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Original Article

# A retrospective comparative study of patient-reported outcome measures, pre-treatment and twelve months post-treatment using tumescent liposuction for the management of lower limb lipoedema ☆

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ABSTRACT

*Background:* Lipoedema is a painful adipose tissue disorder, affecting the limbs of women, that is resistant to diet and exercise. The purpose of the study was to evaluate the retrospective health-related quality-of-life (HRQoL) outcomes for patients with lower limb lipoedema (LLL) following tumescent liposuction (TL).
*Methods:* Forty-seven patients received TL over 5 years from 2015-2020 for LLL. As part of their routine treatment evaluation, each patient completed 4 validated HRQoL questionnaires at initial assessment. The questionnaires examined the patients' experiences relating to anxiety and depression, lower extremity function, appearance, and symptoms. The same questionnaires were posted to the patients after an average of 12 months post-procedure/s to establish the outcomes of the intervention.
*Results:* The study demonstrated that patients' HRQoL improved at 12 months (average) following TL. The results of all the questionnaires were statistically significant, and patients with stage 3 LLL showed the most improvement in outcomes.
*Conclusion:* The findings demonstrated that TL achieves positive HRQoL outcomes in patients with LLL; however, long-term follow-

☆ This work has not been presented anywhere.

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up is needed to determine if the benefits sustain. Additionally, larger prospective controlled studies are required to provide robust evidence for this procedure.



## Introduction

Lower limb lipoedema (LLL) is described as a painful adipose tissue disorder that almost exclusively affects women. It is of unknown origin and currently without a definitive cure. It is estimated to affect 1 in 72,000 women in the United Kingdom (UK), with higher percentages of up to 19% reported by other countries.[1,2] LLL often develops during puberty (or hormonal change), and there is strong evidence of an underlying genetic factor.[3] Lipoedema is characterised by disproportionate amounts of symmetrical subcutaneous adipose deposition developing bilaterally in the lower extremities (the trunk being unaffected) and it can also affect the arms.[4,5]

The fat cells found in lipoedema are considered to be distinctly different from normal fat cells, which may account for an individual's inability to lose weight through conventional methods, such as diet and exercise, although this is not robustly evidenced.[4–8]

Frequently, women with LLL report symptoms of heaviness, bruising, tenderness, pain and inability to walk for any distance or stand for long periods.[9–12] These physical symptoms paired with the psychosocial effect, can negatively impact women's professional lives.[9–15]

If LLL progresses, the further accumulation of adipose tissue increases pain and bruising, significantly reduces mobility due to joint degeneration and may cause the development of orthostatic oedema/lymphoedema and several potential complications.[11,16,17] These associated long-term health issues can be physically and psychosocially debilitating.[18]

Currently, most patients in the UK with LLL are offered conservative treatment or combined decongestive therapy (CDT).[14] CDT consists of compression garments (tights and stockings), manual lymphatic drainage (MLD), skin care and exercise, and aims to manage symptoms, but cannot prevent the progression of LLL.

Debate continues among clinicians and authors regarding the efficacy of conservative management for this cohort of patients.[19] According to Ricardo et al. 2023 [20] and Fetzer (2016),[21] CDT has no effect on adipose tissue and its progression, although Lipoedema UK (2020)[22] states that compression therapy remains an important element in the treatment of patients with lipoedema as it reduces inflammation in the subcutaneous tissues, which is considered to be a contributing factor in the pain experienced by the patients.[23] The efficacy of MLD to date, has not been demonstrated; however, it may play an important role in pain management and symptom control in the early stages of lipoedema, as does intermittent pneumatic compression and off the shelf compression garments.[19,24]

It is apparent that the need for new, effective intervention that offers long-term benefits is paramount and it appears from recent studies that tumescent liposuction is emerging as a possible solution.[21,25–27] Despite this, the National Institute of Clinical Evidence (NICE, 2022, Fig. 1 and Table 1)[28] found that evidence is insufficient to support liposuction for lipoedema treatment and that it posed risk. It went on to recommend that liposuction should only be carried out in the UK currently, if it is part of a research study.

