LYMPHOEDEMA
EDUCATION SOLUTIONS

Upper Limb - Become a Lymphoedema Practitioner

LEVEL 1

SELF PACED ONLINE MANUAL

LYMPHOEDEMA
EDUCATION SOLUTIONS

Introduction

The Upper Limb Lymphoedema Course Online Manual is designed to assist with navigating your way through the modules and topics in this course.

The Table of Contents indicates what is included in this manual. The lessons and topics that are shaded indicates that there are handouts in this manual to assist you with watching the videos.
There are other resources to support these modules within the course that you can download as required.

Part of the online course is delivered by Klose Training. You will be directed to their online course as you work your way through the modules. These are indicated in italic in the table of contents. The handouts for Klose Training lectures can be accessed directly from their online course. Remember to follow the instructions in the LES course regarding which Klose section to complete then return to the LES upper limb course when you have completed that particular section.

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Anatomy of the Lymphatic System and the Lymphosome Concept with Reference to Lymphoedema

Hiroo Suami, MD, PhD. Mario F. Scaglioni, MD

Semin Plast Surg 2018; 32:5-11

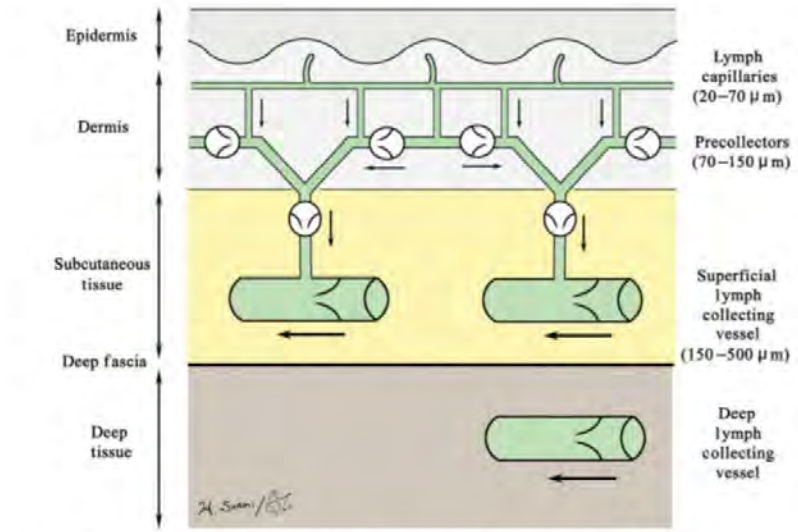


Fig. 1 Schematic diagram of the lymphatic system. (Adapted from Suami et al.[5] Reproduced with permission.)

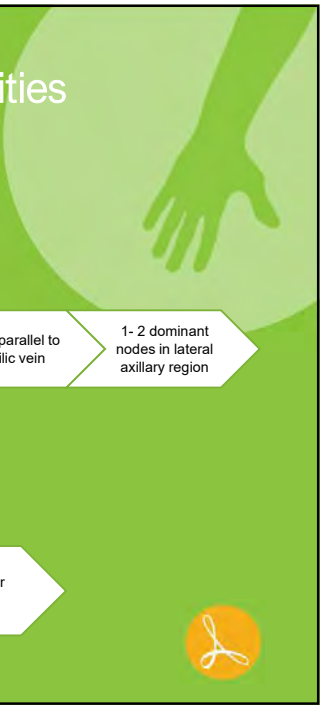
Regional and Interval Lymph Nodes

- Regional lymph nodes are groups of lymph nodes that form lymphatic basins into which lymph drains from different skin regions or organs.
- Interval lymph nodes are located in the limbs, lymph vessels pass through them on the way to the regional lymph nodes.
- Regional lymph nodes - more afferent lymph-collecting vessels than efferent lymph-collecting vessels.
- Interval lymph nodes - similar number of each type.

Superficial Lymphatic System - Upper Extremities

- Originates in the lymph capillaries in the fingertips and palm
- Lymph capillaries transition into pre-collectors in the dermis
- These join to superficial lymph collectors

Alternative



Lymphosomes

- Superficial lymph collecting vessels are arranged in a plane and don't overlap.
- Divide skin into territories which includes the superficial lymph collecting vessels and the nodes they are connected to.

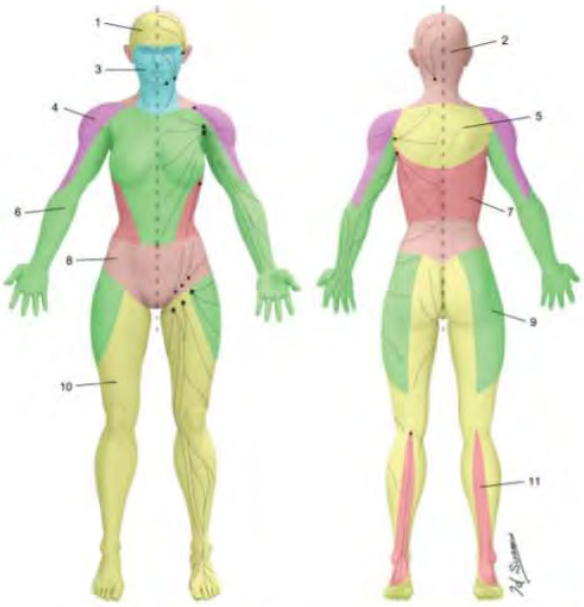
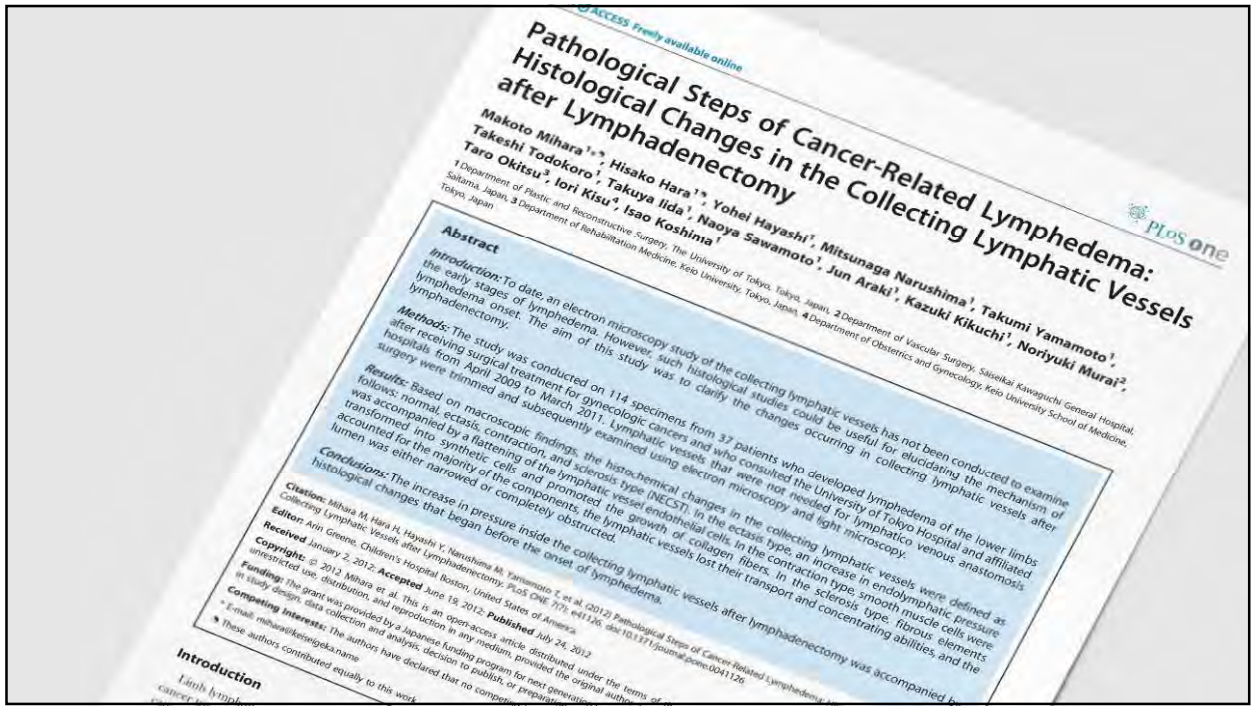


Fig. 6 Lymphosomes of the body. The lymphatic territories are demarcated according to their corresponding lymphatic basins: 1. temporal, 2. occipital, 3. submental, 4. subclavicular, 5. subscapular, 6. lateral axillary, 7. pectoral, 8. superior inguinal, 9. lateral inguinal, 10. inferior inguinal, 11. popliteal. (Reproduced with permission of Hiroo Suami, 2018.)

4 = Subclavicular
5 = Subscapular
6 = Lateral axillary
7 = Pectoral



Pathological Steps of Cancer-Related Lymphedema: Histological Changes in the Collecting Lymphatic Vessels after Lymphadenectomy

PLoS one

Freely available online

Makoto Mihara[1,*], Hisako Hara[1,*], Yohei Hayashi[1], Mitsunaga Narushima[1], Takumi Yamamoto[1], Takeshi Todokoro[1], Takuya Iida[1], Naoya Sawamoto[1], Jun Araki[1], Kazuki Kikuchi[1], Noriyuki Murai[2], Taro Okitsu[3], Iori Kisu[4], Isao Koshina[1]

1 Department of Plastic and Reconstructive Surgery, The University of Tokyo, Tokyo, Japan, 2 Department of Vascular Surgery, Saiseikai Kawaguchi General Hospital, Saitama, Japan, 3 Department of Rehabilitation Medicine, Keio University, Tokyo, Japan, 4 Department of Obstetrics and Gynecology, Keio University School of Medicine, Tokyo, Japan

Abstract

Introduction: To date, an electron microscopy study of the collecting lymphatic vessels has not been conducted to examine the early stages of lymphedema. However, such histological studies could be useful for elucidating the mechanism of lymphedema onset. The aim of this study was to clarify the changes occurring in collecting lymphatic vessels after lymphadenectomy.

Methods: The study was conducted on 114 specimens from 37 patients who developed lymphedema of the lower limbs after receiving surgical treatment for gynecologic cancers and who consulted the University of Tokyo Hospital and affiliated hospitals from April 2009 to March 2011. Lymphatic vessels that were not needed for lymphaticovenous anastomosis surgery were trimmed, and subsequently examined using electron microscopy and light microscopy.

Results: Based on macroscopic findings, the histochemical changes in the collecting lymphatic vessels were defined as follows: normal, ectasis, contraction, and sclerosis type (NECST). In the ectasis type, an increase in endolymphatic pressure was accompanied by a flattening of the lymphatic vessel endothelial cells. In the contraction type, smooth muscle cells were transformed into synthetic cells and promoted the growth of collagen fibers. In the sclerosis type, fibrous elements accounted for the majority of the components the lymphatic vessels lost their transport and concentrating abilities, and the lumen was either narrowed or completely obstructed.

Conclusions: The increase in pressure inside the collecting lymphatic vessels after lymphadenectomy was accompanied by histological changes that began before the onset of lymphedema.

Citation: Mihara M, Hara H, Hayashi Y, Narushima M, Yamamoto T, et al. (2012) Pathological Steps of Cancer-Related Lymphedema: Histological Changes in the Collecting Lymphatic Vessels after Lymphadenectomy. PLoS ONE 7(7): e41126. doi:10.1371/journal.pone.0041126

Editor: Arin Greene, Children's Hospital Boston, United States of America

Received January 2, 2012; **Accepted** June 19, 2012; **Published** July 24, 2012

Funding: The grant was provided by a Japanese funding program for next generation world-leading researchers. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: miharat@keiseigeka.name

These authors contributed equally to this work.

Introduction

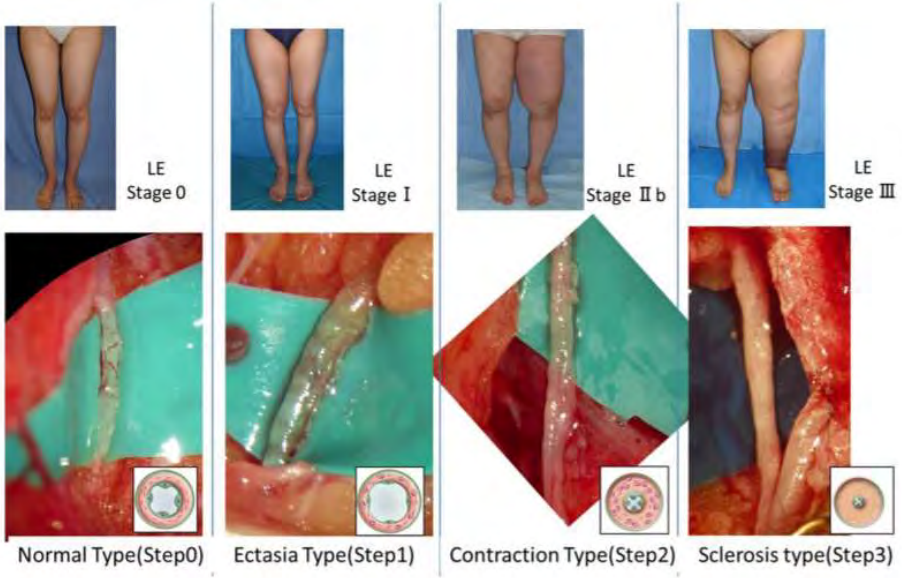


Figure 2. Staging of lymphedema and the macroscopic anatomical findings in the collecting lymphatic vessels associated with the stages.

Changes to Lymphatic Vessels

- Microvascular networks gradually lost with progression of disease.
- In the ectasis phase the lumen is dilated due to increase in endolymphatic pressure.
- Increase in smooth muscle cells and collagen fibers thickens the lymphatic wall.
- Lymphoedema progression causes the lymphatics to become harder, lost elasticity.

ELSEVIER

Surgical Oncology 27 (2018) 742–750

Contents lists available at ScienceDirect

Surgical Oncology

journal homepage: www.elsevier.com/locate/suronc

Patterns of lymphatic drainage after axillary node dissection impact arm lymphoedema severity: A review of animal and clinical imaging studies

Hiroo Suami[a,*], Louise Koelmeyer[b], Helen Mackie[a,b], John Boyages[a]

[a] Australian Lymphoedema Education, Research and Treatment Centre, Faculty of Medicine and Health Sciences, Macquarie University, Sydney, New South Wales, Australia
[b] Mt. Wilga Private Hospital, Hornsby, New South Wales, Australia

ARTICLE INFO

Keywords:
Anatomy
Lymphangiography
Imaging
Axillary node dissection
Lymphedema
Lymphoscintigraphy

ABSTRACT

Upper extremity lymphoedema after axillary node dissection is an iatrogenic disease particularly associated with treatment for breast or skin cancer. Anatomical studies and lymphangiography in healthy subjects identified that axillary node dissection removes a segment of the lymphatic drainage pathway running from the upper limb to the sub-clavicular vein, creating a surgical break. It is reasonable to infer that different patterns of lymphatic drainage may occur in the upper limb following surgery and contribute to the various presentations of lymphoedema from none to severe.

Firstly, we reviewed animal imaging studies that investigated the repair of lymphatic drainage pathways from the limb after lymph node dissection. Secondly, we examined clinical imaging studies of lymphatic drainage pathways after axillary node dissection, including lymphangiography and indocyanine green fluorescence lymphography. Finally, based on the gathered data, we devised a set of general principles for the restoration of lymphatic pathways after surgery.

Lymphoscintigraphy shows that restoration of the original lymphatic pathway to the axilla after lymphatic disruption by nodal dissection was not uncommon and may prevent lymphoedema. We found that original pathway or tortuating of the lymphatic pathway to the skin) contributed to other regional nodes. Variation in the lymphatic drainage pathway and the mechanisms of fluid new lymphatic drainage patterns considered to be significant in the phoedema develops.

1. Introduction

Upper extremity lymphoedema after axillary node dissection well-known iatrogenic disease particularly associated with for breast or skin cancers, including malignant melanoma extremity lymphoedema causes debilitating oedema, fatigue, discomfort and disfigurement, and psychosocial issues [3–5].

The incidence of [illegible] proximately [illegible] have

Pattern of Lymphatic Drainage

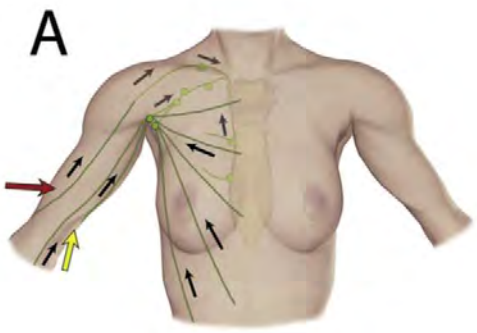
Research shows:

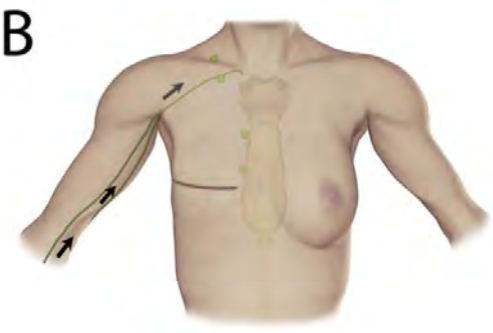
- Correlates to the severity of lymphoedema

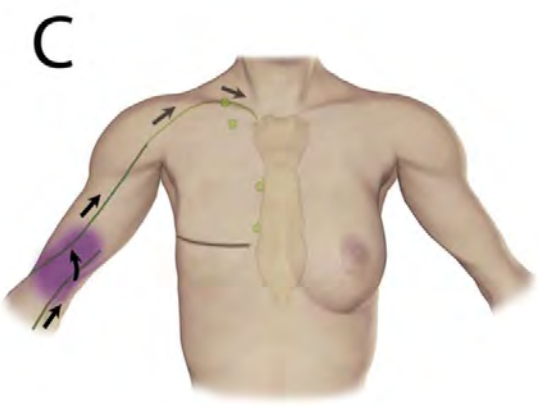
For example

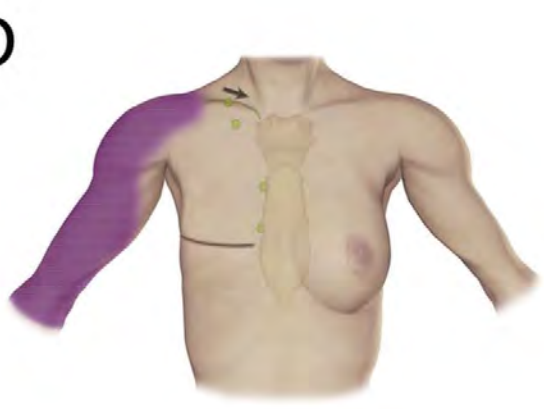
- Type 1 = follows usual path through the axilla = mild oedema
- Type 2 = stops at axilla and flows towards shoulder of lateral chest wall = moderate oedema
- Type 3 = stops at the axilla only = severe oedema

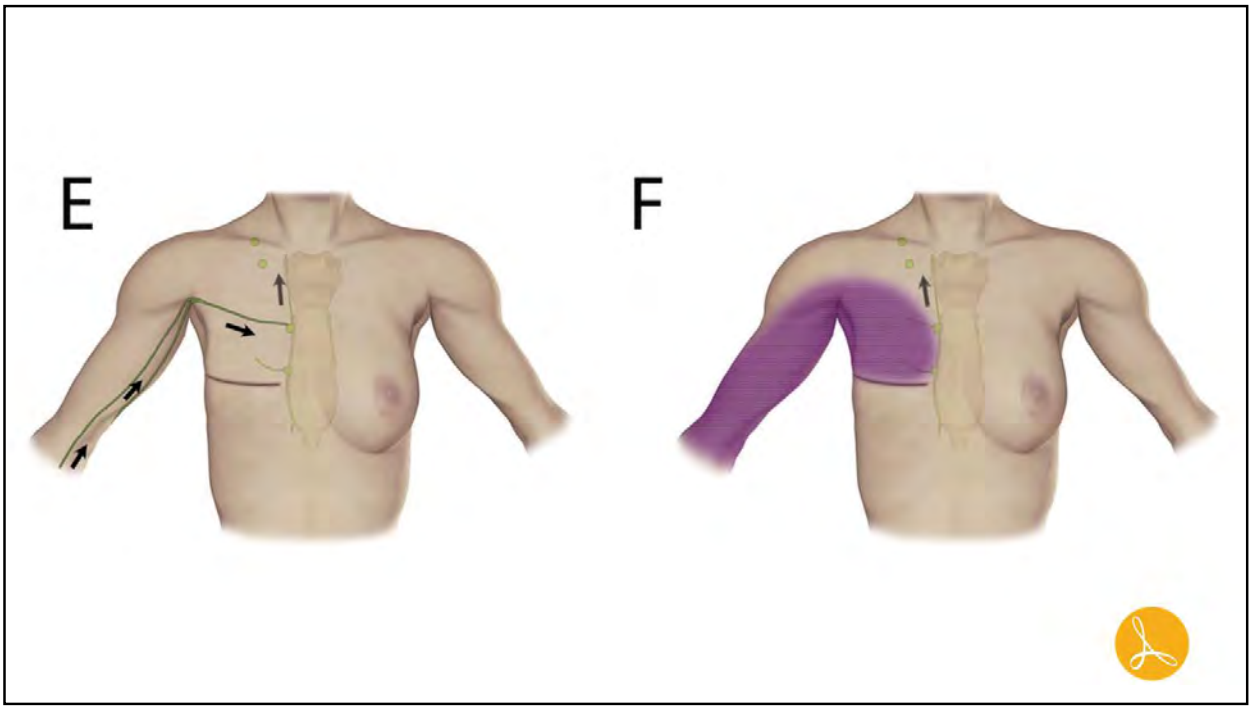
ICG Findings







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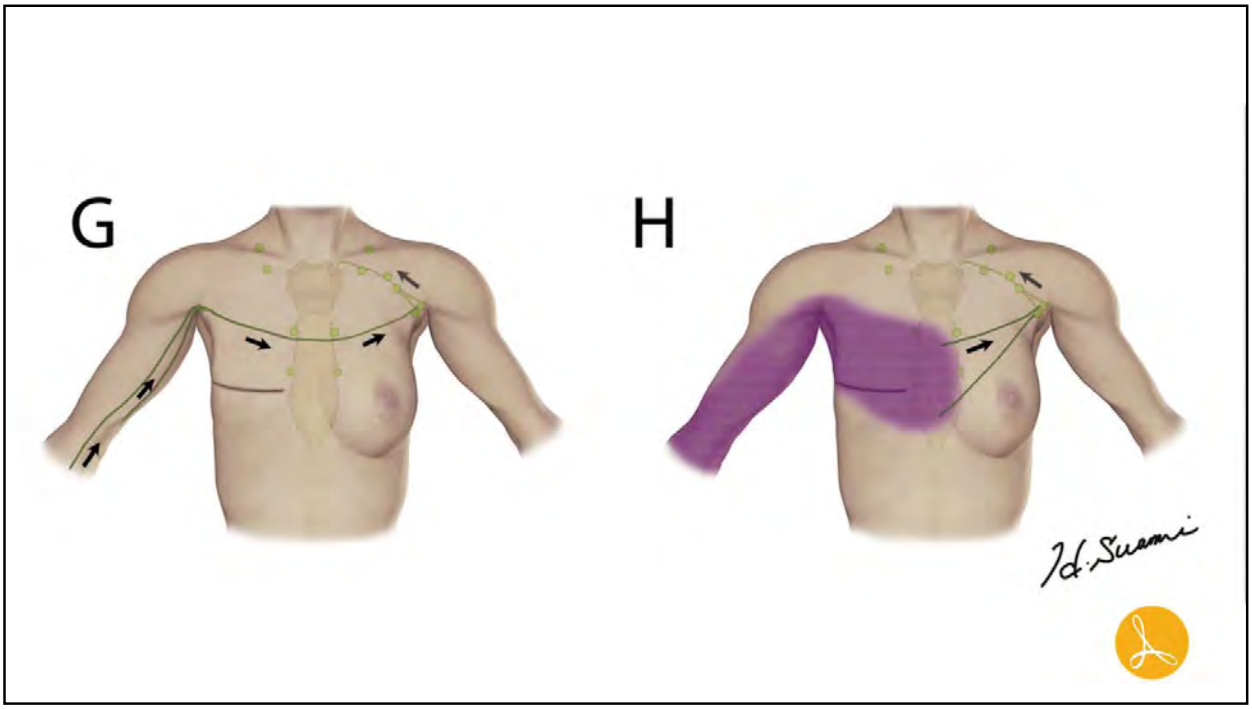
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DYSFUNCTION
LYMPHATIC
FAT
DEPOSITION
INFLAMMATION
THE VICIOUS
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LYMPHATIC DYSFUNCTION
SWELLING
RECURRENT INFECTION
FAT DEPOSITION
ONGOING INFLAMMATION
INCREASING FIBROUS TISSUE
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Incidence of lymphoedema is it all about the nodes?

Ann Surg Oncol (2017) 24:1064–1070
DOI 10.1245/s10434-016-5669-2

Annals of SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – BREAST ONCOLOGY

Sentinel-Lymph-Node-Based Management or Routine Axillary Clearance? Five-Year Outcomes of the RACS Sentinel Node Biopsy Versus Axillary Clearance (SNAC) 1 Trial: Assessment and Incidence of True Lymphedema

Neil Wetzig, MB BS, FRCS, FRACS[1], Peter Grantley Gill, MB BS, MD, FRACS[2,3], David Espinoza, BArch, BSc[4], Rebecca Mister, Bsc, MSc[4], Martin R. Stockler, MB BS, MSc, FRACP[4,5], Val J. Gebski, BA, MStat[4], Owen A. Ung, MB BS, FRACP[6,7], Ian Campbell, MB ChB, FRACS[8], and John Simes, MD, BSc(Med), SM, FRACP[4]

ALND = 26%
SLNB = 17%

More marked oedema
ALND = 5%
SLNB = 1.7%

The Breast 36 (2017) 67–73

Contents lists available at ScienceDirect

The Breast

journal homepage: www.elsevier.com/brst

Original article

Incidence and risk factors of lymphedema after breast cancer treatment: 10 years of follow-up

Ana Carolina Padula Ribeiro Pereira [a], Rosalina Jorge Koifman [a], Anke Bergmann [b, *]

[a] National School of Public Health, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil

Cumulative incidence ALND = 41.1% in 10 years

75.3% of cases in first 4 years

Breast Cancer (2018) 25:309–314
https://doi.org/10.1007/s12282-018-0830-3

ORIGINAL ARTICLE

The incidence and risk factors of related lymphedema for breast cancer survivors post-operation: a 2-year follow-up prospective cohort study

Li Zou[1] · Feng-hua Liu[1] · Pei-pei Shen[1] · Yan Hu[1] · Xiao-qian Liu[1] · Ying-ying Xu[1] · Qi-liang Pen[1] · Bei Wang[2] · Ya-qun Zhu[1] · Ye Tian[1]

ALND = 21.4 % in first 2 years

Lymphedema Incidence After Axillary Lymph Node Dissection

Quantifying the Impact of Radiation and the Lymphatic Microsurgical Preventive Healing Approach

Anna Rose Johnson, MPH, Sarah Kimball, MD,† Sherise Epstein, MD, MPH,*‡ Abram Recht, MD,§ Samuel J. Lin, MD, MBA,* Bernard T. Lee, MD, MBA, MPH,* Ted A. Ivmes, MD, MS // and Dhruv Singhal, MD**

Annals of Plastic Surgery • Volume 82, Supplement 3, April 2019 *Lymphedema After Axillary Management*

ALND = 14.1%

ALND + RLNR = 33.4 %

Incidence and Time Path of Lymphedema in Sentinel Node Negative Breast Cancer Patients: A Systematic Review

Nick Gebruers, PhD, PT,[a] Hanne Verbelen, PT,[a] Tessa De Vrieze, PT,[a] Dorith Coeck, PT,[a] Wiebren Tjalma, PhD, MD[b,c]

Archives of Physical Medicine and Rehabilitation 2015;96:1131-9

- **20% of SLNB have a lymphatic route that passes the sentinel node (s)**
- **6.6 % of these developed lymphedema**
- **Time frame – usually 6 – 12 months after surgery**

Recent Progress in the Treatment and Prevention of Cancer-Related Lymphedema

Simona F. Shaitelman, MD, EdM[1]; Kate D. Cromwell, MS, MPH[2]; John C. Rasmussen, PhD[3]; Nicole L. Stout, DPT, CLT-LANA[4]; Jane M. Armer, RN, PhD, FAAN[5]; Bonnie B. Lasinski, MA, PT, CLT-LANA[6,7]; Janice N. Cormier, MD, MPH[8]*

CA CANCER J CLIN 2015;65:55–81

Pooled incidence BCRL

- **SLNB 6.3% (0 – 23%)**
- **ALND 22.3% (11-57%)**

Is it just the nodes?

- Radiotherapy – breast, axilla, supra clavicular
- Chemotherapy – taxanes
- BMI vs fat mass
- BP, IV, etc
- Air travel
- AWS
- Seroma
- Cellulitis
- Anatomy

Is it just the nodes?

- Radiotherapy – breast, axilla, supra clavicular
- Chemotherapy – taxanes

The Impact of Taxane-based Chemotherapy on the Lymphatic System

Anna Rose Johnson, MPH, Melisa D. Granoff, BA,* Bernard T. Lee, MD, MBA, MPH, FACS,* Timothy P. Padera, PhD,† Echoe M. Bouta, PhD,† and Dhruv Singhal, MD**

Annals of Plastic Surgery • Volume 82, Supplement 3, April 2019 www.annalsplasticsurgery.com

- Variability observed in the contractility rates between the 4 different taxane-based NAC regimens
- Did not identify a statistically significant difference in the lymphatic contractility rates
- Those with taxane-based neuropathy had statistically significant lower contractility rate

Current Breast Cancer Reports
https://doi.org/10.1007/s12609-020-00379-8

LYMPHEDEMA INCIDENCE, PREVENTION AND TREATMENT (J ARMER, SECTION EDITOR)

Drugs and Breast Cancer–Related Lymphoedema (BCRL): Incidence and Progression

Vaughan Keeley[1,2]

Published online: 14 August 2020

- Docetaxel can lead to reversible peripheral oedema affecting the lower limbs in up to 60% of patients.
- Relationship between the cumulative dose of docetaxel and oedema. Often not present until the fourth or fifth cycle of treatment
- Growing evidence that it is a risk factor for the development of BCRL.

Is it just the nodes?

- BMI vs fat mass
- BP, IV, etc
- Air travel

- N = 632 subjects.
- SLNB group = 541
  - 22 of these developed lymphoedema
- ALND group = 159
  - 34 went on to develop lymphoedema
- BMI and cellulitis remained significant
- Blood draws, injections, blood pressures, trauma, and air travel, were not associated with increased arm swelling.
- Question the sample size of ALND v SLNB.
- One form of objective measurement

Debunking Lymphedema Risk-Reduction Behaviors: Risky Conclusions

Guest Editorial

- Diagnosis of lymphoedema cannot be made by perometry alone.
- Lymphoedema isn't a static disease and those women with fluctuating swelling and swelling in the hands, trunks, or breasts will be missed by the perometer
- Very few recalled having experienced "risky" behaviour in their arms.
- No differentiation between manual blood pressure readings and repetitive automated readings

Is it just the nodes?

