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Selective combined liposuction (SCL) for lipedema treatment: Outcomes in symptoms improvement and aesthetic self-perception

Nicolás Pereira [a,b,*], Josefa Venegas [a], Antonella López [a], Vanessa Oñate [a,b], José Ruiz-Tagle [c]

[a] *Department of Plastic Surgery and Burns, Hospital del Trabajador, Santiago, Chile*
[b] *Specialized Center in Lymphedema and Lipedema, Clínica Nea, Santiago, Chile*
[c] *Professional Institute Foundation DUOC UC, Santiago, Chile*

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Summary *Background:* Lipedema is a chronic, progressive and underdiagnosed condition characterized by bilateral, disproportionate and painful subcutaneous fat accumulation in extremities. Key symptoms include pain, heaviness and easy bruising. Surgical treatment, particularly liposuction, has shown excellent outcomes in symptom reduction and quality of life improvement. This study evaluates clinical outcomes in symptoms and aesthetic self-perception improvements in patients treated with selective combined liposuction (SCL).
Patients and methods: A retrospective review of 126 female patients who underwent surgical treatment over a four-year period was performed. Selective tumescent liposuction combining power-assisted liposuction (PAL) with VASER (ultrasound-assisted liposuction) for proximal areas, especially the thighs. Demographic and clinical data, including BMI, medical history and comorbidities were analyzed. Symptoms such as pain, heaviness and edema, and body image perception were assessed preoperatively and six months postoperatively with a structured questionnaire.
Results: The mean patient age was 39 years, with a mean BMI of 27.2. The mean aspirated volume was 3270 mL per procedure. In 25.4% of the cases (n=32), a second procedure was required, with an average total aspirated volume of 5150 mL. Significant symptom improvement was observed: 89% reported reduced pain, 92% reduced heaviness, 82% reduced edema. Mobility limitations improved in 91% of patients, while 60% reported enhanced aesthetic

* Correspondence to: Department of Plastic Surgery and Burns, Hospital del Trabajador, 185 Ramon Carnicer, 4th floor, Santiago, Chile.
E-mail address: npereira@hts.cl (N. Pereira).

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perception of their extremities. Additionally, 68% of patients expanded their wardrobe postoperatively.
Conclusions: Selective combined liposuction is a safe and highly effective technique for lipedema treatment, providing substantial symptom relief, improved body aesthetic self-perception, which leads to an improvement in the quality of life.

Background

Lipedema is a common, underdiagnosed, chronic and progressive disease.[1] Its estimated prevalence ranges from 6% to 10% worldwide,[2] with strong predilection for females.[3] In the United States, it is estimated to affect 1 in 9 adult women.[4] It is characterized by disproportionate and painful accumulation of subcutaneous fat tissue in the extremities. Unlike obesity, fat deposits and edema associated with lipedema are resistant to dietary changes, caloric restriction, physical activity or bariatric surgery.[5] The disease typically presents bilaterally, primarily affecting the lower extremities, and may include the buttocks, thighs, knees and legs, while spearing hands and feet.[6] The upper extremities are less frequently affected.

Almost exclusively affects women, with onset most commonly occurring between puberty and the third decade of life.[6] Due to a general lack of knowledge about lipedema, underdiagnosis often leads to delayed treatment, highlighting the importance of clinical awareness and early intervention. The main symptoms include pain, heaviness and easy bruising. Diagnosis is predominantly clinical, based on specific diagnostic criteria, after excluding other conditions [7] (Supplementary Table 1). Treatment is focused on reducing symptoms and disability, avoiding progression and preventing the onset of complications to improve quality of life.[8]

Since the role of complex decongestive therapy has been debated, improvements in edema, petechiae and capillary fragility have been reported.[9] While surgical treatment using liposuction in various modalities has gained popularity as a means of controlling the painful and deforming symptoms of lipedema.[10] Liposuction techniques in lipedema aim to remove fat in a less traumatic manner. These methods are reported to cause less damage to lymphatic vessels compared to traditional techniques and are therefore considered more selective in preserving the lymphatic system's anatomy.[8,11] These techniques include water-assisted liposuction(WAL)[8,11] and power-assisted liposuction (PAL), the latter being the most used and associated with minimal tissue damage.[8,12,13] In addition, ultrasonic energy consists of the use of mechanical and thermal effects that selectively emulsify adipocytes and contribute to skin tightening.[14]

This retrospective study analyzes the clinical outcomes in symptoms and aesthetic self-perception in patients undergoing selective liposuction combining PAL technique with ultrasound for proximal areas when thighs are involved, as a treatment for lower extremities lipedema.

