

# Ultrasound-guided Fat Graft of the Obliques–Serratus Complex

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**Background:** The idea of the anterolateral thoracic musculature in men during the contour procedure is very limited, particularly in terms of surgical techniques that improve its appearance and aesthetics. Therefore, this study aimed to describe a technique of deep definition liposuction with intramuscular grafting of the serratus external oblique muscle complex.

**Methods:** A retrospective case series of a total of 11 cases of male patients aged between 29 and 60 years in the year 2022 is presented. These patients underwent body contouring surgery and subsequently underwent ultrasound-guided intramuscular fat grafting in the serratus external oblique complex. As part of the study, measurements were taken before and immediately after surgery. The data were stored in a database and analyzed with the statistical software SPSS, v23.0.

**Results:** The patients were aged between 29 and 60 years, with a mean age of 38.3 years ( $\pm 8.5$ ). All cases had a body mass index of 30. Results were matched preinfiltration and postinfiltration; These results were subjected to statistical validation using the Student *t* test for related samples, and statistically significant differences were obtained in all the measures tested.

**Conclusions:** The technique of fat grafting in the oblique-serratus complex allows for increasing muscle thickness. The measurements were made only immediately after the infiltration; it is important in the future to show the long-term follow-up. No adverse events occurred during the study. (*Plast Reconstr Surg Glob Open* 2023; 11:e5390; doi: 10.1097/GOX.0000000000005390; Published online 13 November 2023.)

## INTRODUCTION

Although body contouring has long been considered a female-dominated market, the growing popularity among men has led to a shift in focus on the market, which has grown exponentially over the past two decades. The rise of male body contouring surgery has been fueled by increased recognition of its safety and efficacy, decreased stigma through social media awareness, and increased

desire among men seeking to remain competitive in the social ambit. Recently, liposuction has evolved from a procedure of which the goal was primarily the removal of fat, to one that reshapes tissue with the goal of improving muscle definition. Historically, this patient population was composed of overweight men primarily concerned with abdominal circumference; it has since been dominated by two new patient populations: (1) massive weight loss with mild to moderate adiposity but significant excess skin,<sup>1</sup> and (2) young, athletic men looking to improve their muscle definition more than can be achieved by exercise alone.<sup>1–3</sup>

There are important differences between men and women when it comes to body definition. For example, the “six pack” in men is more defined, and in women, it is more discreet. With women, the shadow is more important; for men, you can create more abrupt grooves. The chest area is very important in male definition, and in women, the hip-buttock-posterior thigh areas are more important, and the arms are a great complement for a well-defined body, both in men and women.<sup>4</sup>

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Today, the use of muscle fat grafting for volumization within the body contouring procedure is clear, such as the one already described by Viaro.<sup>5</sup> With his ultrasound-guided rectus abdominis fat transfer technique, with flattering results, the inclusion of other muscle groups begins a boom in the subject of volumization within the male body contour. In this article, we emphasize a modification of the volumization technique with ultrasound-guided fat grafting.

The shape, volume, and definition of the anterolateral surface of the thorax play a crucial role in the aesthetics of male human anatomy. This is an undertreated or even neglected area during male body contouring treatment; however, fat deposits in men at this level are often prominent, so that the musculature at this level is hidden.<sup>6</sup> High-definition liposuction was designed to enhance the musculature by generating transitions in the fat layers and not in the musculature itself.<sup>6</sup> However, nowadays these techniques are not enough because new procedures have emerged, such as ultrasound-guided muscle fat grafting and liposuction techniques, which generate greater dynamism and definition from real muscle transformations.<sup>7</sup>

