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Superficial Intramuscular Gluteal Lipograft by Doppler Ultrasound: A Report of 24 Patients

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Background: Gluteal fat grafting is a common procedure in liposculpture. This study proposes a Doppler ultrasound–guided intramuscular and subcutaneous gluteal lipotransfer technique that allows for visualization of the location of the gluteal vessels, avoiding approaching them during lipotransfer by having the cannula localized during fat infiltration.

Methods: This new technique was applied to 24 women after obtaining informed consent and providing them with a clear explanation of potential risks and complications. Doppler ultrasound was used to locate the site and depth of blood vessels, and for quadrant scanning of vessels and superficial intramuscular visualization of the cannula's location. Intramuscular lipotransfer was performed with a volume of 400 mL per gluteus (or less), and 12 patients underwent magnetic resonance imaging before and 3 months after surgery.

Results: This technique allowed for visualizing the location of the gluteal vessels, and infiltration could be easily performed in patients. In the 24 glutei reviewed postsurgery, from 12 patients who underwent pre- and postsurgery magnetic resonance imaging, intramuscular fat was found; however, there was no migration outside the gluteus maximus muscle.

Conclusions: No local or systemic complications were observed. The results of our report show that fat filtration did not migrate outside the gluteus maximus muscle. This finding seeks to promote new research to create theoretical/practical precedents for the intervention of plastic surgeons and, from there, promote the standardization of a new and safe technique. *(Plast Reconstr Surg Glob Open 2024; 12:e5743; doi: 10.1097/GOX.0000000000005743; Published online 15 April 2024.)*

INTRODUCTION

Autologous fat tissue grafting for gluteal contouring is widely used in reconstructive and aesthetic surgery to treat volume and body contour defects. Gluteal fat grafting is a common procedure in liposculpture; however, it has been associated with medical complications.[1] Among those complications, fat embolism and death have been found to occur as a result of either direct damage to deep gluteal vessels or rupture by expansion.[2–4]

Previous studies have shown that migration of intramuscularly injected fat tissue can rupture veins and, through a suction mechanism, can allow fat to enter the bloodstream and cause complications.[5] It should be noted that these studies did not have an accurate visualization of the depth of infiltration, and they were conducted on cadavers, wherein the tissue does not have the same viability and resistance as that of living tissue. Therefore, the mechanism of venous damage is still unclear.[6,7]

Due to the increase in secondary fatalities to fat embolism from intramuscular lipotransfer in the United States, the Task Force on Lipoinjection was created to establish appropriate measures for lipotransfer.[5] One of its recommendations is not to perform lipoinjection deeply into the muscle. Subsequent to this establishment, studies reported a decrease in fatality rate; however, they did not specify the exact site of lipotransfer, let alone whether the exact injection plane was visualized by any method.[8–10]

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The current recommendation suggests performing lipoinjection only outside the muscle (subcutaneous) to avoid complications; however, the aesthetic result of gluteal contouring is inferior when compared with infiltration in both planes.[9,10] This study proposes a technique for intramuscular and subcutaneous gluteal lipotransfer[11] guided by Doppler ultrasound, which allows for visualization of the location of the gluteal vessels, avoiding approaching them during lipotransfer while also locating the cannula during fat infiltration. Additionally, presurgery and postsurgery MRI are proposed for 24 glutei to visualize whether fat migrates to deep spaces.

MATERIALS AND METHODS

The study sample consisted of 24 women who met the following criteria: aged between 18 and 60 years, body mass index of 25 kg/m² or less, surgical risk according to the Goldman index II or less, no sagging in the buttock area, and no history of buttock surgery (aesthetic or other specialties), excluding pregnant patients and those with degenerative neuromuscular diseases affecting the gluteal region. Patients were properly informed about the new technique to be applied, possible risks, complications, and even the possibility of death, and they confirmed their participation by signing informed consent. This study obtained approval from the local ethics committee of all the participating institutions, and procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki.

