ASRM Scientific Paper Presentations: Lymphedema
Monday, January 15, 2018, 7:30am – 9:00am

7:30 AM - 7:35 AM

RM 60. **Critical Ischemia Time for Vascularized Lymph Node Flaps**

Keck School of Medicine, University of Southern California, Los Angeles
Presenter: David P. Perrault
David Perrault, Gene Lee, Cynthia Sung, Roy Yu, Austin Pourmoussa, Antoun Bouz, Sun Young Park, Antoine Lyonel Carre, Ketan Patel, Young Hong, Alex Wong
Keck School of Medicine, University of Southern California, Los Angeles, CA

Background: Tolerance of ischemia time is a critical factor in microvascular surgery given the inherent exposure of tissue to ischemia and reperfusion. Prolonged ischemia, past the critical ischemia time, induces a cascade of cell swelling, irreversible membrane damage, and ultimately cell death. The critical ischemia time for multiple tissue types has been defined. However, the response of lymphatic tissue to ischemia has not been well characterized. With the increasing use of vascularized lymph node flaps as a therapy for lymphedema, this information now has a greater practical significance. The purpose of this study was to determine the critical ischemia time of lymphatic tissue and characterize the response of lymphatic tissue to ischemic injury.
Methods: A rat ischemia model was used in which a groin flap based on the superficial epigastric artery was isolated and then subject to ischemia for varying periods of time (1, 2, 4, and 8 hours) via clamping of the vascular pedicle. Clamps were then removed and the flaps were harvested at 0 hours, 24 hours, or 5 days after reperfusion. Apoptotic cells were marked via the Terminal deoxynucleotidyl transferase dUTP Nick-End Labeling (TUNEL) assay and quantified.
Results: In the tissue harvest at the time of reperfusion, there was a significantly greater density of apoptotic cells with 4 and 8 hours of ischemia compared to 1 and 2 hours of ischemia. In the tissue harvested 24 hours after reperfusion, there was a significantly greater density of apoptotic cells with 8 hours of ischemia compared to 2 and 1 hours of ischemia. In the tissue harvested 5 days after reperfusion, there was a significantly greater density of apoptotic cells with 8 hours of ischemia compared to 4, 2, and 1 hours of ischemia.
Conclusion: The tissue harvested 5 days after reperfusion is likely the most useful measure of ischemic injury, since the delayed harvest would allow for demarcation of the apoptotic cells. Given this, the greatest increase in ischemic injury appears to be between 4 and 8 hours of ischemia time.

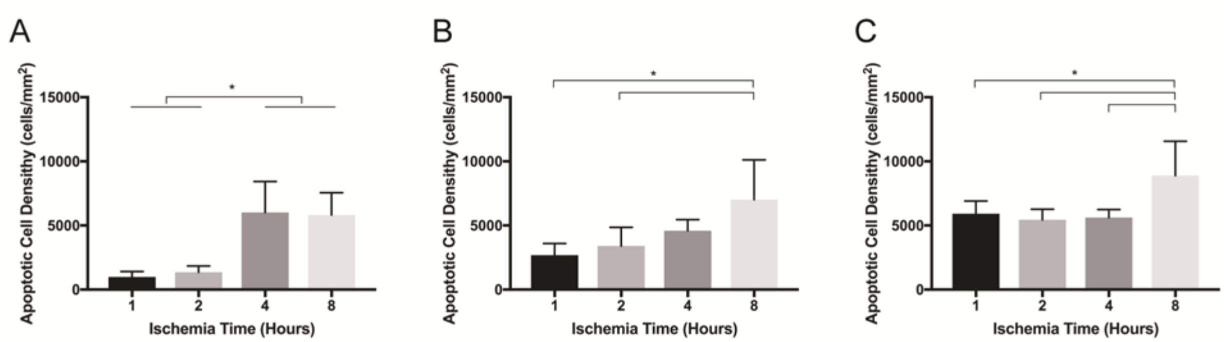

Figure 1. Apoptotic cell density increases with greater ischemia time in lymph node flaps. Apoptotic cell density was quantified in lymphatic tissue at (A) the time of reperfusion, (B) 24 hours after reperfusion, and (C) 5 days after reperfusion. (*p<0.05)

7:35 AM - 7:40 AM

RM 61. **Distal Placement of Vascularized Submental Lymph Node Flaps Delivers Improved Outcome in the Treatment of Lower Limb Lymphedema Compared to Proximal Placement**

Chang Gung Memorial Hospital, Taoyuan
Presenter: Charles Anton Fries, MA, MB, BChir, FRCS (Plast)
Charles Anton Fries, MA, MB, BChir, FRCS (Plast)(1) and Ming-Huei Cheng, MD, MBA(2)
(1)Chang Gung Memorial Hospital, Taoyuan, Taiwan, (2)Chang Gung Memorial Hospital, Linkou Medical Center, Taoyuan, Taiwan

Background

Lower limb lymphedema is a debilitating condition conferring lifelong morbidity to patients. Aetiology may be primary, infective, neoplastic or iatrogenic. Physiologic lymphatic surgery has proven utility in treating lymphedema of all aetiologies. With respect to lymph node transfer the mechanism of action is a combination of ‘lymphatic pumping’ and lymphangiogenesis. The relative importance of each has not yet been defined; this has implications for treatment planning.

This study evaluated whether the distal placement of vascularized lymphatic flaps, at the ankle, thus maximising the lymphatic pump mechanism, would be superior to placement at the knee, where the lymphangiogenic ‘bridging’ mechanism might have primacy, and scar placement be more cosmetic.

Methods

43 patients were consecutively enrolled in the study with lymphedema Cheng’s grade 2-3. Vascularized submental lymph node flaps were implanted at the knee (medial sural vessels) or ankle (anterior tibial or posterior tibial vessles) respectively. Patients were analysed for quality of life outcomes, episodes of cellulitis and measurements of limb circumference; both absolute reduction and reduction rate were recorded. **Results** were analysed at three months and one-year postoperative time points.

Results

The proximal leg was used in 12 cases and the distal leg in 31 cases. There were no differences in patient demographics between the two groups. There were no differences in the diameters of the recipient arteries (p=0.5) or veins (p=0.7) between knee and ankle, or in the number of lymph nodes in the transferred flaps (p=0.5).

