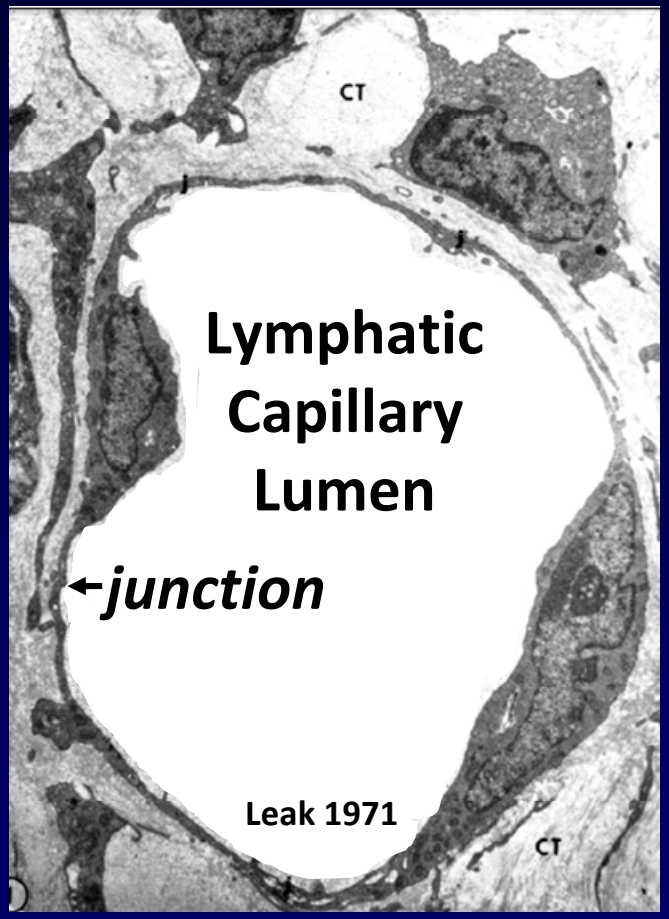
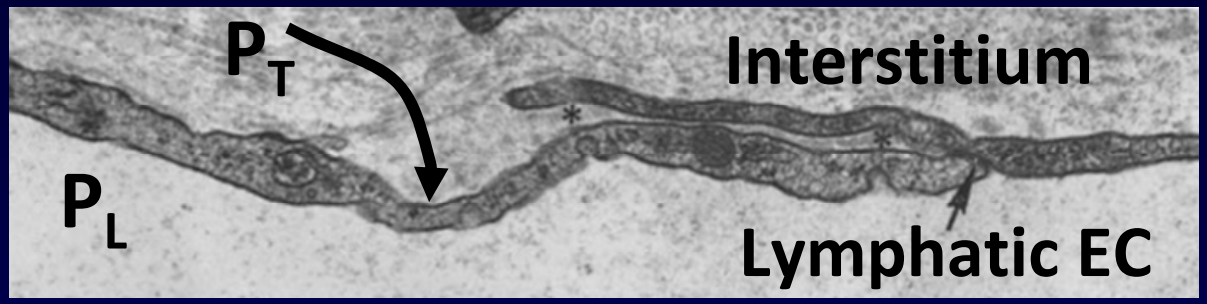
IPC Use in Lymphedema: Physiological Considerations

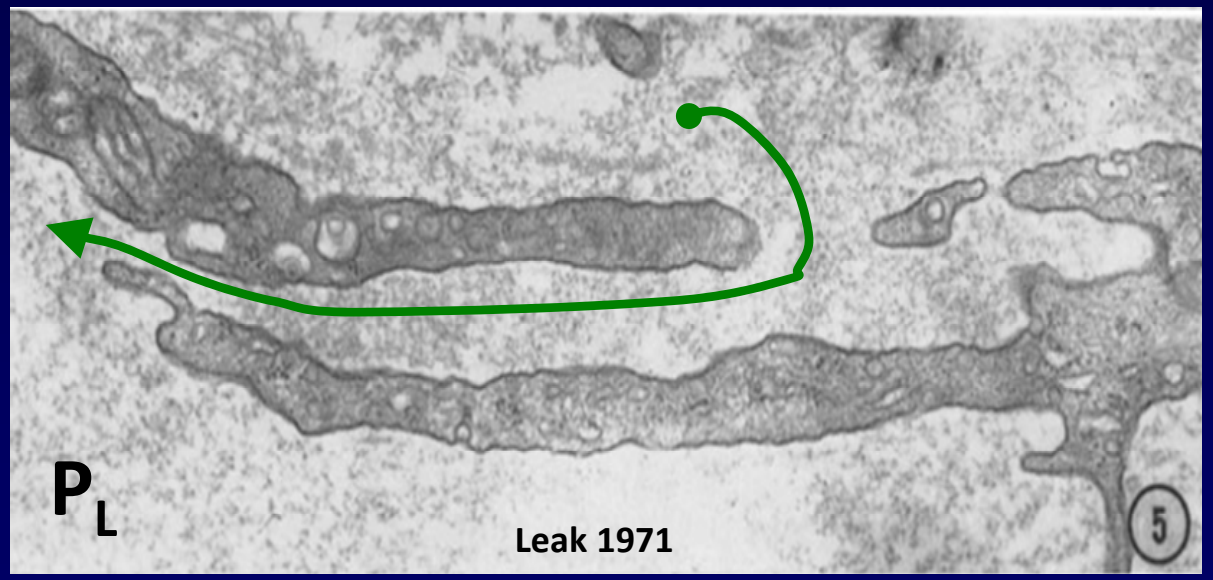
Harvey N. Mayrovitz PhD, Professor of Physiology
College of Medical Sciences, Nova Southeastern University
Ft. Lauderdale Florida mayrovit@nova.edu
ICC meeting Boston 9/8/2013

