

Lymphedema Research



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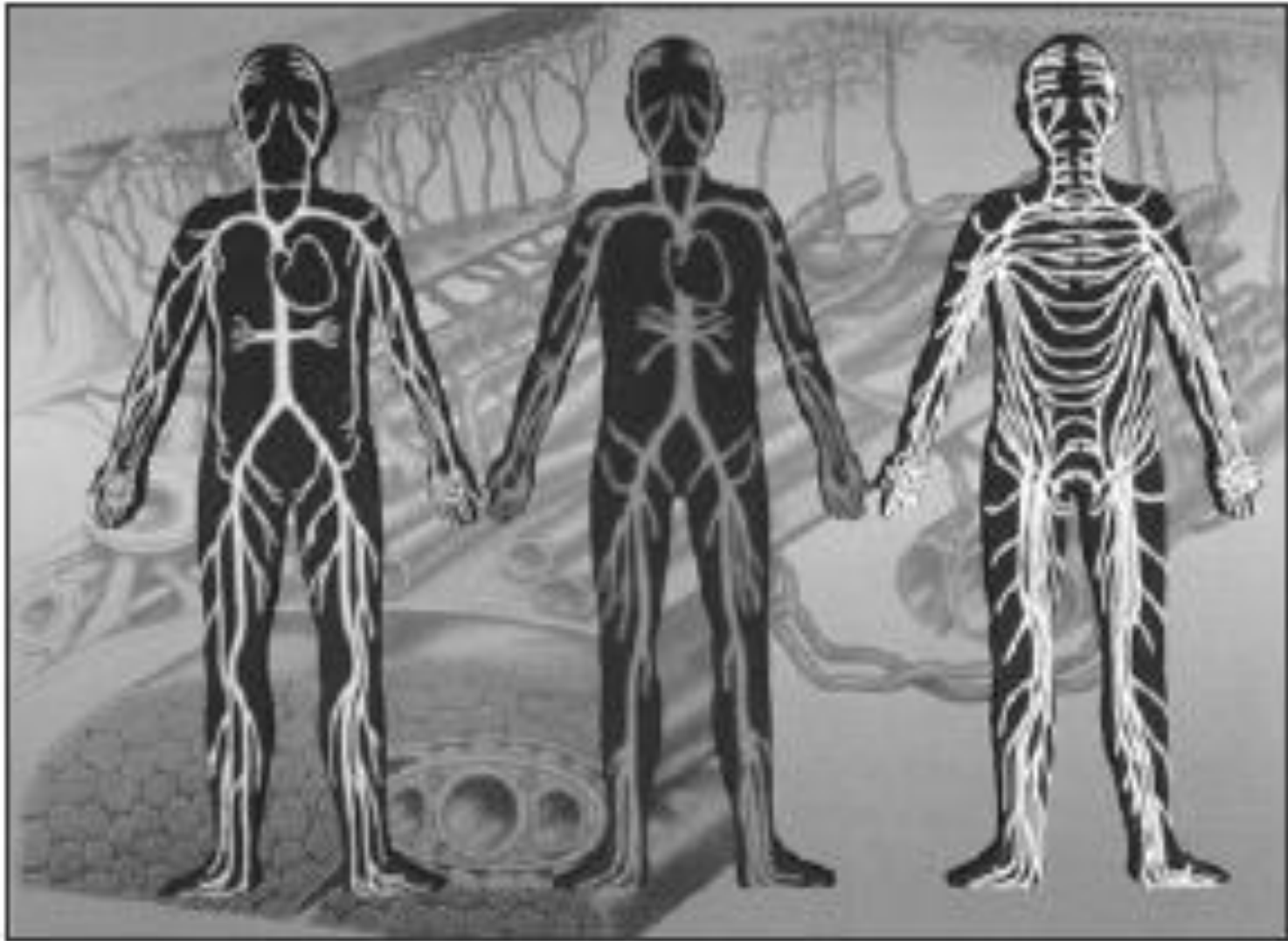
- **Lymphatic System**
- **Lymphedema**
- **Quantitative Measures**
- **Current Research Projects**

All in 20 minutes!