- Cellulitis
- Anatomy
- Seroma
- AWS

Supportive Care in Cancer
https://doi.org/10.1007/s00520-020-05424-x

ORIGINAL ARTICLE

Check for updates

Incidence and predictors of axillary web syndrome and its association with lymphedema in women following breast cancer treatment: a retrospective study

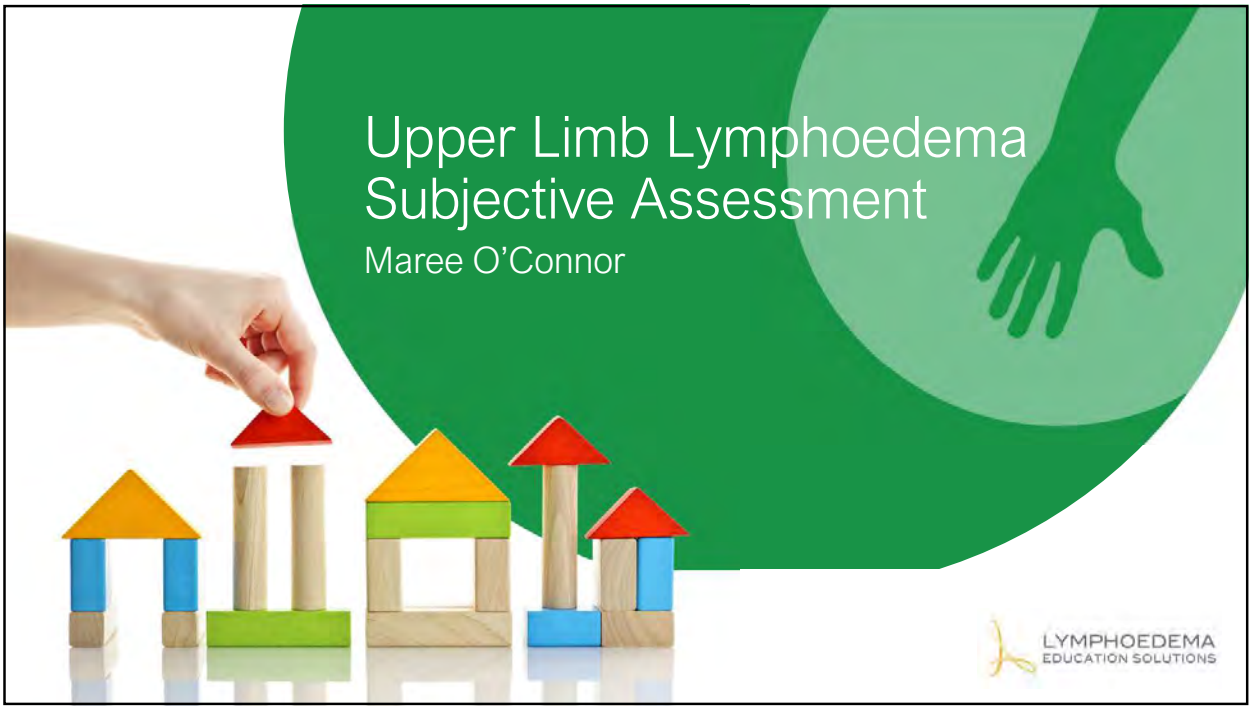
Kathryn Ryans[1,2] · Claire C. Davies[3] · Gizela Gaw[4] · Caroline Lambe[5] · Morgan Henninge[6] · Lisa VanHoose[7]

Received: 4 November 2019 / Accepted: 17 March 2020

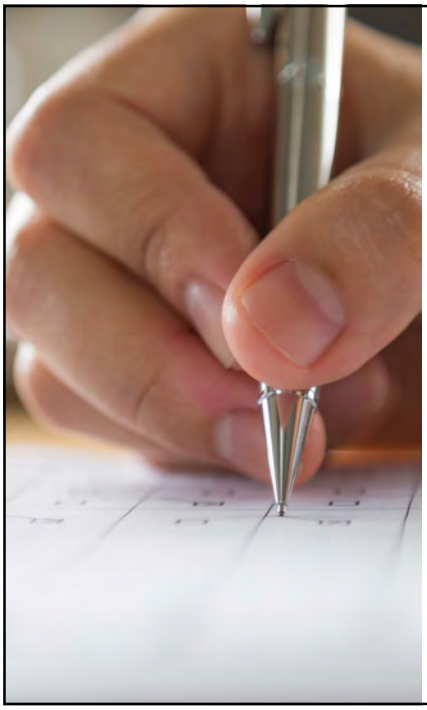
- Retrospective study of 354 women
- Women with AWS had 44% greater risk to develop lymphedema during the first postoperative year.
- If AWS developed within the first postoperative month, women were almost 3 times more likely to develop lymphedema within the first 3 postoperative months compared with other women with AWS

Risk Assessment

- Objective measuring tools
- Surveillance over a period of time



A model for decision making

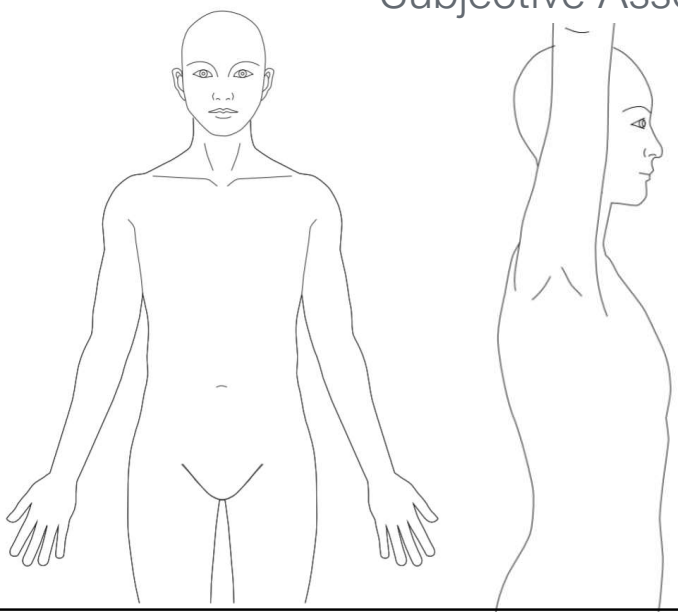


Subjective Assessment

Cancer management

- Surgical – ALND, SNB, Reconstruction
- Chemotherapy – hot flushes, weight gain, peripheral neuropathy, bone loss, increase oedema
- Radiotherapy – Breast vs Axilla vs Supraclavicular
- Hormone therapy – Tamoxifen
- When did they last see a specialist?
- Have there been any tests to investigate the swelling

Subjective Assessment



Lymphoedema History

Where is the swelling? (Also include chest wall/breast)

For each of the areas how long has the client had swelling?

a) Months?
b) Years?

When is the swelling present?

a) All day
b) End of day
c) Certain activities
d) Summer only

Does the swelling disappear completely overnight or on elevation?

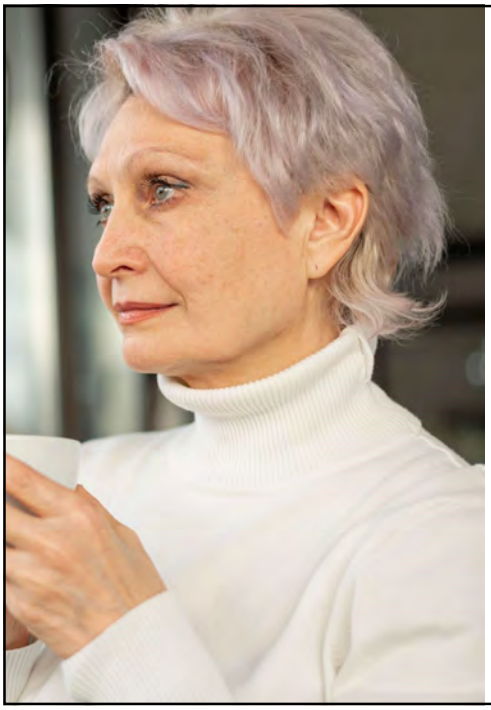
Yes / No / Don't know

What is their current living arrangement?

Cellulitis

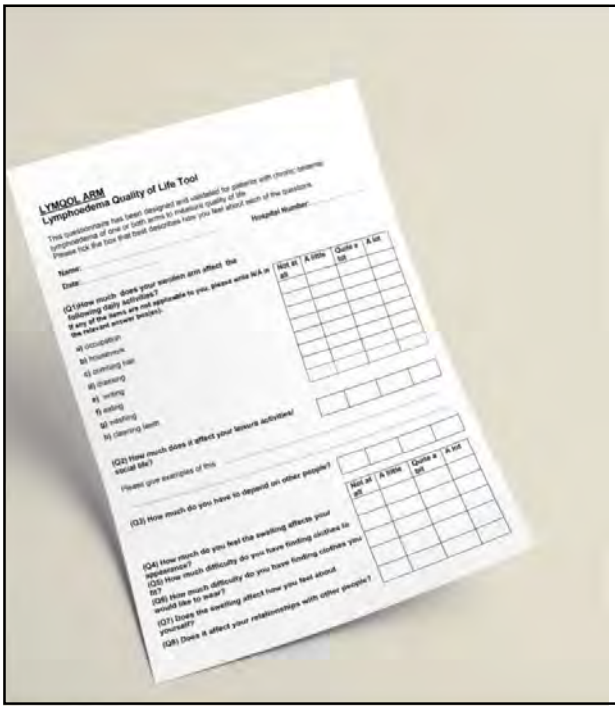
Previous episodes of cellulitis ?

- How many?
- Date of last episode?
- Management?



A Quality of Life Measure for Limb Lymphoedema (LYMQOL)

- Assess the impact of lymphoedema and also monitor the impact of treatment
- It is a validated tool
- Used in many clinical trials
- Resources available in this module. This course provides you with access to this tool and any updates that may occur.

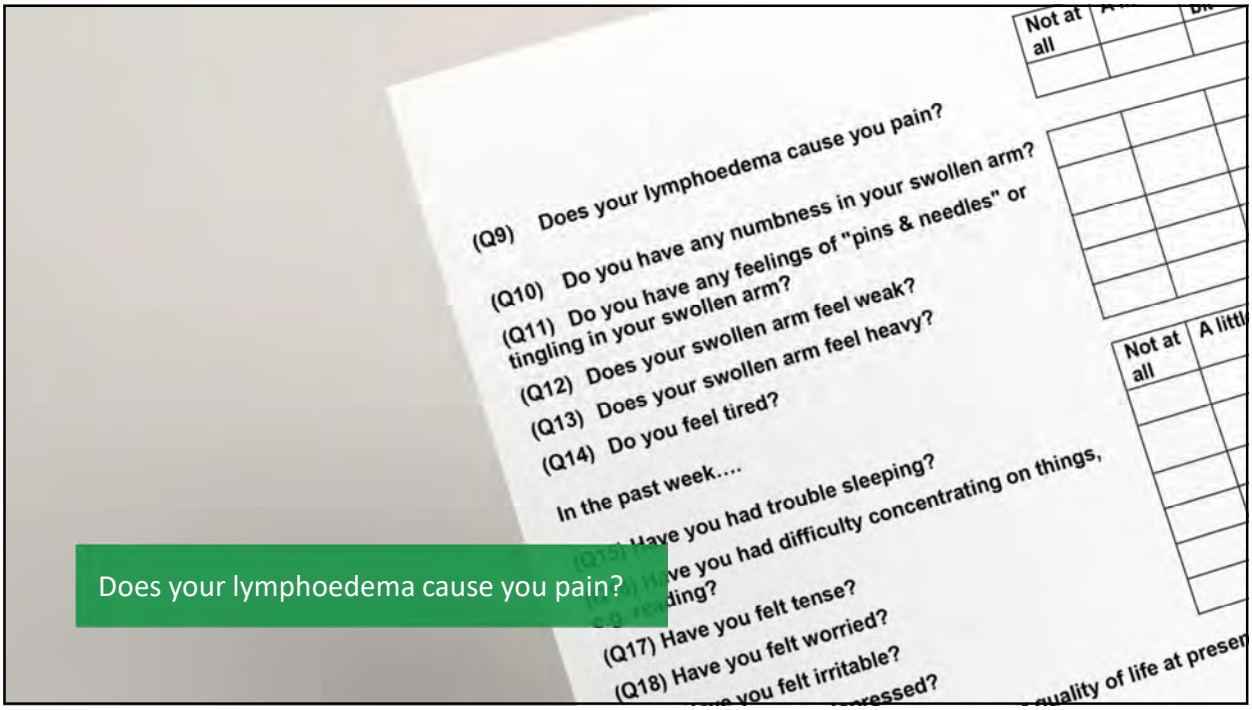


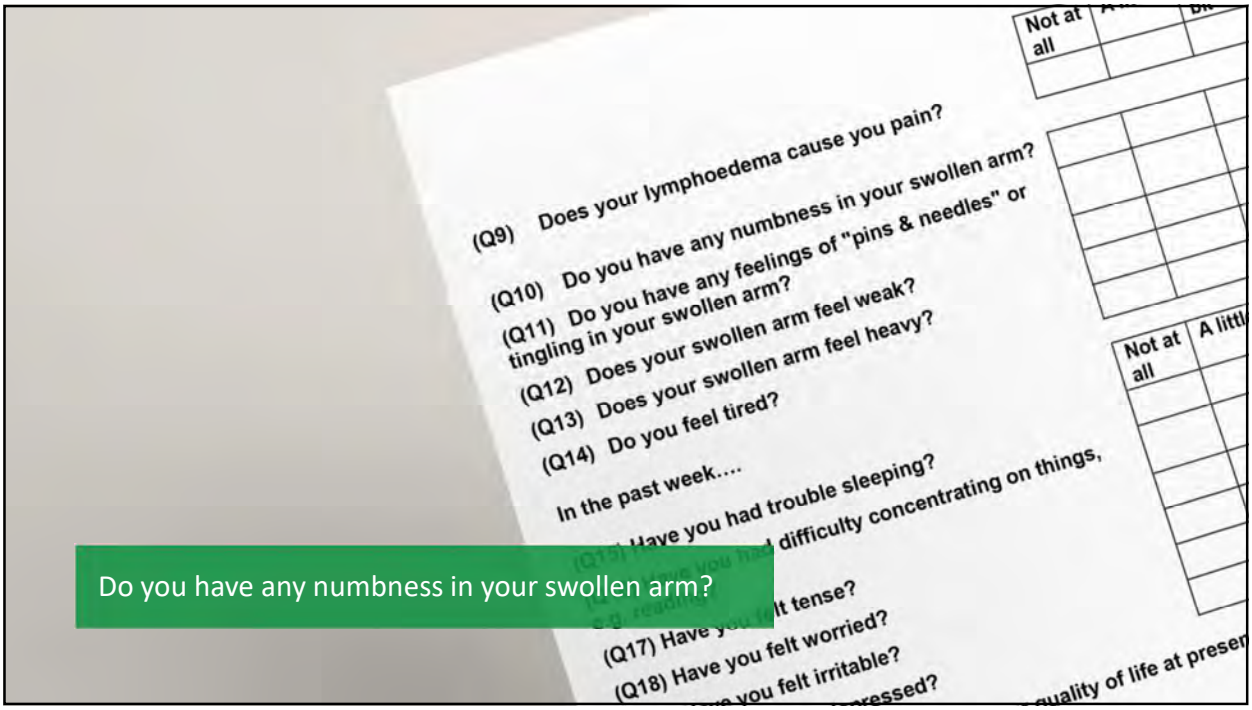
LYMQOL

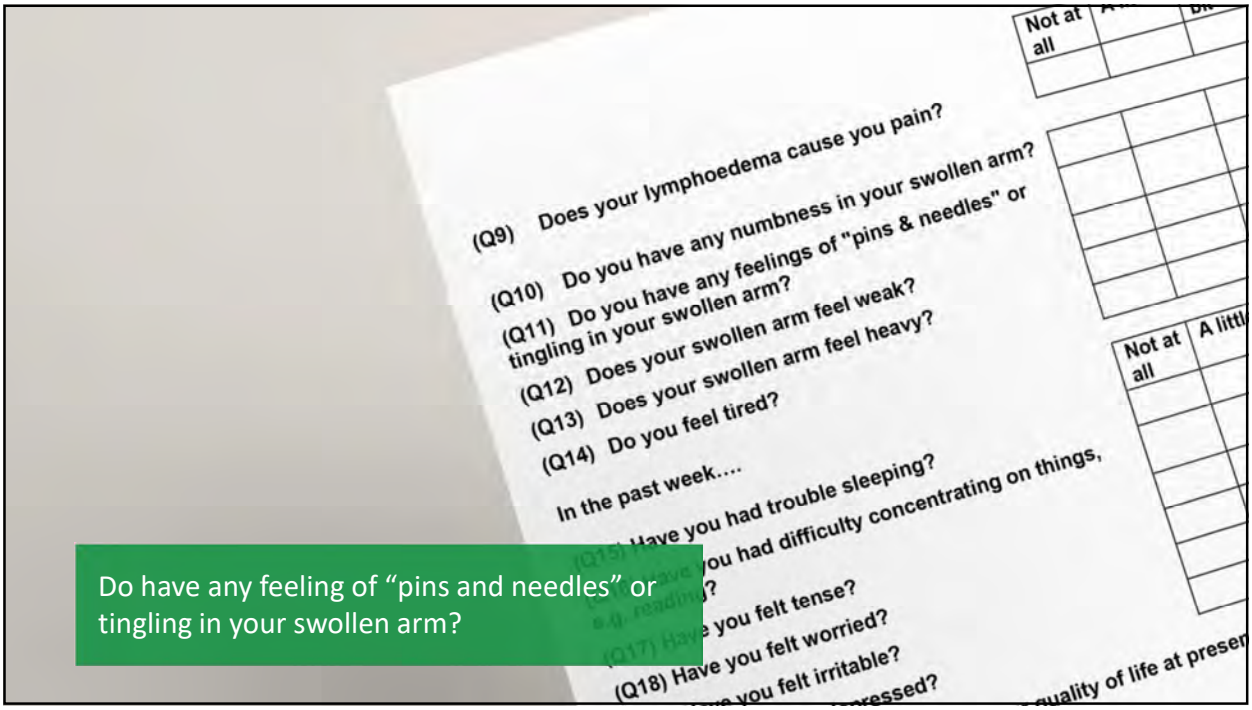
- How much does your swollen arm affect daily activities?
  - Occupation
  - Housework
  - Dressing
  - Washing
  - Cleaning teeth etc
- How much does it affect your leisure activities/ social life?
- How much do you have to depend on other people?
- How much do you feel the swelling affects your appearance?
- How much difficulty do you have finding clothes to fit?

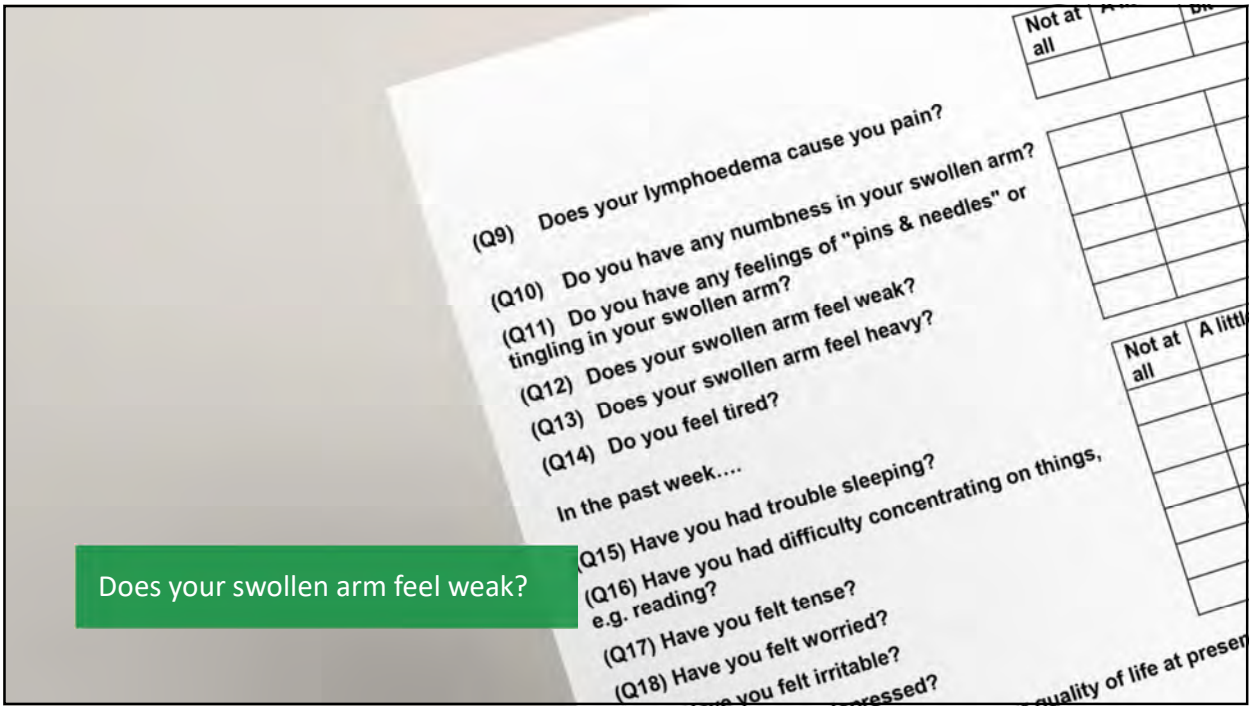
LYMQOL

- How much difficulty do you have finding clothes you would like to wear?
- Does the swelling affect how you feel about yourself?
- Does it affect your relationships with other people?




Not at all
(Q9) Does your lymphoedema cause you pain?
(Q10) Do you have any numbness in your swollen arm?
(Q11) Do you have any feelings of "pins & needles" or tingling in your swollen arm?
(Q12) Does your swollen arm feel weak?
(Q13) Does your swollen arm feel heavy?
(Q14) Do you feel tired?
In the past week....
(Q15) Have you had trouble sleeping?
(Q17) Have you felt tense?
(Q18) Have you felt worried?
Have you felt irritable?
Not at all
A littl
Do you have any numbness in your swollen arm?


Not at all
(Q9) Does your lymphoedema cause you pain?
(Q10) Do you have any numbness in your swollen arm?
(Q11) Do you have any feelings of "pins & needles" or tingling in your swollen arm?
(Q12) Does your swollen arm feel weak?
(Q13) Does your swollen arm feel heavy?
(Q14) Do you feel tired?
In the past week....
(Q15) Have you had trouble sleeping?
(Q17) Have you felt tense?
(Q18) Have you felt worried?
Have you felt irritable?
Not at all
A littl
Do have any feeling of “pins and needles” or tingling in your swollen arm?


Not at all
(Q9) Does your lymphoedema cause you pain?
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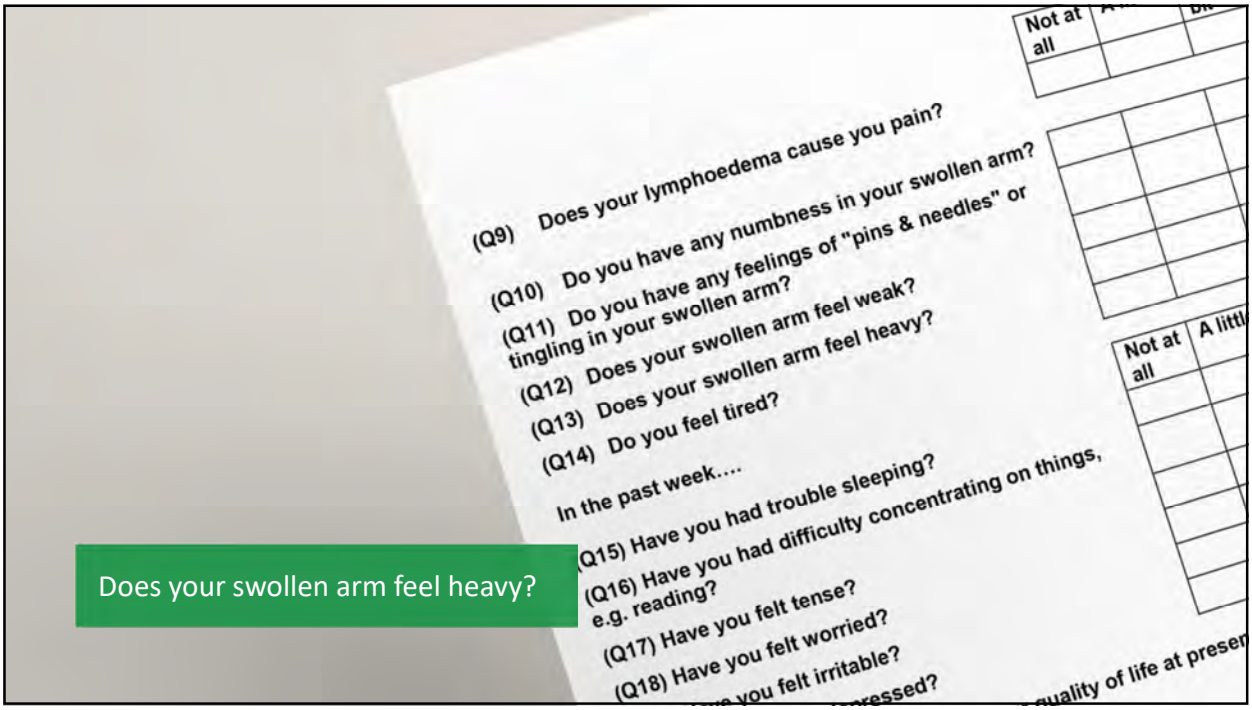
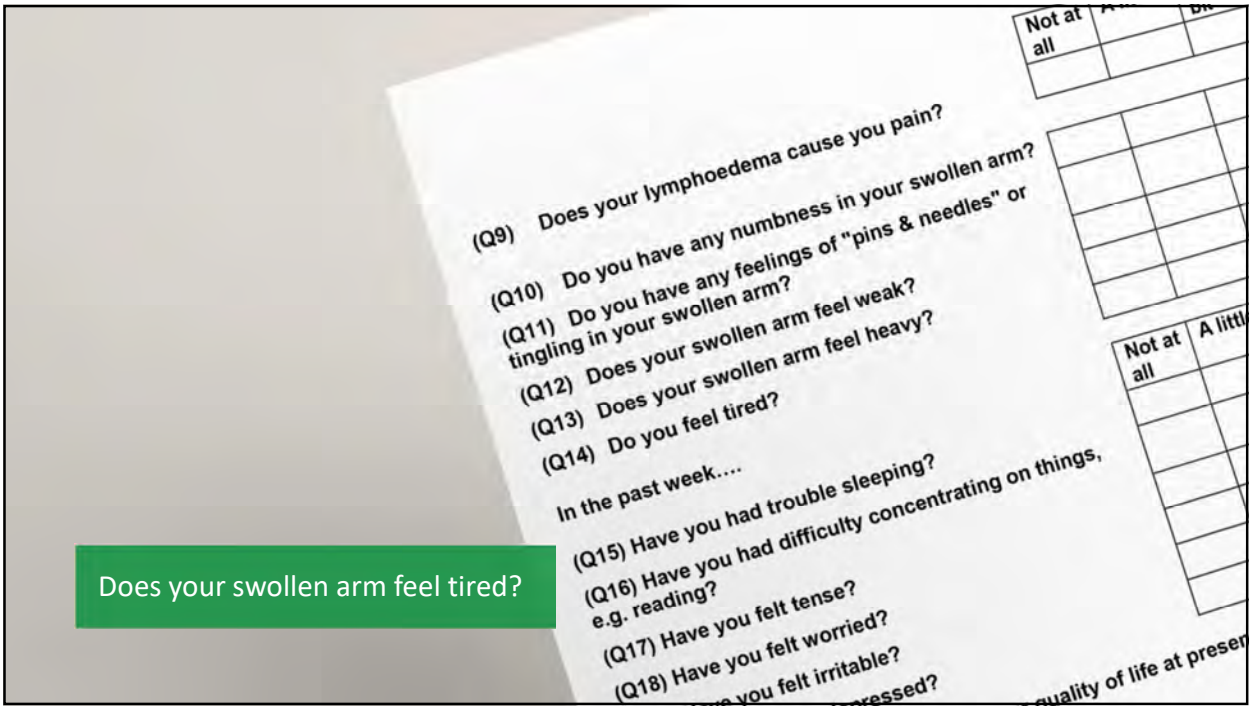
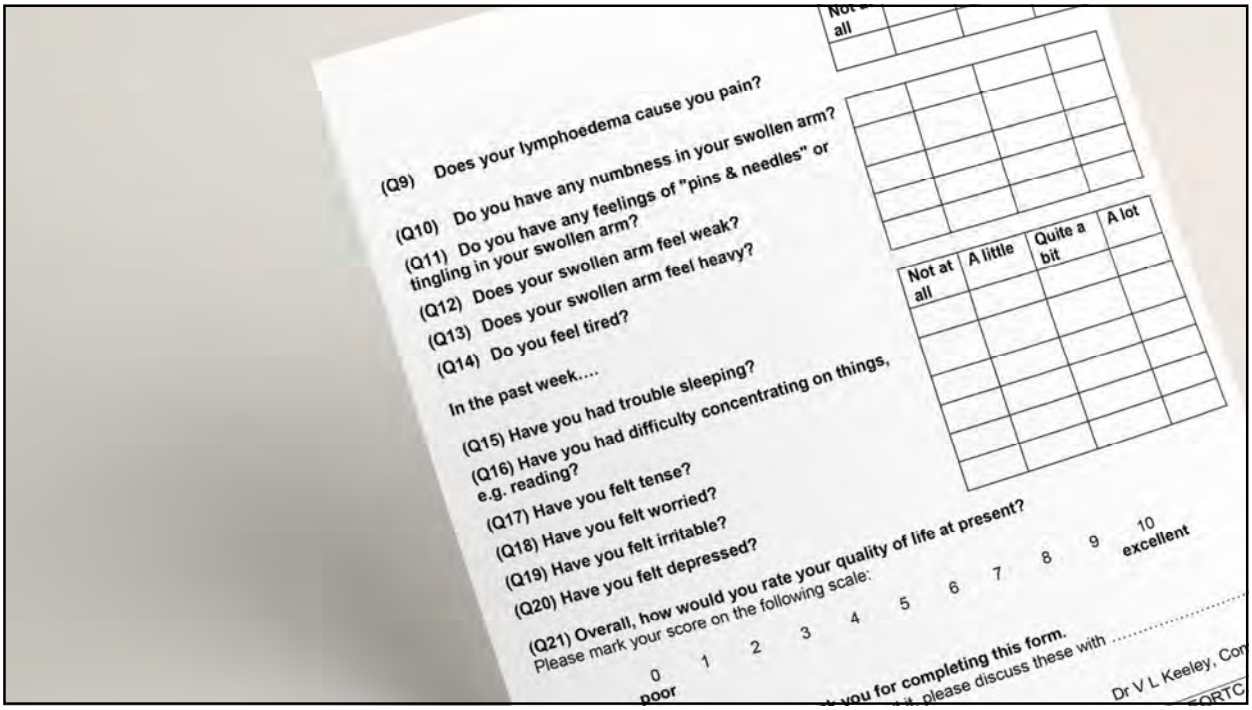
(Q11) Do you have any feelings of "pins & needles" or tingling in your swollen arm?
(Q12) Does your swollen arm feel weak?
(Q13) Does your swollen arm feel heavy?
(Q14) Do you feel tired?
In the past week....
(Q15) Have you had trouble sleeping?
(Q16) Have you had difficulty concentrating on things, e.g. reading?
(Q17) Have you felt tense?
(Q18) Have you felt worried?
you felt irritable?
quality of life at preser
Does your swollen arm feel weak?


Not at all
(Q9) Does your lymphoedema cause you pain?
(Q10) Do you have any numbness in your swollen arm?
(Q11) Do you have any feelings of "pins & needles" or tingling in your swollen arm?
(Q12) Does your swollen arm feel weak?
(Q13) Does your swollen arm feel heavy?
(Q14) Do you feel tired?
In the past week....
(Q15) Have you had trouble sleeping?
(Q16) Have you had difficulty concentrating on things, e.g. reading?
(Q17) Have you felt tense?
(Q18) Have you felt worried?
you felt irritable?
quality of life at preser
Does your swollen arm feel heavy?



Does your swollen arm feel tired?



Any other issues?

- Shoulder
- Arthritis
- Heart
- Balance
- Other surgery
- Other medical issues

Previous Treatment

- When was the last treatment?
- What was the treatment and did it help?

If compression garments worn, type, compression, style, how old and outcome.

Social history

Activities of Daily Living –

- What activities is the person involved in - include social as well as exercise. Include what they achieve with this activity and how often?

E.g walking how far (do they measure this with eg a pedometer) how long and how often

- What activities would they like to be able to do. Is this currently limited by the oedema?

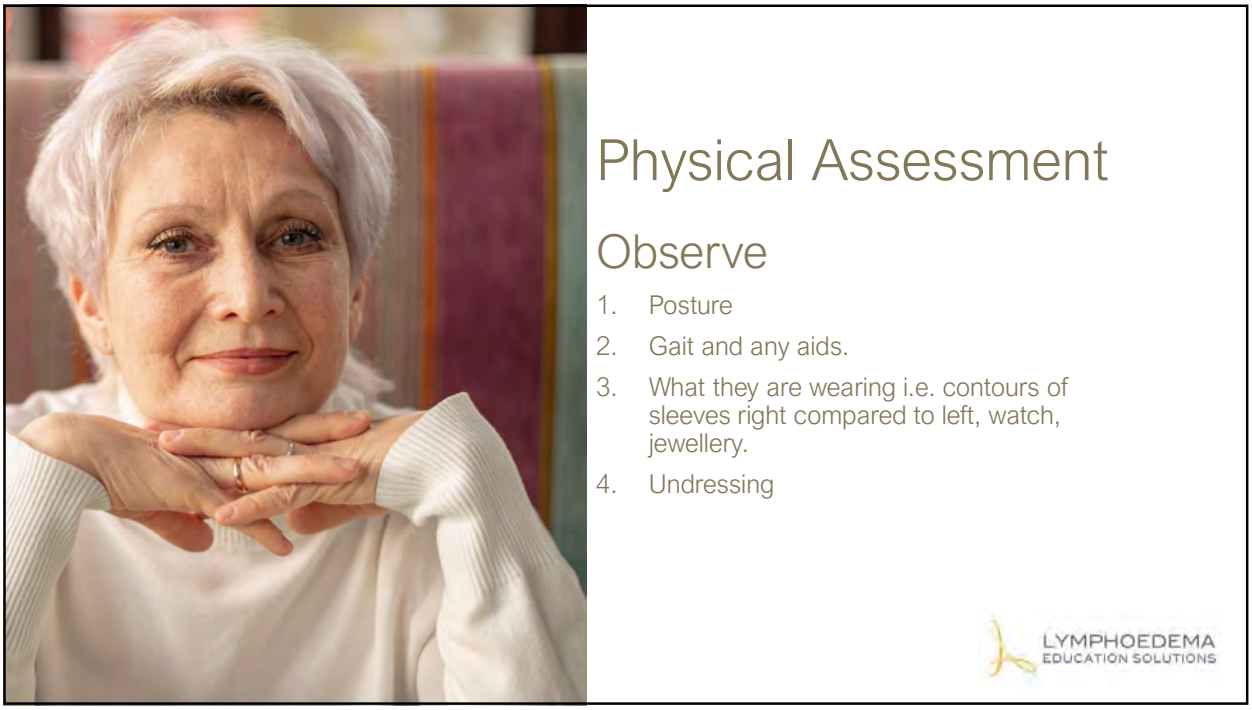
Medication

- GP should review all medication

Clients Goals

- What do they want to achieve in relation to the swelling?
- Be specific breast versus arm


Objective Assessment
Observation
LYMPHOEDEMA
EDUCATION SOLUTIONS


Physical Assessment
Observe
1. Posture
2. Gait and any aids.
3. What they are wearing i.e. contours of sleeves right compared to left, watch, jewellery.
4. Undressing
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Physical Examination - A. Observe continued

4. Basic upper limb range of movement comparing left to right.
   - Shoulder Flexion
   - Shoulder Abduction
   - Hand behind head
   - Hand behind back

   If any abnormalities detected further investigation or if outside your scope of practice refer on.

Physical Examination - A. Observe continued

5. Contours of the normal limb versus unaffected side
   - Identify location - note on assessment form
   - Asymmetry
   - Marks left by clothing
6. Skin integrity
   - Is there evidence of an skin break / wound?
   - dryness,
7. Colour - Is the skin colour of the arm and chest wall normal or red?

