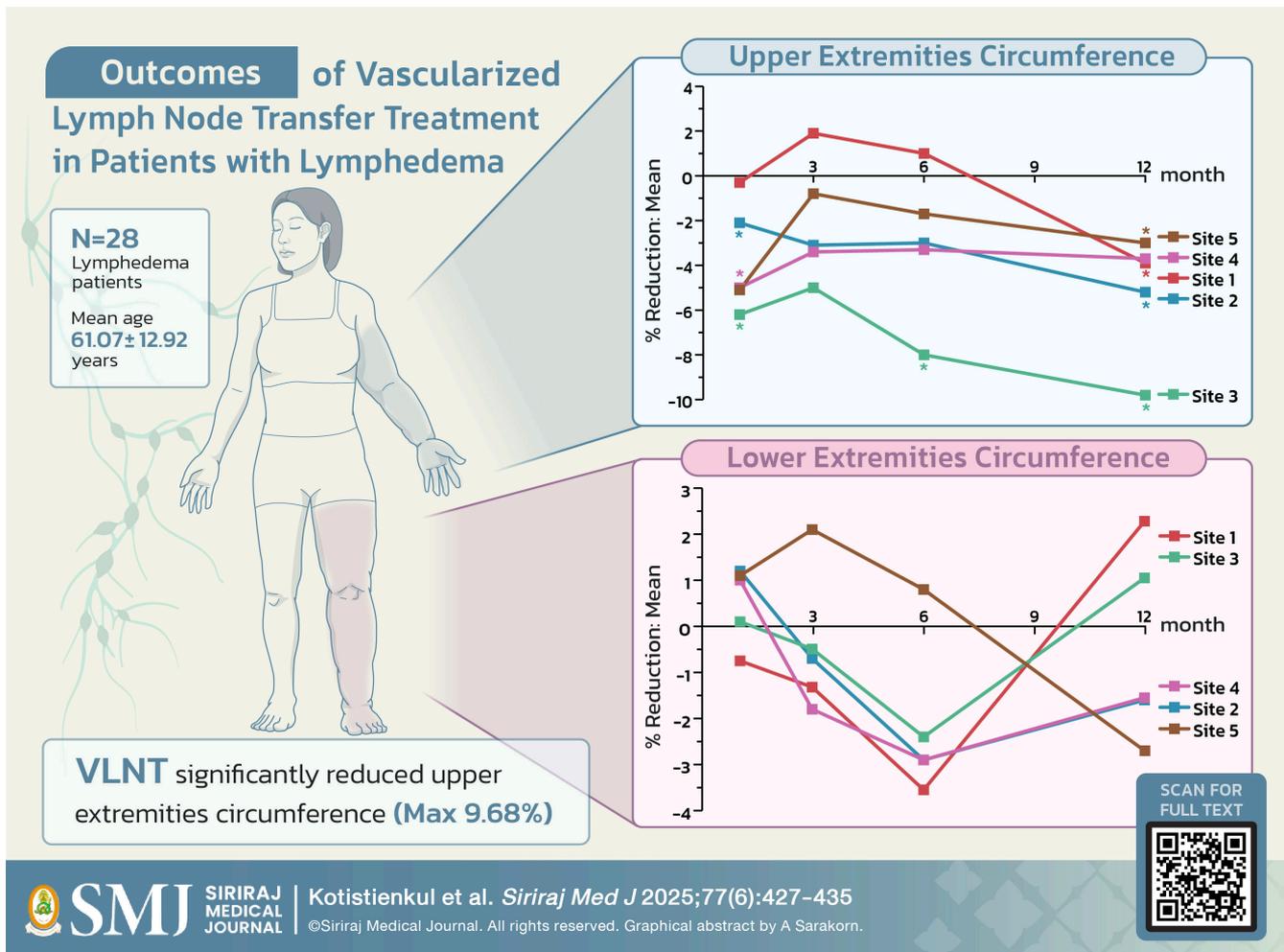


Outcomes of Vascularized Lymph Node Transfer Treatment in Patients with Lymphedema

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ABSTRACT

Objective: This study aimed to evaluate the postoperative outcomes of patients with lymphedema treated with vascularized lymph node transfer (VLNT).