So



Three Circulations



Arterial

Venous

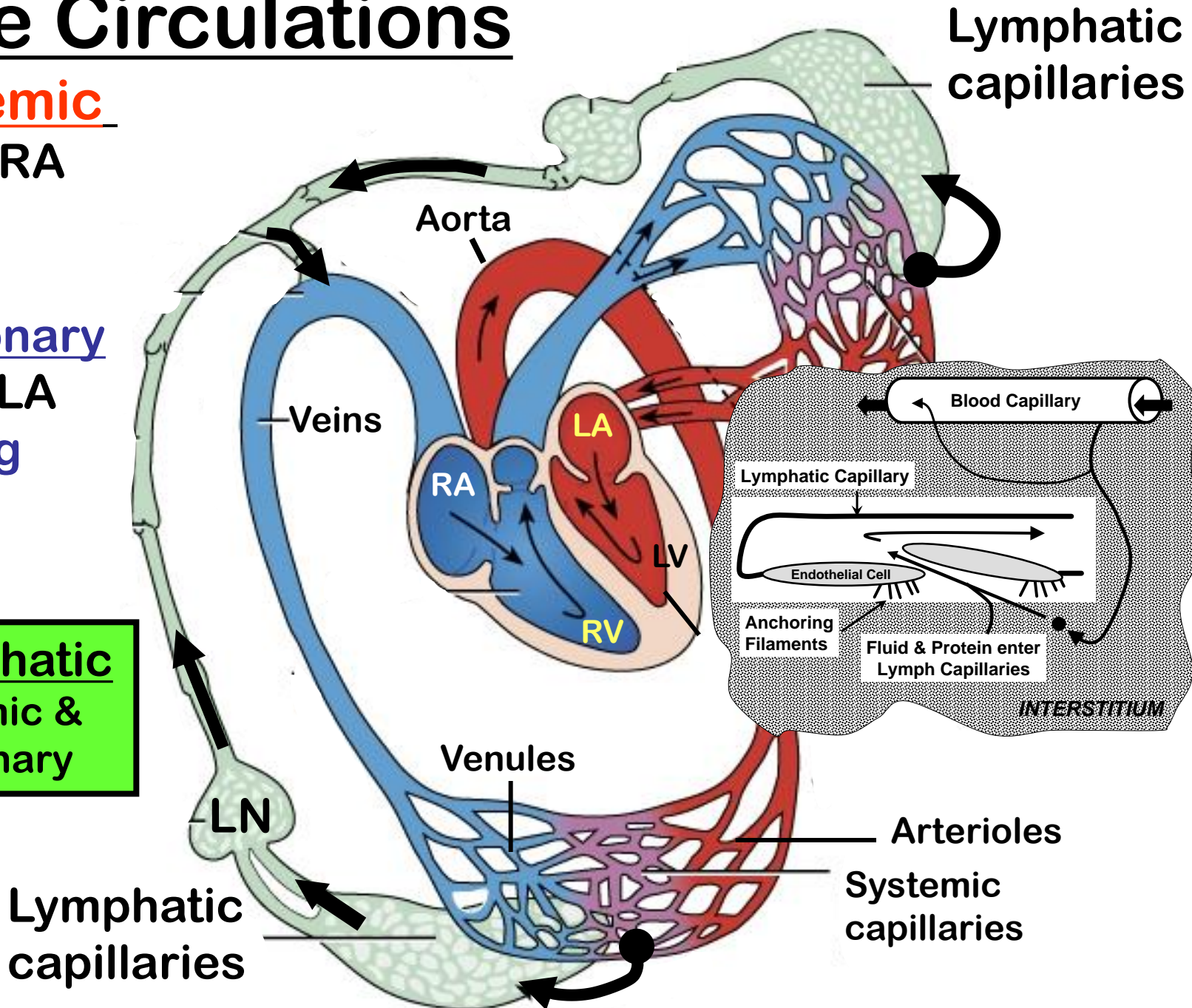
Lymphatic

Three Circulations

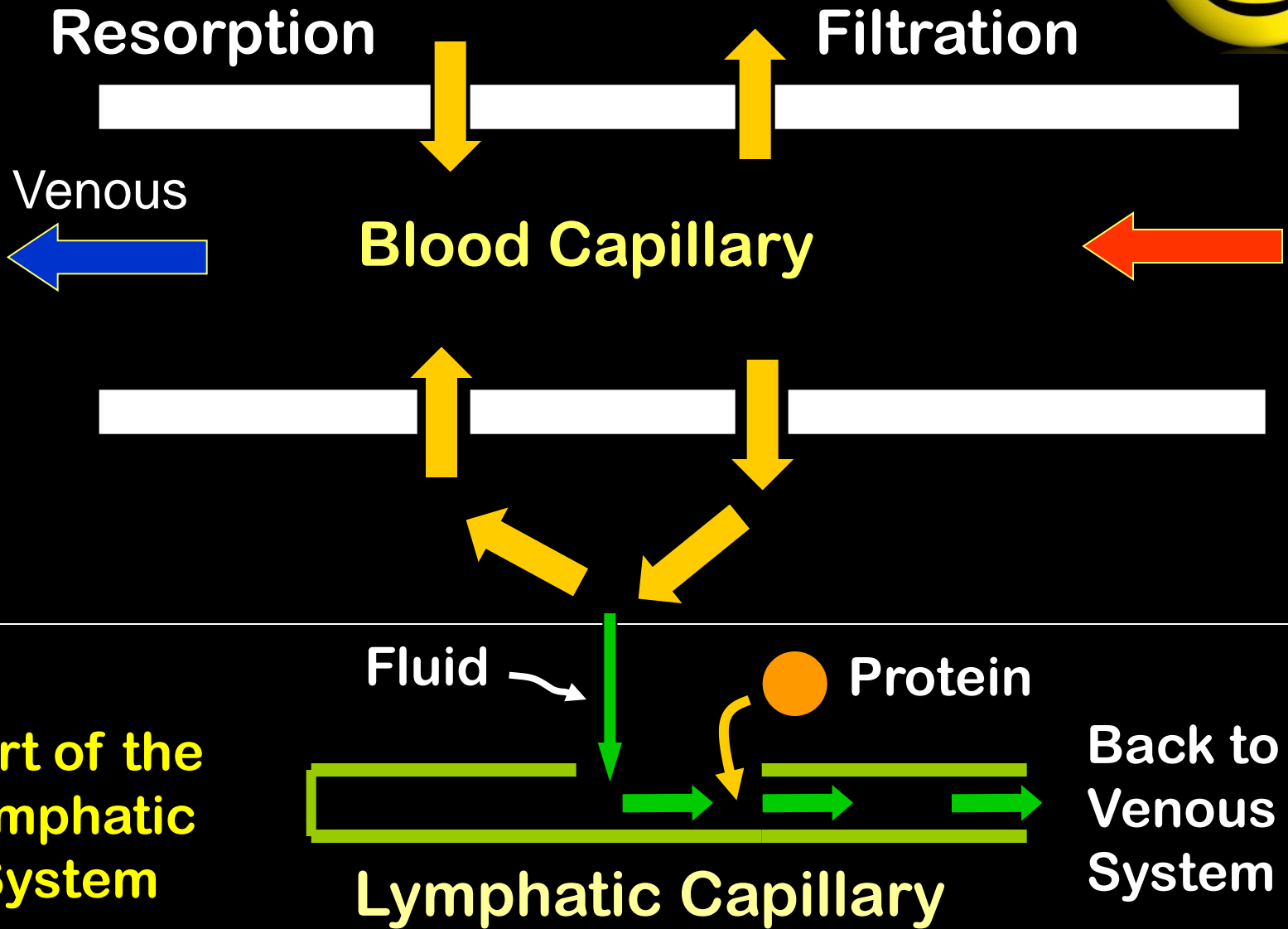
1. Systemic
LV → RA

2. Pulmonary
RV → LA
Lung

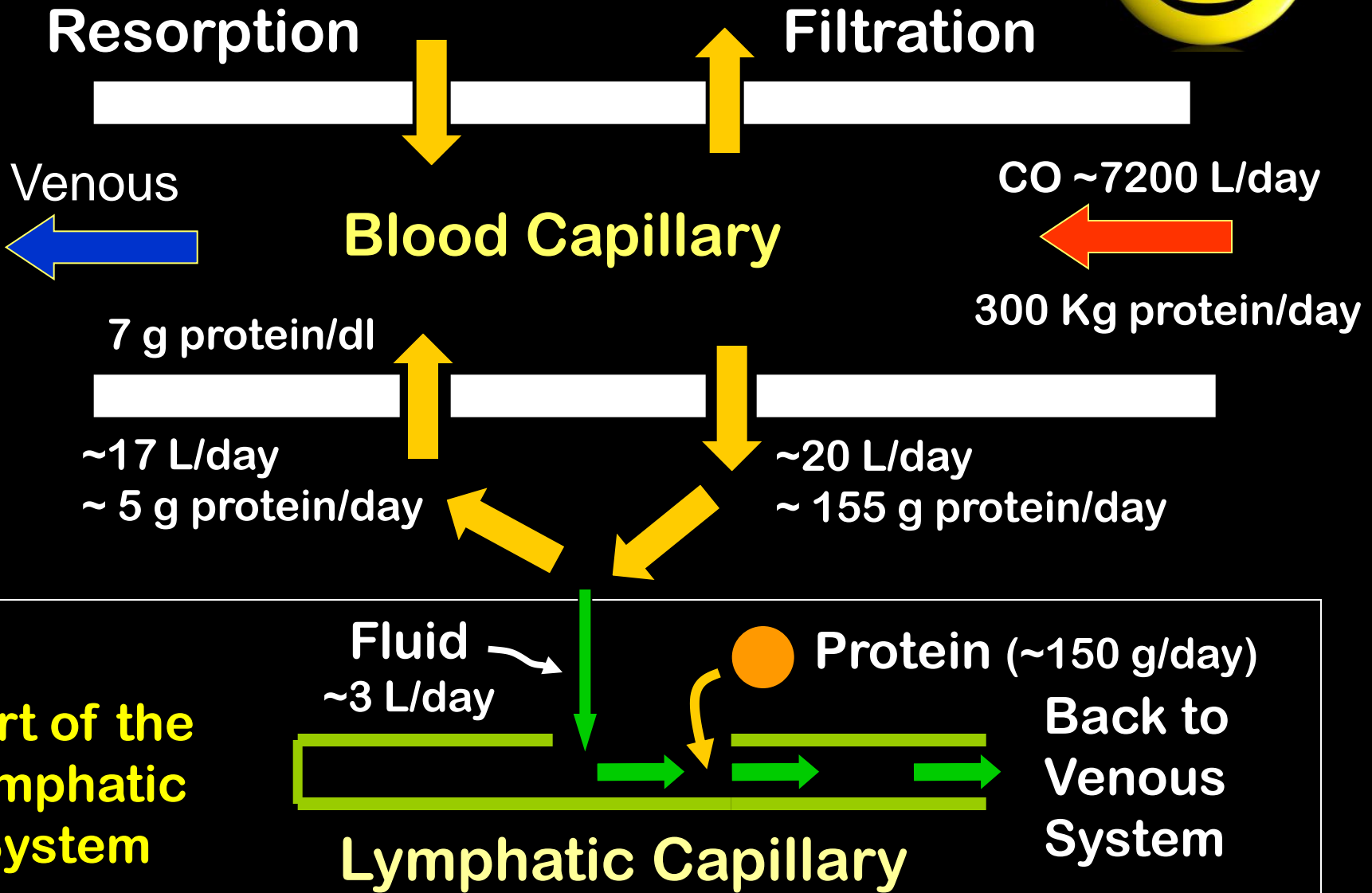
3. Lymphatic
Systemic &
Pulmonary



Normal Fluid Balance

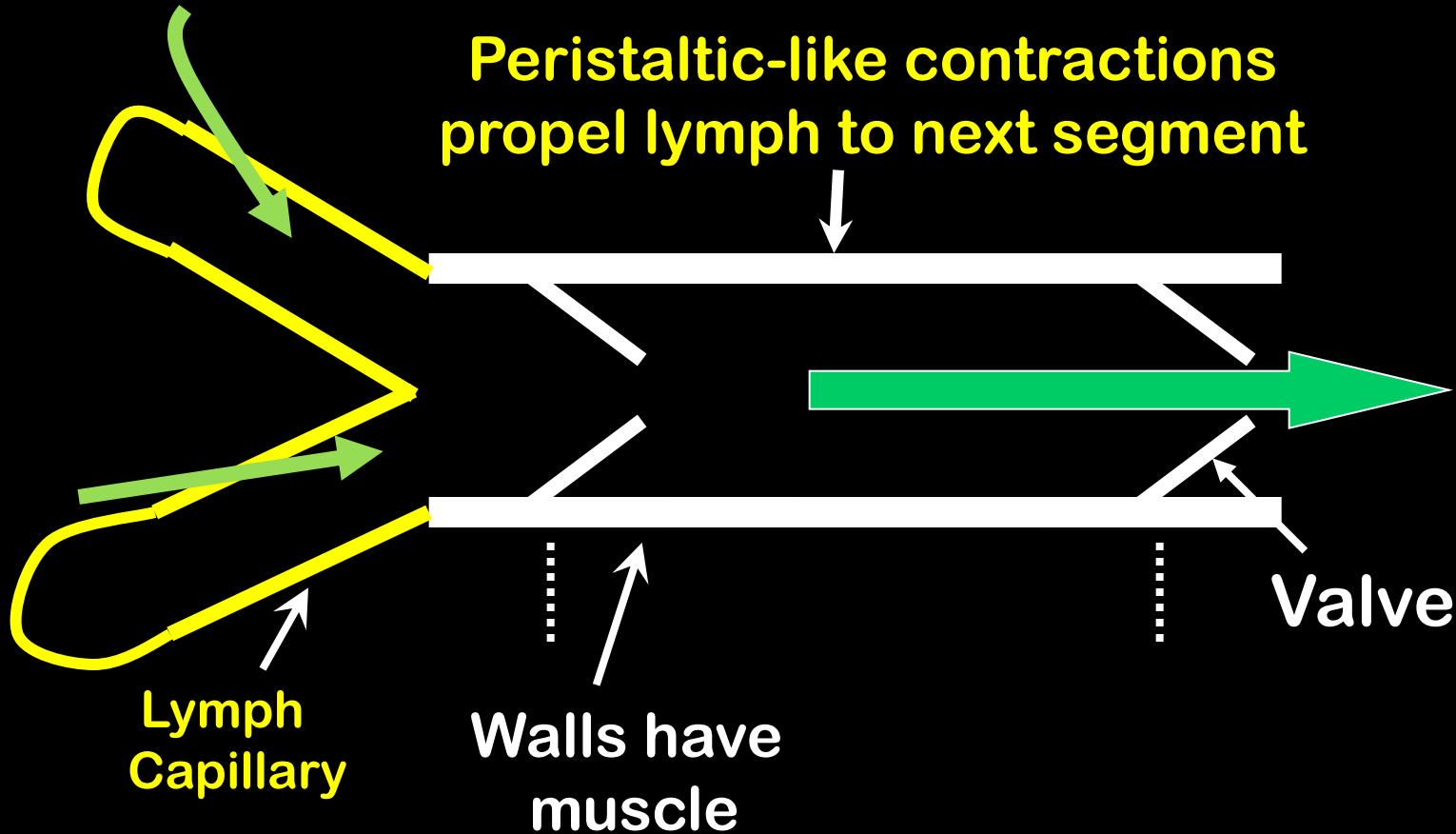


Normal Fluid Balance

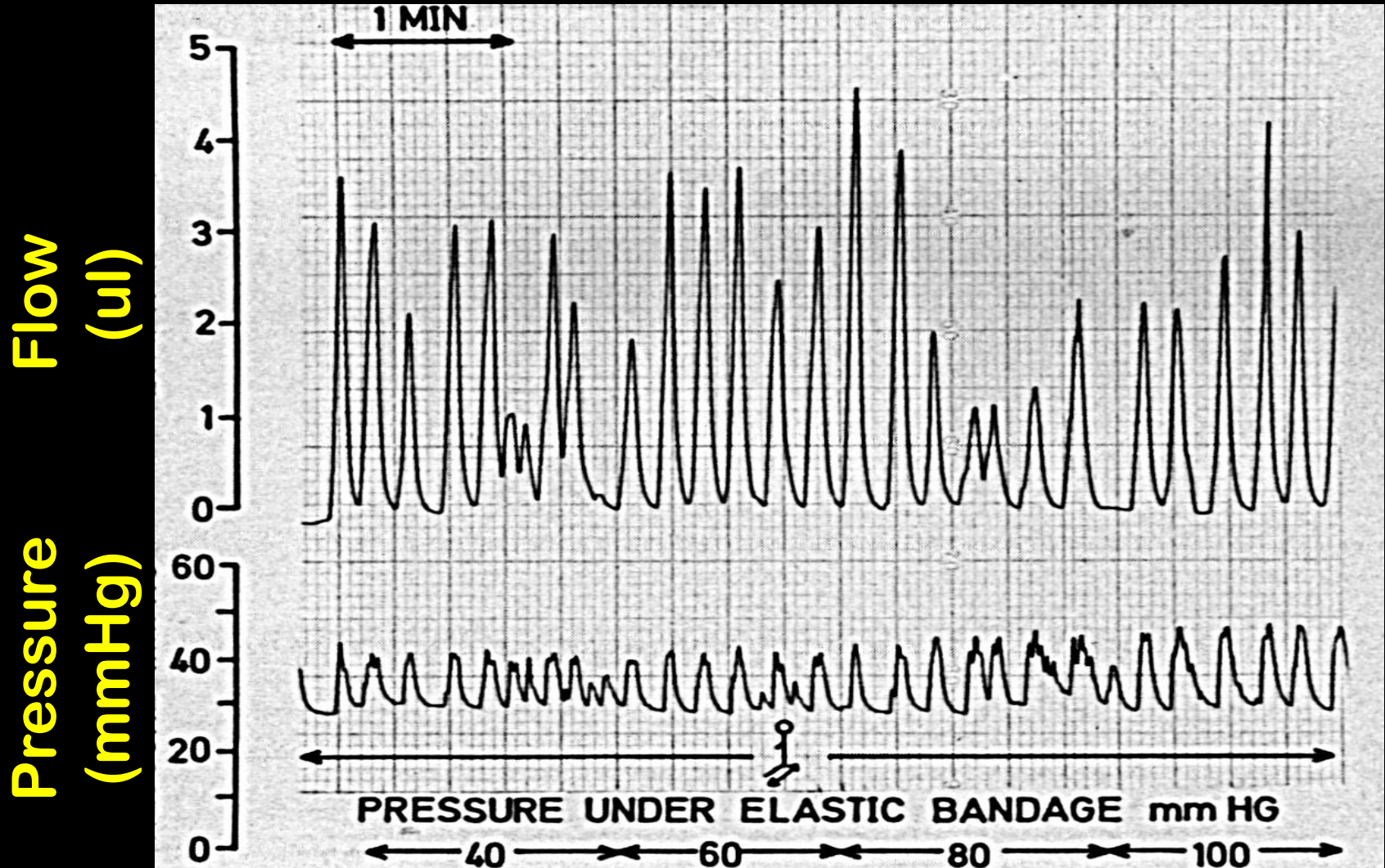


Lymphangions

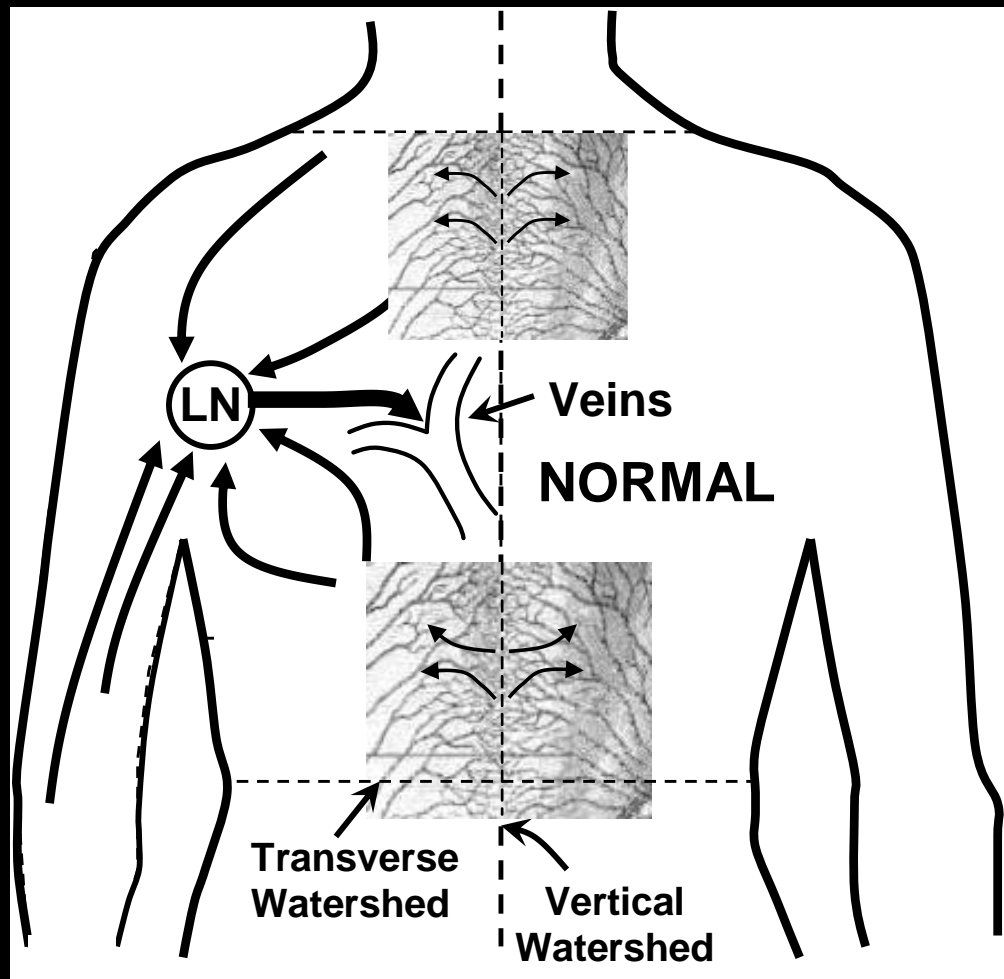
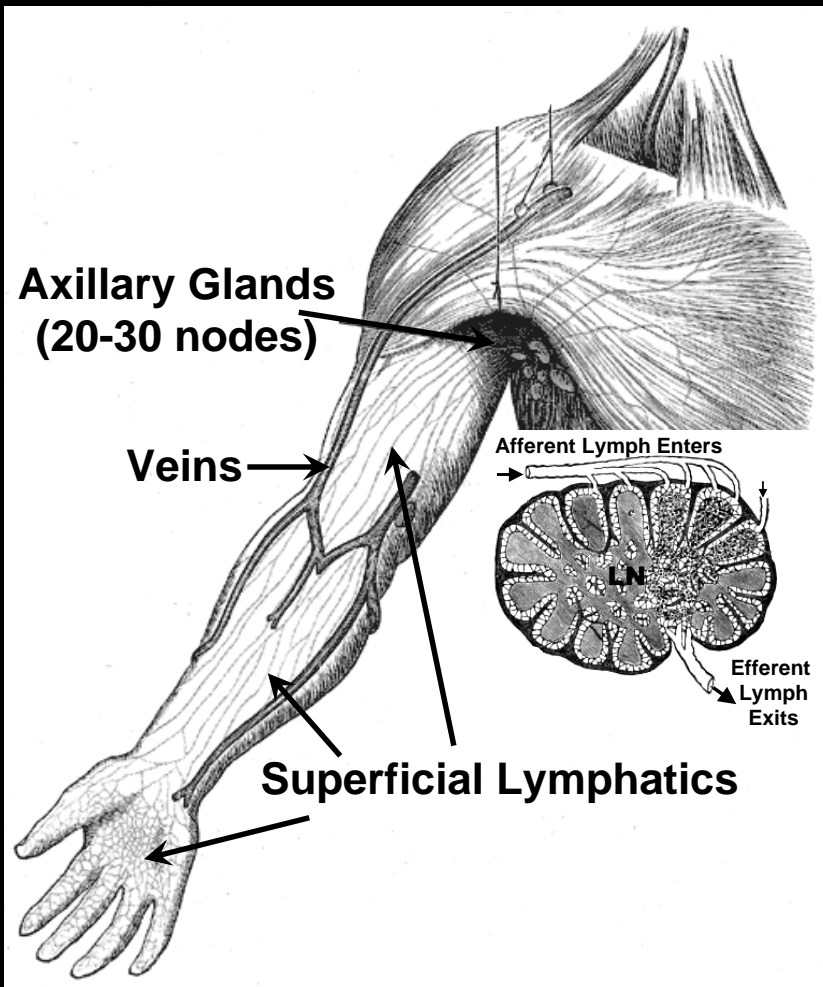
Peristaltic-like contractions
propel lymph to next segment