Brief Excursion into Normal Physiological Process Consideration

Capillary → Tissue → Lymph Capillary







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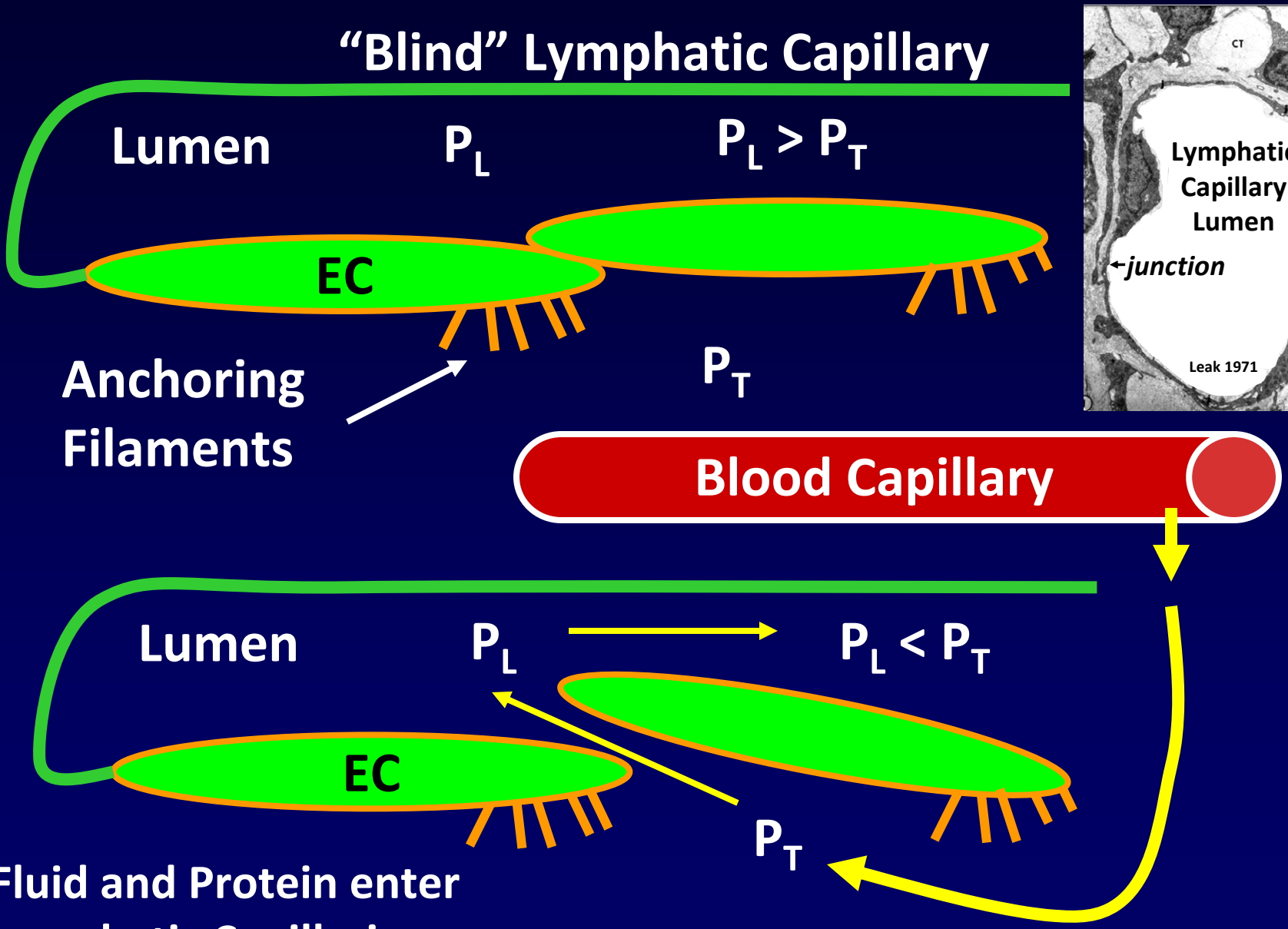
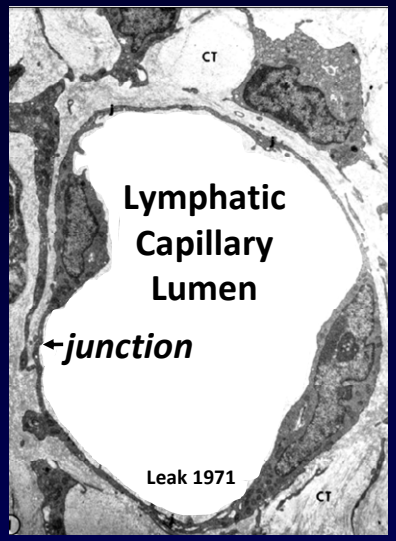
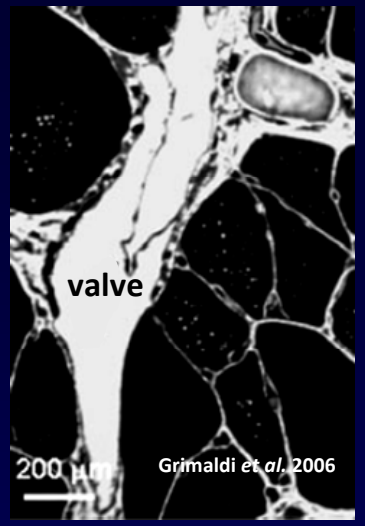
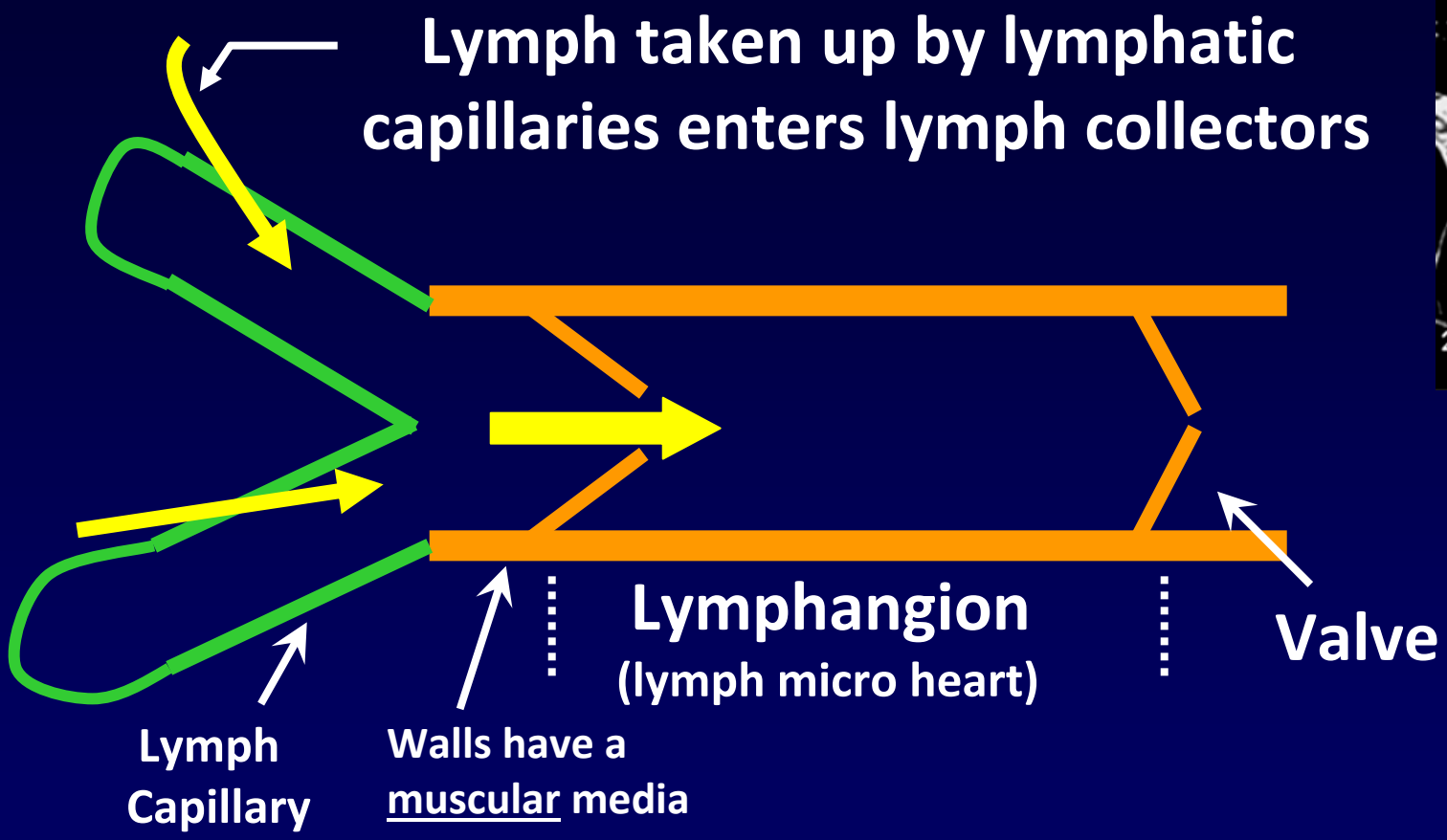