Materials and Methods: A retrospective chart review was conducted on 28 patients who underwent VLNT procedures at Siriraj Hospital between 2010 and 2020. Data collected included patient demographics, underlying diseases, previous cancer treatments, duration of lymphedema, etiology of lymphedema, donor and recipient sites, operative time, and limb circumference measurements were taken pre-operatively and at 1, 3, 6, and 12 months postoperatively. Additionally, postoperative complications were documented and analyzed.

Results: The review identified various underlying diseases associated with lymphedema, mostly linked to cancer. Noteworthy cancer treatments included node dissection, radiotherapy, and chemotherapy. The etiology of lymphedema varied, with multiple donor and recipient sites used for VLNT procedures. Postoperative limb circumference measurements showed significant percentage reduction in limb circumference, particularly in patients with upper limb lymphedema ($p < 0.05$), while the lower limb showed no statistical significance. Postoperative complications included flap necrosis, flap congestion, flap hematoma, and cellulitis.

Conclusion: Our retrospective analysis underscores the effectiveness of VLNT procedures in managing lymphedema at Siriraj Hospital. Despite the diverse etiologies and prior treatments, VLNT demonstrated favorable outcomes in terms of limb circumference reduction, particularly in upper extremities. Further prospective analytic studies are warranted to validate these findings and optimize treatment protocols.

Keywords: Vascular lymph nodes transfer (VLNT); lymphedema; limb circumference; postoperative reduction; postoperative complication (Siriraj Med J 2025; 77: 427-435)

INTRODUCTION

Lymphedema is a chronic condition characterized by impaired lymphatic drainage, leading to limb swelling and tissue changes such as adipose tissue deposition and skin thickening.^{1,2} Lymphedema is classified into two etiological groups: primary and secondary lymphedema. While primary lymphedema is typically caused by congenital abnormalities or developmental defects in the lymphatic system, secondary lymphedema often results from surgical interventions, trauma, or underlying medical conditions that disrupt lymphatic flow, such as cancer.³⁻⁵

Common symptoms of lymphedema include pain, heaviness, swelling, decreased limb function, decreased quality of life, skin changes and recurrent infections. Diagnosis is often based on limb circumference or volume measurements, with differences of 2 cm or more in limb circumference compared to the contralateral limb, or volume differences of 200 mL or 10% from baseline, considered diagnostic.⁶

Management of lymphedema consists of nonoperative and surgical treatment. The nonoperative treatment started with decongestive therapy (CDT), while surgical treatment is mostly second-line therapy, offered after unsuccessful CDT. The surgical treatment can be classified into debulking procedures; direct excision (Charles or Sistrunk procedure) and liposuction, and physiologic procedures; lymphatic bypass and lymph node

transplants.⁷ The emerging surgical procedure including lymphaticovenous anastomosis (LVA), vascularized lymph node transfer (VLNT), liposuction and Charles procedure.⁸ VLNT involves transferring lymphatic tissue to an area of lymph obstruction to reconstruct the affected part. Lymph nodes for VLNT can be harvested from various donor sites, including the groin, submental region, supraclavicular area, thoracodorsal region, lateral thoracic region, internal mammary region, deep inferior epigastric, lateral intercostal artery region, gastroepiploic, jejunal mesentery, mesoappendix and ileocecal area.⁹⁻¹⁵ The mechanism of VLNT consist of 2 main actions, of which are lymphatic pump, which is an immediate action and lymphangiogenesis which requires time. Therefore, VLNT is indicated for patients whose lymphatic vessels are impaired, higher stage of ISL, or failure of prior LVA.⁷

This study focuses on the surgical outcomes of patients treated with VLNT at Siriraj Hospital between 2010 and 2020. The analysis includes postoperative limb circumferences, complications, and percentage reduction in limb circumference.

MATERIALS AND METHODS

A case series study was conducted with approval from the Institutional Review Board (IRB) of the Faculty of Medicine Siriraj Hospital No. 073/2566, COA No. Si 187/2023. The study focused on patients diagnosed

with lymphedema who underwent VLNT using lymph nodes harvested from the supraclavicular, submental, omentum, or other donor sites between 2010 and 2020. Demographic data, including age, sex, weight, height, and underlying disease(s) were collected. Patients were graded according to ISL staging, primary or secondary lymphedema, and the location of affected limb(s). Operational data included the donor site location and the duration of the operation were collected.

