

**Oedema, its contents and
their impact on cellular and
tissue health when it
accumulates and where our
leverage points are**

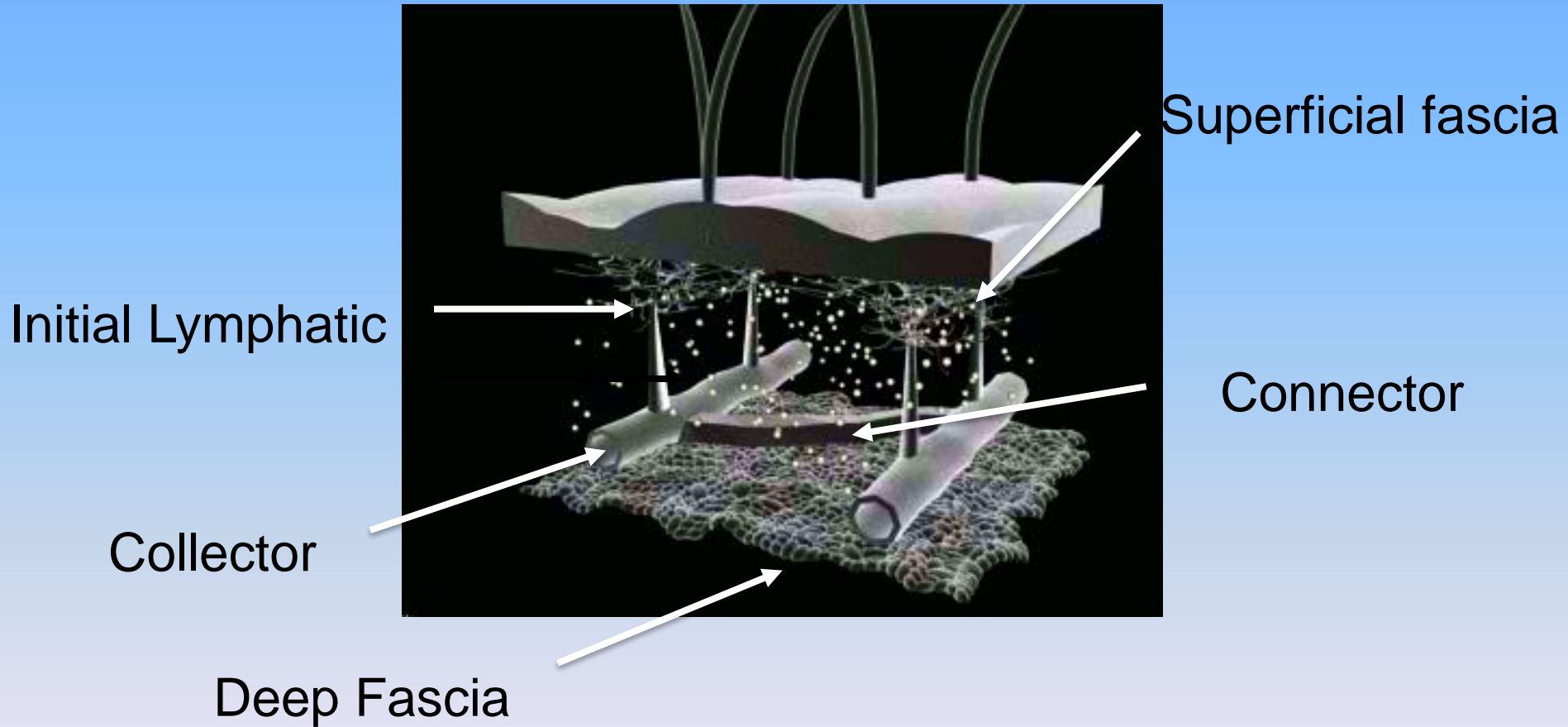
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About me

- Director, Lymphoedema Clinical Research Unit, FCIC
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- Member Advisory Committee ENCORE Australia
- Member SA Health Advisory Group Compression Garment Scheme
- Member Scientific Committee Vasculab
- Member Scientific Advisory Committee Union Internationale de Phlebology
- Patron Lymphoedema Association of Australia

Oedema

Most often a problem above the Deep Fascia



If we see or detect fluid accumulation we should ask/know about

- First time or prior history ?
- What's the likely cause: Acute or Chronic?
- Any underlying systemic issues (heart, kidney etc)
- What is its duration
- What's likely to be happening (path, bloods)
- Location (with respect to lymphosomes/lymph territories)
- Whats in the fluid and what's it doing !

