

# Tracking Symptoms of Patients With Lymphedema Before and After Power-Assisted Liposuction Surgery

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**Purpose:** Lymphedema negatively impacts patients from a psychosocial standpoint and consequently affects patient's quality of life. Debulking procedures using power-assisted liposuction (PAL) are currently deemed an effective treatment for fat-dominant lymphedema and improves anthropometric measurements as well as quality of life. However, there have been no studies specifically evaluating changes in symptoms related to lymphedema after PAL. An understanding of how symptoms change after this procedure would be valuable for preoperative counseling and to guide patient expectations.

**Methods:** A cross-sectional study was performed in patients with extremity lymphedema who underwent PAL from January 2018 to December 2020 at a tertiary care facility. A retrospective chart review and follow-up phone survey were conducted to compare signs and symptoms related to lymphedema before and after PAL.

**Results:** Forty-five patients were included in this study. Of these, 27 patients (60%) underwent upper extremity PAL and 18 patients (40%) underwent lower extremity PAL. The mean follow-up time was 15.5±7.9 months. After PAL, patients with upper extremity lymphedema reported having resolved heaviness (44%), as well as improved achiness (79%) and swelling (78%). In patients with lower extremity lymphedema, they reported having improved all signs and symptoms, particularly swelling (78%), tightness (72%), and achiness (71%).

**Conclusions:** In patients with fat-dominant lymphedema, PAL positively impacts patient-reported outcomes in a sustained fashion over time. Continuous surveillance of postoperative studies is required to elucidate factors independently associated with the outcomes found in our study. Moreover, further studies using a mixed method approach will help us better understand patient's expectations to achieve informed decision and adequate treatment goals.

**Key Words:** lymphedema [MeSH term], lipectomy [MeSH term], symptom, breast cancer

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Patients with lymphedema experience discomforts and functional limitations in the affected extremity that negatively impact their quality of life (QoL).<sup>1–3</sup> Conservative and surgical treatments have been used to ameliorate this disease.<sup>4–6</sup> Adipose tissue expansion and remodeling in patients with lymphedema lead to disruption in the fluid and lipid transport, which can consequently lead to fat accumulation in the epifascial and subfascial compartment.<sup>7–9</sup> For patients with fat-dominant lymphedema, power-assisted liposuction (PAL) has demonstrated promising results in decreasing limb circumference, infection incidence, and improving QoL among this population.<sup>5,6,10</sup> Despite these positive outcomes, patients often present to our lymphatic center specifically requesting a physiologic procedure (eg, lymphovenous bypass or lymph node transplantation). While sharing expected changes in total QoL scores with patients preoperatively is a strategy to explain the potential benefits of PAL, we believe that being able to counsel based on expected symptom changes is more relatable for the patient. More than 20 symptoms are associated with lymphedema, including swelling, pain, aching, heaviness, tightness, tingling, numbness, and limb fatigue.<sup>11,12</sup> Despite this, the evaluation and reporting of lymphedema symptoms as a clinical outcome after PAL is lacking even though lymphedema symptoms are a major daily stressor for patients with lymphedema and a predictor of poor QoL.<sup>13,14</sup>

Previous studies have assessed surgical and patient-reported outcomes after debulking procedures.<sup>6,15–18</sup> Specifically, debulking procedures have been shown to decrease extremity volume, improve functionality, increase patient satisfaction and QoL, and positively impact patients' psychological burden by improving anxiety, depression, and overall well-being.<sup>6,15–18</sup> Moreover, it has been hypothesized that poor QoL and psychosocial burden are a reflection of the distress generated by lymphedema symptoms.<sup>11,13,14,19</sup> Until now, no studies have been conducted to evaluate the true impact of debulking procedures on lymphedema-related symptoms. In fact, there is a lack of guidance on how to evaluate these symptoms and how to manage them with standardized and effective interventions.<sup>11</sup> As surgeons, it is important to recognize the impacts of various surgical procedures on symptoms, because this is fundamental to create patient-specific interventions, and suggest the most appropriate procedures based on current symptoms.

Therefore, this study aims to assess changes in lymphedema symptoms in patients before and after PAL surgery. We conducted a retrospective chart review and follow-up phone survey at a single tertiary healthcare center, to assess lymphedema symptom changes in patients after PAL surgery.

## METHODS

### Study Design and Population

This is an institutional review board–approved cross-sectional study performed on all patients with fat-dominant lymphedema who underwent PAL as their initial treatment from January 2018 to December 2020 at our institution.