Effects of Muscular Contractions on lymphatic Flow and pressure

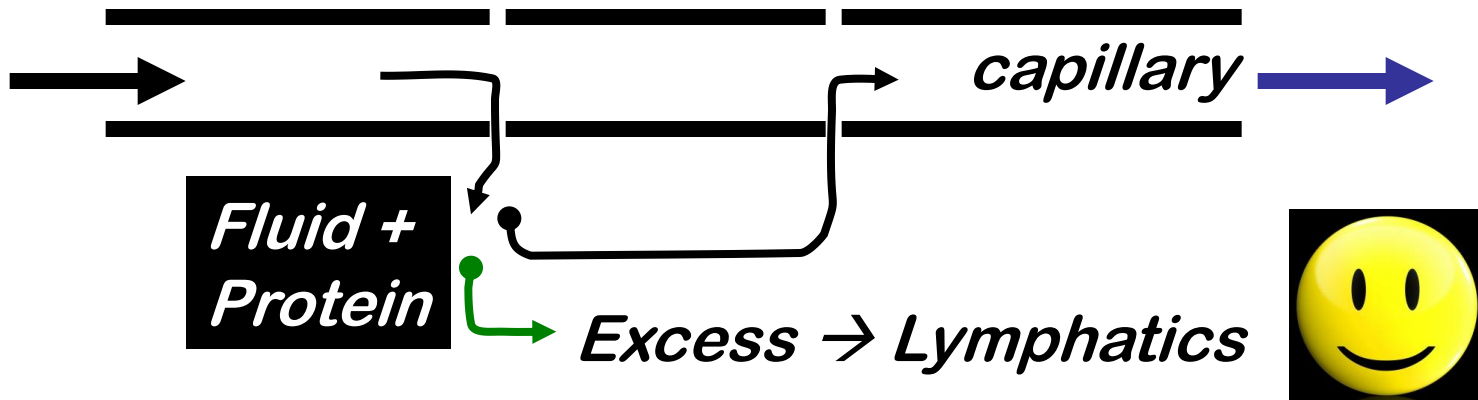


Entry/Exit to/from Lymph Nodes



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

Normal Lymphatic Function



**If Net Filtration Exceeds
Lymphatic Transport Capacity**

Overload = Edema

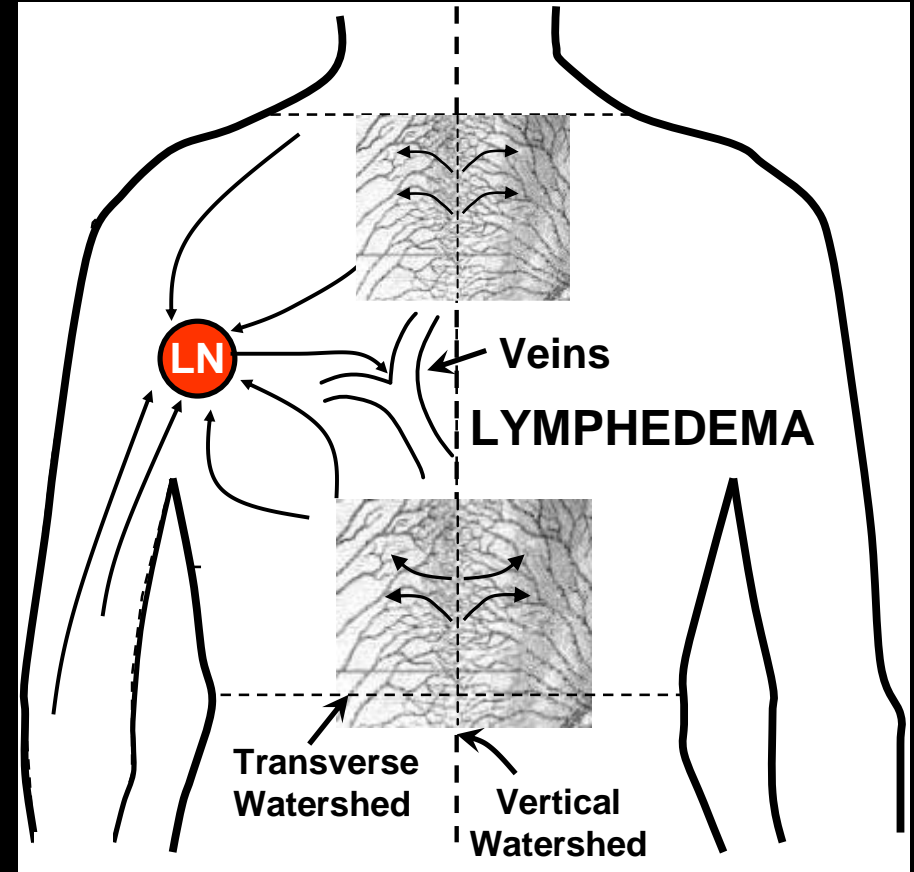
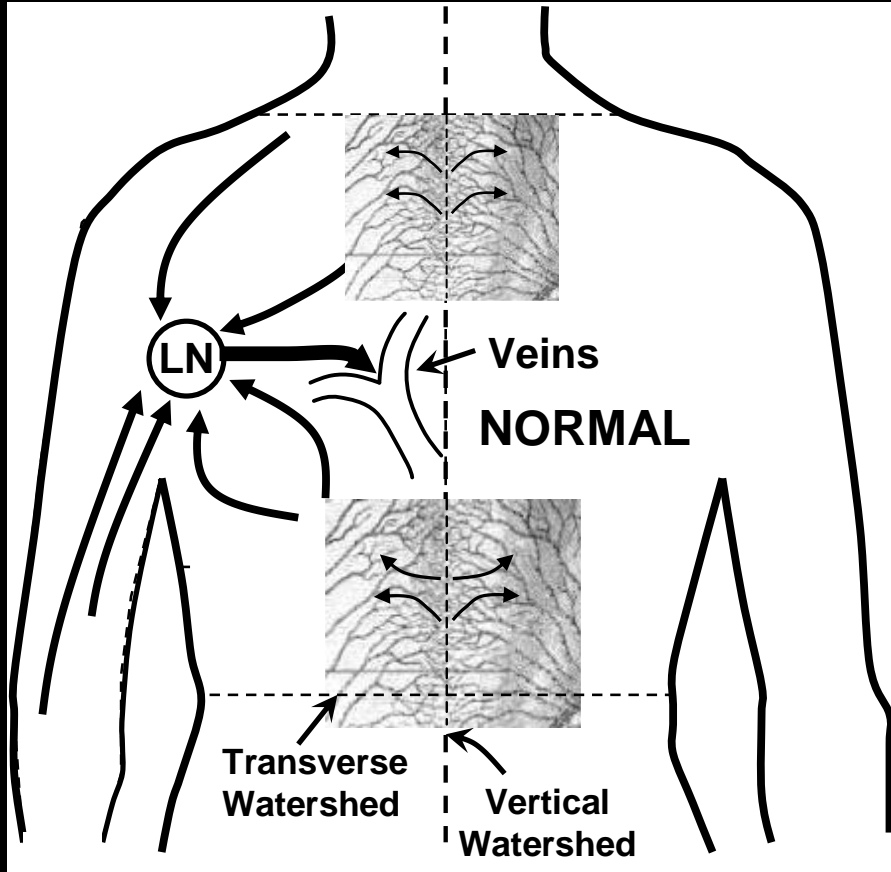


+ [Protein]



= Lymphedema

Lymphatic Drainage Diminished

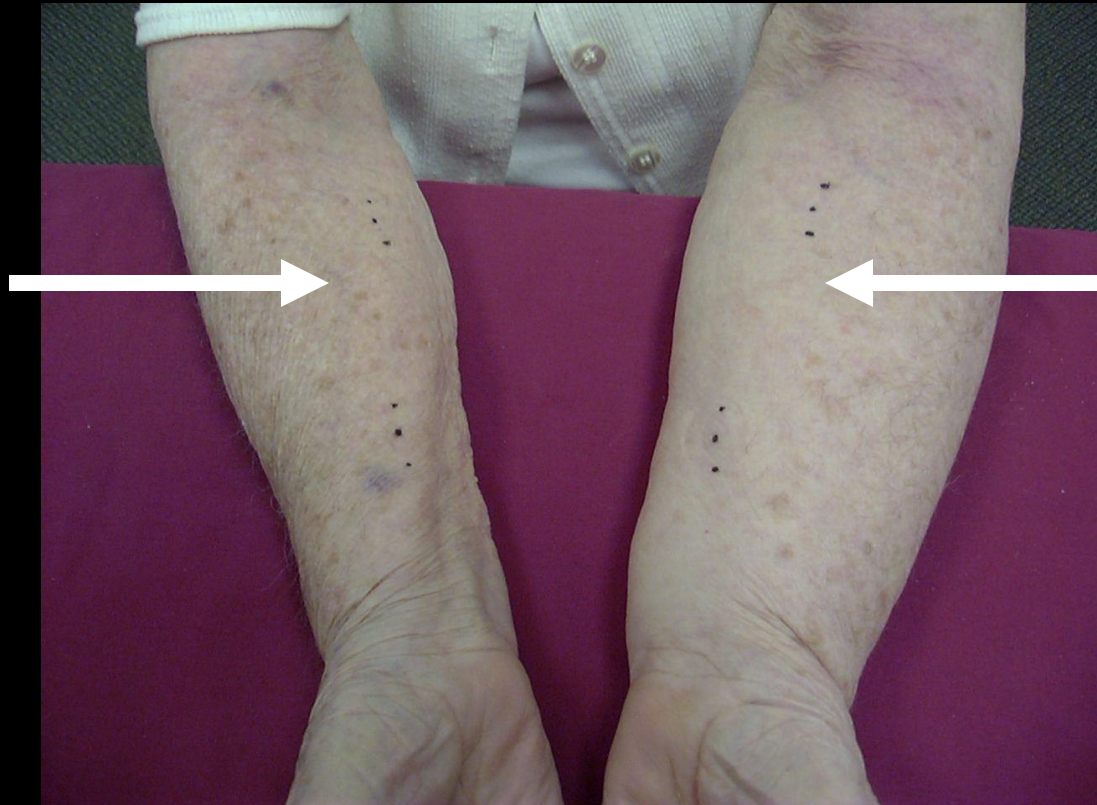


Drainage via normal physiological processes and lymphatic pathways

Drainage *reduced or absent* due to nodal or lymph vessel obstruction and dysfunction

Potential Outcome

System
Works
OK Here



System
Not OK
Here



Care Goals

- Reduce Risk



- Detect Early



- Arrest &
Reduce



- Maintain Gains
- Complications

Care Goals

Related Research

• Reduce Risk



• Surgical Issues
• Patient Education



• Detect Early



• Pre-surgery biophysical test
• Periodic sequential follow-up
• Self recognition of symptoms



• Arrest &
Reduce



• Intense Decongestive Therapy
• Tissue Fibrosis (LLLT)