Patients and methods

A retrospective study was conducted on 162 patients who underwent surgery for lipedema from February 2019 to May 2023. This research was conducted by following the principles of the Helsinki declaration and approved by the Scientific Ethics Committee. All patients gave written consent to participate in this study. The authors adhered to the STROBE guidelines (http://www.strobe-statement.org/) for this study. Those with a postoperative period of less than six months (29) and patients with pending additional surgeries were excluded (7).

One hundred twenty-six female patients were included. All patients answered a questionnaire sent by email addressing clinical and demographic history, as well as symptoms associated with lipedema, both pre- and 6 months postoperatively. Data collected included relevant medical history, comorbidities, use of oral contraceptives, body mass index (BMI), aspirated volume, complications during follow-up and frequency of physical exercise.

The questionnaire focused on classical lipedema symptoms such as pain, heaviness, edema and physical movement limitations. Patients were asked to rate these symptoms on a scale from 0 to 10 (Visual Analogue Scale - VAS) for both the preoperative period and six months after surgery. Body image self-perception was also evaluated, with patients rating their appearance on a scale from 1 to 5 (1 poor, 2 average, 3 acceptable, 4 good, 5 excellent) (Supplementary Table 2).

Additional assessments included the ability to add fitted clothes into their wardrobe, time to return to work, duration of compression stocking use and surgical expectations from both aesthetic and symptomatic perspectives.

For ordinal variables with limited categories, such as surgical expectations, data were dichotomized into two groups (e.g., low expectations vs. moderate/high expectations and unfulfilled expectations vs fulfilled expectations.

Statistical analysis

Data were analyzed combining parametric and non-parametric tests with a significance of 5%. Test of Anderson-Darling was performed to evaluate normality in the different measures pre- and post-operatively. Paired T test was used depending on the results and Wilcoxon (if the distribution wasn't normal), to compare the different measures, median and average. McNemar's test was performed to compare the proportion of expectations pre- and post-operatively. Every statistical analysis was done with statistics software R (version 4.2.1).

Surgical technique

Surgical treatment was performed under regional anesthesia. Prophylactic antibiotics and tranexamic acid were administered intravenously preoperatively. Cutaneous incisions of 5 mm were made in the skin located strategically in the creases of lower extremities. Tumescent solution of 0.9% saline with epinephrine 1:500,000, and tranexamic acid 250 mg/mL was added. Power-assisted liposuction technique with Microaire® (Charlottesville, Virginia, United States), combined with ultrasound VASER® (vibration amplification of sound energy at resonance) (Lafayette, CO, EEUU), was applied in thighs with a power of 60% during 30–60 s per 100 mL of tumescent solution. The orientation of liposuction was always parallel to the lymph anatomy to reduce damage. As a reference to estimate how much liposuction was necessary, a cutaneous pinch test was performed.

The maximum volume to be aspirated per surgery was ideally less than 4000–4500 mL. When more than 4500 mL was estimated, two sessions separated 6 to 8 weeks were planned. Patients were discharged 6 h after surgery with circular knit compression garments of 20–30 mmHg.

Results

The average age was 39 years old (range 18–72 years). Most of the patients were overweight with a BMI average of 27.2 (range 18–72 kg/m2) and most cases were in lipedema stage II (68.3%). (Table 1). Forty-eight patients had at least one comorbidity (38.1%) (Supplementary Table 3). Fifty-nine patients (46.8%) had oral contraceptives n=15 progesterone, n=6 estrogen, n=27 combined therapy.

The average aspirated volume was 3270 mL (range 500–8100 mL). Thirty-two patients (25.4%) needed 2 surgical procedures, first surgery focused distally (legs), and the second to the proximal aspect (tights). The mean aspirated volume in these patients was 5150 mL. The second stage was performed in an average time of eleven weeks after the first surgery (range 4–51 weeks).

Physical activity after surgery among the patients was on average twice a week (range 0–4). Time off work was 3 weeks on average (range 1–3 weeks) and the use of compression garments was 4 months (range 1–5 months).