This multicenter study was carried out in Peru, Brazil, and Mexico. All patients were evaluated by four board-certified plastic surgeons trained in this procedure at Santa Julia Clinic, Lima; Le Blanc Clinic, Sao Paulo, Jardines Clinic, Tuxtla Gutiérrez-Chiapas; and Los Angeles Hospital, Mexico City. Additionally, all surgeons used calibrated and standardized ultrasound Doppler power machines, specifically the Butterfly iQ wireless portable ultrasound machine, a Clarius L7 HD, a SonoSite M-Turbo, and a Mindray Z60 shared service portable ultrasound machine.

The sociodemographic data of each patient were recorded in an Excel database for the corresponding statistical analysis. Of the total patients, 12 underwent pre- and postsurgery magnetic resonance imaging (MRI) of the buttocks, of which three patients agreed to the use of their images as visual material to contribute to the purpose of this study.

Regarding the evaluation process, with the patients standing and facing away, the buttocks were palpated to locate the ischial tuberosity (Fig. 1). In some patients, it was difficult to palpate the tuberosity, so they were asked to flex the upper body to locate it more easily. Once located, the area was marked with an indelible marker, which helped quickly locate the blood vessels; then, the buttock was marked according to the areas that needed to be increased. [**See Video (online),** which shows a superficial intramuscular gluteal lipograft by Doppler ultrasound.] To proceed with liposuction, patients were put under general anesthesia, with tumescent technique, and the tumescent solution used was 1.5 amp of epinephrine per liter of physiological solution. First, visualization of the gluteus maximus was performed to look for superficial vessels. If any of those vessels were visualized, we moved the syringe an average of 1 cm away from them. The fat was applied in boluses, seeking to give shape and projection to the gluteus. The average intramuscular application was 400 mL or less. It was not uniform in all cases due to variations in buttock shapes.

The original invention technique of the team began with the preparation of the fat using decantation process, with direct filtration performed with a closed technique. The process was carried out by surgeons and specialists trained in ultrasound-guided rectus abdominis fat transfer

Takeaways

Question: Is Doppler ultrasound–guided lipotransfer to the glutes at the intramuscular and subcutaneous level a safe option for surgeons?

Findings: This study included 24 women who underwent surgery with a new buttock lipotransfer technique. Gluteal fat transfer guided by Doppler ultrasound can be an effective and secure option for surgeons because it allows for visualization of the correct infiltration plane, detects gluteal blood vessels, and avoids approaching those vessels during the procedure.

Meaning: Doppler ultrasound–guided lipotransfer to the glutes at the intramuscular and subcutaneous level is a safe option for surgeons.

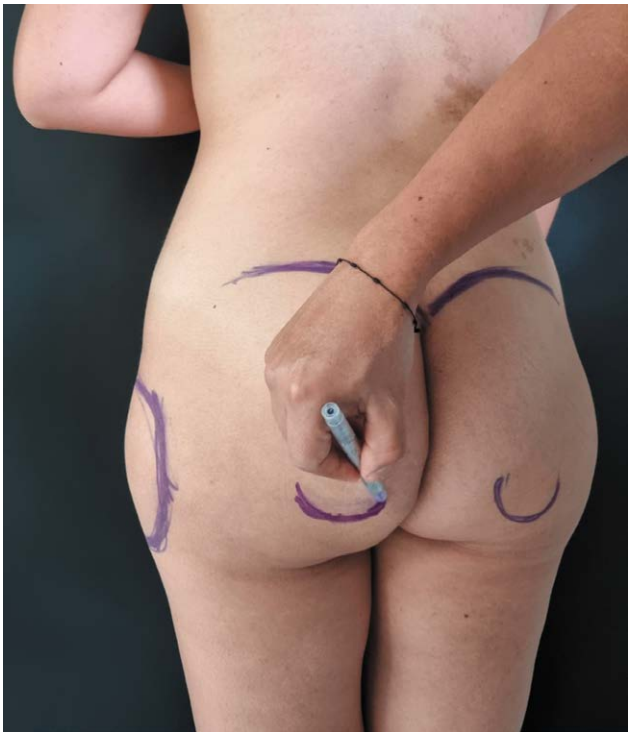

Fig. 1. Marking of the ischial tuberosity.

technique (the ultrasound-guided rectus abdominis fat transfer).[12,13] In patients, in the prone position with the transducer placed 5 cm above the mark, the tuberosity and the emergence of blood vessels were observed, visualizing the pulsations of the artery and corroborating with the Doppler (Fig. 2). The sciatic nerve and the superior and inferior gluteal veins were also visualized; it was necessary to decrease the pressure exerted on the transducer against the skin of the buttock to allow the vein to dilate and appreciate the flow. Once the emergence of the vessels was spotted, their location in their largest diameter was recognized, and care was taken not to perform lipoinjection near this area during lipotransfer.