An important role in this new approach is occupied by the external oblique muscle, which originates on the external surfaces and inferior borders of the fifth to twelfth ribs and inserts in the anterior and superior iliac spine, mid-iliac crest, pubic crest, pubic tubercle, and linea alba. Recalling that the division of the fasciae of this muscle has a relevant implication on the semilunar lines, the Spiegel semilunar line corresponds to the line of division of the aponeuroses of the broad muscles of the abdomen to form the sheath of the rectus muscles. It extends from the end of the ninth costal cartilage to the pubic spine, following a curve with medial concavity. This is relevant because the volumization of both the rectus abdominis and external oblique muscles in the area discussed for this technique will produce a transition zone generated by the semilinear lines, where a true negative area not dependent on marking a line or shadow in the fatty tissue during liposuction will be produced. On the other hand, we have the serratus anterior muscle, which has an origin in the external surfaces of the first to ninth ribs and inserts in the medial border of the scapula, in the path of this muscle, and its contiguity with the external oblique muscle in ribs 6, 7, and 8 generate another important transition zone for the lateral aspect of the thorax where the insertions of this muscle on the surface of these ribs have relevance in men to give greater dimension and volume that contributes to the male V-shape, as well as in a natural way, the hypertrophy of this muscle visually contributes to an exercised and defined body (Fig. 1).

It is important to remember that these muscles, both the external oblique and the serratus, are flat muscles which, being hypertrophied and located on the costal bones, exert a visual effect of indentation, characteristic of this serratus-oblique complex, which exerts a visual effect of a better body definition.

The central objective of our work was to describe the increase in muscle volume in the oblique-serratus

### Takeaways

**Question:** Do male patients who undergo deep liposuction and USG-guided fat grafting of the oblique-serratus muscle complex, compared to those who do not undergo fat grafting, gain greater muscle volume in this area?

**Findings:** A total of 11 male patients underwent body contouring surgery with USG-guided intramuscular fat grafting to the oblique-serratus complex. Oblique and serratus thickness measurements were taken bilaterally before and immediately after infiltration. The results were subjected to statistical validation, and significant differences were obtained, demonstrating an increase in volume immediately after infiltration.

**Meaning:** In the Achilles technique, an increase in muscle volume is obtained immediately, improving body contour results.

complex, using the technique of ultrasound-guided muscle fat grafting.<sup>6</sup>

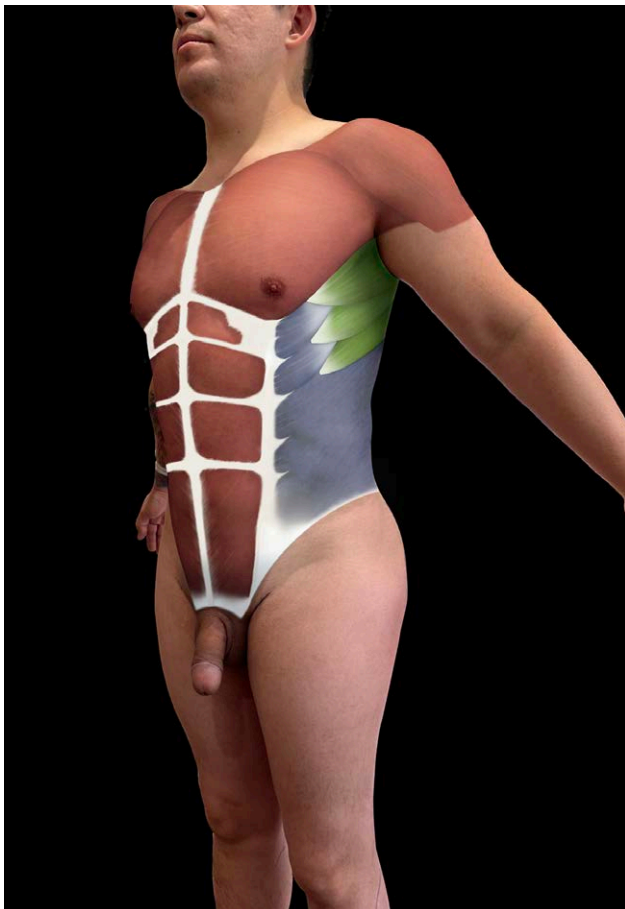
### MATERIAL AND METHOD

A series of retrospective cases is presented where a modification of the technique of ultrasound-guided fat-muscular grafting is performed, which included the cases of male patients undergoing body contouring surgery during the year 2022 in a private hospital. All patients received an evaluation consultation by a certified aesthetic and reconstructive plastic surgeon. They accepted the deep definition liposuction performance with the addition of fat grafting of certain muscle groups (pectoralis, deltoid, rectus abdominis, biceps, triceps, among others), including that of muscle complex serratus external-oblique muscles, forming part of the male body contouring procedure. They signed informed consent as part of the presurgical protocol.