Limb circumferences were measured using a standardized approach with five anatomical reference points. For the upper extremities, measurements were taken at 20 cm above the olecranon (Site 1), 10 cm above the olecranon (Site 2), 10 cm below the olecranon (Site 3), 20 cm below the olecranon (Site 4), and mid palm (Site 5). For the lower extremities, measurements were taken at 20 cm above the patella (Site 1), 10 cm above the patella (Site 2), 10 cm below the tibial tuberosity (Site 3), 10 cm above the medial malleolus (Site 4), and the mid-arch of the foot (Site 5).

The outcomes were evaluated by comparing pre-operative and postoperative limb circumferences at 1, 3, 6, and 12 months. Results were calculated as the percentage of limb circumference reduction. Additional postoperative complications, including flap loss, flap congestion, hematoma, lymphocele, and infection were assessed and compared across donor site areas.

Baseline data were summarized using descriptive statistics, presented as medians with percentile 25 and percentile 75 (Q1, Q3), mean with standard deviations (SD), or frequencies with percentages as appropriate. Due to repeated measures of outcomes over time and missing data, generalized estimating equations (GEE) was employed. The dependent variable was percentage reduction in limb circumference from baseline and independent variable was time as a factor. To assess change over time, only subjects with at least two values of percentage reduction were included in GEE model. The correlation among repeated outcomes was tested using corrected quasi likelihood under the independent model criterion (QICC) and resulted in exchangeable correlation structure. Results from GEE were presented as estimated mean, standard error (SE) and p-value. A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS 29.

Ethical considerations were upheld throughout the study in accordance with the principles of the Declaration of Helsinki. Patient confidentiality was rigorously maintained by anonymizing patient data during both analysis and reporting.

RESULTS

Demographic Data

A retrospective analysis was conducted on 43 patient charts. Fifteen patients were excluded due to missing data or insufficient data. Thus, the final analysis included 28 patients, consisting of 26 females (92.9%) and 2 males (7.1%). This examination provided valuable insights into the complex management of lymphedema. The mean age of the patients was 61.1 ± 12.9 years the mean BMI was 27.4 ± 5.6 kg/m². Gynecological cancer was the most common underlying condition, affecting 13 patients (46.4%), followed by breast cancer, which accounted for 8 cases (28.6%). Additionally, 6 patients (21.4%) were diagnosed with primary lymphedema, and one patient (3.6%) presented with lymphedema caused by other factors, such as trauma (Table 1).

Among patients with cancer-related lymphedema, prior treatments played a significant role in disease progression and management. The analysis revealed that 14 patients had undergone radiotherapy, 12 had received chemotherapy, and seven had undergone node dissection. These findings highlight the prevalence of these treatments and intricate relationship between cancer therapies and the development of secondary lymphedema, emphasizing the importance of comprehensive preoperative assessments and tailored surgical interventions to optimize patient outcomes.

The average duration of lymphedema before diagnosis by a specialized professional was 3.5 years. Concurrently, patients experienced an average of 1 episodes of infection. Among the 28 patients, 11 had undergone LVA prior to VLNT, one had a failed outcome from a prior VLNT procedure, and another had undergone liposuction before VLNT. Patients were also categorized based on their ISL staging. Seven patients (25.0%) were classified as ISL stage 1, 18 patients (64.3%) as ISL stage 2, and three patients (10.7%) as ISL stage 3. Regarding the location of lymphedema, 19 patients were diagnosed with lower extremity lymphedema, of whom 12 (42.9%) had lymphedema in the left leg and seven patients (25.0%) in the right leg. Additionally, nine patients presented with upper extremity lymphedema, with four patients (14.3%) experiencing lymphedema in the left arm and five patients (17.9%) in the right arm.

Surgical Outcomes and Parameters

The mean operative duration for VLNT procedures was 6.8 ± 1.5 hours, highlighting the complexity of microsurgical techniques employed. The average hospital stay was 11.0 days with mean follow-up time of 18.9 months. Among the 28 patients who underwent VLNT,

TABLE 1. Demographic Characteristics of Patients Who Received VLNT.

