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# Calf lipo-reshaping

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**KEYWORDS**
Calf augmentation;
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**Summary** *Background:* Augmentation and remodelling of the calf is becoming more and more frequent, representing a challenge for the surgeon who must consider this body zone as a functional and aesthetical whole. Historically, calf reshaping has been carried out with silicone implants, mainly in the subaponeurotic plane; nonetheless, as in other body sites it is possible to perform lipoinjection which is a reliable procedure with minimal scarring and a lasting outcome with rare, long-term complications.
*Materials and methods:* Between the years 2009 and 2011, five patients (three women and two men) underwent bilateral calf liporemodelling. Follow-up was between 6 and 18 months. The larger perimeter of each calf was measured for follow-up.

Magnetic resonance imaging was used to localise the injected fat at the end of the follow-up period in two of the patients.
*Results:* An average of 126.8 ± 21.2 cc was lipoinjected into each calf. The average final augmentation in the larger perimeter of each leg was 2.8 cm. All patients obtained a good aesthetical outcome and were satisfied. No important complications were seen in this series.
*Conclusion:* According to our experience and outcomes we can recommend the liporemodelling technique of the calf as a valid alternative for the reshaping of the distal third of the inferior extremity.


There is increasing interest in patients to improve the aspect of their calves, which certainly presents a challenge for the surgeon who must consider remodelling of the inferior extremity as a functional and aesthetic whole.

In general, the series for calf remodelling are scarce in the literature; nonetheless, it is clear that carrying out personalised anthropometric and personalised measurements for each patient allows fine-tuning the surgical techniques for this procedure and therefore obtaining

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better postoperative outcomes, and fulfilling more and more the aesthetical requirements of the patients.[1,2]

The universally most used technique for calf remodelling is the placement of silicone implants in the subfascia of the gastrocnemius muscle for the correction of the different degrees of gastrocnemius hypoplasia, leading to an augmentation between 3 and 4 cm of the perimeter of the leg.[3] In the literature, this technique is considered reliable, safe and efficient and allows giving a natural and harmonious aspect to the calf.[4,5] However, other possible locations for the implant are also described, as for example the submuscular placement that may give a more natural aspect than other localisations as the contour of the calf would be given by the gastrocnemius and not by the implant itself.[6]

It is important to consider that calf remodelling with silicone implants is not a too complex technique, but does imply risks and complications.[3,5] The principal factor is that the lower extremity has a functional role and is exposed to trauma and lesions and placing an implant in this highly movable area might have unfavourable consequences.

With the development of liposuction, the fat graft has becomes a simple and easy tool that allows the correction of soft tissues and improves the corporal and facial contour.[7] There are references in the literature about 'autologous lipoinjection' for the remodelling of calves, as a feasible alternative to implants and could even be the only treatment for calf remodelling and only complemented with other techniques such as silicone implants,[8] offering outcomes with small scars, a long-lasting effect with no long-term complications and with the possibility of repeating it if necessary.[9]

However, the procedure of autologous lipoinjection of the calves has not been too popular, probably due to the lack of long-term follow-up. We believe that calf remodelling with this technique may be a real alternative to silicone implants and it is able to fulfil the functional and aesthetical expectations of the patients, obtaining the aesthetically acceptable range of 33—36 cm in the perimeter of the calf, as described for women,[10] together with other anthropometric measurements described in the literature.[1,2,11]

The objective of this study is to present calf lipoinjection as an alternative to the remodelling of the distal lower extremity, based on the good results obtained with this technique in other body zones and assessing the outcomes obtained with this technique.

## Materials and methods

### Patients

Between the years 2009 and 2011, five patients underwent autologous lipoinjection in bilateral calves. Two were men and three were women, general age average 42.8 ± 14.5 years. The indication was aesthetical for all these patients; it was associated to traditional lipoaspiration in other body sites with more frequency in hips and waist. The appearance of the calves was analysed in relation to the Cuenca-Guerra et al. classification[1] (Table 1), all the patients presented medial hypoplasia (Type I) and additionally two patients had posterior hypoplasia (Type III). In one patient the liporemodelling was corrective, to fill a secondary defect that appeared when removing malpositioned Glicenstein implants, 6 months previous to consultation, the four remaining patients underwent primary aesthetical liporemodelling.