Afterward, an intentional search with Doppler was carried out in each quadrant of both buttocks to determine the course of any branch of the artery or vein; it is easier to locate the arteries due to their pulsation. It is pertinent to remember that where an artery passes, there is a vein. Three incisions were made to introduce the cannula: one in the lower gluteal fold, the second at the level of the trochanter, and the third at the upper limit of the buttock. The cannula was introduced, and its location in plane and depth of the tip was visualized via ultrasound, as well as the gluteal fascia, which was crossed to determine that lipoinjection was also intramuscular. Once it was determined that there were no blood vessels in the path, lipotransfer was performed by infusion with 60-mL Toomy syringes in a retrograde direction. The two lateral quadrants were the first in which lipotransfer was performed from the orifice of the gluteal fold. Once the appropriate amount of fatty tissue had been placed, fat infiltration was performed through the lateral hole located at the level of the trochanter to give volume to the upper internal quadrant. After visualizing the paths of blood vessels with ultrasound and locating the tip of the cannula, 5-mm Toomey syringes were used, with Mercedes-type holes; the holes of the cannulas were filed on their edges to reduce the sharpness. From the upper hole, the cannula was directed to the medial portion of the buttock, and from there, lipotransfer was performed. Once the intramuscular lipotransfer was completed, subcutaneous lipotransfer was performed for better shape, as intramuscular fat provides greater projection.

All patients completed an online satisfaction survey using Google Forms 3 months postsurgery. The survey included questions about their satisfaction with the aesthetic and was created in Microsoft Excel, v.19. Statistical analysis was performed in SPSS software. (**See appendix, Supplemental Digital Content 1,** which shows the postoperative satisfaction survey. **http://links.lww.com/PRSGO/D156**.) (**See table, Supplemental Digital Content 2**, which shows postoperative satisfaction with aesthetic results. **http://links.lww.com/PRSGO/D157**.)

RESULTS

The surgical technique was performed on 24 women (average age: 34.5 years; average weight: 63.5 kg; average height: 1.58 m; average body mass index: 25.8), without any comorbidity (Table 1). In lipotransfer to the buttocks, when Doppler ultrasound was added for monitoring lipoinjection, deep venous and arterial vessels in the buttocks were identified, which were found at an average depth of 4–5 cm. Superficial branches were verified in gluteal quadrants; they were avoided by visualizing the tip of the cannula during fatty tissue injection, which was done at no more than 1-cm depth from the gluteal muscle. Although the surgical time increased by an average of 30 minutes, no local or systemic complications were presented, and adequate postsurgery buttock shaping was achieved. The difference can be observed in the pre- and postsurgery stage in patients 1 (Fig. 3A and B), 2 (Fig. 3C and D), and 3 (Fig. 3E and F).

By visualizing gluteal blood vessels and the exact level of placement of the grafted fatty tissue, placement can be precisely monitored, and approaching blood vessels can be avoided. The amount of fat extracted in patients averaged 1235.5 mL and infiltrated into the hip at 132.3 mL (Table 2); for the infiltration in the right buttock, it averaged 429.5 mL; and in the left buttock, it averaged 476.2 mL (Table 3).

The 12 patients who underwent preoperative MRI of the buttocks were invited to undergo MRI control at 3 months postsurgery. In the 24 buttocks reviewed by MRI, intramuscular fat was found, without migration outside