Table 1 Demographic characteristics (N = 126).

Age, years (range)	39 (18–72)
Chronic disease, n (%)	48 (38.1)
Oral contraceptive pills, n (%)	59 (46.8)
Body mass index, kg/m^2 (range)	27.2 (18–35)
Aspirated volume (mL)	3270 (500–8100)
Lipedema stage	
Stage I	30 (23.8%)
Stage II	86 (68.3%)
Stage III	10 (7.9%)
Time off work, weeks (range)	3 (1–4)
Use of compression stockings, months (range)	4 (1–5)
Physical activity frequency post op., days per week (range)	2 (0–4)

Of the total sample, 123 reported preoperatory pain, which improved significantly in 89% of cases from 6.4 to 2.7 according to the Visual Analogue Scale (VAS) (symptom reduction of 58%; $P < 0.001$). All the patients (126) referred to extremities' heaviness, 92% of them noted improvements from 7.9 points to 2.9 (63% symptom reduction; $P < 0.001$). Preoperative swelling was reported in 124 patients; 82% of them reported symptom improvement, from 5.0 to 1.6, with a significant reduction of 68% ($P < 0.001$).

Physical limitation to mobility secondary to lipedema was reported in 101 patients, 91% reported improvement from 5.0 to 1.6 (symptom improvement of 68%; $P < .001$) (Table 2). A reduction of BMI was noted from 27.0 to 25.2 kg/m2 after surgery ($P < 0.001$). Sixty-eight percent of the patients referred to adding tight clothes after surgery that they couldn't wear before.

Regarding symptoms, all the variables had significant reduction after treatment. (Figure 1). Pain, extremities heaviness, swelling and mobility limitations reported significant reduction after surgery.

The distribution of data points, as indicated by the interquartile range, appeared to narrow for pain, swelling and mobility limitations, suggesting a concentration of scores around a lower average following treatment. Despite these improvements, some outlier values were observed across all variables, indicating exceptions to the general trend of improvement. The charts display a clear positive trend toward symptom relief after the intervention.

Regarding self-image perception before surgery, 85% had negative thoughts toward self-image. However, after surgery, there is a noticeable decrease in the number of patients who maintain a poor aesthetic self-perception (12%). In addition, 60% of patients report satisfactory results (excellent, good and acceptable). (Figure 2).

Before surgery, half of the patients had moderate expectation of postoperative results. More than 78% of the women with low expectations declared that surgery fulfilled or exceeded their expectations regarding symptoms. Among patients with moderate expectations, 94% fulfilled or exceeded their expectations. Finally, 75% of women with high expectations declared that they were fulfilled or exceeded after surgery (Figure 3).

Before surgery, aesthetic expectations were high, with a desire for significant improvement in appearance. Thirty-three percent of women with high expectations declared not fulfilled them after surgery, and 50% of women with low expectations declared to fulfill or exceed them (Figure 4). On the other hand, 84% of women with moderate expectations reported that the surgery fulfilled or exceeded their expectations (Figure 5, Figure 6, Supplementary Figure 1).

Table 2 Clinical difference between symptoms before and after surgery.

Symptoms	Pre op.	Post op.	P-Value
Pain, average	6.4	2.7	< 0.001
Heaviness, average	7.9	2.9	< 0.001
Swelling, average	5.0	1.6	< 0.001
Mobility limitation, average	5.0	1.6	< 0.001