Collection → Propulsion





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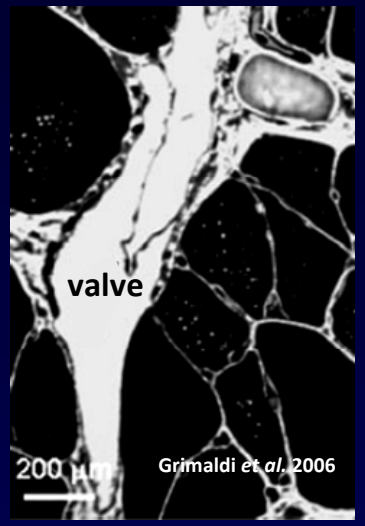
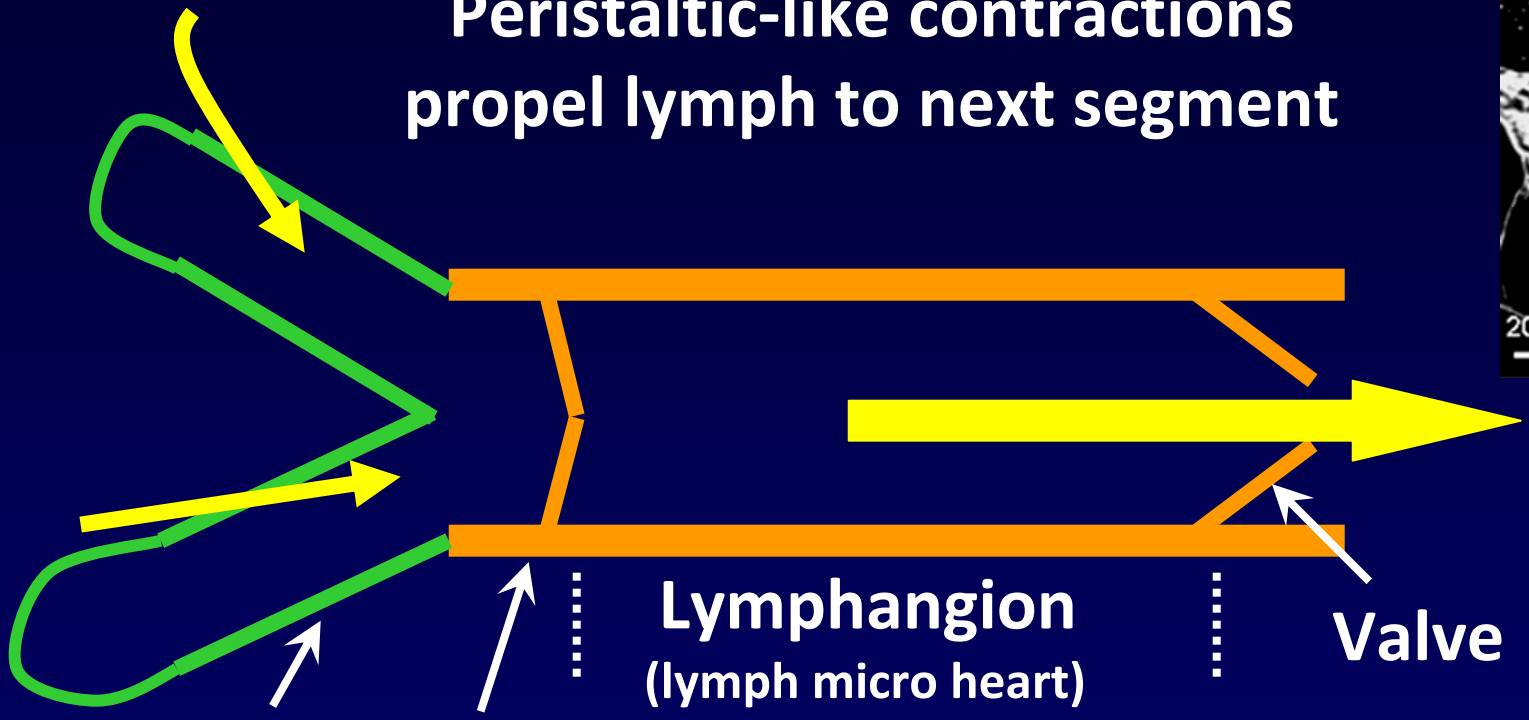