Guide to Observation

OBSCURATION OF ANATOMICAL STRUCTURES

ANATOMICAL STRUCTURE	NONE	CLOSE INSPECTION	READILY APPARENT
Knuckles Metacarpal phalangeal (MCP) joint (2-4)	Symmetrical convexity of MCP joints, and symmetrical concavity between 2nd-3rd, 3rd-4th, and 5th MCP joints	Loss of convexity or concavity but still able to visualize with full digit flexion compared to unaffected side.	Complete loss of convexity or concavity; unable to visualize MCP joints with full digit flexion

Knuckles

☐ None

☐ Close Inspection

☐ Readily Apparent

OBSCURATION OF ANATOMICAL STRUCTURES

ANATOMICAL STRUCTURE	NONE	CLOSE INSPECTION	READILY APPARENT
Extensor tendons	Symmetrical appearance of extensor tendons at dorsal hand	Extensor tendons not as prominent compared to unaffected side with full active digit extension and abduction	Unable to visualize extensor tendons

Extensor Tendons

☐ None

☐ Close Inspection

☐ Readily Apparent

OBSCURATION OF ANATOMICAL STRUCTURES

ANATOMICAL STRUCTURE	NONE	CLOSE INSPECTION	READILY APPARENT
Flexor tendons	Symmetrical appearance of flexor tendons at ventral wrist	Flexor tendons not as prominent with active wrist and finger flexion and thumb opposition compared to unaffected side	Unable to visualize flexor tendons

Flexor Tendons

☐ None

☐ Close Inspection

☐ Readily Apparent

OBSCURATION OF ANATOMICAL STRUCTURES

ANATOMICAL STRUCTURE	NONE	CLOSE INSPECTION	READILY APPARENT
Ulnar Styloid	Symmetrical appearance of ulnar styloid	Ulnar styloid less visible compared to unaffected side; loss of convexity	Unable to visualize ulnar styloid

Ulnar Styloid

☐ None

☐ Close Inspection

☐ Readily Apparent

OBSCURATION OF ANATOMICAL STRUCTURES

ANATOMICAL STRUCTURE	NONE	CLOSE INSPECTION	READILY APPARENT
Olecranon process	Symmetrical appearance of olecranon process with elbow flexed	Olecranon process less prominent compared to unaffected side	Unable to visualize olecranon process

Elbow

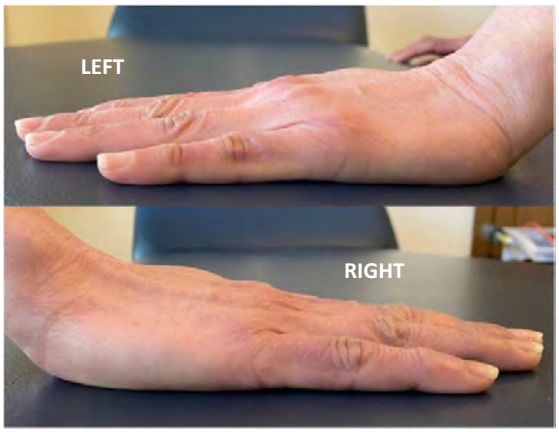
- ☐ None
- ☐ Close Inspection
- ☐ Readily Apparent

DEVIATION FROM NORMAL ANATOMICAL ARCHITECTURE

ANATOMICAL REGION	NORMAL	READILY APPARENT	GROSS DEVIATION
Hand	Symmetrical appearance of hand; relatively flat dorsal hand with a smooth transition between the hand and digits.	"Hump" on the dorsal aspect of the hand (raised <1cm)	"Hump" on the dorsal aspect of the hand (raised >1cm)

Posterior Hand

- ☐ None
- ☐ Readily Apparent
- ☐ Gross Deviation



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DEVIATION FROM NORMAL ANATOMICAL ARCHITECTURE

ANATOMICAL REGION	NORMAL	READILY APPARENT	GROSS DEVIATION
Wrist-forearm (Figure 1)	Symmetrical appearance of wrist forearm; forearm circumference should be larger than the wrist	Decreased forearm to-wrist circumference ratio causing a cylinder shaped appearance (< width of hand); Increased forearm to-wrist circumference ratio (forearm ≈2x size of wrist)	Cylinder shaped appearance (=/> width of hand) Forearm: wrist circumference ratio (forearm >2x size of wrist)

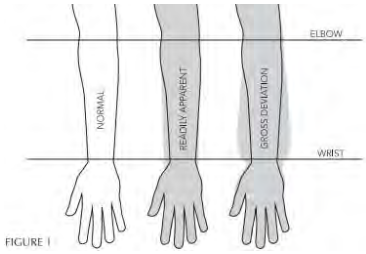

FIGURE 1

Wrist & Forearm

☐ None

☐ Readily Apparent

☐ Gross Deviation

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DEVIATION FROM NORMAL ANATOMICAL ARCHITECTURE

ANATOMICAL REGION	NORMAL	READILY APPARENT	GROSS DEVIATION
Elbow-Upper Arm (Figure 2)	Symmetrical appearance of elbow and upper arm	Increased posterior arm convexity (<5cm compared to unaffected side)	Increased posterior arm convexity (>5cm compared to unaffected side)

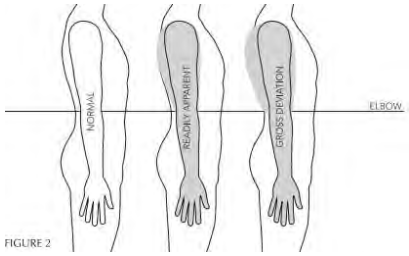

FIGURE 2

Elbow & Upper Arm

☐ None

☐ Readily Apparent

☐ Gross Deviation

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TISSUE TEXTURE

Posterior Wrist	Anterior Wrist	Posterior Forearm	Anterior Forearm	Elbow Medial Epicondyle	Elbow Lateral Epicondyle	Upper Arm Medial	Upper Arm Lateral
☐ Normal	☐ Normal	☐ Normal	☐ Normal	☐ Normal	☐ Normal	☐ Normal	☐ Normal
☐ Spongy	☐ Spongy	☐ Spongy	☐ Spongy	☐ Spongy	☐ Spongy	☐ Spongy	☐ Spongy
☐ Firm	☐ Firm	☐ Firm	☐ Firm	☐ Firm	☐ Firm	☐ Firm	☐ Firm
☐ Hard	☐ Hard	☐ Hard	☐ Hard	☐ Hard	☐ Hard	☐ Hard	☐ Hard

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OEDEMA

Posterior Wrist	Anterior Wrist	Posterior Forearm	Anterior Forearm	Elbow Medial Epicondyle	Elbow Lateral Epicondyle	Upper Arm Medial	Upper Arm Lateral
☐ None	☐ None	☐ None	☐ None	☐ None	☐ None	☐ None	☐ None
☐ Pitting	☐ Pitting	☐ Pitting	☐ Pitting	☐ Pitting	☐ Pitting	☐ Pitting	☐ Pitting
☐ Non-pitting	☐ Non-pitting	☐ Non-pitting	☐ Non-pitting	☐ Non-pitting	☐ Non-pitting	☐ Non-pitting	☐ Non-pitting

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Other tools

- Photos of the arm, chest wall:
  - Anterior
  - Posterior
  - Sideways

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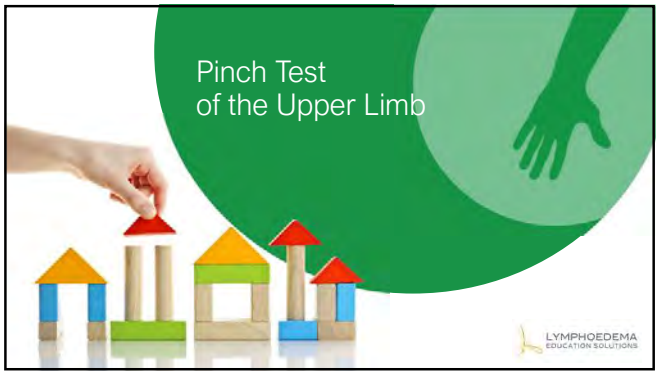
Pinch Test
of the Upper Limb
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UPPER LIMB CIRCUMFERENCE MEASURING FOR ASSESSMENT

YOU WILL NEED:

- Narrow retractable measuring tape
- Finger measuring tape
- Set square
- Skin pencil
- Measuring board
- Circumference measuring form
- Pen
- Wipes

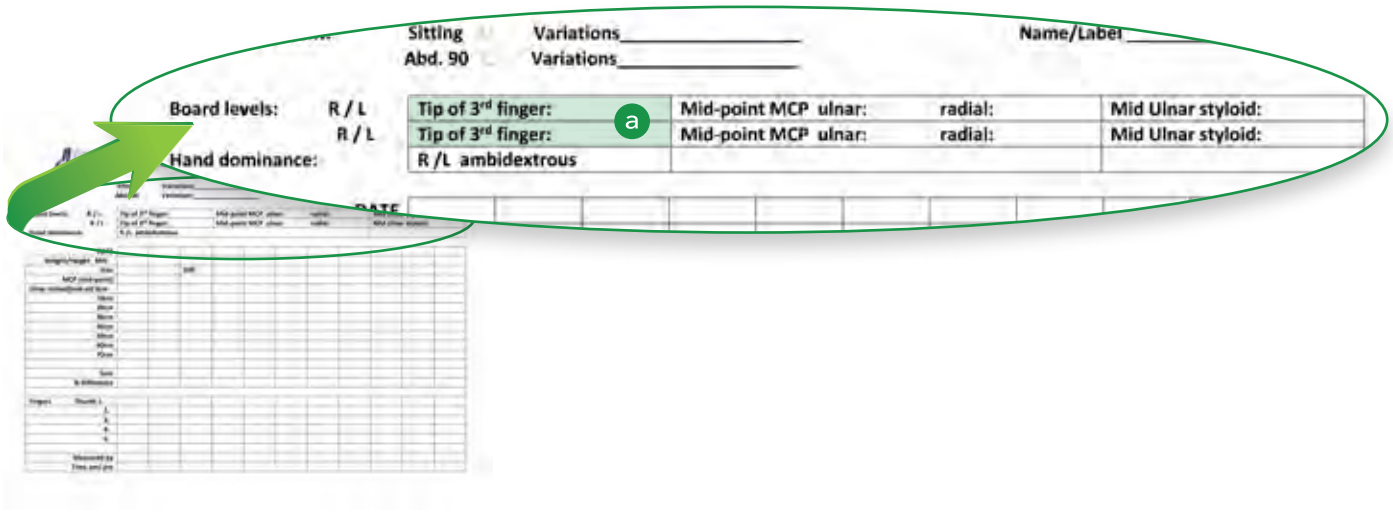
On the arm measurement form fill in the:

- Name or add the client label
- Position of the client and any variations

The patient should be seated with the arm abducted and pronated in a horizontal position, resting on the measuring board which is supported on a stable flat surface.

Position the measuring board at the anterior axillary fold

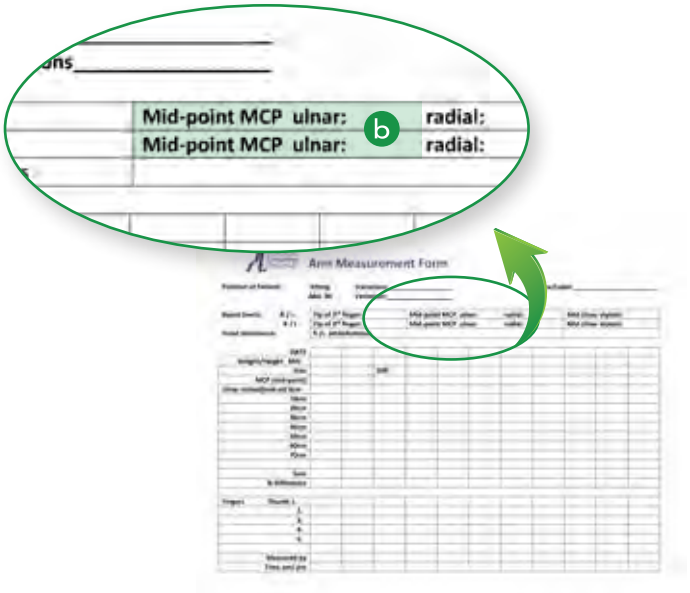
Measure the length of the tip of the third finger (under fingernail overhang) mark on form (a)



Using the set-square to ensure vertical alignment is maintained, and using the distal side of the set-square, mark the ulnar and radial aspects of the hand and arm

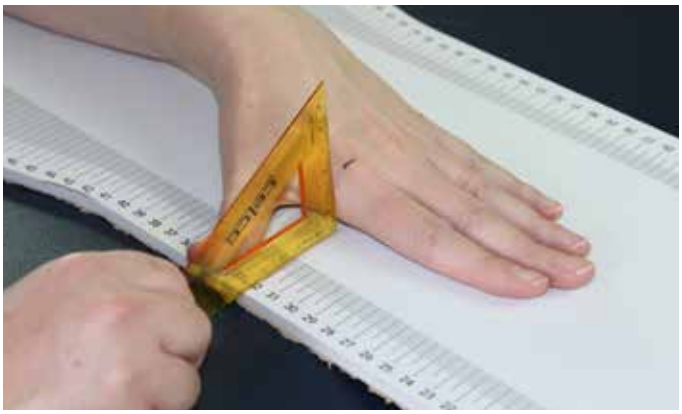
1. Mark the mid points of the ulnar side MCP joints of the hand

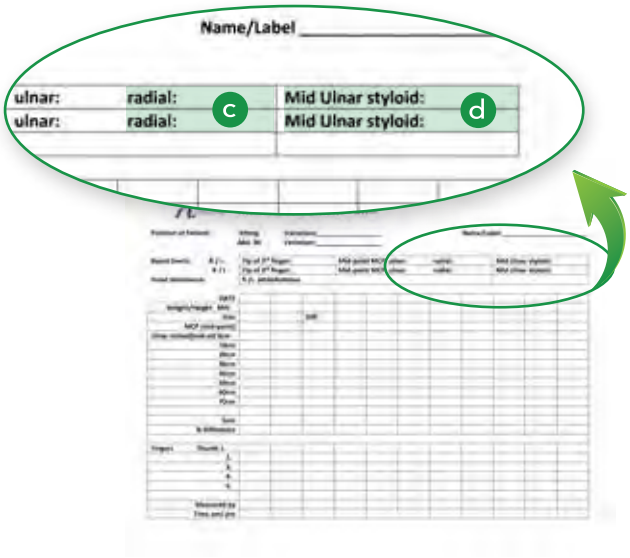
2. Measure the length and indicate on form b



3 Mark the mid points of the radial side MCP joints of the hand

4 Measure the length and indicate on form c





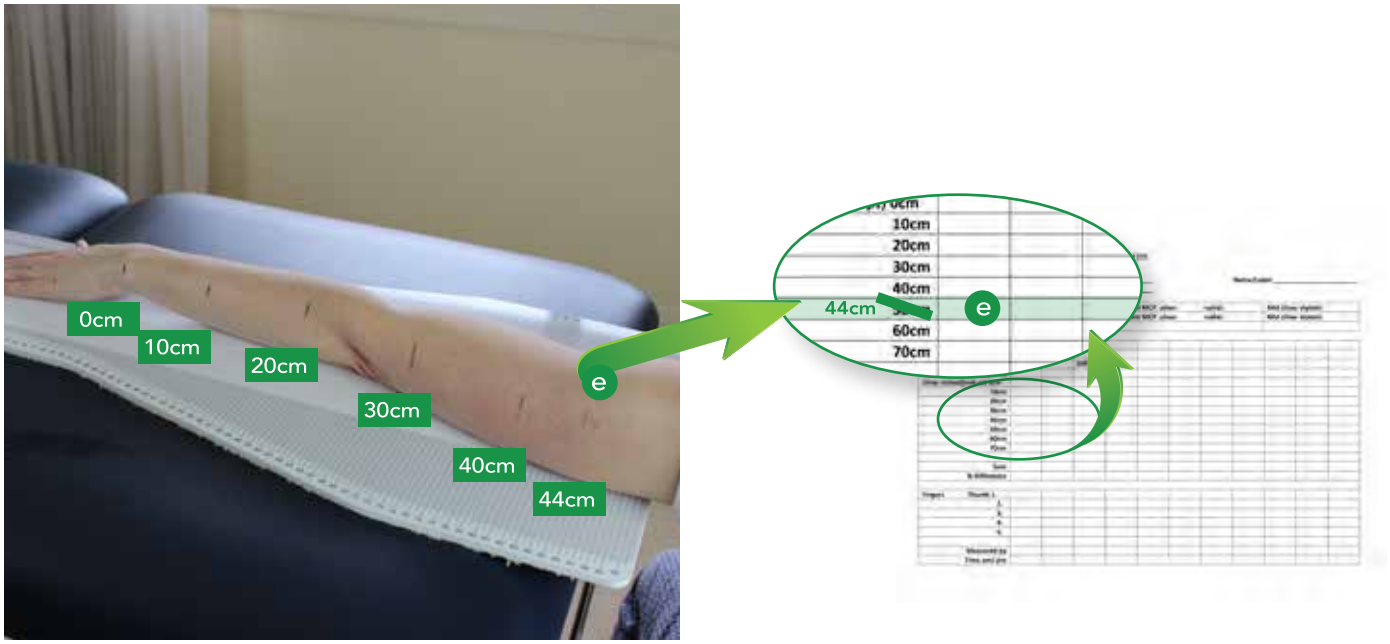
5 Mark the ulnar styloid process at the wrist (o reference)

6 Measure the length and indicate on form d

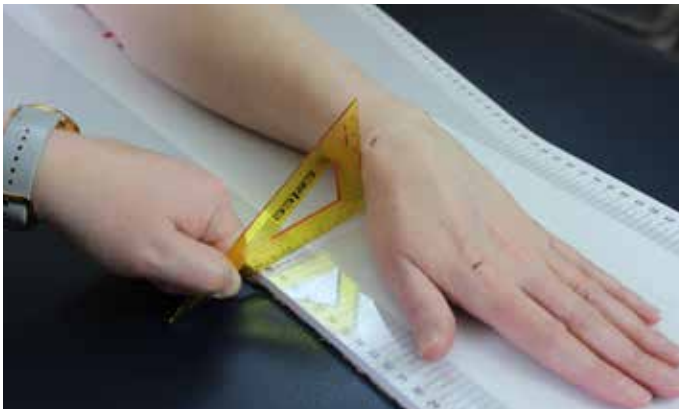
7 Mark up the arm in 10cm interval from ulnar process on the ulnar side

The pencil should be on the distal side of the set square and at a 45 degree angle

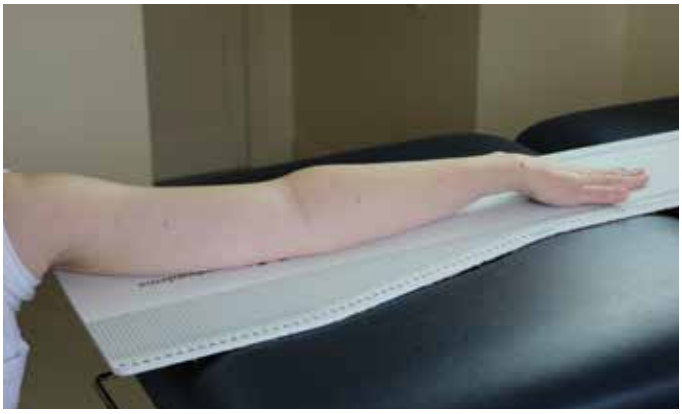
8 Continue marking up the arm at 10cm intervals. The top mark may not be at 10cm to the previous - mark the point at which you can take a circumference measurment and record this position on the form. e



9 Using the length of the ulnar styloid process mark the length on the radial side



10 Continue marking up the board at 10cm interval



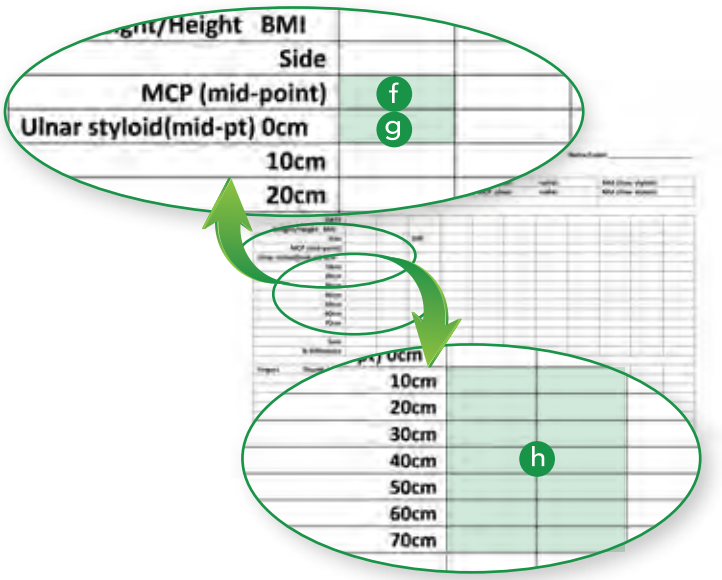
11 Remove the board if uncomfortable

NOTE: *If there are areas along the arm that you want to take more measurements, such as due to more oedema or fibrosis, you can alter the lengths and indicate these on the form.*

CIRCUMFERENCES OF THE ARM

The measuring tape should be lying distal to the marks on the skin on both sides (ulnar and radial) and the circumference measurement read from the proximal edge of the tape.

12 Measure the MCP circumference and indicate this on the form f



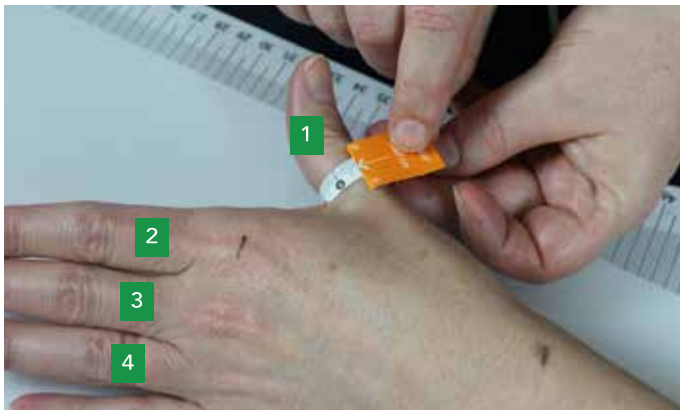
13 Measure the circumference at the ulnar styloid process and indicate this on the form g

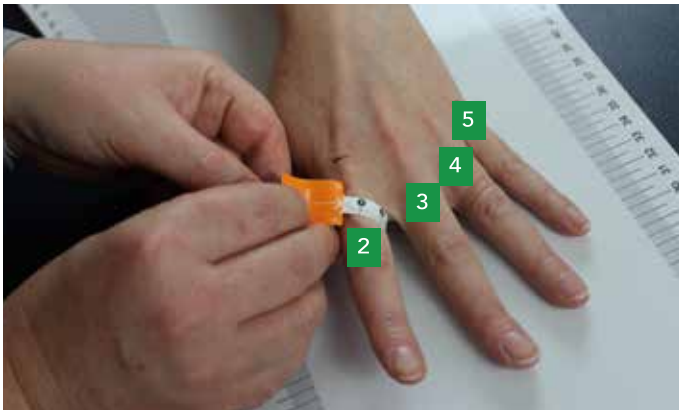
14 Measure the circumference at each level up the arm and indicate on the form h

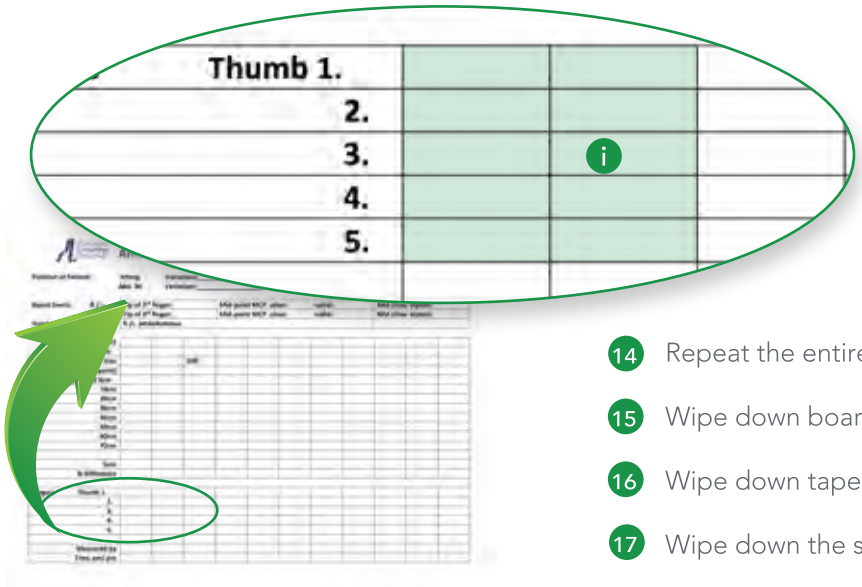
Be careful not to measure too tight or too loose. It should be skin tension.

TIP: *If there is a very large upper arm draping the tape can be more accurate. Use the weight of the tape. Indicate at what level you have done this technique on the form.*

14 Measure each finger distal to the web space with narrow tape show for each finger. Fill in the circumferences on the form i







14 Repeat the entire procedure on the other arm

15 Wipe down board

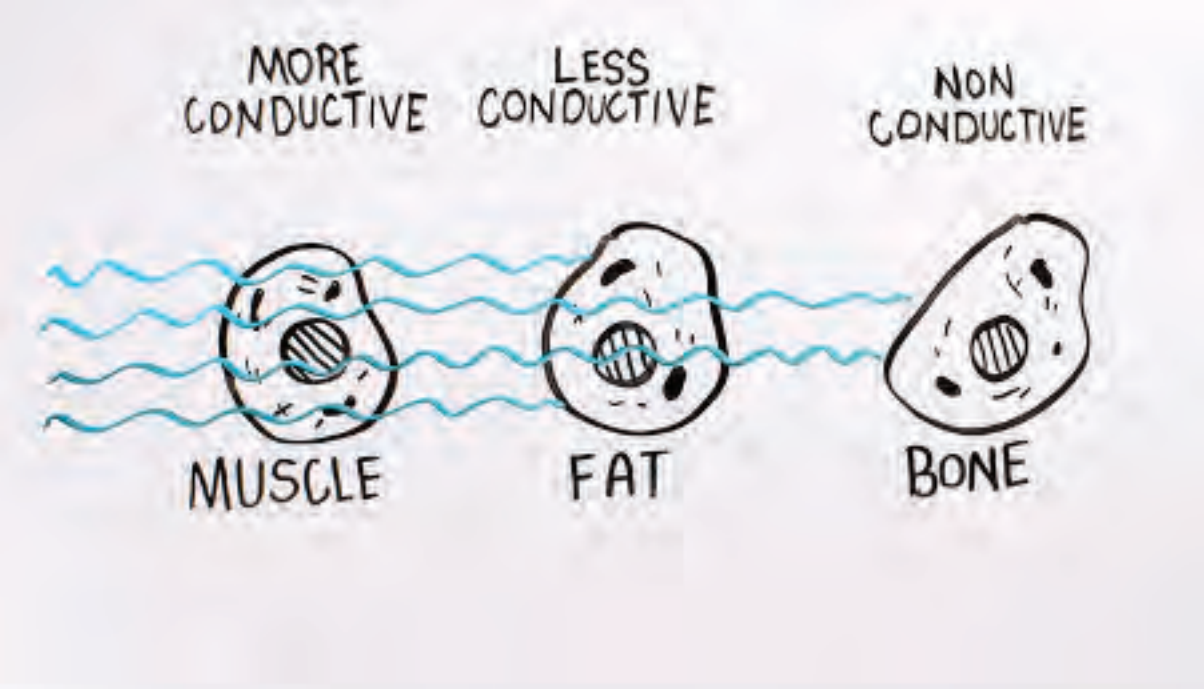
16 Wipe down tape measures leaving it out to dry

17 Wipe down the set square

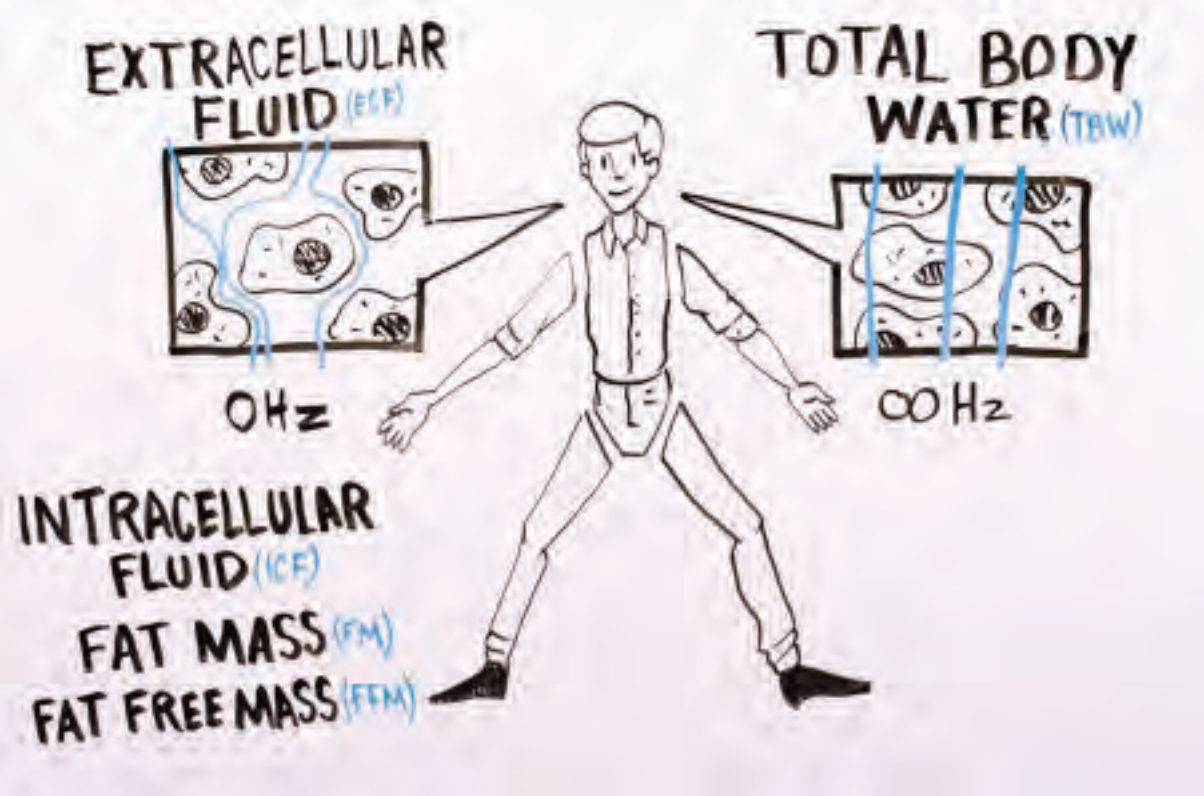
BIOIMPEDANCE SPECTROSCOPY

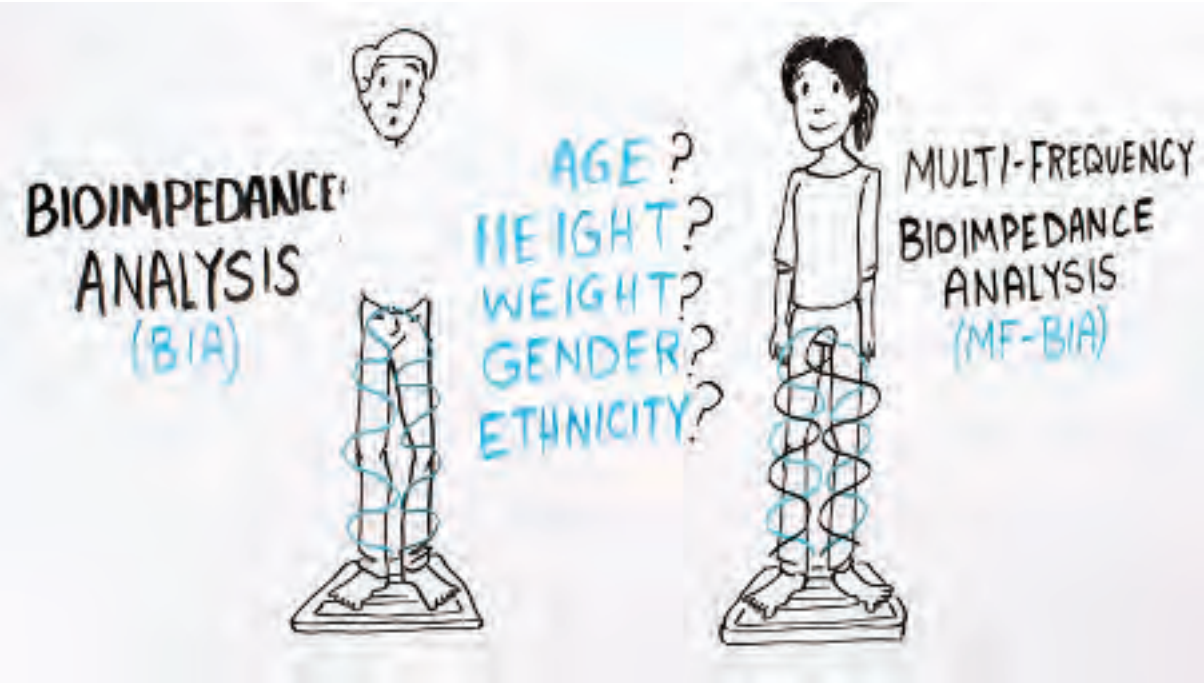
Bioimpedance spectroscopy (BIS) has become a recognised tool to assess lymphoedema. It is used in conjunction with such tools as circumference measurement and tissue dielectric constant (to be discussed in the next lesson). It not only is used for surveillance, early detection and a way to assess the amount of lymphoedema but it can also provide information on changes to the tissue. As practitioners we also need to look holistically at the whole person and not just the oedema. BIS provides us with information on body composition so that we can effectively plan management and refer on as required.

Below are the graphics from the video that explains BIS. You can make notes as you listen to it.