At three months the circumferential reduction rate was improved at the below knee and above ankle level in the distal placement group (p=0.01 and p=0.01), and improved in the proximal leg in the proximal placement group (p=0.01). At one year post operatively there was equal improvement in the above knee region (p=0.04) but there was significantly higher improvement in the distally placed group in the below knee, above ankle, and overall measurements (p=0.01, p=0.01, p=0.01 respectively).

Conclusion

Distal placement gives an overall improvement in treatment of lower limb lymphedema, particularly over the longer term, compared to placement more proximally. In this position the dependant position increases the pump / catchment effect. The finding that at the early time point placement at the knee improves proximal leg lymphedema adds weight to the lymphatic pump theory; suggesting that over time the distally placed flaps will drain the proximal lymphedema as they drain the whole leg.

7:40 AM - 7:45 AM

RM 62. **Supermicrosurgical Lymph Node Transfer: Lymph Node True Perforator Flap Transfer with or Without Efferent Lymphatic Vessel Anastomosis**

National Center for Global Health and Medicine, Tokyo
Presenter: Takumi Yamamoto, MD, PhD
Takumi Yamamoto, MD, PhD
Department of Plastic and Reconstructive Surgery, National Center for Global Health and Medicine, Tokyo, Japan

Background: Lymphedema is a progressive debilitating edematous disease, which requires a life-long conservative treatment. Vascularized lymph node transfer (LNT) is performed on severe progressive lymphedema. However, conventional LNT has a risk of donor site lymphedema and lymph node sclerosis due to efferent lymphatic vessel (ELV) obstruction.

Methods: One hundred five lower extremity lymphedema (LEL) patients had undergone LVA with poor results, and underwent further surgical treatment with supermicrosurgical true perforator lymph node transfer (LNT) under indocyanine green (ICG) lymphography navigation. The ELV of transferred lymph node was anastomosed to a nearby vein as possible; ELV anastomosis (ELVA). Perioperative morbidity, postoperative results such as volume reduction and cellulitis frequency were evaluated.

Results: Two hundred nineteen lymph node flaps were transferred on 174 limbs of 105 LVA-refractory LEL patients with ICG lymphography-based DB stage of stage III/IV/V. ELVA was performed in 83 limbs (ELVA+ group), and not in 91 limbs (ELVA- group). Postoperatively, 83% of the patients showed volume reduction, and 94% showed reduction in cellulitis frequency. Patients with higher LDB stage showed poorer results both in volume reduction rate (DB stage III/IV/V, 97%/80%/44%; $P < 0.05$) and in cellulitis frequency reduction rate (DB stage III/IV/V, 88%/75%/55%; $P < 0.05$). No donor site lymphedema was observed; postoperative ICG lymphography showed no DB pattern. Postoperative volume reduction was significantly higher in ELVA+ group than in ELVA- group (17.6% vs. 10.5%, $P < 0.05$).

Conclusion: Supermicrosurgical LNT allowed clinical improvement even for LVA-refractory severe LEL cases with no donor site lymphedema. To avoid donor site lymphedema, supermicrosurgical dissection under ICG lymphography navigation is essential. To maximize therapeutic efficacy of LNT, ELVA should be performed as possible.

7:48 AM - 7:53 AM

RM 63. **The Treatment of Primary Lymphedema with Physiological Microsurgery**

University of Chicago Medicine, Chicago
Presenter: Chad M Teven, M.D.
Chad M Teven, M.D.(1), Rebecca Garza, MD(2), Joshua Falk, MA(2) and David W Chang, MD, FACS(2)
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Background

Primary lymphedema is due to congenital abnormalities of the lymphatic system. Depending upon the underlying pathophysiology, clinical symptoms may present soon after birth or in a delayed fashion. Limited data exist on the treatment of primary lymphedema. The purpose of this study is to evaluate the treatment of primary lymphedema with physiological microsurgical techniques including vascularized lymph node transfer (VLNT) and lymphovenous anastomosis (LVA).

Methods

An IRB-approved retrospective review of all patients who underwent VLNT and/or LVA for primary lymphedema at our institution over a 3-year period was performed. Collected information included patient characteristics and surgical outcomes. Quantitative (e.g., volume differential reduction) and qualitative (e.g., Lymphedema Life Impact Scale [LLIS]) measures of lymphedema were assessed.

Results

A consecutive series of 33 patients were treated for lymphedema in 34 extremities (Table 1). Twenty-five patients (75.8%) underwent VLNT, 21 of which were combined with LVA and 4 of which were performed in isolation. Thirty patients (90.9%) underwent LVA, 9 of which were performed in isolation. The mean number of bypasses performed was 2.4 (range, 1-5). The total number of complications was 4 (12%; Table 2). No flaps were lost.

At 3 months, patients had a 19.5% reduction in volume difference between limbs, 17.1% reduction at 6 months, and 18.9% reduction at 1 year. For 3 patients with longitudinal data available, reduction in volume difference was 25.1% at 3 months and 21.6% at 1 year. LLIS was also decreased by 19.5% at 3 months, 3.3% at 6 months, and 18.4% at 1 year. Patients reported subjective improvement of symptoms in 24 of 34 affected limbs (70.1%).

Conclusion

Our series, which is one of the largest to date of physiologic microsurgical techniques for primary lymphedema, demonstrates that this is a viable option for primary lymphedema in selected patients. Further research that would include a larger sample size and longer follow-up is warranted to more robustly study the strengths and limitations of these techniques in the treatment of primary lymphedema.

Table 1. Patient Characteristics

Characteristic	
Number of Patients	33
Number of Extremities	34
Age (years)	44.2 (13-72)
Sex Female Male	 27 6
Body Mass Index (kg/m^2)	25.6
Location of Lymphedema Arm Leg	 4 30
ICG Stage	3.4
Clinical Stage	1.6

Table 2. Complications

Site	Location	Complication	Treatment	Outcome
Donor	Supraclavicular	Seroma	I&D	Resolved
Donor	Supraclavicular	Cellulitis	IV Antibiotic	Resolved
Recipient	Groin	Hematoma	I&D	Resolved
Recipient	Ankle	Venous congestion of VLNT	Flap exploration/re-inset	Savage

7:53 AM - 7:58 AM

RM 64. **What We Have Learned After 100 Cases of Supermicrosurgical Lymphaticovenular Anastomosis - A Single Surgeon's Experience**

University of Iowa Hospitals and Clinics, Iowa City
Presenter: Wei F Chen, MD, FACS
Wei F Chen, MD, FACS(1), Maria McNurlen, MD(2) and Mindy Bowen, RN(2)
(1)Department of Plastic and Reconstructive Surgery, University of Iowa Hospitals and Clinics, Iowa City, IA, (2)University of Iowa Hospitals and Clinics, Iowa City, IA

Background

We reviewed the senior aurthor's experience of 100 consecutive cases of supermicrosurgical lymphaticovenular anastomosis (LVA) for treatment of extremity lymphedema and critically assessed the procedure's efficacy, limitation, indications, and contraindications. We also described the technical strategies and maneuvers developed as a result of this experience.