## Materials and Methods

The purpose of this study was to report on the experiences of 47 women with LLL who received tumescent liposuction/s with a private provider between 2015 and 2020. Validated patient-reported

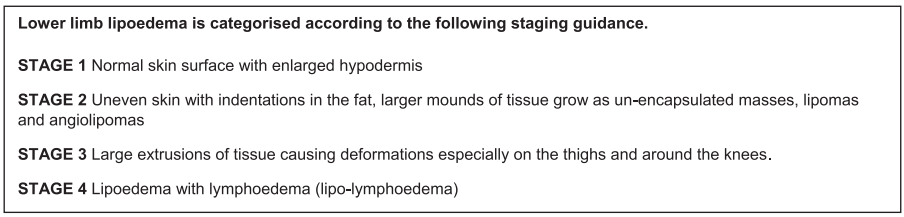



**Figure 1.** The four stages of lipoedema (Buck and Herbst, 2016)

**Table 1**
Overall Results: Median values pre- and post-liposuction

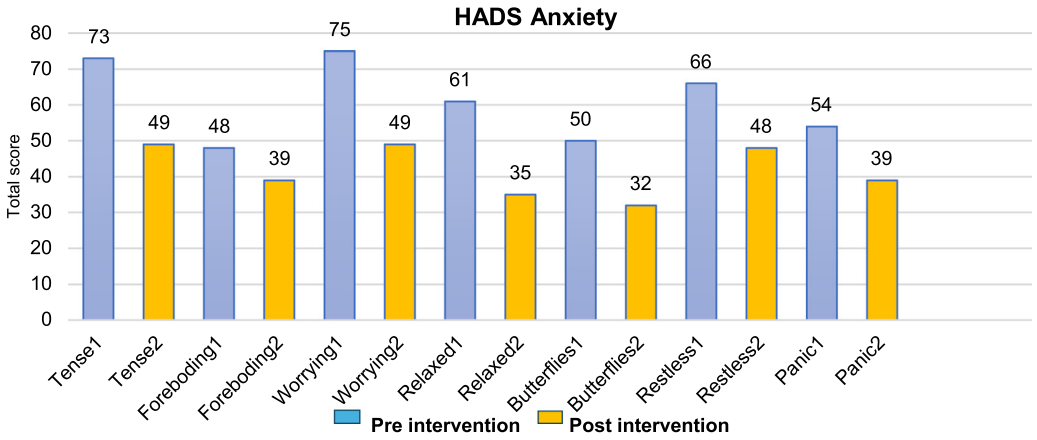
| Health-Related Quality of life (HRQoL) Tool | Pre- & Post-Intervention | Median (Quartiles) | *p* value* |
|---|---|---|---|
| Hospital anxiety and depression scale - Anxiety | Pre-intervention score | 9.00 (6.50, 12.00) | $p = 0.000$ |
| | Post-intervention score | 6.00 (3.00, 9.00) | |
| Hospital anxiety and depression scale - Depression | Pre-intervention score | 7.00 (3.00, 10.00) | $p = 0.000$ |
| | Post-intervention score | 2.00 (0.00, 5.25) | |
| Lower extremity functional scale | Pre-intervention score | 69.38 (48.44, 82.19) | $p = 0.000$ |
| | Post-intervention score | 88.13 (76.25, 97.19) | |
| Derriford appearance scale 24 | Pre-intervention score | 65.00 (51.00, 74.50) | $p = 0.000$ |
| | Post-intervention score | 41.00 (36.00, 54.00) | |
| Derriford appearance scale 24 - Pain | Pre-intervention score | 3.00 (2.00, 4.00) | $p = 0.000$ |
| | Post-intervention score | 1.00 (1.00, 2.00) | |
| Derriford appearance scale 24 - Limits the ability to do things | Pre-intervention score | 3.00 (2.00, 4.00) | $p = 0.000$ |
| | Post-intervention score | 2.00 (1.00, 2.00) | |
| Lymphoedema quality of life - TOTAL | Pre-intervention score | 2.46 (2.03, 2.74) | $p = 0.000$ |
| | Post-intervention score | 1.38 (1.19, 1.76) | |
| Lymphoedema quality of life – Function | Pre-intervention score | 2.19 (1.50, 2.88) | $p = 0.000$ |
| | Post-intervention score | 1.12 (1.00, 1.41) | |
| Lymphoedema quality of life – Appearance | Pre-intervention score | 3.43(3.00, 3.71) | $p = 0.000$ |
| | Post-intervention score | 1.50 (1.14, 2.29) | |
| Lymphoedema quality of life - Symptoms | Pre-intervention score | 2.60 (2.00, 2.80) | $p = 0.000$ |
| | Post-intervention score | 1.40 (1.20, 2.10) | |
| Lymphoedema quality of life - Pain | Pre-intervention score | 3.00 (2.00, 1.00) | $p = 0.000$ |
| | Post-intervention score | 2.00 (1.00, 2.00) | |
| Lymphoedema quality of life - Mood | Pre-intervention score | 2.08 (1.67, 2.67) | $p = 0.000$ |
| | Post-intervention score | 1.50 (1.04, 1.83) | |
| Lymphoedema quality of life – QoL | Pre-intervention score | 5.00 (3.00, 7.00) | $p = 0.000$ |
| | Post-intervention score | 8.00 (7.00, 9.00) | |