The inclusion criteria include the following: age between 18 and 60 years, body mass index of 30 kg/m<sup>2</sup> or less, surgical risk according to the American Society of Anesthesiologist grade II, no anterolateral thoracic flaccidity, and no surgery or scars at that level.<sup>8</sup>

As part of the presurgical protocol, previously, in the medical consultation, the real goals and objectives of each patient were taken into consideration. Likewise, 7 days before the surgical procedure, patients were evaluated by an anesthesiologist and an internist, implementing the safe surgical measures recommended by anticoagulation protocols, according to the modified Caprini classification<sup>9</sup> (moderate and high risk), intermittent lower limb compression equipment, vital signs monitoring, antibiotic prophylaxis, and guidelines decreed by the American Association of Plastic Surgeons.

Patients underwent body contouring surgery, together with sculpting of the anterolateral and upper thoracic surface by fat grafting using the oblique-serratus complex fat grafting technique. This procedure was performed by a plastic surgeon trained in ultrasound-guided muscle fat grafting.



**Fig. 1.** Male anatomical model, where the external oblique-serratus anterior complex is represented. The external oblique muscle is shown in blue, and the serratus anterior muscles are shown in green.

### THE OBLIQUE-SERRATUS COMPLEX FAT GRAFTING TECHNIQUE

The muscles involved in this technique are the serratus anterior muscles and their contiguity with the external oblique muscles in their cephalic portion and bordering the medial border of the superior and medial packs of the rectus abdominis muscle.

The surgical marking is performed with the patient in a standing position. The medial borders of the external oblique and its fasciae, the semilunar line on the border of the superior, and the medial packs are located by means of software and a Sonosite Edge HFL38x 13-6 MHz ultrasound scanner and flat transducer. Once this area is found, which is approximately on ribs 6–8, the semilunar line and the anterior surfaces of these ribs are marked on their upper and lower edges. In the same way via ultrasound in longitudinal direction to the fibers of the external oblique muscle and traveling toward the lateral portion of the same, and on the anterior surface of ribs 6, 7, and 8, we will find the edges of the serratus anterior muscle and its transition with the external oblique muscle and mark this transition zone and the



**Fig. 2.** Scheme that symbolizes the surgical marking of the Achilles technique, which is carried out on the patient's own musculature.

path of these serratus indentations on the surface of ribs 6, 7, and 8 (Fig. 2).

During the surgical process with the patient in the lateral decubitus position, the 2.5×250 mm fr Viaro cannula (Serial Number: PAC-LP1352525) with two orifices of 25 cm length is inserted through an incision in the inferior border of the nipple. This cannula is visualized by ultrasound, and the medial border of the external oblique muscle is sought in its contiguity to the semilunar line; the previously marked costal borders are located, and the cannula will follow a trajectory in a transverse sense to the muscular fibers of the external oblique muscle; the cannula will be intruded and will follow the trajectory of the external oblique muscle passing through the sixth to seventh and until locating the eighth rib. Once this reference is reached, the intramuscular fat infiltration is started; 20–50 mL bolus infiltration is performed, starting from distal to proximal to the insertion site of the cannula. Once the infiltration of the external oblique muscle is completed, the previously identified serratus muscle is continued. In the same way, the same cannula is directed through the same previous site, in the same position of the patient, and continues in the previously marked trajectory of the serratus anterior muscle. The direction of this muscle will lead to introduce the cannula and to have a trajectory of the cannula parallel to the fibers of the oblique muscle and meeting the serratus muscle in its trajectory over the sixth, seventh, and eighth ribs, infiltrating in the same way fat from distal to proximal to the site of insertion of the cannula and in the same way intramuscular on the muscular

surface located in the costal bones in boluses of 20–50 mL. The whole process of cannula insertion, cannula trajectory, and fat infiltration is performed under ultrasound guidance. (See Video [online], which shows the detailed technique of fat grafting over the serratus-external oblique muscle complex in a 29-year-old male patient.)

The following data were collected from each case: pre- and immediate postoperative muscle thickness and the presence of complications such as embolism and hematoma. During the surgical procedure, the measurement of the infiltrated muscles was routinely performed at the moment before the infiltration and immediately after it.

