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Adipose Tissue Transfer in Dynamic Definition Liposculpture Part II. The Lower Limb: Gastrocnemius, Vastus Medialis, Vastus Lateralis, and Rectus Femoris Muscles

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Background: One big challenge of body contouring surgery is the liposculpture of the lower limbs, probably because of the imperative symmetry and the risk of contour irregularities. We are reporting our experience in fat grafting of the thighs and calves for men and women undergoing dynamic definition liposculpture.
Methods: We did cadaveric dissections of the vastus lateralis, vastus medialis, rectus femoris, and gastrocnemius muscles and identified each of their primary pedicles. We also performed fat grafting of these muscles in the contralateral virgin cadaveric specimen. We searched our records for patients who underwent fat grafting of the lower extremity in addition to dynamic definition liposculpture, from January 2016 to May 2022 at a single center in Bogotá, Colombia.
Results: Seventy-three consecutive patients met the inclusion criteria (26 men and 47 women). We grafted 102 gastrocnemius muscles, 86 vastus medialis muscles, 98 vastus lateralis muscles, and 22 rectus femoris muscles. Mean age was 34 and 41 years for men and women, respectively. Range of the fat graft volume was 50–200 mL. No complications were recorded related to fat grafting. Almost all patients were satisfied with the procedure (89%). Follow-up period ranged from 2 to 36 months.
Conclusions: Fat grafting of the lower limb muscles should be considered an alternative operative technique to enhance volume and athletic appearance of this body segment. Based on cadaveric dissections and clinical evidence, our technique is considered reliable and reproducible with remarkable outcomes and a very low complication rate.
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INTRODUCTION

Concepts of beauty have been linked to humanity since dawns of civilizations, in particular well-developed limbs do exemplify strength, athleticism, youthfulness, and beauty in both men and women. As goals for symmetry are set, liposculpture of the lower limbs is a challenging body contouring surgery as it carries a high risk of contour irregularities, since the shape of the thighs and legs depends on the balance and proper development of muscles, bones, and subcutaneous fat.[1,2]

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Thigh lift and liposuction are the most widely used techniques to enhance the aesthetic appearance of the leg and to correct deformities caused by congenital defects, trauma, disease, or infections,[1,2] although aging and/or massive weight loss patients do get the greatest benefit.[3,4] The use of silicone implants for calves' and thighs' volumizing has also been described, although case series is limited and has reported a considerable number of complications.[5–7] Although they may improve the overall appearance of the leg, their use has several potential complications, including hyperpigmentation, seromas, extrusion, infection, capsular contracture, secondary surgeries, and compartment syndrome.[1,8–10] Comparatively, fat grafting is likely to volumize the leg with a reduced likelihood of complications due to the autologous nature of the tissue transfer. We did an anatomical review + cadaveric dissections of the quadriceps and the gastrocnemius muscles before and after our fat grafting technique to provide safety recommendations. We are also reporting our surgical experience about intramuscular (IM) fat grafting of such muscles.

Artistic Anatomy

Thighs have three muscle compartments (anterior, posterior, and medial), similar to the legs (anterior, posterior, and lateral).[11] All of the muscles from these compartments get their blood supply from two main arteries: the femoral artery and the tibial artery.

The vastus lateralis is one of the four muscles of the quadriceps and occupies two-thirds of the lateral thigh surface. Its size is near 10 cm wide and 26 cm long, extending from the proximal femur to the patella, running between the vastus intermedius and biceps femoris muscles, and beneath the tensor fascia latae m.[12,13] The descending branch of the lateral circumflex femoral artery corresponds to its dominant pedicle[14,15] (Fig. 1), which also provides the blood supply for the rectus femoris muscle (Table 1). The vastus medialis muscle is located at the medial aspect of the thigh, deep to the sartorius and medial to the rectus femoris.[16] Its length and width are 15 and 8 cm in average, respectively. Surface anatomy of the posterior thigh is mostly configurated by the biceps femoris on the lateral region and the hamstrings on the medial one. Both these muscles receive their innervation from muscular branches of the sciatic nerve and blood supply from perforating branches from the deep femoral artery (Fig. 2).

The Gastrocnemius is the most superficial muscle of the posterior upper third of the leg, its size is about 20 cm long and 8 cm width,[15] composed by two muscular bellies, from which the medial one is a bit longer and extends more inferiorly (Fig. 3).

The venous system of the lower limb has a special configuration and comprises three different plexus that are connected between each other: (1) the subcutaneous venous network (between the deep muscular fascia and the skin); (2) the deep venous network (main veins); and (3) the perforating veins, which are short vessels that penetrate the deep fascia and connect the superficial and deep systems.[13–17]

Takeaways

Question: Is there any type of surgery to improve both the leg contour and its definition for men and women?

Findings: We did cadaveric dissections to identify the relevant anatomic structures to achieve a safe fat grafting technique of the lower limb muscles. Furthermore, we completed over 140 lipoinjections of its different muscles with great results and very low rate of complications.

Meaning: Intramuscular and subcutaneous fat grafting of the lower limb can be considered a great alternative for both muscular enhancement and definition.