*p value is from the Wilcoxon signed-rank test

outcome measures (PROMs) were collected pre-treatment in clinic and 12 months (average) post-procedure as part of their routine treatment evaluation. The PROMs consisted of 4 questionnaires, which gathered information about the patients' biopsychosocial experiences relating to their LLL and the outcomes after receiving liposuction treatment. The stage of lipoedema was also explored in relation to the results of each questionnaire. The questionnaires (apart from Lymphoedema quality of life questionnaire (LymQol)) were established as reliable and validated tools used routinely in the general practice of the plastic surgeon to measure PROMs as part of all treatment outcomes. Although LymQol was designed to measure the QoL for patients with lymphoedema, it correlated on many levels for patients with lipoedema and to date a lipoedema specific QoL tool has not been designed.[10]

The Wilcoxon signed-rank test was performed to establish statistical significance of the outcomes at $p<0.05$ level.[29,30] The Wilcoxon signed-rank test was appropriate as the sample size was small, and the data were non-parametric and showed skew.[31] The objective of the test was to calculate the total median scores for each patient from the questionnaires at 2 points in time; pre-liposuction and

**Table 2**
HADS anxiety (average) scores pre- and post-surgery




at 12 months post-liposuction/s, and then rank the difference between both scores as a median value (Wilcoxon, 1945, cited in Kaur & Kumar, 2015).[32]

*Overall Results*

The patients in the study were all women ($n = 47$) residing in the UK and from international locations. The patients' ages ranged from 21-73 years, with the median age calculated as 46 years, and 57% of women were aged between 40-59 years. Most patients (77%) were diagnosed with stage 2 (16) and 3 (20) LLL. The pre- and post-test comparison results for the 4 PROMs showed statistical improvement $p<0.05$, disproving the hypothesis following application of the Wilcoxon signed-rank test.

*Depression and Anxiety*

Pre-treatment scores denoted that patients with stage 2 and 3 LLL were considered to be depressed (Table 2) whereas the post-scores for the same patients were in the normal range. This correlated with the LYMQoL findings for mood post-TL. Anxiety scores for stage 1 patients improved more than those for stage 2 and 3 LLL post-TL; however, depression for stage 1 post-treatment was less improved than stage 2 and 3 post-TL.

Further detail from the Hospital Anxiety and Depression Scale (HADs) anxiety outcomes showed the highest pre-scores (worst) were 'I feel tense or wound up' (Tense1, 73) and 'worrying thoughts go through my mind' (Worrying1), which scored 75. Both these categories also achieved the greatest improvement post-TL with a reduction in score of 24 and 26, respectively.

Examining the responses to the Hospital Anxiety and Depression Scale (HADS) depression domain (Table 3), the highest pre-score of 73, related to the problem 'I feel as if I am slowed down' (Slowed1). This question achieved the second greatest reduction in the score at 33 following TL, after a difference in post-score of 36 in answer to 'I still enjoy the things, I used to enjoy (Enjoy2).

*Pain*

Table 4 includes the results for the 3 HRQoL questionnaires, which examined pain (LymQol and DAS 24), and post-treatment scores showed statistically significant results, for all stages of LLL, with the most marked improvement for patients with stage 3 LLL. Patients with stage 1 LLL showed the least improvement.

