

**Multimodality Approach to Lymphedema Surgery Achieves and
Maintains Normal Limb Volumes:
A Treatment Algorithm to Optimize Outcome**

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Objectives

- Identify physiology pathophysiology of lymphatic systems
- Identify Stages of Lymphedema
- Learn about Complete Decongestive Therapy
- Learn about surgical treatment of Lymphedema
- Learn about Lymphedema prevention

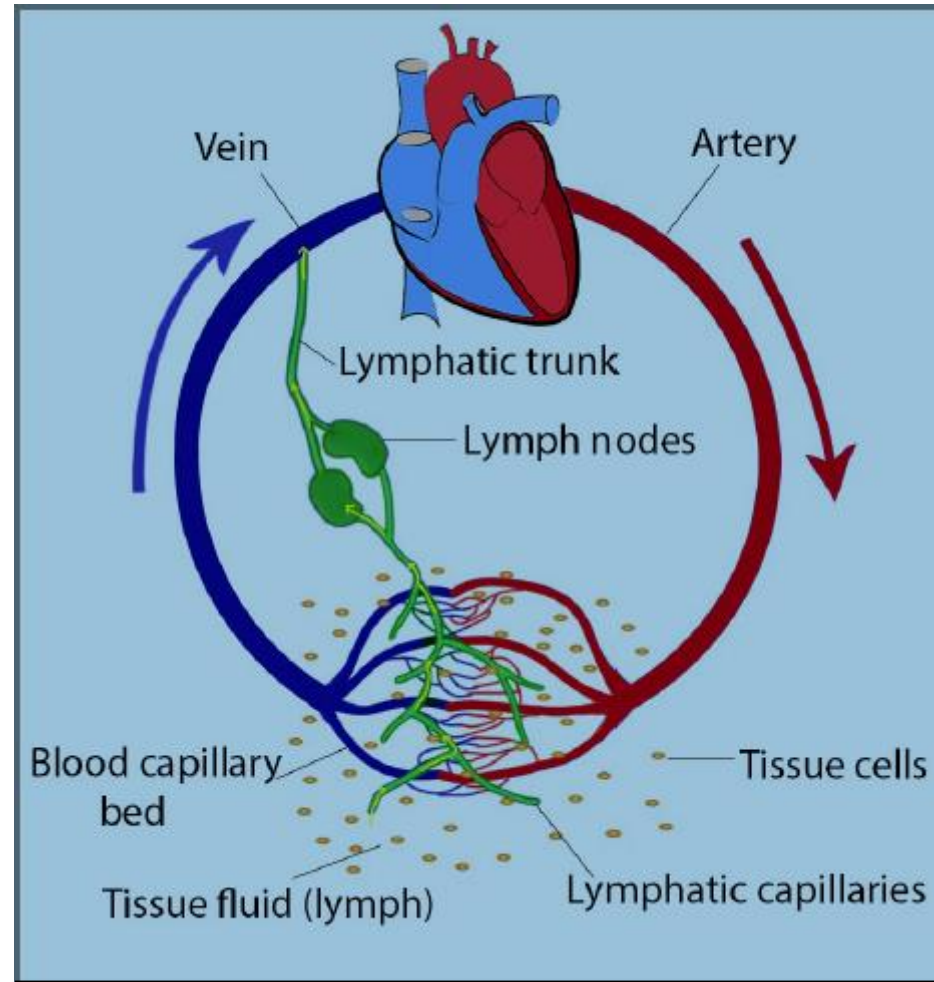
Disclosures

- None

What is Lymphedema?

- Medical diagnosis
- Accumulation of protein rich fluid (lymph) in a particular area of the body
- Chronic disease