Measurements of the thickness of the oblique muscles were taken at the level of the sixth, seventh, and eighth costal arches, before infiltration (io8, io7, and io6), on the right (io8d, io7d, and io6d) and left (io8i, io7i and io6i), and the measurements obtained were compared with their analogues after infiltration (postinfiltration) of the same muscles (po8d, po7d, and po6d, and po8i, po7i and po6i).

With the authorization of the patients in some cases, photographs were obtained to assess the postoperative results at 3 months. All data obtained were entered into a database using Microsoft Excel, v16.47.1. Statistical analysis was performed with SPSS software, v23.0. Demographic data were analyzed using measures of central tendency and dispersion. The thickness of the pre- and postoperative muscles were contrasted using the Student *t* test, considering values equal to or less than 0.05 as significant.

### ETHICAL CONSIDERATIONS

This study was carried out taking into account the Regulation of the General Health Law on research, with the latest reform published on April 2, 2014 and with the principles of the Declaration of Helsinki. According to the Regulations of the General Health Law on research, this is a type of research without risk because it uses techniques and methods of retrospective documentary research, in which no intentional intervention or modification was made in the physiological, psychological, and social variables of the individuals participating in the study.<sup>10</sup> This study does not contemplate any intervention in the medical management of patients and, therefore, does not

interfere in the doctor-patient relationship because it is solely observational. The information collected will be kept in absolute confidentiality, safeguarding the identity of the patients and their clinical history. It should be mentioned that all patients have informed consent as part of the presurgical routine.

### RESULTS

Eleven cases of male patients who underwent body contouring and muscle volumization surgery using ultrasound-guided fat grafting of the oblique-serratus muscle complex were analyzed. The mean age was 38.3 (8.5) years, and 73% of patients were under the age of 40 years. All cases had a body mass index of 30. Seven of the 11 patients (63.6%) underwent primary liposuction, and four of the 11 patients (36.4%) underwent secondary liposuction. In all cases, deep liposuction was performed, ultrasound was used for infiltration during liposuction, and lipotransfer was performed. Primary abdominoplasty was performed in six of the 11 cases (54.5%; Table 1).

A mean of 3.52L (±0.69) was obtained when using primary liposuction, and an extraction of 2.87L (±0.66) when using secondary liposuction; these differences were validated by the Mann-Whitney *U* test, without finding statistically significant differences (*P* = 0.23) between the techniques.

The measurements of the muscle thicknesses of the oblique-serratus complex are presented in Tables 2 and 3. The average thickness of each muscle is reported, and when comparing the pre- and postoperative measurements, the change was statistically significant in all muscles. There were no complications such as hematoma or embolism.

### DISCUSSION

Fat grafting has been used for more than 100 years, with different clinical applications: breast cancer sequelae, burn scars, autoimmune diseases, facial rejuvenation, etc. Therefore, autologous fat has always been considered one of the safest fillers, with success estimates of up to 50%. However, two problems remain. The original en bloc

**Table 1. Demographic Characteristics of the Patients**

No.	Patient Demographics					
	Age (y)	BMI (kg/m <sup>2</sup> )	Primary Liposuction	Secondary Liposuction	Extracted Fat (L)	Primary Abdominoplasty
1	45	30	No	Yes	3.4	Yes
2	38	26.1	Yes	No	3.3	Yes
3	37	26.7	Yes	No	2.5	Yes
4	41	28.1	Yes	No	2.9	Yes
5	29	30	Yes	No	4.2	Yes
6	39	28.4	Yes	No	4.1	Yes
7	33	27.1	No	Yes	3.1	No
8	37	26.2	Yes	No	4.3	No
9	33	27.7	No	Yes	1.9	No
10	60	29.7	No	Yes	3.1	No
11	30	28.1	Yes	No	3.4	No

**Table 2. Preoperative Diameter (before Lipoinfiltration) of the Oblique Muscles, Measured by Ultrasound, and the Postinfiltration Fat Diameter with a Value of  $P = 0.001$** 

Infiltrated Site	Oblique Muscles		<i>P</i>
	Pre Infiltration (cm)	Post Infiltration (cm)	
M. O. 8 <sup>a</sup> right	0.46 (0.15)	1.27 (0.14)	0.001*
M. O. 7 <sup>a</sup> right	0.46 (0.15)	1.30 (0.12)	0.001*
M. O. 6 <sup>a</sup> right	0.46 (0.16)	1.32 (0.14)	0.001*
M. O. 8 <sup>a</sup> left	0.44 (0.14)	1.31 (0.09)	0.001*
M. O. 7 <sup>a</sup> left	0.45 (0.16)	1.31 (0.15)	0.001*
M. O. 6 <sup>a</sup> left	0.48 (0.17)	1.31 (0.11)	0.001*

Values in parentheses indicate SD.