**Table 3**
HADS Depression (average scores pre- and post-surgery)

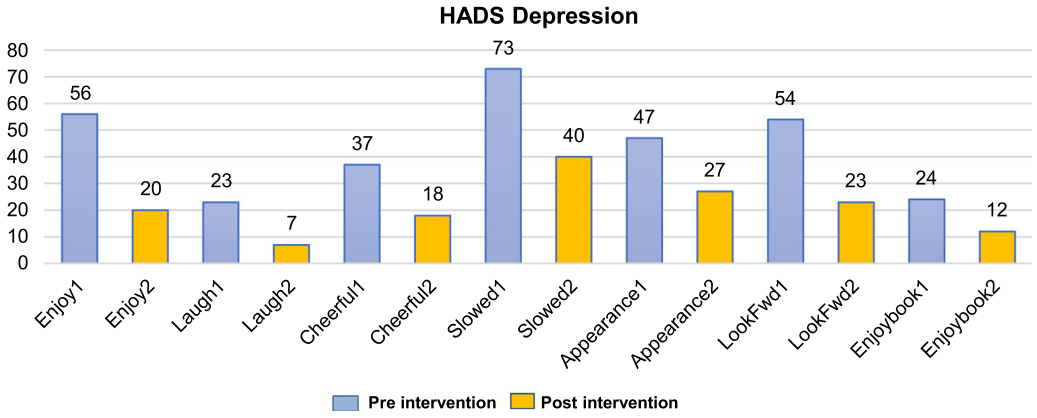
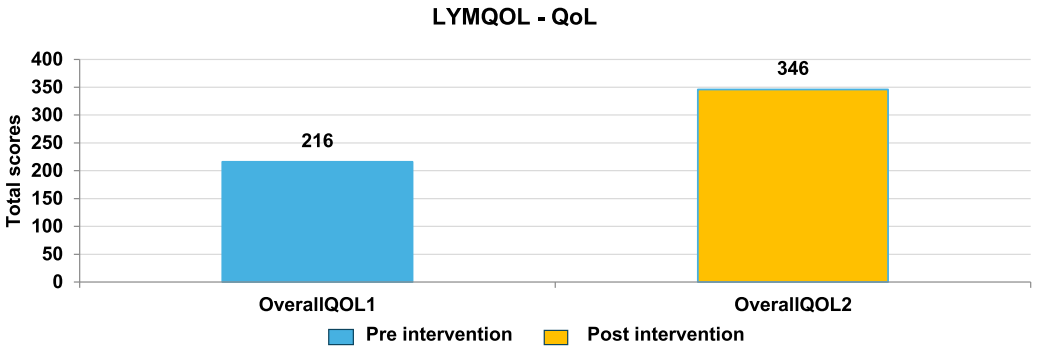