Lymphedema-related symptoms (ie, swelling, heaviness, tightness, numbness/tingling, fatigue, achiness, and pain)<sup>11,12,19</sup> were evaluated prospectively during the initial evaluation of lymphedema patients

**TABLE 1.** Demographics

|                             | Overall     | UE          | LE         |
|-----------------------------|-------------|-------------|------------|
| Total                       | 45* (100)   | 27 (60)     | 18 (40)    |
| Age, mean (SD)              | 58.3 (13.5) | 62.1 (11.2) | 53 (14.9)  |
| Follow-up months, mean (SD) | 15.5 (7.9)  | 13.3 (7.8)  | 18.5 (7.2) |
| Sex, n (%)                  |             |             |            |
| Female                      | 40 (88.9)   | 26 (96.3)   | 14 (77.8)  |
| Male                        | 5 (11.1)    | 1 (3.7)     | 4 (22.2)   |
| Race, n (%)                 |             |             |            |
| White                       | 38 (84.4)   | 23 (85.2)   | 15 (83.3)  |
| Black or African American   | 2 (4.4)     | 2 (7.4)     | 0          |
| Asian                       | 2 (4.4)     | 1 (3.7)     | 1 (5.6)    |
| Other                       | 2 (4.4)     | 0           | 1 (5.6)    |
| Unknown                     | 1 (2.2)     | 1 (3.7)     | 1 (5.6)    |
| Hand dominance, n (%)       |             |             |            |
| Right-handed                | 37 (80.4)   | 23 (85.2)   | 14 (73.3)  |
| Left-handed                 | 5 (10.9)    | 3 (11.1)    | 2 (10.5)   |
| Ambidextrous                | 2 (6.5)     | 1 (3.7)     | 1 (10.5)   |
| BMI, mean (SD)              | 27.6 (4.2)  | 28.3 (3.9)  | 26.7 (4.6) |
| Chemotherapy, n (%)†        | 32 (69.6)   | 23 (85.2)   | 9 (47.4)   |
| Radiotherapy, n (%)†        | 34 (73.9)   | 26 (96.3)   | 8 (42.1)   |

\*One female patient had bilateral LE lymphedema.

†Chemotherapy and radiotherapy frequency and percentage by extremity.

at our center. Patients were simultaneously queried about and ranked their top 3 goals for seeking out lymphatic surgery (ie, reduce the amount of time in or class of compression, improve symptoms, prevent disease progression, reduce the incidence of infection, improve the appearance/size of the extremity, improve their ability to wear clothing). Baseline lymphedema-related symptoms and patients' goals were collected through medical records at patients' initial consultation.

At postoperative visits beginning at 3 months, preoperative positive symptoms were queried as to whether the lymphedema symptom

had resolved, improved, had the same, or worse. A retrospective chart review was performed to extract all patients' demographic data, baseline characteristics, and follow-up symptom. All patients received a follow-up phone survey to update their symptom characteristics before data analysis. For any patients who underwent a second stage lymphatic procedure (eg, a physiologic procedure) after PAL, only data from their last clinic visit before the second stage were included. Any patient who had undergone a prior lymphatic procedure before PAL was excluded.

To ascertain how changes in symptoms progress over time, the cohort was divided into 3 groups based on their follow-up time. Group 1 corresponded to all patients whose follow-up was less than 8 months. Group 2 pertained to patients with follow-up between 9 and 15 months. Lastly, group 3 represented all patients with follow-up greater than 16 months.

## Surgical Technique

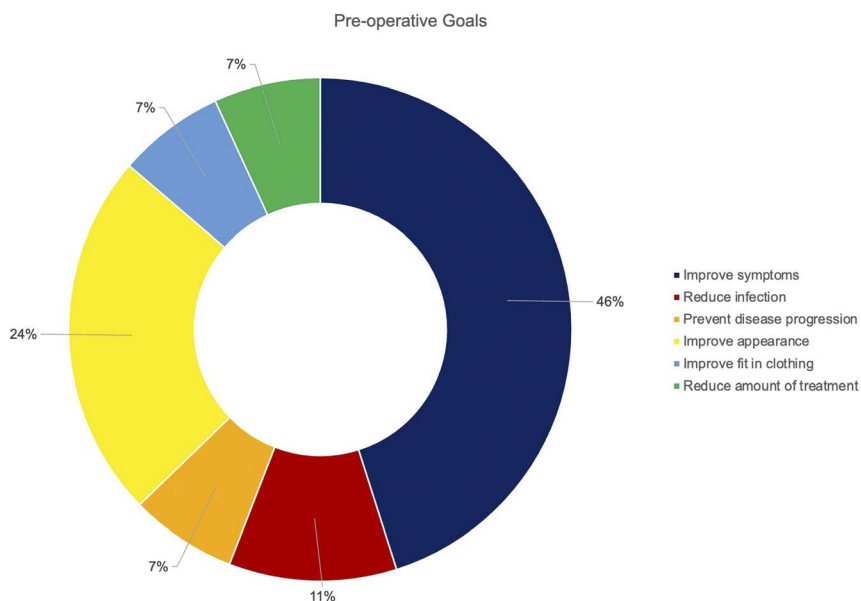
Debulking surgery with PAL (MicroAire Surgical Instruments, Va) was performed in all the patients included in the current study. This surgical approach was performed at our institution by the same plastic surgeon (D.S.) using an adapted form of the surgical technique proposed by Hakan Bronson in 1997.<sup>8</sup> A detailed explanation of this procedure has been previously described.<sup>6,10</sup>

