

# Managing Orthopedic Edema

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## WS OBJECTIVES

1. Demonstrate an understanding of the basic anatomy and physiology of the lymphatic and venous system.
2. Identify the ways in which edema can impede tissue healing and orthopedic outcomes.
3. Identify the ways in which Manual Lymph Drainage is more effective than retrograde massage.
4. Identify the signs and symptoms of lymphedema and when to refer a patient to a Certified Lymphedema Therapist (CLT) for treatment.
5. Identify contraindications for edema intervention.



## INFLUENCES OF EDEMA

- Scar adhesion
- Decreased skin mobility
- Cosmetic changes
- Decreased ADL
- Delayed wound healing
- Pain
- Joint stiffness and decreased ROM
- Increased risk of infection



## TYPICAL METHODS TO MANAGE EDEMA

- RICE
  - Exercise
  - Retrograde massage
  - Compression pumps
  - Electrotherapy
  - Thermal modalities
  - Diuretics
- J. Colditz, 2006



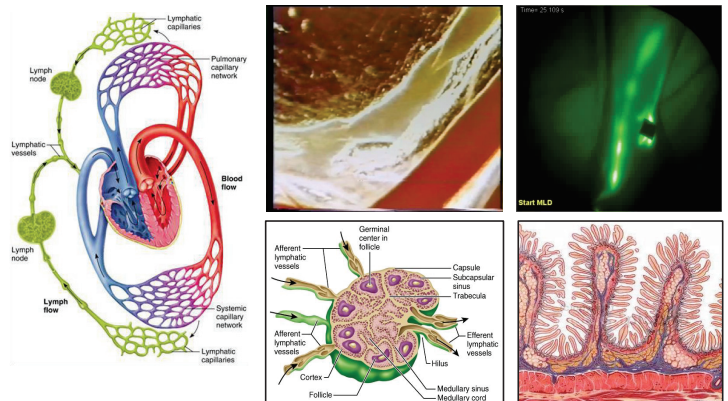
## VICKI'S PET PEEVE

Patients are told they just need to wait for the swelling to resolve on its own

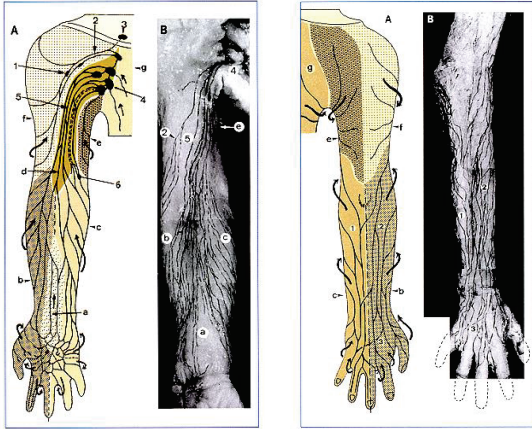
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## THE LYMPHATIC SYSTEM



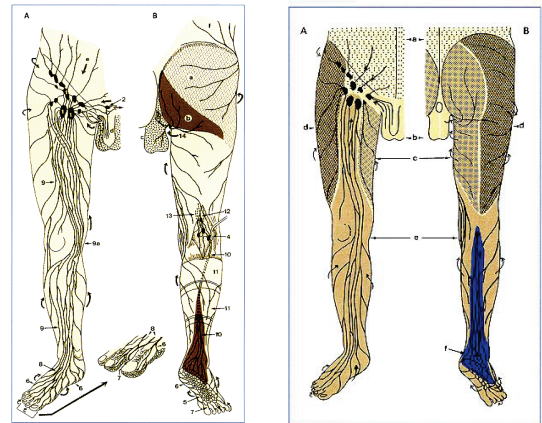
## COLLECTORS OF THE UPPER EXTREMITY



Földi: Textbook of Lymphology



## COLLECTORS OF THE LOWER EXTREMITY



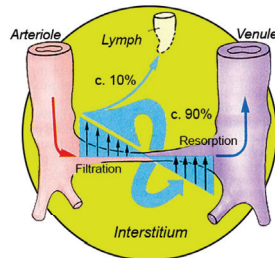
Földi: Textbook of Lymphology



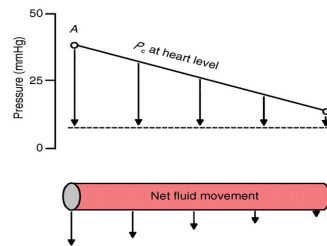
## TRADITIONAL HYPOTHESIS OF FLUID EXCHANGE IN THE CAPILLARIES

“The purpose of blood circulation is fulfilled in the blood capillaries where the tissue receives nutrients and waste is removed and transported away.”