\*Statistically significant.

**Table 3. Preoperative Diameter (before Lipoinfiltration) of the Serratus Muscles, Measured by Ultrasound; and the Postinfiltration Fat Diameter with a Value of  $P = 0.001$** 

Infiltrated Site	Serratus Muscles		<i>P</i>
	Pre Infiltration (cm)	Post Infiltration (cm)	
M. S. 8 <sup>a</sup> right	0.49 (0.18)	1.31 (0.11)	0.001*
M. S. 7 <sup>a</sup> right	0.54 (0.19)	1.34 (0.17)	0.001*
M. S. 6 <sup>a</sup> right	0.58 (0.21)	1.38 (0.13)	0.001*
M. S. 8 <sup>a</sup> left	0.50 (0.18)	1.31 (0.14)	0.001*
M. S. 7 <sup>a</sup> left	0.54 (0.19)	1.33 (0.16)	0.001*
M. S. 6 <sup>a</sup> left	0.58 (0.18)	1.39 (0.11)	0.001*

Values in parentheses indicate SD.

\*Statistically significant.

technique required removal of donor tissue and resulted in a second problem; patients were essentially exchanging one defect for another. In addition, the solid, particle-free nature of the tissue required implantation, which could result in surgical scarring.<sup>11</sup>

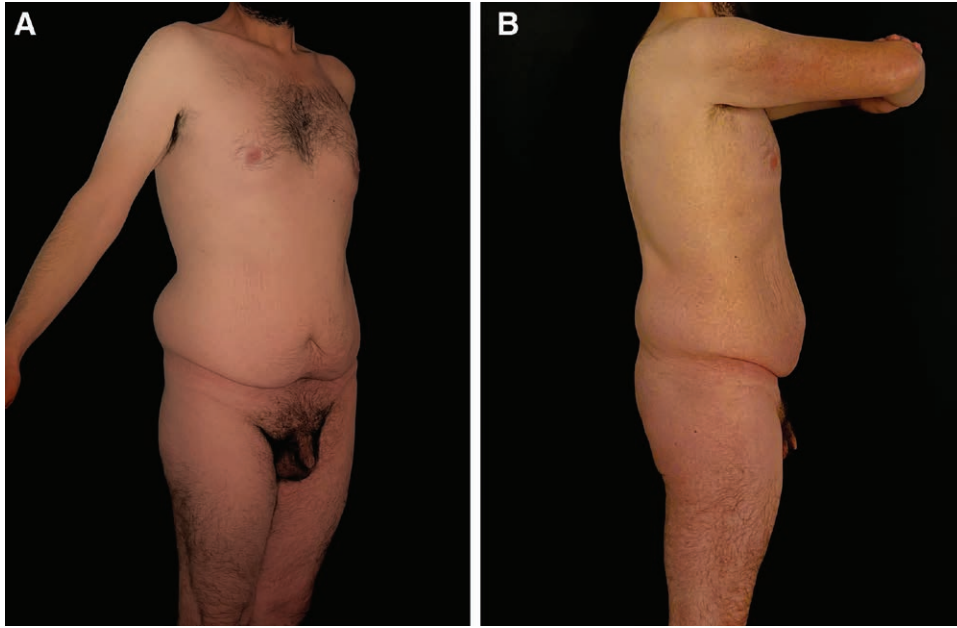
In multiple studies, there is evidence that adult mesenchymal stem cells seem to be an ideal stem cell population for regenerative medicine. Among these cells, adipose-derived stem cells have the potential to differentiate mesenchymal, ectodermal, and endodermal lineages. In particular, the ability of fat stem cells in a stimulating and proactive environment to promote tissue regeneration and maturation through the active participation of growth factors, and the differentiation of latent cells into active cells have been demonstrated.<sup>12–16</sup>