Methods

100 consecutive cases of extremity lymphedema treated with LVA were recruited into the study. Patients were evaluated with self-assessment, circumference measurement, quality of life assessment (LYMQOL), bioimpedance spectroscopy (BIS), and indocyanine green (ICG) lymphography at preoperative visit, 3-month, 6-month, and 12-month postoperative visit.

Results

59 upper extremity and 41 lower extremity lymphedema were treated. Disease severity ranged from Campisi I to IV. 94% reported relief of symptoms (reduction of edema, pain, rigidity, and paresthesia). 77% demonstrated limb volume reduction. 79% (69 of 87) showed improvement in quality of life on LYMQOL. 70% (45 of 64) had confirmed edema reduction on BIS. ICG lymphography demonstrated favorable lymphographic changes in 84% (67/79) of the patients. All patients had improvement demonstrable in at least one of the tracking modalities used. Postoperative improvements were observed promptly following surgery and continued for six months in majority of the patients (93%, or 81 of 87). In 7% (6 of 87) of the patients, the improvements continued and stabilized at one-year postoperatively. Following were what we have learned:

1. LVA is a "drainage" procedure and is particularly effective in patients with early, fluid-predominant lymphedema. Do not use it to treat advanced, solid-predominant form of the disease.
2. Preoperative imaging (ICG lymphatic and infrared vein mappings) allows efficient and minimally invasive incision placement.
3. Adequate magnification and proper instrumentation are prerequisites.
4. The surgeon needs to be proficient in various anastomotic configurations to overcome challenging situations of lymphatic vessels and veins size/number mismatch.
5. Immediate postoperative limb compression facilitates and augment lymph-to-vein drainage and maximize the procedural efficacy.
6. Multi-modal patient tracking is necessary due to the limitations associated with individual tracking modalities.

Conclusion

With proper patient selection and technical execution, supermicrosurgical LVA is an efficacious procedure for the treatment of extremity lymphedema that is associated with objectively demonstrable and durable improvements.

8:01 AM - 8:06 AM

RM 65. **One-year update on reverse lymphatic mapping during vascularized lymph node transfer**

Memorial Sloan Kettering Cancer Center , New York City
Presenter: Richa Verma, MD
Richa Verma, MD(1), Joseph H Dayan, MD(2), Babak J Mehrara, MD(3) and Smith L. Mark, M.D.(4)
(1)Memorial Sloan Kettering Cancer Center, New York, NY, (2)Memorial Sloan Kettering Cancer Center, NYC, NY, (3)Division of Plastic and Reconstructive Surgery, Memorial Sloan Kettering Cancer Center, New York, NY, (4)Northwell Health, New Hyde Park, NY

Background Reverse lymphatic mapping (RLM) was developed to reduce the risk of iatrogenic lymphedema in the donor extremity following peripheral VLNT. However, long term outcomes of the donor limb have not reported. In the present study, we report one-year post-operative outcomes of the donor extremity in patients undergoing peripheral VLNT. **Methods** RLM was conducted intra-operatively during all peripheral VLNTs using technetium-99 (T99) and indocyanine green lymphangiography (ICGL). T99 was injected into the first and third webspaces of the donor limb. ICG was injected into the trunk above and parallel to the groin crease for lower extremity transfer or into the lateral chest wall for upper extremity transfer prior to flap harvest. A gamma probe was used to localize sentinel lymph nodes draining the donor extremity. ICGL was used to identify trunk lymph nodes. Only lymph nodes that fluoresced with ICG and had a gamma count less than 10 percent of the extremity sentinel lymph nodes (ESLN) were harvested for transfer. Patients underwent lymphoscintigraphy (LS) and ICGL one-year post-operatively to assess lymphatic function. **Results** A total of 95 patients (male = 6, 6.32%; female = 89, 93.7%) underwent 113 VLNTs during our study period. 66/95 (69.5%) patients underwent 69/113 (61.1%) peripheral VLNTs. One-year follow up is pending on 6/66 patients who received a peripheral VLNT. 48/60 (80%) patients who underwent peripheral VLNT with RLM had 1-year post-operative LS only, and 36/60 (60%) patients had both LS and ICGL. RLM altered the operation in 5 cases: 3 were started from the groin, 1 was changed to axilla and 2 were changed to supraclavicular flaps; 2 were started as axilla and converted to a supraclavicular flap. All patients demonstrated radiotracer uptake and there was no dermal reflux in the limb adjacent to the donor site on LS in any of these patients. All patients had normal appearing lymphatic vessels with active pumping and no dermal reflux in the donor limb on ICG. No patients reported any swelling in their donor limbs.Ê **Conclusion** The results of our study suggest that RLM effectively reduces the risk of iatrogenic lymphedema of the donor limb in patients undergoing peripheral VLNT. Patients who underwent RLM did not demonstrate any lymphatic dysfunction one year following peripheral VLNT.

8:06 AM - 8:11 AM

RM 66. **Double Level Vascularized Lymph Node Transfer Utilizing the Abdomen as a Donor Site for Treatment of Extremity Lymphedema**

The Ohio State University , Columbus

Presenter: Michelle Coriddi, MD

Michelle Coriddi, MD(1), Juan L Rendon, MD, PhD(2), Daniel Eiferman, MD(3) and Roman J. Skoracki, MD(4)

(1)Memorial Sloan Kettering Cancer Center, New York, NY, (2)The Ohio State University Wexner Medical Center, Columbus, OH, (3)The Ohio State University, Columbus, OH, (4)Department of Plastic Surgery, The Ohio State University, Columbus, OH

Background: Vascularized lymph node transfer (VLNT) is a surgical treatment for lymphedema. Placement of the vascularized lymph node can be either proximal or distal on the extremity. Literature has shown improvements in lymphedema regardless of placement site. Some believe distal placement is most beneficial since this is the most dependent part of the extremity. Others believe proximal vascularized node flap placement is best to assist with lymphangiogenesis. Since the mechanism contributed to the success of VLNT has not yet been elucidated, we believe double level lymph vascularized node transfer with both distal and proximal placement would give patients maximal benefit.