Demographic Data of Patients Who Received VLNT	
Etiology (%)	
Ob-Gyn Cancer Related	13 (46.4)
HNB Cancer Related	8 (28.6)
Non-Cancer Related	1 (3.6)
Primary	6 (21.4)
Cancer Treatment	
Surgery	19 (67.9)
Node Dissection	7 (25.0)
Chemotherapy	12 (42.9)
Radiotherapy	14 (50.0)
Lymphedema Duration (year): Median [Q1, Q3]	3.5 [1.25, 9.75]
Previous Infection (episodes): Median [Q1, Q3]	1.0 [0.0, 3.0]
Previous Lymphedema Treatment (%)	
Lymphaticovenous anastomosis (LVA)	11 (39.3)
Vascular Lymph Node Transfer (VLNT)	1 (3.6)
Liposuction	1 (3.6)
ISL (%)	
1	7 (25.0)
2	18 (64.3)
3	3 (10.7)
Location (%)	
Left Arm	4 (14.3)
Right Arm	5 (17.9)
Left Leg	12 (42.9)
Right Leg	7 (25.0)

23 (85.2%) were categorized as having successful outcomes, while 4 patients (14.8%) were classified as failed surgeries, with one additional patient lost to follow-up. Postoperative complications were delineated into four categories: flap congestion, flap necrosis, hematoma, and cellulitis, affecting three, two, two and five patients, respectively. Overall, 14 patients (51.9%) experienced postoperative infections, while 13 patients (48.1%) remained infection-free. Additionally, patients were categorized based on donor and recipient sites. Donor sites included the supraclavicular (7 patients, 25%), submental (7 patients, 25%), and omental (14 patients, 50%) area. Recipient sites included the axilla (1 patient, 3.6%), wrist (8 patients, 28.6%), thigh (3 patients, 10.7%), calf (8 patients,

28.6%), ankle (6 patients, 21.4%), and dorsum of the foot (2 patients, 7.1%) (Table 2).

Quantitative measurements, including preoperative and postoperative limb circumference assessments, were essential for evaluating treatment efficacy and tracking disease progression longitudinally. We calculated the percentage reduction in limb circumference by comparing preoperative measurements to postoperative results at 1, 3, 6, and 12 months, respectively. The findings revealed that patients with upper extremity lymphedema patients showed the highest percentage reduction in limb circumference at 12 months postoperatively, particularly at site 3, with a reduction of 9.68%. Conversely, patients with lower extremity lymphedema demonstrated the greatest

TABLE 2. Surgical Outcomes and Parameters of Lymphedema Patients Who Received VLNT.

Surgical Outcomes and Parameters of Lymphedema Patients Who Received VLNT	
Operative Time (hours): Mean ± SD	6.8 ± 1.5
Hospital Stay (days): Median [Q1, Q3]	11.0 [9.5, 21.0]
Mean Follow-up Time (months): Median [Q1, Q3]	18.9 [13.7, 37.6]
Donor Site (%)	
Supraclavicular	7 (25.0)
Submental	7 (25.0)
Omentum	14 (50.0)
Recipient Sites (%)	
Axilla	1 (3.6)
Wrist	8 (28.6)
Thigh	3 (10.7)
Calf	8 (28.6)
Ankle	6 (21.4)
Dorsum of foot	2 (7.1)
Operation Results (%)	
Success	23 (85.2)
Failed	4 (14.8)
Complications (%)	
Flap Necrosis	3 (11.1)
Flap Congestion	2 (7.4)
Hematoma	2 (7.4)
Postoperative Infection (%)	
No 13 (48.1)	
Yes	14 (51.9)

percentage reduction in limb circumference at site 1, 6 months postoperatively, with a reduction of 3.56%. For upper extremity lymphedema patients, the percentage reduction in limb circumference progressed from most reduction to least at 12, 1, 6, and 3 months postoperatively, respectively. For lower extremity lymphedema patients, the percentage reduction in limb circumference, the order was 6, 3, 1, and 12 months, respectively, from most to least reduction. Fig 1 and 2 illustrate the postoperative percentage reduction in limb circumference relative to preoperative measurements, where a negative value indicates a decrease in limb circumference, while a positive value indicates an increase in limb circumference compared to the baseline.