And Most importantly

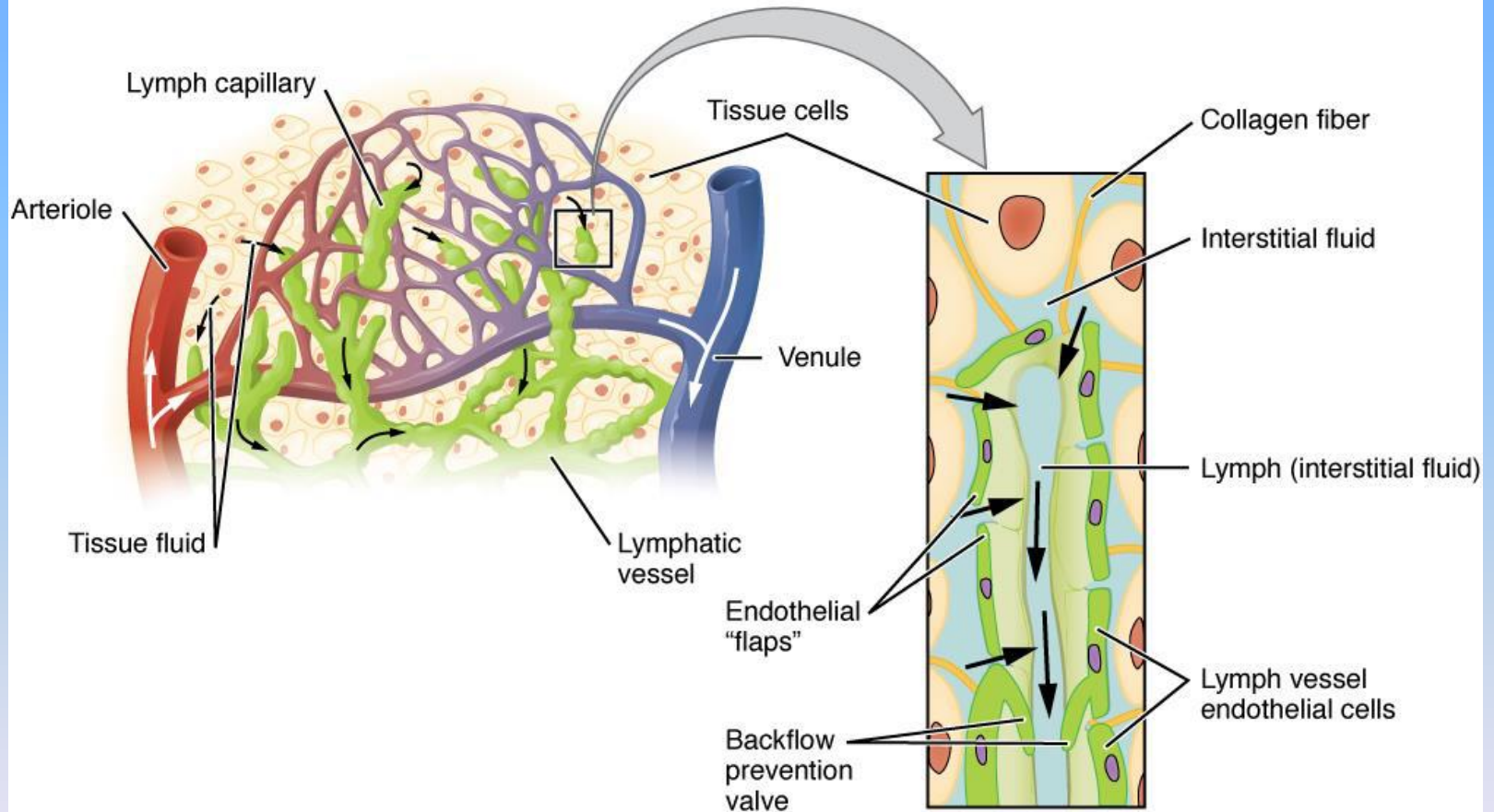
Minimize further fluid (and its contents) **accumulation**