Methods: Using the abdomen as a donor site, two vascularized lymph node flaps were harvested in 5 patients. The jejunal mesenteric vascularized lymph node flap was harvested from the periphery of the proximal jejunum and transferred to the distal aspect of the extremity. A section of omentum was then harvested and transferred to the proximal area of the extremity. Scar removal was performed prior to inset of the flap proximally. Etiology of lymphedema, surgical details, and results including subjective and objective data were analyzed for each patient. These results were also compared to single level lymph node transfer.

Results: The double level VLNT was used in five patients for treatment of upper extremity lymphedema. Average age at presentation was 63.6(+/-10.8), average BMI was 35.4(+/-4.9), average duration of symptoms was 45.2(+/-18.4) months, and average follow up was 4.6(+/-2.1) months (range 2-7). Etiology of lymphedema was treatment for malignancy in four patients and trauma in one patient. Three patients treated for malignancy had lymph node dissections, and three had radiation. No complications were observed. All patients had subjective improvement in lymphedema. Of the five patients, four patients had pre-operative measurements and three had objective improvement in lymphedema. Compared to single level VLNT, more patients with double level VLNT showed subjective improvement (100% vs 86%) and objective improvement (75% vs 60%).

Conclusion: Double level VLNT, using a jejunal mesenteric lymph node flap and an omentum flap, provides patients with maximum benefit. By using the abdomen as a donor site, there is a decreased risk of donor site lymphedema and more than one flap can be harvested. Additionally, double level VLNT may be superior to single level VLNT.

8:11 AM - 8:16 AM

RM 67. **Indocyanine Green Lymphangiography Findings in Patients Who Do Not Meet Diagnostic Criteria for Lymphedema**

Memorial Sloan Kettering Cancer Center, New York City
Presenter: Svetlana Kleyman, MD
Svetlana Kleyman, MD(1), Joseph H Dayan, MD(1), Richa Verma, MD(2), Andrew L. Weinstein, MD, MS(3) and Babak J Mehrara, MD(4)
(1)Memorial Sloan Kettering Cancer Center, NYC, NY, (2)Memorial Sloan Kettering Cancer Center, New York, NY, (3)Division of Plastic Surgery, NewYork-Presbyterian/Weill Cornell Medical College, New York, NY, (4)Division of Plastic and Reconstructive Surgery, Memorial Sloan Kettering Cancer Center, New York, NY

Background: Lymphedema following oncologic treatment is a common and morbid condition. Patients typically do not seek medical attention for their lymphedema until swelling is visible. However, significant damage may have already occurred to the lymphatic system by this point. Furthermore, there is a subset of patients who report symptoms of heaviness or discomfort consistent with lymphedema, though do not meet standard diagnostic criteria based on limb volume, bioimpedance score or lymphoscintigraphy (LS). Delayed diagnosis in these patients may negatively affect their outcomes. In the present study, we use indocyanine green lymphangiography (ICGL) to evaluate the lymphatic system in patients with subclinical lymphedema. **Methods:** Patients who presented to Memorial Sloan Kettering Cancer Center (MSKCC) for surgical management of their lymphedema between January 1, 2015 and May 31, 2016 were included. Patients were diagnosed with subclinical lymphedema if they reported symptoms of heaviness or discomfort in their extremity, failed to have a volume difference greater than 200 ml or ten percent relative to their uninvolved limb, had normal bioimpedance scores and did not demonstrate any dermal reflux in their affected limb on LS. These patients underwent ICGL to evaluate their lymphatic system. **Results:** A total of 95 patients (87 females, 8 males) underwent ICGL during our study period. Of these, 10 patients had normal bioimpedance scores (median 4.8) and limb volume measurements (median 67.5cc using manual measurement and 44.5cc via perometry) though reported heaviness and discomfort in their extremity. Three of these patients also reported a history of cellulitis. These 10 patients were deemed as having subclinical lymphedema. Nine out of the 10 (9/10, 90%) demonstrated lymphatic dysfunction on ICGL. None had dermal reflux in their affected limb on LS. ICGL had a 0.90 sensitivity and 1.00 specificity for diagnosing subclinical lymphedema. **Conclusion:** ICGL has a high sensitivity and specificity for diagnosing lymphatic dysfunction in patients with upper extremity cancer related subclinical lymphedema who do not exhibit limb swelling or dermal reflux on LS and have normal bioimpedance scores. Early diagnosis in these patients is important because it may facilitate intervention and improve their outcomes.

8:19 AM - 8:24 AM

RM 68. **Visualization of lymphangiogenesis after vascularized lymph node transfer using a Prox1-GFP reporter rat**

Presenter: Alex K. Wong, MD
Daniel J. Gardner, M.D.(1), Zhao Zhou, M.D.(1), Eunson Jung, M.S.(1), Maxwell B. Johnson, M.D.(1), Young-Kwon Hong, Ph.D.(1) and Alex K. Wong, MD(2)
(1)Keck School of Medicine of USC, Los Angeles, CA, (2)Division of Plastic and Reconstructive Surgery, Keck School of Medicine of University of Southern California, Los Angeles, CA

Background:

Vascularized lymph node transfer (VLNT) is one of several possible treatment modalities for lymphedema. The host response to VLNT is not fully elucidated and specifically it is not known whether recipient site lymphatics coapt with those that are in the donor lymphatic tissue.

Methods:

Using a newly derived transgenic rat that expresses green fluorescent protein (GFP) in lymphatic endothelial cells (LECs), we transplanted wildtype/non-GFP superficial inferior epigastric artery (SIEA) lymph node flaps into transgenic rats at the femoral recipient site. After 6 weeks, transplanted flaps (n=5) were analyzed by H&E and immunofluorescence for podoplanin (lymphatic marker) and GFP.

Results:

Transplanted lymph node flaps were viable after 4 weeks. At the edges of the flap, immunofluorescence identified areas of lymphatic lumens that had podoplanin$^+$/GFP$^+$ LECs, demonstrating that these LECs were host-derived. However, throughout most of the flap, LECs were podoplanin$^+$/GFP$^-$, suggesting that most of the flap contained only donor LECs.

Conclusion: At 4 weeks after vascularized lymph node transfer, while the majority of the flap retains donor LECs, there is evidence of coaptation of recipient site LECs at the periphery.