**Table 4**
Outcomes relating to the stage of Lipoedema

| HRQoL Tool | Lipoedema Stage | Pre-intervention score Median (quartiles) | Post-intervention score Median (quartiles) | *p* value* |
|---|---|---|---|---|
| Hospital anxiety and depression scale - Anxiety | Lipoedema stage 1 | 10.00 (6.50, 11.50) | 4.00 (3.50, 8.00) | $p = 0.012$ |
| | Lipoedema stage 2 | 11.00 (6.00, 14.00) | 9.00 (4.00, 10.00) | $p = 0.020$ |
| | Lipoedema stage 3 | 9.00 (7.00, 10.00) | 6.00 (2.00, 11.00) | $p = 0.001$ |
| Hospital anxiety and depression scale - Depression | Lipoedema stage 1 | 6.00 (2.50, 7.00) | 2.00 (0.00, 4.00) | $p = 0.018$ |
| | Lipoedema stage 2 | 8.50 (2.25, 10.75) | 1.50 (1.00, 7.50) | $p = 0.016$ |
| | Lipoedema stage 3 | 9.00 (5.00, 10.00) | 3.00 (0.00, 6.00) | $p = 0.001$ |
| Lower extremity functional scale | Lipoedema stage 1 | 81.88 (73.13, 96.09) | 96.25 (85.63, 99.38) | $p = 0.012$ |
| | Lipoedema stage 2 | 71.25 (45.94, 87.19) | 86.88 (78.75, 96.88) | $p = 0.004$ |
| | Lipoedema stage 3 | 58.13 (40.31, 69.69) | 80.00 (68.91, 96.56) | $p = 0.001$ |
| Derriford appearance scale 24 | Lipoedema stage 1 | 63.00 (44.25, 72.50) | 37.50 (32.25, 53.88) | $p = 0.036$ |
| | Lipoedema stage 2 | 66.00 (54.00, 77.00) | 44.00 (38.00, 57.00) | $p = 0.001$ |
| | Lipoedema stage 3 | 70.50 (58.00, 75.50) | 44.00 (39.00, 54.75) | $p = 0.001$ |
| Derriford appearance scale 24 - Pain | Lipoedema stage 1 | 2.00 (2.00, 3.50) | 1.00 (1.00, 2.00) | $p = 0.026$ |
| | Lipoedema stage 2 | 3.00 (2.00, 3.75) | 2.00 (1.00, 2.00) | $p = 0.021$ |
| | Lipoedema stage 3 | 4.00 (2.25, 4.00) | 1.50 (1.00, 2.75) | $p = 0.001$ |
| Derriford appearance scale 24 – Limits the ability to do things | Lipoedema stage 1 | 2.00 (2.00, 2.00) | 1.00 (1.00, 2.00) | $p = 0.206$ |
| | Lipoedema stage 2 | 3.00 (3.00, 4.00) | 2.00 (1.00, 2.00) | $p = 0.001$ |
| | Lipoedema stage 3 | 4.00 (2.25, 4.00) | 1.50 (1.00, 2.75) | $p = 0.000$ |
| Lymphoedema quality of life - TOTAL | Lipoedema stage 1 | 1.38 (1.38, 2.19) | 1.13 (1.06, 1.31) | $p = 0.042$ |
| | Lipoedema stage 2 | 3.00 (3.00, 4.00) | 2.00 (1.00, 2.00) | $p = 0.001$ |
| | Lipoedema stage 3 | 4.00 (2.25, 4.00) | 1.50 (1.00, 2.75) | $p = 0.000$ |
| Lymphoedema quality of life – Function | Lipoedema stage 1 | 1.38 (1.38, 2.19) | 1.13 (1.06, 1.31) | $p = 0.042$ |
| | Lipoedema stage 2 | 2.00 (1.66, 2.56) | 1.19 (1.03, 1.59) | $p = 0.005$ |
| | Lipoedema stage 3 | 2.75 (2.25, 3.00) | 1.13 (1.00, 1.38) | $p = 0.013$ |
| Lymphoedema quality of life – Appearance | Lipoedema stage 1 | 3.14 (2.71, 3.38) | 1.43 (1.00, 2.00) | $p = 0.011$ |
| | Lipoedema stage 2 | 3.50 (3.04, 3.71) | 1.57 (1.14, 2.29) | $p = 0.000$ |
| | Lipoedema stage 3 | 3.43 (3.14, 3.71) | 1.71 (1.29, 2.29) | $p = 0.000$ |
| Lymphoedema quality of life - Symptoms | Lipoedema stage 1 | 2.20 (2.00, 2.60) | 1.40 (1.20, 1.40) | $p = 0.018$ |
| | Lipoedema stage 2 | 2.40 (1.90, 2.70) | 1.60 (1.40, 2.30) | $p = 0.013$ |
| | Lipoedema stage 3 | 2.60 (2.40, 2.80) | 1.30 (1.20, 2.30) | $p = 0.000$ |
| Lymphoedema quality of life - Pain | Lipoedema stage 1 | 2.50 (1.25, 3.00) | 1.00 (1.00, 2.00) | $p = 0.052$ |
| | Lipoedema stage 2 | 2.00 (2.00, 3.00) | 2.00 (1.00, 2.00) | $p = 0.018$ |
| | Lipoedema stage 3 | 3.00 (4.00, 3.75) | 1.00 (1.00, 2.00) | $p = 0.001$ |

* p value is from the Wilcoxon signed-rank test

**Table 5**
Lymqol Quality of life pre- and post-surgery




*Quality of Life (QoL)*

The QoL scores from the LYMQoL questionnaire showed statistically significant outcomes post-treatment for patients with all stages of LLL, but that patients with stage 3 LLL achieved the most notable improvement ($p = 0.000$; Table 5).