Peristaltic-like contractions propel lymph to next segment



Lymphangion
(lymph micro heart)

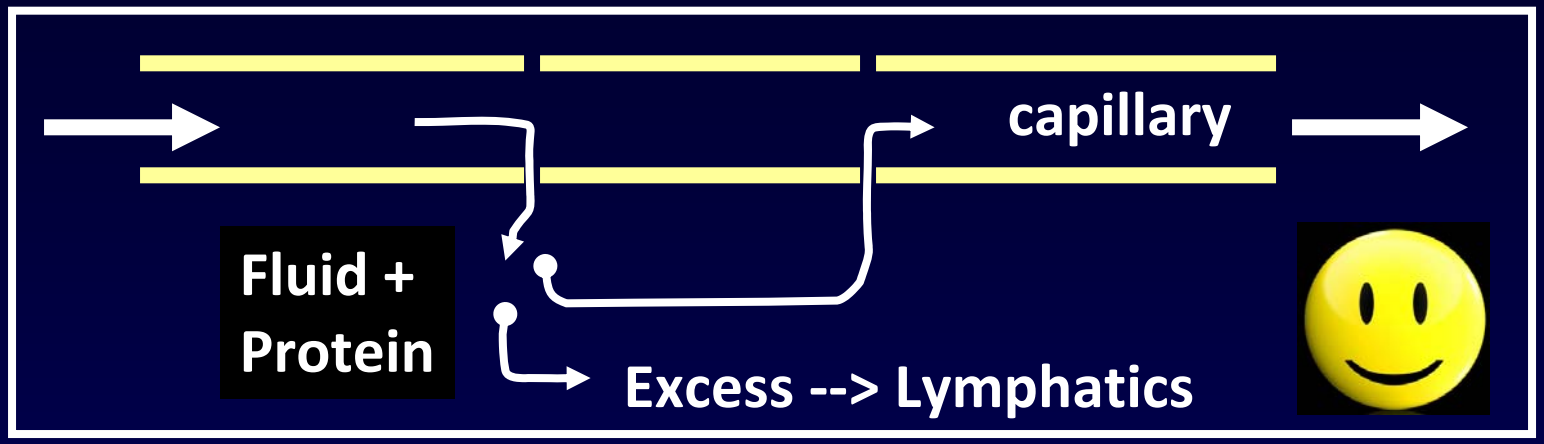
Valve

Lymph Capillary

Walls have a muscular media

Contraction force & frequency is preload & afterload dependent - analogous to heart

Normal Lymphatic Function



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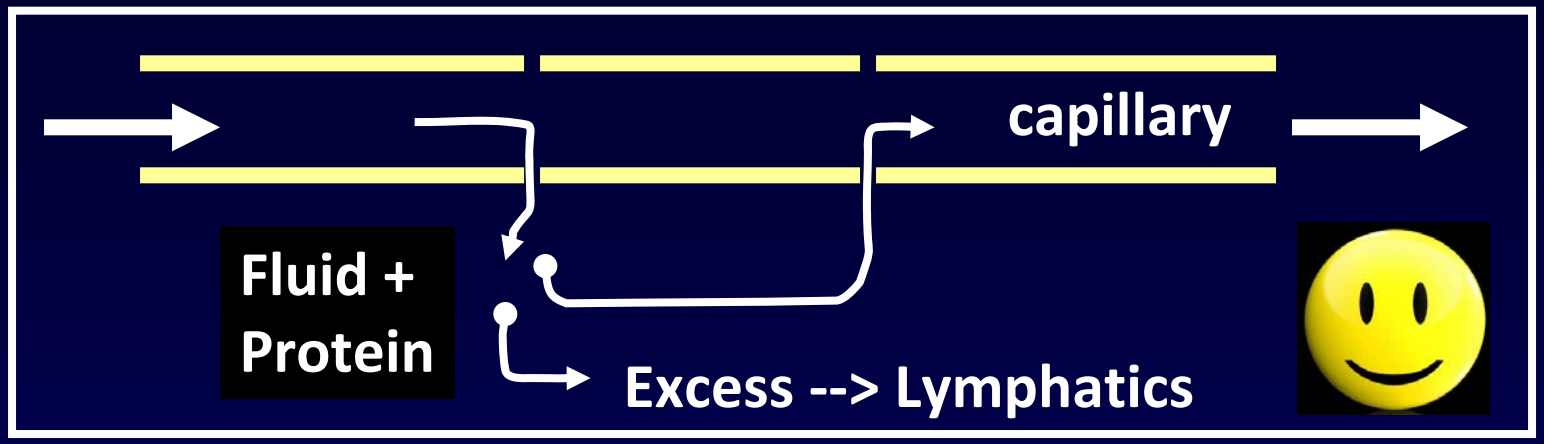
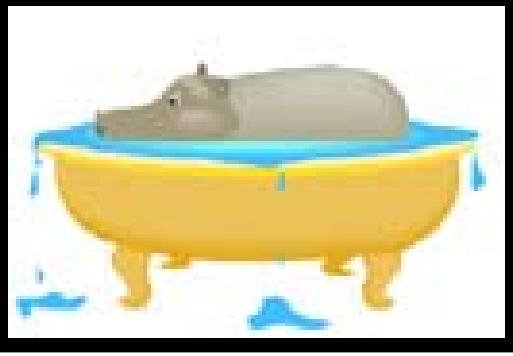