Normal Lymphatic Circulation



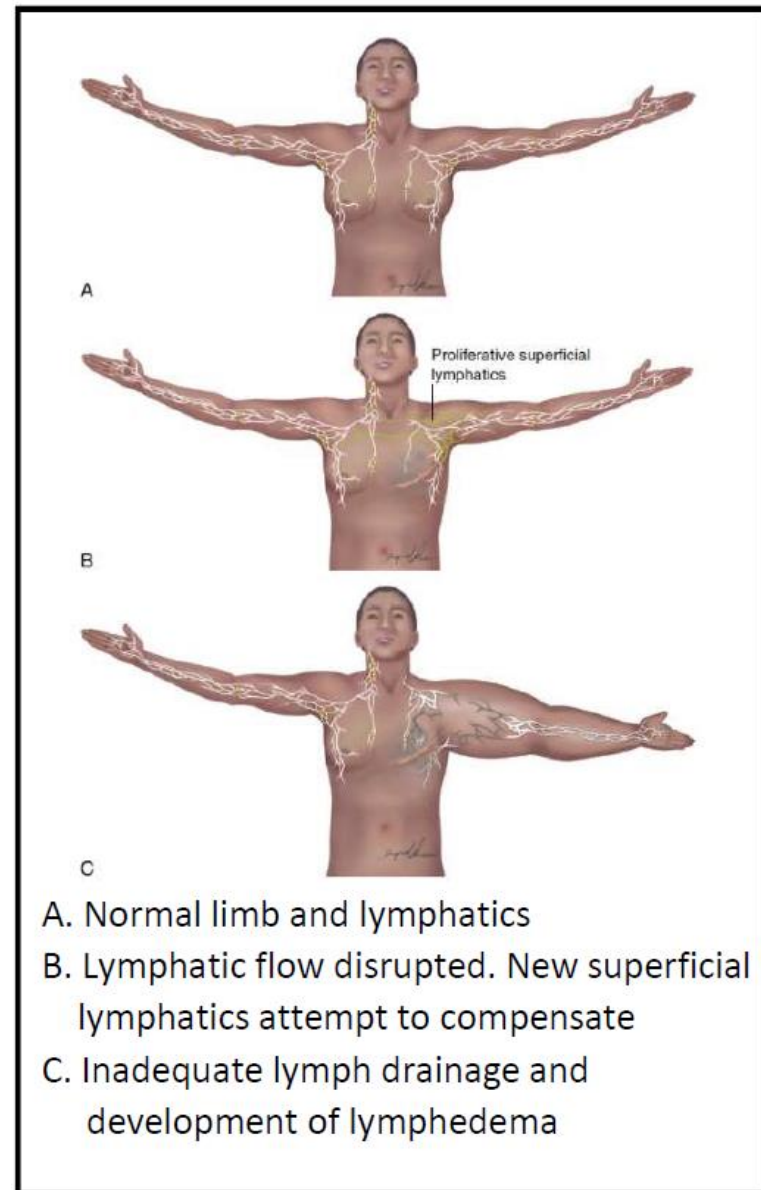
Surgical Approach to Lymphedema Treatment

- Surgical management of lymphedema remains challenging and requires a multimodal approach to restoring the affected limb to its normal volume and function.
- Current treatment options include debulking and physiologic procedures.
- Debulking procedures – suction assisted lipectomy
- Physiologic procedures – LVA and VLNT.
- Neither debulking nor physiologic procedures aim at restoring the nonfunctional lymphatic channels throughout the length of the limb, which characterize later stage lymphedema.
- To address this problem, our authors have begun to incorporate BioBridge™ (BB) (Fibralign Corp, Union City, CA, USA) into our treatment of late-stage lymphedema.

Goals of Care

- Restore lymphatic flow after cancer treatment
- Aid in physiological and psychological benefit
- Cure and Perfection is not attainable