Improve the **clearance** of fluid and its contents

Protect and **enhance** the skin as a barrier

Blood-Tissue-Lymph Interface

Lymph capillaries in the tissue spaces



Oedema fluid contents and consequences of its accumulation

- Increased endothelial cell permeability
- Leukocyte infiltration
- Higher levels of Inflammatory cytokines
- Accumulation of Metalloproteinases
- Reactive O₂ and Nitrogen
- Accumulation of Tissue metabolites
- Increases in Lipogenic factors
- Higher levels of Substance P

Lymph/ECF as an environment

- **It's where Intensive metabolic activity occurs**
 - Inactive products of parenchymal cells become active in blood
- **It Impacts on resident and migrating immune cells** when Physiochemical properties vary ie
 - pH, O₂, CO₂, hydrostatic and oncotic pressures
- **It's a pathway** for signalling molecules to flow between tissue fluids, endothelial cells and muscles
- **It's where medications act** on endothelium and muscle elements
- It's where Substance P accumulates and can have an impact

Substance - P

- It's a 11 amino acid long neuropeptide
- It's a member of the tachykinin family
- It elicits its activity by interacting with G-protein neurokinin receptors (NKR's)
 - NKR's are expressed on cells of the BV's, lymphatic endothelial cells, immune cells, fibroblasts, neurons
 - Activation of NKR's have impact on inflammation, wound healing and angiogenesis

Substance P Key points

- A pro-inflammatory neuro-peptide which can exacerbate inflammation by promoting release of other mediators!
- Increases vascular permeability leading to more fluids and contents in tissues
- Activates immune cells (macrophages, dendritic cells) these have a role in the inflammatory response + tissue re-modeling
- Role in pain and pain perception

Back to the Lymphatic System: Other important facts

It controls immune responses (innate and acquired)

It's poor function contributes to cellulitis

Low lymph flow

Means poor lymphatic regeneration

Results in fat deposition (which can further
reduce lymph flow!)

The lymphatics are now more important than ever !

Oncotic pressure differences oppose but do **NOT** reverse filtration rate

ALL filtered fluids return to circulation via the lymph

Another point to consider

The Skin Microbiome!

- The skin is under constant assault which
 - Results in formation of reactive oxygen sp. (ROS)
 - These attack DNA
 - Rupture cell membranes
 - Unravel some of the proteins
- ROS can be “mopped up” by anti-oxidants
 - Carotenoids
 - Vitamin C and E
 - Help production of collagen and prevent fat oxidation