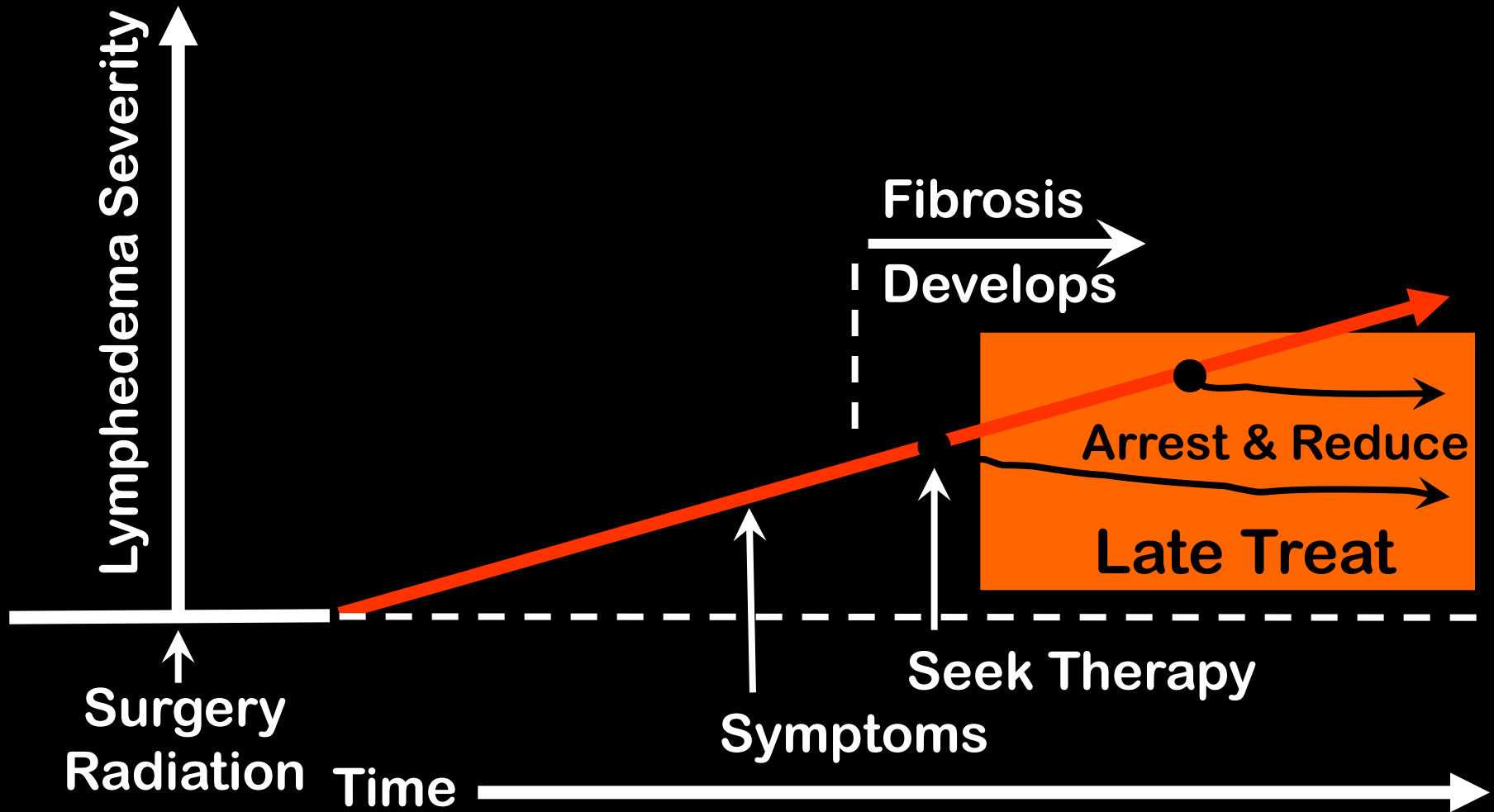


• Maintain Gains
- Complications

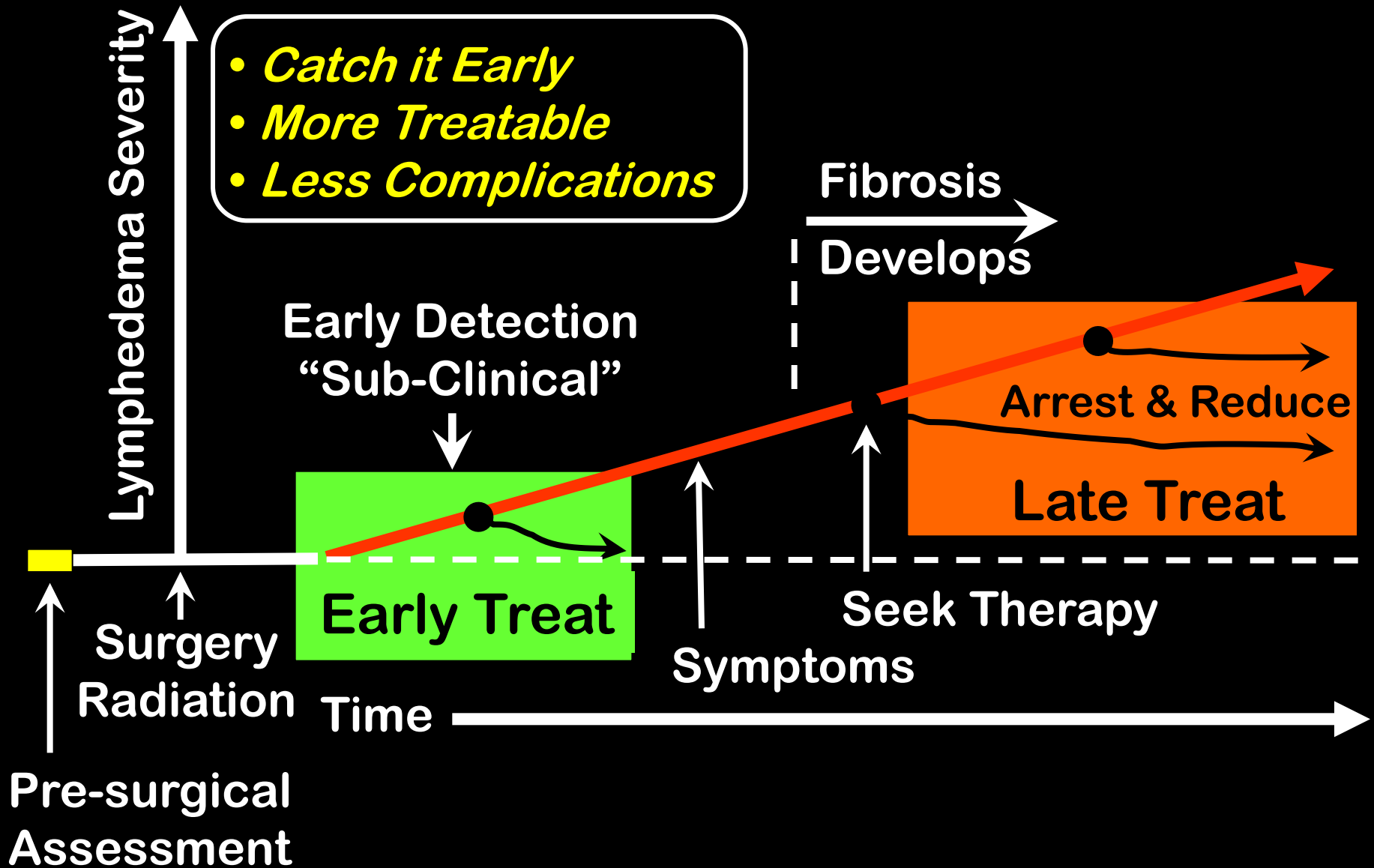


IPC Therapy Optimization
Flexitouch System

Worsens Without Treatment



Worsens Without Treatment



Quantitative Assessment Methods

For Early Detection and Treatment Effectiveness

- **Limb Volumes**
 - **Bioimpedance**
- } Limbs
- **Local Tissue Fluid**
 - **Tissue Properties**
- } Any At-Risk Location
(e.g. Trunk, Face and etc.)

Limb Volumes and Circumference



Automated

Circumference
If unilateral then
lymphedema if
difference > X cm



Manual

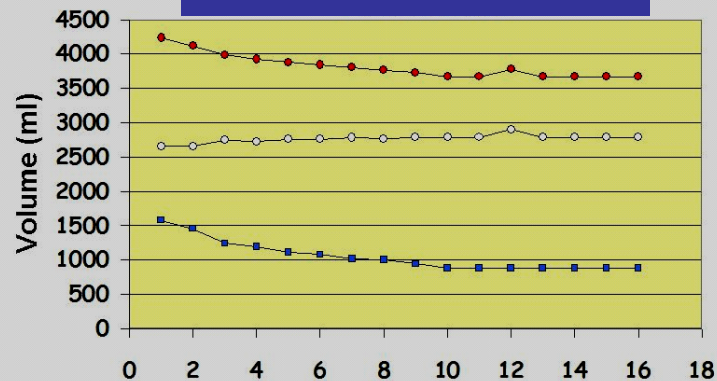
Multiple Circumferences

**Geometric Model
or Algorithm**

If unilateral then lymphedema
if volume difference > Y ml
If volume difference > Z %

● Tx Limb Volume (ml)
○ Norm Limb Volume (ml)
■ Edema (ml)