Patho- physiologic Lymphatic Impairment



Etiology of Lymphedema

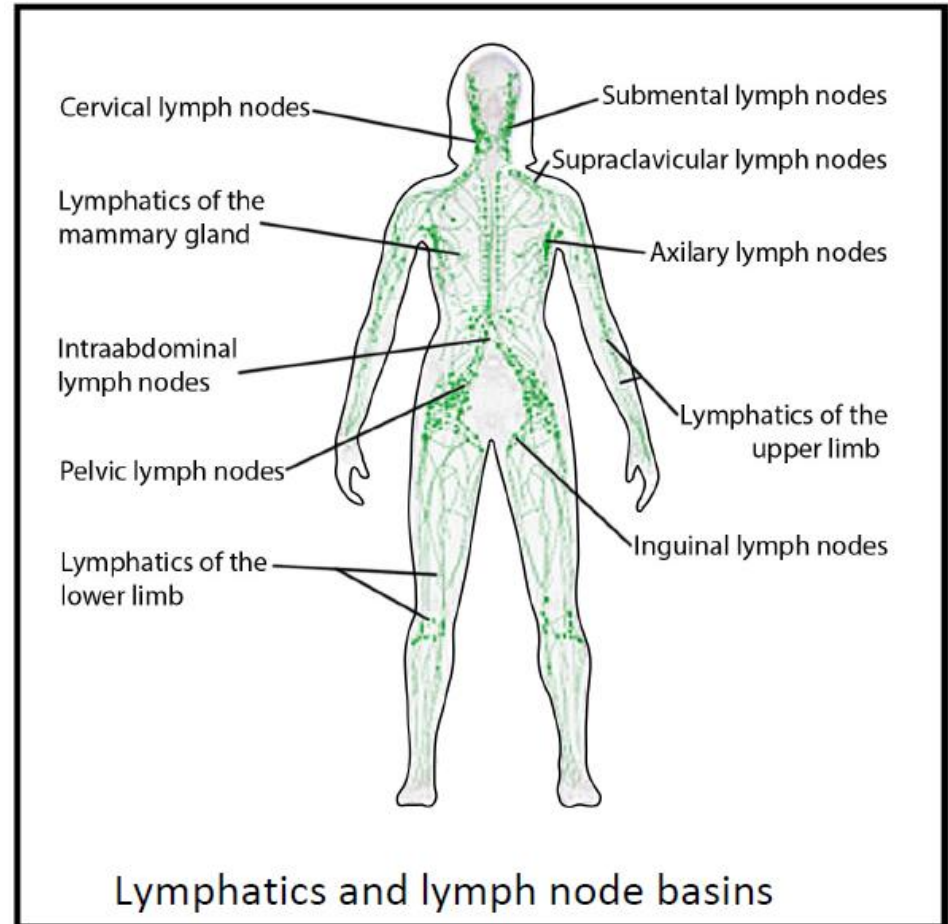
Primary Lymphedema

- Congenital /Milroy's disease
- Lymphedema Praecox
- Lymphedema Tarda

Secondary Lymphedema

- Trauma
- Parasitic Infection
- Cancer Treatment

- NOT ALL CANCER PATIENTS WILL DEVELOP LYMPHEDEMA

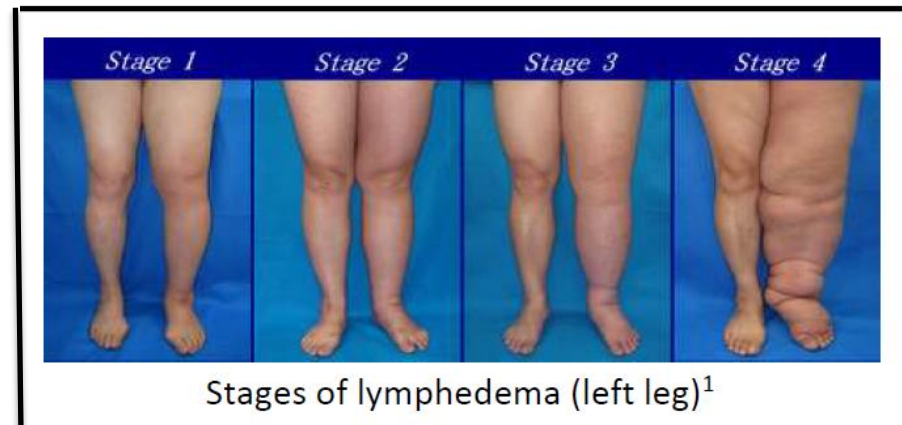
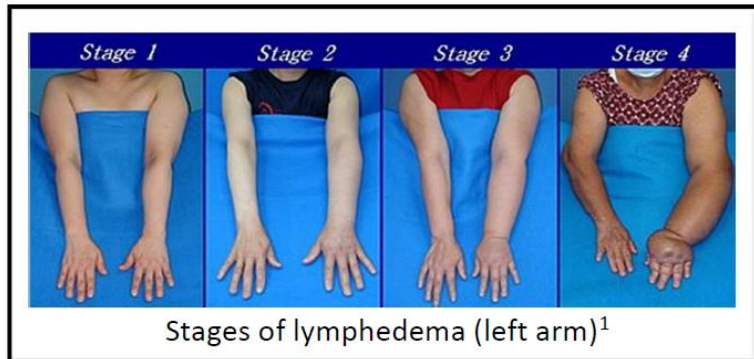


Pathophysiology of Lymphedema

- Two lymphatic systems
 - Deep
 - Superficial
- LN removed or severed
 - Lymphatic fluid balance is shifted
 - Compensatory mechanism
 - No extremity swelling
- Lymphedema occurs if damage happens to either of lymphatic systems
 - Drainage capacity reaches threshold
 - IV placement may damage superficial system
 - Superficial lymphatics are very thin vessels
 - DO NOT HARM
 - If avoidable – use contralateral extremity
 - High altitude / Airplane flights
 - Vessels collapse and not reopen
 - Overcompression
 - Tight clothes