The table below showed the mean percentage limb reduction with standard error (SE) in relation to the follow-up time at 1, 3, 6, and 12 months post-operatively (Table 3). The p-value showed significantly reduction in the upper extremities especially in 12 months post-operative (Table 3a), while the lower extremities showed most reduction at 6 months post-operative (Table 3b). The table illustrated that the upper extremities benefit from the VLNT treatment the most, with the significant reduction shown in most of the site and follow-up month, while the lower extremities showed no statistical significance in the percentage reduction. However, the dynamic and trend of the outcome can still be seen from the outcomes.

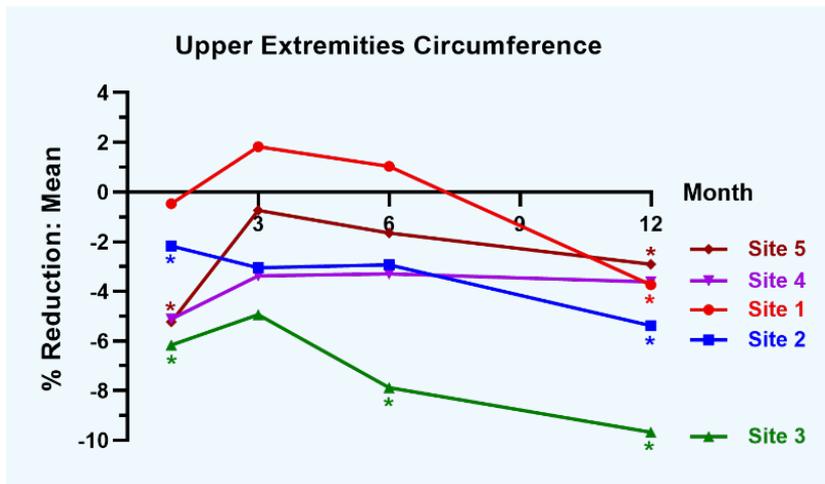


Fig 1. Postoperative Percent Reduction in Limb Circumference Among Upper Extremity Lymphedema Patients Compared to Preoperative Measurements

Upper extremities landmarks starting at 20 cm above olecranon (Site 1), 10 cm above olecranon (Site 2), 10 cm below olecranon (Site 3), 20 cm below olecranon (Site 4), and mid palm (Site 5). The (*) in the graph indicated statistical significance at the point of time and site.

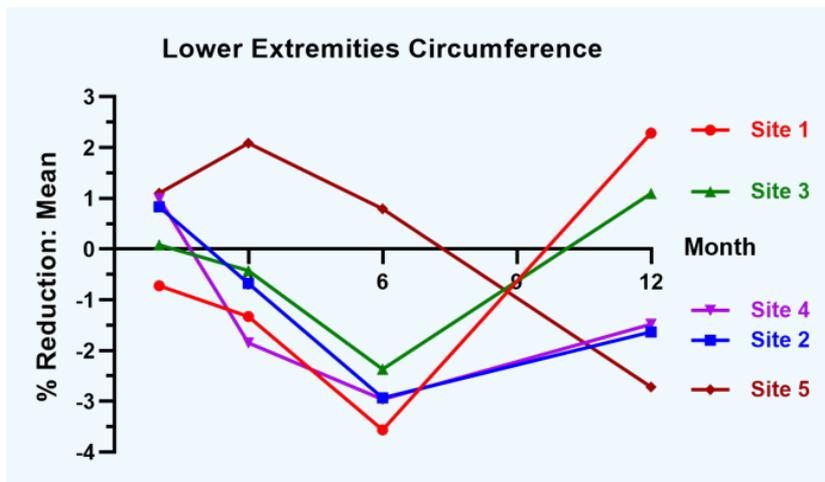


Fig 2. Postoperative Percent Reduction in Limb Circumference Among Lower Extremity Lymphedema Patients Compared to Preoperative Measurements

Lower extremities landmarks starting at 20 cm above patella (Site 1), 10 cm above patella (Site 2), 10 cm below tibial tuberosity (Site 3), 10cm above medial malleolus (Site 4), and mid-arch of the foot (Site5)

DISCUSSION

The comprehensive retrospective analysis of 28 patient charts demonstrated the complexities of lymphedema management. The predominance of female patients in our study (92.9%) aligns with the higher prevalence of lymphedema among women, emphasizing the need for gender-specific considerations in lymphedema management. The mean age of our patient cohort (61.07 years) underscores the significance of lymphedema as a condition commonly affecting older individuals, necessitating age-appropriate strategies in treatment planning and care. Cancer also was a major contributor to lymphedema, with up to 75.0% of patients having cancer including gynecological cancers, particularly breast cancer.