At present, an increase in the use of autologous fat transfer for muscle tissue augmentation has paralleled the growing popularity of liposuction for body contouring. This creates an inexpensive and readily available product for lipografting, which is the application of liposuctioned material. In recent times, there is the precedent of muscle fat grafting in body contouring surgery, initially with Viaro, Manzaneda, Danilla, and Hoyos<sup>5,7,12,17</sup> Therefore, muscle fat grafting in surgery is an essential part to complement body contouring surgery, which has evolved sharply in recent years, with big contrasts between the standards of care that were used in earlier times for traditional liposuction and those that we use today for high-definition liposuction involving the principle of “all or nothing” in which all body and muscle surfaces are intervened, following the aesthetic and natural concept of results.<sup>18</sup>

In a specific search carried out in databases (PubMed, ScienceDirect, Ovid, ClinicalKey), this issue related to volume increase using fat grafting of the external oblique–serratus anterior muscle complex was not found; however, as already mentioned, there is the history of volume increase in other muscle groups. In this review, a modification of the surgical technique is exposed. Specifically in this anatomical area, we handle muscle volumization by combining deep liposuction and intramuscular fat grafting, generating muscle transitions. So, we consider that the aesthetic and sculptural concept of the anterolateral surface of the thorax is underappreciated and undertreated and therefore underdeveloped, considering that it can be enhanced in combination with fat infiltration of other muscle groups and with body contouring surgery itself.

This study aimed to detail our surgical technique of muscle augmentation by ultrasound-guided fat grafting of the serratus external oblique muscle complex. For this purpose, an ultrasound study was conducted, and before and after surgical procedure photographs were taken to verify obtained volume increase and to statistically analyze the volumization, obtaining the preinfiltration and postinfiltration values of both muscles, which showed statistically significant differences in all the evaluated measures ( $P < 0.001$ ).

Below are two examples of male patients undergoing high-definition deep liposuction with ultrasound-guided fat grafting of the serratus-external oblique muscle complex (Fig. 3A–6B). It is worth mentioning that the use of ultrasound for this surgical technique represents a lot of value because it helps us to accurately locate this muscle complex, ensuring that we are in the desired space, avoiding vascular and even pulmonary injury.



**Fig. 3.** Before and after the Achilles technique. A, Presurgical oblique view of a 37-year-old male patient undergoing deep high-definition liposuction and lipoinfiltration of the external oblique-serratus complex. B, Presurgical lateral view of the patient.