8:24 AM - 8:29 AM

RM 69. **Immediate Limb Compression Following Supermicrosurgical Lymphaticovenular Anastomosis - Is it Helpful or Harmful?**

Univeristy of Iowa Hospitals and Clinics, Iowa City
Presenter: Wei F Chen, MD, FACS
Wei F Chen, MD, FACS(1), Mindy Bowen, RN(2) and Johnson Ding, BS(2)
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IMMEDIATE LIMB COMPRESSION FOLLOWING SUPERMICROSURGICAL LYMPHATICOVENULAR ANASTMOSIS Ð IS IT HELPFUL OR HARMFUL?

Background

Lymphaticovenular anastomosis (LVA) is an established supermicrosurgical treatment of lymphedema. However, success rates vary, possibly related to variation in patient selection, surgical technique, and postoperative care. One of the controversies on postoperative care is whether to apply limb compression. We evaluated the effect of external limb compression on the LVA.

Methods

Following each of the anastomoses of the LVA procedure, the flow across the anastomosis was immediately assessed. A ÒwashoutÓ sign was observed when the favorable antegrade, lymph-to-vein flow Òwashed outÓ the blood in the vein (Fig 1A), whereas a ÒbackflowÓ sign was observed when the venous blood refluxed into the lymphatic vessel (Fig 1B). After the initial flow pattern was recorded, bandage compression was applied to the leg (Fig 2) and the changes to the flow pattern were recorded. Patients were tracked with lymphedema indices as well as lymphedema quality of life (LYMQOL) assessment system at preoperative, 3, and 6 month visits.

Results

42 LVAs were constructed in 5 patients - 26 with the standard, and 16 via the octopus technique (Fig 3). Initially, 25 LVAs (60%) demonstrated ÒwashoutÓ, with the remaining 17 (40%) showing ÒbackflowÓ. After compression, all of those initially demonstrating ÒwashoutÓ maintained the ÒwashoutÓ pattern, while 16 of 17, or 94%, that initially demonstrated ÒbackflowÓ (Fig 4A) converted to ÒwashoutÓ (Fig 4B) (Fig 5). In follow up, all patients had statistically significant edema reduction based on lower extremity lymphedema indices ($p = 0.0009$) and relief of symptoms based on the LYMQOL assessment ($p = 0.0006$).

Conclusion

Postoperative compression following LVA facilitates antegrade lymph-to-vein flow and helps to increase the efficacy of the procedure.