## Statistical Analysis

One female patient had bilateral lower extremity (LE) lymphedema. For analysis purposes, each extremity was considered individually. Descriptive statistics using frequency and percentage were performed to evaluate lymphedema symptom changes. Normal distribution was found with the Shapiro Wilk test and visually with a histogram; thus, means and standard deviations were used to present continuous variables. Proportion and confidence intervals were calculated for each symptom, as well as for patients' primary reason for seeking lymphatic surgery. Stata Software/IC (16.1; StataCorp LLC, College Station, Tex) was used for the statistical analysis.

## RESULTS

Forty-nine patients underwent PAL during the 2-year study period. Of those, 45 patients met our inclusion criteria. All patients were surveyed by a phone to update their symptoms and 29 patients



**FIGURE 1.** Patients primary reason for seeking lymphatic surgery.

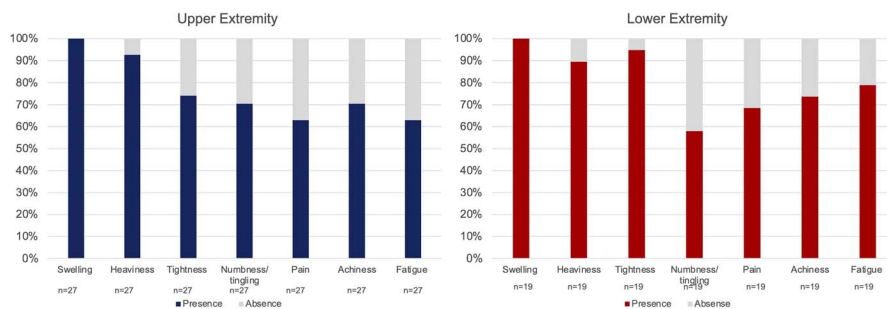


FIGURE 2. Baseline lymphedema-related symptoms.

completed the survey with a response rate of 66%. For patients who did not complete the survey, the information was extracted from the medical record of their last follow-up visit. Most patients were female 89% (n = 40) and White 84% (n = 38). Most patients had undergone prior chemotherapy and radiotherapy (70% and 74%, respectively). Twenty-seven patients (60%) underwent upper extremity (UE) PAL and 18 patients (40%) underwent LE PAL. The mean follow-up time was 15.5 ± 7.9 months (Table 1). For patients with UE lymphedema, 6 patients (22%) had follow-up less than 8 months (group 1), 13 (48%) had follow-up between 9 and 15 months (group 2), and 8 (30%) had follow-up more than 16 months (group 3). For patients with LE lymphedema, 2 (11%) had follow-up less than 8 months (group 1), 5 (26%) had follow-up between 9 and 15 months (group 2), and 12 (63%) had follow-up more than 16 months (group 3).

**Preoperative Goals and Baseline Symptoms**

The most common primary reason for seeking lymphatic surgery was to improve symptoms (n = 21, 46%). The second most common reason was to improve the appearance/size of the extremity (n = 11, 24%; Fig. 1).

All patients with UE and LE lymphedema reported having swelling in their affected extremity during the initial consultation. Heaviness was the second most common symptom in those with UE lymphedema (93%) and tightness was the third most common (74%). Tightness was the second most common symptom in those with LE lymphedema (95%) and heaviness was third (90%; Fig. 2).