MATERIALS AND METHODS

We performed cadaveric dissections of the lower limb in an attempt to support the safety and reliable approach of the IM fat grafting of the muscles from the thigh and the leg. The vastus medialis, the vastus lateralis, the rectus femoris, the gastrocnemius, and the soleus muscles were all dissected following the anatomic models to locate the main pedicles and their distribution within the muscle. Scalpel with 15/20 blades, tissue scissors, and tissue forceps were used to separate the anatomic layers, vascular retractors, and markers that were used to denote the main pedicles and vessels. First, we located the pedicle and then did a lipoinjection test on the contralateral virgin muscle with methylene blue to identify its proper placement at the IM layer for the thigh's muscles and the gastrocnemius muscle. (**See Video 1 [online]**, which displays cadaveric dissection of the thigh. Beware of the "danger triangle" where most vital structures of the thigh are located. Fat grafting of the vastus medialis and vastus lateralis muscles shows the superficial location of the graft, which is an actual premise for a safe approach.) (**See Video 2 [online],** which displays cadaveric dissection and fat grafting of the gastrocnemius muscle. The lateral head and the medial head have different access points to avoid the popliteal fossa, where critical neurovascular structures are present. The distal access [Achilles region] may be too close to neurovascular structures; hence, it should be avoided.)

The senior author incorporated the fat grafting technique for the rectus femoris, the vastus medialis, vastus lateralis, and the gastrocnemius muscles into dynamic definition liposculpture (HD2) since mid 2015; hence, we conducted a retrospective review of the medical records from January 2016 to May 2022 at a single center (Dhara Clinic) in Bogotá, Colombia. Inclusion criteria were: any patient who underwent high definition liposculpture (HDL) or HD2 in addition to fat grafting of any muscle of the lower limb. Exclusion criteria included active smokers, patients with body mass index above 30 kg/m^2, patients with PMH with blood clotting disorders or any thrombotic event (ie, DVT and PE), and patients with American Society of Anesthesiologists (ASA) risk classification of III or superior. Cardiology assessment, including EKG and chest X-ray, was required for patients above 40 years old. All patients were subject to protocols for safe large-volume liposuction including those for thromboembolic

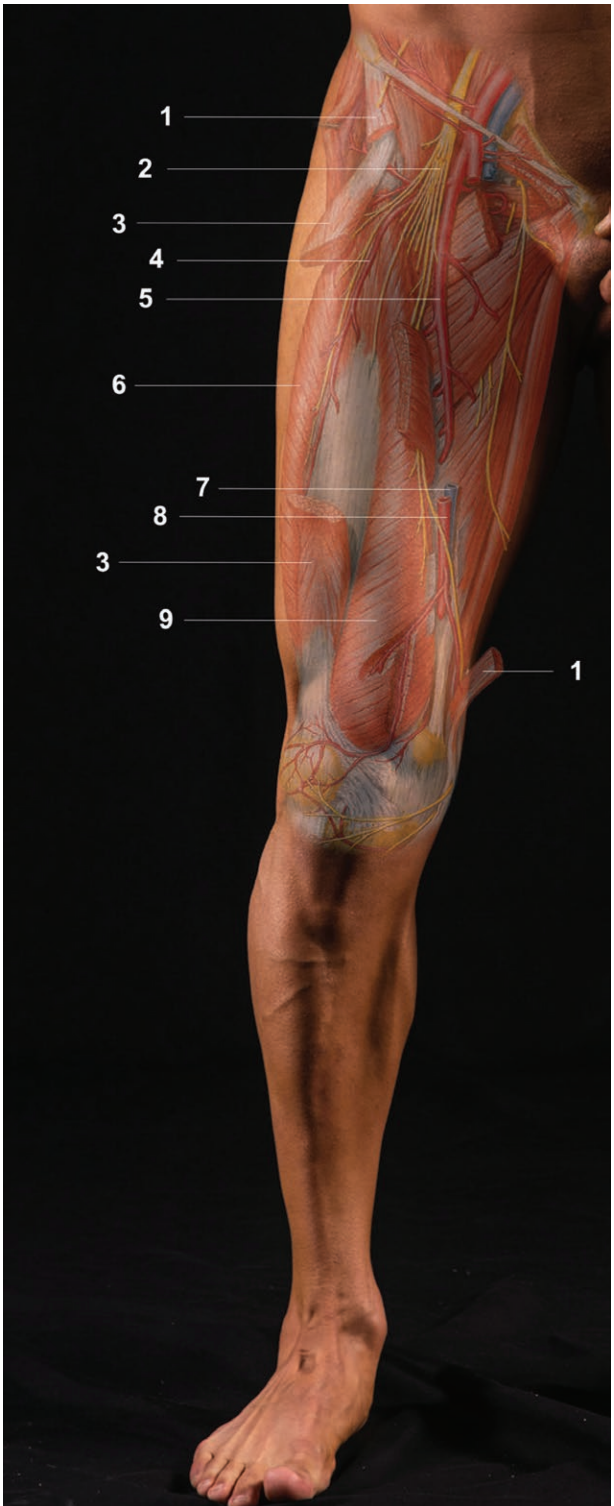

Fig. 1. Muscles and neurovascular structures related to the anterior thigh: sartorius muscle (cut) (1), femoral nerve (2), rectus femoris muscle (3), lateral circumflex femoral artery (4), deep femoral artery (5), vastus lateralis muscle (6), femoral vein (7), femoral artery (8), vastus medialis muscle (9).