If Net Filtration Exceeds Lymphatic Transport Capacity

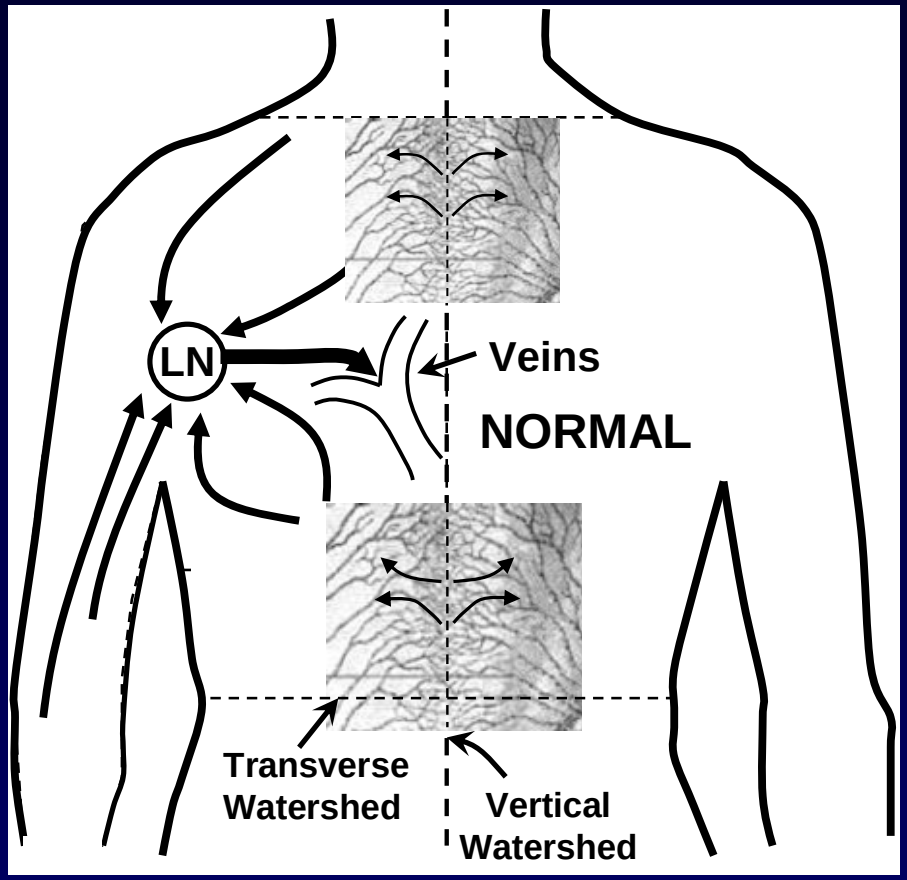
Overload = Edema

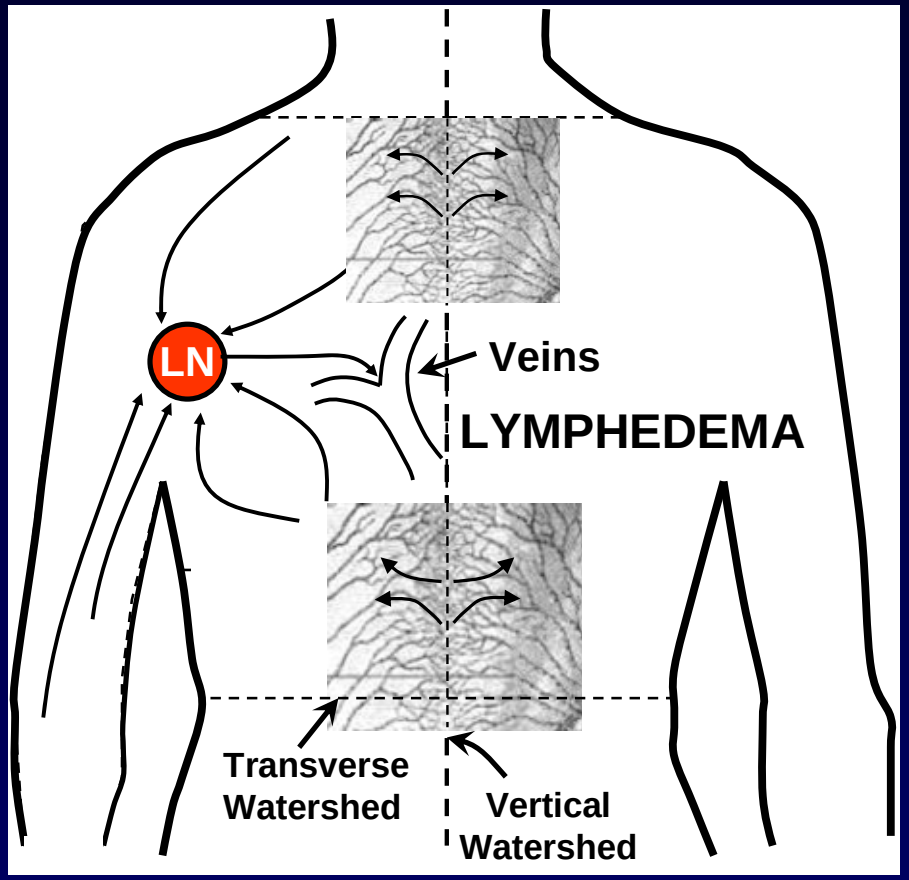


+ [Protein]