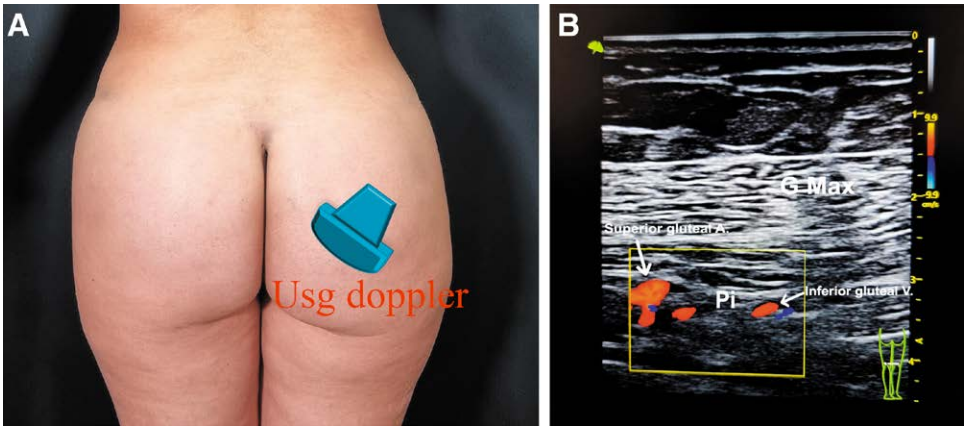

Fig. 2. A–B, Transducer placement to visualize the piriformis muscle and gluteal blood vessels.

Table 1. Sociodemographic Data of the Sample

Variable	Total	Minimum	Maximum	Mean
Age	24	18	60	34.5
Average weight	24	57	80	63.5 kg
Height (cm)	24	150	172	158
BMI	24	21.1	27.3	25.8
Comorbidity	24	—	—	None reported
Medications or antibiotic exposure before the procedure	24	—	—	None
Average time	24	38 min	60 min	40 min
Average IM amount	24			350 mL
Satisfaction with the procedure	24			100% satisfied

the major gluteal muscle in patients 1 (Fig. 4A) and 2 (Fig. 4B and C).

The results of satisfaction with the aesthetic outcome from the survey conducted during the third postsurgery month were divided into three groups: satisfactory (containing very satisfied and satisfied answers), indifferent (containing neither satisfied nor dissatisfied answers), and unsatisfactory (containing dissatisfied or very dissatisfied answers), showing 100% satisfactory results.

DISCUSSION

In our opinion, advances in liposuction techniques aim to achieve more precise results, prioritizing the safety and health of patients.[14,15] Proposing an appropriate surgical intervention should not only be based on the individual patient's characteristics and needs, but also develop techniques that contribute to a higher level of patient satisfaction.

For intramuscular lipotransfer to the buttocks, a high level of intraoperative mortality has been detected. The main reasons for mortality, among others, include fat embolism detected during intramuscular lipotransfer to the buttocks, multiple lesions of massive fatty pulmonary embolism, and right heart chambers with fat lobes, which have caused mechanical tamponade and death on the operating table. Cárdenas-Camarena et al[16] reported that of the 92 deaths due to liposuction, 22 were due to lipotransfer to the buttocks, and the remaining were attributed to liposuction as such. Unfortunately, they did not report the total number of patients attended and focused only on lipotransfer to the buttocks, without being clear about the exact reasons for the other 70 reported deaths. Deaths occurred intraoperatively, at the end of surgery and in a period of 1–24 hours after the end of surgery.[16,17]

The Aesthetic Plastic Surgery Education and Research Foundation (ASERF) established a working group of the American Society of Plastic Surgeons to establish recommendations to reduce mortality in buttock lipotransfer. The recommendations they propose include avoiding injecting deep into the muscle, using a cannula of 4.1 mm or more, and avoiding angling the injection downward, among others.[18] The analysis in this publication does not establish that lipotransfer should only be subcutaneous or that it should not be performed in the superficial muscle.

Studies have been carried out on cadavers, in which they evaluated the migration of the graft by placing it at the superficial and subcutaneous muscular level.[7] Researchers were able to identify migration of the applied material to the deep space when the application was done at the superficial muscular level. They measured a 2.5-cm vein and found that the maximum distention it reaches is 2 mm more. Due to migration, they established the "theory" of venous traction, wherein they reported that when fat is applied intramuscularly, the material migrates to the deep space and, due to distention of the deep space, this causes rupture of the vein. By a siphon mechanism caused by inspiration, the vein attracts the fat contained inside and, due to the proximity of the iliac veins, the fat quickly moves to circulation, causing fat embolism. However, we consider that this study, being carried out on cadavers, may cause greater slippage of the grafted tissue to other spaces because it does not have the resistance of living tissue. Likewise, the material they used for the experiment was not fatty tissue; it was applesauce with coloring, a material with a lower density than fat. They also base their findings on the "theory of venous traction," which has not yet been confirmed.[6,19]