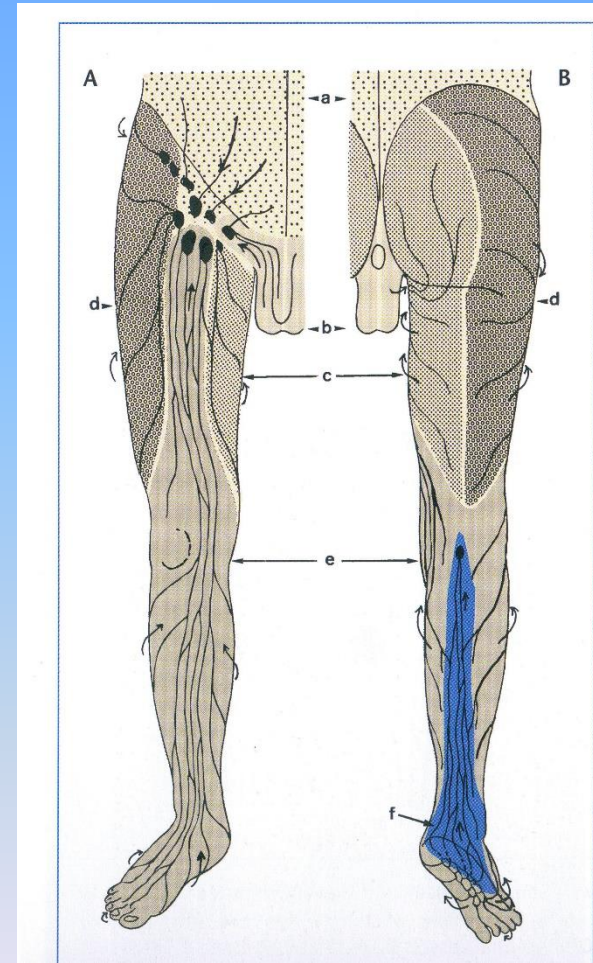
Skin Microbiome

- Important defense against invading pathogens
- Helps “train” our immune system about what’s good and bad!
- **Linked to skin integrity – its critical to maintain it !**

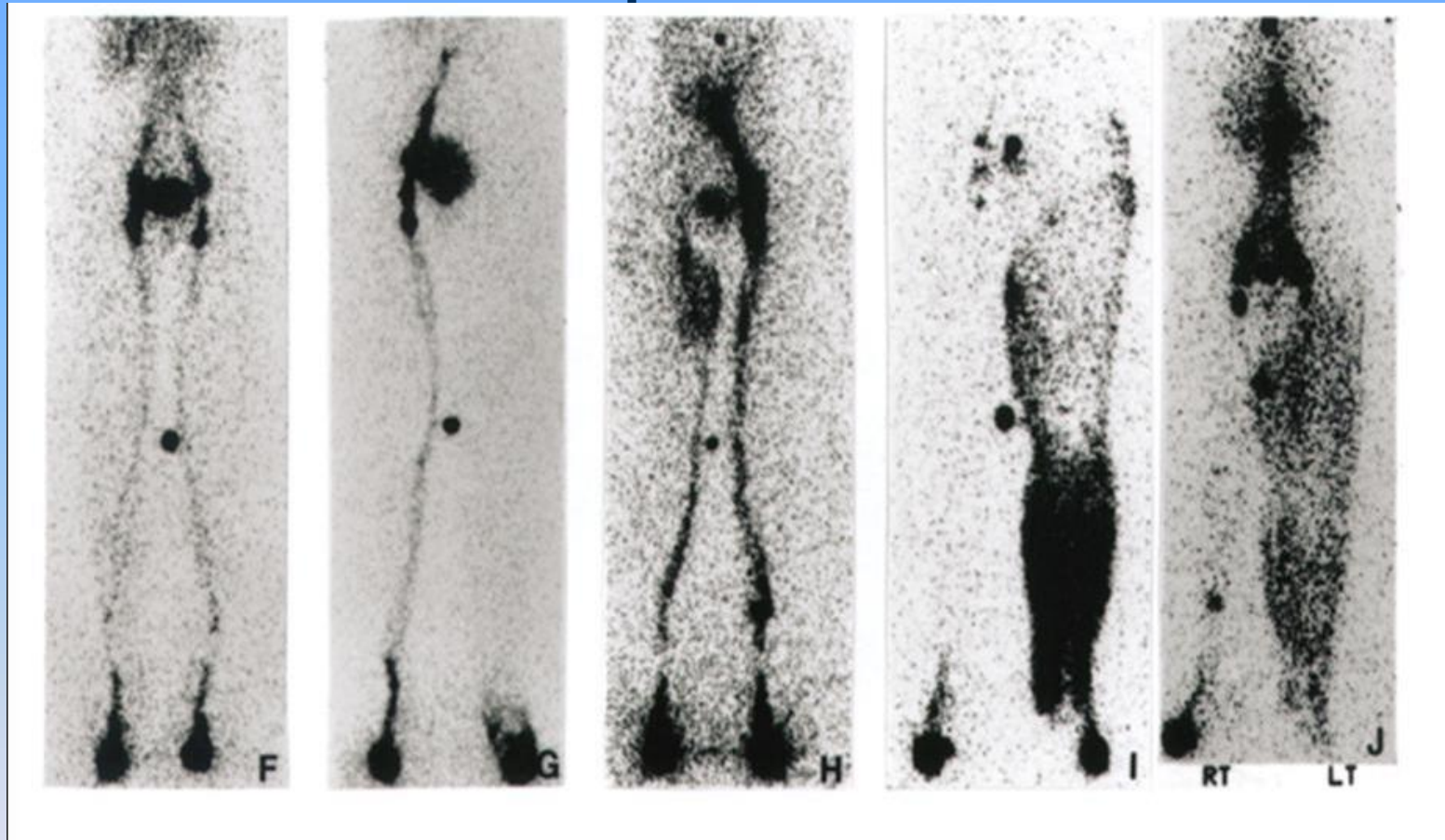
Apart from managing
infections, improving skin
quality and facilitating activity
the most important thing to do
it to **get the Lymphatics
working optimally**