The comparison of postoperative and preoperative limb circumference measurements provides valuable insights into the effectiveness of surgical interventions in reducing limb volume and managing lymphedema. Our findings highlight the dynamic nature of lymphedema management, with significant differences observed across various measurement sites and time points. Notably,

the findings revealed significant reduction in upper limb circumference with the highest percentage at 12 months postoperatively, with a reduction of 11.063%. Conversely, the greatest percentage reduction in lower limb circumference at 6 months postoperatively, with a reduction of 7.029%. These findings underscore the efficacy of surgical interventions, such as vascularized lymph node transfer (VLNT), in restoring lymphatic function especially in the upper extremities.

The variation in response to surgical interventions between upper and lower extremity lymphedema patients underscores the importance of tailoring treatment strategies to individual patient characteristics and disease severity. Furthermore, the calculated percentage reduction in limb circumference provides quantitative evidence of treatment efficacy, with upper extremity lymphedema patients demonstrating the highest percentage reduction at 12 months postoperatively and lower extremity lymphedema patients exhibiting the greatest reduction at 6 months postoperatively.

Compared to prior research, *Brown et al. (2023)* conducted an extensive review of studies evaluating

TABLE 3. Estimated mean of percent reduction at each month and site by Generalized Estimating Equations (GEE).

		% Reduction from baseline			
Site		Month 1	Month 3	Month 6	Month 12
1	Mean (SE)	-0.47 (1.29)	1.82 (1.54)	1.03 (1.86)	-3.74 (1.89)
	p-value	0.717	0.238	0.580	0.048
2	Mean (SE)	-2.18 (1.09)	-3.06 (1.93)	-2.94 (1.77)	-5.39 (2.19)
	p-value	0.046	0.112	0.096	0.014
3	Mean (SE)	-6.17 (1.61)	-4.94 (3.21)	-7.89 (3.28)	-9.68 (3.09)
	p-value	<0.001	0.124	0.016	0.002
4	Mean (SE)	-5.12 (3.47)	-3.37 (3.22)	-3.30 (3.72)	-3.62 (2.91)
	p-value	0.141	0.295	0.375	0.213
5	Mean (SE)	-5.23 (1.89)	-0.74 (2.50)	-1.65 (1.34)	-2.91 (1.39)
	p-value	0.006	0.767	0.220	0.035

		% Reduction from baseline			
Site		Month 1	Month 3	Month 6	Month 12
1	Mean (SE)	-0.73 (1.84)	-1.33 (2.99)	-3.56 (2.16)	2.29 (3.15)
	p-value	0.694	0.656	0.100	0.468
2	Mean (SE)	0.83 (2.40)	-0.68 (3.18)	-2.93 (2.88)	-1.64 (3.19)
	p-value	0.728	0.831	0.308	0.608
3	Mean (SE)	0.08 (2.46)	-0.43 (2.72)	-2.37 (2.23)	1.10 (2.81)
	p-value	0.975	0.874	0.288	0.697
4	Mean (SE)	0.99 (2.75)	-1.85 (2.22)	-2.97 (1.63)	-1.49 (3.09)
	p-value	0.718	0.403	0.069	0.631
5	Mean (SE)	1.10 (1.16)	2.09 (2.10)	0.79 (1.61)	-2.72 (1.79)
	p-value	0.342	0.319	0.623	0.128

Lower extremities landmarks starting at 20 cm above patella (Site 1), 10 cm above patella (Site 2), 10 cm below tibial tuberosity (Site 3), 10 cm above medial malleolus (Site 4), and mid-arch of the foot (Site 5)

outcomes following VLNT, addressing factors such as limb measurements, bio-impedance, Patient-Reported Outcome Measures (PROMs), cellulitis, and complications.²² While our study primarily focuses on limb circumference measurements and percentage reduction, our findings aligned with the broader consensus that VLNT offered significant advantages in managing lymphedema. The observed improvements in postoperative complications further validate the effectiveness of VLNT as a therapeutic approach for managing lymphedema. Similarly, *Ciudad et al.*