*Function*

Post-TL scores for Lower Extremity Functional Scale (LEFS) and LYMQoL tools showed statistically significant improvement, $p = 0.000$ in functional ability. Further detail from the LEFS questionnaire pre-TL, reveals the 2 areas that patients reported as being the most problematic in relation to their condition, was 'running on uneven ground' (RunUneven1), scoring 54.5 and 'making sharp turns while running fast' (SharpTurns1), scoring 59 (Table 13). LYMQoL results showed walking, bending, standing and leisure activities were the most affected, pre-TL.

The LEFS post-TL result for function showing the greatest improvement following surgery was 'your usual hobbies, recreational or sporting activities' (Hobbies1 and Hobbies2), improving from 85 to 146, indicating a 71.76% increase.

## Interpretation

There is currently no validated tool to measure the quality of life for patients with lipoedema. While using 4 different questionnaires, themes emerged across all data produced pre- and post-treatment.

Post-intervention outcomes from the LymQol and HADs questionnaires strongly suggest that lipoedema does impact a patient's mental health, which aligns with the results of the study by Bauer et al. (2019)[33] that indicated that the symptoms of depression were significantly reduced post-liposuction. Additionally, the severity of a chronic condition often coincides with the worsening of depression, which was confirmed by the results for patients with stage 3 LLL.[34] Ghods et al.[13] 2020 stated that the women with LLL experienced depression (25.5%) are reported to be double that of women without the condition (6.6-10.2%). Additionally, Smidt et al. (2015)[35] found that 39.7% of patients with lipoedema experienced depression and 16.5% cited eating disorders. Furthermore, Dudek et al. (2016)[18] indicated that 31.8% of women had eating disorders and 56.8% showed high to very high scores for depression. However, the impact of LLL on mental health continues to be debated amongst health professionals despite the link between chronic illness and depression being widely acknowledged,[36,37] which perhaps reflects the poor understanding and awareness about LLL.[38]

If a patients' pain and symptoms improved following liposuction, this would suggest that the pre-depression score was a direct response to the symptoms experienced, as found by Bauer et al. (2019)[33] and Dudek et al. 2018.[6] It also implies that patients may not have had mental health issues before de-

veloping LLL, contrary to the views of Bertsch, Erbacher and Elwell (2020).[39] Furthermore, it could be argued that conventional treatment becomes more burdensome psychologically in the later stages of LLL owing to the abnormalities in limb shape, impact on mobility and ability to manage compression garments effectively.

Other outcomes from this study also indicate that undergoing liposuction contributed to the improved well-being of patients, as confirmed by the Derriford Appearance Scale (DAS24) results, highlighting that patients were feeling happier with their appearance, reflection, becoming less self-conscious and being able to wear clothes that they previously could not. This demonstrates improved body image and positive psychological response and is also confirmed in the post-TL appearance scores from the LYMQoL questionnaire. Anecdotal evidence from clinical practice, indicates that following TL, women often regain a sense of normalcy and feel less judged by others, which contributes to improved mental well-being and reduces anxiety/depression, as confirmed by the outcomes of the HADS questionnaire.[40] The results for the HADS anxiety domain were mixed when compared with the stage of lipoedema as patients in stage 2 and 3 LLL recorded less of an improvement in anxiety post-procedure than patients in stage 1. However, patients with stage 1 LLL also reported less improvement in depression than patients with stage 2 and 3 LLL. The outcomes suggest that patients with stage 1 LLL experience greater anxiety than depression. Moreover, as the number of patients with stage 1 LLL represented in the study was low, it may not accurately reflect this category of patients. Overall, the findings suggest that patients with LLL experience elements of depression or anxiety to some extent pre-treatment, which correlates with the findings of other authors.[21,41,42]

The physical symptoms experienced by patients with LLL can also be attributed to the levels of depression or anxiety pre-liposuction and add to the opinion of many authors who reported that pain has a relationship with depression, although the actual association remains unclear.[43,44] Pain was examined by using 2 of the HRQoL questionnaires, LYMQoL and DAS24. The overall outcome found using both questionnaires was statistically significant for patients post-TL, $p = 0.000$. Further analysis of the DAS24 outcome produced positive results for all stages, with stage 3 recording the most improved score. The results for LYMQoL, relating to stage of LLL, revealed that patients with stage 3 LLL presented the most marked improvement in pain, with patients in stage 1 LLL also showing improvement although less statistically significant ($p = 0.052$) and patients with stage 2 presenting no change ($p = 0.018$). Results may have been misrepresented due to the wording in the questionnaire 'Does your lymphoedema cause you pain?' This refers to 'swollen legs', lipoedema pain symptoms are different from those of lymphoedema.[45] The interpretation of this question may have led to confusion among the patients and highlights the need for a disease-specific PROM which would eliminate any ambiguity.[44]