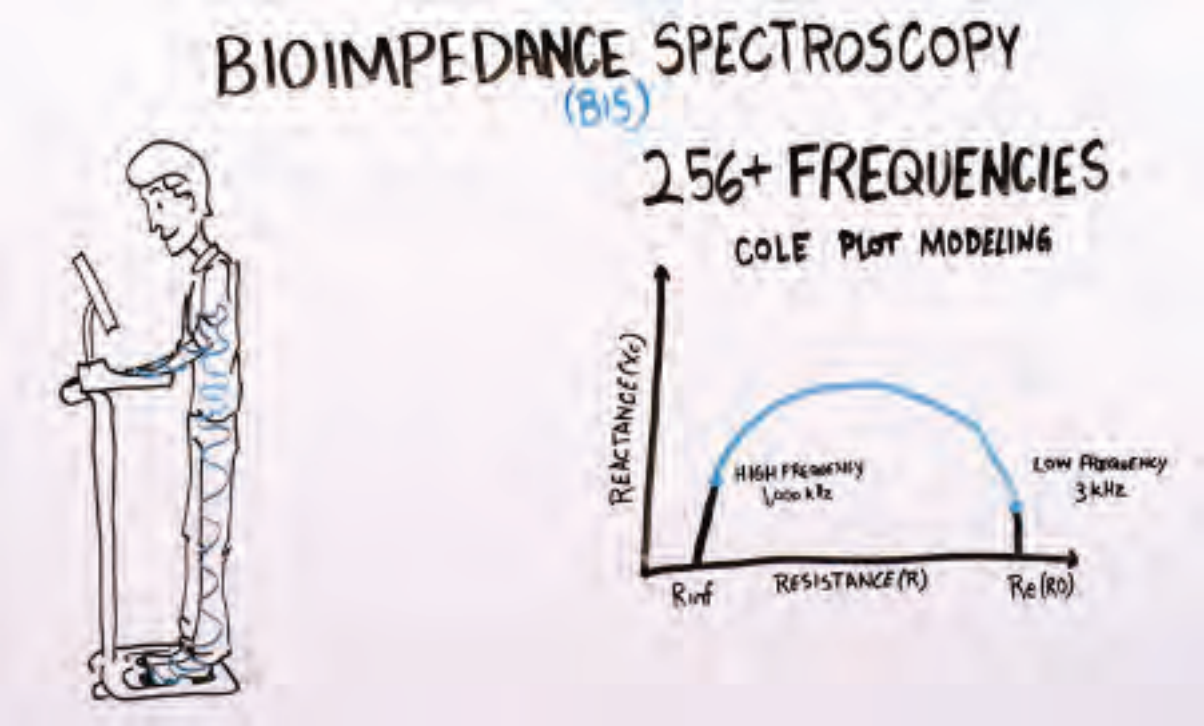


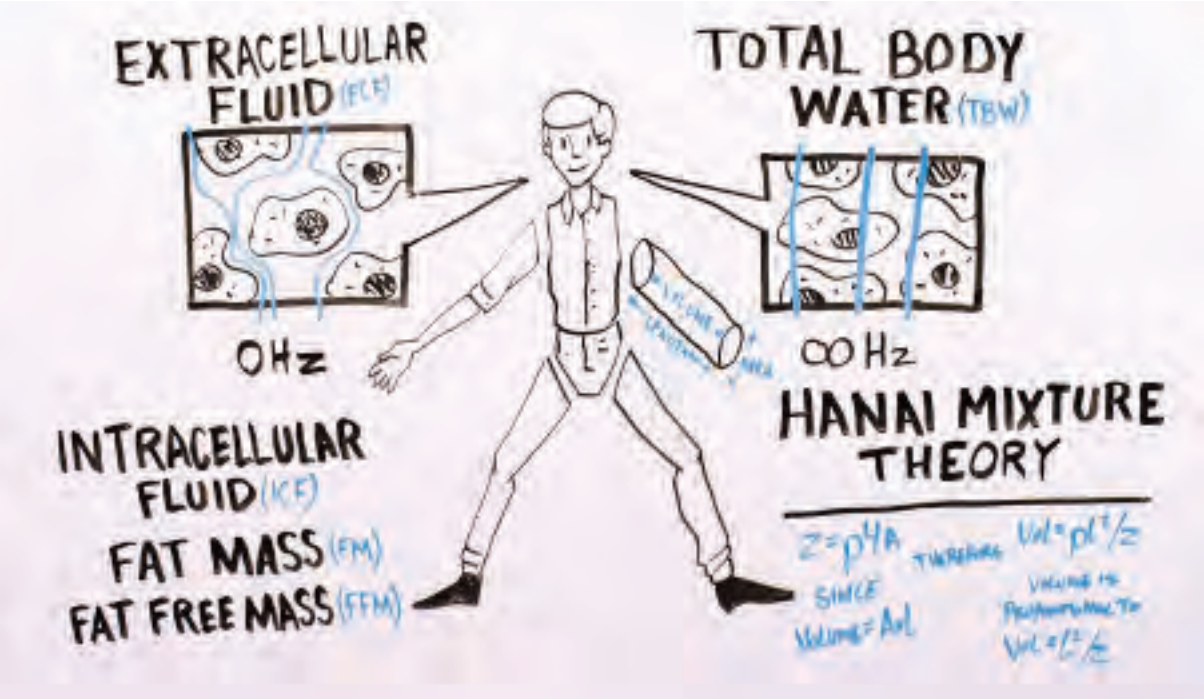
BIOIMPEDANCE SPECTROSCOPY

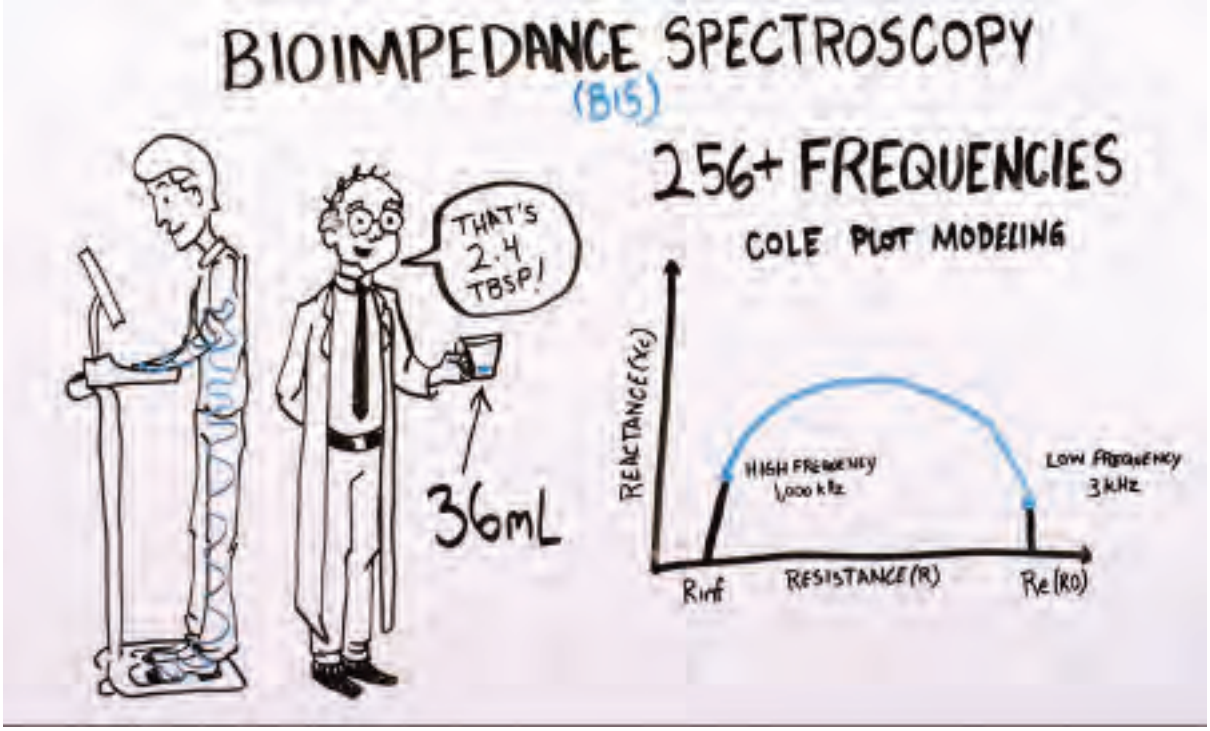




BIOIMPEDANCE SPECTROSCOPY



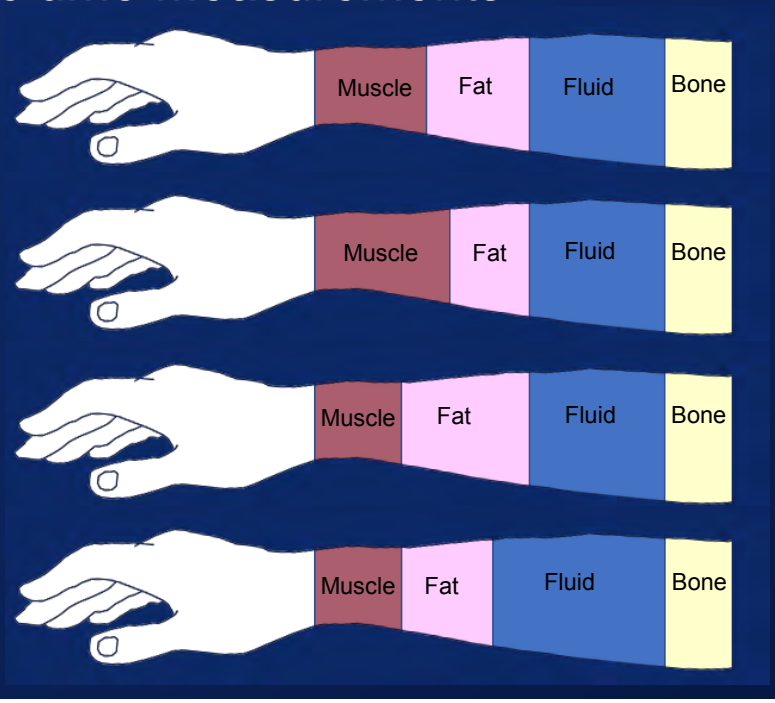



BIOIMPEDANCE SPECTROSCOPY
(BIS)
256+ FREQUENCIES
COLE PLOT MODELING
THAT'S 2.4 TBSP!
36mL
REACTANCE (Xc)
HIGH FREQUENCY 1,000 kHz
LOW FREQUENCY 3 kHz
Rinf
RESISTANCE (R)
Re (R0)

Understanding Unilateral L-Dex

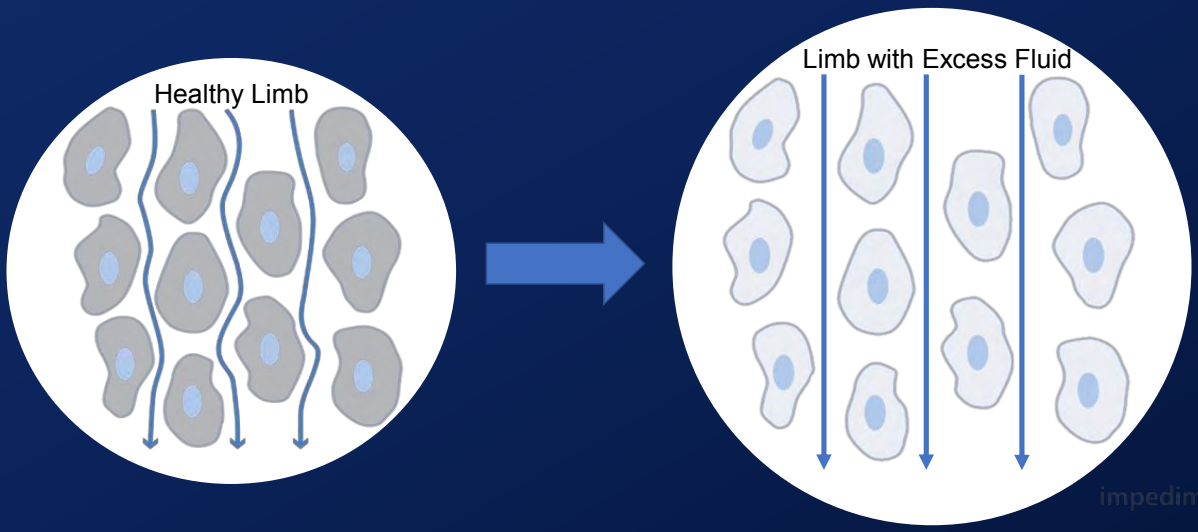
Richelle Gaw, BEng(Hons), PhD
Project Engineer, ImpediMed Limited

Total Volume Measurements



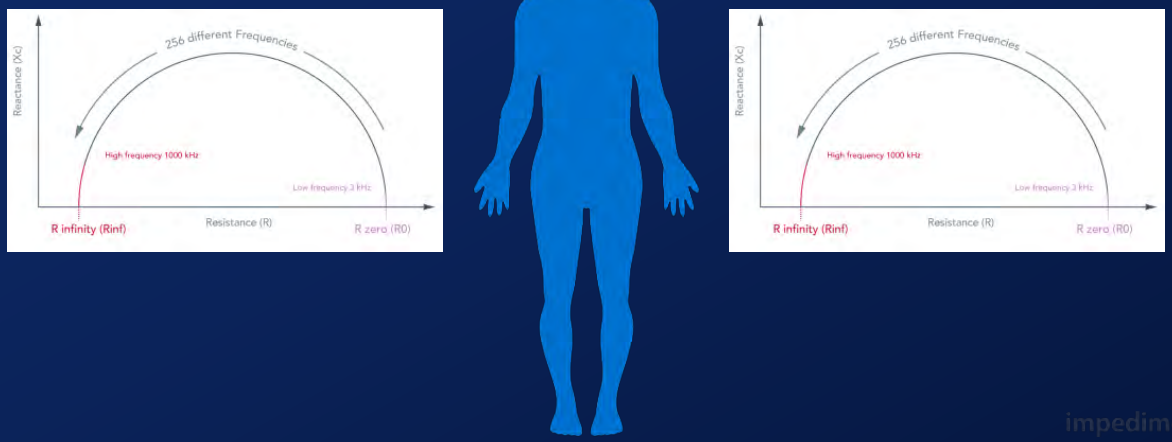
Bioimpedance Spectroscopy

R0 is the impedance of the extracellular fluid (ECF)



Measuring Unilateral Lymphoedema

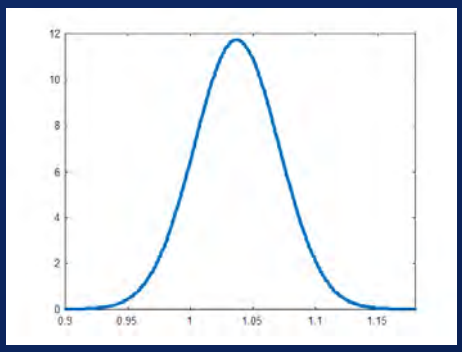
Measure the impedance of both limbs



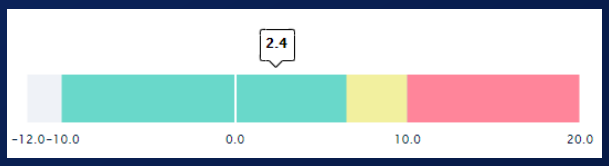
Where Rinf is the impedance of the intracellular fluid (ICF) , R0 is the impedance of the extracellular fluid (ECF)

Measuring Unilateral Lymphoedema

Calculate the limb ratio $\frac{R0\ of\ Control\ Limb}{R0\ of\ AtRisk\ Limb}$



Determine the L-Dex®



Where R0 is the impedance of the extracellular fluid (ECF)

Interpreting Results

- A unilateral L-Dex score is best suited for measuring patients with one limb at risk
- An L-Dex score can be positive or negative
- An L-Dex score can lie in the green, yellow or red section of the L-Dex graph
- The fluid state of the ipsilateral control limb is important
- A baseline measurement allows individualised tracking

Clinical Use

I’d now like to pass the presentation over to our clinicians

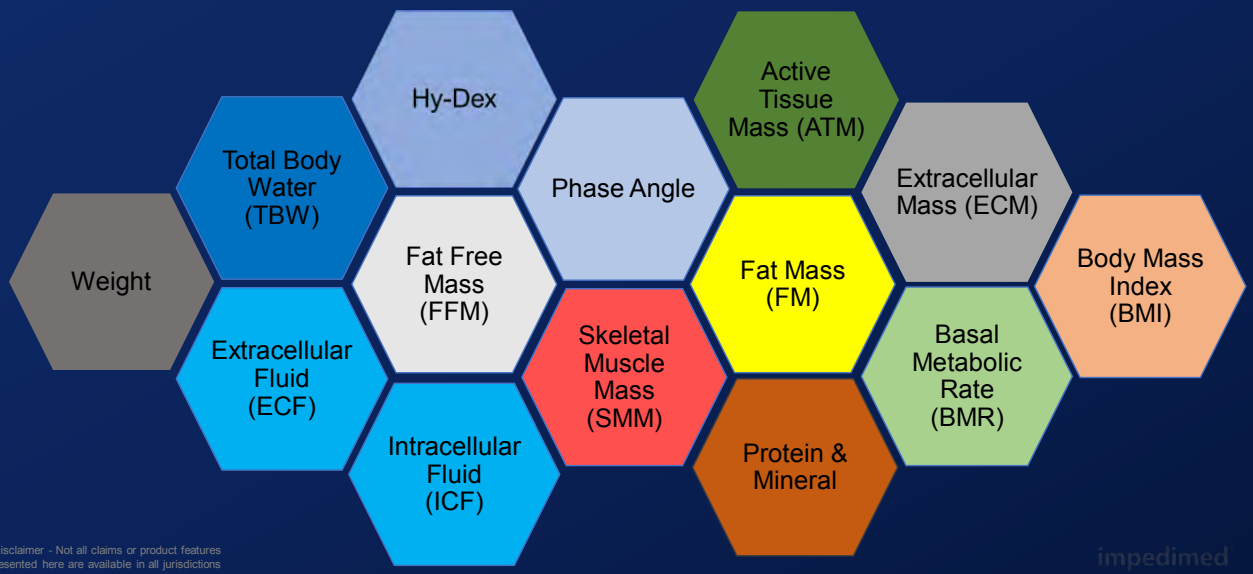
impedimed

Understanding Tissue and Fluid Outputs from SOZO

Adam Brown
BAppSc (Ex Sc)
Business Manager APAC, ImpediMed Limited
abrown@impedimed.com

impedimed

??? Lots of outputs, where do I begin..



*Disclaimer - Not all claims or product features presented here are available in all jurisdictions

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It's All About the Patient

Which outputs will have the biggest impact on the outcome of my patient?

- ✓ Instant feedback for the health professional and patient
- ✓ Improve patient compliance to recommendations
- ✓ Motivation to change habits

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It's All About the Patient

How do I want to explain the results to my patient?

Do I use kg/lb. or %?
Change from baseline?
Change from the previous measurement?
Which outputs line up with the patient's goals?

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Body Composition 101

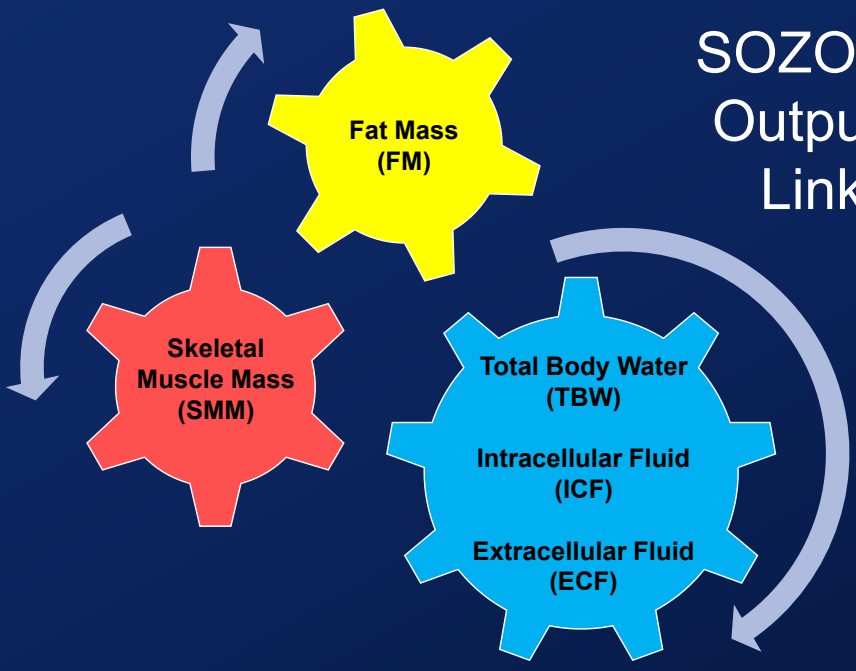
- Pre –Test Protocol
- How often should I take a tissue and fluid measurement?
- **Trend over Time!**
- Establish a Baseline
- Reference Ranges
  (Useful only when they benefit the patient & clinician goals/outcomes)

SOZO Output Essentials

Fluid
Total Body Water (TBW)
Extracellular Fluid (ECF)
Intracellular Fluid (ICF)

Muscle
Skeletal Muscle Mass (SMM)

Fat
Fat Mass (FM)



SOZO Tissue & Fluid Outputs are Closely Linked Together

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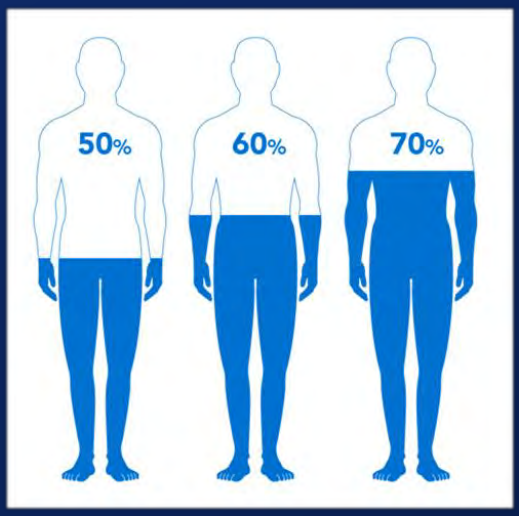
SOZO Fluid Output Essential



Total Body Water (TBW)

(ICF + ECF = TBW)

- Expressed as litres/pints & %
- Female TBW generally lower than males
- Muscle contains more water than fat, obese patient TBW can be much lower than healthy population as a result

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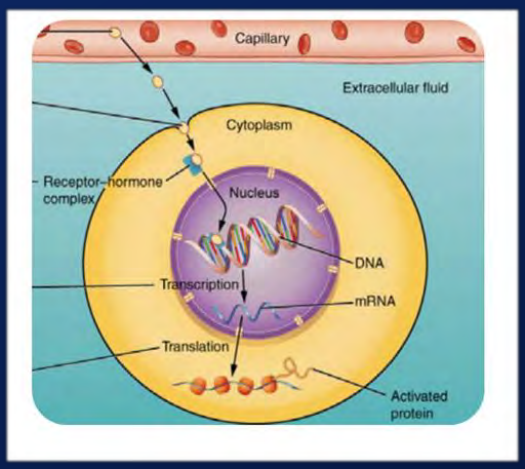
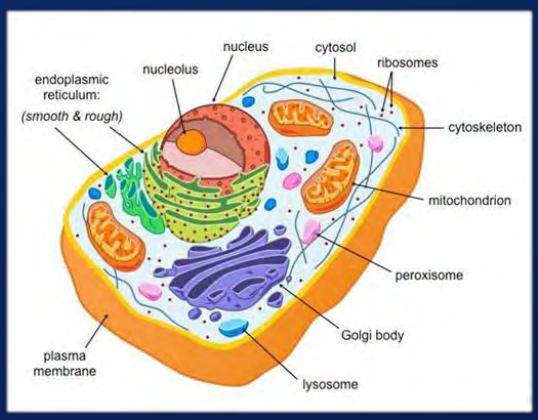
SOZO Fluid Output Essential

Extracellular Fluid (ECF)

- Contains all of the fluid outside the body's cells
- ECF includes blood and interstitial fluid
- Expressed as litres/pints and % of TBW
- Excess ECF can be indicative of disease, early stage lymphoedema, nutritional imbalance, heart failure



SOZO Fluid Output Essential



Intracellular Fluid (ECF)

- All fluid contained within cell membranes
- Expressed as litres/pints and % of TBW
- Change in ICF often as result of increase or loss of muscle mass

SOZO Tissue Output Essential

Skeletal Muscle Mass (SMM)

- Expressed as kg/lb. or %
- No specific reference range for SMM
- **Trend over time!**

SOZO Tissue Output Essential

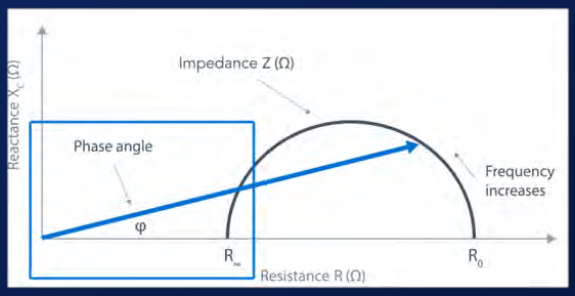
Fat Mass (FM)

- Expressed as kg/lb. or %
- Reference ranges are available that suit specific demographics
- **Trend over time!**

Additional SOZO Tissue Output

Phase Angle

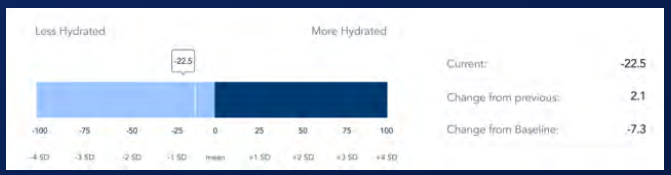
- It's the angle between the measured impedance and the measured pure resistance
- May be an indicator of cell function
- Phase Angle is expressed as degrees
- Reference ranges are often reported between 3 & 10 degrees



Additional SOZO Fluid Output

Hy-Dex

- Represents relative fluid status compared to a healthy population dataset
- Fluid outputs are matched to data using age, gender, height and weight
- A positive Hy-Dex = more hydrated
- A negative Hy-Dex = less hydrated



*Disclaimer – Hy-Dex cleared for use for healthy population only in the USA

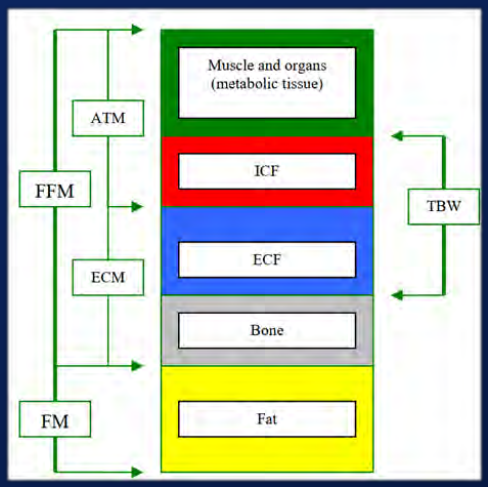
Additional SOZO Tissue Outputs

Active Tissue Mass (ATM)

(Includes metabolically active tissue –
Organs, nervous tissue, blood cell, ICF)

Extracellular Mass (ECM)

(Includes metabolically inactive tissue –
Bone, minerals, ECF including Blood Plasma)



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Additional SOZO Tissue Outputs

Basal Metabolic Rate (BMR)

(Rate of daily energy expenditure a person burns at rest)

Protein & Mineral

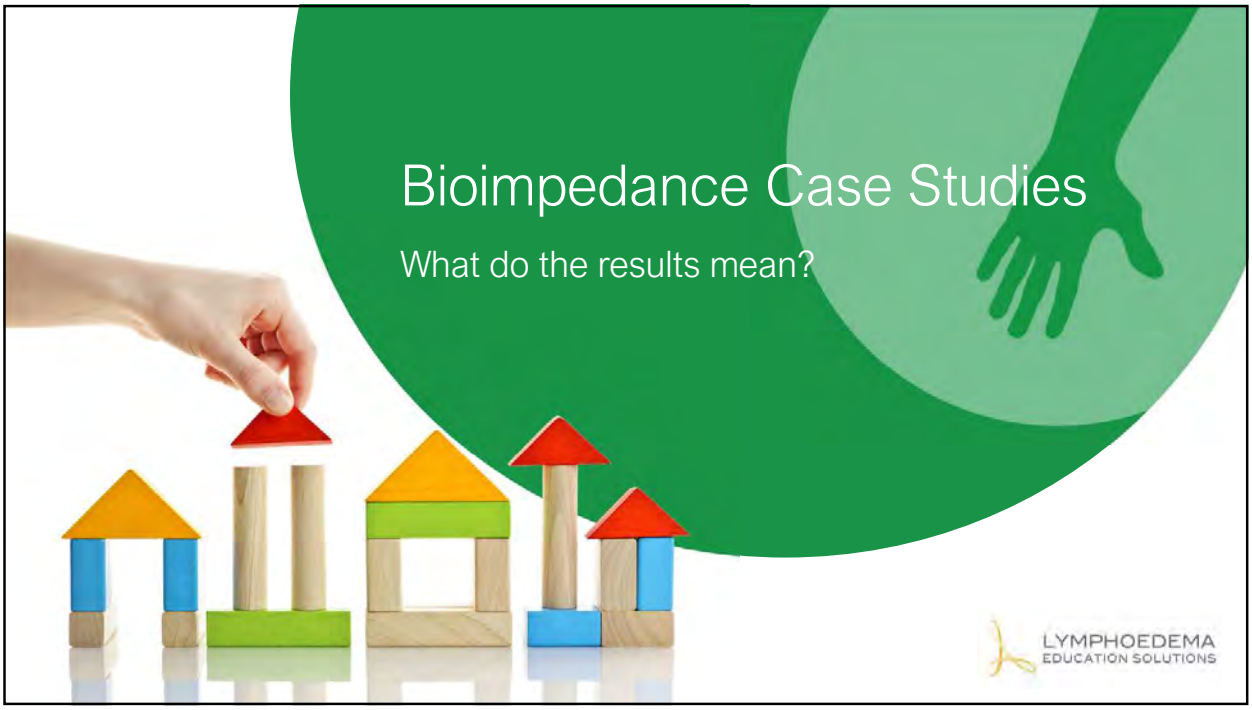
(FFM – TBW = Protein & Mineral)

Summary

- It's all about the patient
- Sharing SOZO outputs across a multi-disciplinary team may assist to achieve best possible patient care
- Tissue and Fluid outputs are linked – look at ALL the essential outputs before result interpretation
- Always be looking at the **Trend over time!**

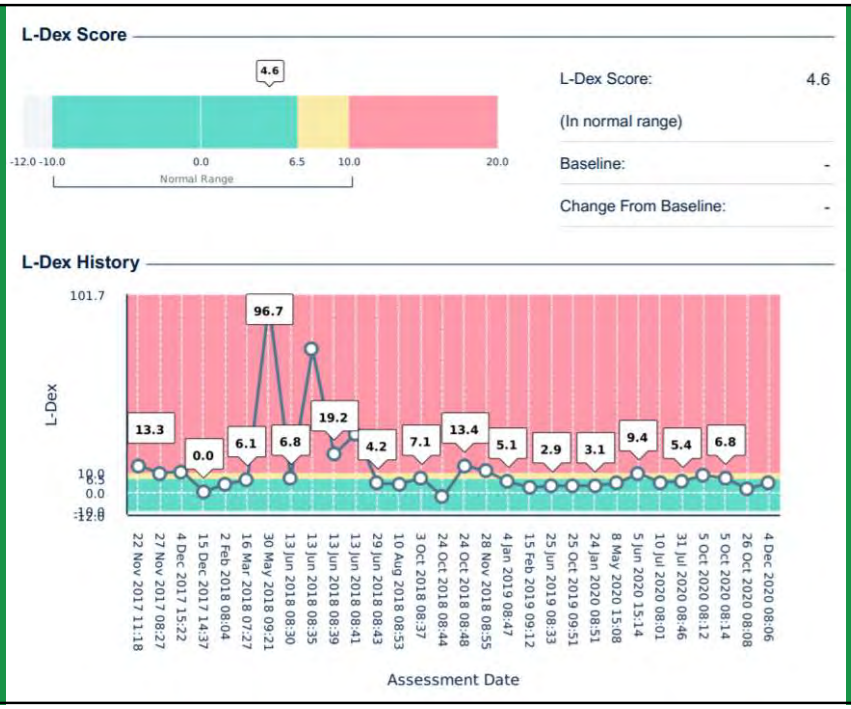
Thank You

Adam Brown
abrown@impedimed.com



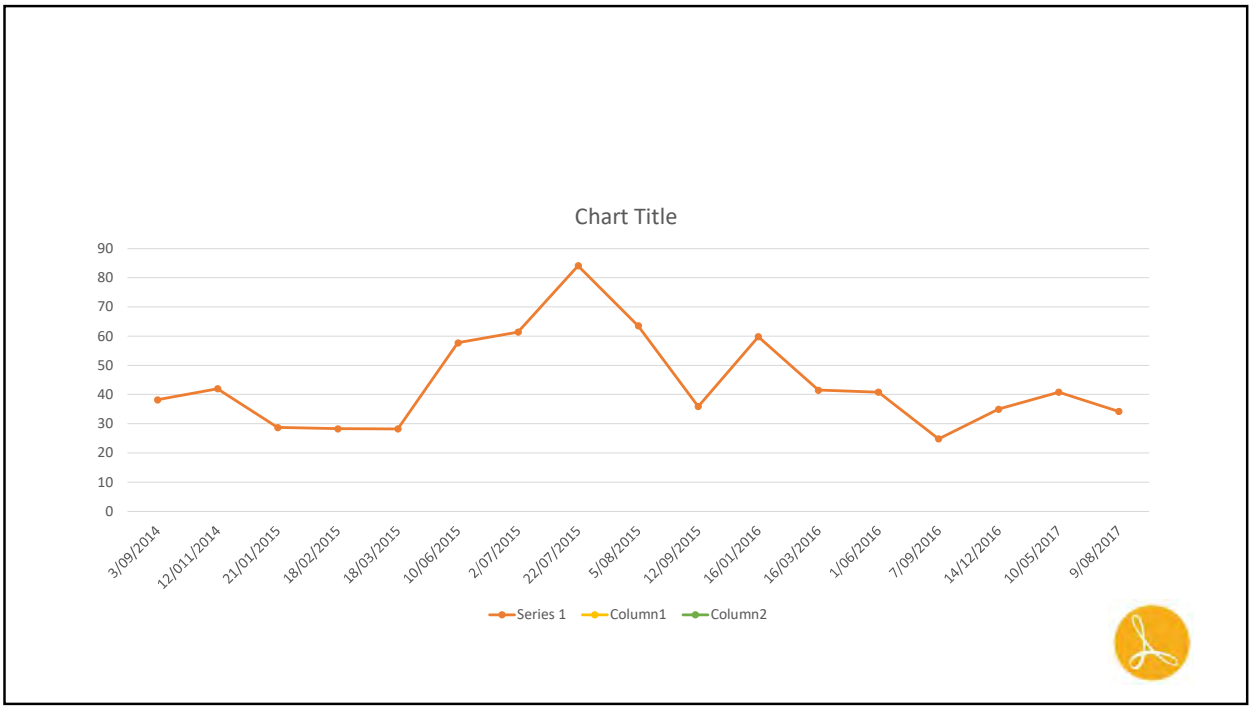
Alison Surveillance and Early Intervention

- L mastectomy, tissue expander, and ALND Feb 2016
- Severe AWS and pain from expander
- Chemo AC and Taxol
- RT chest wall, supraclavicular and axilla
- Nov 2017 felt swelling, heaviness in the upper arm after a trip overseas.