- Földi 2003



## REVISED PRINCIPLE OF FLUID EXCHANGE



Even though there is dwindling filtration throughout the capillary surface, there is no resorption in “normal” capillaries.

Levick J, Michel C. Microvascular fluid exchange and the revised Starling principle. *Cardiovascular Research*. 2010



A disturbance of microcirculation /lymphatic vessels

Tissue Congestion

Edema

## Edema techniques discussed today can be used in...

- recovery from orthopedic surgery.
- acute muscle or bone trauma.
- acute neurologic swelling (flaccid hand, foot).
- hematomas.
- whiplash.

If the lymphatic system is intact the approach is straightforward!



## TRADITIONAL TECHNIQUES REST, ICE, COMPRESSION, ELEVATION (RICE)

Limited motor activity causes stagnation and protein accumulation. Casley-Smith, 1997

During the initial trauma phase (72 hours), elevation and rest can help to reduce hydrostatic pressures and control edema by reducing dependency. Proximal “decongestion” accomplished by moving uninvolved joints will help increase lymph drainage while not stressing the region of injury.



## QUESTIONING RICE

Rest – evidence that immediate posttraumatic mobilization can be beneficial

Ice – Using cryotherapy to manage acute soft tissue based on anecdotal evidence. Can be effective with pain, but other efficacies ?? –Hubbard TJ et al 2004

Compression – long stretch vs short stretch???

Elevation – perhaps the most beneficial from the above list to manage edema – but studies needed to measure these benefits vs manual lymph drainage.



## THERMAL MODALITIES (HEAT/ICE PACKS)

Lymph mobility is greatest with temperature ranges of 22–41°C (74–106°F). Mobility sharply decreases below or beyond these ranges.

-Casley-Smith, 1997

★ Lymphatic peristalsis becomes lethargic with wide temperature ranges.

Use of RICE protocols are appropriate for the first 48–72 hours s/p. Consider other modalities for more effective intervention.



## RETROGRADE MASSAGE

Traditional “retrograde” massage is performed by pushing edema from distal to proximal limbs.



## BENEFITS OF MLD



↑ lymph-angio-motricity and re-absorption of protein-rich fluid

Promotes relaxation

Provides analgesic effect

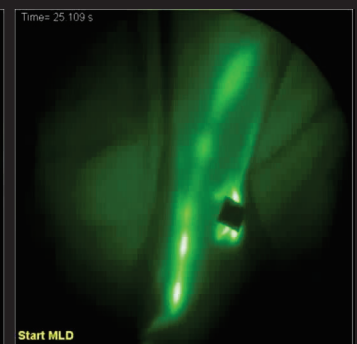
- Ernst, 2004; Földi 2006



## Near-Infrared Fluorescence Imaging



Before MLD



Start MLD

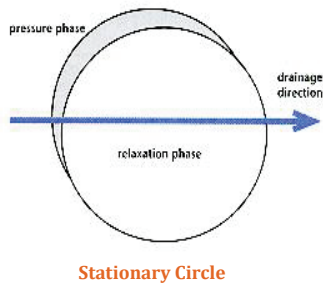
E.M. Sevick-Muraca

Before MLD

During MLD

## COMMON MLD CHARACTERISTICS

Gentle, circular  
stretching of the skin  
Alternating pressure  
and relaxation phase  
Rate of about 1/sec,  
with 5-7 repetitions  
per area