Table 1. Power Muscles of the Leg

Muscle	Anatomy	Description
Vastus lateralis m.	Main arterial pedicle	Descending branch of the lateral circumflex femoral artery is approximately 3 cm long and 1.5 mm in diameter and is located in the superior third of the muscle, extending along its medial border.
	Secondary arterial pedicle	1. Transverse branch of the lateral circumflex femoral artery: 3 cm long, 1 mm in diameter, and enters the muscle at the superior-posterior surface. 2. Posterior branch of the deep femoris artery: 1–2 cm long, 0.4 cm in diameter, and located in the inferior half of the muscle at the arterial intermuscular septum. 3. Superficial branch of the lateral superior genicular artery: 3 cm long, 0.5 mm in diameter, and located at the lateral condyle of the knee.
	Innervation	Femoral nerve
Vastus medialis m.	Main arterial pedicle	Descending branch of the Superficial femoral artery: 1–3 cm long and 1–1.5 mm in diameter, and enters the muscle at the junction of the mid third with the upper third.
	Secondary arterial pedicle	Branches coming from the superficial femoral artery (about 1–3 cm long and 1 mm in diameter) located deep and medial to the muscle. Some musculoarticular branches of the descending genicular artery (about 2 cm long and 1 mm in diameter) are located deep to the distal portion of the muscle.
	Innervation	Femoral nerve
Rectus femoris m.	Main arterial pedicle	Profunda femoris and descending branch of the lateral circumflex femoral artery.
	Secondary arterial pedicle	Branches coming from the superficial femoral artery.
	Innervation	Femoral nerve
Gastrocnemius m.	Main arterial pedicle	Medial and lateral sural arteries, branches from the posterior tibial artery and the popliteal artery, both 6 cm long and 2 mm in diameter
	Secondary arterial pedicle	Posterior and superficial branches of the peroneal artery.
	Innervation	Tibial nerve

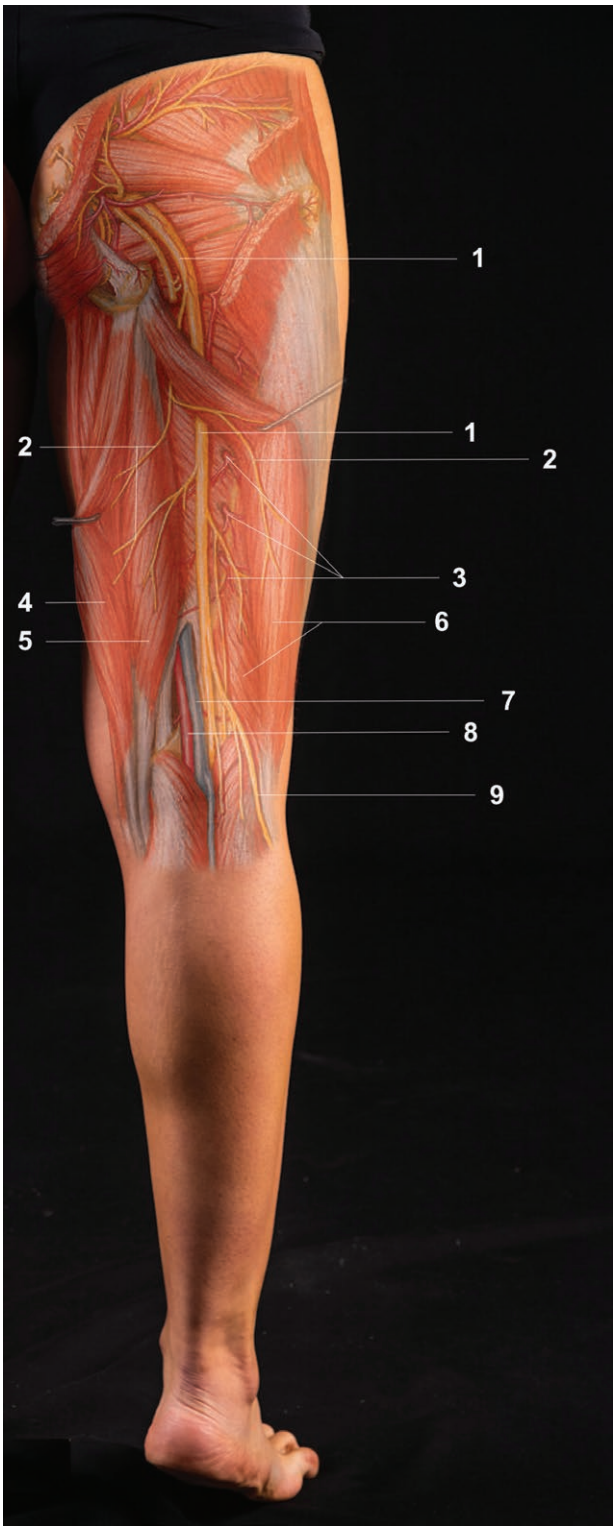

Fig. 2. Neurovascular structures related to the posterior thigh: sciatic nerve (1) and its muscular branches (2); perforating branches of the deep femoral artery (3). Semitendinosus (4) and semimembranosus muscles (5), biceps femoris (6), popliteal vein (7), popliteal artery (8), common fibular nerve (9). *Note: The incision for liposuction and fat grafting of the posterior lower limb should be away from both the center (popliteal fossa) and the bony prominences (common fibular nerve).*

Fig. 3. Neurovascular structures related to the leg: medial head (1) and lateral head (2) of the gastrocnemius muscle. Popliteal artery (3), tibial nerve (4), anterior tibial artery (5), soleus muscle (6), posterior tibial artery (7), fibular artery (8).

events prevention, blood conservation, and hypothermia prevention.[18]

IV medications used were: antibiotic prophylaxis with cefazolin (2 gr IV, 60 minutes before incision), dexamethasone 8 mg, metoclopramide 10 mg, diclofenac 50 mg, and ranitidine 50 mg. Photographic records were taken before and during follow-up at 2 days and 1, 3, 6, and 12 months after surgery.