Symptoms and Stages of Lymphedema

- 5 Stages from 0-4
- Symptoms



Lymphedema Workup and Diagnostics

- Lymphoscintigraphy
- Venous Duplex
- SPY mapping
- Lympho MRI
- CT Scan

Lymphedema Diagnostic Studies

Required:	Type of Test	What is it for?	What To Expect?	Who Schedules This?
YES NO	Lymphoscintigraphy	To evaluate deep and superficial lymphatic system. This test confirms the diagnosis of lymphedema.	4 hour appointment, consists of several injections spread apart with imaging after each injection.	Please call Nuclear Medicine at 650-725-8264 to schedule.
YES NO	Venous Duplex (aka Venous Ultrasound)	To evaluate superficial and deep vein systems. This test is to confirm that the swelling is not due to any venous issues, but truly a lymphatic problem.	30 minute procedure. Non-invasive test that can depict blood flow by using high-frequency sound waves.	Please call the Vascular Lab at 650-725-5227 to schedule.
YES NO	Lymphatic SPY Mapping	To evaluate for superficial lymphatic system and check for any superficial lymphatic blockages.	20 minute procedure with local injection of numbing medicine and green dye into the extremity web space by Dr. Nguyen. The subcutaneous lymphatic system will uptake the green dye and on the screen of the SPY machine you will see live pictures of the lymphatic flow, or lack of it.	Aloha Basa, Coordinator at Plastics Clinic, 1000 Welch Road. We will call you to schedule your appointment. Plastic Clinic number: is 650-723-7001
YES NO	Lympho MRI	To evaluate lymph nodes, lymphatic channels, and fat-fluid composition	45 minute procedure, consists of lying still inside an open-ended tube. During the actual imaging, you will hear a loud intermittent banging noise.	Please call Radiology Department at 650-723-6855 to schedule.

*Many of these appointments can be scheduled on the same day, but it is not required. If you would like to consolidate your appointments on the same day, we recommend first scheduling your SPY mapping appointment as a priority. The order of appointments does not matter. Please feel free to send any questions via MyHealth or call the office at 650-723-7001.

Non-Surgical Treatment



Methods

- Retrospective, single surgeon, single center study.
- All patients undergoing triple therapy (liposuction, physiologic procedures, and BioBridge placement) (2016-2019)
- Outcome measures included volumetric analysis and lymphatic mapping with indocyanine green.

Surgical Treatment - Suction Assisted Lumpectomy



Many liters of fibrofatty tissue and fluid can be removed from lymphedema extremity.

Surgical Treatment: LVA



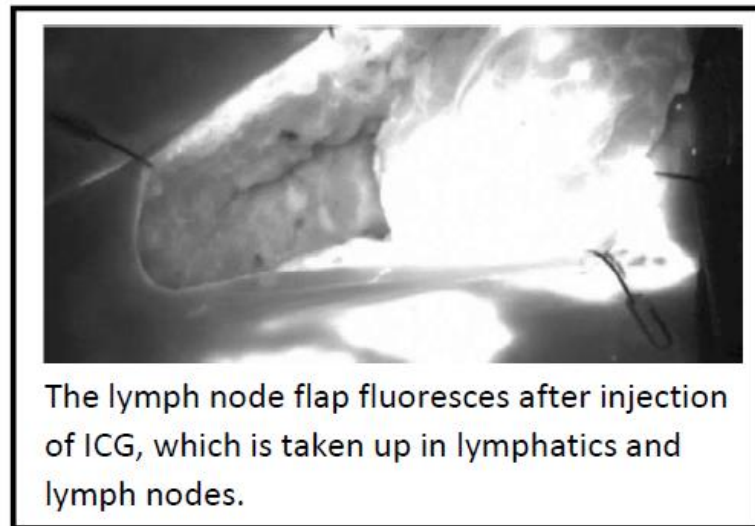
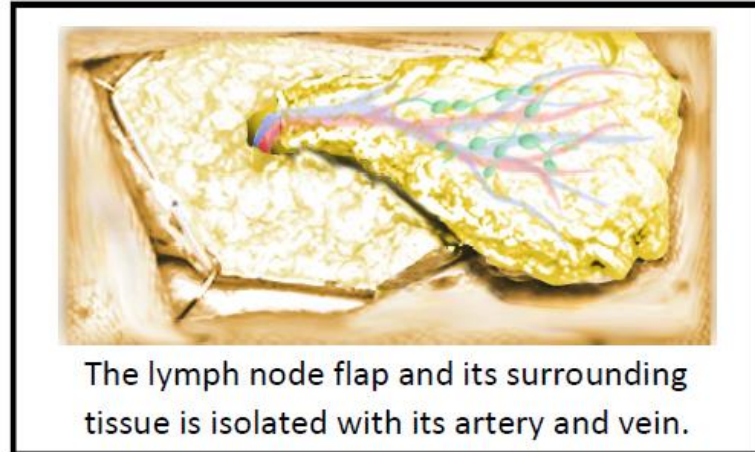
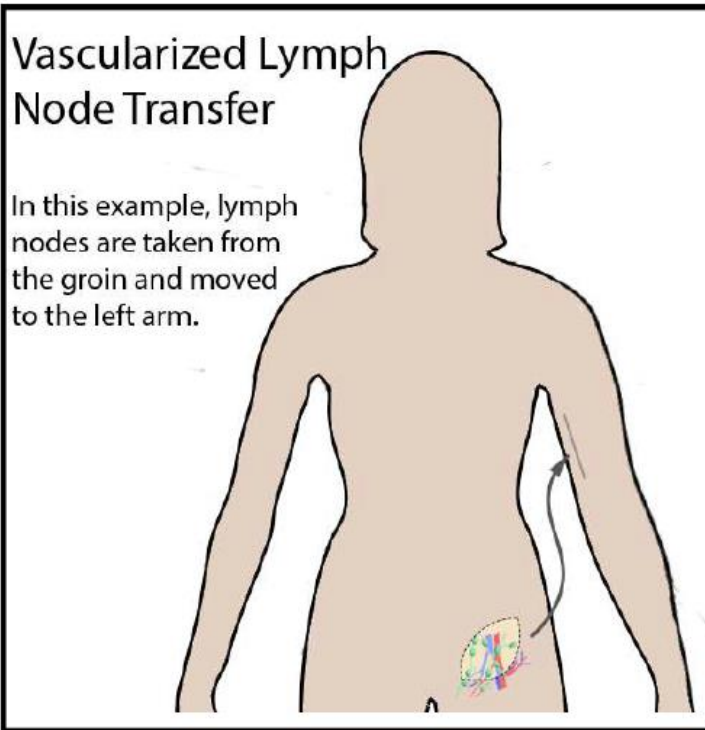
(Left) A vein finder is used to locate veins.