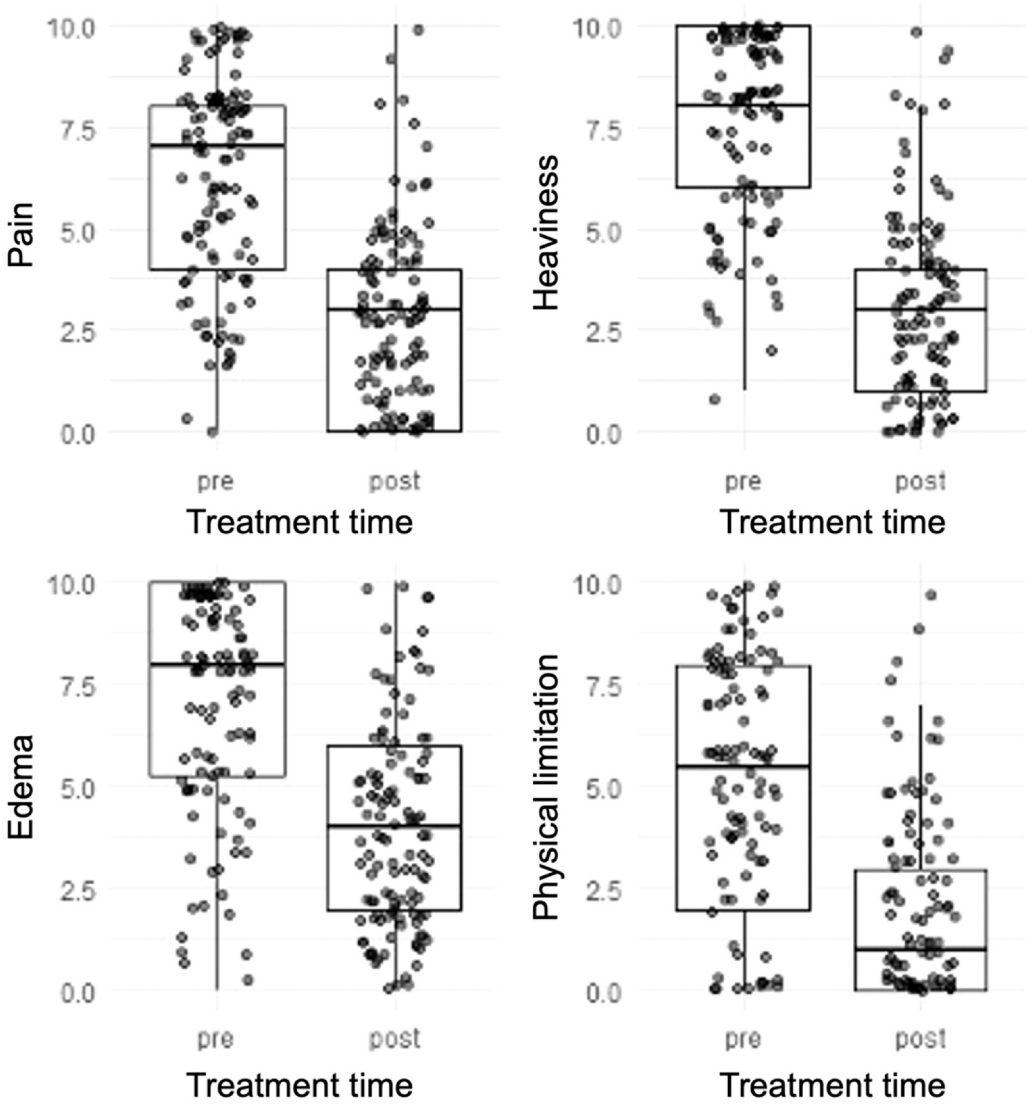


Figure 1 Box plot illustrating the improvement of symptoms after surgery.

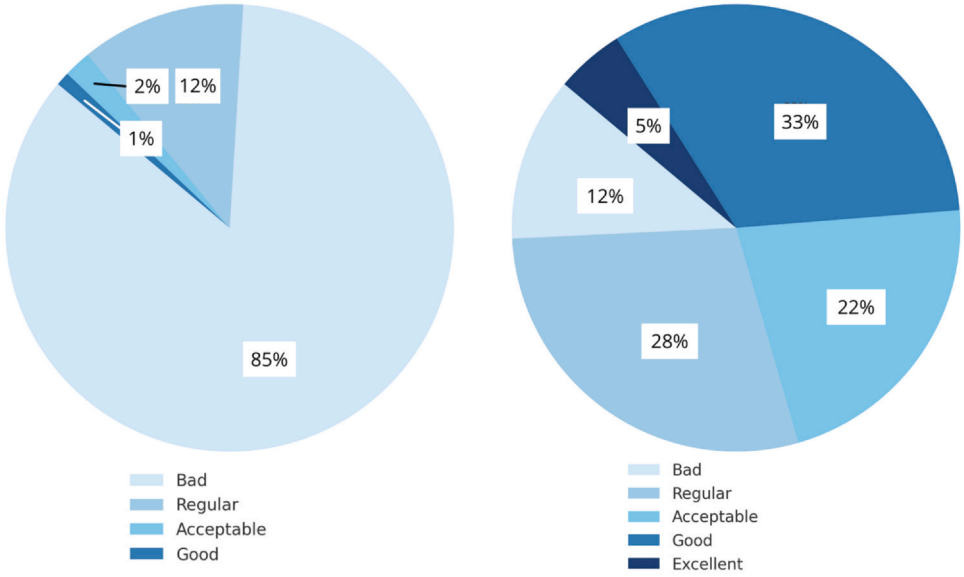


Figure 2 Circular graph showing the difference in patients' self-perception of aesthetics before (left) and after (right) surgery.