(2019) performed a comparative examination of clinical outcomes in upper and lower extremity lymphedema, suggesting potential benefits of VLNT, particularly in upper extremity cases.²⁴ Our findings supported these findings, demonstrating favorable outcomes in upper extremity lymphedema, including significant reductions in limb volume over the follow-up period. However, our research not only showed the similar outcome, but also showed the dynamic nature of the limb reduction, where the circumferences can vary with time. This highlights

the potential advantages of VLNT in addressing upper extremity lymphedema and emphasizes the importance of tailoring treatment strategies to specific anatomical considerations.

Numerous studies have investigated lymphedema treatment, including comprehensive reviews of VLNT outcomes,^{16,17} complications,¹⁸⁻²⁰ and meta-analysis of VLNT efficacy in lymphedema treatment.²¹⁻²³ Meuli et al. (2023) conducted a meta-analysis of microsurgical treatments for lymphedema, concluding that both LVA and VLNT are effective in reducing the severity of secondary lymphedema.²¹ Brown et al. (2023) reviewed studies that evaluated outcomes such as limb-measurement, bio-impedance, Patient-Reported-Outcome-Measures (PROMs), cellulitis and complications at 1 and 2 years post-VLNT.²² Similarly, Ciudad et al.²⁴ compared clinical outcomes between upper and lower extremity lymphedema, finding that VLNT may provide greater benefits for upper extremities, a result consistent with Ward et al.'s meta-analysis.²³

A limitation of this study is the relatively small number of VLNT cases at Siriraj Hospital. Lymphedema is not the most common cause of limb edema and is often misdiagnosed,²⁵ resulting in a limited number of lymphedema cases, and an even smaller cohort receiving VLNT treatment. Despite this limitation, our research focused specifically on patients with VLNT at Siriraj Hospital and included sequential follow-up evaluations. This approach provided more detailed insights into the progression of postoperative outcomes compared to methods used in previous studies.

These findings highlight the importance of longitudinal assessment and monitoring in evaluating treatment outcomes and guiding therapeutic decision-making in lymphedema management. By employing objective metrics such as limb circumference measurements and percentage reduction, clinicians can track disease progression, assess treatment response, and optimize patient care strategies. Moving forward, further research should explore the long-term efficacy and durability of surgical interventions, as well as identify predictive factors associated with treatment success across different patient subgroups. Overall, our study underscored the dynamic nature of lymphedema management and emphasized the importance of individualized, multidisciplinary approaches to optimize patient outcomes and enhance quality of life.

CONCLUSION

Our study underscores the importance of a multidisciplinary approach to lymphedema care, integrating

surgical expertise with comprehensive assessment and rehabilitation. Tailored interventions, such as VLNT, demonstrated significant potential in reducing limb volume and managing complications. The VLNT showed better result in reducing upper extremities lymphedema than in lower extremities lymphedema. The study also showed the dynamic result compared to time of follow-up. Therefore, the study suggests VLNT as a surgical option for upper extremities lymphedema patients. However, further analytic research is suggested to refine treatment strategies, identify predictive factors, and enhance patient care. By advancing our understanding and refining approaches, we can improve outcomes and enhance the quality of life for individuals living with lymphedema.

Data Availability Statement

The authors confirm that the data supporting the finding of this study are available within the article and its supplementary materials.

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DECLARATIONS

Grants and Funding Information

None.

Conflict of Interest

The authors declare no conflict of interest.

Registration Number of Clinical Trial

Not applicable.

Author Contributions

Conceptualization and methodology, N.P, and S.T. ; Investigation, N.T., and S.T. ; Formal analysis, B.K., and M.Y. ; Visualization and writing – original draft, B.K., M.Y., and S.T. ; Writing – review and editing, B.K., and S.T. ; Supervision, S.T. All authors have read and agreed to the final version of the manuscript.

Use of Artificial Intelligence

The study does not use artificial intelligence for the manuscript.

Human Ethics Approval Declaration

The study was conducted with approval from the Institutional Review Board (IRB) of the Faculty of Medicine Siriraj Hospital No. 073/2566, COA No. Si 187/2023.

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