Figure 1

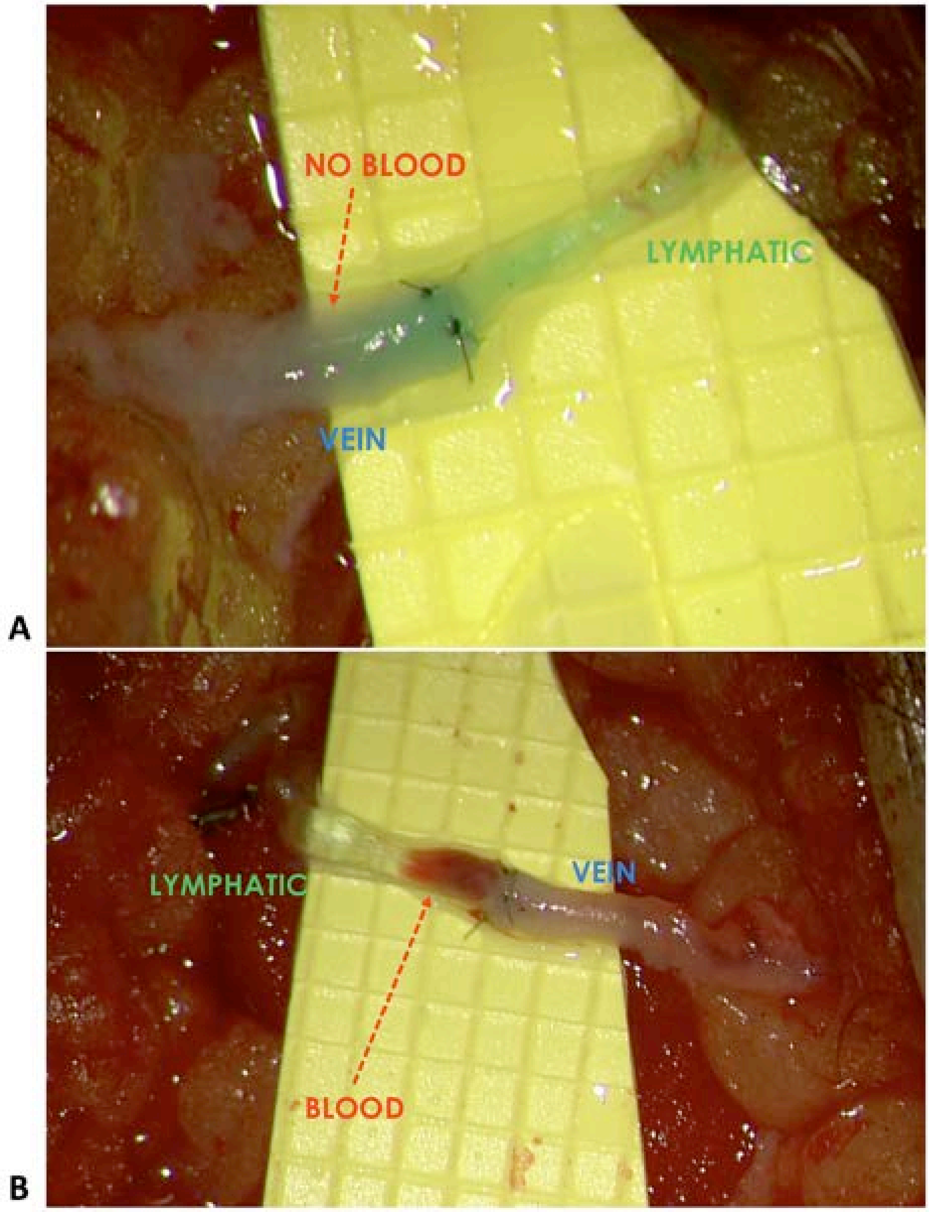


Figure 2

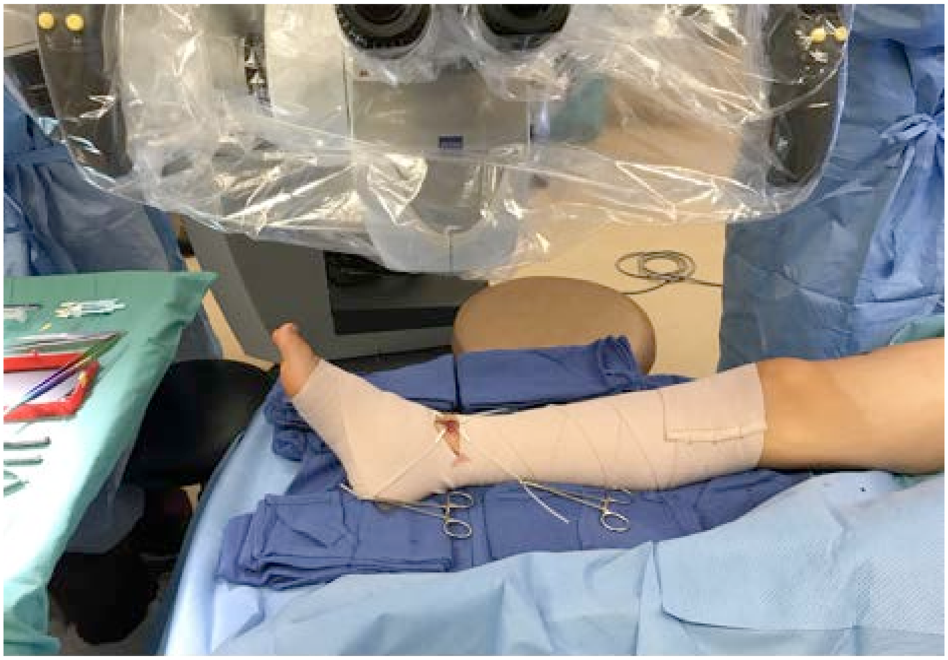


Figure 3

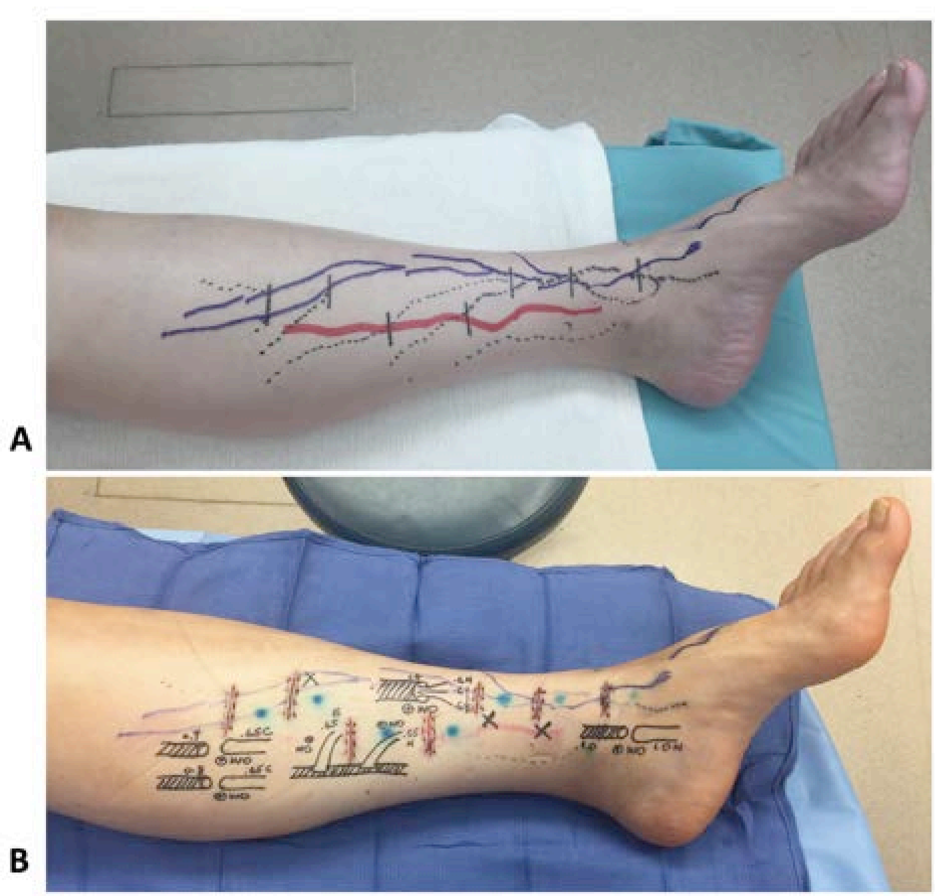


Figure 4

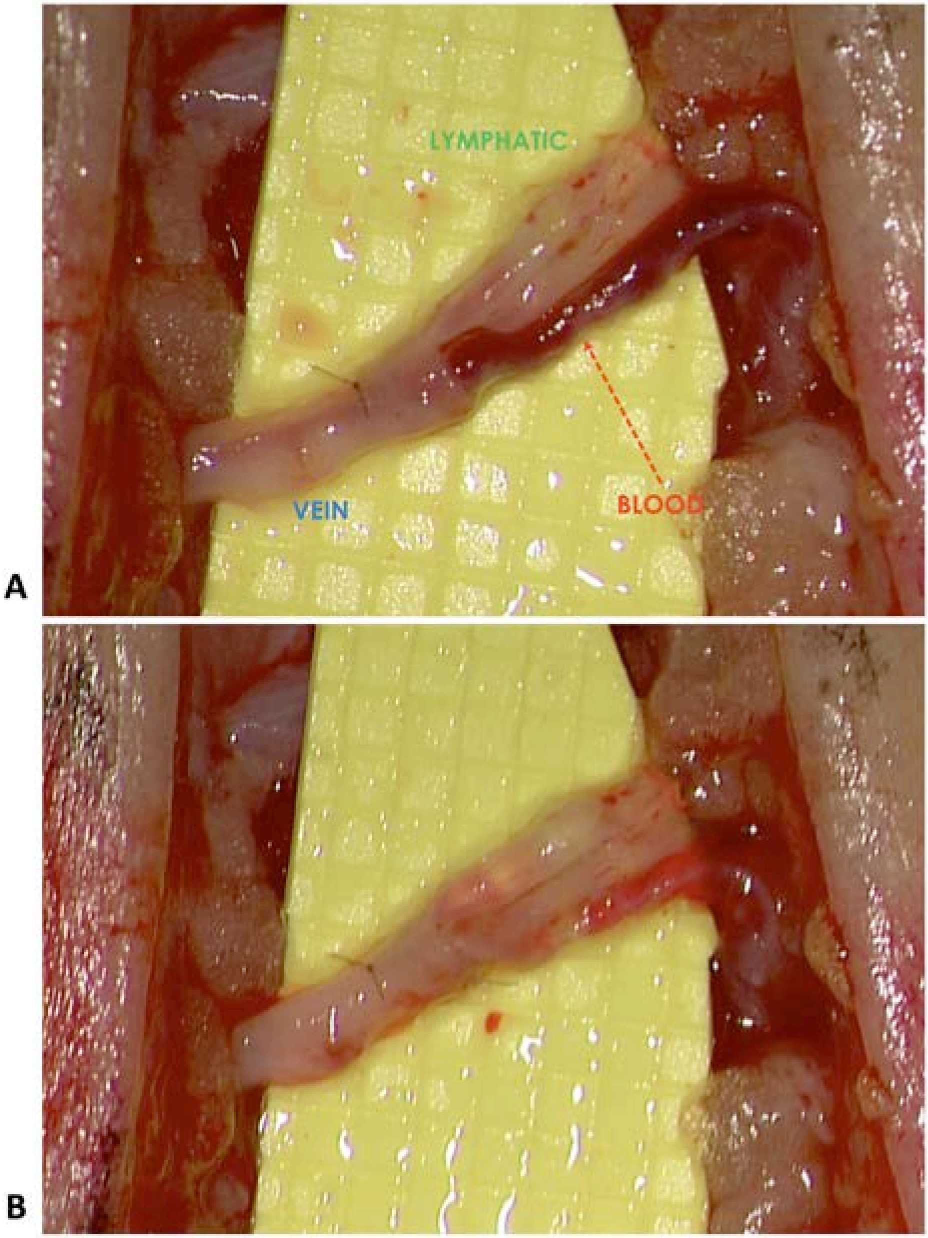
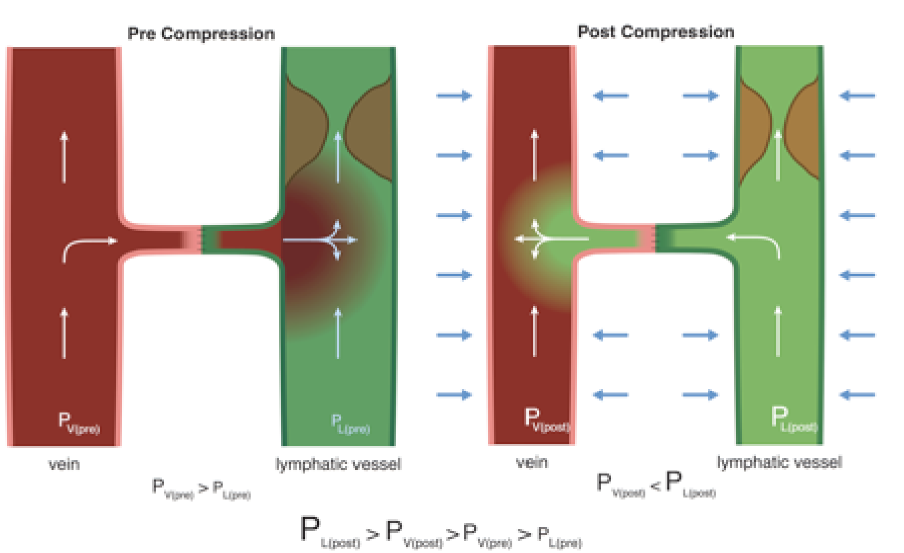


Figure 5



8:29 AM - 8:34 AM

RM 70. **Analysis on Lymph Circulation After Tissue Replantation or Transfer: Possibility of Lymph Flow Reconstruction using Free Flap Transfer without Lymph Node**

National Center for Global Health and Medicine, Tokyo
Presenter: Takumi Yamamoto, MD, PhD
Takumi Yamamoto, MD, PhD
Department of Plastic and Reconstructive Surgery, National Center for Global Health and Medicine, Tokyo, Japan

Background: After tissue replantation or transfer, some cases suffer from long-lasting edema or lymphedema due to interruption of main lymph flows, but its mechanism is yet to be clarified. It is important for lymphatic reconstructive surgeons to understand the mechanism for improving lymphatic surgeries.

Methods: Medical charts of 36 patients who underwent ICG lymphography after tissue replantation or free flap transfer were reviewed to obtain data of clinical, intraoperative, and postoperative ICG lymphography findings. Postoperative lymph flow restoration (LFR) was assessed with ICG lymphography, and its findings were evaluated according to intraoperative findings including lymph axiality; raw-surface in lymph axiality (RLA) and conformation of lymph axiality (CLA).

Results: LFR was observed in 22 cases (61%). There were significant differences of LFR (+) rate in sex (male 76% vs. female 40%, $P = 0.023$), cause of defect (trauma 81% vs. others 33%, $P = 0.003$), type of operation (replantation 93% vs. free flap 41%, $P = 0.001$), and CLA (positive 96% vs. negative 0%, $P < 0.001$). Based on lymph axiality, “RLA (-) and CLA (+)” was completely matched with LFR (+); 100% accuracy to predict postoperative LFR.