Barbara

- July 14: Left Total Mastectomy and Axillary Dissection
- Chemo (including Taxol), Herceptin and RT
- Multiple Seroma drainages
- Severe RT burns++
- April 15: developed polymyalgia rheumatica.
- Prescribed Prednisolone
- L-Dex: increased gradually (to 84.1 22/7/15)
- L-Dex: back to baseline of 35.9 12/9/15

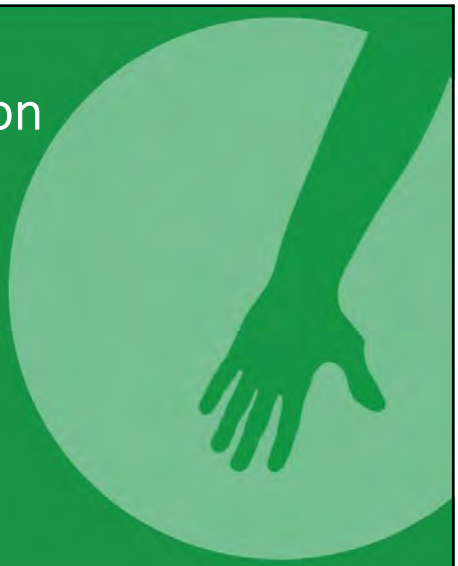


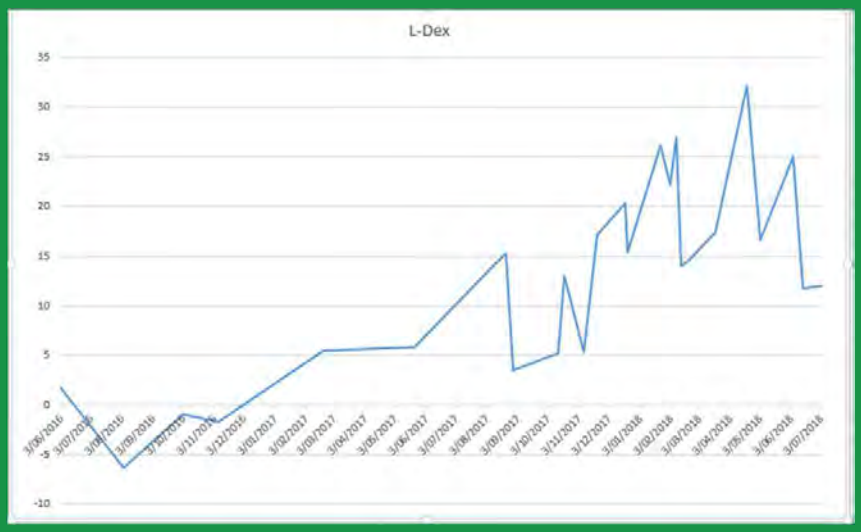
Petrina

- 1st visit preop June 2016 whilst having chemo
- August 2016 R WLE and ALND 25/27 nodes +ve, triple negative
- RT post op
- AWS
- Nov 2016 Petrina c/o swollen upper arm – perometry NAD
- Dec 2016 aches all over, seeing physio for shoulder pain, perometry increase by 2cm at most levels

Sook Surveillance and Intervention

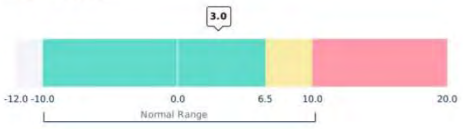
- L mastectomy and ALND May 2016
- R handed
- Chemo and AC and taxol
- RT chest wall and axilla – burns
- Severe AWS
- Initially perometry measurements NAD





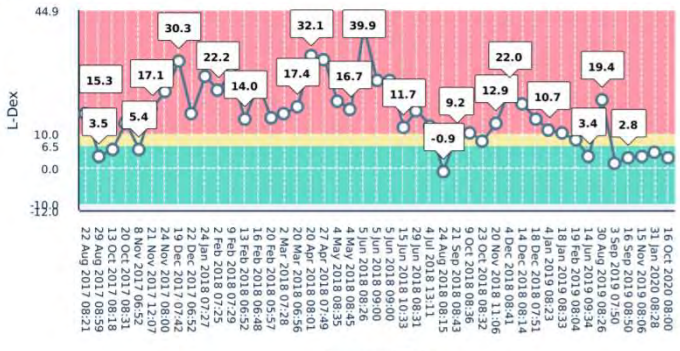
Lymphedema Analysis

L-Dex Score



L-Dex Score:	3.0
(In normal range)	
Baseline:	-
Change From Baseline:	-

L-Dex History



Sonia

Raffaela early intervention perhaps too late?

- R WLE and ALND 2011, 16 nodes positive
- Chemo RT to chest, axilla and SC
- 1st visit 2014 as travelling overseas – compression garments for flying
- Monitored
- July 2017 oedema in arm, perometry 2cm greater at levels upper arm


L-Dex
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
16/07/2014
16/09/2014
16/11/2014
16/01/2015
16/03/2015
16/05/2015
16/07/2015
16/09/2015
16/11/2015
16/01/2016
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16/11/2017
16/01/2018
16/03/2018

Innovations in Lymphoedema Assessment and Treatment

Using the LymphScanner in Clinical Practice

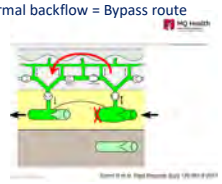
Module 3 - Research, design & development

Presented by Dr Tapani Lahtinen, Delfin Technologies Ltd

Background for the localized superficial measurement of lymphedema

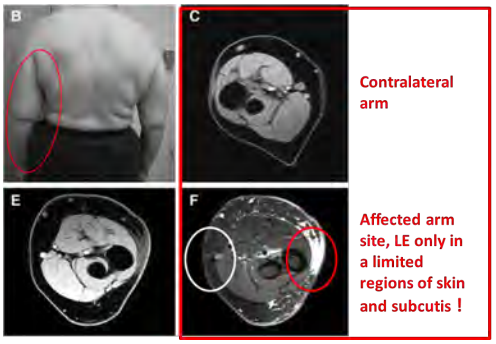
- Lymphedema manifests in skin due to dermal backflow
- Superficial lymphedema might be highly localized
- Fluorescence imaging is not a routine instrument for lymph therapy centers
- There has not been an easy-to-use instrument
  - to detect superficial lymphedema at all body sites
  - to quantify the level of tissue swelling

Dermal backflow = Bypass route



Suami et al, Surg Oncol 27(4), 743-50, 2018

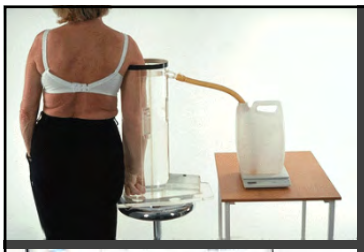
Background for the localized superficial measurement of lymphedema: Example of an MRI study



Gardner et al (LRB 2014): MR imaging of BCRL patient at 1 year

Background for the localized superficial measurement of lymphedema

There have not been easy-to-use methods to assess **midline/truncal lymphedema**

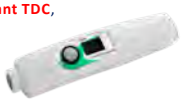


Background for the localized superficial measurement of lymphedema

- Arm volume or arm cirfumference measurements are not sensitive to detect superficial lymphedema
- Arm volume technique measures the whole arm
- Bioimpedance (L-Dex, Sozo) is not sensitive to detect localized lymphedema in skin and subcutis, since
  - skin is a small tissue
  - electric currents used in bioimpedance systems do not penetrate adipose subcutaneous tissue

LymphScanner operation principle, TDC

- **LymphScanner generates an electromagnetic (EM) microwave field** (300 MHz) guided into an integrated **coaxial probe** placed in contact with skin
- **The microwave field is rotating water molecules in skin**
  - ⇒ Energy is absorbed from the device
  - ⇒ From this information an electrical parameter, **Tissue Dielectric Constant TDC**, is calculated
  - ⇒ TDC = 1 for no water (0 % of water)
  - ⇒ TDC = 80 for pure water (100% of water)



- The TDC scale (1 – 80) can be converted into a practical **Percentage Water Content PWC (0 – 100%)** scale
- **LymphScanner display is PWC scale: 0 – 100%**
- **Large macromolecules (proteins) are not measured** since they too large to rotate in a microwave field.
- Tissue electrolytes have no effect, since they cannot rotate and absorb energy.

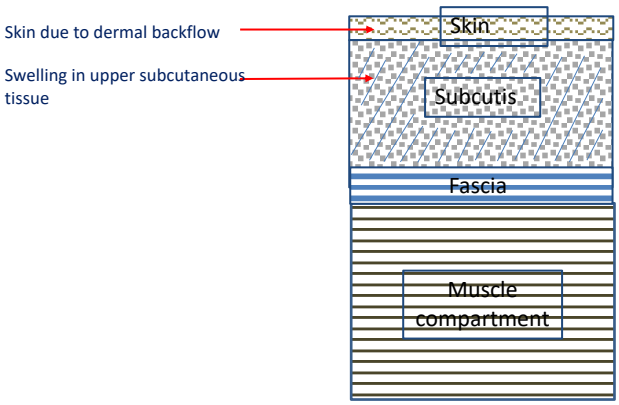
⇒ Microwaves are ideal to measure interstitial fluid!

Effective measurement depth 2.5 mm

- **Microwaves are attenuating when penetrating deeper in tissue**
- **Microwaves are strongest in skin and upper subcutis until to the depth of 2.5 mm**

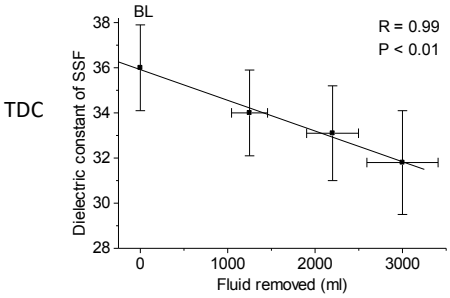
⇒ LymphScanner is sensitive to interstitial fluid in skin and upper subcutis!

LymphScanner is assessing lymphedema in skin and upper subcutis



Validation of TDC technique

During hemodialysis, TDC decreases linearly as a function of removal of interstitial fluid:



From: Nuutinen J., Ikäheimo R. and Lahtinen T. Validation of a new dielectric device to assess changes of tissue water in skin and subcutaneous fat *Physiol. Meas.* 25: 447-454, 2004

Calibration of the TDC measurement with solutions simulating water and solid components in the skin

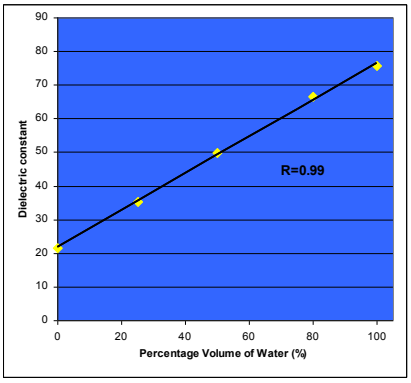
(1) A water component with a high dielectric constant DC

(2) A solid component with a low dielectric constant DC (ethanol)

Model: water ethanol mixtures

Five different mixtures measured with the MoistureMeter D (percentage water volume content, V%)

- V =0 % (pure ethanol, DC = 22)
- V =25%
- V =50%
- V =80%
- V =100% (pure water, DC = 78)

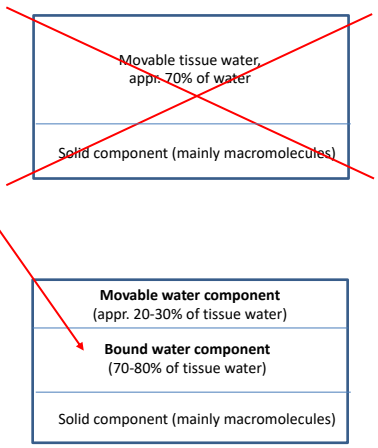


Terminology of human tissue water

Tissue water components i.e. components of interstitial fluid in skin and subcutis

Skin tissue water components: Free and bound water

- Interstitial fluid is not one water compartment of movable water.
- 70-80% of human skin water cannot move. This water component is called bound water.
- In skin, bound water is attached mainly on the surface of skin collagens.
- Just after death when proteins start to break down, bound water becomes movable again.

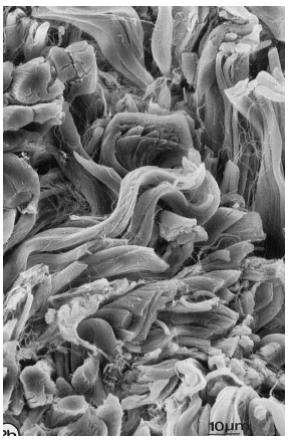


Concept of free and bound water:

Bound water is attached on the surface of collagen fibers

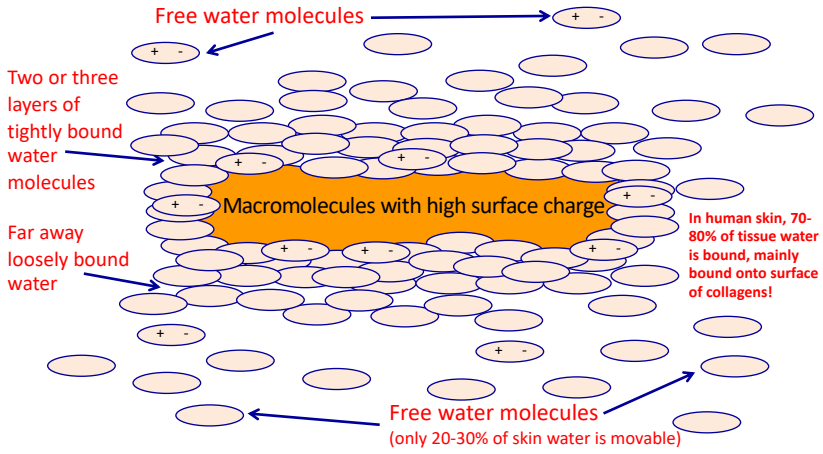
Fine collagen in papillary (upper) dermis

Coarse collagen in reticular (deep) dermis



From: K.A. Holbrook and P.H. Byers, Diseases of Extracellular Matrix. In: Connective Tissue Disease, Molecular Pathology of the Extracellular Matrix, J. Uitto and A.J. Perejda (Eds). Marcel Deker, New York and Basel 1987

Concept of Free and Bound Water in Tissue



Terminology for human tissue water measurement

Lymph fluid, Free/bound water,
Tissue water content, Interstitial fluid

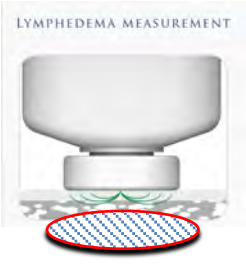
- Free water = Freely movable extracellular fluid in tissue: **Target of therapists!**
- Bound water = Motionally restricted water molecules localized on the surface of macromolucules (mainly collagen in skin)
- Free + bound water in extracellular space ≈ Interstitial fluid
- Tissue water: Free and bound water molecules in intra- and extracellular fluid and in plasma. Since skin is cell-poor and the amount of water in plasma is small, water content in skin is equivalent to interstital fluid in skin
- Lymph fluid is a protein-rich fluid, due to protein leakage from plasma into extravascular space. Lymph fluid consists of proteins covered with bound water.

LymphScanner guidance (1)

- Instructions to patients:
  - No smoking for one hour before measurements
  - No strong alcohols in the same day before measurements
  - Not carrying heavy items just before measurements
  - No heavy training just before measurements
- Removal of compression devices 10-15 min before measurements!

LymphScanner guidance (2)

- LymphScanner measures lymphedema in **soft tissue sites**
- **Avoid measurement over superficial bones and tendons**
- **Avoid measurement over larger veins**
- **Avoid very hairy skin**



Superficial bone

LymphScanner guidance (3)

- **Measurement position:** Sitting or supine
- **Arm and hand position:** Freely on both sides
- **Removal of shoes, socks, watches, bracelets, anklets:** Not needed
- **Diurnal variation:** No
- **Bladder emptying necessary:** Not needed
- **Contact force against skin:** Force-controlled measurement
- **Contact probe:** No electrode paste
- **Pregnancy contraindication:** No problem
- **Pacemaker or metals contraindication:** No problem
- **Problems if patient contacting with metals:** No effect

LymphScanner guidance (4)

Handedness has practically no effect on the measurements in women for whom pre-surgery TDC values have not been obtained

LymphScanner: Spot vs Scan mode

- Spot mode: Local measurement of interstitial fluid
  - Results expressed as Percentage Water Content PWC (%)
  - Each anatomical skin site has its own PWC value (depending on age, BMI, site, gender)
  - Typical values 25-40%
- Scan mode: Regional assessment of lymphedema using a user-selected contralateral site as a reference
  - Results expressed as a ratio of affected/at-risk tissue site and reference site
  - Reference site: Nearly the anatomically equivalent skin site on the contralateral side
  - If limbs are measured, the inter-limb PWC ratio eliminates individual variation in age, BMI, measurement site and gender

Check Tool for LymphScanner

- LymphScanner calibrated at the factory. Calibration certificate valid for 2 years
- With this tool the user can check the accuracy of LymphScanner against the reference value set at the factory
- If passed:
  Use of LymphScanner can be continued after 2 years' expiry date unless
  - formal certificate is not needed for the user QA system
  - LymphScanner is used to assist medical decisions in the diagnosis or treatment of patients

Innovations in Lymphoedema Assessment and Treatment

Using the LymphScanner in Clinical Practice

Module 4 - Use of the LymphScanner in clinical practice

Part 1 - A guide for use in clinical practice

Operation principles

- TDC 1 = no water 80% = pure water
- The lymphscanner converts to PWC for our convenience
- PWC 1= no water 100% = pure water
- Moisture Meter reads TDC
- Lymphscanner reads PWC
- TDC can be converted manually to a PWC reading using a mathematical formula
- Microwaves are ideal to measure INTERSTITIAL FLUID
- The LYMPSCANNER is sensitive to interstitial fluid in the skin and the upper subcutaneous

Terminology

BOUND

70 to 80% of human skin water is BOUND

20 to 30% of tissue water is FREE, this is our target for therapy

FREE

INTERSTITIAL FLUID

Free and Bound water in the extracellular space = INTERSTITIAL FLUID. Water content in the skin is equivalent to INTERSTITUAL FLUID

Spot mode

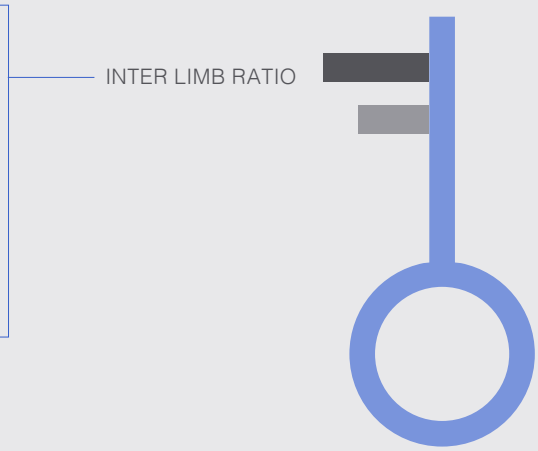
Normative values have been devised and from this a TYPICAL PWC reading of between 25% and 40% has been determined

Spot mode provides you with a localised measure of interstitial fluid

Scan Mode

Provides an INTER LIMB RATIO which eliminates individual differences in BMI, age and a measurement site.

For example PWC interlimb ratio of 1.50 = 50% greater fluid / oedema



Reliability

A values are 0.19 which means excellent repeatability except for foot where a lower reliability was found due to prevalence of veins and tendons

Understanding the display on Lymphscanner

Display shows:

- PWC at “actual” site
- PWC Reference at site you chose as the reference
- PWC RATIO in % reading in this case 46% more fluid from reference to actual site

LO FORCE

Yellow warning pressure is too low

HI FORCE

Red warning pressure is too high

Arm recording

Gill Buckley marking an arm and taking spot measurements

Spot Mode

From study by Harvey N Mayrovitz, Daniel N Weingrad and Lidice Lopez Assessing Localized Skin-to-Fat Water in Arms of Women with Breast Cancer Via Tissue Dielectric Constant Measurements in Pre- and Post-Surgery Patients

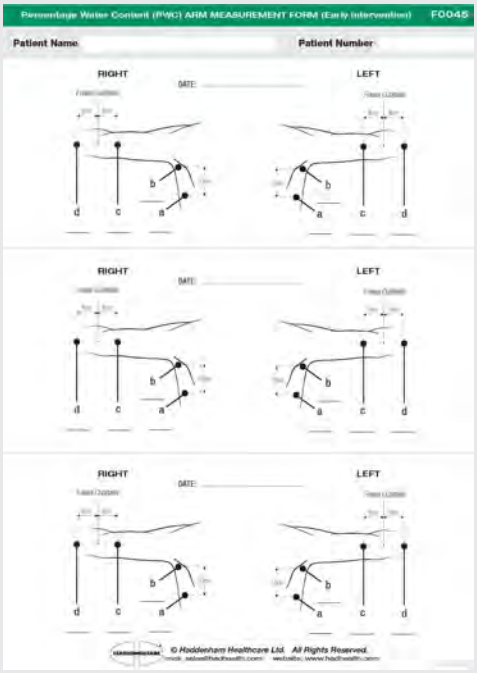
Published 12 November 2014

Purpose: To compare TDC values in breast cancer patients prior to surgery (group A) and in patients who had breast cancer related surgery (group B) to determine if TDC of group B were related to nodes removed and to develop tentative lymphoedema-detection thresholds.

Conclusion: Inner-arm TDC ratios are significantly related to symptoms and nodes removed. Ratios increased with increasing symptom score and might be used to detect preclinical unilateral lymphoedema using TDC ratio thresholds of 1.30 for forearms and 1.45 for biceps.

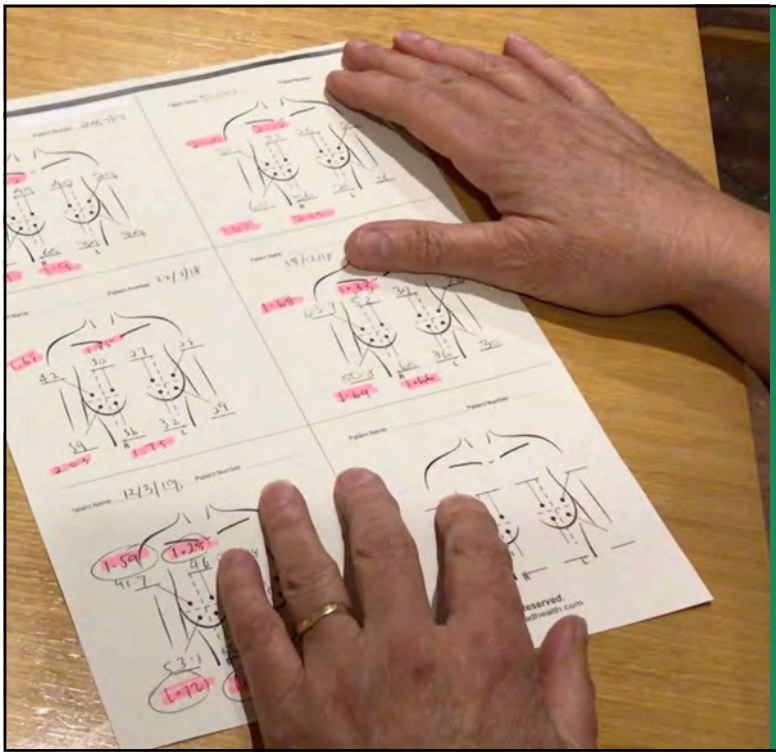
Early intervention arm measurement form

Spot Mode



Using a template

Jan Hunter marking a breast using a template and taking spot measurements.

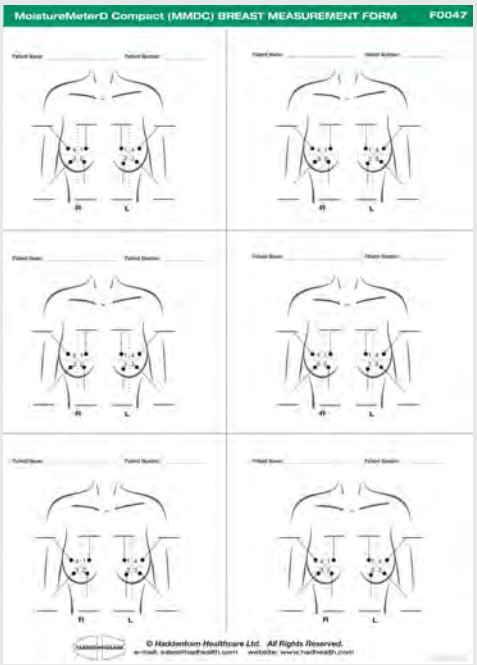


Keeping a record

Sharon Tilley recording spot measurements on the Breast Measurement form.

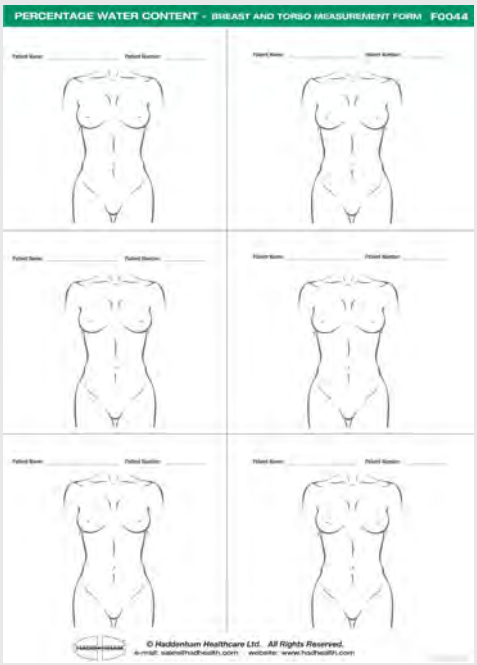
Early intervention breast measurement form

Spot Mode



Additional early intervention breast measurement form

Spot Mode



Innovations in Lymphoedema Assessment and Treatment

LymphScanner

Marking the upper limb to measure for early intervention

Measurement forms available at **hadhealth.com**

HADDENHAM®


LymphScanner
Scanning an arm for manual massage planning
Measurement forms available at hadhealth.com
HADDENHAM®

Implementing a prospective surveillance and early intervention model of care for breast cancer rehabilitation

Louise Koelmeyer
Director, ALERT Program
Faculty of Medicine, Health & Human Sciences
Macquarie University
Louise.Koelmeyer@mq.edu.au

Presentation Outline

- Overview of a “Prospective surveillance & early intervention model of care”
- Briefly review clinical and governance evidence to support the model of care
- Monitoring & early intervention protocol
- Considerations for developing a prospective surveillance model of care
- Implementing model of care across healthcare systems – Private & public

What is a prospective surveillance and early intervention model of care in breast cancer rehabilitation?

Breast cancer rehabilitation

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

- **Optimal framework to guide clinical implementation of a screening method for the early identification and management of breast cancer treatment–related impairments including lymphoedema.**

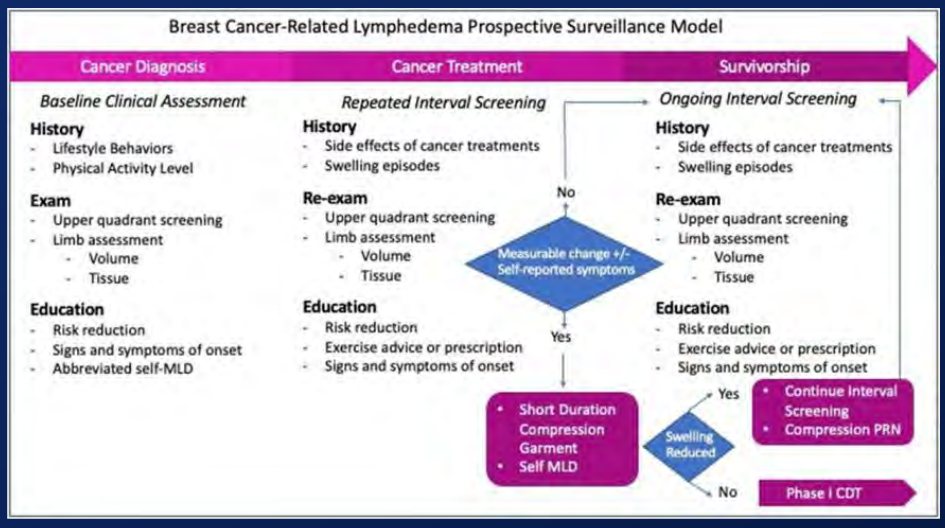
- Stout and colleagues in 2012 proposed a comprehensive approach to cancer survivorship health care.

- The goals of the model of care that they defined were to:-
  - **promote surveillance** for common physical impairments and functional limitations associated with breast cancer treatment
  - to **provide education** to facilitate early identification of impairments
  - to **introduce rehabilitation** and exercise intervention **when physical impairments are identified**
  - to **promote** and support **physical activity and exercise behaviours**

Stout, N. et al. (2012), A prospective surveillance model for rehabilitation for women with breast cancer. Cancer, 118: 2191–2200. doi: 10.1002/cncr.27476

Breast cancer rehabilitation

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE



Lymphoedema monitoring

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

- Prospective surveillance aims to detect stage 0 or early stage 1 lymphoedema
- Early intervention is more easily managed than later stage lymphoedema and potentially reversible
- Early intervention aims to prevent progression to chronic late stage lymphoedema
- All individuals at risk of lymphoedema should have access to a prospective surveillance & early intervention model of care in all healthcare settings

Key aspects of this model of care

PROSPECTIVE SURVEILLANCE & EARLY INTERVENTION MODEL OF CARE

Screening – pre-operatively or pre-treatment with risk stratification (based on individual risk factors)	Screening – post-operatively and at regular intervals with risk stratification	Assessment - technology that can detect lymphoedema before clinical signs are apparent (bio-impedance spectroscopy) and other assessments specific to cancer care
Implementation of appropriate therapy for lymphoedema:- education, exercise, garments and scar therapy	Implementation of appropriate therapy for general cancer rehabilitation:- education, exercise, musculoskeletal, psychological support	Ongoing health promotion including encouraging exercise

Why adopt a prospective surveillance and early intervention model of care in breast cancer rehabilitation?

Clinical & governance evidence

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

Key position statements & protocols on prospective surveillance & early intervention – recommend routine monitoring from time of breast cancer diagnosis and ongoing education and rehabilitation according to risk

- Australasian Lymphology Association (ALA), Aus
- Agency for Clinical Innovation (ACI), Aus
- American Society of Clinical Oncology (ASCO), USA
- National lymphoedema Network (NLN), USA
- National Comprehensive Cancer Network, NCCN, USA
- National Accreditation Program for Breast Centers (NAPBC), USA
- American Physical Therapy Association (APTA), USA

Clinical evidence

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

Author	Study Design	Year	Number	BCRL diagnostic technique / intervention	BCRL (early vs late intervention)
Box	Randomised	2002	65	Circumference, BIS / early Physio	11% vs 30%
Torres Lacomba	Randomised	2010	120	Circumference / early Physio	7% vs 25%
Stout	Prospective	2011	196	Perometry / compression garment	25% subclinical and 6% Stage I-II
Soran	Prospective	2014	186	BIS, Physio, compression garment	33% subclinical, early intervention, 4% vs 36%
Yang	Prospective	2016	707 - 390 Surveillance group, 317 Historical control group.	lymphoedema symptom experience index & BIA Garment, education, MLD	5-year data - 6.4 % surveillance group vs 15.1 % control group.
Ridner	Randomised	2018	280	BIS ≥7 / compression sleeve	L-Dex ≥7 units change = clinical LE

Clinical evidence

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

Author	Study Design	Year	Number	BCRL diagnostic technique/intervention	BCRL (early vs late intervention)
Kilgore	Retrospective	2018	146	BIS (2SD) Garment, education, MLD	34% had elevated BIS. After EI 6% chronic BCRL
Whitworth	Prospective	2018	93	BIS RTW Garment, education, MLD	3% developed chronic BCRL
Koelmeyer	Retrospective	2019	188-early surveillance (ES); 285-traditional referral (TR)	Education, BIS, compression garment	4% ES vs 24% TR, Stage II-III
Ridner	RCT	2019	508	≥5<10% volume by tape OR ≥6.5 L-Dex points from baseline Compression sleeve & gauntlet for 28 days	lymphoedema progression after intervention Tape = 10/68 (14%) L-Dex = 2/41 (5%)

Governance evidence

ALA POSITION STATEMENT 2019

Australasian Lymphology Association

- The Australasian Lymphology Association (ALA) endorses the need for all patients treated for breast cancer to have access to:
  - an educational program informing them about lymphoedema
  - a prospective monitoring program for changes indicative of developing swelling, particularly for those at higher risk of developing breast cancer-related lymphoedema

- Early detection of changes indicative of developing lymphoedema, and immediate conservative treatment, may reduce the long-term physical and functional impacts caused by progression and establishment of the condition.