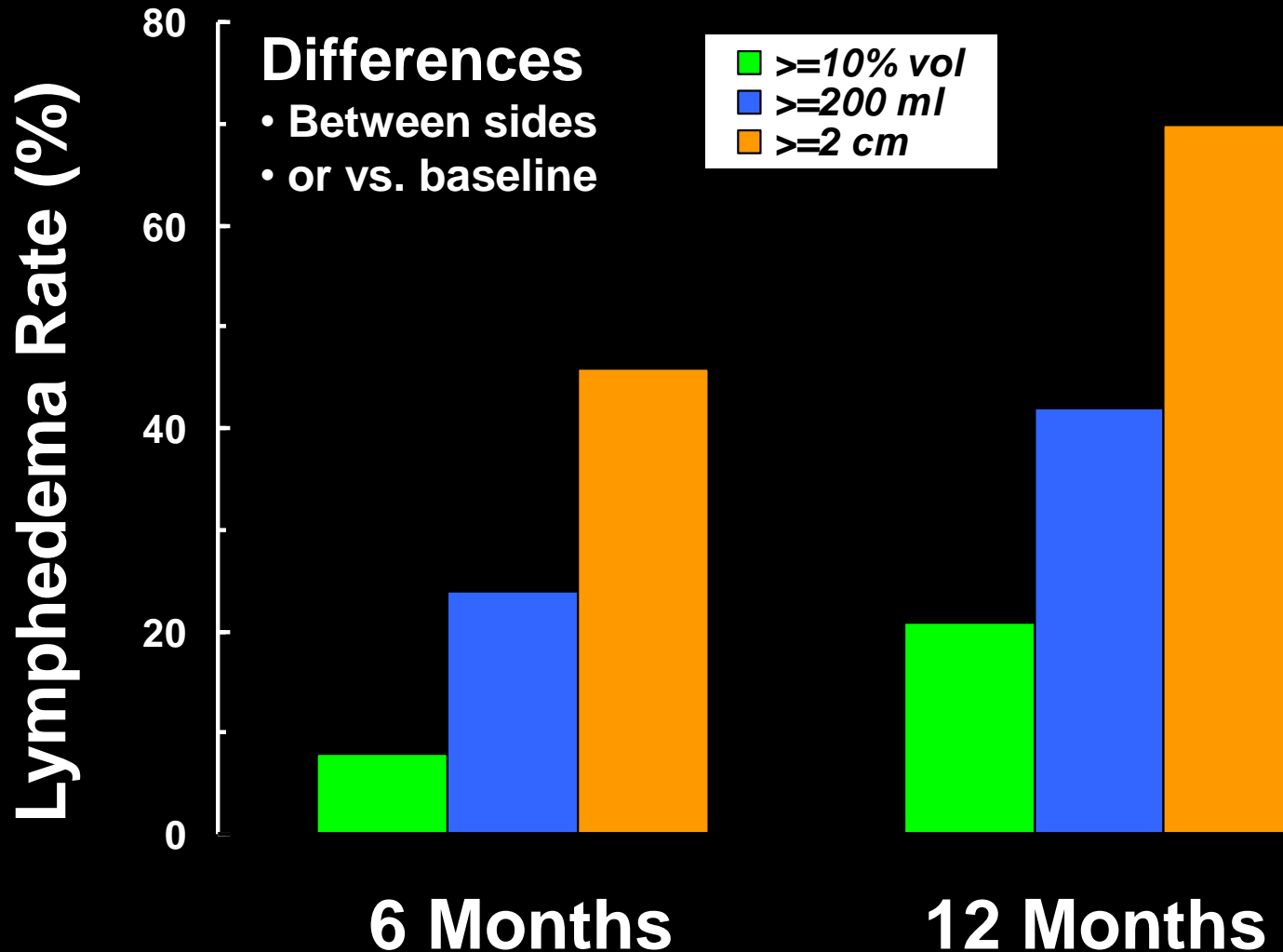
Limb Volumes



www.limbvolumes.org Visit

Arm Lymphedema Metric Criteria

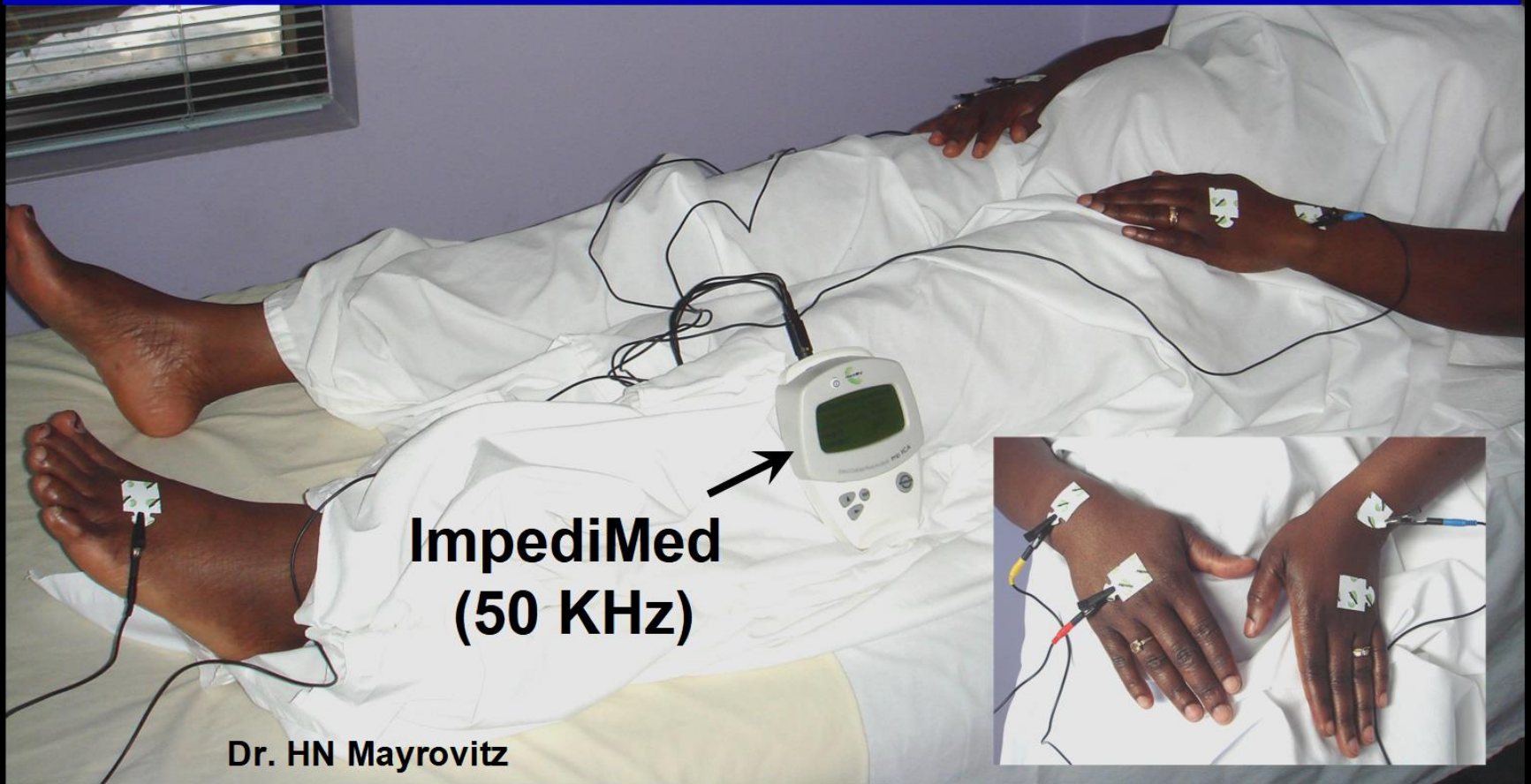
LE rate dependent on criteria used



Data from: Armer and Stewart Lymphat Res Biol. 2005;3(4):208-217.

Bioimpedance Measurements

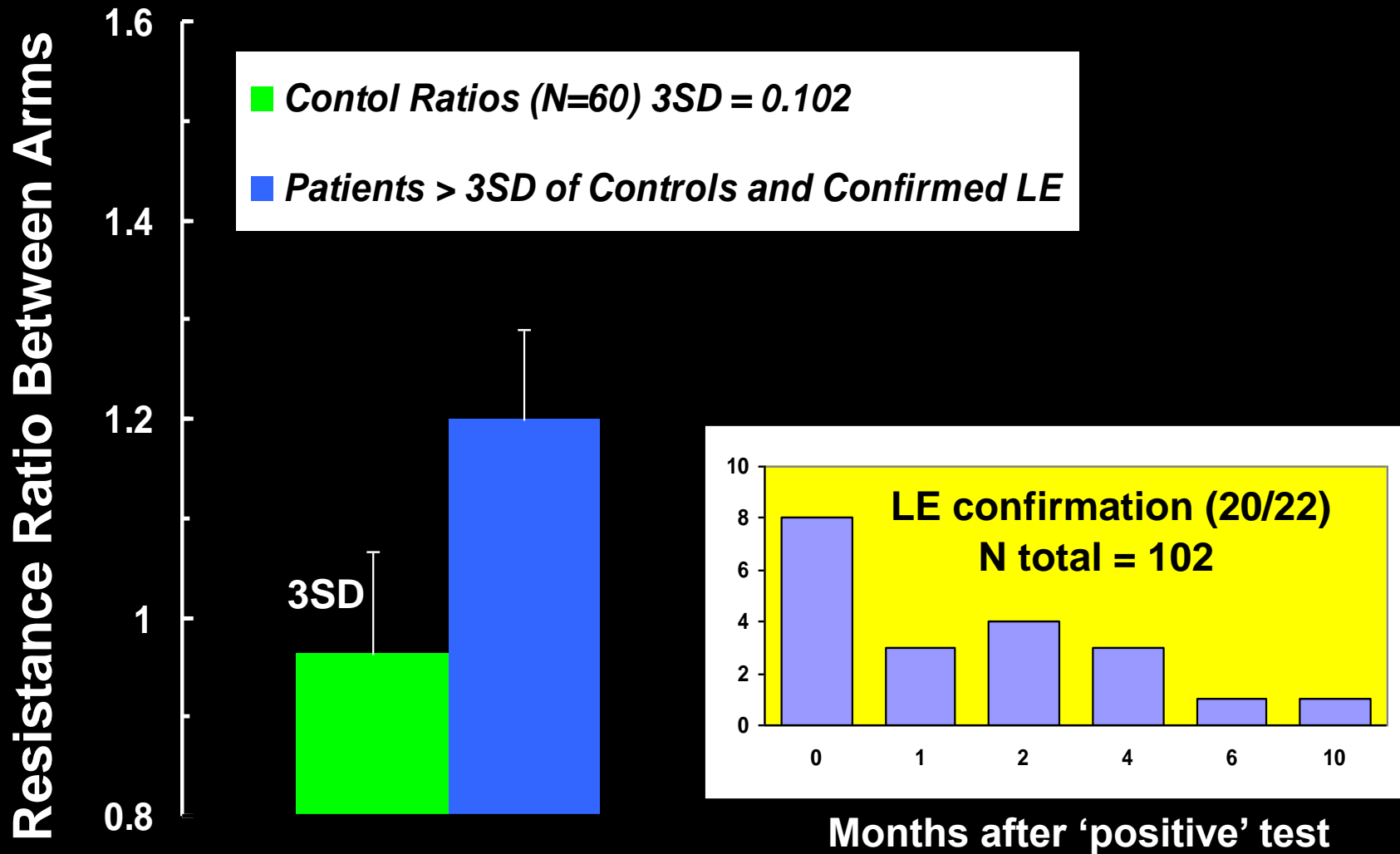
Arm Electrical Impedance ~ Total Arm Tissue Water



**ImpediMed
(50 KHz)**

Dr. HN Mayrovitz

Bioimpedance- Arm Lymphedema



Tissue Water via Dielectric Constant



MoistureMeter-D

Penetration Depth (0.5 – 5 mm)

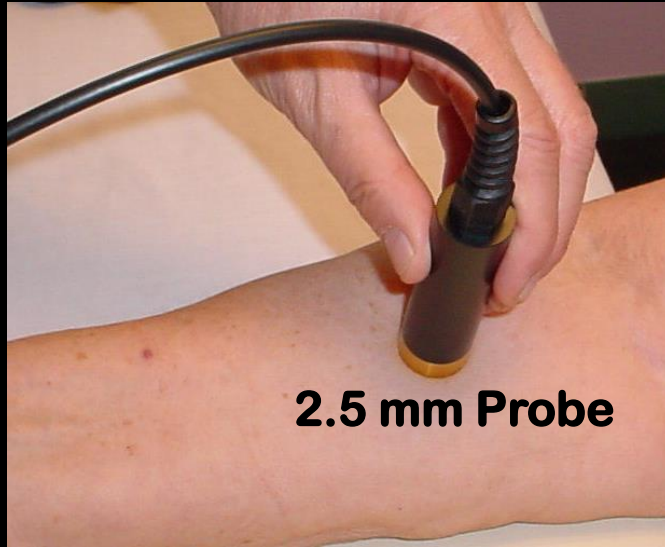


0.5 1.5 2.5 5.0 mm

- Low power 300 MHz incident wave
- Reflected wave depends on the tissue's dielectric constant
- Dielectric constant depends on total tissue water (free + bound)
- Pure water has a dielectric constant of about 78

Can measure at almost any site!