Surgical Technique

Markings

They are done in the standing position.

1. Gastrocnemius muscle: Ask the patient to stand on tip toes, then palpate the limits of the muscle mass and draw a line for demarcation, particularly the medial head in women and the lateral head in men. Address any lack of projection, the muscle volume, and tone as well.
2. Quadriceps: Ask the patient to do an isometric contraction and feel/see the muscular bellies. Delineate the distal portion of the vastus lateralis, the vastus medialis, and the rectus femoris muscles. Any muscle requiring volume augmentation is marked with a crossed pattern, so as to recognize which one has to be grafted once at the operating table (OT).
3. The "danger triangle" between the sartorius muscle, the adductor group, and inguinal ligament is drawn to prevent any injury of the main neurovascular pedicles.

Dynamic Definition Liposculpture

Liposculpture is achieved by a three-step process.

1. Infiltration: Tumescent solution (1000 mL of saline and 1 mL of 1:1000 epinephrine) + lidocaine (10 mg/kg), for both the lower limb and the arms liposuction, which will help to ameliorate the exquisite postoperative pain of the extremities.
2. Fat Emulsification: Third-generation ultrasound (VASER system) in pulsed (60%–70% power) and continuous modes (60-80% power) for the superficial and deep adipose layers, respectively. Pulsed mode at 60% power for all four extremities.
3. Microaire-assisted Liposuction: Thorough debulking of the adipose tissue with 4.0-mm and/or 5.0-mm Mercedes cannulas over the deep layer. We use 3.0-mm Mercedes cannulas for detailed muscular definition (superficial layer), which is achieved based on the Basic, Moderate, and Xtreme definition algorithm.[19]

Fat Grafting

The adipose graft is harvested from the lipoaspirate, mainly from the abdomen and inner thighs. We add hypochlorous acid into the harvesting canister, which servers as both a bactericide and a cleansing solution. The Vibratory Tissue Separator (VTS Wells Johnson, Tucson, Ariz.) accelerates the process of decantation, then we transfer the supernatant to 60-mL syringes in preparation for adipose grafting.

Vastus Medialis and Lateralis

Patient must be in the supine position over the OT.

1. The kneecap incision gives access to both vastus muscles.
2. The tip of the cannula must be perpendicular to and far from the pedicle: about 45° and 30° away from the thigh's midline for the vastus medialis and vastus lateralis, respectively.
3. Pinch the muscle bulk with almost a complete hand grip.
4. Place the tip at the center of the muscle bulk and drive the cannula into the muscle (by means of a gentle stab). One should feel a click or a decrease in resistance once inside.

Keep the tip stable and place the graft superficially through fanning and retrograde movements. (**See Video 3 [online]**, which displays fat grafting of the male lower extremity. A 35-year-old male patient undergoes fat grafting of his thighs in addition to HDL. Rectus femoris muscle and both vastus muscles were all grafted with ≈120 mL of adipose tissue. Then, a 27-year-old male patient with a congenital asymmetric body undergoes fat grafting of his right calf in addition to HDL. Both heads of the right gastrocnemius muscle were grafted with 80 mL of adipose tissue. The subcutaneous layer was also grafted to compensate the overall lack of tissue. He actually underwent fat grafting of most of the ipsilateral muscles of his body.) (**See Video 4 [online]**, which displays fat grafting of the female lower extremity. A 42-year-old female patient undergoes fat grafting of her thighs in addition to HDL. Both vastus muscles were grafted with ≈80 mL of adipose tissue. Then, a 29-year-old female patient undergoes fat grafting of her thighs and calves in addition to HDL. The vastus medialis and the gastrocnemius muscles were all grafted with 50–60 mL of adipose tissue. Subcutaneous fat grafting was also performed below the calves to avoid a masculine appearance of the leg.)

Rectus Femoris

1. Ipsilateral pubic incision allows its access (patient in supine position).
2. Direct the tip of the cannula perpendicular to the pedicle's course: about 30° away from the thigh's midline. (**See Video 3 [online]**.)
3. Avoid the "danger triangle": Always point the tip up, from the incision until surpassing the sartorius muscle.
4. Pinch the muscle bulk.
5. Go as distal as possible from the pedicle (distal third of the thigh) before the maneuver. Then, point the tip horizontally and stab the muscle gently.
6. Place the graft.

Gastrocnemius

The patient must be in the prone position over the OT.

1. The medial and lateral popliteal-crease incisions allow access to the medial and lateral heads of the

gastrocnemius muscle, respectively (away from the main neurovascular structures of the leg to avoid unexpected injuries).
2. Point the tip of the cannula about 45° away from the midline of the leg for both heads (perpendicular to the pedicle).
3. Pinch the muscle bulk.
4. Point the tip horizontally and drive the cannula into the muscle.
5. Then, point the tip of the cannula up, keep it stable, and place the adipose graft in small superficial strips inside the muscle through retrograde movements. (**See Video 3 [online].**) (**See Video 4 [online].**)
6. Most graft volume should be placed within the medial head for women and the lateral head for men.

Outcome's Evaluation

A nonstandardized survey aimed to evaluate the overall satisfaction with the procedure by asking the patient to rate their results in a scale from 1 to 5 (1 = poor results, 2 = below expectations, 3 = average results, 4 = good results, and 5 = above expectations) during the postoperative follow-up appointment.