### Planning the operation

The marking is performed with the patient standing. First, according to the analysis with the patient and the photographs, the areas for liposuction were marked. Second, we proceed to evaluate the type of hypoplasia, identifying relevant anatomical landmarks. All patients were initially evaluated from a posterior view. The mid-point of the popliteal fossa and the limit of the Achilles tendon were marked, drawing an axis between the two points. We measured the total distance of this axis, dividing it into three equal parts and proceeded to locate the limit between the proximal and middle third. At this point a horizontal axis was drawn perpendicular to the longitudinal axis, identifying the point of maximum convexity of the calf. The maximum circumference was measured at this point; the relationship is established between the medial and lateral segments to the longitudinal axis, establishing the type of hypoplasia (as classified by Cuenca-Guerra et al.[1]). On the other hand we consider that the maximum circumference of the calf must be 75% of the leg length, the length of the leg being 26% of the height of the patient.[2] Another important aspect that we consider useful in planning is proportional gastrocnemius height, the proportion described by Howard,[11] where the gastrocnemius is 1.6 times the value in between the knee and the largest

**Table 1** Calf hypoplasia classification depending leg compartment. By Cuenca-Guerra.[1]

| Cuenca-Guerra classification: calf hypoplasia | |
|---|---|
| Type I | Medial hypoplasia, lack of projection in the medial edge of the calf, caused by lack development of soleus and gastrocnemius medial portions. |
| Type II | Lateral hypoplasia, a deficiency in the projection of the lateral edge of the calf caused by poor growth of the soleus and gastrocnemius lateral portions, besides decreased long peroneal muscle development. |
| Type III | Posterior hypoplasia, poor soleus and gastrocnemius belly muscle development, which causes the lack of the posterior convexity of the leg. |
| Type IV | Hypoplasia of the three sides. Deficiency in soleus, gastrocnemius, long peroneal and flexor digitorum longus muscle development. "Tubular leg". |
| Type V | Any type of congenital or acquired sequela that affects the calf's shape. |

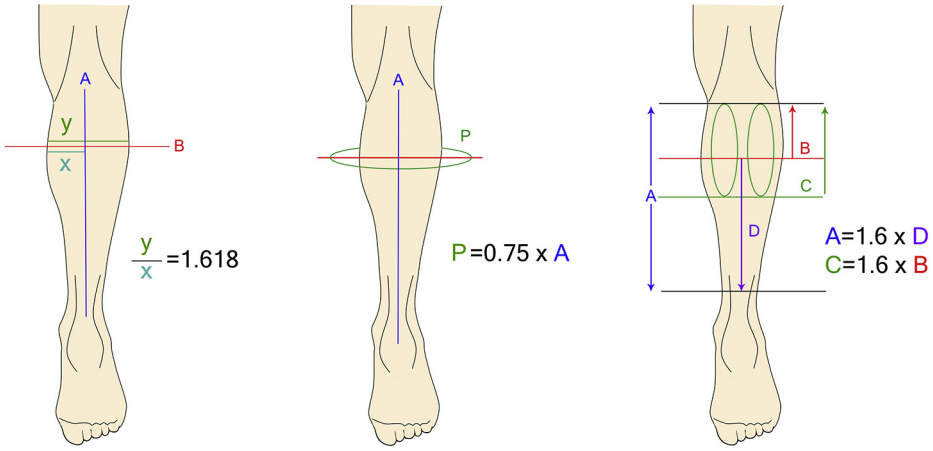


**Figure 1** Different anthropometric measurements for surgical planning. Phi number applied to posterior view of the calf by Cuenca Guerra et al.[1] (**left**). Ratio of maximum calf perimeter and leg length by Tsai et al.[2] (**centre**). Golden ratio and length of the gastrocnemius muscle by Howard[11] (**right**). In all figures the horizontal red line represents the point of maximum projection of the calf.

circumference of the calf. With all this information we obtained an approximation of the sites needed to be increased (Figure 1). Thereby, the areas that would be filled and the access routes for the injection cannula were marked.

## Surgery

General anaesthesia was used in all the patients. Once anaesthetised, the patient is placed in prone decubitus and super wet infiltration is carried out in the areas to be lipoaspirated with a solution of saline and 1:500,000 epinephrine. Lipoaspiration is performed at −760 mmHg, with 3 and 4 mm cannulas connecting a sterile flask located in the circuit of the aspiration and in the operatory field (Figure 2), which permits obtaining the necessary amount of fat to use. Once the fat is collected, it is decanted in order to preserve only the solid fraction of the aspirated tissue with no other type of processing done.