## INEFFECTIVE MLD



## EFFECTIVE MLD



## SHORT UE MLD SEQUENCE



## SHORT LE MLD SEQUENCE



## PATIENT TESTIMONIAL



## SHORT LE MLD SEQUENCE



## STAGES OF WOUND HEALING

1. **Hemostasis** – Stop the bleeding, Fibrin mesh and blood clot formation. Can take a few minutes to hours.
2. **Inflammatory** – Neutrophils enter wound to destroy bacteria and remove debris (24-48 hours) Main characteristic -edema, erythema, heat and pain – typically last 4-6 days
3. **Proliferation Stage** – Occurs once wound is cleaned out - margins contract, epithelialization - Lasts 4 – 24 days
4. **Maturation** -New Tissue slowly gains strength and flexibility. Lasts 21 – 2 years+



## CHRONIC SUB-ACUTE EDEMA

Luther Kloth (1991) and Casley-Smith (1997) state that the inflammation stage of wound healing lasts from 2 days to the appearance of fibroblasts in the wound, can take 2–4 weeks.

If edema lingers into the proliferation stage of healing, the patient is at high risk for sub-acute and chronic edema. Elevation, rigorous massage, joint stretching, uncontrolled compression and diuretics may be counter-productive with this type of edema.



## ACUTE VS. SUB-ACUTE

### POST-TRAUMATIC/POST-SURGICAL EDEMA

Postoperative edema peaks 2–4 days P.O.

Soft-tissue fibrosis 14–42 days P.O.

Extent of edema and fibrosis varies

#### Study Outcomes

P.O. *without* MLD and deep tissue massage:

Complete resolution of edema & fibrosis in 9–18 months

P.O. *with* MLD and Deep Tissue Massage:

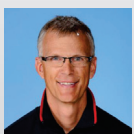
Complete resolution of edema & fibrosis in 6 wks–3 months

- Casas LA, DePoli P. 1999



## Swelling after Total Knee Arthroplasty

Michael Bade, PT, PhD, OCS, FAAOMPT



Joel Carmichael, DC, PhDc



Brian Loyd, DPT, PhD



## Impairments and Activity TKA

### Impairments

- Pain
- Swelling
- Healing Wound/Scarring
- ROM (Osteokinematic/Arthrokinematic)
- Decreased proprioception/balance
- Aberrant movement patterns
- Decreased strength
  - Decreased neuromuscular activation
  - atrophy
- Decreased flexibility

### Activity Limitations

- Transfers
  - Bed mobility
  - Sit to Stand
  - Floor to Stand
- Gait
  - Endurance
  - Speed
  - Agility
- Stair climbing
- Squatting
- Kneeling

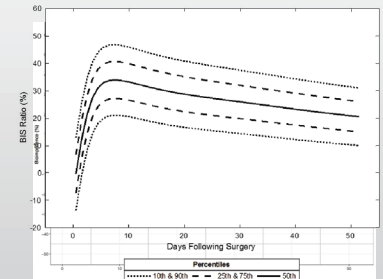
## Why is Swelling Important?

- Major complaint of patients
- Related to the development of complications (DVT)
- Potential mechanism for arthrogenic muscle inhibition (AMI)
- Alters energy availability in muscle and can cause mechanical damage
- Related to pain, ROM, quadriceps strength, and functional performance

Rice and McNair 2010, Loyd in press

## What is “normal” swelling recovery?

- Can peak anywhere from POD1-7
  - Mean swelling – 36% increase
- Swelling can persist chronically
  - Mean swelling at POD90 – 10% above baseline
  - 26% at 3 years have felt swelling in the knee in the last 30 days
- Currently working on the development of personalized reference charts for swelling recovery



Pua 2015, Nam 2016, Loyd in press

## How can we measure it clinically?

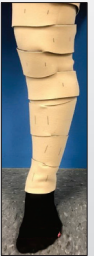
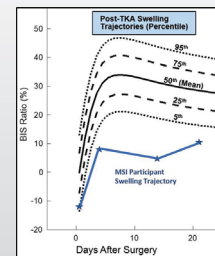
- Volumetric?
  - Not realistic given wound healing and burden
- Circumferential?
  - Questions regarding reliability and validity
  - Can be confounded due to muscle atrophy and bandaging
- Ultrasound?
  - Questions regarding reliability and operator error
- Bioelectrical Impedance
  - High reliability (ICC > 0.80)
  - Good responsiveness (SEM = 2%)
  - Limitations – not joint specific and cost (~\$2000)