Ethical Considerations

Each patient was informed of the purpose, methods, the experimental technique, the potential risks and benefits specific from fat grafting and also HDL/HD2, sources of funding, any possible conflicts of interest, institutional affiliations of the authors, the anticipated benefits and potential risks of the study and the discomfort it may entail, poststudy provisions, and outcomes according to the Helsinki declaration. They were also informed of the right to refuse to participate in the study or to withdraw consent to participate at any time without reprisal. A freely given informed consent was signed for each patient participating in our report. Dissections were performed at a center for research and surgical training, which holds the ethical rights/standards and legal credentials to provide corpses for medical academic/private institutions for either training or research purposes.

RESULTS

We found 73 consecutive patients (26 men and 47 women) who underwent either HDL or HD2 and fat grafting of either the gastrocnemius m. (102 muscles), the vastus medialis m. (86 muscles), the vastus lateralis m. (98 muscles), the rectus femoris (22 muscles), or a combination of them (Table 2). Mean age was 34 and 41 years for men and women, respectively. The range of the fat graft volume was 50–200 mL. Combination of vastus lateralis + vastus medialis was more common among men than women. Almost all patients underwent fat grafting of muscles other than those from the lower limb. There were no major complications; however, two patients did have temporary numbness sensation over the lateral thigh skin surface after fat grafting of the vastus lateralis muscle, which solved spontaneously after 1 week without sequalae. Follow-up period ranged from 2 to 36 months (average = 18 months). The nonstandardized survey showed that most patients were satisfied with their postoperative appearance (Table 3).

Table 2. Patient Demographics

	Men			Women		
n = 73	**n = 26 (35%)**	**Average***	**Range**	**n = 47 (65%)**	**Average**	**Range**
Age		41	28–64		34	25–58
Weight (kg)		73	64–95		62	53–78
Height (m)		174	160–194		161	157–180
BMI (kg/m^2)		24.2	23.5–28.2		23.7	22.4–28.6
Smoking history (2 wk before)	4 (15)			2 (4)		
		Volume (mL)			Volume (mL)	
Surgery						
HD2 + vastus medialis FG	21 (81)	120	50–180	22 (46)	100	50–120
HD2 + vastus lateralis FG	14 (54)	120	50–200	35 (75)	100	50–150
HD2 + rectus femoris FG	9 (35)	80	50–100	2 (4)	60	50–80
HD2 + VM + VL	15 (58)			19 (40)		
HD2 + VM + VL + RF	9 (35)			2 (4)		
HD2 + gastrocnemius	17 (65)	120	50–180	34 (72)	90	50–130
HD2 + gastrocnemius + thigh	16 (62)			31 (66)		
HD2 + leg FG and other zones	25 (96)			47 (100)		
Infiltration (mL)		5800	3600–10,400		5200	3200–9000
Lipoaspirate (mL)		4200	2900–8600		3950	2100–7600
Complications						
Infection	0 (0)			0 (0)		
Dysesthesia	2 (8)			0 (0)		
Ischemia	0 (0)			0 (0)		
Hematoma	0 (0)			0 (0)		
Necrosis	0 (0)			0 (0)		

*Average volume and ranges were calculated per muscle unit. The contralateral side was grafted with the same amount of adipose tissue, only with specific exceptions.

BMI, body mass index; Hb, hemoglobin; HCT, hematocrit; FG, fat grafting.

Table 3. Survey for Outcomes Evaluation

		Timing of the Survey		
Grading	**Data, n = 65 (89%)**	**3 months, n = 22 (34%)**	**6 months, n = 35 (54%)**	**9 months, n = 8 (12%)**
1—Poor results	0 (0)	—	—	—
2—Below expectations	0 (0)	—	—	—
3—Average results	2 (3)	1 (1.5)	1 (1.5)	
4—Good results*	34 (52)	10 (15)	18 (28)	6 (9)
5—Above expectations*	29 (45)	11 (17)	16 (25)	2 (3)

*89% (n = 65) of patients rated their results as favorable and above the average. There were no complaints or results below "average" score.