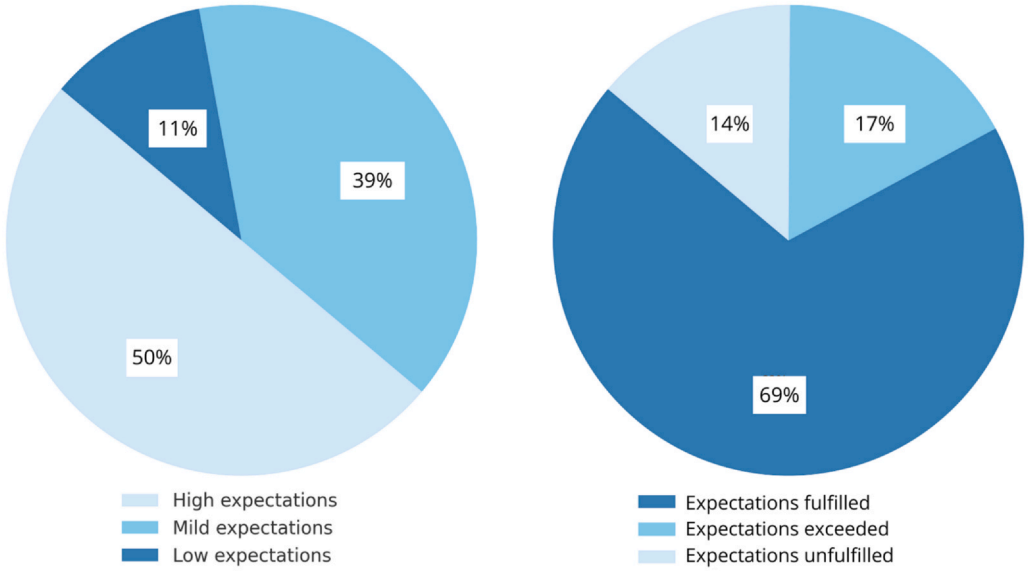


Figure 3 Circular graph illustrating patients' expectations regarding symptom improvement before surgery (left) and expectations fulfilled after surgery (right).

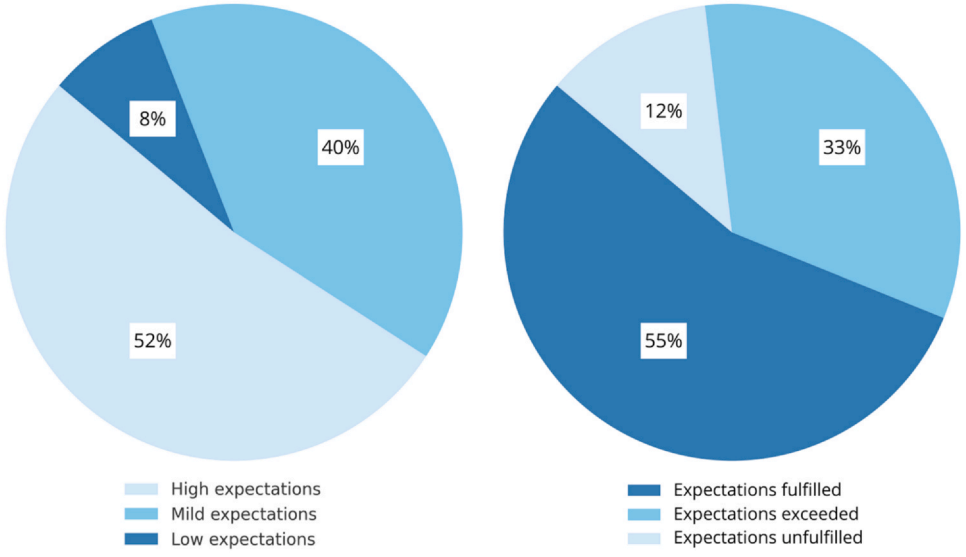


Figure 4 Circular graph illustrating patients' expectations regarding aesthetic improvement before surgery (left) and expectations fulfilled after surgery (right).