A study was also carried out through surveying plastic surgeons from various associations around the world, asking whether the surgeons were aware of the ASERF recommendations,[8] whether they have followed them, and whether they have presented complications and cases of mortality. A change in mortality from one in 3000 to one in 14,921 was reported 2 years after the recommendations were reported. From these findings, the application of the recommendations made by ASERF, including not injecting the deep muscle, coincides with a decrease in mortality. It is pertinent to mention that this study does not mention the use of any device or other methods to determine the exact site of placement of the grafted fatty tissue.[9,19] It is known that intramuscular lipotransfer to the buttocks causes migration of the infiltrated tissue; however, the mechanism of venous traction injury remains a theory.[6]

Surgical anatomy studies of the gluteus maximus describe an intramuscular space (FROD space) that is easy to dissect with a muscle aponeurosis in its floor.[20] We consider that this space could contain the deepening of the infiltrated fat on the surface of the muscle when quantities are placed less than 400 mL intramuscularly.

Postmortem studies conducted in Florida reported that all cases of pulmonary fat embolism due to the Brazilian butt lift had fat injected into the gluteal muscles at all and at different levels, with the common finding being damage to the muscles adjacent to the gluteal vessels.[21,22] We consider that with Doppler-guided superficial muscle injection, fat injection near the gluteal vessels is avoided, which can also be verified with the results of MRI in the late postoperative period, where we see that there is no tissue migration to the subgluteal space of the injected fat even many days after surgery, during which the patient was in a supine position for long periods.