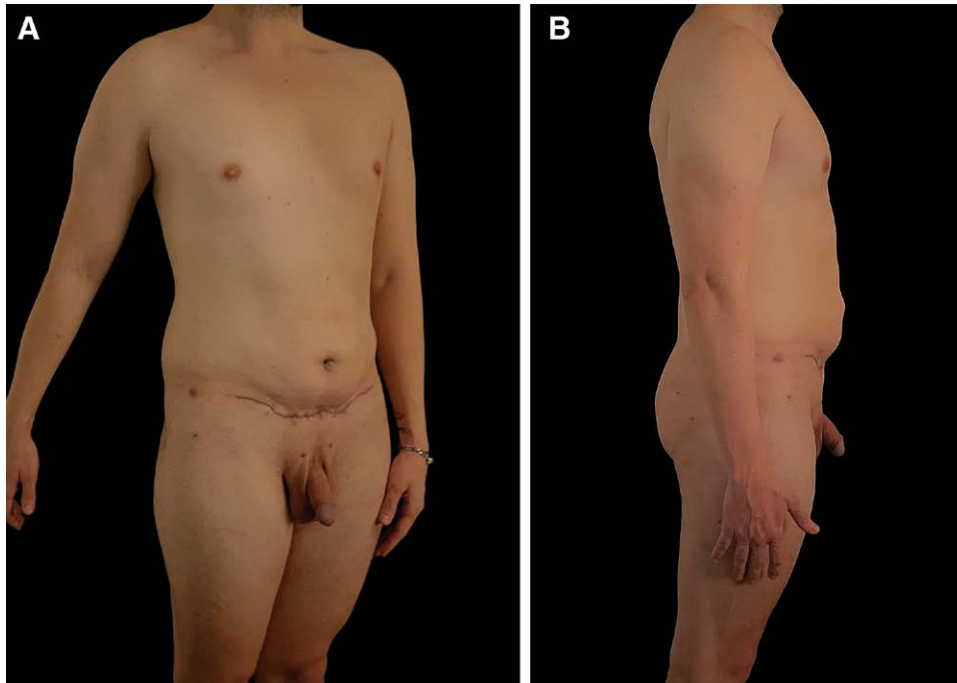


**Fig. 4.** Before and after the Achilles technique. A, Postoperative oblique view 3 months after high-definition deep liposuction and lipoinfiltration of the external oblique-serratus complex. B, Postoperative lateral view.

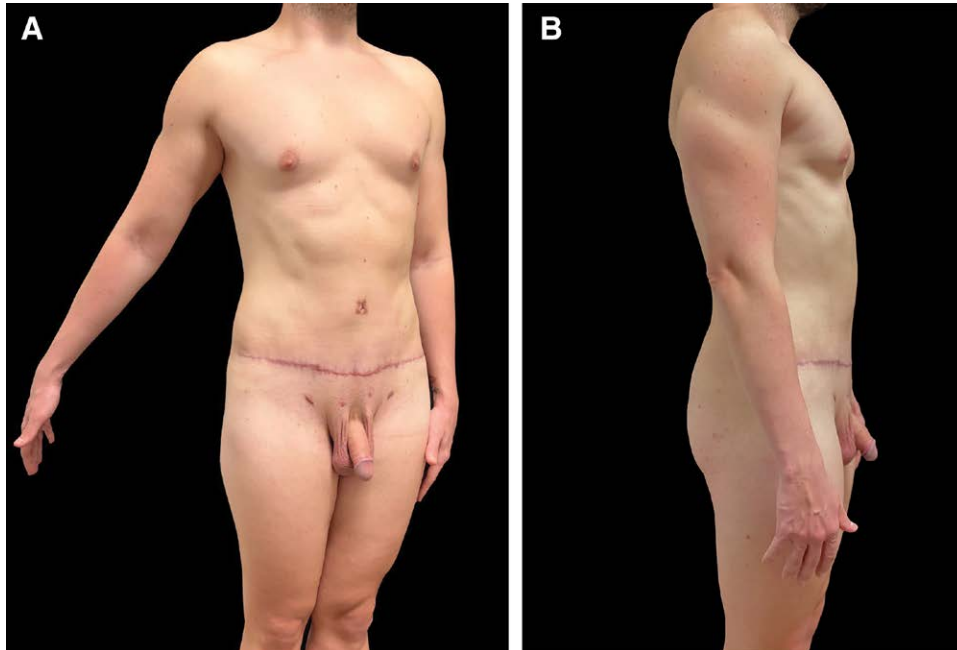
### LIMITATIONS

The main limitation here is that it is a retrospective study (the information from clinical records was recovered), even though an attempt was made to explain, via

diagrams and video, how the technique was performed and measurements were taken. The measurements were taken only immediately after the infiltration. It is important in the future to show the long-term follow-up.



**Fig. 5.** Before and after the Achilles technique. A, Pre-surgical oblique view of a 39-year-old male patient undergoing deep high-definition liposuction and lipoinfiltration of the external oblique-serratus complex. B, Pre-surgical lateral view of a patient undergoing deep high-definition liposuction and lipoinfiltration of the external oblique-serratus complex.



**Fig. 6.** Before and after the Achilles technique. A, Postoperative oblique view 3 months after high-definition deep liposuction and lipoinfiltration of the external oblique-serratus complex. B, Postoperative lateral view.

### CONCLUSIONS

In the reported cases, a significant increase in the thickness of the oblique-serratus complex muscles was

observed after the use of the ultrasound fat infiltration technique already described in the literature. In this particular case, it was performed in an unexplored

muscle group, without the presence of complications. This study, despite being retrospective and merely descriptive, provides the basis for the description of the infiltration technique of this muscle complex and for carrying out studies with greater methodological rigor that demonstrate the efficacy and safety of this technique modification.

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#### DISCLOSURE

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

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