- All patients treated for breast cancer should undergo preoperative measurements of their arm, as well as receive education on lymphoedema, its risk factors, early signs of its development and a point of contact for clinical assessment if needed. For those who are at higher risk of developing lymphoedema, monitoring should begin postoperatively and continue at regular intervals for at least two years.

Assessing sub-clinical lymphoedema

BIOIMPEDANCE SPECTROSCOPY (BIS)

- A non-invasive method of determining the composition of body tissues to evaluate the presence of body fluids such as lymph.
- BIS measures parameters over a frequency range of 3 - 1000 kHz with 256 data points. Comparison of the data collected within that frequency range enables calculation of extracellular, intracellular and total body water.
- Measured in L-Dex units. Normal range = -10 to +10. Change of ≥6.5 from baseline triggers early intervention
- Recent validation study comparing positions (lying, sitting and standing) show excellent comparison between U400 and SOZO devices

SOZO

impedimed

Breast cancer rehabilitation

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

Pre-breast cancer treatment Ax, monitoring & education

Ongoing education, rehabilitation support and monitoring

Early intervention as appropriate using CLT

impedimed

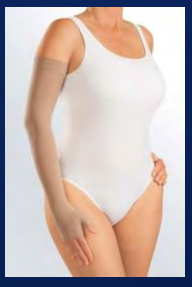
Monitoring Protocol

PROSPECTIVE SURVEILLANCE AND EARLY INTERVENTION MODEL OF CARE

- All individuals diagnosed with breast cancer should have pre-treatment measurements recorded and should have similar measurements repeated at 3 to 6 monthly intervals for the first 2 years post treatment.
- Both arms should be measured to reduce standard measurement error.
- Risk stratification needs to be considered for ongoing “drip-filtering” education

Early intervention protocol

PROSPECTIVE SURVEILLANCE & EARLY INTERVENTION MODEL OF CARE

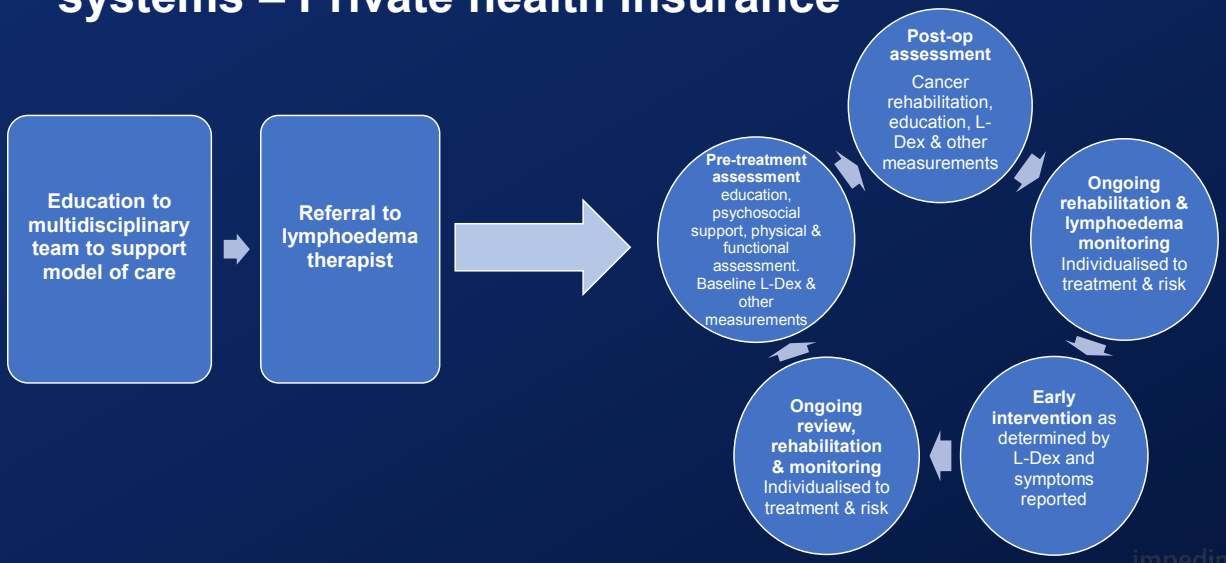


- Compression Therapy – Class 2 (23-32 mmHg) compression sleeve and gauntlet
  - Must fit appropriately – RTW or Custom made
  - To be worn ~10-12 hours / day when most active for 4-6 weeks
- To be reviewed at 4 weeks
- Ongoing education on risk minimisation education & skin care

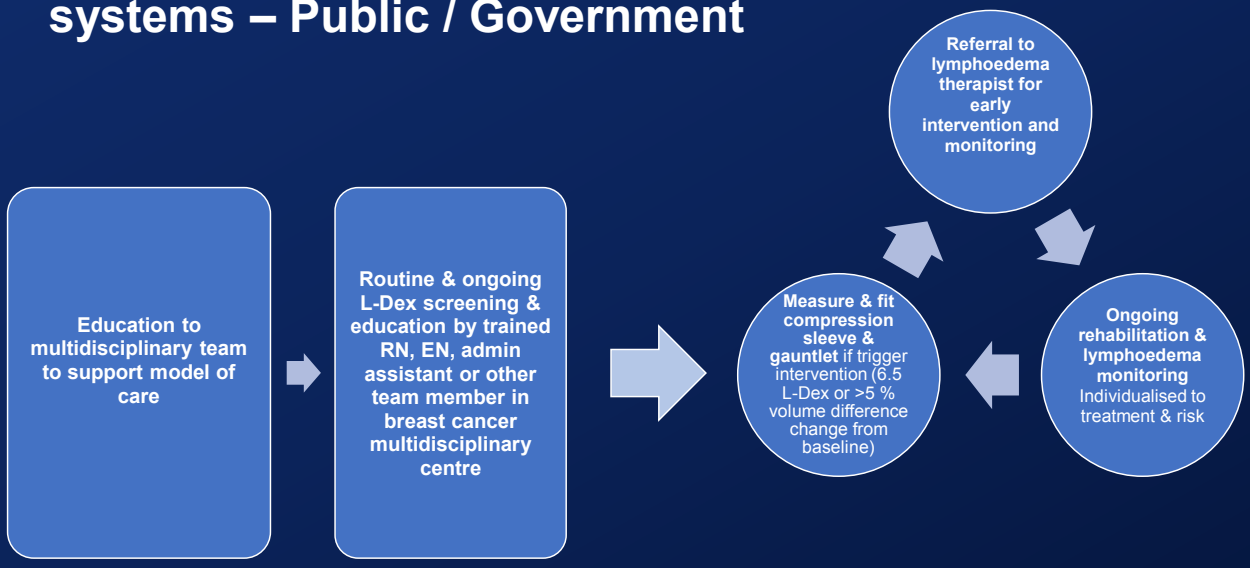
- Exercise - Clinical Oncology Society of Australia (COSA) position statement on exercise in cancer care states that exercise to be embedded as part of standard practice in cancer care.
- Avoid inactivity and progress towards at least 150 minutes of moderate intensity aerobic exercise and two to three moderate intensity resistance exercise sessions each week.
- SOZO to track Body Composition (% Skeletal Muscle Mass, Fat mass, Fluid levels)

Considerations for developing a prospective surveillance model of care

Implementing model of care across healthcare systems – Private health insurance

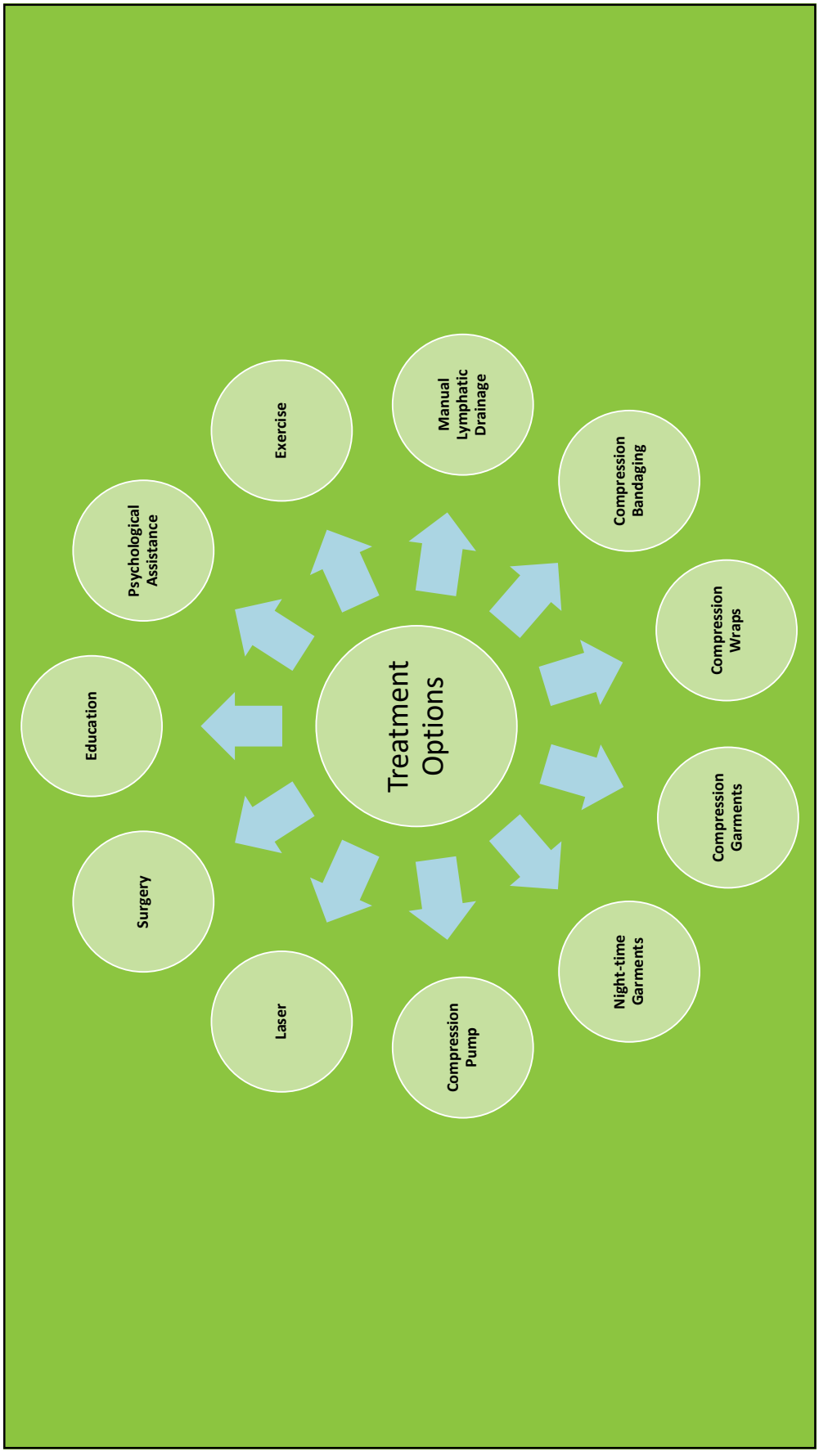


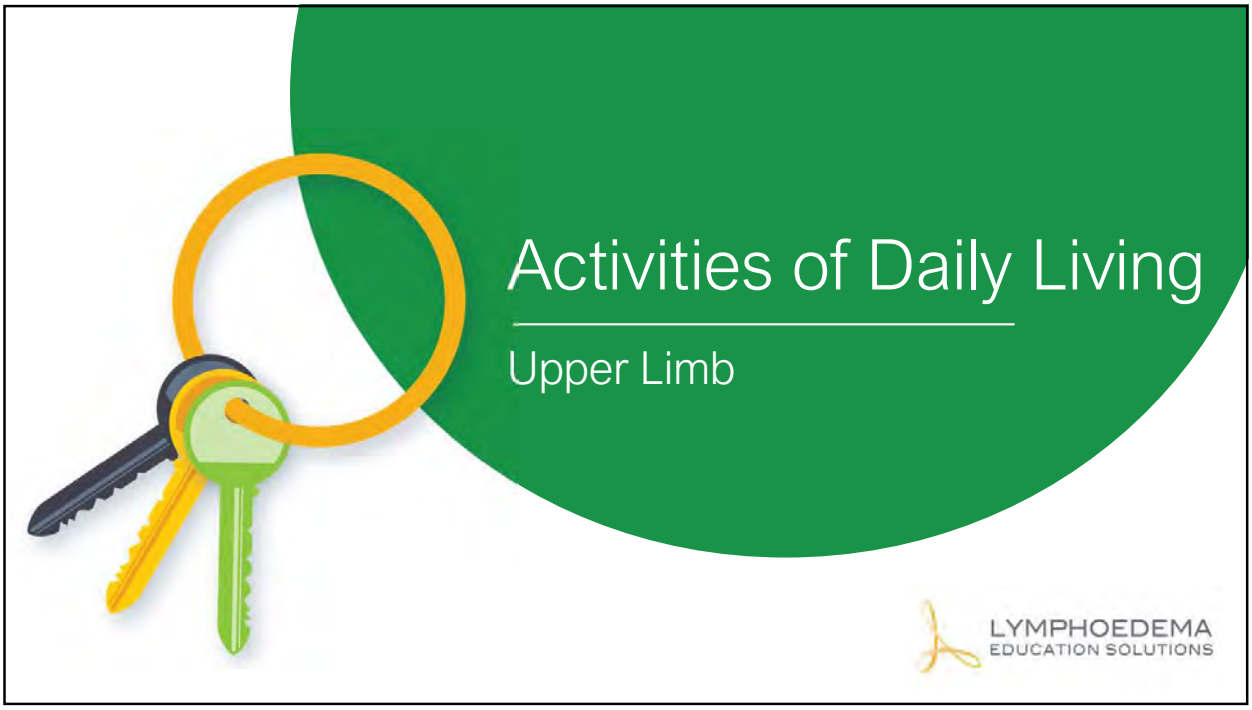
Implementing model of care across healthcare systems – Public / Government

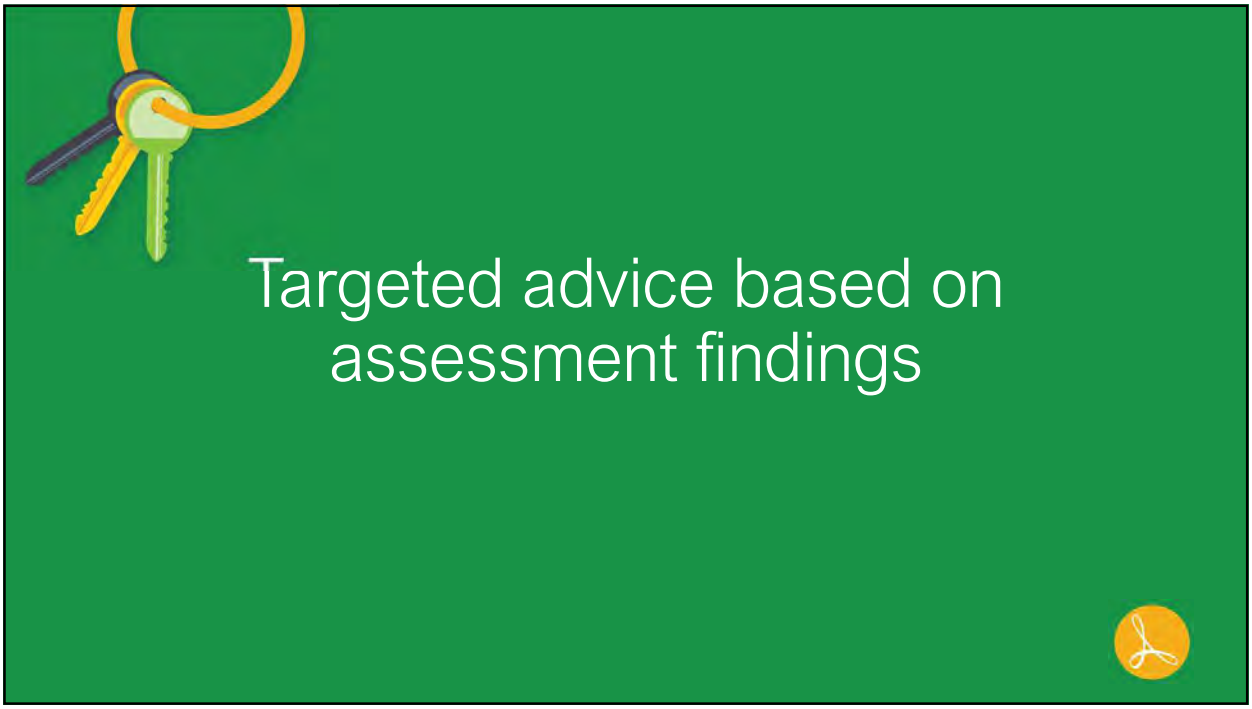


Thank you

Louise.Koelmeyer@mq.edu.au


Treatment Options
Exercise
Manual Lymphatic Drainage
Compression Bandaging
Compression Wraps
Compression Garments
Night-time Garments
Compression Pump
Laser
Surgery
Education
Psychological Assistance


Activities of Daily Living
Upper Limb
LYMPHOEDEMA
EDUCATION SOLUTIONS


Targeted advice based on
assessment findings

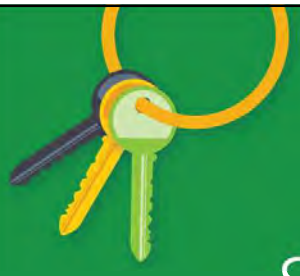
What aggravates the lymphoedema?

- Family activities e.g young children
- Work
- Sport
- Hobbies e.g gardening, dancing etc

Summer versus Winter

All or Nothing May Make it Worse

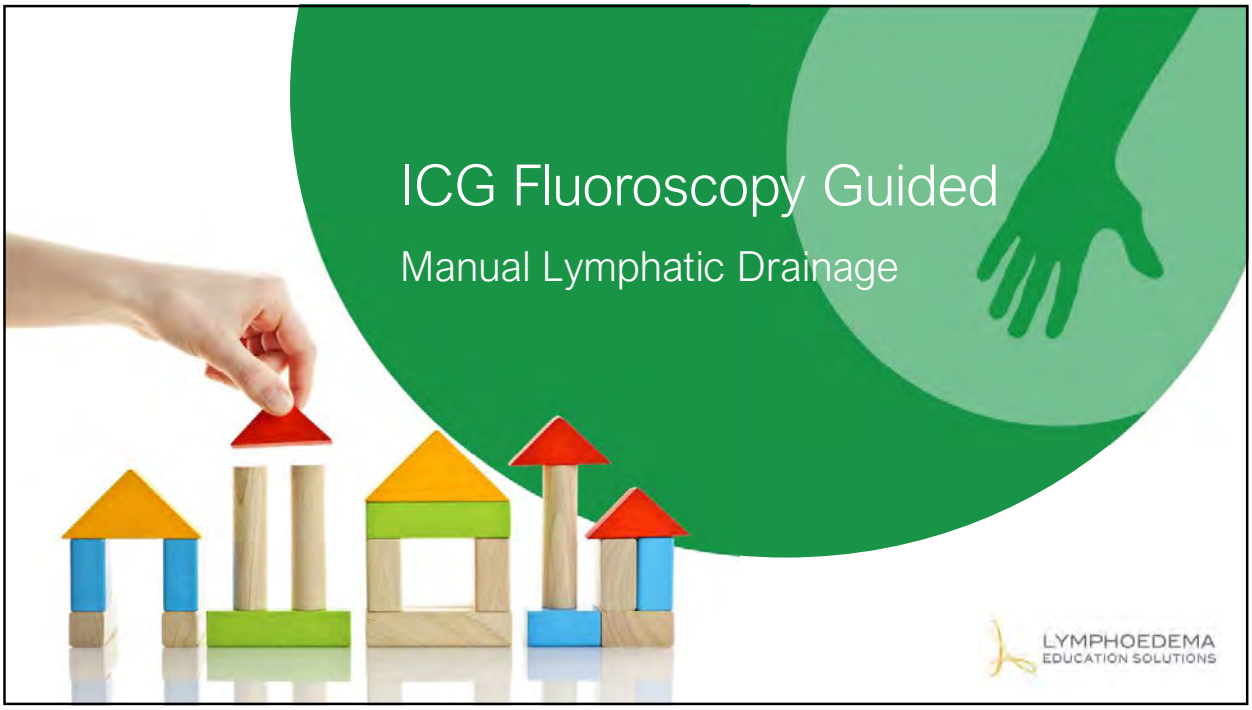
- Build up to pre – cancer function
- Spread the activities
- Avoid overloading the system
- Muscle pump is important



Self Awareness of Arm Changes

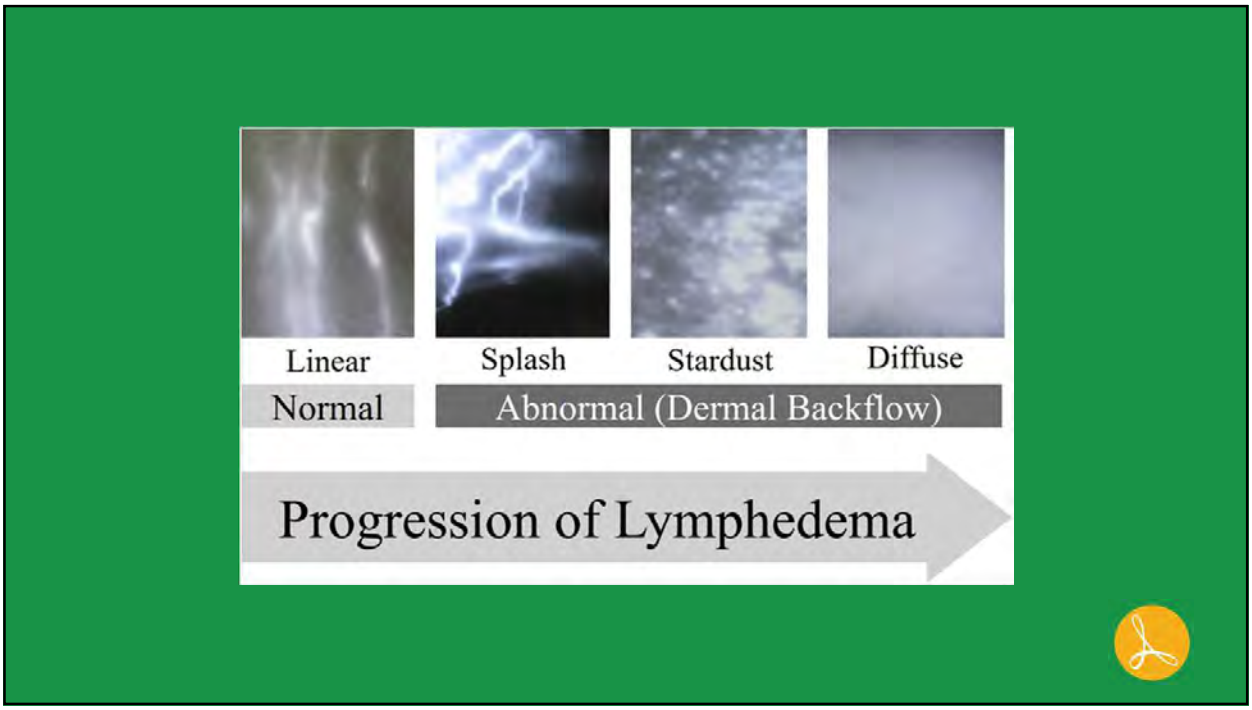
Goals

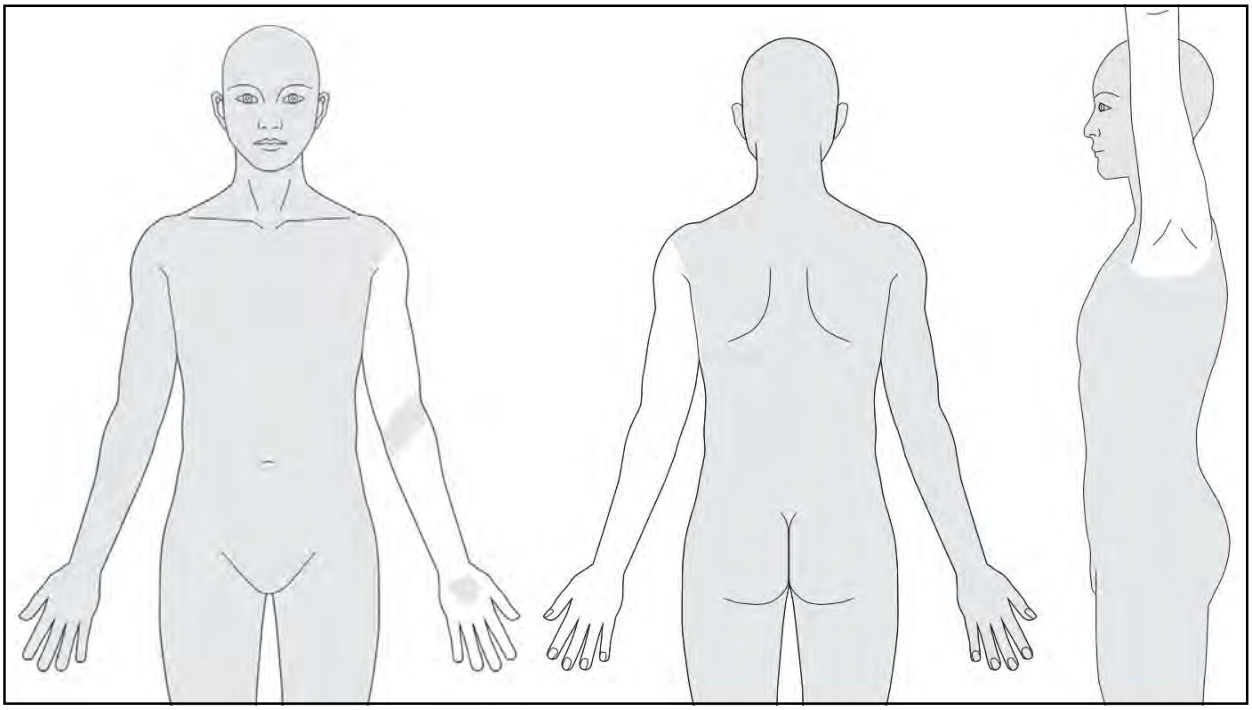
- Make sure you are aware of what they want to achieve
- Pre cancer function?
- Realistic?
- Plan return to function

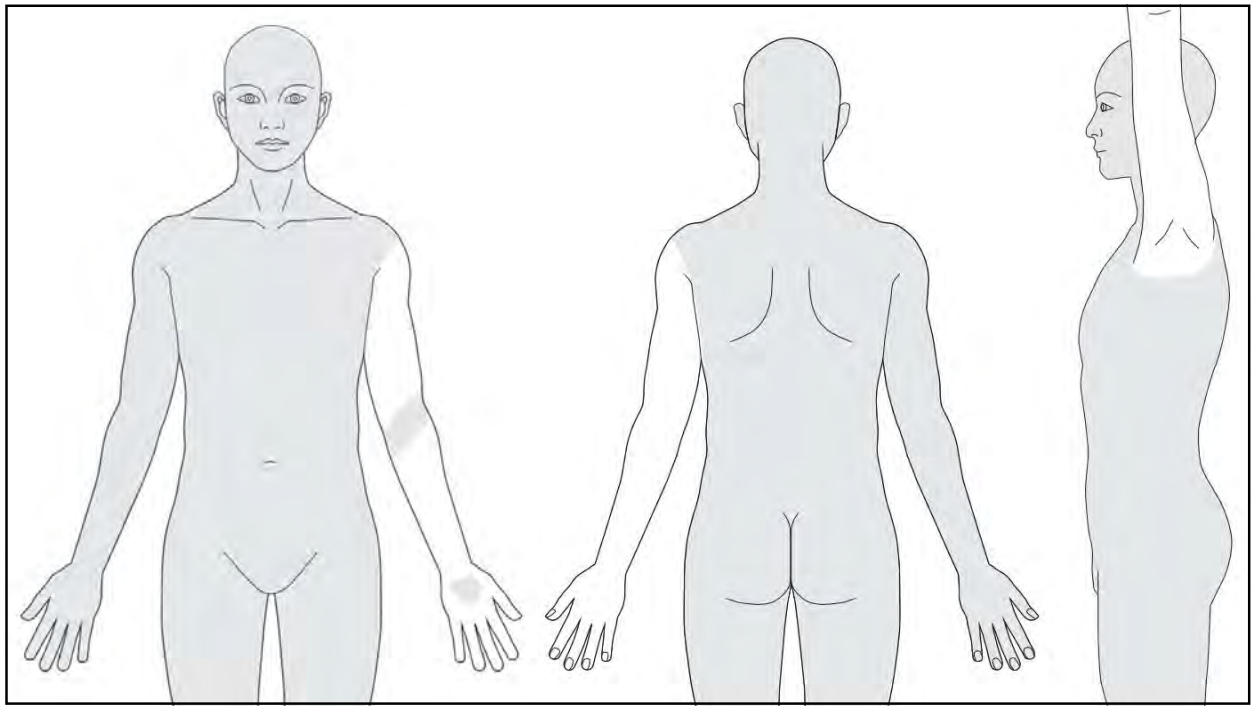


ICG Fluoroscopy

- Indocyanine green injected intradermally.
- It is a dye.
- It is highly fluorescent.
- Attaches with protein and taken exclusively into the lymphatic system
- Visualised with an infra red camera


Linear
Splash
Stardust
Diffuse
Normal
Abnormal (Dermal Backflow)
Progression of Lymphedema



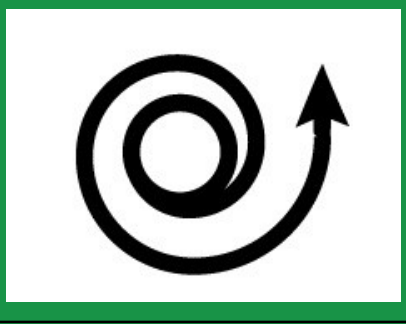


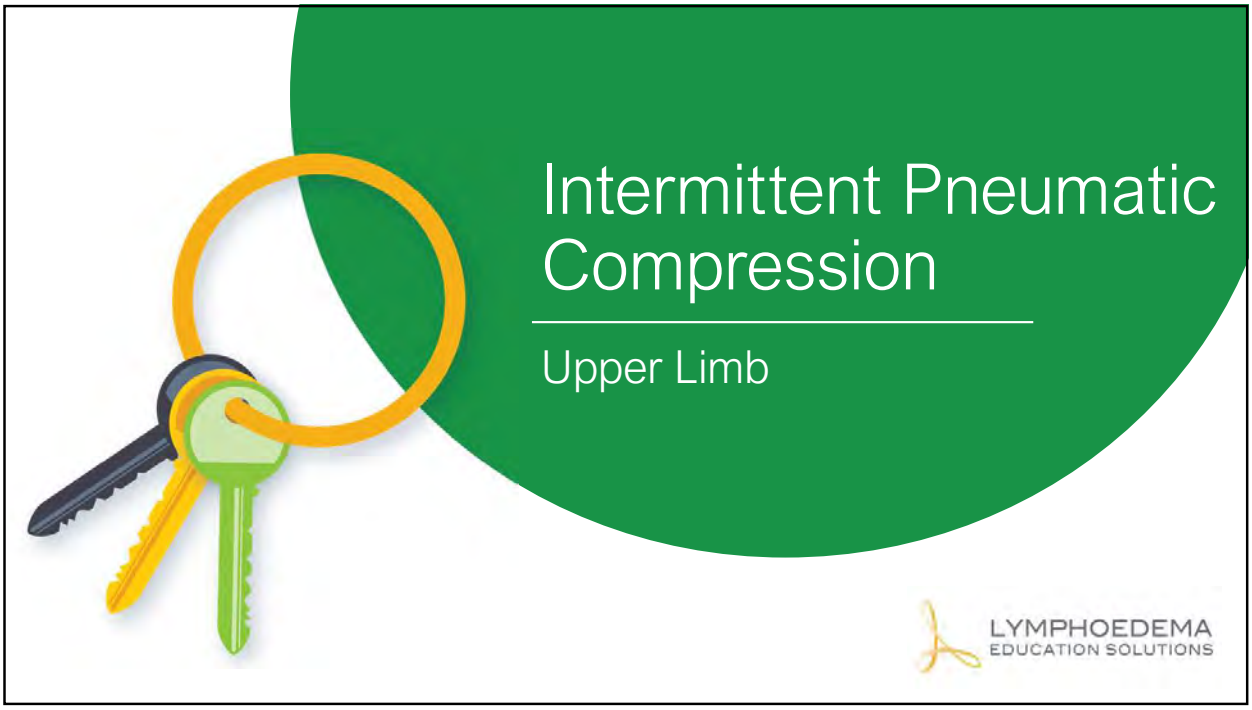
Techniques

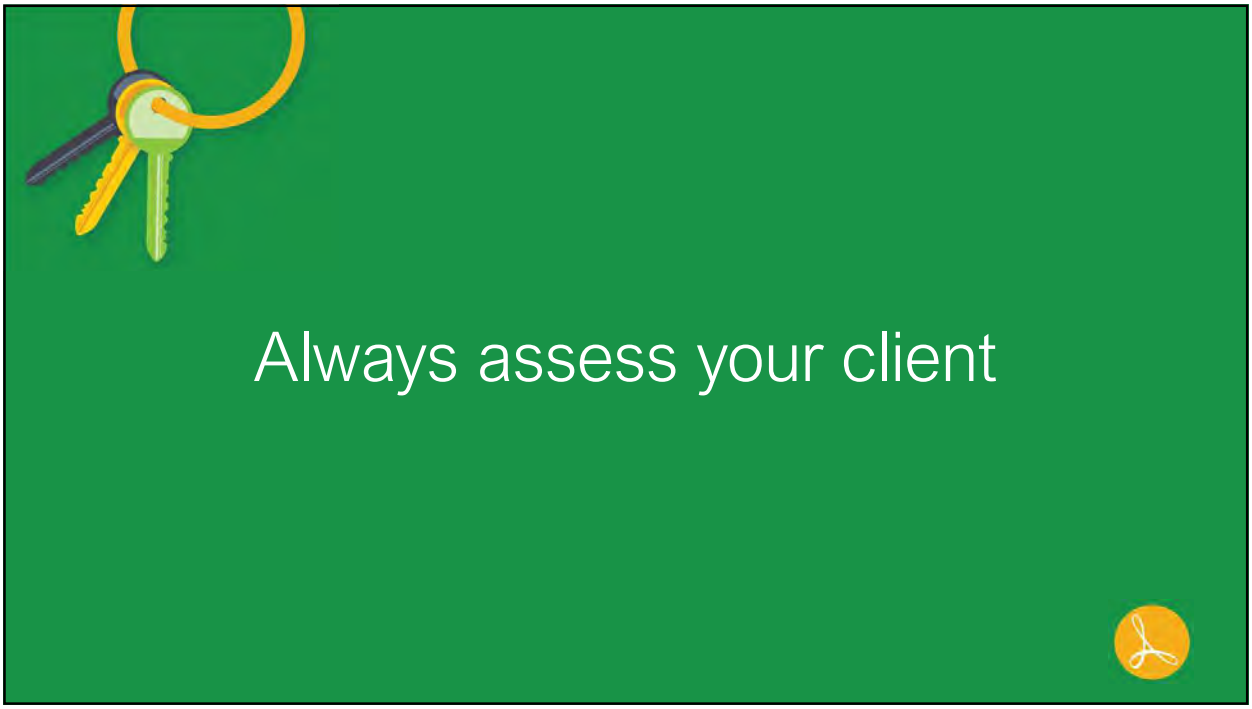
- ✓ Slow
- ✓ Shouldn't cause redness
- ✓ Move fluid to areas free of oedema
- ✓ Move to functional nodes

Techniques

- ✓ Areas free of oedema light compression, flat of hand
- ✓ If oedema more pressure border of index finger and thumb
- ✓ Circles for fibrosis

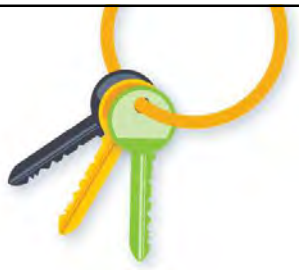



Intermittent Pneumatic Compression
Upper Limb
LYMPHOEDEMA
EDUCATION SOLUTIONS


Always assess your client

What is IPC

- Is composed of an inflatable garment consisting of multiple pressure compartments that wraps around the arm or leg,
- An electrical pneumatic pump fills the garment with compressed air.
- The garment is intermittently inflated and deflated with cycle times and pressures that vary between devices.