(Right) Intradermal ICG injection identifies blocked lymphatics.



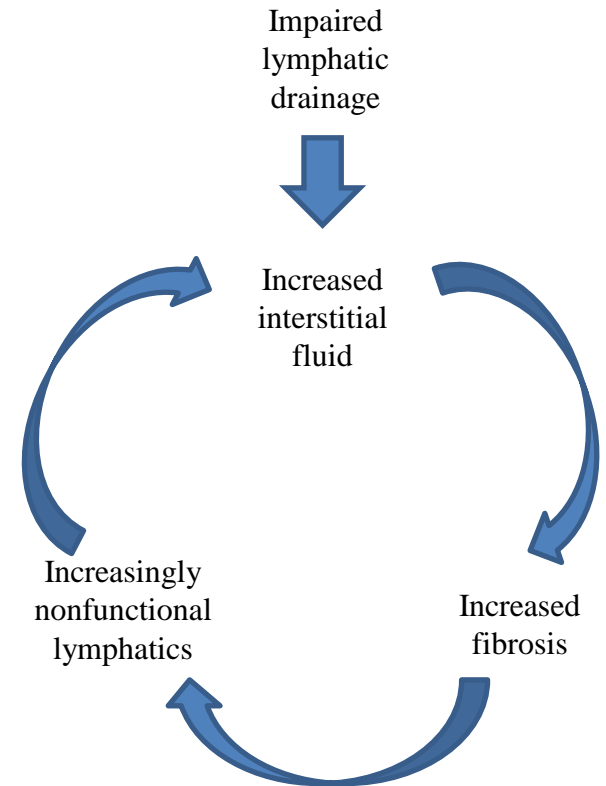
A map of veins (blue) and lymphatics (green) is marked on the skin. The vertical lines mark the target blocked lymphatics and the veins suitable for bypass.

Surgical Treatment : VLNT



Current Surgical Treatments

- Debulking procedures
 - Suction lipectomy
 - address soft tissue excess
- Physiologic procedures
 - LVA
 - VLNT
 - address fluid excess
- Do not address nonfunctional lymphatic channels throughout the length of the limb.