TDC Measurement Sites



Forearm



Biceps



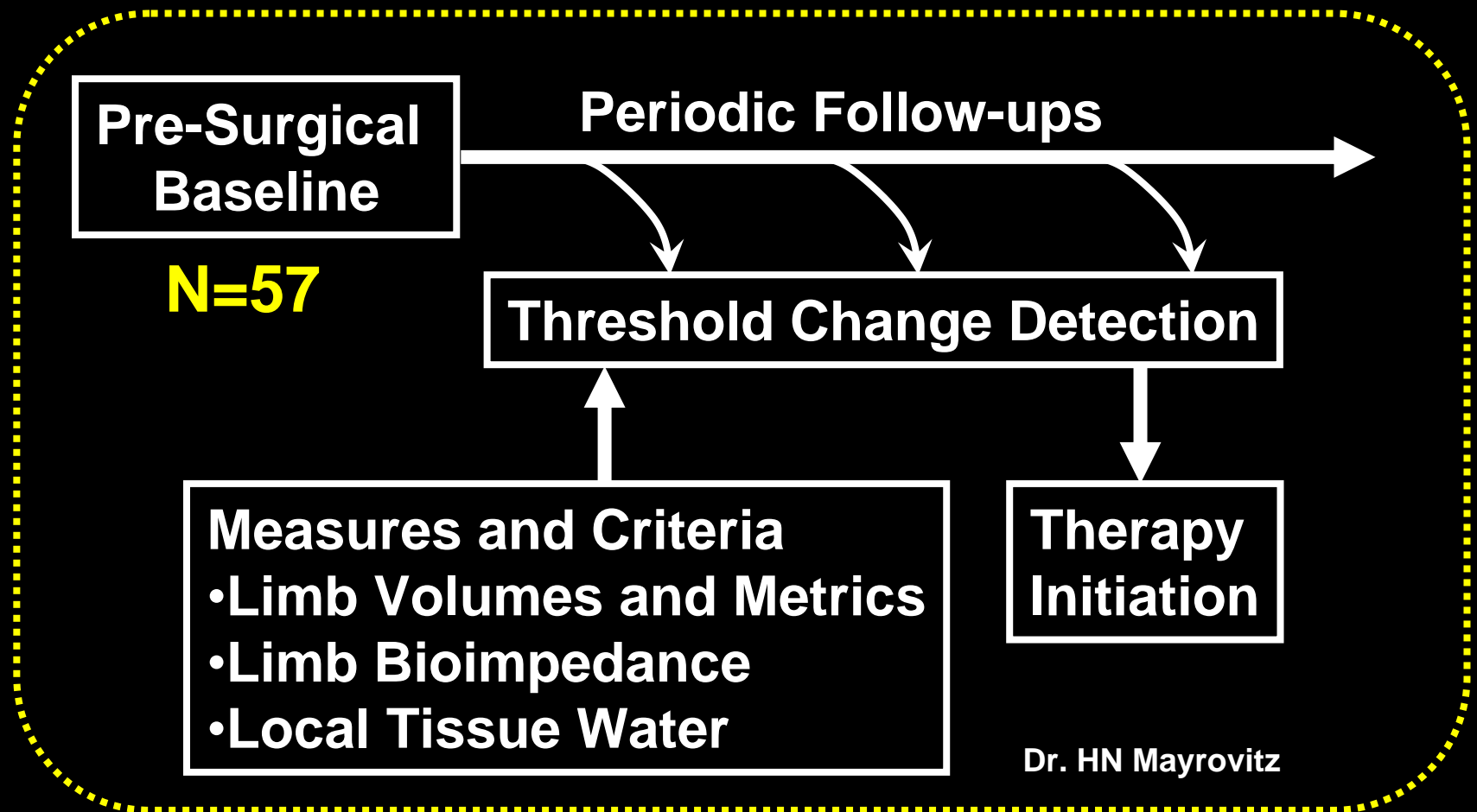
Lateral Thorax



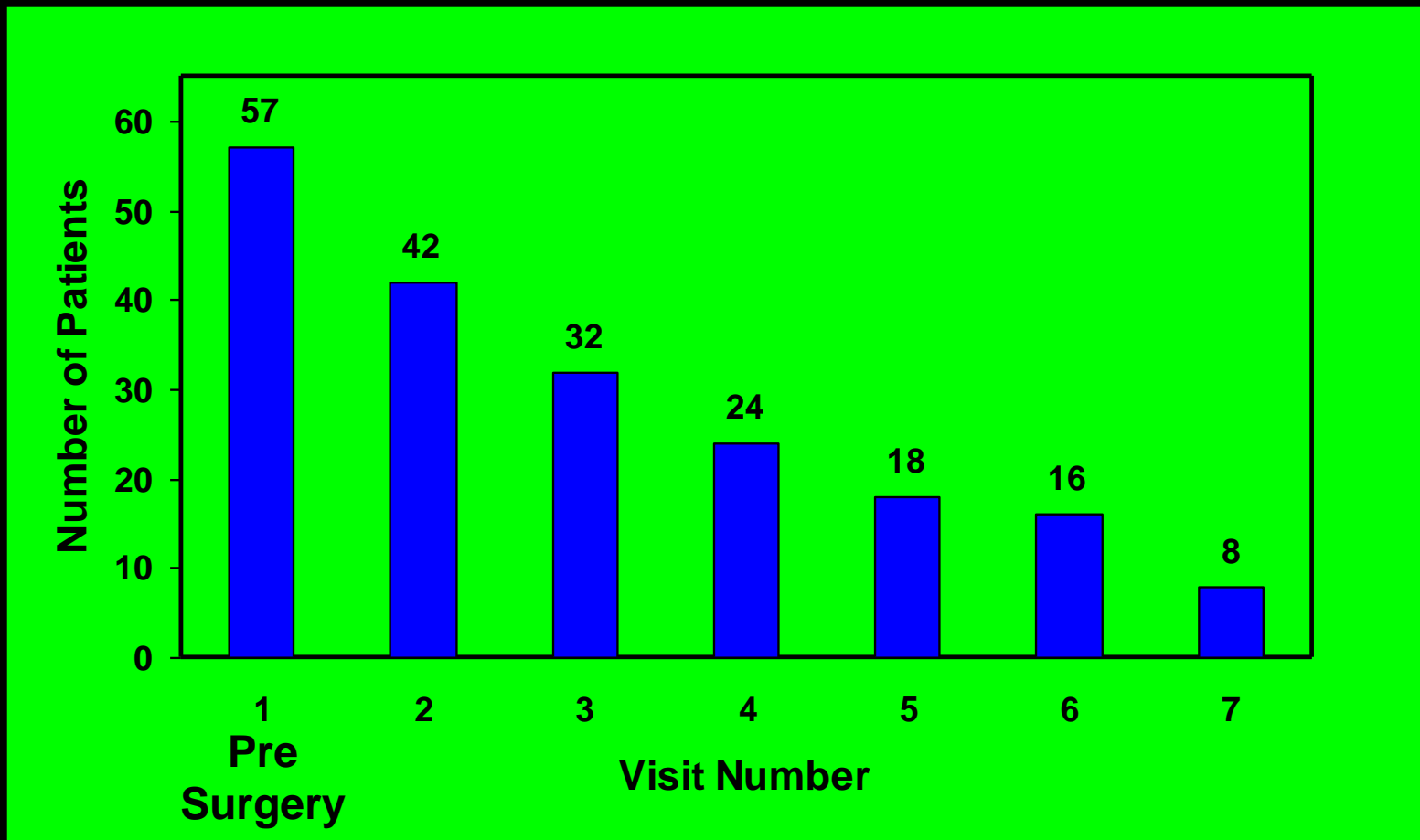
Axilla

Women Diagnosed with Breast Cancer

Early Detection of Latent Lymphedema

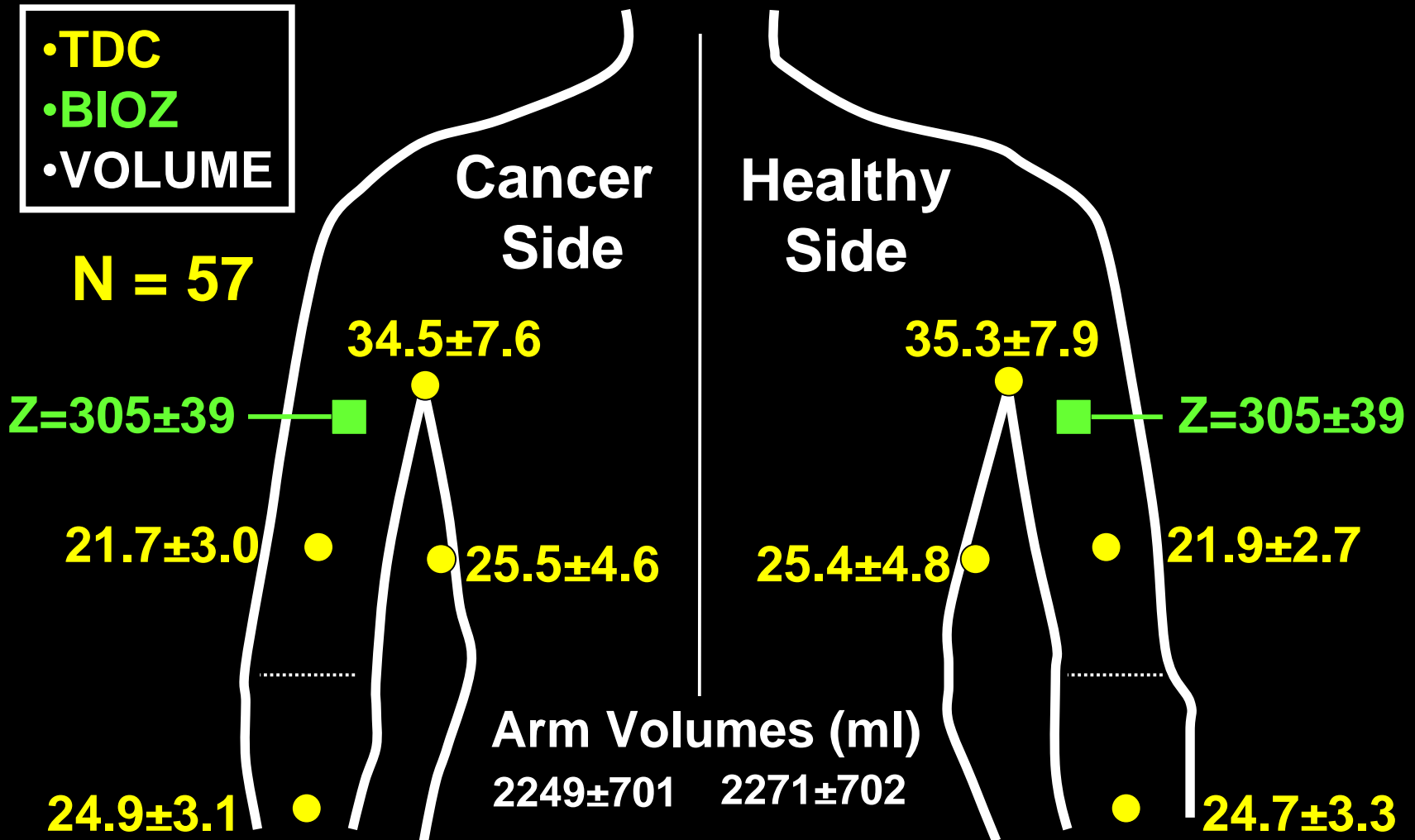


Number of Patients Evaluated



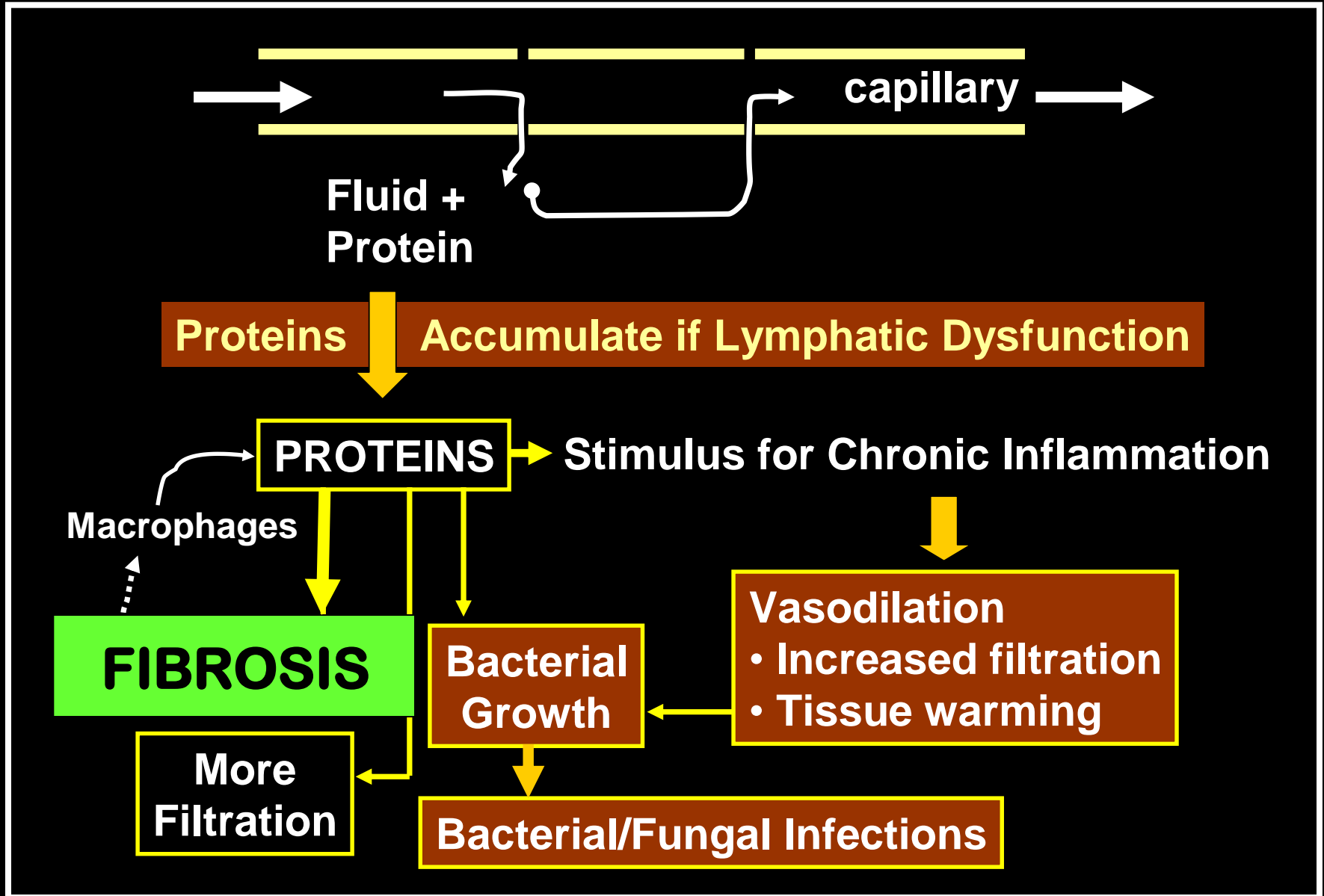
Insufficient follow-ups for conclusions

Pre-surgery Assessments



Insignificant Side-to-Side Differentials

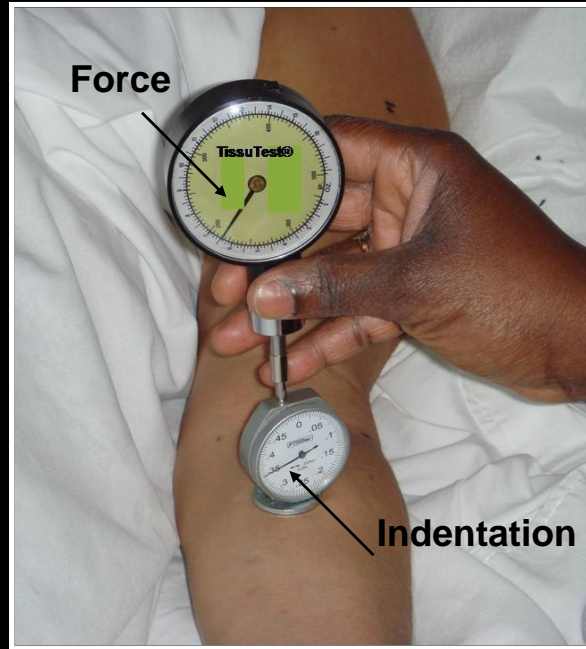
Lymphedema Related Fibrosis



Efficacy of Low Level Laser Therapy



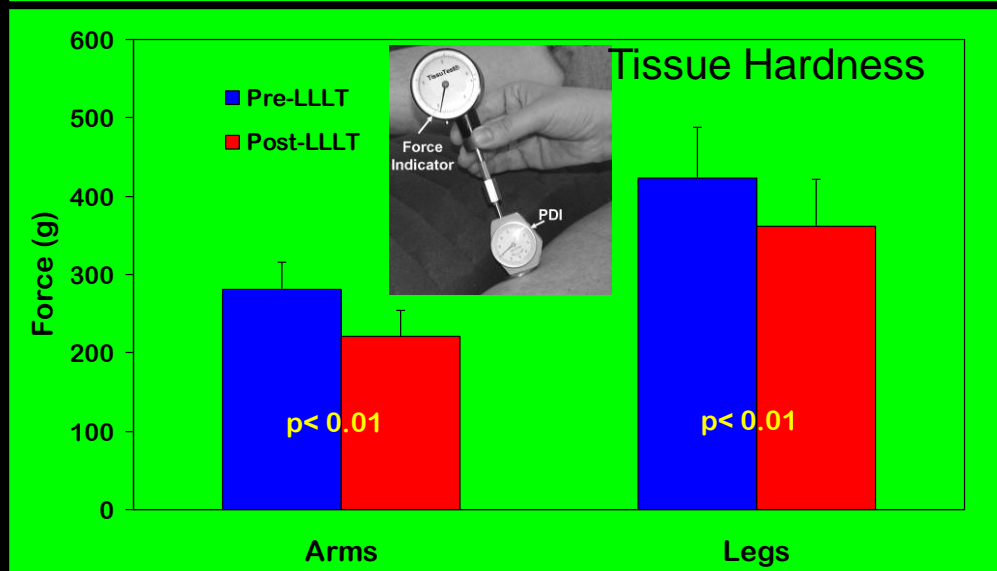
