Applying our scientific knowledge to measure tissue density and texture (compositional) changes

Professor Neil B Piller
Vice Chair Internaional Lymphoedema Framework
Director Lymphoedema Clinical Research Unit
Department of Surgery
Flinders University

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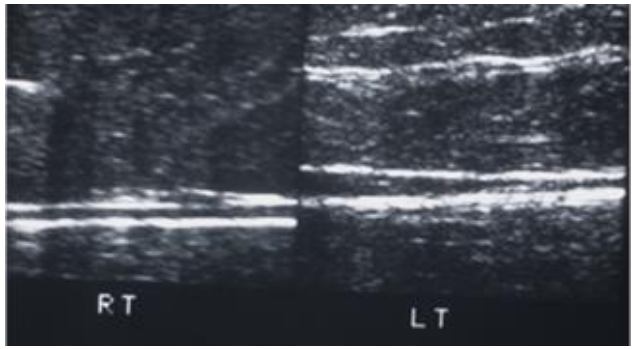
Some of the tools we have
But Why, What, When and Where to measure?



The texture and density of a limb changes from normal and continues to change as lymphoedema progresses from **Fluids, to Fats to Fibrous in each territory**

Development of Lymphoedema

Major stages (ISL Classification)

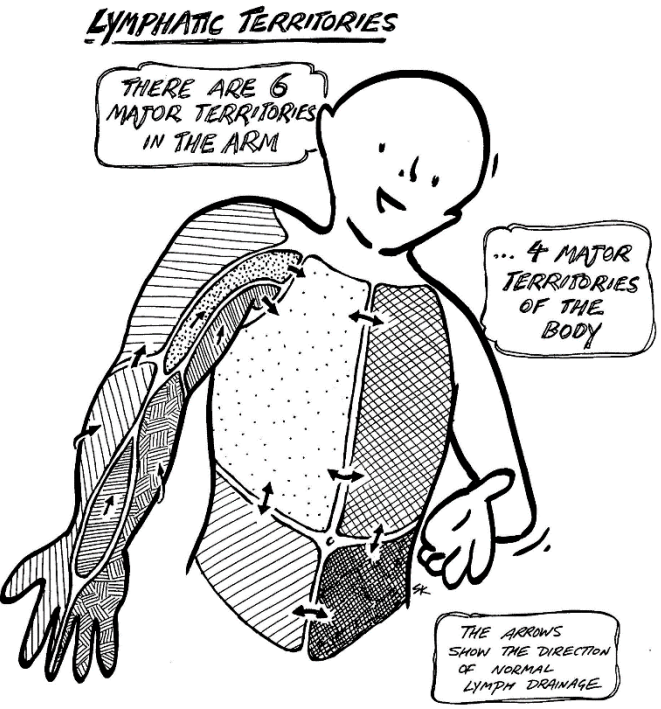
- Stage 0: Subclinical – swelling not evident but lymph transport impaired (detected by bio-impedance)
- Stage I: Fluid accumulation which subsides when limb elevated
- Stage II: limb elevation rarely reduces swelling, pitting
- Stage II(late); Increasing tissue adiposity and appearance general fibrosis
- Stage III; Tissues fibrotic, pitting absent, skin changes, hyper-pigmentation, papalomati