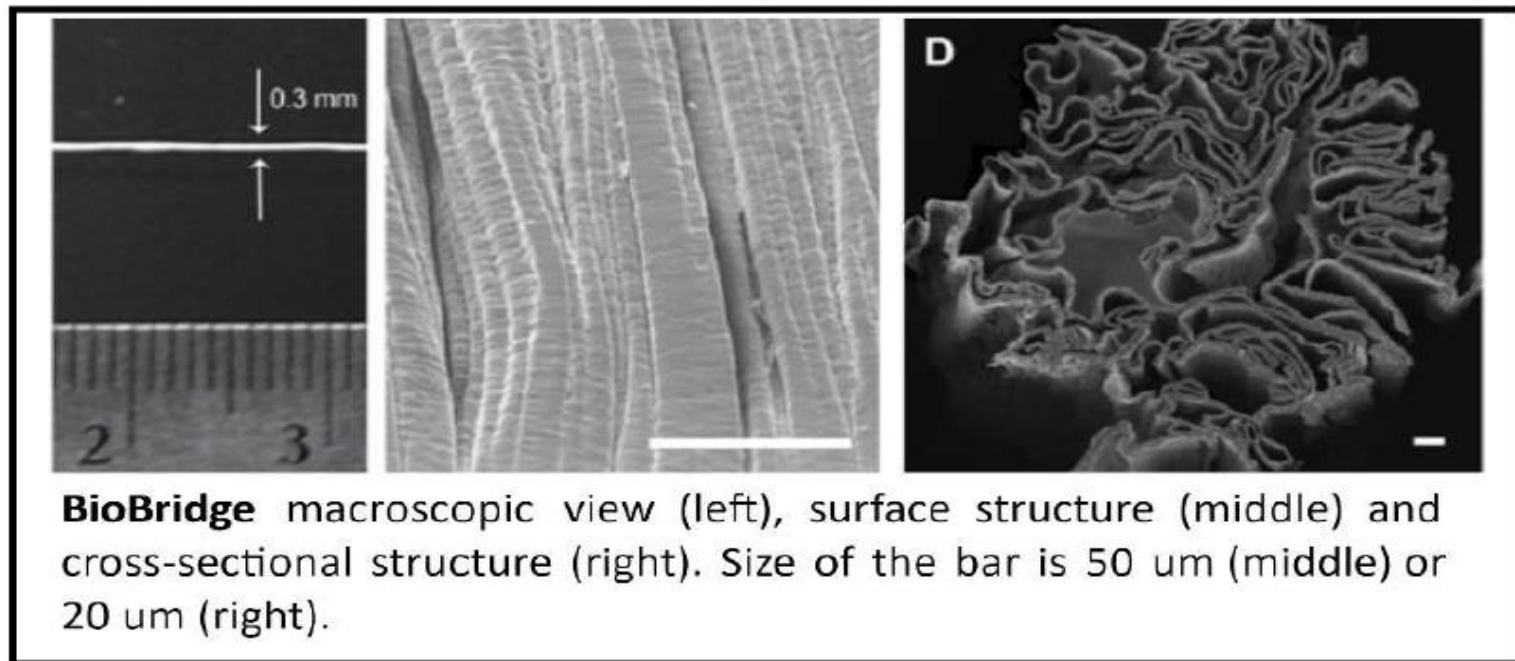


Surgical Approach for Treatment of Lymphedema

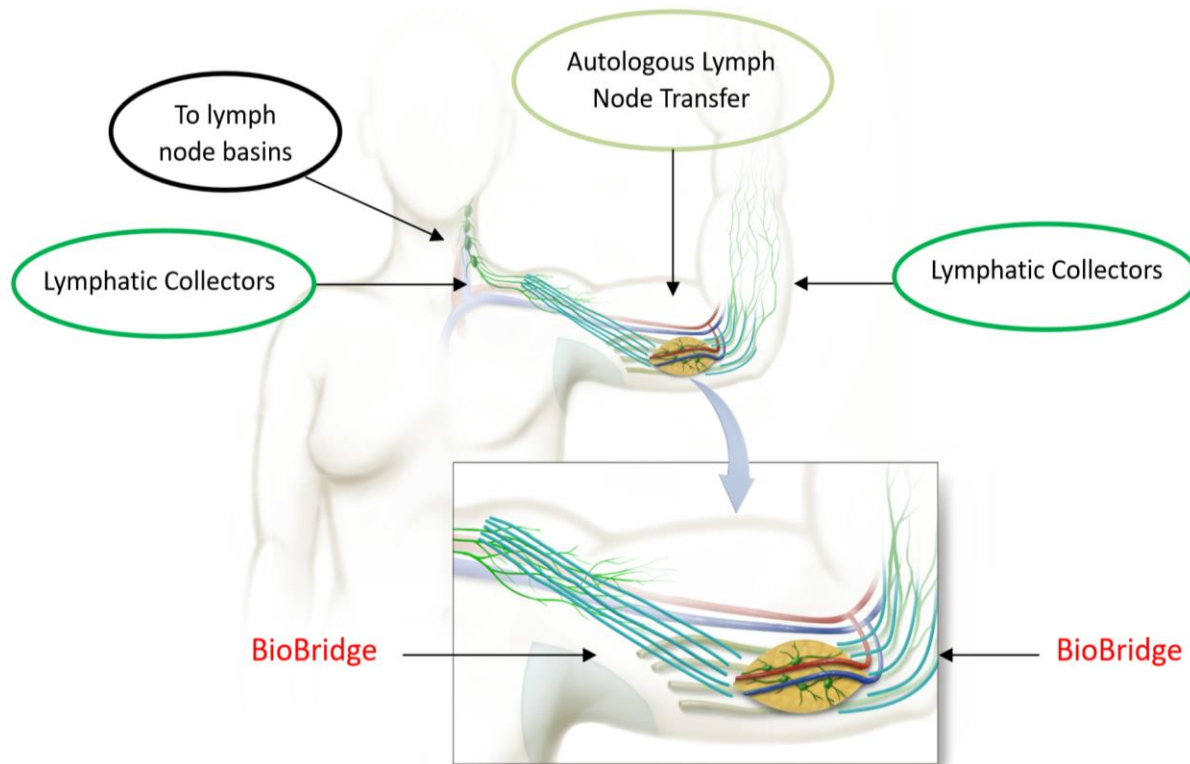
- Debulking Procedure
 - Suction Assisted Lipectomy
- Physiologic Procedure
 - Lymphatico-Venous Anastomosis (LVA)
 - Vascularized Lymph Node Transfer (VLNT)
- Compliance with CDT
 - Maximized conservative therapy
 - No active infection within 1 month from surgery
 - No active malignancy
- None of the currently performed surgeries cure lymphedema.
 - Help extremity feel less bulky and heavy
 - Improve lymphatic flow
 - Slow progression of the disease
 - Decrease rate and risk of infections
 - Decrease the need for complex decongestive therapy
 - Decrease dependence on compression garment
- Small number of selected patients may no longer need garment, especially when treated early

