained in the subcutaneous plane. In the best hands, this added almost 30 minutes to the average operative grafting time, an average of only 528 cc of fat per side. The authors noted other significant disadvantages, such as cost, a learning curve, and the need to have an attending surgeon present to follow the movement of the cannula. ⁽²⁶⁾

MATERIAL AND METHODS

A systematic review of the literature was carried out on the fat **grafting in buttocks assisted by ultrasound** for the **effectiveness of aesthetic** results, whose basis is the structured and systematic integration of the information obtained in different research studies published in specialized journals, which was carried out a search for records in the following databases: PubMed, SciELO and ScienceDirect of studies published in the last 10 years (2013-2023). The articles were searched in English and Spanish, Portuguese, French, or once selected, they were read, with the due concentration of the relevant information for this research.

Universe of population:

All clinical studies that studied the use of real-time ultrasound to monitor the injection process in autologous fat grafting.

Sample:

The study sample consisted of all clinical studies that met the selection criteria.

Search strategy:

A query was made based on MeSH terms and words from the title and abstract that included the following keywords: "real time ultrasound", "fat grafting", "gluteus", "aesthetics".

Selection criteria

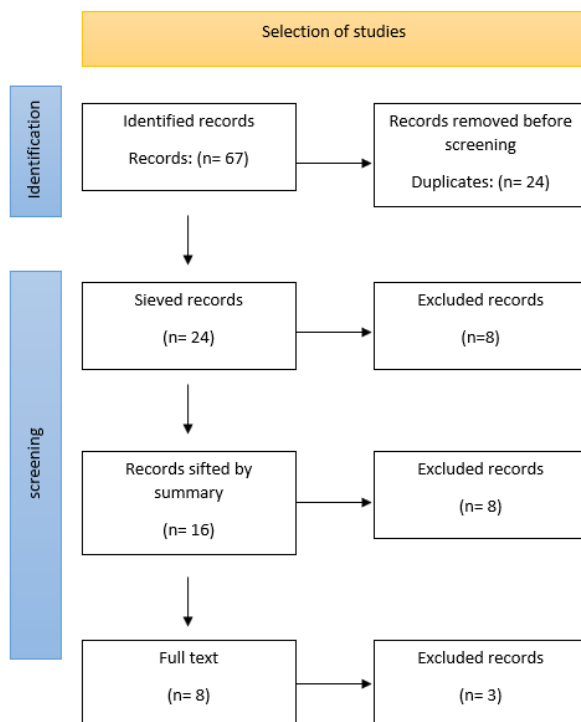
Inclusion criteria

- Prospective studies.
- Studies published between 2013 and 2023.

Exclusion criteria

- Studies not available in their full version.
- Letters to the author and narrative reviews.

PRISMA Diagram



Data extraction:

The method of extracting data from studies that met the selection criteria was the use of a data collection card. We extracted data from: year of publication, author, year, country, population and outcomes.

RESULTS

Author	Year	Country	Population	Results
Cansancao ⁽²⁷⁾	2019	Brazil	35 women	An average of 56.5% of the subcutaneous layer of fat in the immediate postoperative period (range, 39.5-108.6 percent) ($p < 0.0001$). There was no evidence of fat placed involuntarily in the intramuscular plane in any of the ultrasound analyzes performed in the postoperative period
Cansancao ⁽²⁸⁾	2018	Brazil	15 women	The evaluation of the depth and location of the cannula was performed in real time, accurately and reliably identifying the plane into which the fat is being injected. All injections were made in a subcutaneous plane.
Swanson ⁽²⁹⁾	2016	United States of America	25 women	Ultrasound measurements detected a significant change in the thickness of the subcutaneous fat layer after surgery ($P \leq 0.001$), there were no postoperative complications.

Wong ⁽³⁰⁾	2021	United States of America	1 patient	The subcutaneous plane where the fat was to be injected was identified, avoiding penetrating the muscular fascia and it was observed (in real time) how the fat was introduced into the subcutaneous tissue.
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DISCUSSION

While some cosmetic surgeons believe that intramuscular fat injection will give better results, studies have shown that there is no significant difference in fat retention between subcutaneous injection and intramuscular injection in the buttock region.⁽³⁰⁾

Recently, concern has arisen about the risk of fat embolism after injection of such fat into the buttocks. For this reason, it is recommended to avoid entering the subpiriform or suprapiriform canals where the gluteal vessels are located. However, recent research reports that multi-tunnel injection is a measure applied to maximize fat vascularization.⁽²⁹⁾

The present study found that the use of ultrasound during fat transfer in the gluteal region provides a safety measure that allows the injection of fat into the subcutaneous plane, avoiding the complications associated with injection into the muscular plane. This finding is consistent with reports on ultrasound that have shown wide validity as an excellent method to measure outcomes and maintain gluteal fat gain; its ease of use, accessibility and cost-effectiveness; and its reproducibility in other populations. Ultrasound also provides additional useful information, such as the presence of seromas, hematomas, fat necrosis, and oil cysts.⁽²⁷⁾ Intraoperative ultrasound provides a means of verifying the method and ensuring that the fat is injected into the desired subcutaneous plane.⁽³¹⁾

However, this technique has drawbacks: the cost of purchasing the ultrasound machine, the need to have an assistant who holds the ultrasound probe and controls the cannula while the fat is injected. The technique has a learning curve for both the surgeon and the assistant, as they need to follow the trajectory

of the cannula and probe both on the patient and on the screen, where the images are projected, to ensure the proper plane of fat injection. The movements of the cannula and probe must be constantly coordinated to follow the injection plane in real time, increasing surgical time. ⁽²⁸⁾

CONCLUSIONS

The use of real-time ultrasound allows injection into the subcutaneous plane of the skin, avoiding the deep plane where life-threatening complications such as fat embolism can occur.

This systematic review on ultrasound-assisted buttock fat grafting emphasizes the importance of this technique in enhancing patient safety and the effectiveness of aesthetic results. The use of real-time ultrasound allows for precise injections into the subcutaneous plane, avoiding the deeper plane where serious complications such as fat embolism can occur. This methodology aligns with current findings that highlight the need for more accurate and safer techniques in aesthetic procedures, especially those involving fat transfer.

Furthermore, the studies included in this review suggest that ultrasound-assisted injection not only improves safety but also contributes to more effective aesthetic outcomes. However, it's important to consider the limitations and challenges of this technique, such as the cost of ultrasound equipment and the learning curve for its effective use. Despite these challenges, the integration of ultrasound in buttock fat transfer represents a significant advancement in cosmetic surgery, providing a balance between safety and aesthetic effectiveness.

In conclusion, this systematic review supports the use of real-time ultrasound for buttock fat injections, highlighting its crucial role in improving patient safety and achieving optimal aesthetic results. This technique represents a significant advancement in the practice of cosmetic surgery, promoting safer and more effective procedures.

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