Lymph Territories/lymphotomes and Collectors

- Generally 3- 4 major territories/lymphotomes
- Variable number collectors
- Major bottlenecks
- Superficial/deep systems
- In/near vein adventitia
- Delicate/easily damaged
- Hard to see unless lymph visualised (TC-99, ICG)



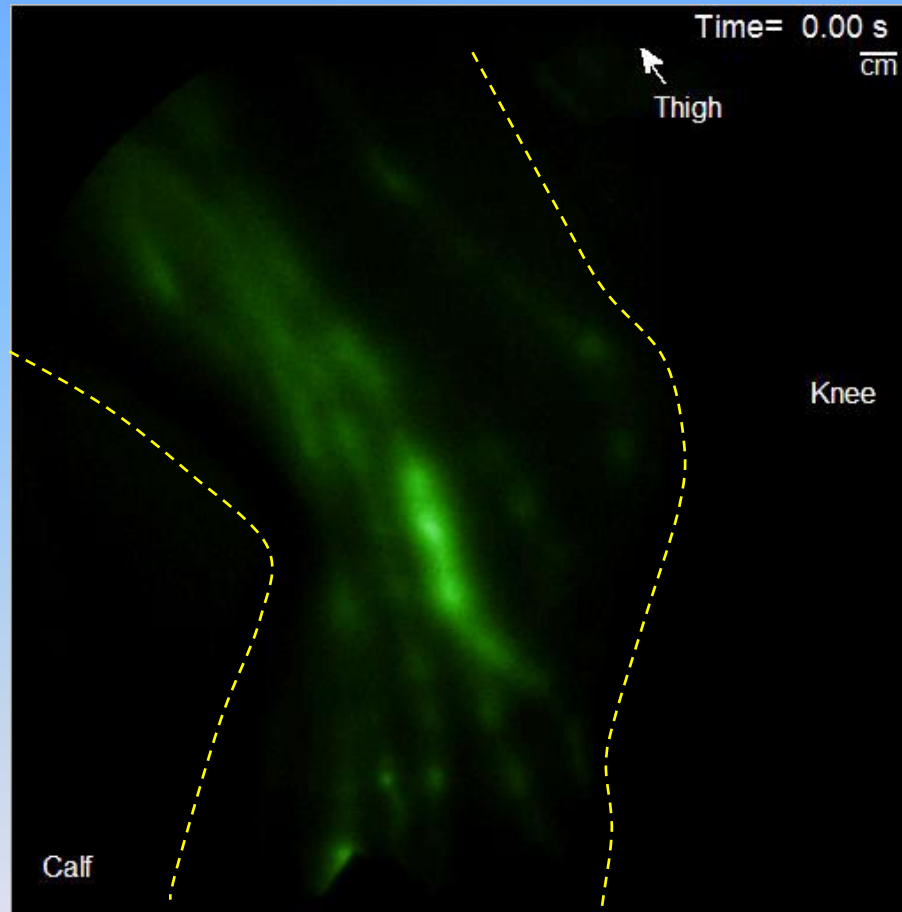
Lympho-scintigraphy: Range of Patterns/presentations



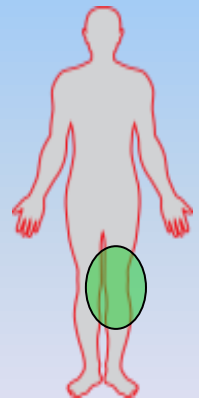
Normal

Dysfunctional

Indocyanine Green and Near-infrared lymphatic imaging (NIRFLI) - visualize the functional lymphatics