Jakobsen 2010, Pichonnaz 2015, Loyd in review

## Future Directions

- Multimodal Swelling Intervention
  - Use of an adjustable compressive garment
    - Circaid Juxtafit Essentials compression garment (20-50 mm gradient pressure worn during the day)
  - Use of frequent AROM/AAROM
    - 1 min of ankle pumps can increase blood flow for up to 30 minutes
  - Use of manual lymph drainage massage
    - Performed daily at home by patient
    - Effective at pain control
- Will also examine the relationship between activity levels and swelling recovery



## FORMS OF COMPRESSION



Compression  
Bandages



Compression  
Garments

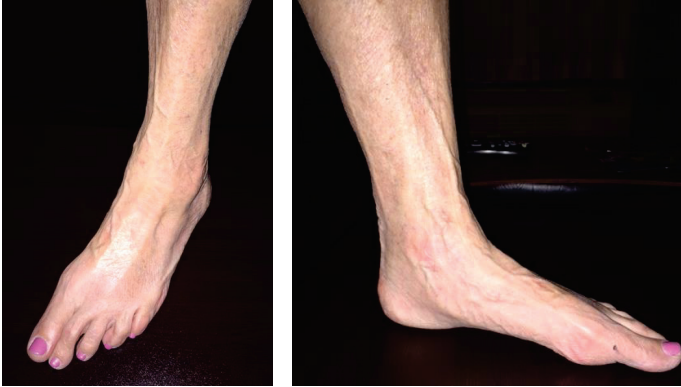


Compression  
Therapy  
Alternatives

## JOVI PAK ANKLE FOOT WRAP



## SIX HOURS LATER...



## COMPRESSION THERAPY CONSIDERATIONS

- Sensation
- Tactile tolerance
- Skin integrity
- Induration
- Wound type and characteristics
- Cognition of the patient (orientation, communication skills, etc.)
- Level of ADL skill set

## LAW OF LAPLACE

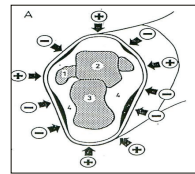
The pressure applied is inversely proportional to the radius.

$$\text{Pressure} = \frac{\text{Tension}}{\text{Radius}} \quad P = \frac{T}{R}$$



Pierre-Simon Laplace,  
French mathematician  
1749-1827

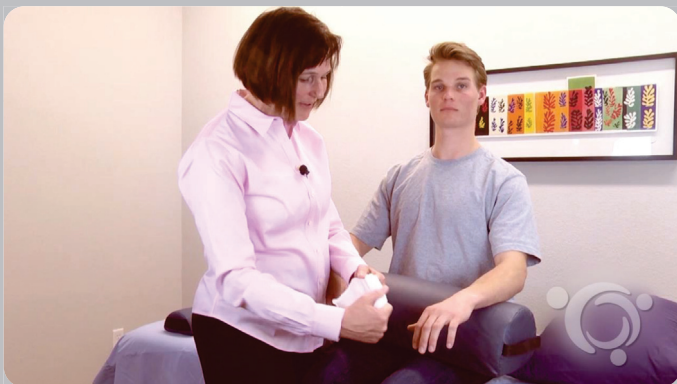
- **Tension** is delivered from the bandage. Each bandage layer must be applied with the same degree of stretch/tension.
- The smaller the **radius** of the limb, the greater the pressure exerted on the tissue.



## PADDING

- Protects the limb injury and irritation.
- Use various forms of padding as appropriate
- Padding needs to be applied:
  - In areas of concavity
  - Where the radius of the limb needs to be increased

## POST-SURGICAL UE BANDAGING



## POST-SURGICAL LE BANDAGING



## RESEARCH PAPER

### “A Novel Method of Postoperative Wound Care Following Total Ankle Arthroplasty”

- Study size: 100 TAA
- Result: Improved wound healing using short-stretch compression bandaging compared to circumferential casting.