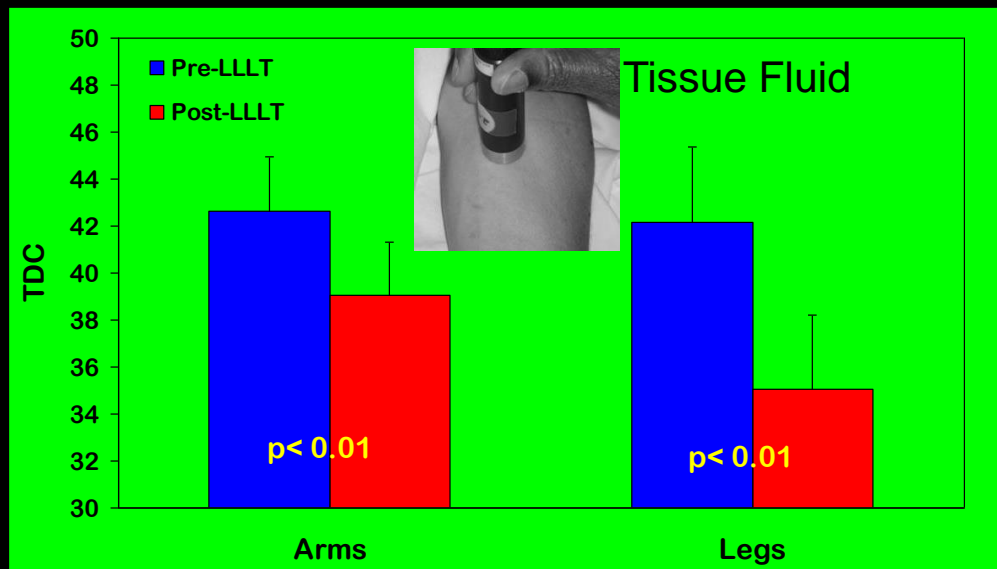
Single Laser Treatment



Tissue (Fibrosis) Hardness

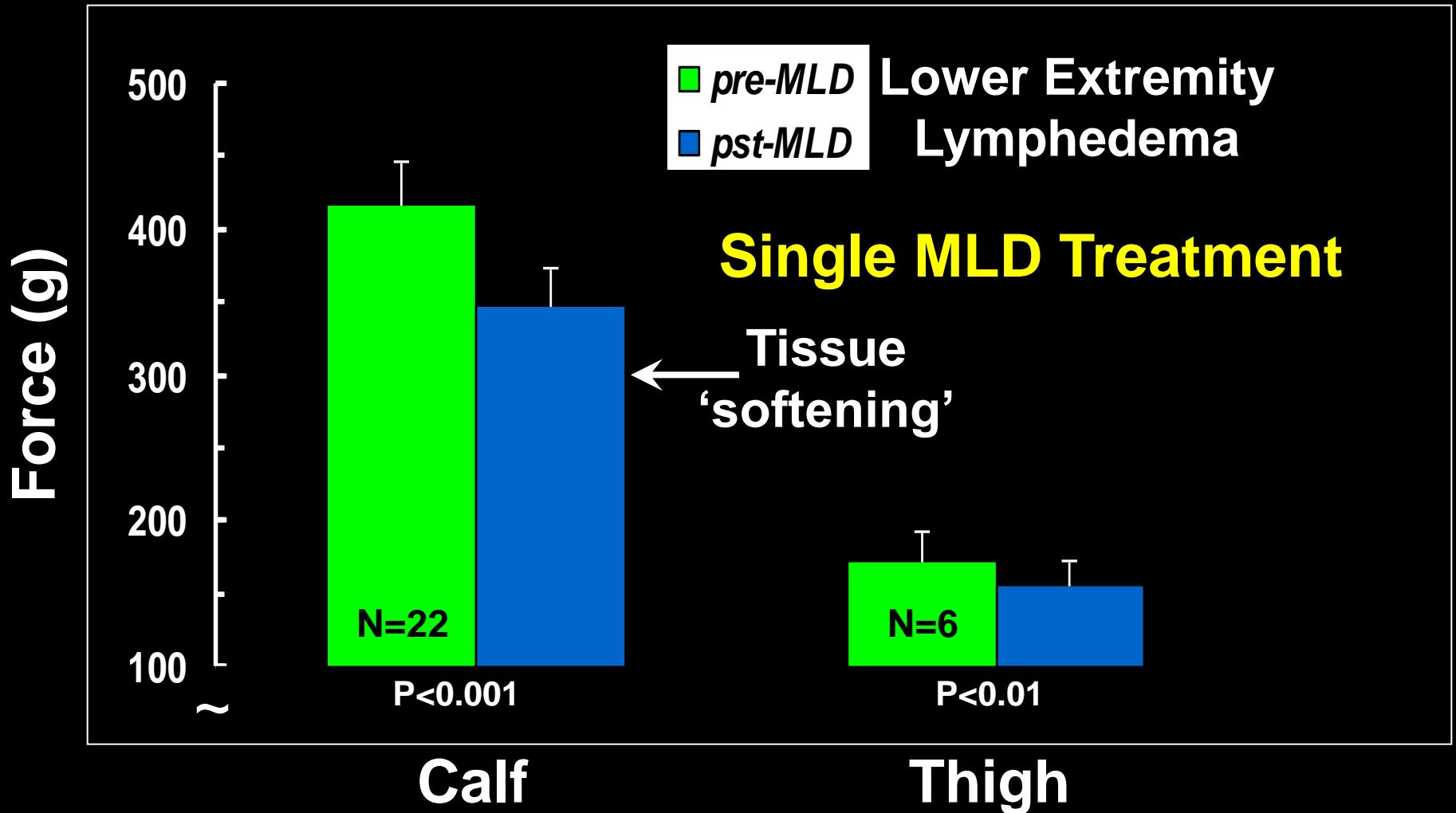


Tissue Water

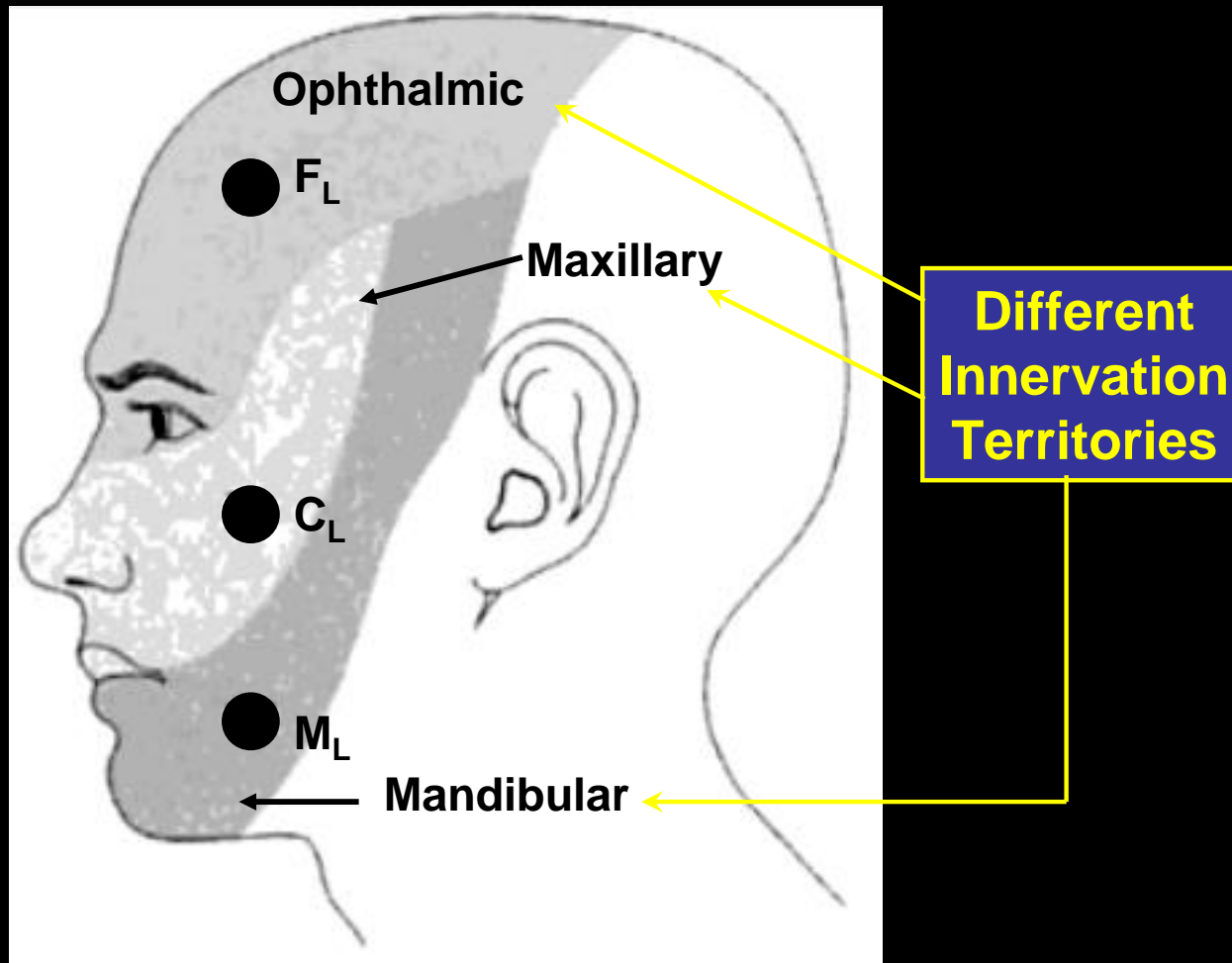


Initial results encouraging
Conclusions premature

Initial Applications and Outcomes



A Reference Framework for Quantifying Facial Edema



Recent NLN Survey of 2899 persons with lymphedema

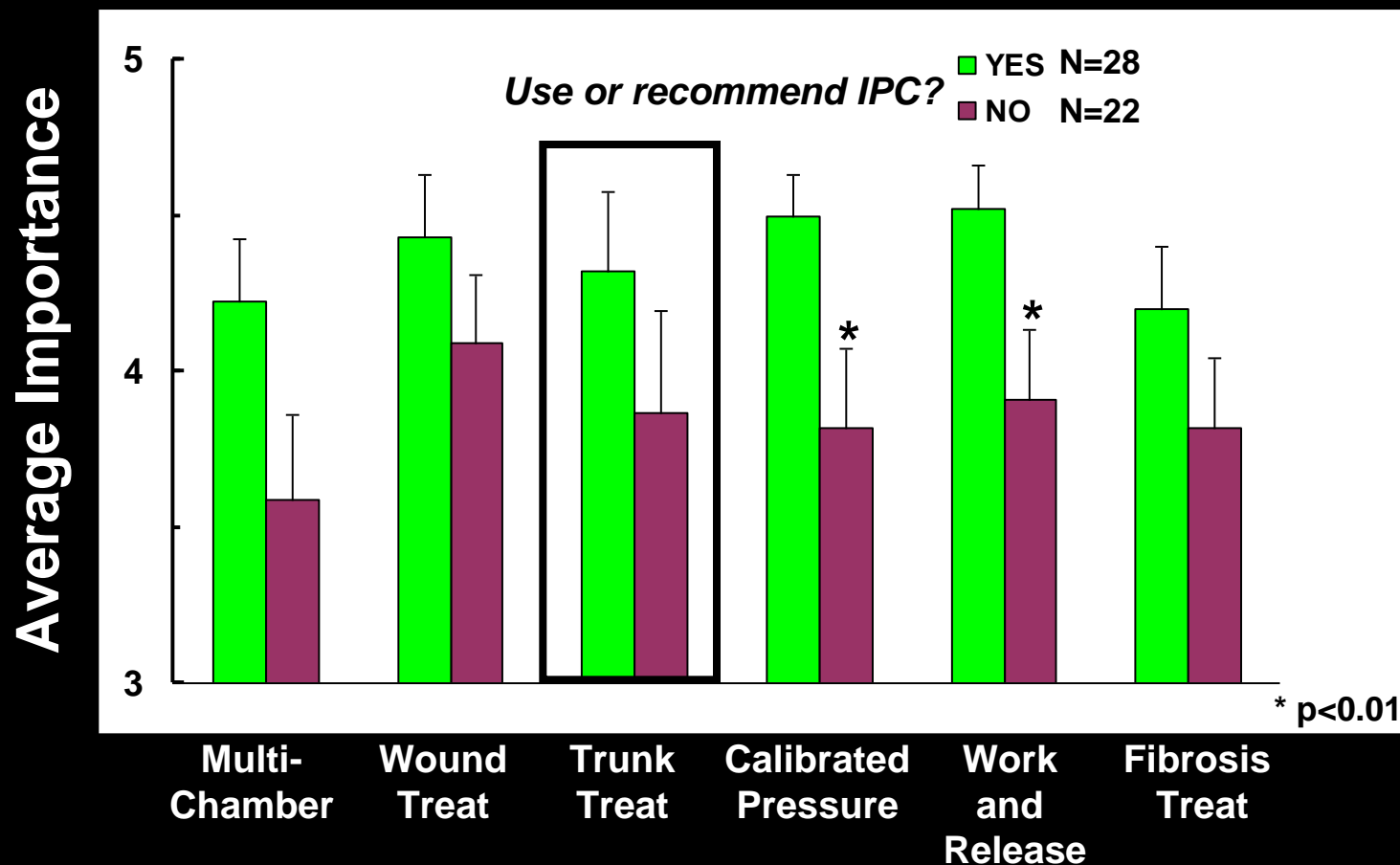
40% reported
co-present edema

Face/Neck	4%
Breast	7%
Trunk	8%
Abdomen	9%
Genitalia	5%
Other	7%

Lymphedema does not just occur in limbs!