Normal Leg



Excess Fluid Management strategies

Most revolve around helping the lymphatic system work better (**improving lymph flow**) but some revolve around **reducing lymph load**

Factors which contribute to lymph load

- **Skin quality** – barrier function
- **Blood pressure** – when high
- **Strength** of small blood vessels (important in lipoedema)
- **Infection** of wounds, cuts and scratches
- **Weight**
- **Fats** (long chain) in diet
- **Venous system dysfunction** – (its also a drainage system) if its not working there is increased lymph load

Knowing these allows us to modify/control them!

Lymph Flow determined by

Lymph Load

Activity of Skeletal muscle

Rhythmicity of the lymph collectors

Variation in intra-thoracic pressure

Pressures exerted by surrounding structures

Be aware that simple events may slow lymph flow

- Bloating
- Constipation
- Fat **in** the tummy area
- Shallow Breathing
- Constant external pressure in wrong place

Key treatment/management areas

Compression (Bandages, Garments, Wraps)

Negative Pressure

Lymphatic Drainage techniques

Lymph taping

Skin Care

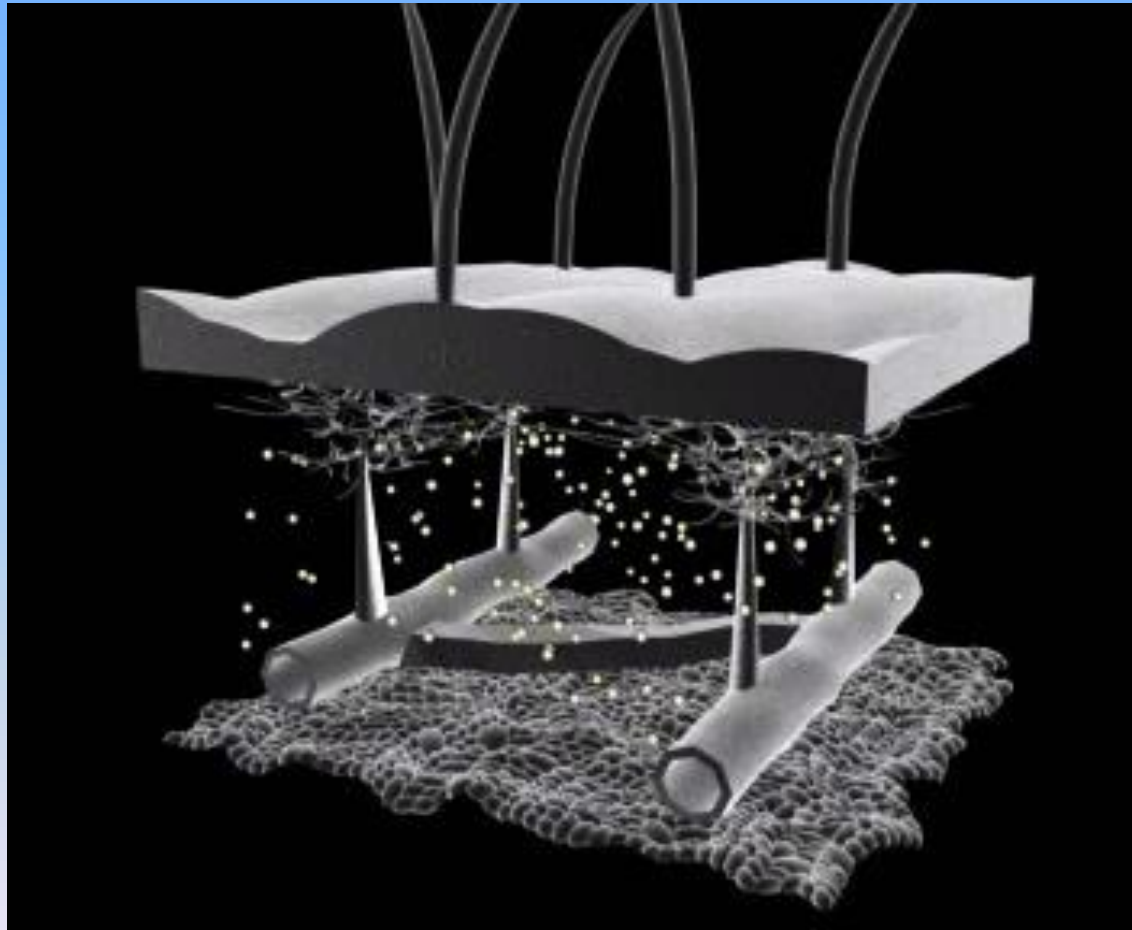
Activity/Exercise/Breathing

Diet (Anti-inflammatory, MCT)

Weight Management



Compression the core and basis of most treatments : What it's doing



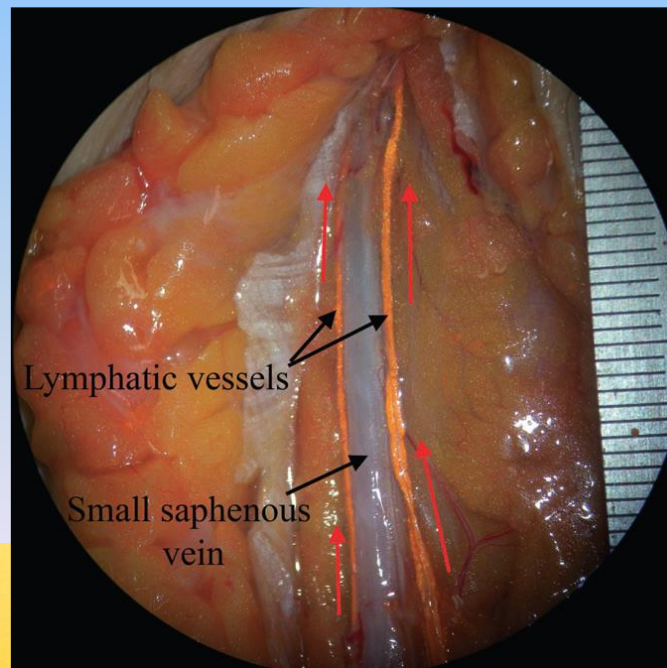
Compression achieved from

- **Tubigrip** – beware poor pressure gradients
- **Bandaging** – consider impact of
 - Short vs medium vs long stretch and how long pressure lasts
- **Garments** - consider impact of knit type
 - Round vs flat and how long the pressure lasts
- **Wraps** - can be adjusted by patient
- **Intermittent pneumatic compression**

What Compression does

- Reduce capillary filtration
- Shift fluids into non compressed parts
- Increase lymphatic reabsorption/transport
 - May improve sub-fascial lymph transport
- Improve venous pump (if dysfunction)
- Accelerate blood flow in venous leg ulcers
- Help breakdown fibro-sclerotic tissues

Always be aware that too much pressure may close the lymphatics or compromise venous drainage