**Postoperative Changes in Symptoms After PAL**

After PAL, greater than 90% of all LE lymphedema patients reported an improvement or resolution of their symptoms. Greater than 90% of UE lymphedema patients reported improvement or resolution of swelling, heaviness, fatigue, achiness, and pain. In addition, 85% and 68% of the UE lymphedema patients reported to have resolved or

improved tightness and numbness/tingling, respectively. None of the patients with LE lymphedema reported worsening of their symptoms after PAL (Table 2). However, 11% and 5% of patients with UE lymphedema reported worsening of numbness/tingling and tightness, respectively (Fig. 3).

For patients with UE lymphedema in group 1 (follow-up <8 months), all patients reported to have improved fatigue and pain and to have resolved in 50% of the cases tightness. Numbness/tingling was improved or resolved in 60% of the cases and stayed the same or gotten worse in 20% each. In group 2 (follow-up 9–15 months), all patients reported to have improved swelling, and 45% and 36% reported to have resolved heaviness and tightness, respectively. In 9% and 11% of the cases, tightness and numbness/tingling were reported to have gotten worse. Finally, in group 3 (follow-up >16 months), 71% and 63% of the cases patients reported to have resolved heaviness and swelling, respectively (Supplemental Data 1, <http://links.lww.com/SAP/A806>).

In patients with LE lymphedema, all patients in group 1 (follow-up <8 months) reported to have improved their lymphedema-related symptoms. In group 2 (follow-up 9–15 months), pain was resolved in 100% of the cases, followed by fatigue (75%) and numbness/tingling (67%). Lastly, in group 3 (follow-up >16 months), 60% of the patients reported to have resolved heaviness and 44% pain (Supplemental Data 2, <http://links.lww.com/SAP/A807>).

**DISCUSSION**

The results of our current study highlight that the primary goal for most patients with fat-dominant lymphedema presenting to our lymphatic center was to improve their lymphedema symptoms. In 90% of patients with LE lymphedema, PAL improved or resolved all lymphedema symptoms. Those with UE lymphedema demonstrated similar results with more than 90% of the cohort reporting improvement or resolution of most of their symptoms, with the exception of numbness/tingling

TABLE 2. Proportion of Patients Who Reported to Have Resolved or Improved Lymphedema-Related Signs and Symptoms After Debulking Procedure

| Lymphedema-Related Symptoms | UE         |                         | LE         |                         |
|-----------------------------|------------|-------------------------|------------|-------------------------|
|                             | Proportion | 95% Confidence Interval | Proportion | 95% Confidence Interval |
| Fatigue                     | 0.94       | 0.7131106–0.9985118     | 1          | 0.7819806–1*            |
| Achiness                    | 0.95       | 0.7397193–0.9986684     | 1          | 0.7683642–1*            |
| Tightness                   | 0.85       | 0.6210732–0.9679291     | 1          | 0.814698–1*             |
| Pain                        | 0.94       | 0.7131106–0.9985118     | 0.92       | 0.6397026–0.9980544     |
| Numbness/tingling           | 0.68       | 0.4344984–0.8742394     | 0.91       | 0.5872201–0.997701      |
| Heaviness                   | 0.96       | 0.7964831–0.9989878     | 1          | 0.8049357–1*            |
| Swelling                    | 1          | 0.8722971–1*            | 0.95       | 0.7397193–0.9986684     |

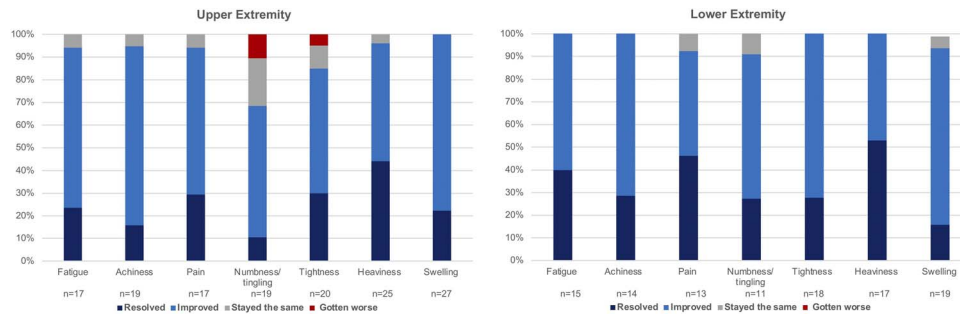


FIGURE 3. Changes in lymphedema-related symptoms after debulking surgery.

and tightness. In both UE and LE lymphedema, patients sustained an improvement or resolution of their preoperative symptoms.