STAGING IS IMPORTANT BUT WHAT IS MORE SO IS
KNOWING THE COMPOSITION OF THE LIMB

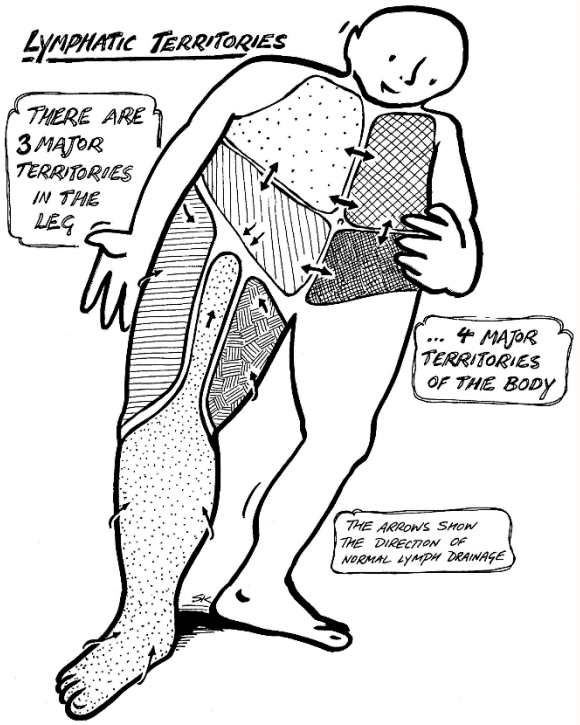
Why tissue composition?

- **Helps us know**
  - If the patient has lymphoedema!
  - What has gone wrong
  - What to do
  - **When treatment is working**
- **Allows**
  - Targeted treatment
  - Sequenced treatment

Everyone and Each Lymphatic Territory may be different



- Major territories
- Each has variable number of collectors
- Bottle-necks
- Superficial/deep systems



Medical Assessment

(In parallel with texture measurments)

- Family
  - Dysplasias of the lymph-vascular systems
  - Cardiovascular
- Medical History
  - Lifetime prior damage to lymphatic system paths or nodes
- Medication History
  - Current oedema causing medications
- Surgical/radio-therapeutical History
  - Lifetime removal or damage to nodes and vessels

Lymphoedema:
(More than just a swelling!)

- Skin Change examples
  - Abnormal thickening (pachydermia)
  - Changes in
    - Basal layers (hyperkeratosis)
    - Surface features (papillomatosis)
    - Color (hyperpigmentation)
    - Temperature (inflammation)
    - Bacterial populations
    - Fungi (Mycosis)

The major parameters we can measure

Circumference

According to standard - tape position, side, tension on tape, position on limb

Optoelectronic (Perometry etc)

Volume

Immersion and reverse Plethysmography

Optoelectronic (Perometry etc)

Fluid accumulation

Bio-impedance Spectroscopy

Pitting test

MR

Fluid movement

Lymphoscintigraphy

Fibre and tissue changes

Viscoelastic tonometry

Indentation Tonometry

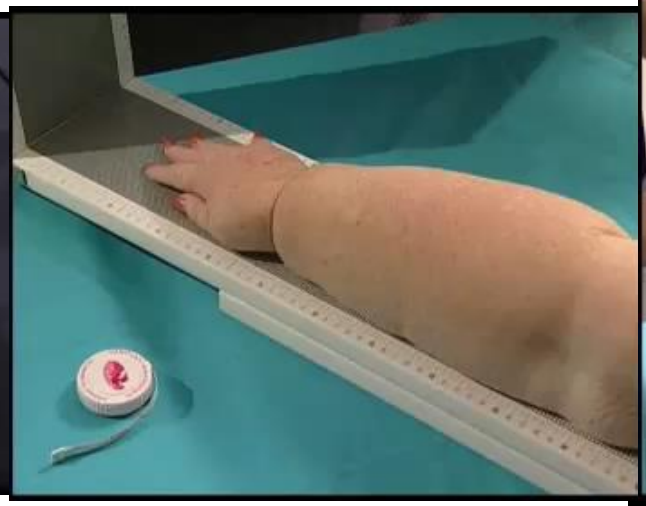
Ultrasound

CT/MR

Circumference and Volume: Perometry

Can measure circumference and volume in segments

Accurately measuring a limb
(Tape and board)



Using an accepted standard is essential

The problems with tape and volumetric measures

[illegible] attributed to fluid only.