**Figure 2** Collection of the lipoaspirated fat in an intermediate sterilised flask connected to central aspiration.

The decanted fat is injected with 3-mm cannulas through two main accesses, one posterior proximal and the other posterior distal. Multiple trajectories are made in a radiated form, palpating the superior aspect of the cannula to decide on the plane of injection.

In general, about 30% of fat is placed subcutaneously; the rest remains subfascial or intramuscular. The total fat volume was adjusted to reach the perimeter estimated according to the patient's anthropometry, considering a slight overcorrection.

In some cases it was necessary to lipoaspirate the distal third especially in the perimaleolar zone of the leg due to a tubular conformation that alters the definite form of the calf.

Once the lipoinjection is done, the largest circumference of both calves are measured and then the access routes are closed with Ethilon® 4.0 (Johnson & Johnson, New Brunswick, NJ, USA) sutures and Self-Adhering Foam (3M™ Reston™) and anti-embolic hose are used.

## Postoperative care

The patients were hospitalised for 24 h. Non-steroidal anti-inflammatory drugs (NSAIDS) are used for analgesia, first intravenously and then by mouth at discharge. Ambulation starts at 12 h, maintaining the Self-Adhering Foam for 72 h, and after 3 days there are no restrictions on physical activity.

## Follow-up

Follow-up time was between 6 and 18 months (average 10 ± 5 months). Measurement of the greater perimeter of each calf was performed in the immediate postoperative period, in the intermediate postoperative period and at the end of the controlled period. During this time, photographic registration was carried out (anterior, posterior and lateral views) for all five patients. At the end of the follow-up two of the patients underwent magnetic resonance

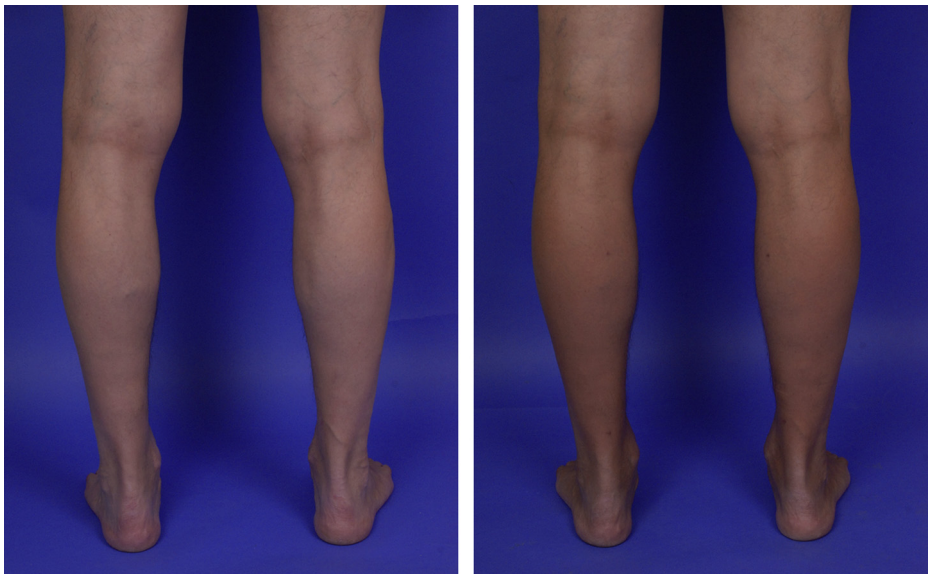

**Figure 3** *Case 3* **Left**: Preoperatory views of a 46-year-old patient with medial and posterior calf hypoplasia. **Right**: Postoperatory views at 6 months after the injections of 110 cc of fat in each leg.

imaging (MRI) control to assess the situation of the injected fat.

## Results

A total of between 110 and 164 ml (average, 126.8 $\pm$ 21.2 ml) of pure fat was injected in each leg; further injections were not necessary.

The aesthetical outcome was satisfactory for all patients, obtaining a natural aspect (Figures 3 and 4).

During the follow-up period of 6—18 months (average 10 months) there was no development of compartmental syndrome, no infection, no vascular or sensitive alterations. The scars were practically imperceptible. Neither contour irregularities nor asymmetries were seen.

Regarding the measurements carried out, there was an average increase of 3.9 cm (from 33 to 36.9 cm) in the immediate postoperative period of greater perimeter per leg, and this increase was maintained at the end of the follow-up in 2.8 cm (Table 2).