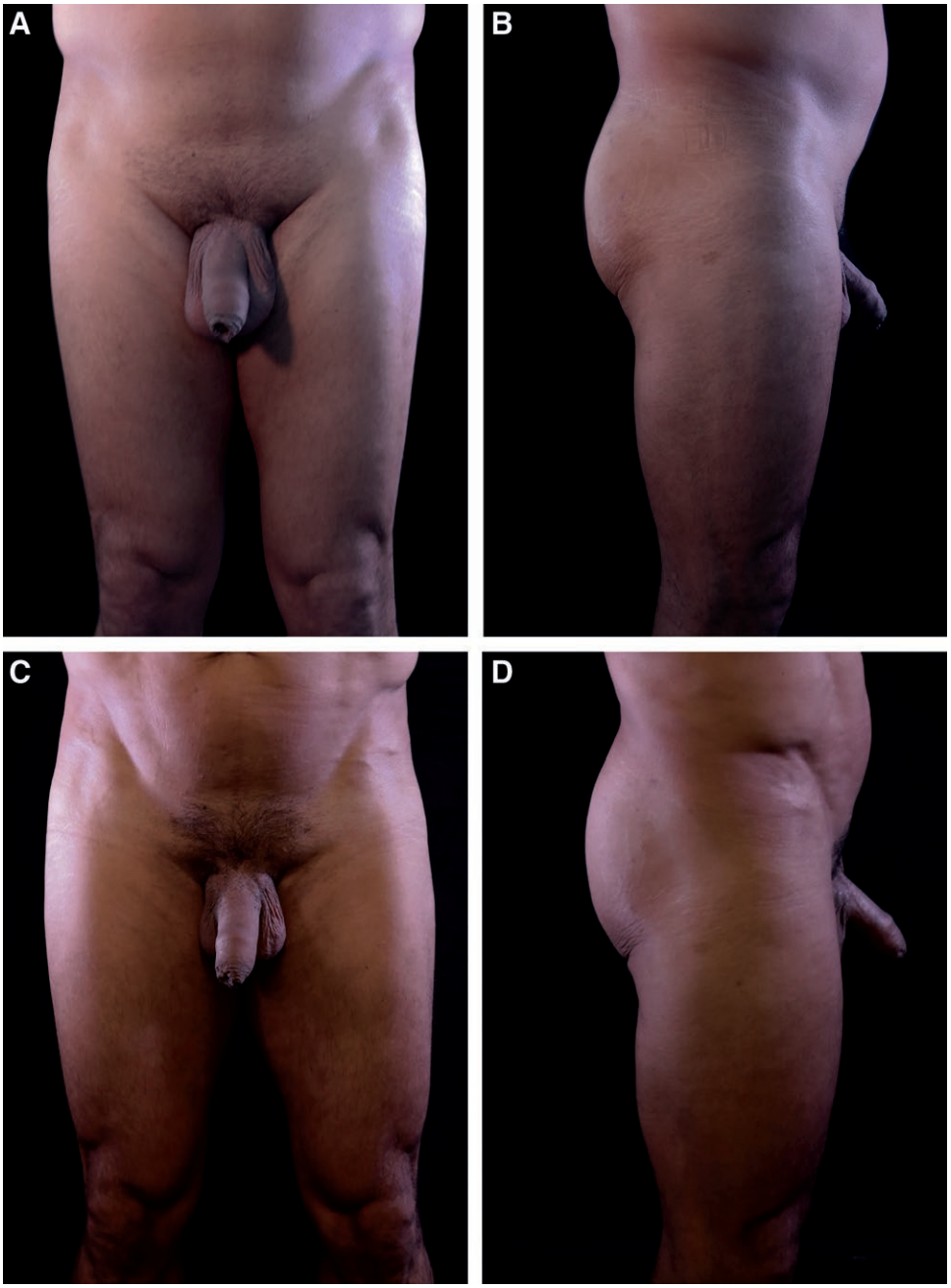

Fig. 4. A 45-year-old male patient presenting with moderate lipodystrophy of the torso, the arms, and the lower limbs, who underwent Dynamic definition Liposculpture in addition to Fat grafting of the Thighs. 150 cc, 120 cc, and 60 cc were grafted into the Vastus medialis, vastus lateralis and rectus femoris muscles, respectively. It is evident the improvement of the muscle volume and definition in the 3-month postoperative pictures (D-F) compared to the preoperative ones (A-C).

DISCUSSION

HDL involves a 3D multilayer concept of body contouring while its evolution, HD2, incorporated concepts about muscle movement and all-or-nothing lipoplasty; hence, both are considered an effective and reproducible method of lipoplasty.[19–21] Fat grafting has been a cornerstone from these techniques as it allows both the volume enhancement and definition of body areas in which shape is established by muscular structures like the lower limb (Figs. 4–6). (**See figure, Supplemental Digital Content 1**, which displays a 42-year-old woman with moderate lipodystrophy of the lower extremity in addition to moderate dermatochalasis and also mild lipodystrophy of the abdomen. She underwent dynamic definition miniabdominoplasty, liposculpture, and fat grafting of the thighs. Both vastus muscles (medialis and lateralis) were grafted with 80 mL