Fluid

Weight gain

Atrophy

A better method of assessment is needed because tape and volumetric measures indicate more than fluid changes ESPECIALLY OVER LONGER TIME PERIODS

Bio-impedance – Whole Body and Segmental fluid distribution

(Inbody unit)

Fluid means current problems with lymph transport

Bio-impedance - Whole body and segmental fluid distribution

(Impedimed)

Fluid means current problems with Lymph transport

Electro-magnetic : Local Area Fluid

(Delfin)

Fluid levels in unique area (lymphatic territory/area under probe) to varying depths depending on head

We can also use the simple

Pitting Test

Can be objective, but need to be sure have maintained pressure for at least 30 seconds (3 types of fluids have to be given chance to be removed)

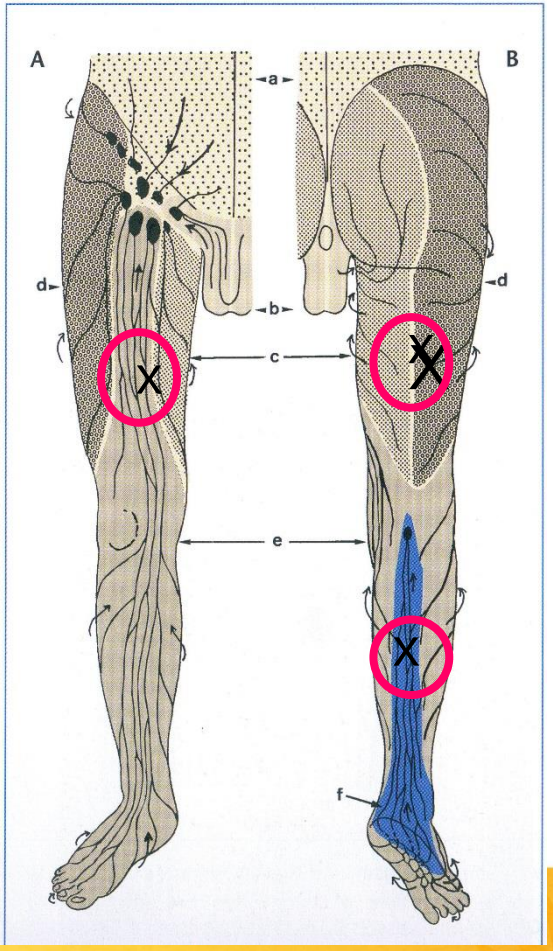
Ensuring accuracy of all measures involving fluids

- Consider
  - Impact of dialysis
  - Renal status
  - Diuretics use
  - Other medications which may influence ECF/ICF or their ratios. (anti hypertensives)

Measuring Structural Change

Fibrous Buildup in territories: Tonometry

- Measured in each of the major territories and at their watersheds
- Ultrasound Generally
- Tonometry, Indurometry and Fibrin meter at specific sites