MRI control in two patients allowed us to corroborate the localisation of the fat in the adequate spaces as well as their durability in the study period (Figures 5 and 6).

## Discussion

Even though there are few references in the literature regarding this technique, we can say that according to our work, liporemodelation is a simple method to reshape the distal third of the lower extremity. It is carried out by injecting fat in the subcutaneous, subfascial, intramuscular or

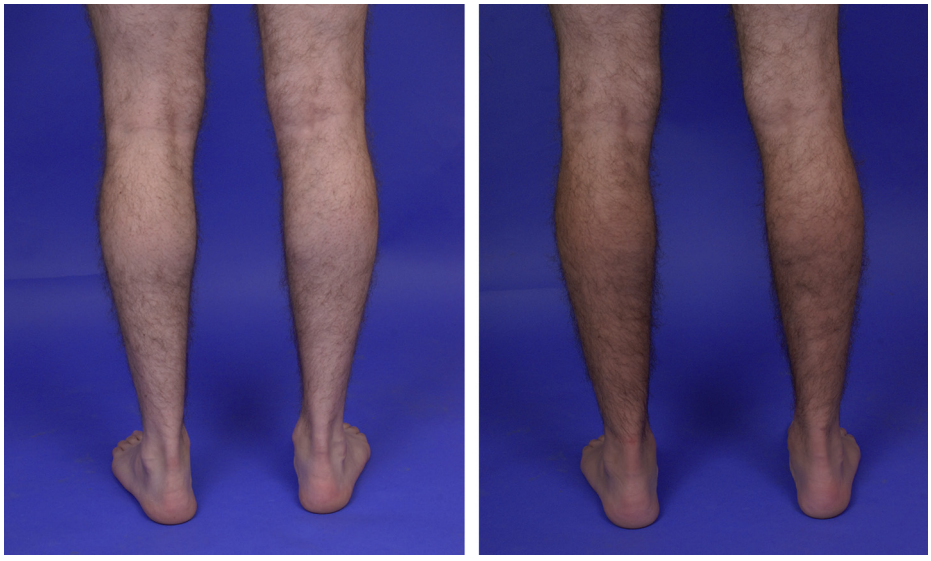

**Figure 4** *Case 4* **Left**: Preoperatory views of a 19-year-old patient with medial hypoplasia of her calves. **Right**: Postoperatory views at 6 months after injection of 111 cc of fat in each leg.

**Table 2** Average volume of fat injected on average per leg, and associated measurements of the larger perimeter of both calves.

| Case N° | Injected fat (ml) | Preoperatory (cm) | Immediate postoperatory (cm) | Postoperatory 10 ± 5 months (cm) |
|---|---|---|---|---|
| 1 | 125 | 30 | 35 | 34 |
| 2 | 162.5 | 33 | 36.5 | 35.8 |
| 3 | 110 | 37 | 41 | 40 |
| 4 | 111.5 | 32 | 36.5 | 35 |
| 5 | 125 | 33 | 35.5 | 34.3 |
| Average | 126.8 ± 21.2 | 33 ± 2.5 | 36.9 ± 2.4 | 35.8 ± 2.4 |