Finally, 56% of women with high expectations stated that the surgery fulfilled or exceeded their expectations.

An ordinal regression was performed to evaluate different variables with the results of surgical satisfaction, and no significant relationship could be observed between age, BMI, total aspirated volume, the presence of comorbidities or physical activity with satisfactory results reported by patients with the surgical intervention.

Total complications reported were 4.7%, and all were grade II or less in Clavien-Dindo Classification of Surgical Complications. One patient with anemia required blood transfusion (0.79%) (grade II), two seroma (1.6%) (grade I), one neuropathic pain (0.79%) (grade II), one wound infection (0.79%) (grade II) and one wound dehiscence (0.79%) (grade I).

Discussion

Lipedema is a chronic and progressive disease characterized by the painful accumulation of subcutaneous adipose tissue in the extremities.[1] In the absence of proper management, this disease can lead to various secondary problems such as lymphedema, osteoarthritis, reduced mobility, psychological disorders, low self-esteem and deterioration of the quality of life of patients.[15] Selective Combined Liposuction is a safe and highly effective technique for lipedema patients stage I to III. For stage IV (lipolymphedema), surgery to treat the lymphedema component (e.g., lymphovenous anastomosis) should be considered initially, followed by resective surgery. For this reason, there were no stage IV patients in this series.

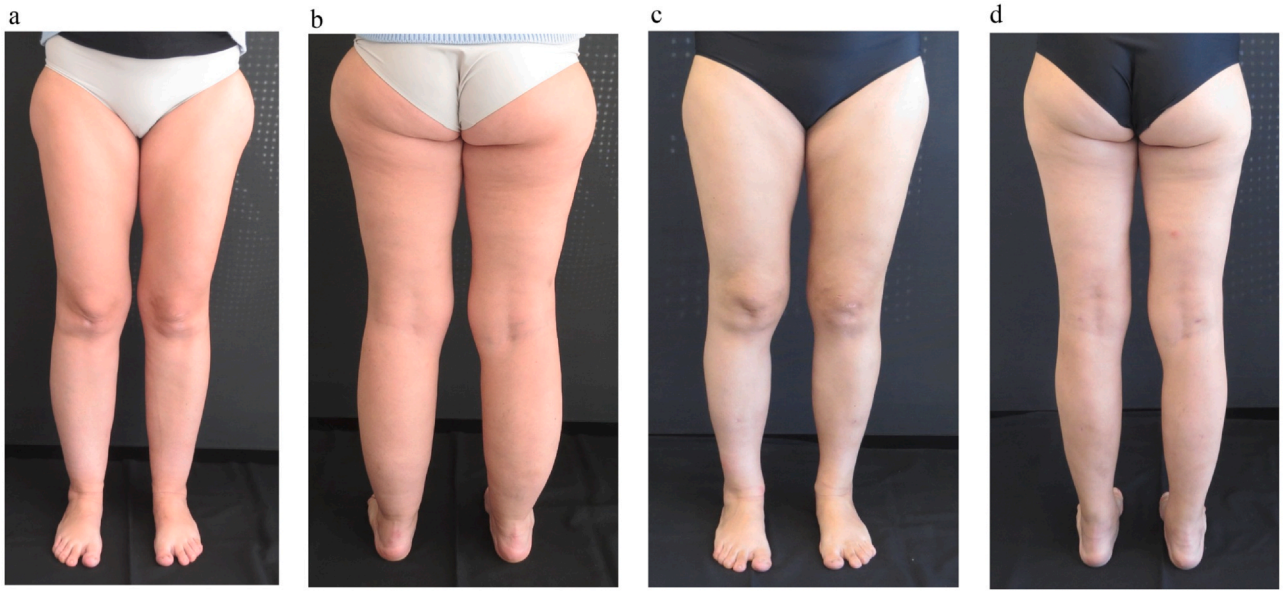


Figure 5 Preoperative (a, b) and six-month follow-up results (c, d) of selective combined liposuction in legs and thighs, with a total aspirated volume of 3500 cc.