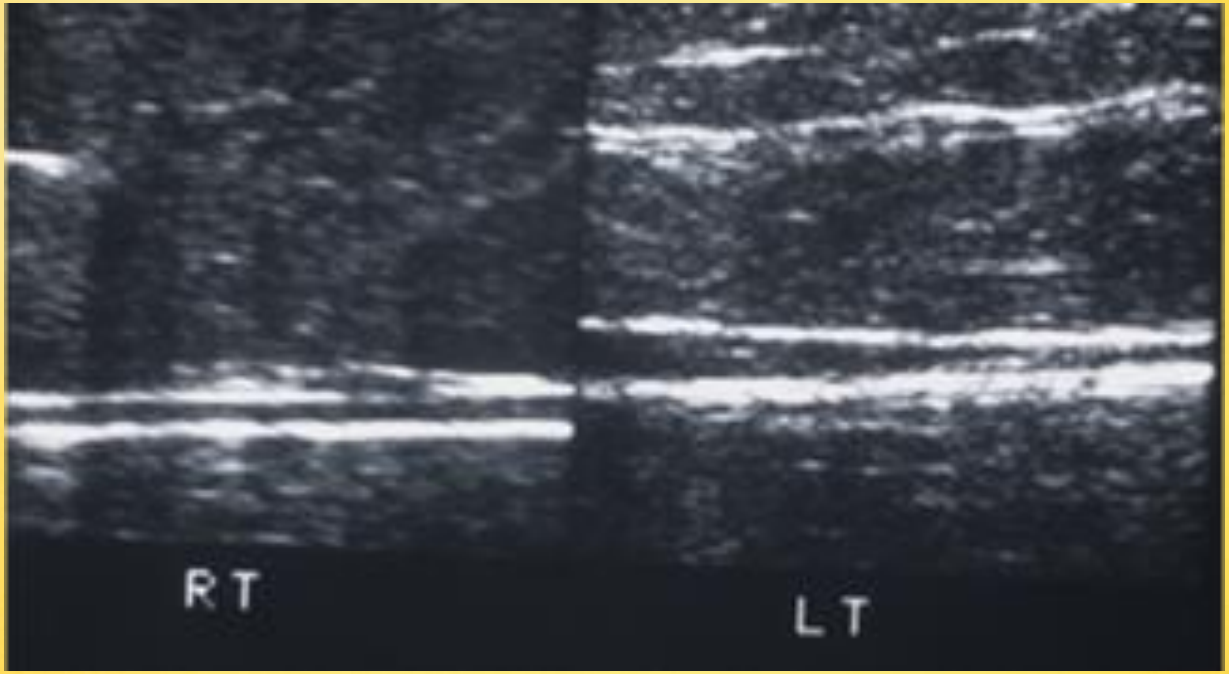


Ultrasound

STRUCTURAL INFORMATION

- Easy to perform- non invasive
- Indicates changes to thickness between skin and superficial and deep fascias
- Indicates changes to thickness of fascial bands
- Indicates general tissue fibrosis
- Indicates areas of deeper surgical or radio-therapeutical scarring