This study and others report that pain improved following liposuction, but it was unknown if these benefits would endure.[2,14,32,46–49] However, a recent long-term follow-up of Baumgartner, Hueppe and Schmeller study found that patients reported sustained symptom outcomes after 12 years.[50]

The LEFS and LYMQoL questionnaires demonstrated that the specific functional problems experienced by patients with LLL had improved following TL, correlating with the results of the other studies; Wollina and Heinig's (2019)[48] study reported that every patient had experienced an improvement in mobility by 86% overall.[14,32,45–47]

Post-TL scores for both the tools showed statistically significant improvement ($p = 0.000$) in functional ability when compared with the findings of other studies.[14,32,45–48] Further detail shows that standing and squatting, running on uneven and even ground, making sharp turns while running fast, and hopping was indicated by the LEFS tool as being the most problematic for patients, while LYMQoL results showed walking, bending, standing and leisure activities were the most affected. Anecdotal evidence from clinical practice has highlighted the difficulties that the patients with LLL experience namely: standing, walking and kneeling often being stated as an issue, and this detailed additional information about functionality could assist in the development of a future LLL specific assessment tool to more accurately diagnose and understand these key problematic areas.[51,52] Improved functional ability and ability to pursue leisure activities following liposuction is likely to positively impact the patients' psychosocial well-being.[53] Moreover, improved physical activity would assist with general weight loss and may reduce potential co-morbidities.[2,19,54]

It is clear from the literature that QoL for patients with LLL is significantly affected by the condition.[18,40,55,56] The QoL scores from the LYMQoL tool showed statistically significant outcomes post-treatment for patients in all stages of LLL, but patients with stage 3 LLL achieved the most notable improvement ($p = 0.000$). The overall improvement of QoL has also been echoed in other studies.[2,9,14,45–48,57]

## Study Limitations

The limitations of this study were that it was not controlled, and its small size (47 patients), making it difficult to draw conclusions for the overall population. Additionally, it was not possible to apply the results to stage 4 LLL, due to the limited number of patients.

The use of HRQoL questionnaires (PROMs) in research offers advantages and disadvantages. While being inexpensive, anonymous, valid, reliable and standardised, they tend to lack personalisation. Moreover, the respondents may omit, misinterpret or misunderstand some questions, as reflected in this study.[58]

## Conclusion

This study shows that patients with LLL face multiple biopsychosocial challenges, which are further compounded by the limited treatment options available through the National Health Service (NHS). A poor evidence base hinders the development of new treatment, but the findings of this study suggest that TL could provide positive biopsychosocial outcomes for patients with LLL.

The results of this retrospective comparative study suggest that TL has positive outcomes for women with LLL after 12 months (average) post-intervention and adds to the limited body of evidence produced outside Germany. It is the first UK study to provide HRQoL outcomes relating to this intervention for patients with LLL. While the study size was small, this should not detract from the results being clinically meaningful and statistically significant.[59]

New robust evidence would improve understanding regarding the pathology of lipoedema, future treatments and the ongoing experiences of the patients.[10,60] All studies to date have acknowledged that the continued follow-up of patients is crucial to evaluate future outcomes. Increasing the quality and quantity of evidence for TL may encourage health services internationally to start offering this treatment instead of incurring the potential costs that untreated LLL yields. It could also determine if TL should be offered at earlier stages of LLL to slow the development of the condition, improve long-term results and prevent the need for additional surgeries to correct excess skin issues.[14] Podda et al.'s (2021)[61] randomised controlled multicentre study may provide the quality of evidence that will support TL for the future management of LLL.

There remains a need for a condition-specific HRQoL tool to be devised to more accurately collect the experiences of women with LLL pre- and post-TL.[9,10] Furthermore, any questionnaire developed should be carried out in conjunction with LLL patients to capture the most holistic and salient information.[62,63]

## Ethical Approval

Received from the University of Wolverhampton (Ref: 1220LMUOWHEA). Approval has also been received from the owner of the PROMs data.

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**Conflict of Interest**:

None.

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