BioBridge Placement

- Nanofibrillar collagen scaffold with highly aligned parallel channels
- FDA approval for soft tissue reinforcement and CE certificate for lymphatic tissue repair
- Nanopatterned channels facilitate:
 - interstitial flow
 - cell migration, attachment, and alignment
 - lymphangiogenesis



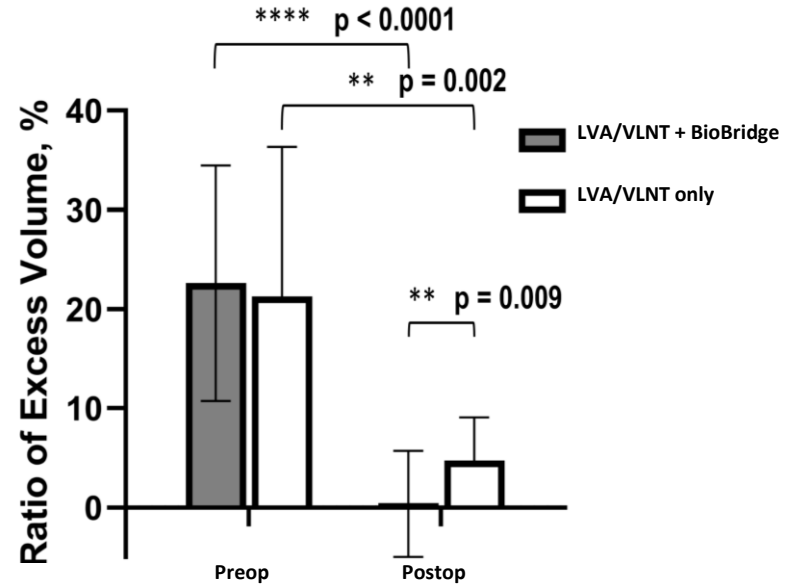
BioBridge



- Subcutaneous placement
- From area with intact lymphatics
- Bridge area of fibrosis
- Directed toward vascularized lymph node flap, nodal basin

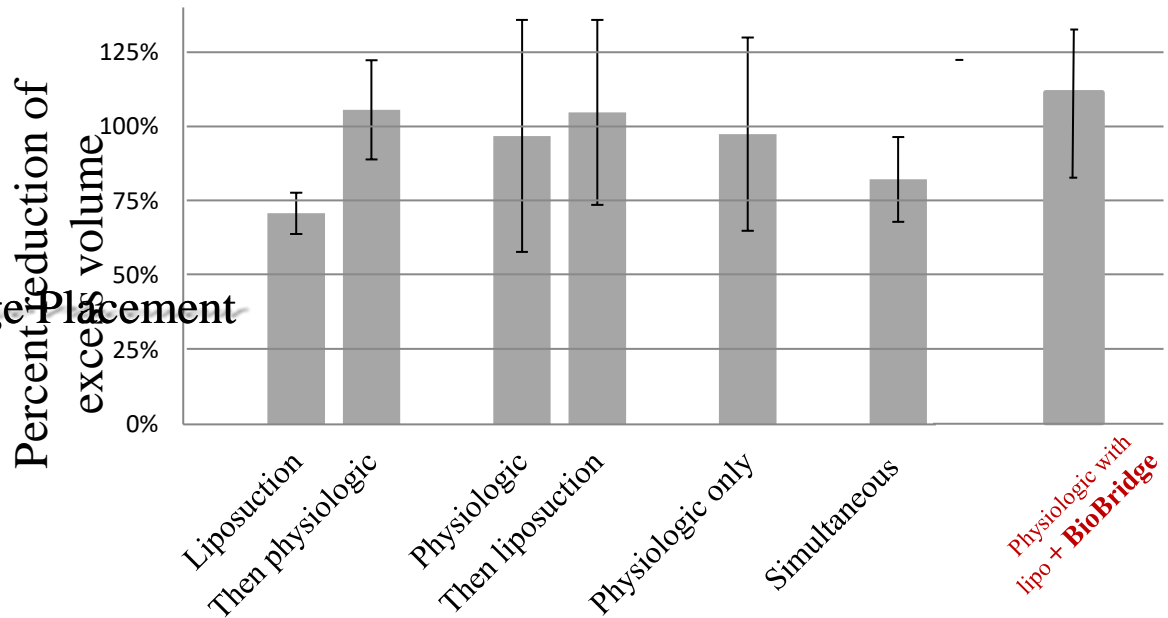
BioBridge

- BioBridge addition improves volume reduction in early disease after LVA/VLNT
 - Control: 67.9%
 - Biobridge: 106.3%
 - P=0.009