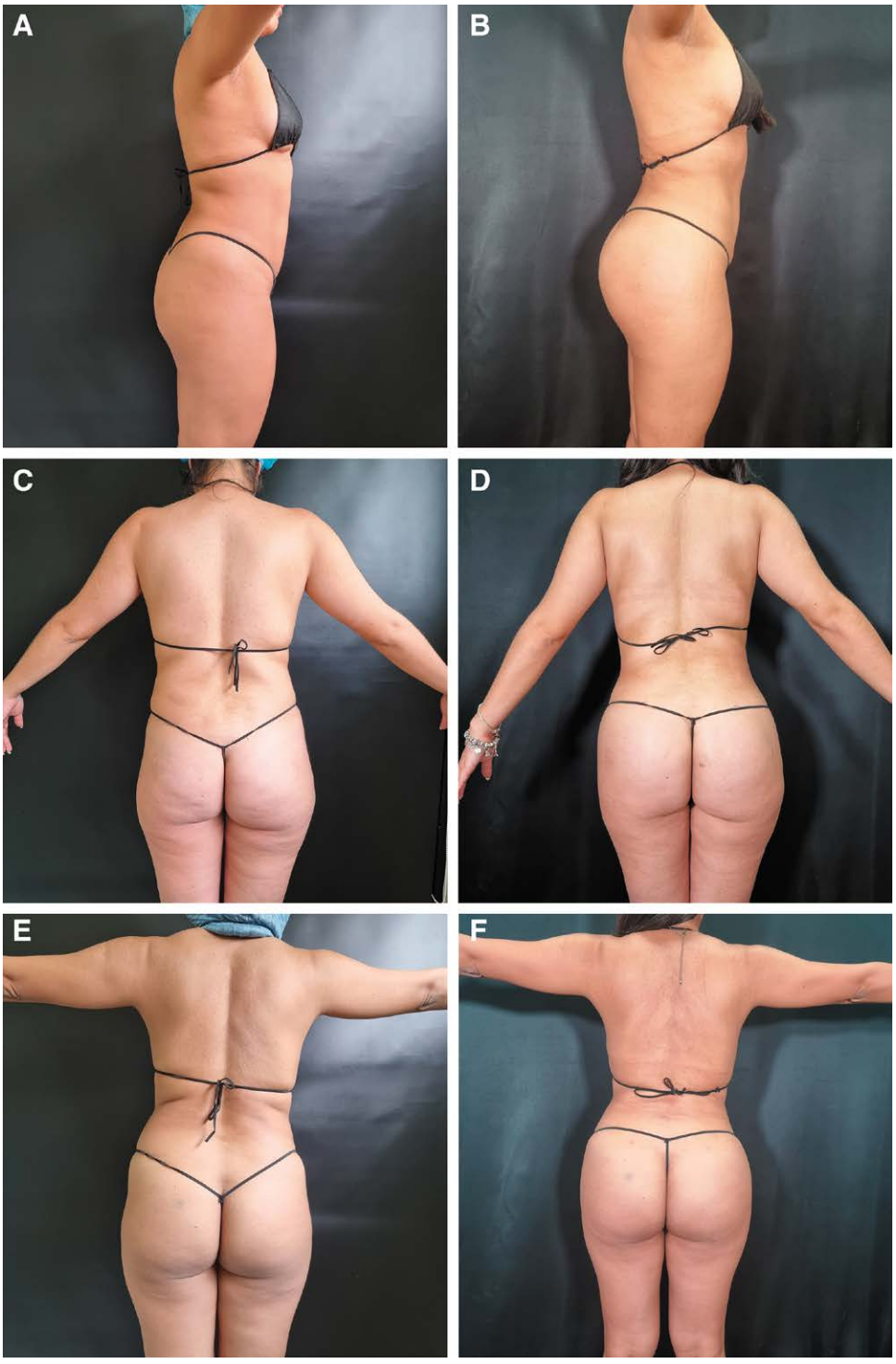

Fig. 3. Comparison of pre- and postsurgery buttock shaping in patients. A–B, Comparison of preoperative and postoperative buttock shaping in patient 1. C–D, Comparison of preoperative and postoperative buttock shaping in patient 2. E–F, Comparison of preoperative and postoperative buttock shaping in patient 3.

Table 2. Fat Extracted and Infiltrated in the Hip

Variable	M	Min.	Max.
Amount of fat extracted	1235.5 mL	40 mL	2500 mL
Amount of fat infiltrated in the hip	132.3 mL	50 mL	200 mL

Regarding lipoinfiltration, it is evident from our study that when guided and localized by Doppler ultrasound, the cannula can be viewed, and the location and depth of the blood vessels can be ascertained; therefore, the risk of venous injury by direct contact can be reduced. It

Table 3. Fat Infiltrated into the Glutes

Glutes	M	Min.	Max.	Lat. (mL)	Sup. (mL)	Sub. (mL)
Right	29.5 mL	200 mL	700 mL	M = 181 Min =100 Max = 200	M = 100 Min =100 Max = 200	M = 155 Min = 50 Max = 300
Left	476.2 mL	200 mL	700 mL	M = 95.5 Min = 10 Max = 100	M = 100 Min =100 Max = 200	M = 148.5 Min = 50 Max = 300