The aim of surgery is to reduce symptoms like pain, swelling, heaviness, easy bruising, mobility restriction and aesthetic alterations of extremities.[1,16] The main symptom, with the greatest impact on quality of life, is pain.[15] In this study, a significant decrease in this symptom was found in 89% of patients, similar to what has been reported in other studies.[17-19] In addition, a significant decrease in other symptoms associated with lipedema is also noted, such as heaviness (92%) and edema of the extremities (82%), which is consistent with what has been reported in the literature.[20,21]

Abnormal accumulation of fat in the lower extremities, mainly on the proximal inner thighs, generates a characteristic gait pattern. To avoid rubbing, patients tend to abduct their legs while walking, which produces an inverted V position, generating a valgus deformity.[22] An improvement in patient mobility has been observed after surgical treatment of lipedema, as evidenced in our study, which reported a 91% decrease in the limitation to perform physical activity. This improvement is attributed both to the reduction of skin irritation on the inner thighs,[18] as well as the reduction of chronic joint pain in the hips and knees,[23] resulting in a more physiological gait.

Lipedema usually presents in puberty, but it can appear at other times of hormonal change, such as pregnancy or menopause.[24,25] This is why studies support the role of sexual hormones, mainly estrogens, in the development of this disorder.[23] Although in this study, half of the patients were using oral contraceptives at the time of surgery, with a high estrogen predominance, the relation of the hormonal status at the time of diagnosis of the disease is unknown, so additional studies would be required to evaluate this relationship.

Various chronic diseases have been described in patients with lipedema. Seefeldt et al. [25] reported the presence of comorbidities in up to 99% of their participants with lipedema. One-third of our sample had some type of comorbidity, highlighting the high prevalence of hypothyroidism, up to 12.6% of patients, which could suggest an association with the disease.

Despite the general trend evidenced in this study regarding overweight, the low prevalence of other concomitant comorbidities such as diabetes (1.5%) and insulin resistance (3.96%) stands out, data similar to that reported in the literature, which is around 2% prevalence.[24,26] This could support what is reported in various sources that suggest that there could be a protective effect against diabetes.[24,27]

A strong association has been seen between psychiatric and mental health comorbidities in patients with lipedema.[28] Highlighting comorbidities such as sleep disorders, eating disorders and depression, and even a consequent unfavorable outcome after surgical interventions.[21] However, in our study, these comorbidities were not reported by the patients and were not evaluated in a targeted manner.

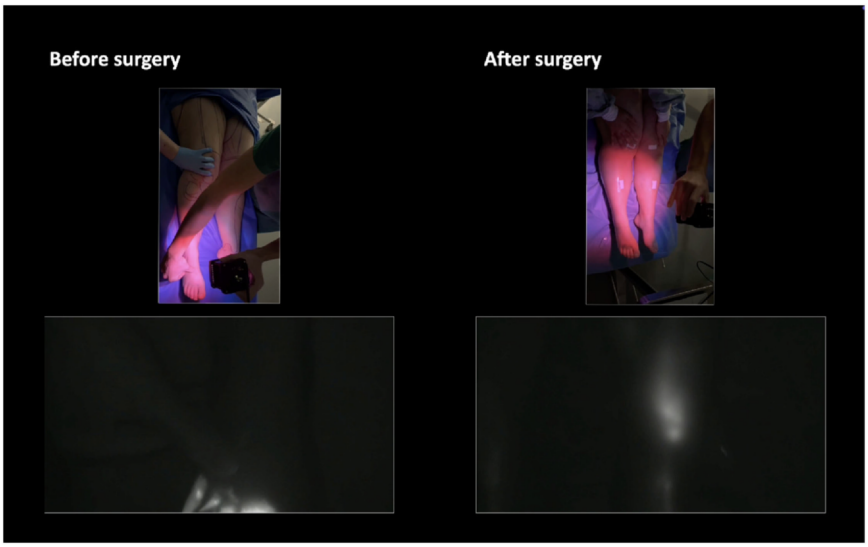
It has been reported that liposuction is an alternative that stops the progression of the disease, especially useful in those patients whose symptoms do not improve despite conservative treatment.[13-15] Selective tumescent liposuction, using microcannulas, is the gold standard in the surgical treatment of lipedema.[29] Power assisted liposuction PAL with microcannulas of 3-4 mm, reduces damage to soft tissue, preserving lymphatic pathways [11,30-32](Video 1). Using the power-assisted liposuction (PAL) technique, the isolation of adipocytes occurs as a result of the variation in the inertia of the adipose and connective tissue due to vibration.[8,33]