-American Orthopaedic Foot and Ankle Society, Hsu et al.



Figure 4. (A) Anterior total ankle arthroplasty (TAA) incision with marked erythema and edema 3 days after surgery using a padded circumferential cast. (B) Anterior TAA incision with minimal edema 3 days postoperative after using compression wrap dressings.

AR Hsu, D Franceschina, SL Haddad  
Foot Ankle Int 2014



## CASE STUDY

64 y/o female

4 months post total ankle arthroplasty

Limited plantar/dorsi flexion

Pain 6/10

Walked with limp

Edema around ankle, dorsum foot, squaring of toes



## CLINIC RESULTS

1. Taught to self bandage on day one.
2. Used her I-phone to record the bandage process.
3. Reported immediate pain relief with bandages.





## AFTER TWO TREATMENT SESSIONS:

Edema reduced at ankle by 3 cm

12 degree increase in dorsi flexion

No longer walked with a limp

Pain 0/10

Measured for a custom compression flat knit knee high class II



## MEASURING TECHNIQUES

- Measure in centimeters for improved accuracy.
- Be consistent; attempt to measure at the same point(s) and in the same position (supinated or pronated)
- Identify the system you and coworkers will use.
- Measure circumference without adding pressure.
- Invest in a Gulick II Tape Measure



## MEASURING THE UE

### Suggested hand measurement points:

At the base of each digit, DIPS, MCPs, Distal Crease of Wrist

### Suggested arm measurement points:

Measure around the distal crease.

Measure every 4 cm proximal to the distal crease to adequately cover above and below the area with edema.



## MEASURING THE LE

### Suggested points to measure the foot:

- Around the base of each digit, and MTPs
- If Applicable, measure a point mid-foot (i.e. 4, 8, 12, 16 cm proximal to the distal end of the middle toe)
- Around the malleoli

### Suggested points to measure the leg:

- Middle of the media malleoli
- Measure every 4 cm proximal up the leg to the point that adequately covers the edematous area.

**Be consistent! Do not pull or tug on the measuring tape. Just measure the circumference**



## MULTI-LAYERED BANDAGING CODES

- Untimed codes 29581, 29584.
- Can only charge one unit per treatment session.
- Get clearance in your facility before using these codes.
- Some facilities only charge once; other facilities charge with every bandage.



## BANDAGING SUPPLIERS



bandagesplus.com  
compressionguru.com  
performancehealth.com  
(formerly Patterson Medical)  
Fastbandages.com



## ARM AND LOWER-LEG BANDAGING SUPPLIES

- Stockinette (Delta, L&R, Jobst)
- Mollelast (L&R): 6 cm finger/toe bandages
- Cast padding: Rosidal (L&R)/Artiflex (Jobst)
- Short-stretch bandages: 6 cm, 8 cm, 10 cm
- ¼-inch and ½-inch gray foam (Performance Health, BandagesPlus, Bandage Guru, etc.)
- CompriFoam (Jobst)/Rosidal Soft (L&R)
- Mollelast (L&R)/Elastomol (Jobst): 4 in



## THIGH BANDAGING SUPPLIES

- Stockinette TG (L&R): 9, K1, K2
- Isoband (Jobst)/Idealbinde (L&R): 15 cm
- Short-stretch: 12 cm
- Cast padding
- Rosidal Soft (L&R)/CompriFoam (Jobst): 12-15 cm



## VIDEO RESOURCE

Get access to videos on how to perform MLD and basic bandaging techniques for UE and LE orthopedic edemas at:

[klosetraining.com/klose-training-graduates/](http://klosetraining.com/klose-training-graduates/)

Select: Orthopedic Swelling Solutions Course

PW: OSSlabtechniques (case sensitive)



## ADAPTIVE EQUIPMENT AIDS



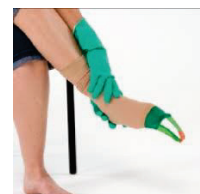
Slippee Gator (Juzo)



Sock-eez



Magnide (Arion)



Easy Slide (Arion)