= Lymphedema

Lymphatic Drainage Pathways



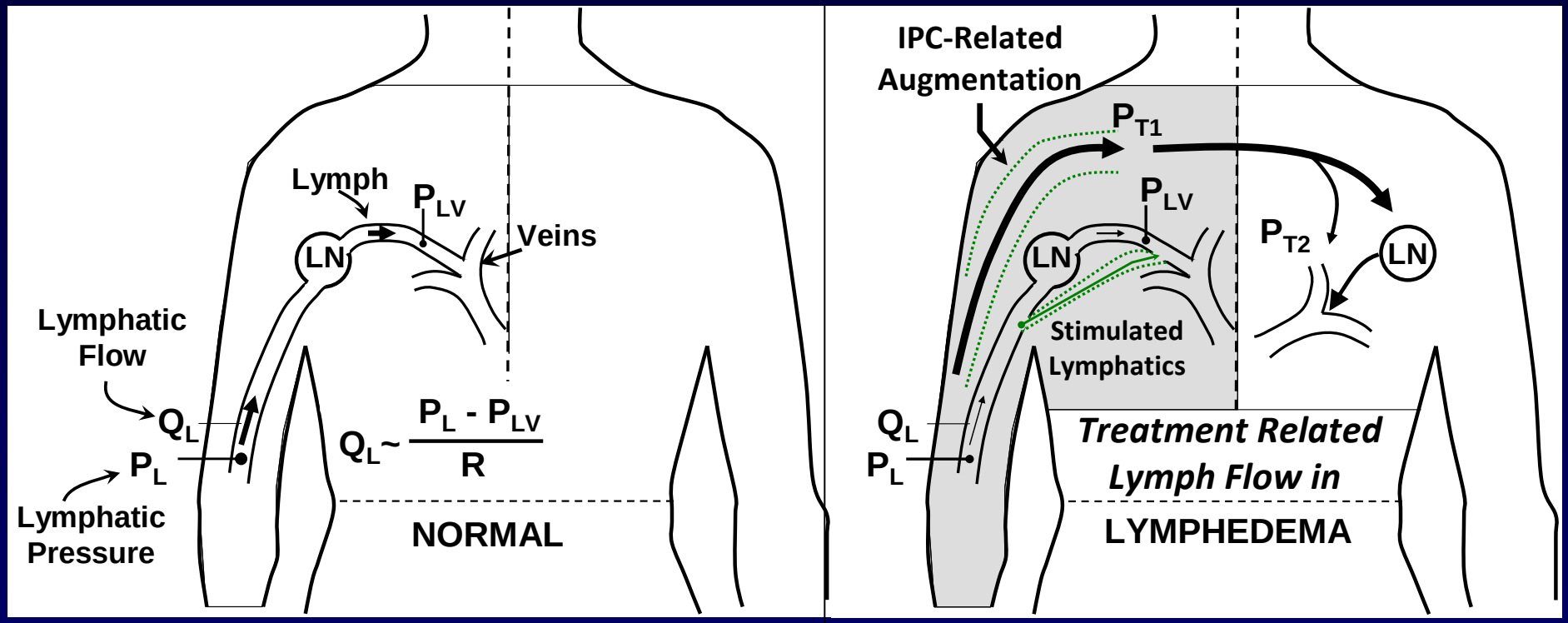


Lymph flow and drainage determined by normal physiological processes and lymphatic pathways

Lymph flow through normal ***pathways reduced or absent*** due to node or lymph vessel obstruction or dysfunction

Therapeutic Strategy

Use Alternate Pathways – Stimulate Lymphatics and Optimize Conditions for IPC related pumping