The total aspirated volume and the number of interventions are variable in the literature. Kruppa et al.[2] reported a maximum of 6355 ± 2797 mL in three surgical stages. Rapprich et al.[19] reported 3 to 5 stages depending on the estimated volume, with average volumes of 2482 ± 968 mL per surgery. Other studies have performed moderate volume liposuctions of less than 4000 mL.[15,17,18,34] Because there are no specific guided recommendations for estimating volume to be extracted in lipedema, based on our experience and given the low complication rate in our study, we recommend extracting a maximum of 4000-4500 mL per surgery, and when a larger volume is anticipated, it is preferable to divide the procedure into two stages.

Figure 6 Preoperative (a, b, c) and six-month follow-up results (d, e, f) after two-stage surgery. The total aspirated volume was 2900 cc for the legs and 1900 cc for the thighs.

The use of SCL avoids damage to important structures. Bleeding is rare [35,36] and in our study a rate of anemia requiring transfusion was reported in only one patient (0.79%), a result that correlates with the rates reported in the literature that range from 0.2 to 0.6% of cases [15,37] Other minor complications were few, reaffirming the safety of the procedure with no serious or life-threatening complications.

According to studies, in patients with lipedema who undergo large volume liposuction, a sustainable reduction in body weight and body mass index is achieved,[21] which in our study was evidenced by an average total decrease of 2 points in the body mass index. However, despite the evident weight loss, there are common sequelae that can persist and even become more pronounced after surgery in patients with severe lipedema who undergo large volume liposuction, such as skin sagging and excess skin. This is why, despite obtaining satisfactory results in terms of symptomatic resolution of the disease, it is often not consistent with the satisfaction of the aesthetic expectations of patients, especially in the thigh region. In such severe cases of sagging and skin redundancy, complementary



Video 1. Selective Combined Liposuction spares the lymphatic system. A video clip is available online. Supplementary material related to this article can be found online at doi:10.1016/j.bjps.2025.06.031.

corrective surgery such as a thigh lift is suggested to obtain optimal aesthetic results.

Although suction-assisted lipectomy is effective in contouring the medial thigh in the patient with lipodystrophy, this technique often fails to reshape or retract this area where the skin is thin and inelastic[38] The use of VASER ultrasonic energy consists of the use of mechanical and thermal effects that selectively emulsify adipocytes,[14] The addition of this technology has increased the efficacy of the procedure and has expanded the indications for body contouring in multiple areas, such as the thighs, where a use of 30 s/100 mL aspirated at 60% is recommended.[39]

It should be noted that lipedema surgery is a reconstructive type of surgery, in which the main objective is to provide symptomatic improvement and, therefore, quality of life for patients. Although the degree of thigh sagging can impact self-perception of the aesthetic outcome, it was not specifically assessed in our study. However, an adequate outcome can be assumed since cosmetic expectations were met or exceeded in 88% of patients. For this reason, it is important to make an adequate selection of patients, evaluating the cases that will require a surgical approach in more than one stage, and to provide information and education to patients beforehand to understand the prognosis and expectations of the surgery.

The surgical results reported in this study are encouraging, showing a significant improvement in symptom reduction and patients' aesthetic self-perception. In this study, it is noteworthy that 68% of patients reported being able to add a new item of clothing that they were previously unable to use due to lipedema (tight pants or shoes, clothing that exposes legs, etc.), which also translates into an improvement in the quality of life of patients undergoing surgery for lipedema.

Some limitations of our study are that it was conducted retrospectively. Patients were not segregated according to the degree of disease severity. Specific and validated questionnaires are needed to assess symptoms associated with lipedema. We believe that this article provides and discusses relevant information that has not been previously studied and may therefore contribute to the study of this disease.

Conclusions

SCL is a safe and highly effective technique for treating lipedema. The use of these techniques generates less impact on the trauma of the lymphatic system, demonstrating low rates of complications and satisfactory results in volume reduction, clinical symptoms, improvement of the aesthetic appearance and quality of life of patients.

Ethical approval

Not required.

Funding

None.

Conflicts of interest

None declared.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bjps.2025.06.031.

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