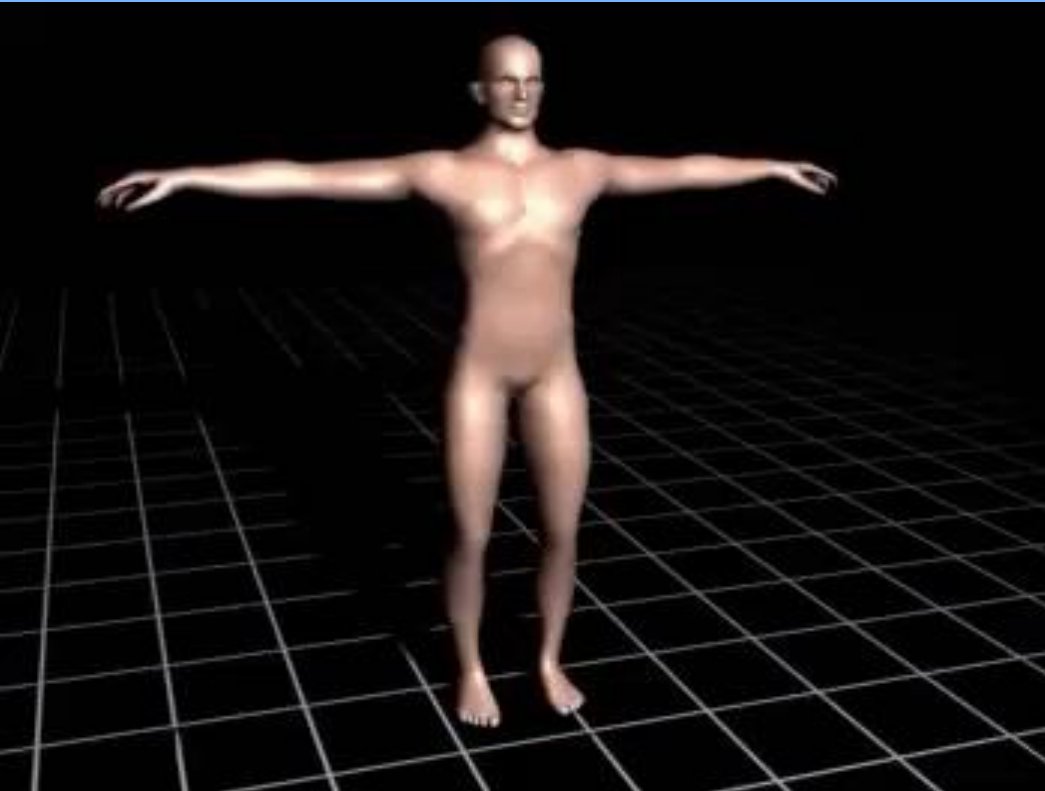
To Remove Oedema Prepare the Lymphatic System!

Reduce lymph load

**Clear/drain proximal lymphatic
pathways !!!**

Ensure un-obstructed flow of lymph
proximally from compressed area

Big picture overview



Drainage pathways from lower body are long and against gravity

Pressure - make sure its right !





Consider: Laplace's law

- Stronger curvature means higher pressure
- What if we don't get the pressure right?
 - At given point on a limb the pressure is **high over a lymph collector** or vein and low elsewhere

Consider Pascal's Law

- **Contained fluids:** A change in pressure in an enclosed fluid is **transmitted undiminished** to all parts of the fluid
- **Uncontained fluids:** Fluids will **flow down** a pressure gradient

What if the fluid is forced from the compressed area distally?

Ask yourself “Where are the vessels (Lymphatics and Veins) with respect to the compressed areas?”

WHY ? Because you do not want to wrongly compress a vein or lymphatic which could be helping the resolution of the oedema !!

If you get the pressure wrong !

Movement of any form,
breathing, walking, massage
will create pressure variation :
So impact of poor pressure or
wrong pressure may be
reduced

Wait ! What about negative pressures !

- Achieved by Respiratory movements
 - Diaphragmatic breathing
- Achieved by lymph/kinesio-taping
- Why **NEGATIVE PRESSURE** is important
 - **Fluids/contents will flow DOWN a pressure gradient**
 - If there is a lower pressure over/near lymphatic collectors/veins this will help clearance of fluids and their contents!

You can make a difference

Help the optimal resolution of
any oedema by helping the
lymphatic system work
optimally !

Its like a Sewer – and you
know what happens when its
not working !

BUT along the way

- We have to encourage good skin health
 - It's integrity as a barrier
 - Using Moisturisers, (with emollients, humectants, occlusives)
 - It's Microbiome
 - Good bacteria protect us from infection, help skin hydration (maintain/promote them)
 - Bad bacteria (Dysbiosis) can lead to psoriasis, problems with wound repair
 - Consider impact of diet/gut bacteria linkage to skin microbiome !

References

Making Legs Matter: A case for system change and transformation in lower-limb management. Consensus Document. Journal of Wound Care 2021; 30 (10)

Piller, N and Tehan, P **The Often ignored importance of the Lymphatics of the foot and legs:** Journal of Lymphoedema, 2023 18, 1

Assessing and Managing Lower Limb Oedema – A clinical review British Journal of Nursing 2024 33, 8-14

The Ultimate Guide to skin care. New Scientist #3523 Dec 2024 28

See also my pre- reading about the basics of **Substance -P**