Ultrasound



Thickening of deep fascia and epi-fascial fibrosis on LT

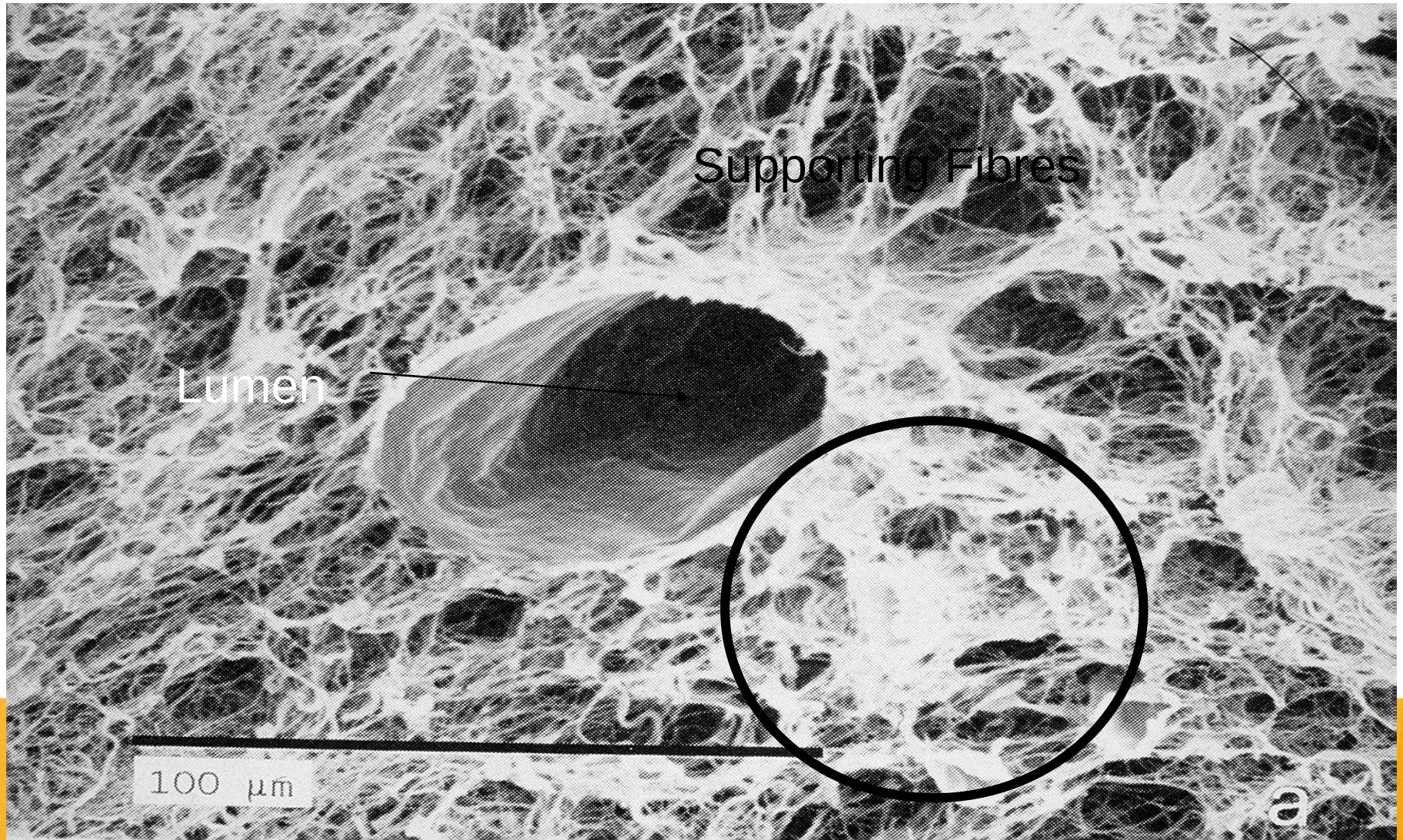
Magnetic Resonance Imaging

(and similar techniques)

STRUCTURAL INFORMATION

- Indicates
  - Subcutaneous tissue thickening
  - Subcutaneous oedema
  - Super-lymphatic channels and lakes
  - Lymph nodes
  - Distinguishes fat from fibre from fluid