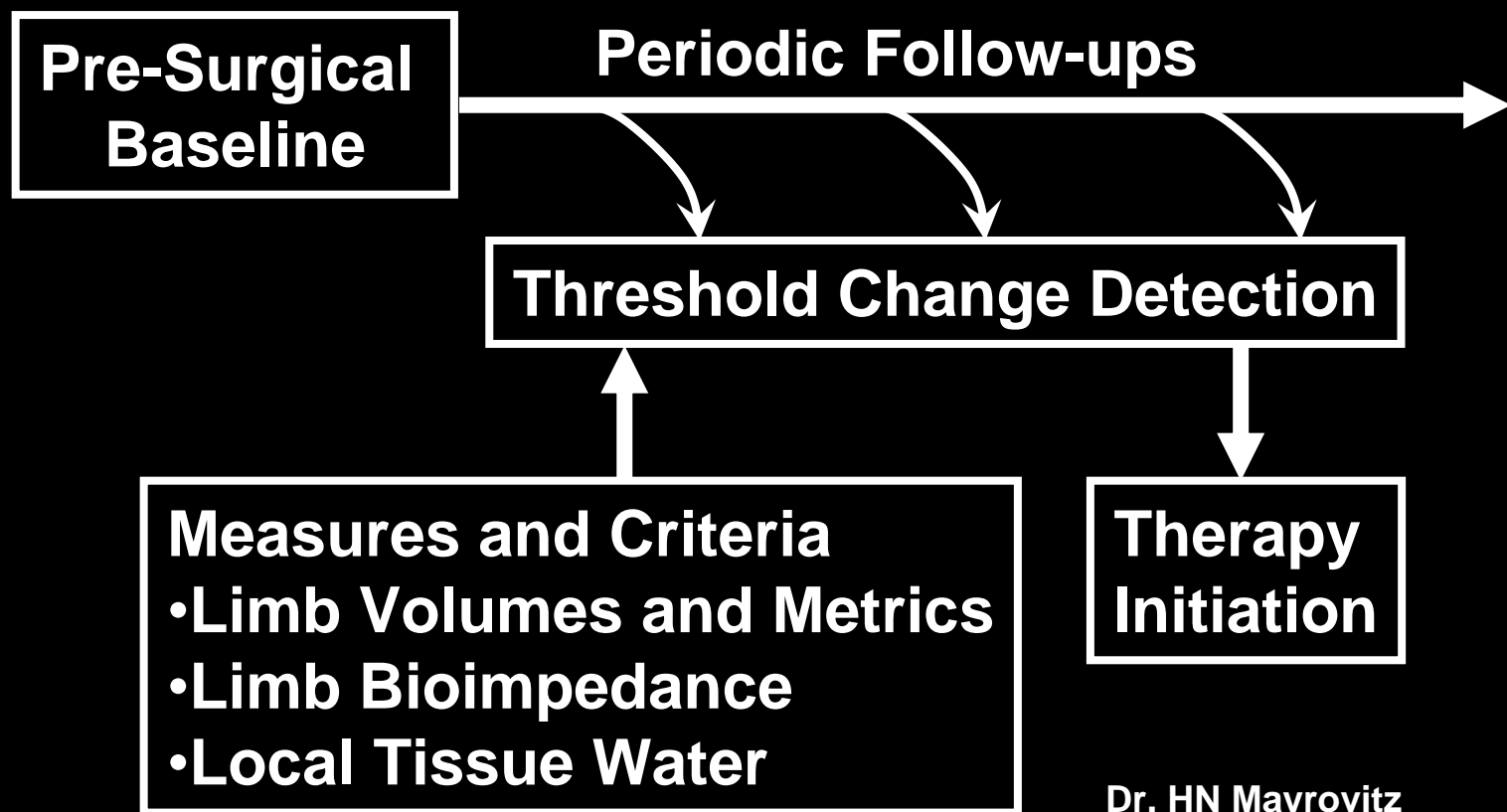
Recent Survey of 50 Lymphedema Therapists

Therapist IPC Important Features

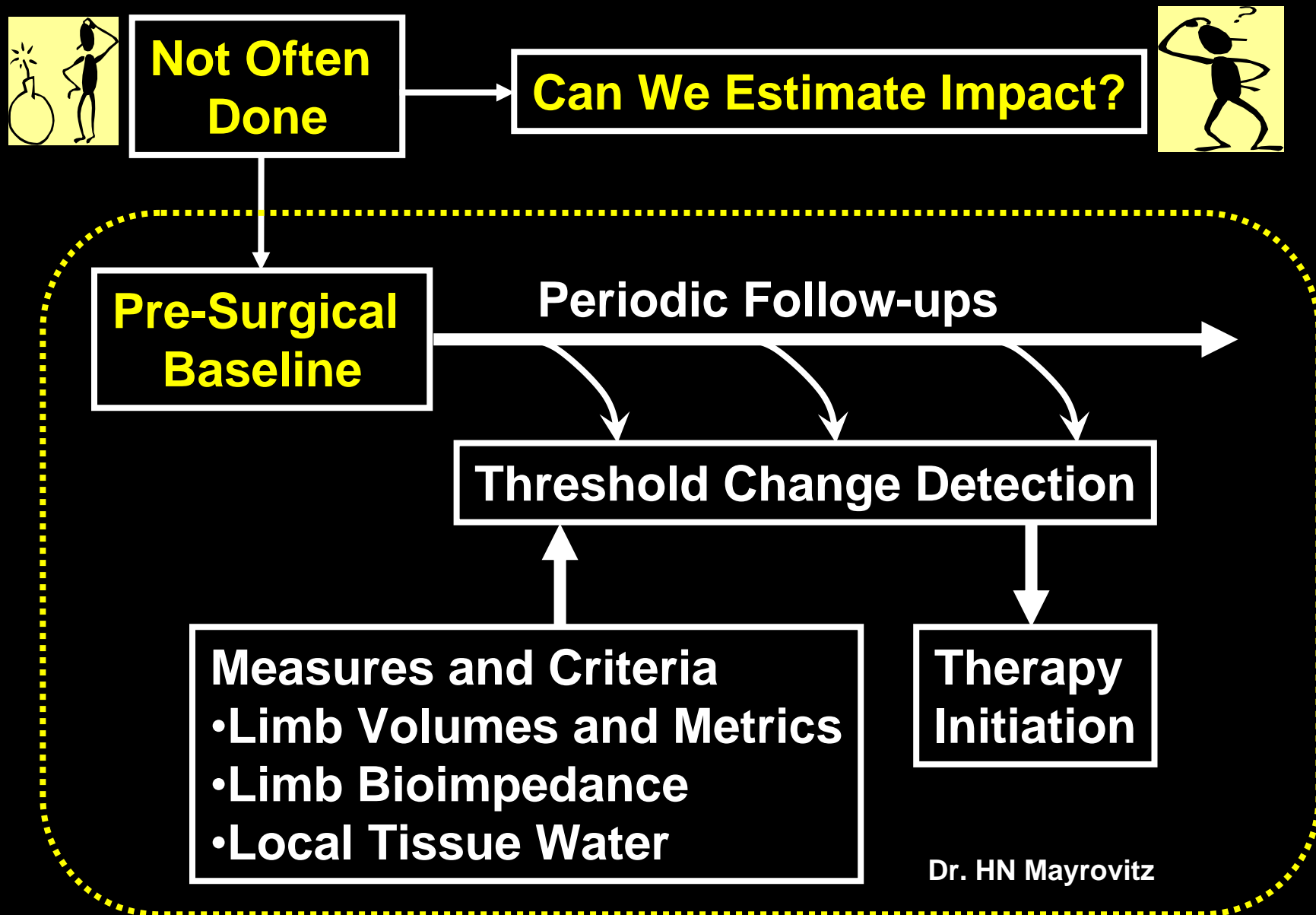


Goal: Early Detection – Timely Intervention

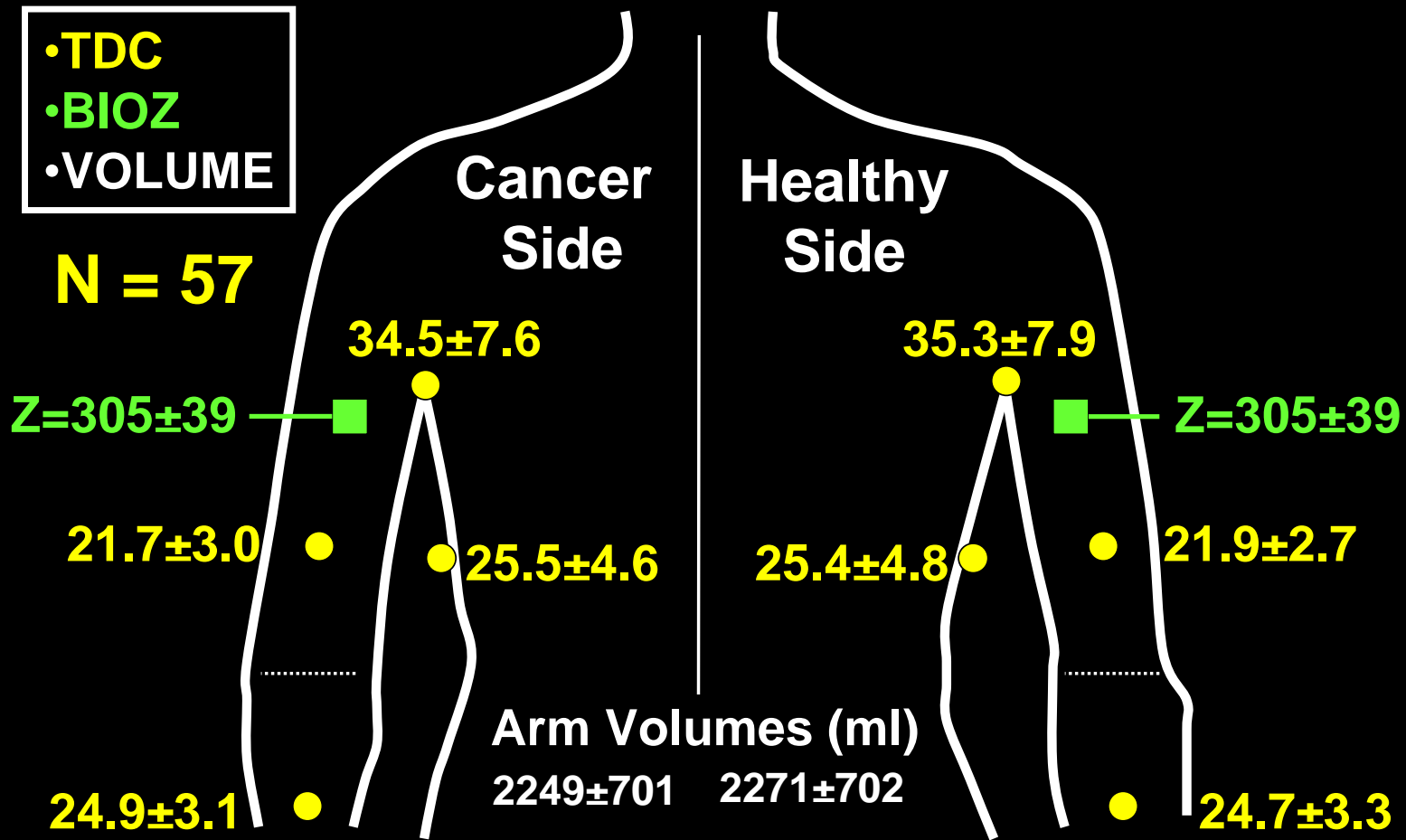
A Rationale and Sensible Approach



Goal: Early Detection – Timely Intervention



Pre-surgery Assessments



Insignificant Side-to-Side Differentials



HEALTH
PROFESSIONS
DIVISION

Thanks for your Attention