Conclusion: Lymph flows could be restored after tissue replantation or free flap transfer. “RLA (-) and CLA (+)” is considered a key to restore lymph flows after surgery affecting main lymph pathway, suggesting a possibility of lymph flow reconstruction using a free flap without lymph node or supermicrosurgical lymphatic anastomosis.

8:37 AM - 8:42 AM

RM 71. **The Modified Superior-Edge-of-the-Knee-Incision Method for Progressive Lower Extremity Lymphedema with severe Lymphatic Sclerosis: Can Theoretical Upward Propulsion of Lymph Decrease Occlusion Risk of Lymphaticovenular Implantation?**

St. Marianna University School of Medicine, Kanagawa
Presenter: Yukio Seki, MD
Yukio Seki, MD(1), Akiyoshi Kajikawa, MD, PhD(2), Takumi Yamamoto, M.D., Ph.D.(3), Takayuki Takeuchi, MD(4), Takahiro Terashima, MD(5) and Norimitsu Kurogi, MD(5)
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Background: The superior-edge-of-the-knee incision (SEKI) method for lower extremity lymphedema (LEL) has a strong therapeutic effect using large, less sclerosed, and high flowing lymphatic vessels for lymphaticovenular anastomosis (LVA) based upon theoretically upward propulsion of lymphatic fluid during normal walking. However, some LEL patients have only lymphatic vessels with severe sclerosis which are inadequate to be used for LVA creation without any sewable lumen even at the SEKI point. We developed the modified SEKI method to create effective lymph-to-venous bypass by lymphaticovenular implantation using severe damaged lymphatic vessels under the superficial fascia at the SEKI point.