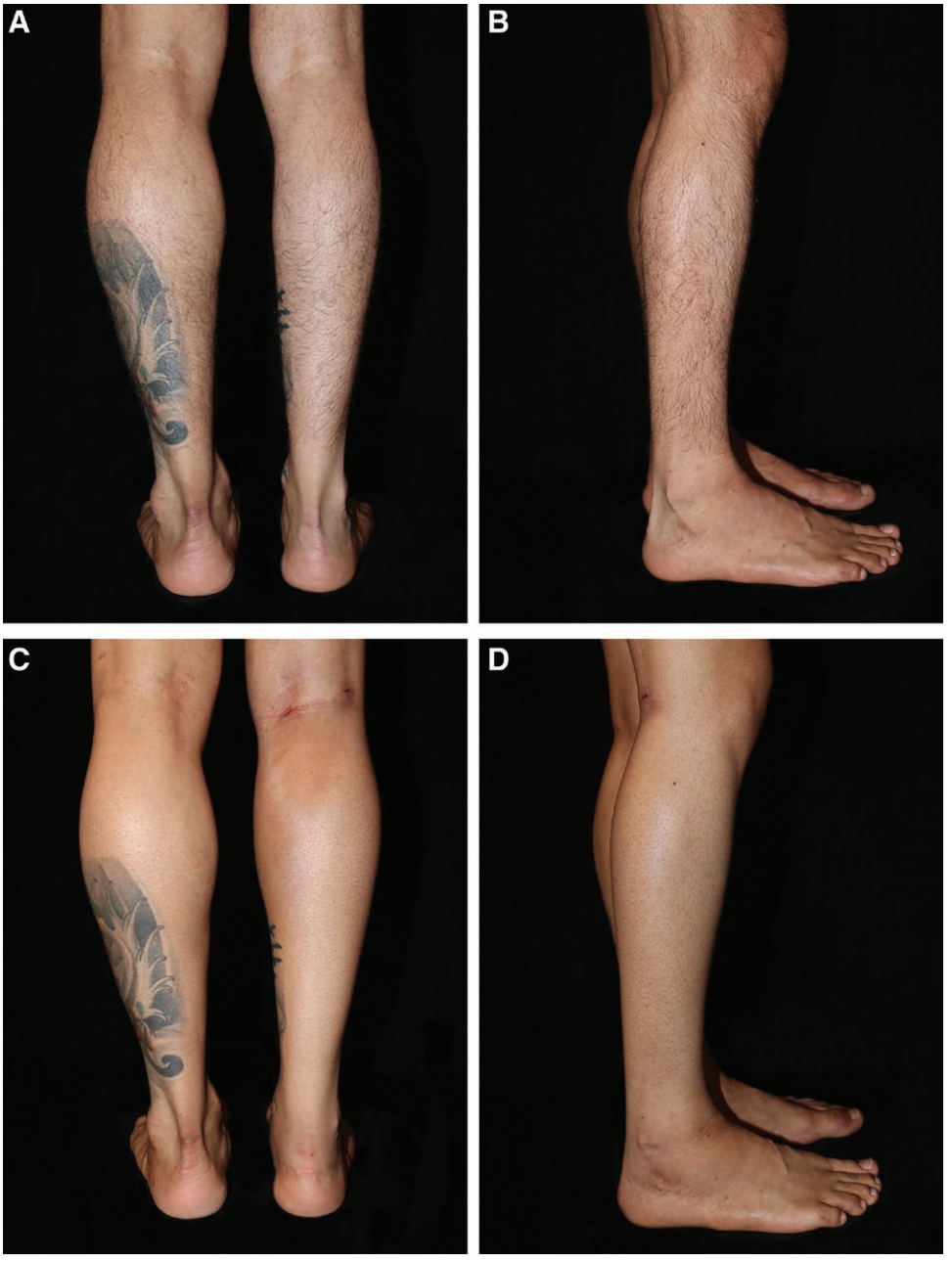

Fig. 5. A 27-year-old male patient with congenital asymmetric body and mild lipodystrophy of the torso, who underwent dynamic definition liposculpture in addition to fat grafting of the calves. Both heads of the gastrocnemius muscle were grafted with 80 cc of adipose tissue, while the subcutaneous layer was with 60 cc. The preoperative photographs (A-C) display a severe asymmetry of the gastrocnemius muscles and overall leg contour; fat grafting helped to achieve a more symmetric appearance of the entire leg (D-F) 4 months after surgery.