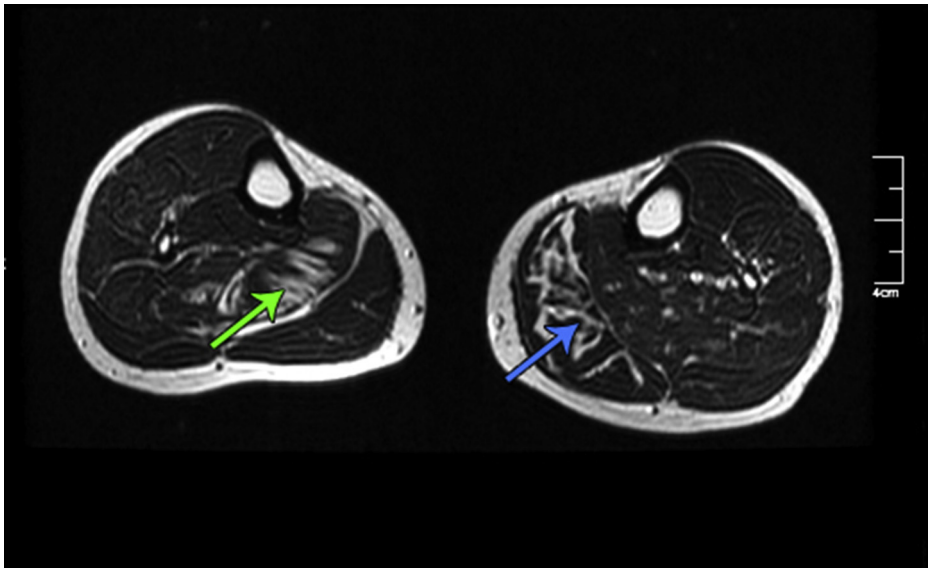

**Figure 5** Magnetic resonance image of *Case 1* carried out at 12 months. The presence of fat tissue is seen in the intra-gastrocnemius (blue arrows) and intra-soleus space (green arrows).

submuscular spaces of the calf and can be combined with lipoaspiration of a donor site with sufficient fat allowing a satisfactory aesthetical outcome for the patient as well as for the surgeon and obtaining a more natural aspect of the calf. Nonetheless, some considerations must be taken into account:

First, to perform a good treatment it is necessary to objectively analyse each one of the segments of the leg. This objective assessment can be carried out using the Cuenca-Guerra classification[1] or simply with an anthropometric and circumferential assessment of the leg.

Second, we consider as complementary performing an objective pre- and postoperative assessment of the receptor zone with an MRI study.

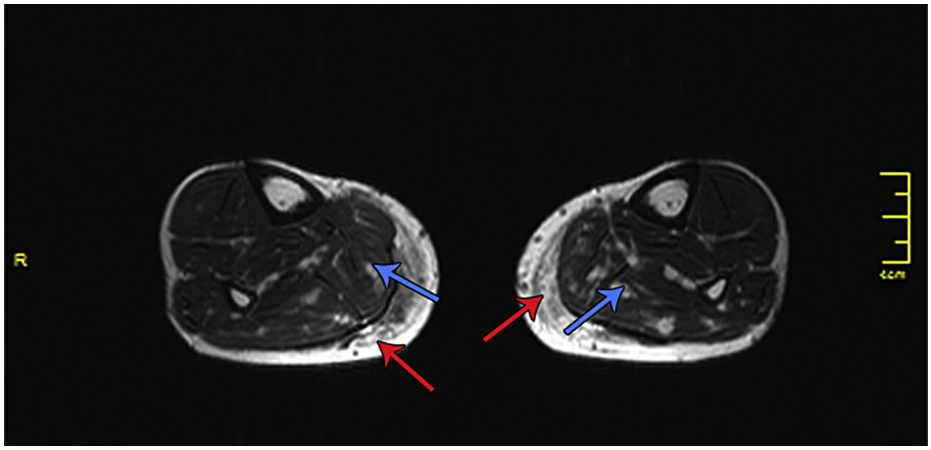


**Figure 6** Magnetic resonance image of *Case 3* carried out at 6 months. The presence of fat tissue is seen in the subcutaneous (red arrows) and intra-gastrocnemius space (blue arrows).

Third and lastly, we consider necessary an over-expansion of the receptor zone considering there is an injected fat resorption of around 20—30%, estimated by the reduction of the greater circumferential perimeter of the leg at the end of the follow-up period.

Regarding the technique, it is important to highlight that the injection with a 3-mm cannula in a radiated form distributes the fat in a safe way for its adequate irrigation and integration to the receptor tissue.[12] We did not observe complications in this series in contradistinction to those seen with prosthesis placement: infections or partial cutaneous necrosis, herniation due to rupture of the deep fascia, displacement, rejection and capsular contraction.

This group of patients has not required a second time for lipoinjection with a good level of satisfaction. However, considering the optimisation of the procedure for reducing the fat reabsorption rate would be a good therapeutic target in the short term, the use of enriched fat grafting with autologous adipose derived stem cells, a technique that improves local vascularisation[13] and probably the fat graft survival. Recent clinical trials show that this technique is safe and effective, promising superior results to traditional fat grafting.[14—16]

## Conclusions

According to our outcomes and in agreement with the already known good outcomes for lipoinjection in other body sites such as the gluteus, we can say that calf remodelling is an alternative and valid technique for the reshaping of the distal third of the lower extremity.

Liporemodelation is a more physiological and natural treatment that must be validated for body zones with high motility, exposed to trauma and lesions.

We recommend this procedure and hope that with more experience and more studies it can become a more disseminated and more used technique.

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## Conflict of interest

None declared.

## Ethical approval

Not required.

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