Historical Reflection

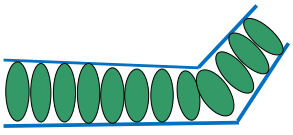
- Single to 3 chambers
- No option of chambers for trunk clearance
- Unclear of accuracy of pressure delivered
- Research suggested risk of genital oedema and root of limb oedema banding

Number of Chambers

- Variation between 4, 8, 12 chambers
- Arm sleeves with or without chest wall compression
- Decision based on the clients oedema distribution and functional areas of lymphatic drainage?

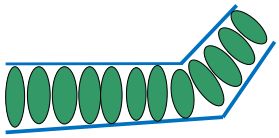
Traditional IPC Sequential Cycle

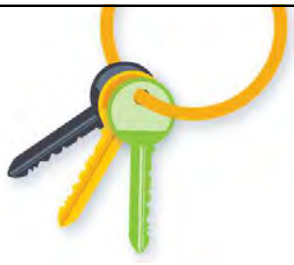
- Starts distally and holds pressure in each chamber
- Releases all chambers together
- Useful for venous and dependency oedemas



Traditional IPC Wave cycle

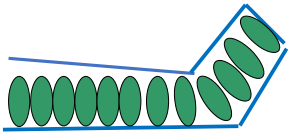
- Applies pressure distally and inflates the next progressive chamber whilst releasing the previous
- It has a 'wave' or peristaltic effect and is useful for palliative , venous and pitting oedema





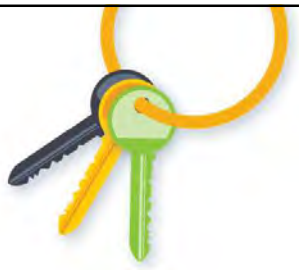
Then Came Retrograde IPC

- Designed for Lymphoedema only
- The first 12 chamber (overlapping) retrograde pump
- Retrograde flow/ commences proximally
- Based on MLD



Now We Have

- IPC that will focus cycles on specific areas
- Can be applied to treat midline oedema
- Allow for tailoring of treatment to specific patient needs

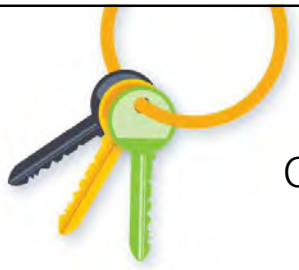


Parameters?

- Pressure setting – what is the correct pressure?
  - Arm- up to 40mmHg
- Deflation and inflation times?
- Pre therapy?
- Sequence of compartment inflation?
- More research required

Choice of Garment

- Influenced by where the oedema is
- Sleeve only
- Sleeve with chest piece
- Palliative care issues

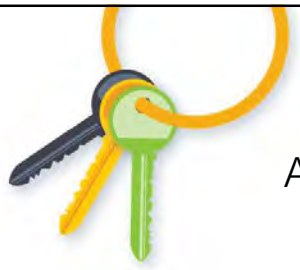


Clinical Use

- Early intervention without compression?
- Prior to intensive therapy combined with compression garment/wrap
- As part of intensive therapy ie IPC, MLD, bandaging/wrap
- Maintenance phase – another tool in the kit
- Palliative care

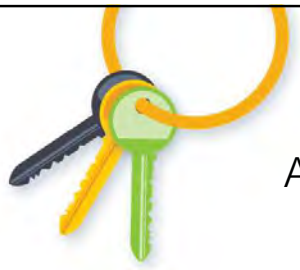
Contraindications / Precautions

- Severe cardiac failure
- Anaesthesia / parasthesia
- Acute infection. E.g cellulitis
- Fragile / sensitive skin
- Immediately following radiotherapy



Application Guidelines

- Exercise proximally, if possible, when having IPC.
- Clear root of limb to functional drainage area if using arm sleeve without trunk section.
- Home use must have application instructions including dosage information.



Application Guidelines

- If the client experiences discomfort/ pain, numbness, pin and needles move the limb into another position when it deflates.
- If the symptoms don't improve after another inflation cycle stop the machine and the client should contact their practitioner.
- If there is an increase in swelling after IPC cease using it and contact the practitioner.

.

Advantages of bandaging

- Enhance muscle and joint pump (create a resting and working pressure)
- Increase in total tissue pressure
- Restore patency of vessels
- Soften fibrotic areas
- Improve skin condition

Advantages of bandaging

- Conserve success of manual lymphatic drainage / IPC
- Maintains and improves the shape of the limb.
- Psychological improvement
- Improve mobility

Contraindications / Precautions for Compression

- Severe cardiac failure – controlled versus uncontrolled
- Be careful with levels of compression with diabetes
- Untreated DVT
- Numbness or paraesthesia.
- Acute infection (eg cellulitis)
- Skin condition that may contraindicate compression
- Unsafe

The Ideal Compression System

Is an inelastic sleeve

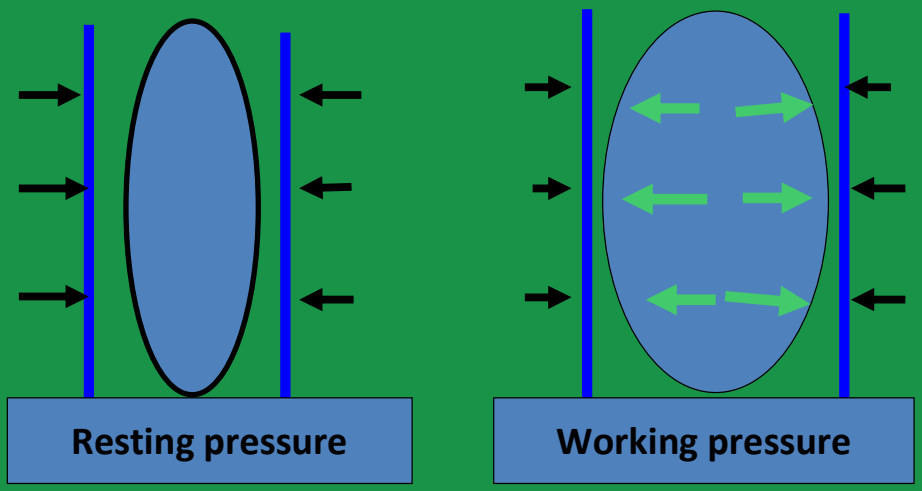
Is an anatomical fit

Stays in place

Is comfortable at rest

LYMPHOEDEMA EDUCATION SOLUTIONS

Static Stiffness Index



Compression bandaging ≠ Graduated compression

- Data collected from three studies of 744 compression bandage applications using pressure sensors
  - Systems applied by **experts** in application of compression bandages
- Graduated compression as predicted by the Law of Laplace was observed in only 7.1% of applications (53 of 744)
- The belief that compression systems provide pressure values graduating from 40 mmHg at the ankle to 17 mmHg below the knee is not supported by the results


The efficacy of Laplace's equation in calculating bandage pressure in venous leg ulcers

Schuren J, Mohr K. The efficacy of Laplace's equation in calculating bandage pressure in venous leg ulcers. Wounds UK 2008; 4(2): 38-47.

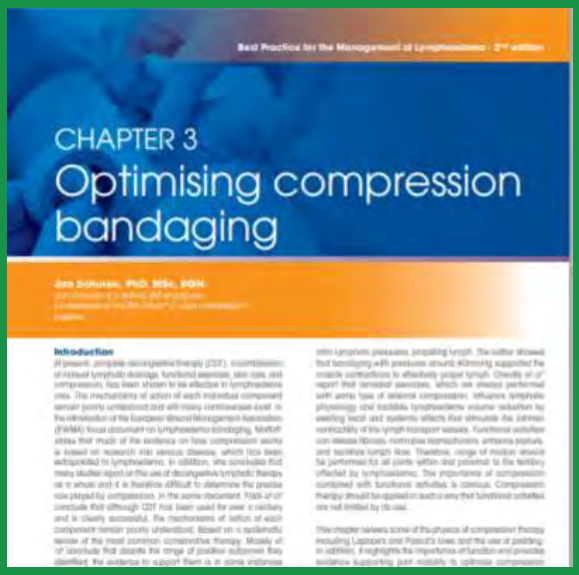
7

Problems with achieving correct compression levels

- Graduated compression profiles are rarely achieved.
- Traditional approaches to the filling of enhanced skin folds in Lymphoedema may result in a negative pressure gradient.
- Excessive padding reduces the compression applied to a limb

Limb shape distortion requires adaption of the application of compression materials

The international Lymphoedema Framework in association with the World Alliance for Wound and Lymphoedema Care June 2012



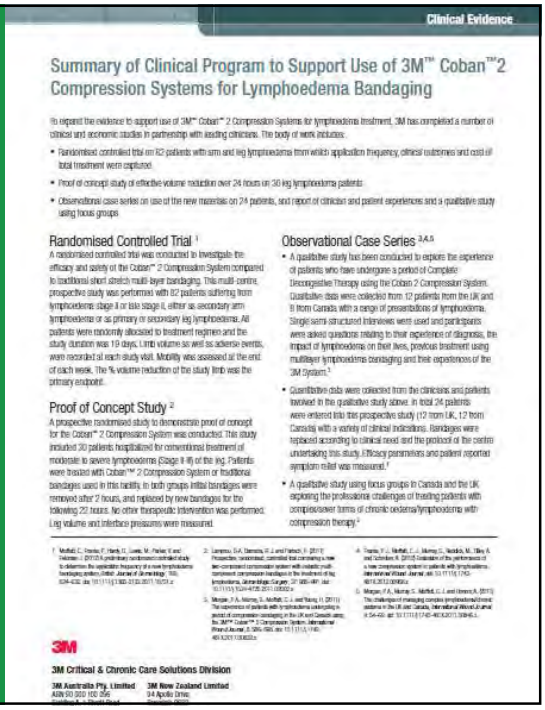
- Laplace versus Pascal's law
- The importance of function
- The use of padding materials
- Improving joint mobility, comfort and effectiveness

Clinical Evidence

3M HAS COMPLETED STUDIES IN PARTNERSHIP WITH LEADING CLINICIANS

- Randomised control trial on 82 patients with arm and leg lymphoedema
- Observational case series on use of the new materials on 24 patients
- Proof of concept study
- Numerous case studies/posters

Copies available on request



The 3M™ Coban™ 2 Compression System

Layer One – Comfort Foam Layer

Layer Two – Compression Layer

Arm Bandaging

FOR THE UPPER LIMBS, FINGERS, WITH SMALLER CIRCUMFERENCES

- 3M™ Coban™ 2 Lite materials
- Bright green package colour & icon
- Reduced sub bandage pressures recommended.

Five Commandments for Bandaging with 3M™ Coban™ 2 Compression Systems

Comfort Layer
Minimal Overlap

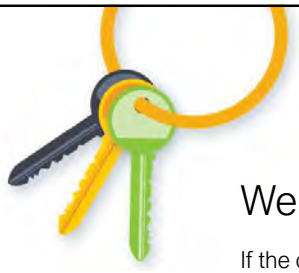
Compression Layer
50% Overlap

Full Stretch

Anatomical Fit

Maximise Mobility
Minimal Layers at Joints

Use the Adaptability and Versatility



Wearing guidelines

If the client experiences:

- Severe pain
- Numbness
- Blue fingers
- Pins and needles
- Increase in swelling hand or fingers

→

- They should check that the bandages are applied correctly and adjust if required.
- It may be due to lack of activity such as sitting for a long period of time and should move their arm and hand.
- If these tips don't help they should remove the bandages by unrolling them and call their lymphoedema practitioner.

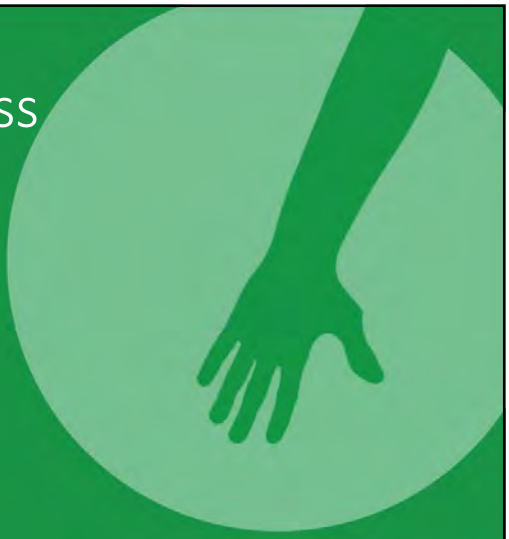
Tip One – Protect the Skin

Use 3M™ Cavilon™ No Sting Barrier Film

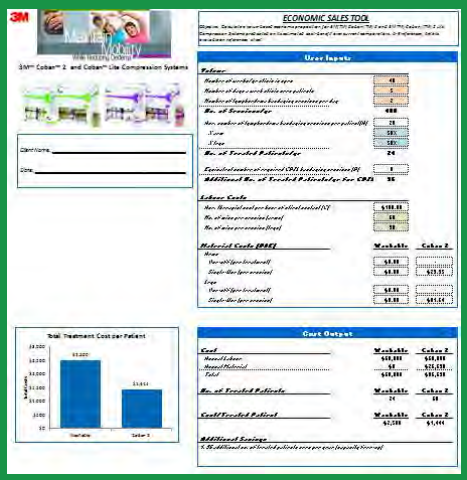
- For areas of friction
- For between Skin folds
- For areas of Moisture
- Peri-wound

Tip Two – Reduce Tackiness

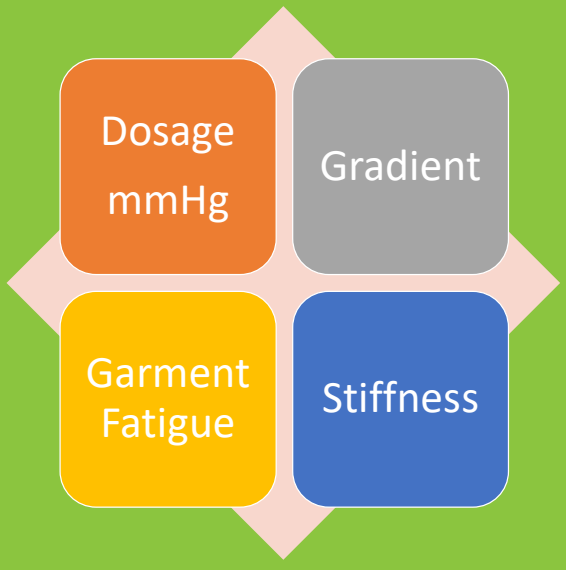
Use 3M™ Cavilon™ Durable Barrier Cream to reduce tackiness



Cost Effectiveness



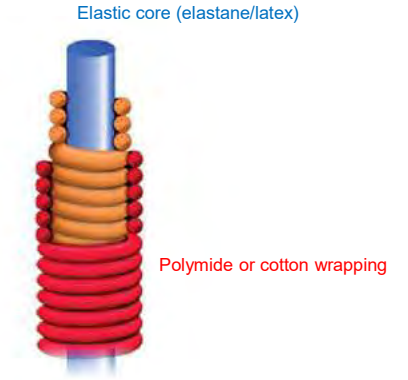
Garment / Wrap Compression Science



Knitting yarns

- The fabric that is used to make flat and circular knit compression garments is produced by knitting two types of yarn together:
  - Inlay yarn which produces the compression
  - Body yarn which delivers the thickness and stiffness of the knitted fabric.
- Higher levels of compression are achieved mainly by increasing the thickness of the elastic core

(ILF 2009)



Source: http://www.lymphedemablog.com/2011/07/29/options-of-care-for-compression-garments/

Levels of compression: OTS garments

Class (mmHg)	British Standard	American Standard	RAL Standard (European)	French Standard
1	14-17	15-20	14-21	10-15
2	18-24	20-30	23-32	15-36
3	25-35	30-40	34-46	

In Australia, the compression class is generally determined using the RAL standard for compression.

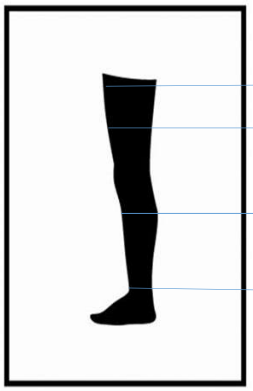
There are some exceptions: Jobst (American), Haddenham, Microfine (French).

The concept of graduated compression

As a broad principle, the level of compression is:

- Directly proportional to the tension with which the compression is applied
- Inversely related to the size of the limb

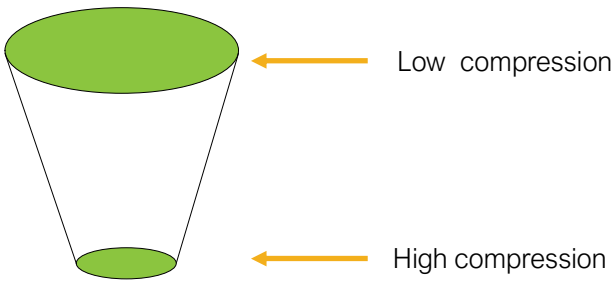
(ILF 2009)

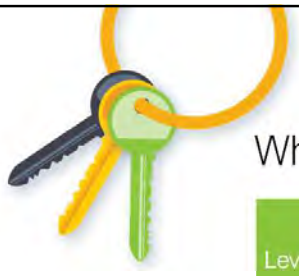


Graduated Compression Profile

La Places Law

Pressure is greatest over the smallest circumference





Which compression when?

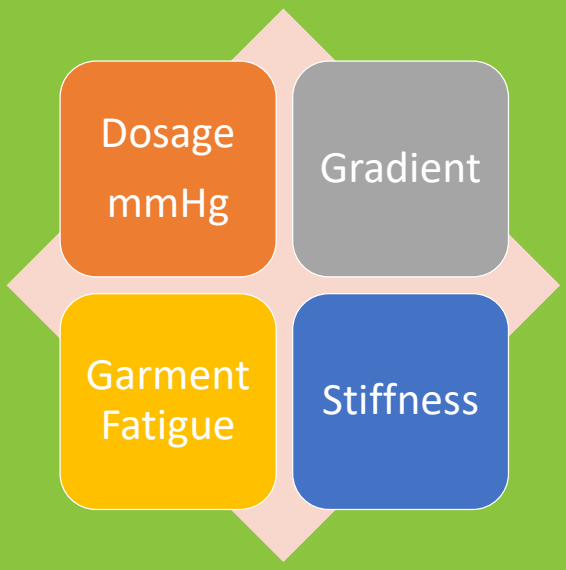
Level of lymphoedema	Level of compression	Equivalent compression class as per RAL standard
Subclinical/early or mild lymphoedema	14-21mmHg	1
Moderate/severe lymphoedema	23-32mmHg	2
Severe lymphoedema	34-46mmHg	3
Severe complex lymphoedema	49-70mmHg	4

Adapted from Lymphoedema Framework Template for practice: compression hosiery in lymphoedema. London: MEP Ltd 2006. Page 16 (1)

Testing the compression of garments

The most common way compression garments are tested is with the HOSY test equipment (Hohenstein System).

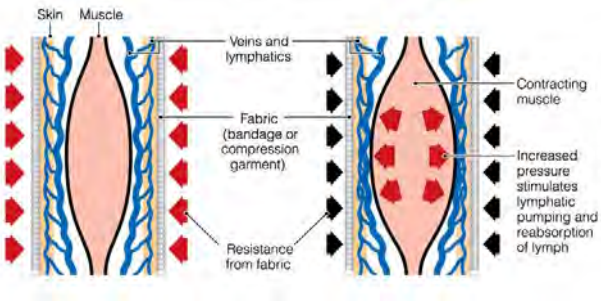
Garment / Wrap Compression Science



Resting Pressure versus Working Pressure

Resting pressure

The bandage or compression garment applies a constant pressure to the skin when the limb is at rest.



Working pressure

Working pressure – when muscles contract and expand (eg during exercise) they press against the resisting bandage and the pressure inside the limb increases temporarily

Lymphoedema Framework. Best Practice for the Management of Lymphoedema. International consensus. London: MEP Ltd, 2006.

Static stiffness

The pressures exerted by compression garments at rest or at work are determined by the stiffness of the garment.

Static Stiffness Index (SSI)

The increase in interface pressure (pressure of garment on the skin's surface) that occurs when moving from lying down to standing up.

Elastic versus Static Stiffness

- Flat knit garments allow a higher working pressure and lower resting pressure than do circular knit.
- Generally, this is most effective for managing lymphoedema / chronic oedema, especially for problem shapes.
- Conversely, circular knit garments exert a lower working and higher resting pressure which might not be tolerated as comfortably by the wearer (eg at knee or ankle).

Garment options

Circular Knit

- Less than 40% excess volume.
- Regular limb shape.
- Intact skin.
- Sometimes more difficult for the client to apply and remove garment.
- Available at RTW and MTM sizes.

Flat Knit

- Ideal for problematic fitting cases.
- Stubborn, fibrotic lymphoedema.
- Intact skin.
- Client able to apply and remove garment.
- Available in RTW and MTM sizes.

Cut and Sew

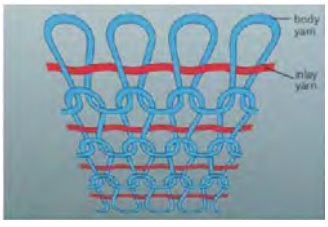
- Regular limb shape.
- Complex case management
  - Midline oedema
  - Lipoedema
  - Head and neck
  - Scar management
- Intact skin.
- Available in RTW and MTM sizes.

Compression garment construction

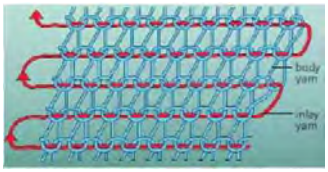
- A variety of styles and fabrics are available to produce appropriate compression for the patient.
- Compression garments are categorised by manufacturing technique:
  - flat knit (with seam)
  - circular knit (seamless)
  - cut and sew

Knitting techniques

- There are two different main knitting techniques used in the production of compression garments for the treatment of lymphoedema
  - Circular knitting
  - Flat knitting
- The wrapping can be adjusted to vary the stretchability and power of the yarn



Inlay and body yarn in a circular knit garment



Inlay and body yarn in a flat knit garment

Source: http://www.lymphedemablog.com/wp-content/uploads/2011/02/inlay-thread1.bmp

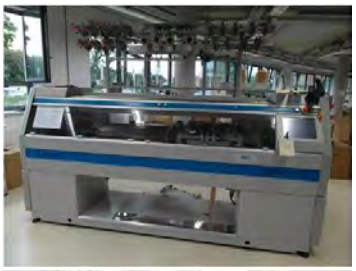
Knit characteristics

	Flat knit	Circular knit
How is shape controlled?	• Elastic inlay has no pre-tension when put into garment • Varying the number of needles in operation • Greater fit range	• Varying the tension of the inlay yarn and stitch height • Number of needles in operation cannot be changed • Limited fit range
Number of needles per inch	• 14-16 • Coarser fabric	• 24-36 • Finer fabric
Yarn thickness	• Coarse to produce sufficient stiffness • Better at bridging skin folds	• Fine to produce a more cosmetically acceptable fabric • May tourniquet at skin folds

Adapted from ILF 2009

Flat knit

- Flat-knit technology produces a flat piece of fabric that is shaped by the addition or removal of needles during the knitting process
- Variable needle count and fixed mesh size
- The material is then stitched together, resulting in a seam, to produce the final garment



Circular knit

- Circular knit garments are produced from material that is continuously knitted on a cylinder resulting in a seamless tube that requires comparatively little finishing to produce the end product.
- Constant needle count and variable mesh size.
- The use of this technique results in a garment which is generally thinner and more cosmetically acceptable.

Cut and sew garments

- The fabric is made with perlon / Lycra fibers or
- Powernet - nylon & elastane fibre content.
- Warp knit elastic fabric (knit fabric produced by a machine with the yarns running in a lengthwise direction).
- Majority of strength in the warp.

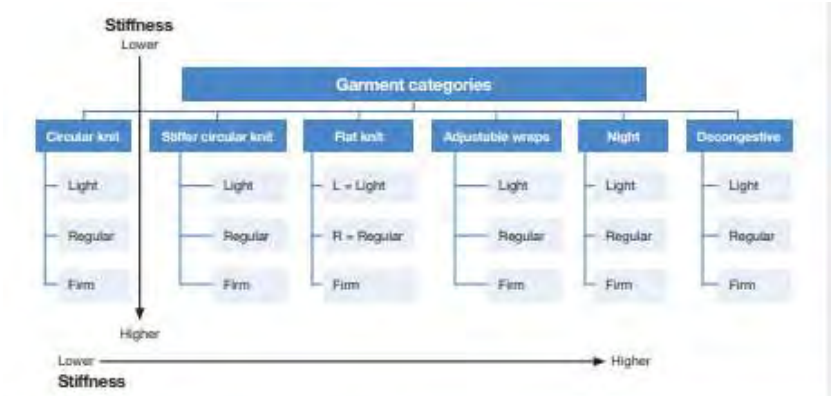


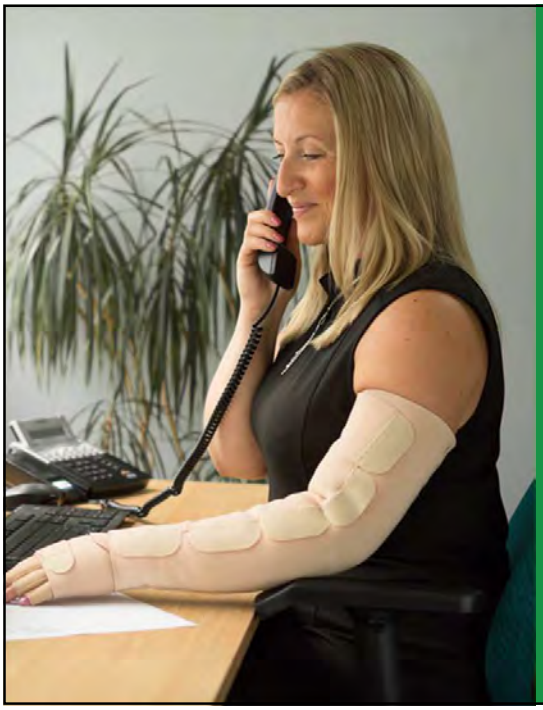
Fig 9. S.T.R.I.D.E. garment categories and subcategories


Compression Wraps
LYMPHOEDEMA
EDUCATION SOLUTIONS


Successful goal directed treatment / each situation will demand a different approach
Consider cost effectiveness
Ensure appropriate treatment
LYMPHOEDEMA
EDUCATION SOLUTIONS

Indications for Upper Wrapping Devices

- Distorted limb shape
- Large and quick volume reduction is anticipated as it can be readjusted easily by the client
- Post-bandage rebound oedema
- Managing exacerbation
- Pre new garment



Indications

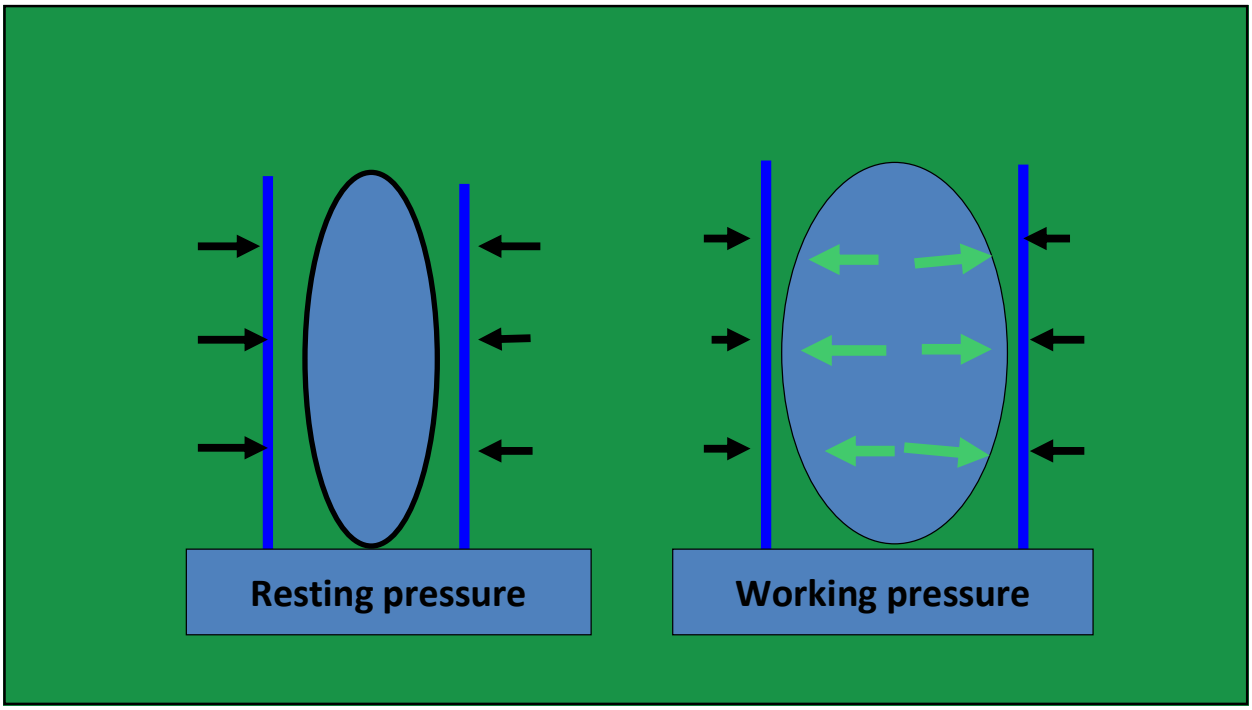
- Combination with glove
- Whilst waiting for custom made compression garments
- Additional compression over garment
- Night time instead of bandaging
- Intolerance to bandaging
- Intolerance to garments
- Non compliance

Indications

- Need for carer involvement in treatment or "home program". Could be a safer and easier option
- Residential facility where donning of garments is difficult.
- When donning is an issue such as post stroke with residual flaccidity
- Neuropathy
- Palliative care
- Skin sensitivity / fragile skin as less dragging on skin when donning

How do they work?

- Ideally wraps follow the same principles of short stretch bandaging.
- **Providing low resting (20 – 30mmHg) and high working pressure**
- Graduated compression is achieved by the end stretch of the material and the limb shape (Which as you do in bandaging you can alter if required).



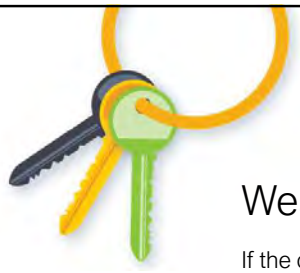
Static stiffness Index (SSI)

Ensuring the correct fit of wraps

- Measure the limb and obtain the correct sizing as per the sizing chart
- Apply the wraps as per the instruction manual
- Check the client after the wraps have been fitted and get them to move their arm through its range of movement and adjust as required.
- Don’t have edges digging into joints.