Our study highlights that patients primarily seek lymphatic surgery to improve lymphedema symptoms and therefore support that lymphedema symptoms should be an important clinical outcome for PAL and other lymphedema surgeries. This finding aligns with Johnson et al,<sup>5</sup> which reported that the primary treatment goal among chronic lymphedema patients was to decrease symptoms in all subgroups: breast cancer, nonbreast cancer, and noncancer. Moreover, the authors concluded that by identifying patients' goals of care, physicians and providers may be able to develop more a personalized care plans.<sup>5</sup> By offering lymphedema patients a surgical procedure that addresses their daily stressors of lymphedema symptoms, we are providing comprehensive patient care and management. As surgeons, it is of paramount importance to listen to patients' concerns and goals to guide them through a tailored decision-making process that will address their individual needs.

When evaluating the changes in symptoms in the UE after debulking surgery, swelling and heaviness were the symptoms with the greatest positive change, followed by tightness and pain. Similar to the UE, symptom with the greatest positive change in the LE was heaviness, followed by pain and fatigue. Interestingly, in the LE, there were no negative changes; however, in the UE, 11% and 5% of the patients reported that numbness/tingling and tightness had worsened, respectively. Patients reported localization of the numbness/tingling to the hand. We have previously reported on the issue of worsening hand swelling after PAL<sup>10</sup> of the UE and believe that this negative finding is related to that physical manifestation. Normally, the hand swelling will resolve over time with appropriate compression therapy, and we would expect improvement of the numbness/tingling over time. With regard to tightness, we believe that this negative change is related to the tightly fitted compression garments used postoperatively. As previously described,<sup>10</sup> patient garments are customized 3 weeks before surgery using the nonlymphedematous extremity to estimate postoperative volume. For LE garments, patients are fitted to custom fabricated (flat knit) class III (34–36 mm Hg) closed toe, waist high garments, and open-toed thigh-high class II (23–32 mm Hg) stockings. For UE garments, patients are fitted to a class II compression sleeve and glove (EssityCorp, Stockholm, Sweden). We believe that patients reporting worsening of tightness after PAL of the UE were not accustomed to this level or compression or potentially required modifications of their compression garment secondary to fitting issues.

In completing this study, our group came to appreciate the complexity of identifying and evaluating lymphedema symptoms due to the lack of standardized and validated questionnaires evaluating symptoms. One tool that has been established to meet this need for the UE lymphedema is the Breast Cancer and Lymphedema Symptom Experience Index.<sup>19,20</sup> This index evaluates laterality, location, limitation to movement, symptoms occurrence, and symptoms distress.<sup>19,20</sup> This validated tool is not only used to diagnose lymphedema using machine learning and as a clinical instrument for lymphedema screening<sup>21</sup> but also used

to evaluate clinical outcomes after treatment of lymphedema.<sup>22</sup> Thus, the Breast Cancer and Lymphedema Symptom Experience Index could potentially be implemented to evaluate lymphedema symptoms as a clinical outcome after lymphatic operations.<sup>19,20</sup> Currently, there is a valid tool to assess LE lymphedema symptoms, which is the Lymphedema Symptom Intensity and Distress Survey–Lower Limb<sup>23</sup>; however, this instrument has not been tested in a clinical setting. Future studies validating tools for the proper surveillance of lymphedema symptoms in a systematic and structured manner are needed so they could be used in lymphatic centers.

A limitation of our current study is that we only evaluate positive symptoms reported by the patient at their initial consultation. However, we did not account for negative symptoms patients could have developed de novo at a later time. Furthermore, in retrospect, we did not specify the anatomic location for the swelling, which led to challenges in identifying associations between different symptoms. This further emphasizes the need for validated questionnaires to systematically evaluate patient symptoms throughout their experience. However, this study still adds to the literature as it clearly demonstrates the positive effects that debulking procedures have on baseline lymphedema-related symptoms. Potential confounders in this study include the compression garments and/or the trauma of the operation itself. The etiology of the few negative effects on symptoms from PAL are unable to be differentiated and definitively ascertained. Moreover, the severity of lymphedema might play an important role in lymphedema-related symptoms; however, we were unable to explore this association as most patients in our cohort presented with stage II lymphedema. In addition, the complexity of the vagueness in symptom descriptors could have also affected patients' responses as some of the terms used might be difficult to differentiate from others (eg, pain and aching).

## CONCLUSIONS

In patients with fat dominant lymphedema, an improvement of lymphedema related symptoms is their primary reason for seeking lymphatic surgery. Power-assisted liposuction positively impacts symptoms in a sustained fashion over time. Further studies with a mixed method approach may help us better understand patients' expectations and set adequate treatment goals.

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