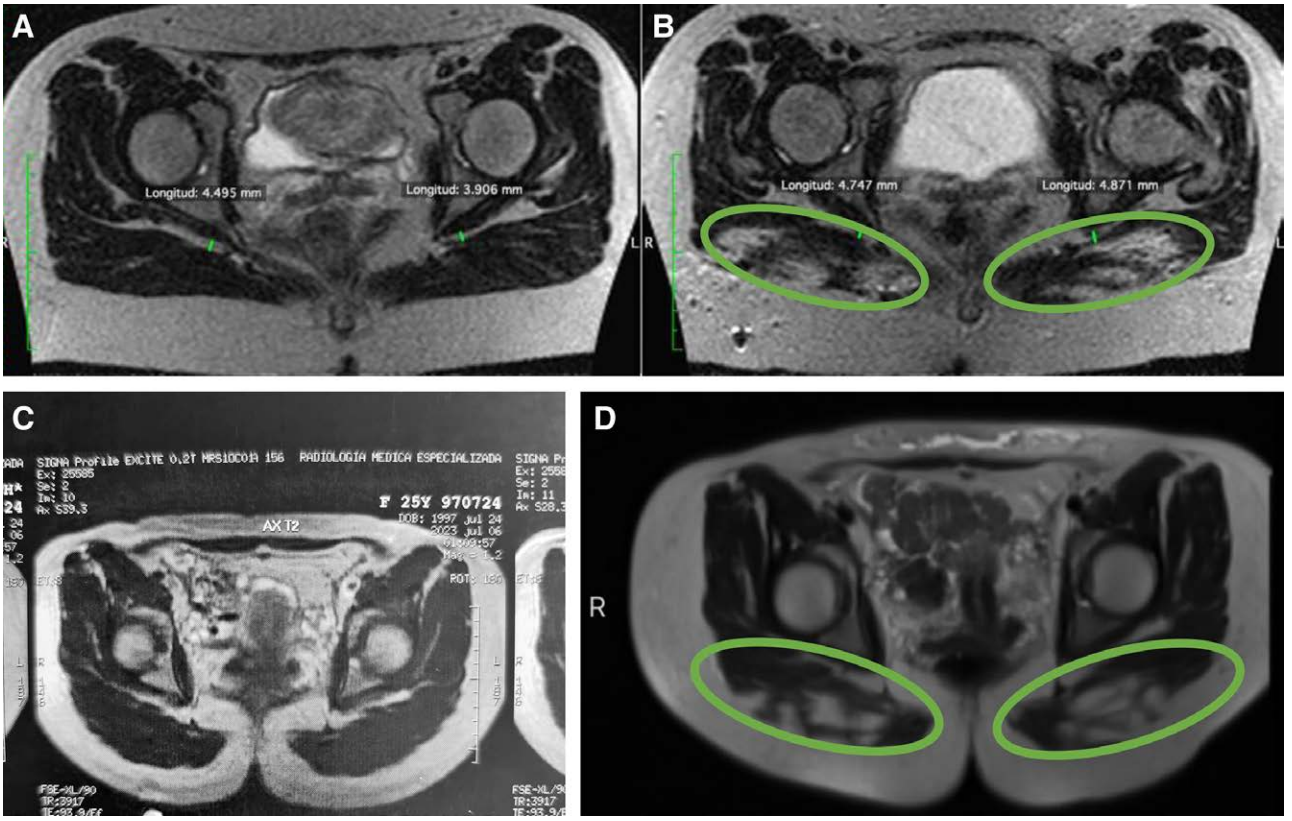

Fig. 4. Pre- and postsurgery MRI in patients. A–B, Pre- and postsurgery MRI in patient 1. C–D, Pre- and postsurgery MRI in patient 2.

is important to mention that with Doppler ultrasound, you can visualize vessels in both veins and arteries only above a certain caliber. The caliber of the superior gluteal artery is approximately 2.5–3.2 mm; in the superior gluteal vein, it is 2.8 to 2.2 mm; in the inferior gluteal artery, from 2.8 to 3.4 mm; and in the inferior gluteal vein, from 2.6 to 3.2 mm There are vessels superficial to the gluteus maximus, which on average measure 1.8 mm for arteries and 1.6 mm for veins. Likewise, the deeper the placement of the intramuscular fat, the greater the projection.

One of the limitations of this study is that the results correspond to a sample of only 24 cases. Therefore, the results cannot be generalized. However, it allows us to create a precedent to promote new research that encourages professional discussion.

The results of our report show that in a case series of 24 patients, fat filtration did not migrate outside the gluteus maximus muscle, and the use of Doppler ultrasound allowed important references in lipoinfiltration. We believe that the technique described here holds future promise in reducing the risks of morbidity and mortality associated with fat grafting into the gluteal muscle layer. This work may promote the evolution of a technique with improved aesthetic results compared with subcutaneous gluteal fat grafting alone. We also believe that this study may provide an opportunity for professional discussion and create an important precedent for future research.

CONCLUSIONS

Doppler ultrasound-guided gluteal fat transfer can be an efficient and secure option for surgeons because it allows for visualization of the correct infiltration plane, detects gluteal blood vessels, and avoids approaching them during the procedure.

In quantities of 400 mL or less, no migration outside the major gluteal muscle was observed, and having two

compartments to inject (muscular and subcutaneous) allows for greater injection of fatty tissue grafts, potentially improving the patient's satisfaction with the aesthetic results.

Significant investment is required for its use, including purchasing or renting ultrasound equipment, as well as the necessary training and preparation for the application of the technique and the use of ultrasound, in addition to considering the increase in surgical time. No adverse events associated with the technique were reported during this study.

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DISCLOSURE

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

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