Lymph flow depends on pathway pressure gradient and resistance

Adjunctive IPC Lymphedema Therapy

ROLE

Phase I → Component of in-clinic therapy

Phase II → At-home maintenance therapy

TYPES

Basic: Few Adjustments – Not Programmable

Advanced: Calibrated-Sequential-Programmable

- With Truncal Clearance Capability
- No Truncal Clearance Capability

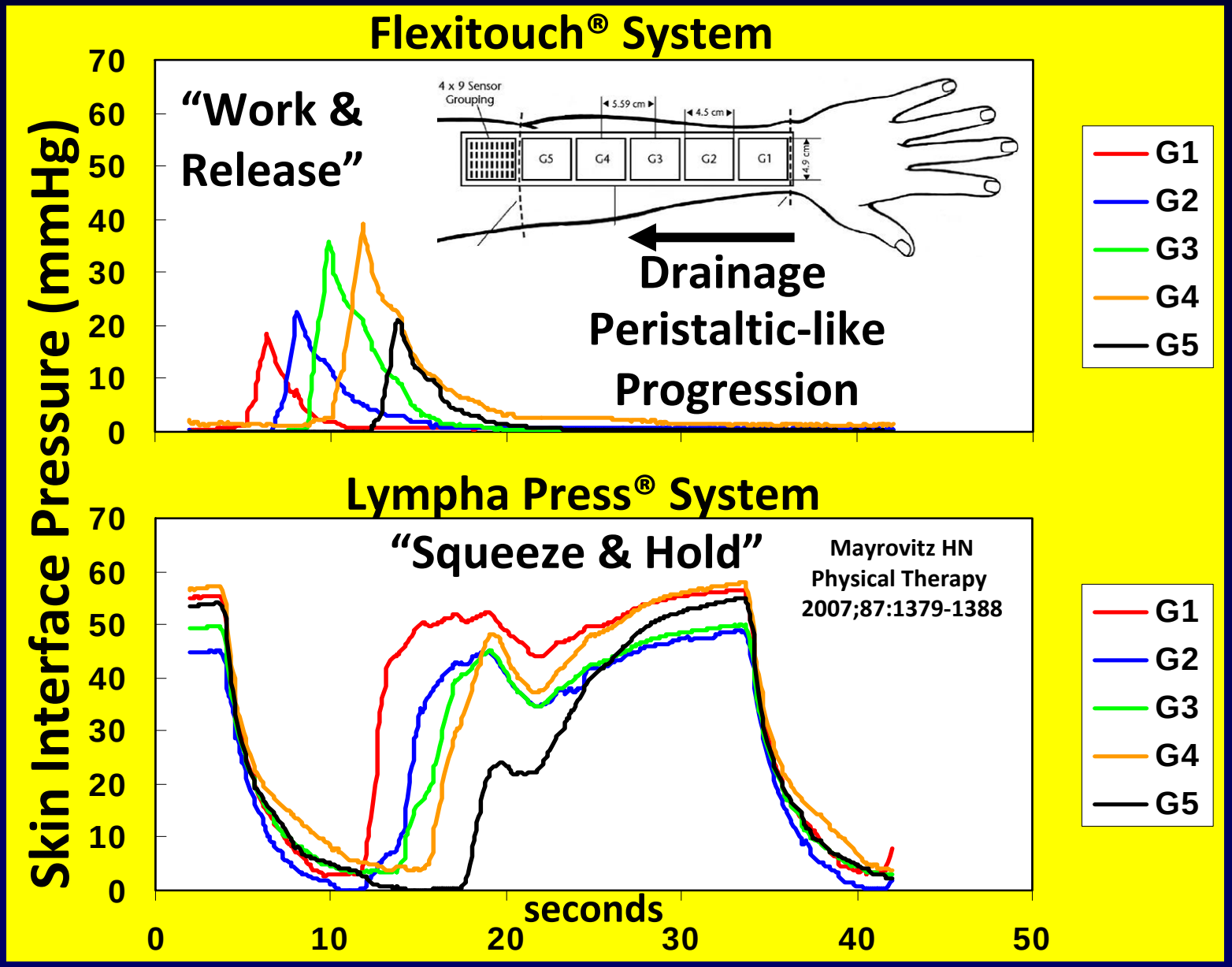
Physiological Considerations

IPC Compression

- **Pattern**
- **Progression**
- **Pressure**

Not independent considerations

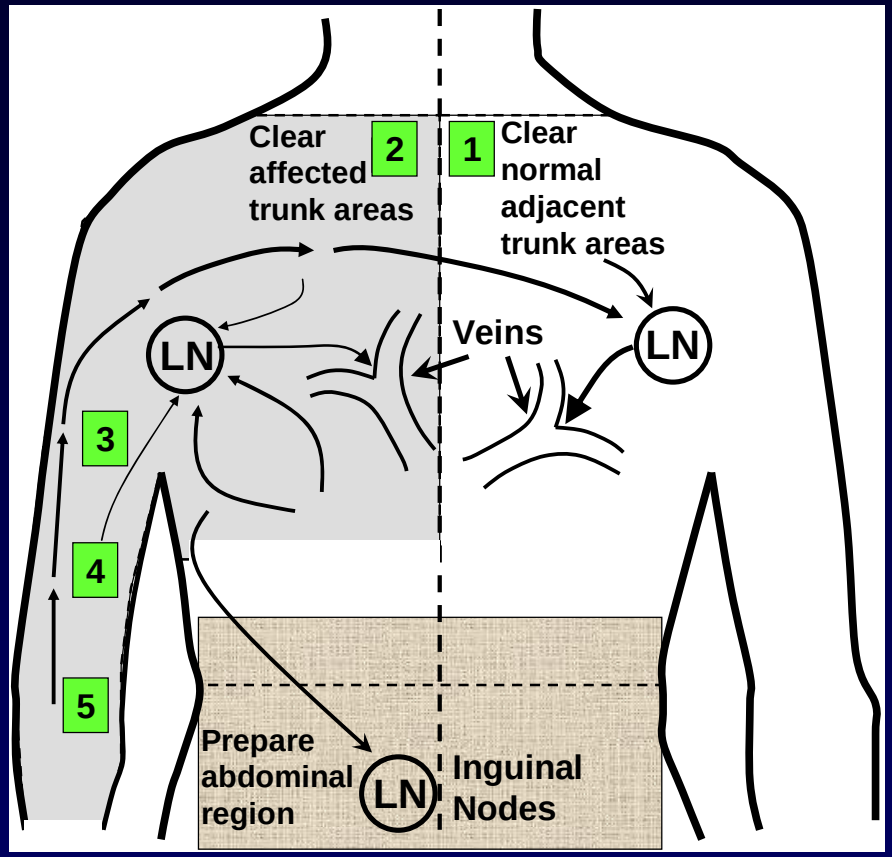
Compression Pattern Examples



Physiological Considerations

- ✓ Proximal/Central clearance *prior to* forward propulsion
- ✓ Distal → Central progressive propulsion

Advanced IPC Progression Approach

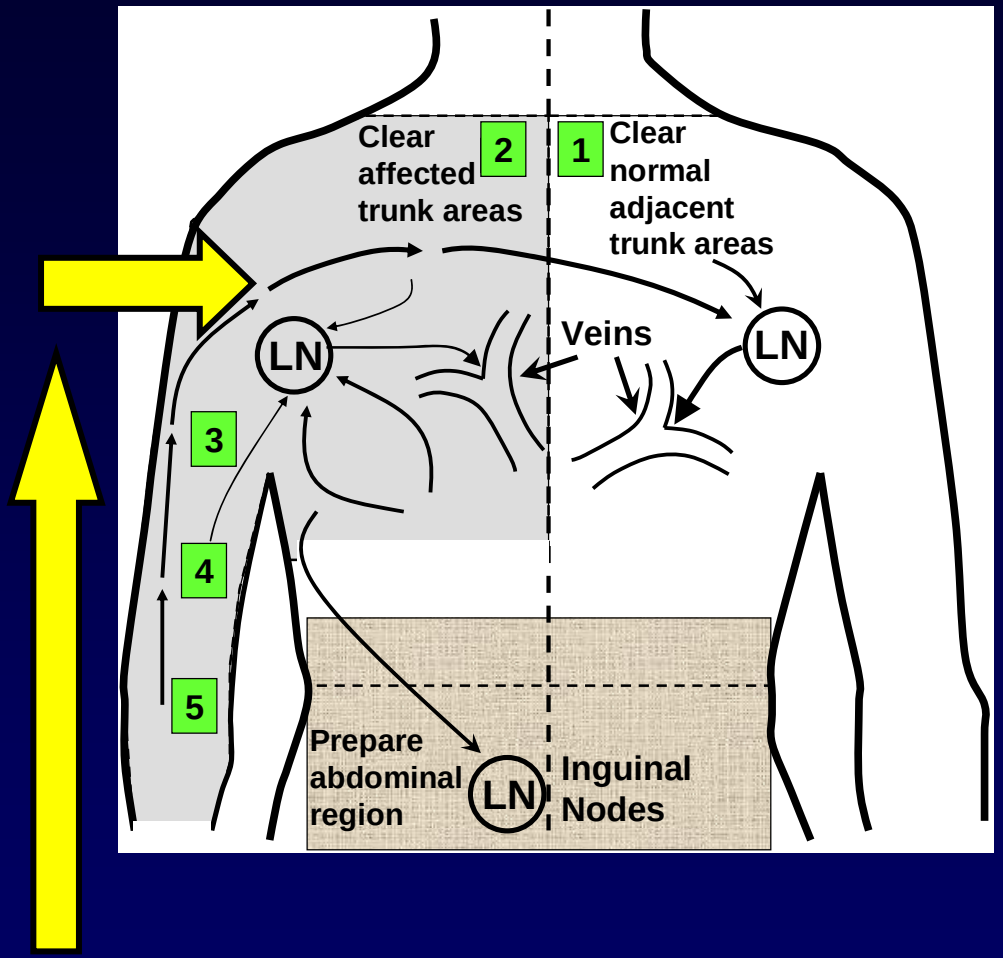


A. First sequentially treat lymph receiving regions (1→5) to optimize gradient and minimize resistance for subsequent limb drainage procedures