What US/ MRI Tonometry etc shows are tissues changes- Induration



Tonometer, Indurometer and fibrometer

Tonometry

Measuring resistance to compression- fibre

Of course we can use some thing simple: The Stemmer Sign

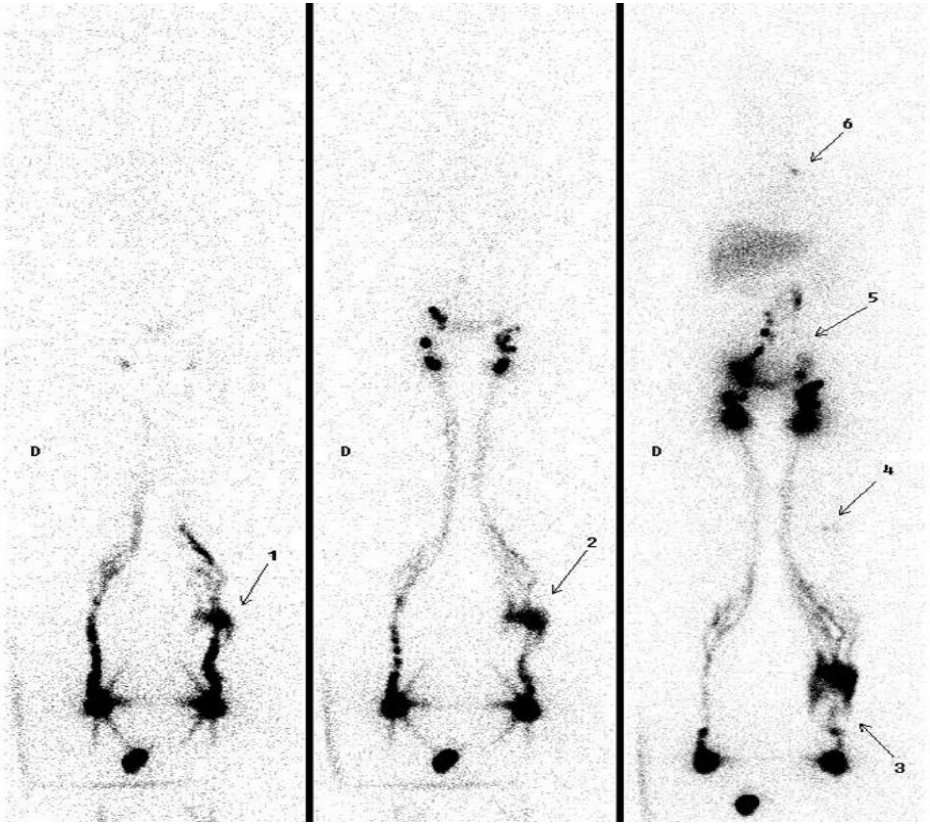
Positive Stemmer Sign – Skin fold cannot be picked up

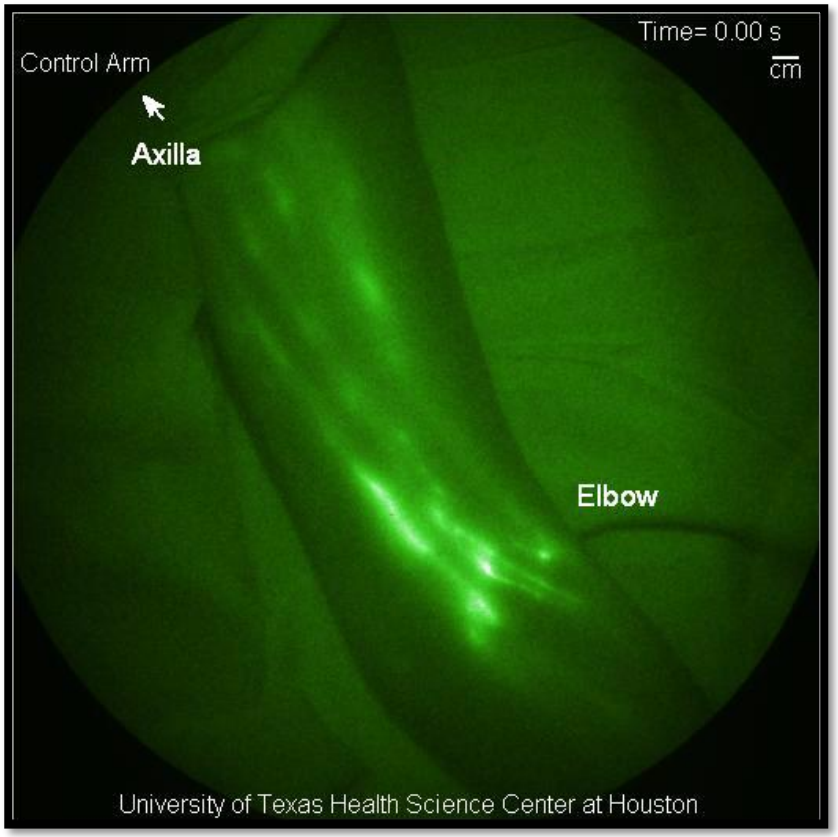
Can use in any lymphatic territory!

Measuring Functional Change

While not part of this session its important to realise that it's the FUNCTIONAL changes which lead to the structural ones!

Lymphoscintigraphy and Indo-Cyanine Green





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