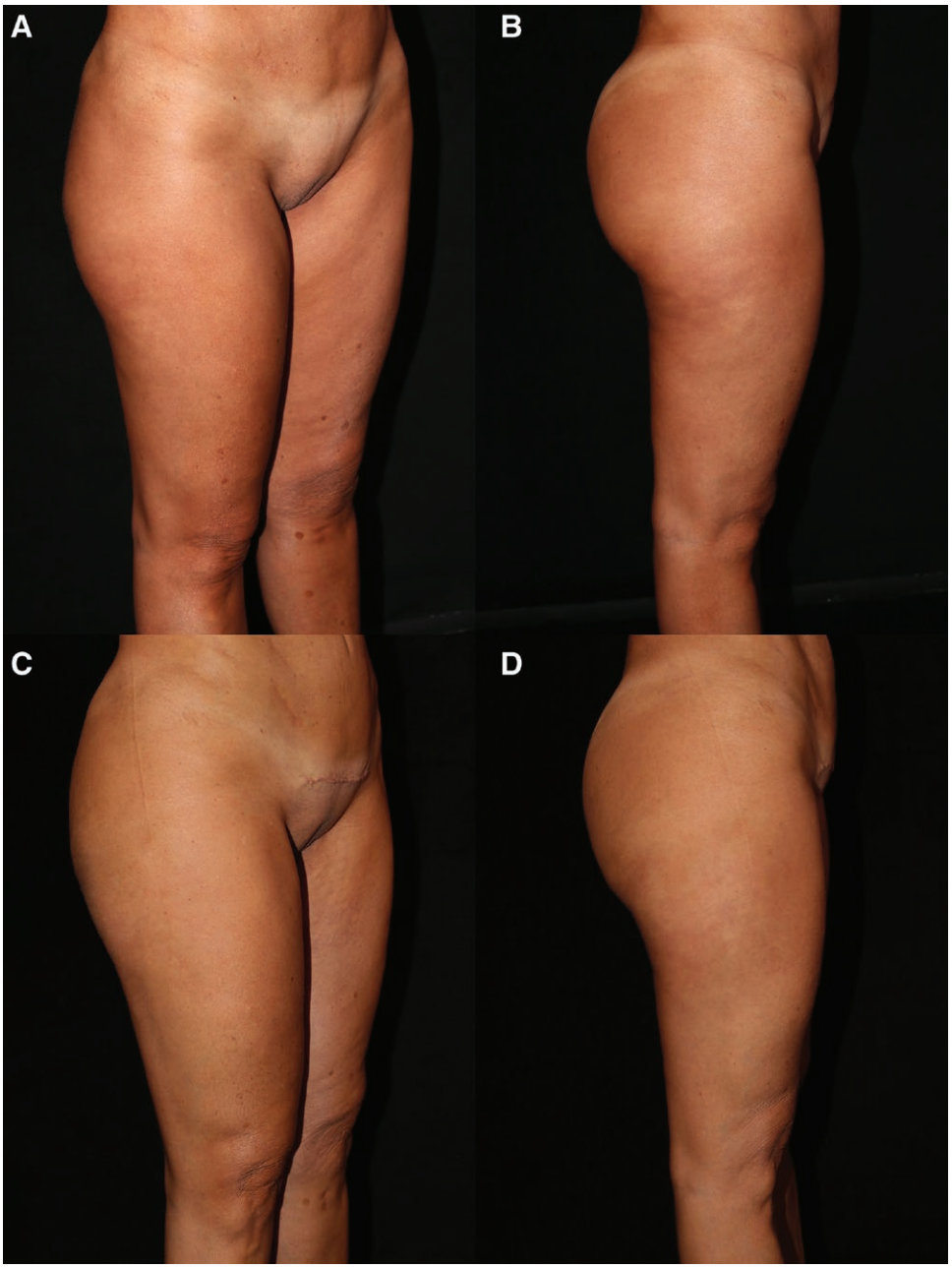

Fig. 6. A 42-year-old female patient with moderate lipodystrophy of the lower extremity in addition to moderate dermatochalasis and also mild lipodystrophy of the abdomen. She underwent dynamic definition miniabdominoplasty, liposculpture and fat grafting of the thighs. Both vastus muscles (medialis and lateralis) were grafted with 80 cc of adipose tissue. Comparatively to the male patient, the female thigh needs contour improvement with fat grafting, rather than just volume and definition, which can be appreciated in the 3-month postoperative photographs (D-F) in comparison to the preoperative ones (A-C).

of adipose tissue. Comparatively to the male patient, the female thigh needs contour improvement with fat grafting, rather than just volume and definition, which can be appreciated in the 3-month postoperative photographs (d–f) in comparison to the preoperative ones (a–c), **http://links.lww.com/PRSGO/C347**.)

The most representative compartments in terms of contour and aesthetic appeal of the lower limbs are the anterior for the thigh and the posterior for the leg. Our results show men preferred augmentation of the vastus medialis while women did the vastus lateralis. Likewise, women would rather have the gastrocnemius muscle grafted compared with men, and the overall leg contour was greatly improved by grafting more fat at the medial head (compared with the lateral head) for them, but vice versa for the male patient.

In recent years, both women and men have shown an increasing interest in the appearance of their thighs and calves, which has run along with the increasing demand of aesthetic procedures of this area.[2–22] In the US in 2,018, 10,100 thigh lifts were performed, 9614 in women (95.1%) and 486 in men (4.8%) and also 655 calf augmentations, 377 in men (58%) and 278 in women (42%).[23] Surprisingly, our population showed a different distribution, as men required less calf augmentations compared with women, and women actually sought the appearance of stronger legs and more voluminous thighs compared with men.

Although it might be difficult to set a unique aesthetic ideal of the lower extremity, we may well state that the male leg is characterized by strong muscular indentations that highlight the definition of the leg, compared with the interaction between convexities and concavities of the female leg.[20] In any case, the surgeon must be aware of any unexpected trauma to the leg (including to varicose veins[12–17]) that might end up in acute compartment syndrome (ACS), so we should not only prevent possible injuries to the muscle's vascular pedicle but also avoid the very superficial planes to prevent severe and devastating complications.[24,25] In addition, the newest recommendations for gluteal adipose grafting (after the 2018 practice advisory from the Multi-Society Task Force for Safety in Gluteal Fat Grafting) include: the use of ultrasound-guided documentation of cannula placement before and during fat injection, and the limitation of three BBL cases as a maximum amount of total operative cases per day.[26] To our knowledge, there has not been any fatality nor pulmonary fat embolism reported in the medical literature after IM fat grafting in a muscle other than the gluteus major,[27–31] neither any case report of ACS following aesthetic procedures of the lower limb.[32–34] Animal studies have shown that IM fat grafts have no association with long-/short-term events of fat embolism after autologous fat transplantation, which further support the special case of the gluteus major muscle. In that sense, the cadaveric dissections allowed us to formulate five strategic tips to perform a safe technique for autologous IM fat grafting (Table 4), as the muscle bulk has healthy vessels and few vascular structures. Moreover, the authors' experience with IM fat grafting techniques goes over 1200 cases for the volume improvement of the pectoral and deltoid muscles. In brief, we believe that HD2 liposculpture + a proper technique for IM fat grafting allowed the improvement of overall aesthetics of the lower limb, by improving the volume of the gastrocnemius, the vastus medialis, the vastus lateralis, the rectus femoris, and at some point the hamstrings/biceps femoris muscles.

Table 4. The "Fav Five": Tips for a Safety Approach to IM Fat Grafting in HD2

1. The access should be as far from the pedicle as possible.
2. The tip of the cannula should be directed in a perpendicular fashion in relation to the anatomical axis of the pedicle.
3. Place the graft at the superficial layer of the muscle.
4. Fat grafting is done in a retrograde fashion.
5. Use 3- to 4-mm diameter cannulas for fat grafting (bigger than the diameter of the pedicle).

Limitations

The lack of inferential statistics and the retrospective nature of the study decrease its power and also preclude a strong association between the procedure and the outcomes, although these were clinically evident. The sample size might look small, since population undergoing/seeking such procedure is limited; nonetheless, more than 300 muscles were grafted. The assessment of the muscular compartments pressure is a critical aspect that should be studied in future clinical studies to support our findings and the reliability of the technique.

CONCLUSIONS

Fat grafting could be considered an alternative surgical procedure that improves the athletic and aesthetic appearance of the lower limb. Both the proper identification of neurovascular structures and a structured technique make this approach reliable and reproducible with outstanding outcomes and a very low complication rate.

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