Methods: The study included 36 patients with International Society of Lymphology stage 2 and 3 LEL who, between May 2014 and August 2016, had undergone preoperative indocyanine green (ICG) lymphography for evaluation of LEL. In patients with stage 2 or 3 leg dermal backflow, a single lymph-to-venous bypass at the SEKI point was created in each patient, and in patients with stage 4 or 5 leg dermal backflow, a single lymph-to-venous bypass at the SEKI point with/without additional single LVA around the ankle was created in each patient. At the SEKI point, lymphaticovenular implantations were created in 6 patients who only have lymphatic vessels with severe sclerosis (modified SEKI group), and lymphaticovenular anastomoses were created in 30 patients who have lymphatic vessels without severe sclerosis (SEKI group). Intraoperative findings in lymph-to-venous bypass and postoperative lymphedematous volume reduction were compared between the two groups.

Results: Large lymphatic vessels were more frequently found in the SEKI group than in the modified SEKI group (0.75 ± 0. 06 mm versus 0.58 ± 0.01 mm; $p < 0.01$). Mean follow up was 12.9 ± 6.7 months (12.3 ± 6.2 months and 16.2 ± 8.3 months, respectively; $p = 0.321$). Reduction of the lower extremity lymphedema index was obtained in both groups (19.6 ± 14.4 versus 22.3 ± 11.9; $p = 0.636$).

Conclusion: The modified SEKI method facilitates utilization of damaged sclerotic lymphatic vessels with optimum therapeutic effects for severe LEL patients. Upward propulsion of lymphatic fluid in normal walking decreases the risk of occlusion both of lymphaticovenular implantation and lymphaticovenular anastomosis at the SEKI point. Creation of small number of lymph-to-venous anastomosis including at the SEKI point might be first line surgical treatment for LEL patients.

8:42 AM - 8:47 AM

RM 72. **Outcomes for Physiologic Microsurgery in the Treatment of Secondary Lymphedema**

University of Chicago, Chicago
Presenter: Rebecca M Garza, MD
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Background: Physiologic surgical options, including both vascularized lymph node transfer (VLNT) and lymphovenous anastamosis (LVA), have become increasingly popular in the treatment of lymphedema. The aim of the present study is to examine the physical and functional impact of these procedures on patients with secondary lymphedema of the upper extremity (UEL).

Methods: A retrospective chart review of all patients who underwent physiologic surgical treatment of secondary UEL over a 3-year period was performed. Patient demographics, surgical details, subjective reported improvements, Lymphedema Life Impact Scale (LLIS) scores, and postoperative limb volume calculations were analyzed.

Results: 124 patients were included. UEL was treated with VLNT in 39.5% of patients, LVA in 8.9%, and combined VLNT/LVA in 51.6%. At 3 months postoperatively, patients with secondary UEL had a 27.4% reduction in volume difference between limbs, 23.6% at 6 months, 25.4% at 12 months, and 23% at 24 months. For 29 patients with longitudinal data available, reduction in volume difference was 36.7% at 3 months and 29.9% at 12 months. LLIS score was decreased by 15.4% at 3 months, 22.8% at 6 months, 26.8% at 12 months, and 28.3% at 24 months. 75% of patients with UEL reported subjective improvement in their lymphedema symptoms postoperatively. 26 minor complications occurred in 188 procedures (13.8%), and flap survival was 100%.

Conclusion: Patients with secondary UEL who undergo VLNT/LVA demonstrate improved functional status and reduced affected limb volume at all time points postoperatively. Greatest reduction in volume difference was observed at 3 months, with less reduction at 6 months, followed by reduction or stabilization at 12 and 24 months. LLIS scores improved progressively over time. In addition to improvement in objective measures, the majority of patients reported subjective improvement in their clinical symptoms.

8:47 AM - 8:52 AM

RM 73. **CT VOLUMETRIC ASSESSMENT CORRELATES STRONGLY WITH CIRCUMFERENTIAL MEASUREMENT IN PATIENTS WITH LYMPHEDEMA AND VASCULARIZED LYMPH NODE TRANSFER**

Chang Gung Memorial Hospital, Taoyuan
Presenter: Olivia Ho, MD FRCSC
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CT Volumetric Assessment Correlates Strongly with Circumferential Measurement in Patients with Lymphedema and Vascularized Lymph Node Transfers Olivia A. Ho M.D., Sung-Yu Chu M.D. Yen-Ling Huang M.D., Wen-Hui Chen M.D., Chia-Yu Lin M.Sc., Ming-Huei Cheng M.D. M.B.A. **Background** Circumferential measurement of lymphedematous limbs at designated anatomic distances has been the primary mode for measuring lymphedematous extremities. However, this approach has been criticized for not being an accurate assessment of the volume of the affected limbs. CT imaging produces accurate, consistent, and hygienic measurements of volume and is a direct representation of the limb. Thus, CT imaging is an excellent standard for comparing other measurement methods. This study aims to compare circumferential measurements to volumetric studies using CT imaging and to assess their correlation. **Methods** Patients with lymphedema who had vascularized lymph node transfers from January 2013 to May 2016 were assessed. CT and circumferential methods were compared using the same standardized position points and the same anatomical landmarks. Cost analysis of the two modalities was performed. **Results** Seventy-six patients were evaluated. Their CT volume measurements significantly correlated with their respective circumferential measurement differentials and were found to have the same Pearson correlation coefficient of $r = +0.7$, which was statistically significant ($p = 0.03$), indicating a strong positive correlation between the circumferential measurement differentials and the actual limb volume changes as determined by CT imaging. Circumferential measurement differentials are more cost effective than CT volume assessments and provide an accurate measurement of clinical improvement after treatment. **Conclusion** Standardized circumferential limb measurement differentials that are currently used are comparable to unbiased CT volumetric measurements and can be used as a reliable, reproducible, minimally invasive, low cost, and accurate method of measuring the lymphedematous limbs.