Results

- Comparison to historical controls
- Similar reduction of excess volume s/p physiologic surgery
- Addition of **BioBridge Placement**
BioBridge: 112.2% excess volume reduction
- 22.6 months follow up



VLNT/LVA/Lipo + BioBridge



Pre-Op
21% excess volume



Post-Op
VLNT/LVA/Lipo (13mo)
4% excess volume



Post-Op
VLNT/LVA/Lipo/BB (12mo)
-2% excess volume

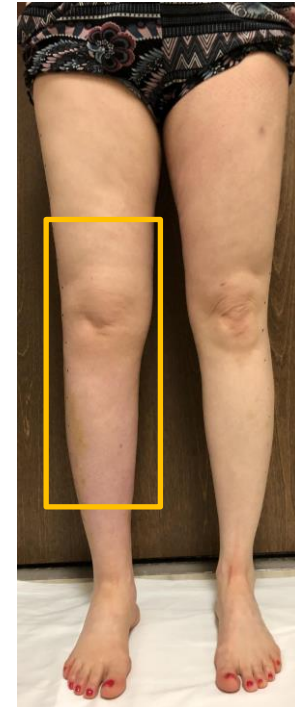
VLNT+ Lipo + BioBridge



Pre-Op
27% excess volume



Post-Op VLNT/Lipo
6% excess volume



Post-Op VLNT/Lipo/BB (1yr)
-3% excess volume

VLNT/LVA/Lipo + BioBridge



Pre-Op
9% excess volume



Post-Op VLNT/LVA/Lipo
-1% excess volume



Post-Op VLNT/LVA/Lipo/BB (1yr)
-3% excess volume

VLNT+Lipo+BioBridge



Pre-Op
24% excess volume



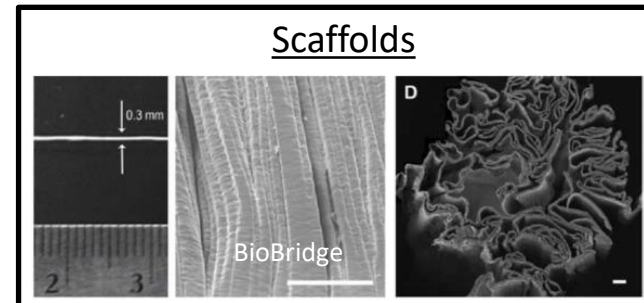
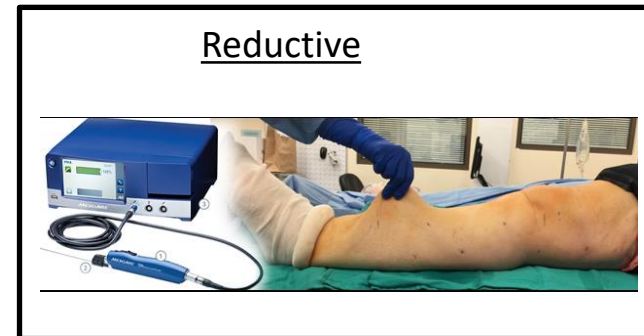
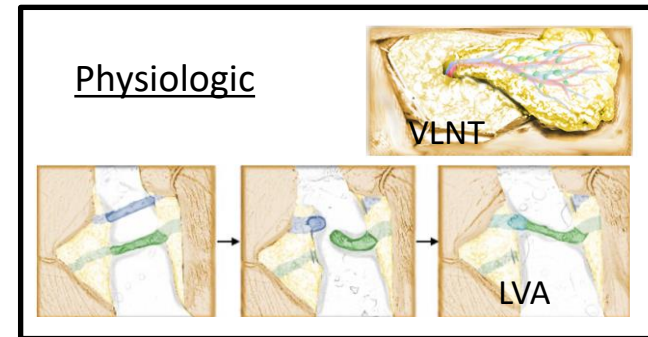
Post-Op
VLNT/Lipo (9mo)
3% excess volume



Post-Op
VLNT/Lipo/BB (21mo)
4% excess volume

Conclusions

- Triple therapy improves and prolongs lymphedema surgery success.
- Addresses each component of late-stage lymphedema:
 - restoration of healthy lymphatic tissue
 - removal of excess tissue
 - guiding restoration of lymphatic channels.



Lymphedema Prevention – LYMPHA

HOPE!!!