Mayrovitz et al. Home Health Care Management & Practice 2009;21(5) 325-337

Hammond & Mayrovitz Home Health Care Management & Practice 2010;22(6) 397-402

Advanced IPC Progression Approach



B. Then progressive treatment of limb and trunk with suitable pump pressure starting at the most peripheral region (5 → 1)

Physiological Considerations

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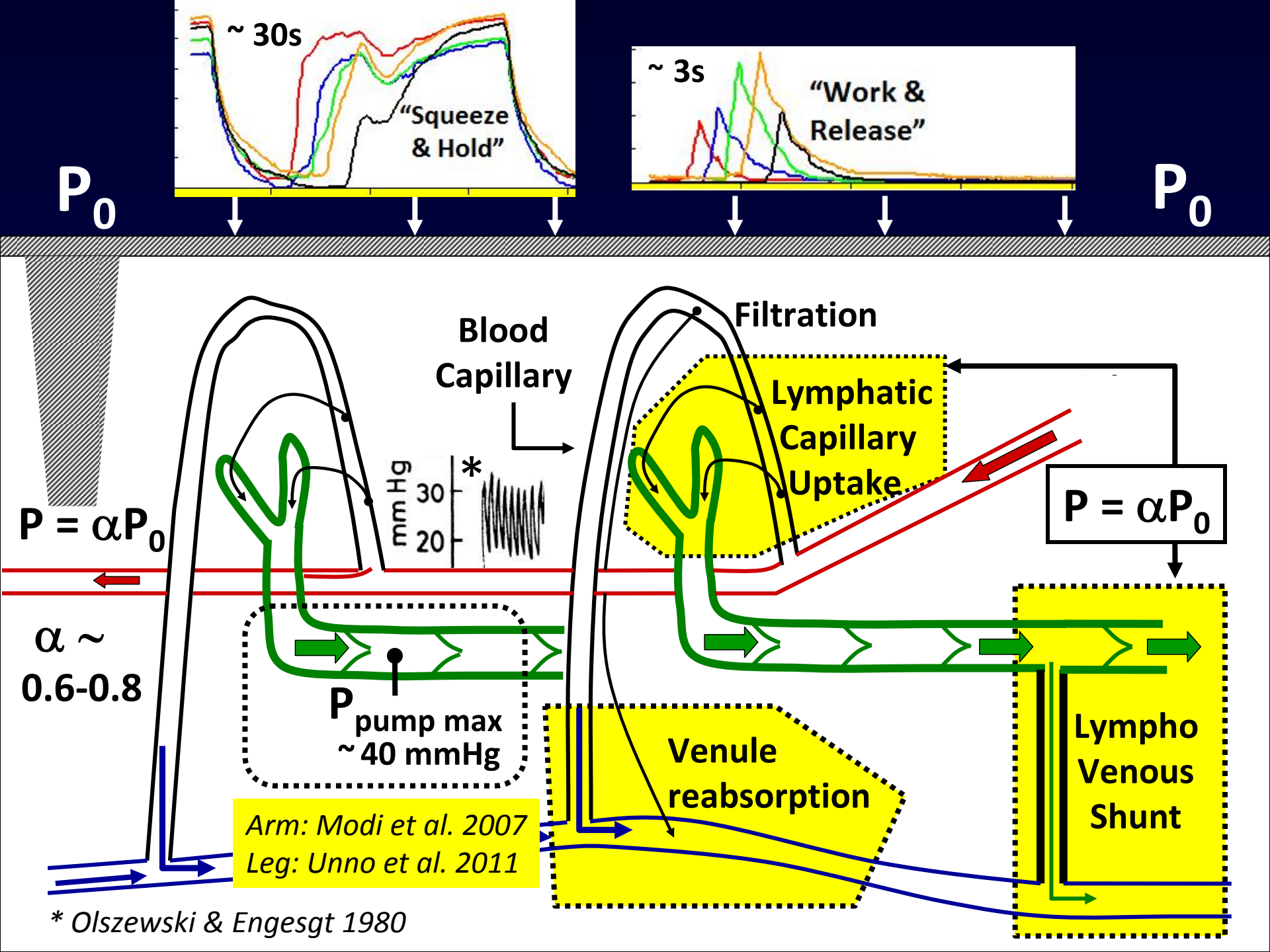
with *minimal inhibition* of:

- Distal lymphatic capillary interstitial fluid uptake
- Lympho-venous flow

Pattern Considerations


~ 30s
"Squeeze & Hold"
~ 3s
"Work & Release"
P_0
P_0
Blood Capillary
Filtration
Lymphatic Capillary Uptake
$P = \alpha P_0$
$P = \alpha P_0$
mm Hg
30
20
*
α ~ 0.6-0.8
$P_{pump\ max}$ ~ 40 mmHg
Venule reabsorption
Lympho Venous Shunt
Arm: Modi et al. 2007
Leg: Unno et al. 2011
* Olszewski & Engesgt 1980

Pressure Considerations

Lower Pressure vs. Higher Pressure

Lower Pressures

- Facilitate lymph movement in functioning lymphatics
- Minimize inhibition of lymph filling during compression
- Minimize potential injury due to higher pressures
- Provide a comfortable treatment experience for patients

Higher Pressures

- Facilitate directional interstitial fluid movement especially if low interstitial hydraulic conductance

Summary View

IPC use in lymphedema should be consistent with Physiological considerations of

- *Initial Central Clearance*
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Using Compression Pressures and Patterns that during compression minimally inhibit

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- *lymphatic intrinsic active pumping*
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Using Compression Pressures and Patterns that during compression minimally inhibit

- *lymph capillary uptake*
- *lymphatic intrinsic active pumping*
- *lymph – venous uptake and drainage*

And facilitate lymph vessel and tissue lymph flow via

- Impulse – like progressive compression
- arterial-lymphatic interactions that tend to occur at lower compression pressures

Examples of Some Research Study Outcomes

Research Study Outcomes

Author	Outcomes
Muluk, et al (2013) *European J of Vasc Endovasc Surg*	**Legs: Significant ↓Limb volume; significantly improved patient-reported outcomes**

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Wilburn, et al (2006) *BMC Cancer*	BCRL: Significant ↓Limb volume but no improvement with self-massage


Thanks for your Attention