Contraindications / Precautions for Compression

- Severe cardiac failure – controlled versus uncontrolled
- Be careful with levels of compression with diabetes
- Untreated DVT
- Numbness or paraesthesia.
- Acute infection (eg cellulitis)
- Fragile / sensitive skin



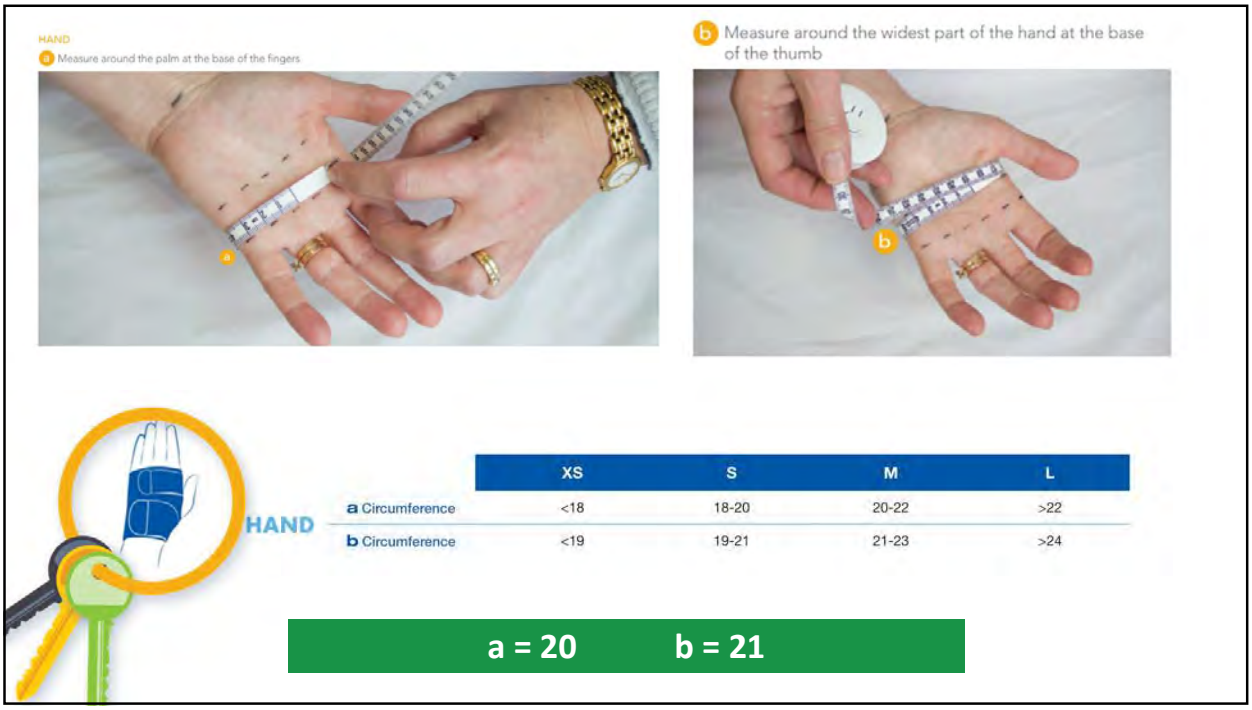
Wearing guidelines

If the client experiences:

- Severe pain
- Numbness
- Blue fingers
- Pins and needles
- Increase in swelling hand or fingers

→

- They should check that the wrap is fitting correctly and adjust if required.
- It may be due to lack of activity such as sitting for a long period of time and should ambulate.
- If these tips don't help they should remove their wraps and call their lymphoedema practitioner.
- If they have previously been bandaged they may be able to do this until they see their practitioner.

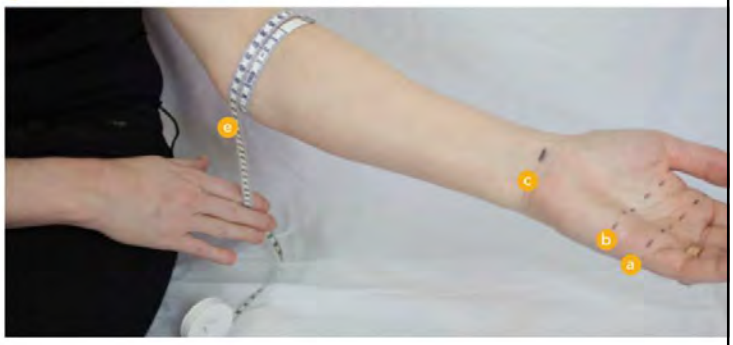


	XS	S	M	L
a Circumference	<18	18-20	20-22	>22
b Circumference	<19	19-21	21-23	>24

c Measure around the wrist crease

ELBOW

e Measure the circumference with the elbow slightly bent

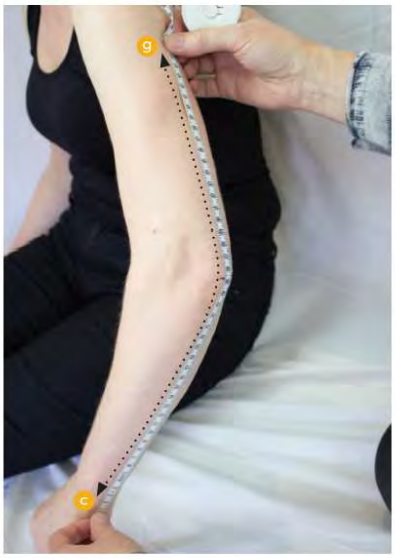


g Measure the top of the arm where you want the wrap to finish, usually 2 fingers width below the arm pit.

LENGTH

1 **c** to **g**

Measure the length between c and g along the outside of the wrist to the axilla with the elbow bent slightly. Follow the contours of the skin.



ARM

	S	M	L	XL
c Circumference	14-18	16-21	19-25	19-25
e Circumference	20-27	25-34	30-40	32-43
g Circumference	22-31	29-39	32-45	36-50
SHORT			40-44	
REGULAR			44-48	
TALL			48-52	

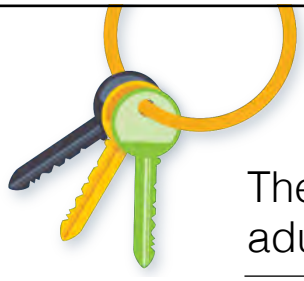
c-g Length

c = 20 e = 33 g = 37 Length = 47

Compression Garments for Upper Limb Lymphoedema

Keys to success

LYMPHOEDEMA
EDUCATION SOLUTIONS



The use of compression in the management of adults with lymphoedema

Queensland Health lymphoedema clinical practice guideline 2014

The aims of wearing compression garments include:

- controlling swelling
- maintaining volume reduction achieved after intensive therapy
- long term management of lymphoedema
- minimising impact from high risk activities that potentially overload the lymphatic system

(Qld Gvt 2014)

Assessing a client for compression garments

1 Subjective assessment

- Client goals
- Check the medical history including:
  - Cardiac, shortness of breath
  - Surgical history including orthopaedic and cancer
  - Cancer management
  - Arthritis
  - Range of movement
  - Grip strength
  - Shoulder pain

1 Subjective assessment

Lymphoedema history:

- How long?
- Where?
- Does it reduce over night?
- 24 hour pattern?
- Past history of wearing compression garments?

1 Subjective assessment

- Client's ability to manage and tolerate compression.
- Activities of daily living including work, social, sport and any limitations.
- Social support.
- Financial ie pensioner, health insurance etc.

2 Objective assessment

Observation

- Gait and assistive devices.
- Posture.
- Mobility including ability to undress and dress.
- Skin – colour, integrity (breaks, dryness).
- Lymphorrhea.
- Shape of limb.
- Location of swelling.

2 Objective - Skin

2

Objective - Skin

Lymphorrhea

- Compression is essential but may need to bandage or wrap with an appropriate wound dressing prior to compression garment.

2

Observation - Shape of limb and location of swelling

2

Objective assessment

Palpation

- Temperature
- Pitting
- Fibrosis
- Location – Lymph Scanner may assist

Range of movement

2

Pitting - check whether clothes leave marks

Contraindications / Precautions for Compression

- Severe cardiac failure – controlled versus uncontrolled
- Untreated DVT
- Numbness or paraesthesia.
- Acute infection (eg cellulitis)
- Fragile / sensitive skin

Garment Selection Considerations

When to wear the garments

Early /mild lymphoedema

- Certain activities eg sport, work, heavy housework, travel, hot day, aggravating factors.

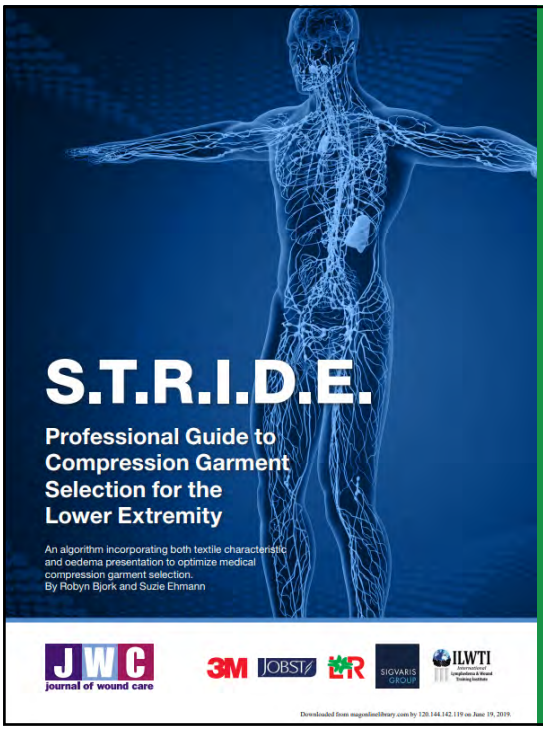
Moderate lymphoedema

- Wear during day and perhaps off at night

Severe lymphoedema

- Day and night

MUST wear compression after finished bandaging or wraps



S = SHAPE

T = TEXTURE

R = REFILL

I = ISSUES

D = DOSAGE

E = ETIOLOGY

1 SHAPE

Q: Where is the swelling located?

Q: Does the dimension of the limb match with standardised sizing charts, or is custom compression needed?

Q: What is the shape of the limb compared to the shape of the garment?

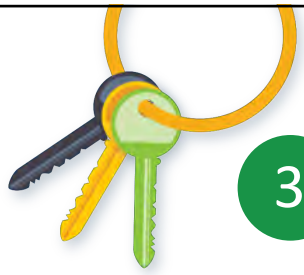
Consider garment types / styles and sizing

2 TEXTURE

Q: What is the texture of the tissue?
Q: Does the tissue easily pit or does it have a more putty-like consistency?
Q: What is the best textile type to match the tissue texture?

Tests: Pitting test, pinch test

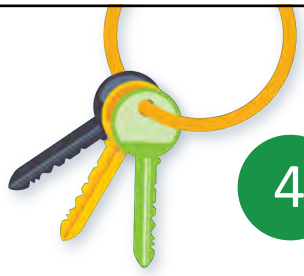
Watery tissue texture = reduces overnight often milder
Fatty tissue texture = may have folds
Putty tissue texture = early fibrotic changes, pits but slow to refill
Woody tissue texture = hard more advanced fibrosis
Fragile tissue texture = thin, fragile skin



3 REFILL

Q: Does the oedema increase during the day only, or day and night?

Q: How fast does the limb increase in size when compression is removed?

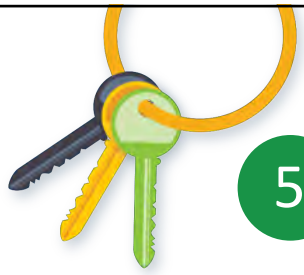


4 ISSUES

Q: Are there medical concerns that would limit compression use/application?

Q: What are the barriers to successful oedema management?

Q: What modifications can be made to overcome identified barriers?

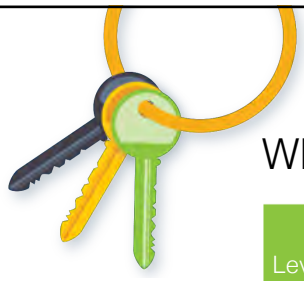


5 DOSAGE

Q: What is the appropriate dosage based on medical diagnosis, precautions, contraindications, and underlying oedema etiologies?

Q: Do certain areas of the limb require greater compression dosage due to size or texture?

Effective compression prescription requires matching the compression selection to the patient presentation, not to the diagnosis alone.



Which compression when?

Level of lymphoedema	Level of compression	Equivalent compression class as per RAL standard
Subclinical/early or mild lymphoedema	14-21mmHg	1
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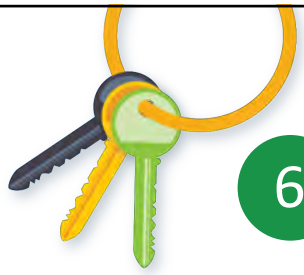
Severe lymphoedema	34-46mmHg	3

Adapted from Lymphoedema Framework Template for practice: compression hosiery in lymphoedema. London: MEP Ltd 2006. Page 16 (1)

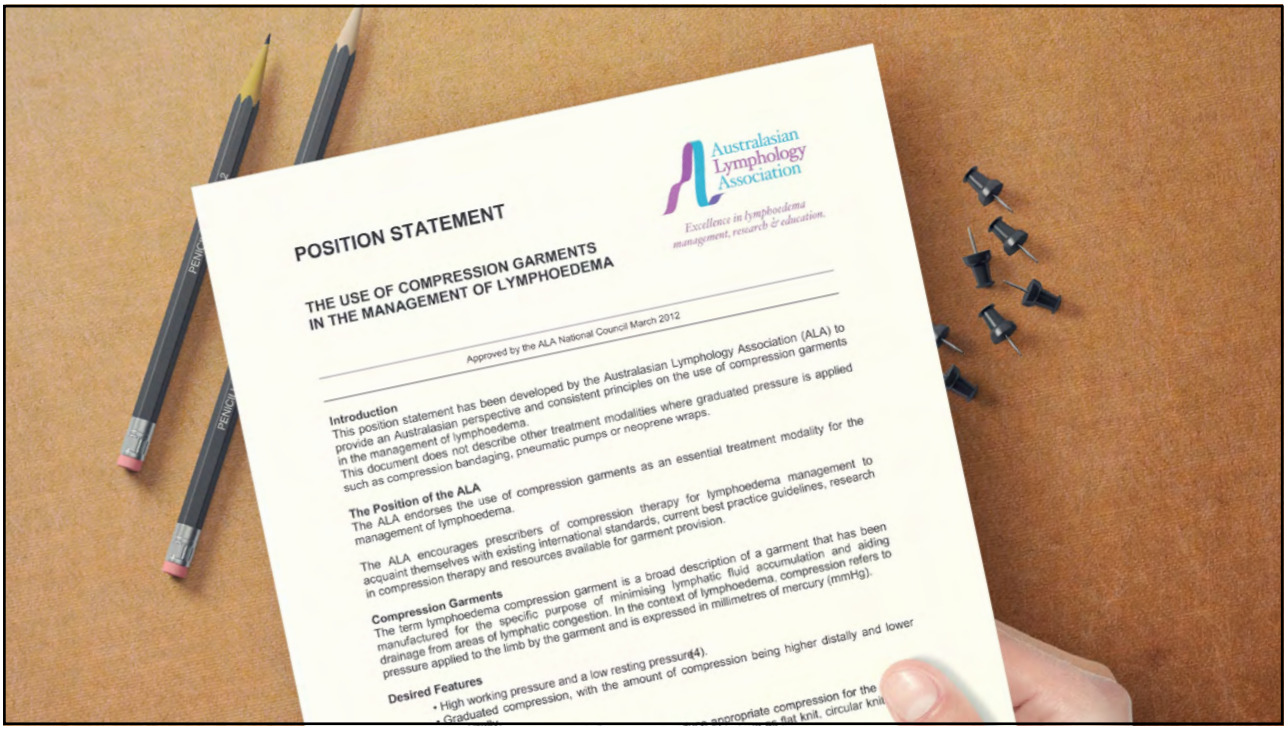


6 ETIOLOGY

Q: What comorbidities are contributing to the oedema/lymphoedema?

Effective communication

- Emotional time – most people would prefer not to wear a garment
- Slowly introduce the concept, work together
- Have goals
- Dynamic process
- Requires commitment
- Contract



What garments for these clients?

STYLE OF GARMENT

Upper limb garments

LYMPHOEDEMA EDUCATION SOLUTIONS

FABRIC

	FLAT KNIT	CIRCULAR KNIT	CUT AND SEW
MATERIAL			

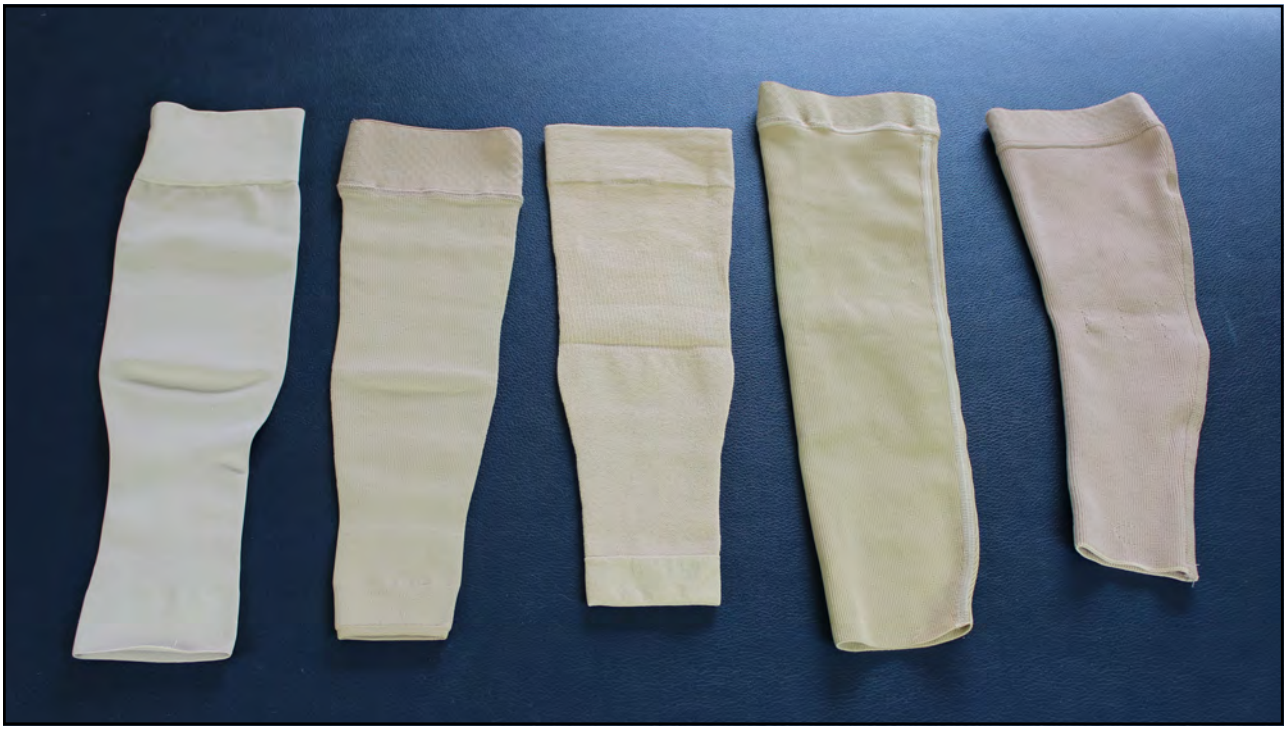
COMPRESSION

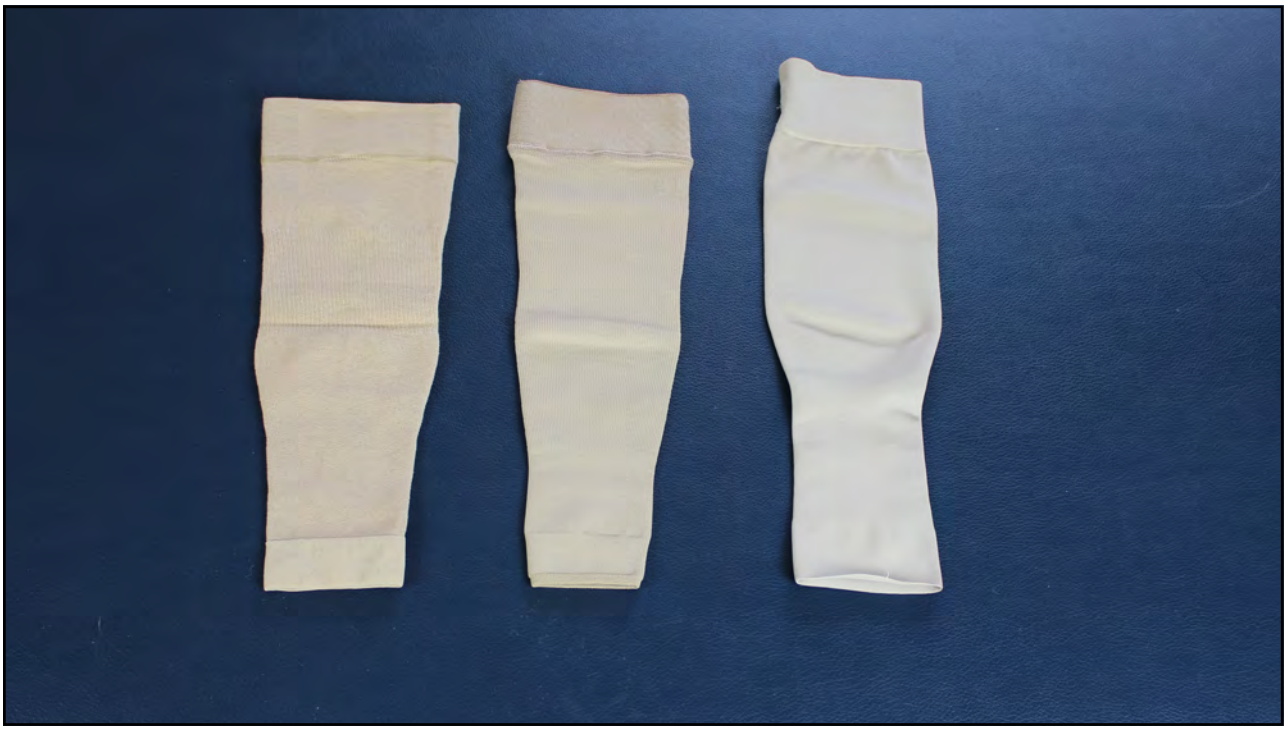
	[RAL] CCL1	[RAL] CCL2	[RAL] CCL3	[RAL] CCL4
COMPRESSION	18 - 21mmHG	23 - 32mmHG	34 - 46mmHG	49mmHG and over
SUITABLE FOR	Mild lymphoedema & palliative care	Moderate lymphoedema	Severe and stubborn lymphoedema	Very severe and stubborn lymphoedema

TYPE

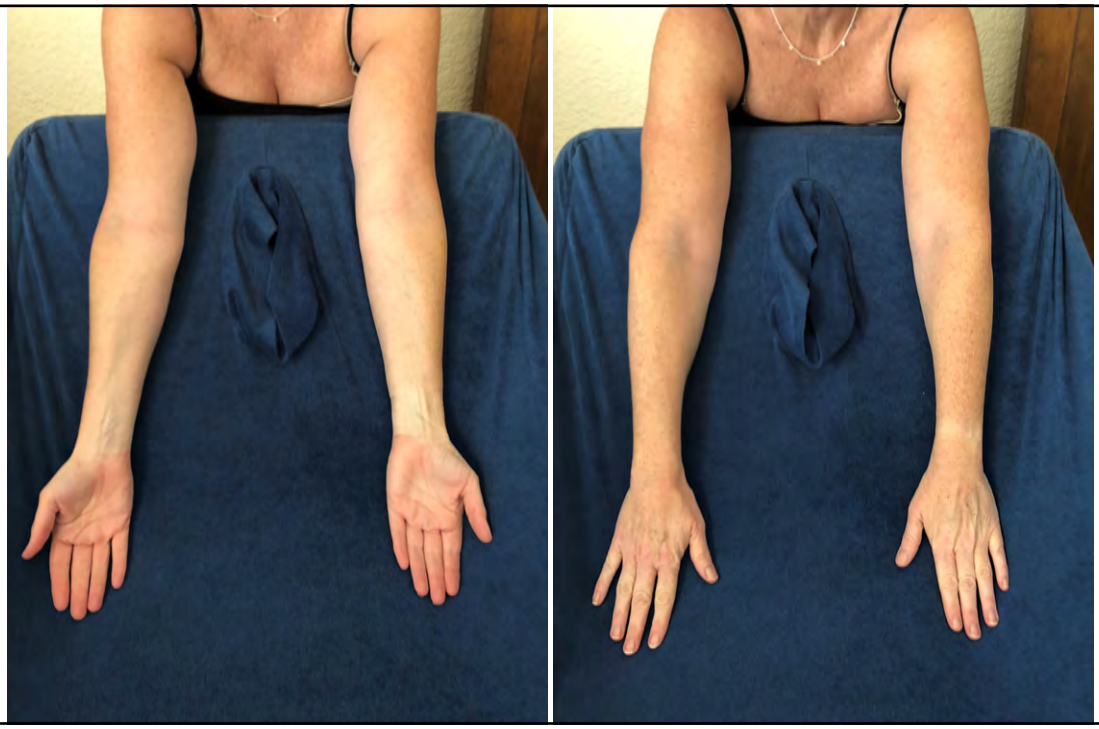
OFF THE SHELF	
CUSTOM	

LYMPHOEDEMA EDUCATION SOLUTIONS





Kate



FABRIC

	FLAT KNIT	CIRCULAR KNIT	CUT AND SEW
MATERIAL	☐	☐	☐

COMPRESSION

	[RAL] CCL1	[RAL] CCL2	[RAL] CCL3	[RAL] CCL4
COMPRESSION	18 - 21mmHG ☐	23 - 32mmHG ☐	34 - 46mmHG ☐	49mmHG and over ☐
SUITABLE FOR	Mild lymphoedema & palliative care	Moderate lymphoedema	Severe and stubborn lymphoedema	Very severe and stubborn lymphoedema

TYPE

OFF THE SHELF	☐
CUSTOM	☐

LYMPHOEDEMA EDUCATION SOLUTIONS

Sonia

STYLE OF GARMENT

Upper limb garments

LYMPHOEDEMA EDUCATION SOLUTIONS

FABRIC

	FLAT KNIT	CIRCULAR KNIT	CUT AND SEW
MATERIAL			

COMPRESSION

	[RAL] CCL1	[RAL] CCL2	[RAL] CCL3	[RAL] CCL4
COMPRESSION	18 - 21mmHG	23 - 32mmHG	34 - 46mmHG	49mmHG and over
SUITABLE FOR	Mild lymphoedema & palliative care	Moderate lymphoedema	Severe and stubborn lymphoedema	Very severe and stubborn lymphoedema

TYPE

OFF THE SHELF	
CUSTOM	

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Maria

STYLE OF GARMENT

Upper limb garments

FABRIC

	FLAT KNIT	CIRCULAR KNIT	CUT AND SEW
MATERIAL	☐	☐	☐

COMPRESSION

	[RAL] CCL1	[RAL] CCL2	[RAL] CCL3	[RAL] CCL4
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STYLE OF GARMENT

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OFF THE SHELF	
CUSTOM	

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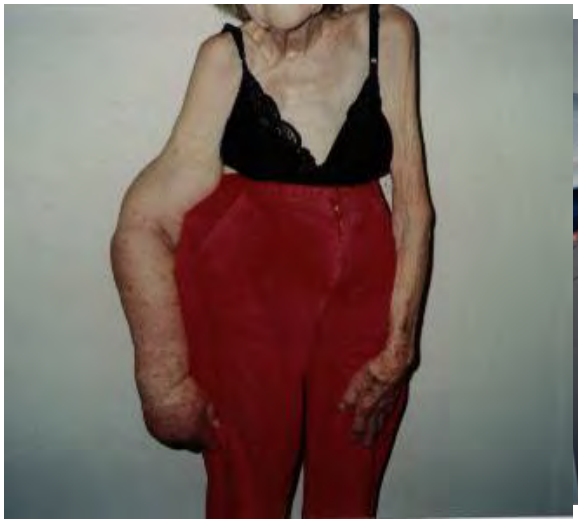

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TYPE

OFF THE SHELF	☐
CUSTOM	☐

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When in doubt, ask for help

In summary

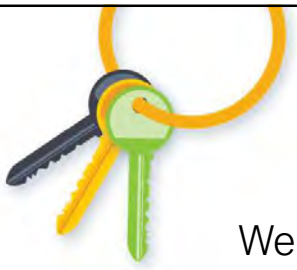
When deciding on compression, think about:

- Comorbidities
- Degree/severity of lymphoedema
- Aims when applying compression
- Consider the garment properties
- Individual limb size and shape
- Activities of daily living
- Consider your clients abilities and capabilities
- Client adherence and client choice

Garment Wearing Guidelines

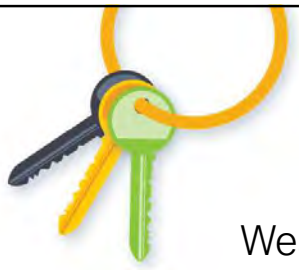
Keys to success

LYMPHOEDEMA EDUCATION SOLUTIONS



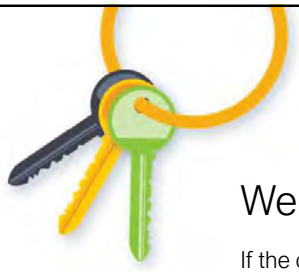
Wearing guidelines

- Ensure fabric of garment evenly distributed along limb.
- Do not roll top down – ease excess fabric along length using rubber gloves.
- No creases or wrinkles – 'elastic bands' stop lymphatic flow.



Wearing guidelines

- Garments should feel firm and supportive but NOT:
  - Painful
  - Cause fingers to change color such as purple or blue
- Patient should be aware of what graduated compression is, stronger distally than proximally.
- If patient closes their eyes where do they feel the strongest compression?



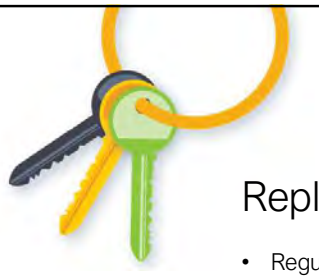
Wearing guidelines

If the client experiences:

- Severe pain
- Numbness
- Blue fingers
- Pins and needles
- Increase in swelling hand or fingers

→

- They should check that the garment is fitting correctly and adjust if required.
- It may be due to lack of activity such as sitting for a long period of time and should move their arm.
- If these tips don't help they should remove their garment and call their lymphoedema practitioner.
- If they have previously been bandaged or wrapped they may be able to do this until they see their practitioner.



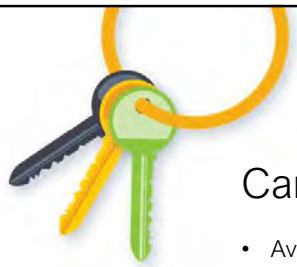
Replacement of garments

- Regularly 4 to 6 months, may be earlier depending on fabric of garment.
- Varies from brand to brand.
- Varies with severity of condition.
- Garments lose their elasticity and effectiveness over time.
- Replace if :
  - Loose
  - Stretched
  - Worn
  - Has holes
  - Broken threads

Care of garments

Generally:

- Hand wash garments in mild detergent or approved washing solution
- Roll out excess water in towel , dry in shade
- Dry flat if concerned about length of garment increasing ie circular knit
- Do not machine wash unless indicated by manufacturer
- Do not dry with artificial heat
- Follow manufacturers instructions



Care of garments

- Avoid petroleum based creams or lotions as they may cause the elastic to deteriorate (Some appropriate products to use may be: Ego, Dermaveen, Hamiltons, Naqi)
- Have two garments for laundering purposes
- Have new garments at the beginning of summer

LES care of garment fact sheet

	BRAND	WASHING: WASH BY HAND	WASHING: DELICATE WASHING MACHINE SETTING 40°C (USING A LAUNDRY / LINGERIE BAG)	WASHING: DETERGENT	WASHING: SPECIAL TIPS	DRYING	MOISTURISING RECOMMENDATIONS
GARMENTS	Lumis	Every day or at least every second day. Inside out. Rinse thoroughly.	Daily 40 degrees	Mild detergent. No fabric softeners.	If the garment has silicone grip top no moisturiser should be used. It can reduce the adhesiveness of the grip top.	Lay on towel or air dried. Lowest speed in a dryer. Do not dry on the radiator.	No recommendations
GARMENTS	Medi Allround and Flat Knit Garments	Preferably by hand using Sunlight or Velvet soap purchased in the laundry aisle at the supermarket.	Daily 40 degrees	Do not wash with bleaches, powders, bleach and do not use softeners or body soaps.		Roll in a towel to remove the excess water and hang away from the sunlight and heaters.	No recommendations
GARMENTS	Sigvaris	Daily	Daily delicate wash setting of your washing machine at 40°C (using a laundry bag)	Mild soap for delicate fabrics without fabric softener or brighteners	For garments with a silicon grip top, clean the silicon strips with Sigvaris clean pack from time to time to keep the silicon in good condition and remove residue such as skin cells and oils	Do not use a drier. Dry in an airy place. Dry flat. Do not expose to direct sunlight. Do not iron. Do not dry clean. Do not use any chemicals.	Do not moisturise directly prior to donning stockings. Moisturise in the evening. If this is unavoidable, allow moisturiser to fully absorb prior to donning the stockings.
GARMENTS	Therapist Support Laboratory	Every 2 - 3 days Wash in warm water and rinse in cold water.	Once per week regular wash (front loader recommended)	Mild detergent (velvet soap recommended) Do not use additives such as Softy & Wool Wash		Place garment in a clean hand towel, roll garment into the towel and gently squeeze. Lay flat to dry indoor.	No recommendations
GARMENTS	Varisan	Hand washing with temperature below 40°C.	Not recommended	Neutral soap is recommended	Rinse deeply using warm water. Do not twist. Frequent washing doesn't damage the garment, it will extend the life.	Garment should dry away from direct sun and any heat source. Preferably in flat.	It is recommended that moisturisers are not used with the garment. Moisturisers can reduce the resistance and effectiveness of the garment.
GARMENTS	Venosan	Daily and rinse stocking in clean water after washing. Do not wring out stocking.	Daily cold water is best	Commercially available detergent. Never use fabric softeners		Do not tumble-dry. Press in towel and air dry. Don't use direct heat to dry nor dry in direct sunlight.	No recommendations
WRAPS	Circaid supplied by Medi	Hand wash warm. Do not bleach. Do not wring.	Washed alone or in a pillowcase to prevent lint from getting caught in the hook tape.	Do not bleach.		Drip dry or flat dry away from sun and heaters. Do not iron. Store in a dry place. Do not dry clean.	No recommendations
WRAPS	Jobst Farrow Wrap LITE and STRONG fabrics		Machine washed on gentle cycle, low heat and within a garment laundry bag.	Like a mild laundry detergent. Do not use any additives such as fabric softeners or bleaches.		Put in the drier however only on gentle no heat. Do not dry clean or iron.	No recommendations
WRAPS	Jobst Farrow Wrap CLASSIC Fabrics	The CLASSIC fabric must be hand washed	Do not machine wash	Like a mild laundry detergent. Do not use any additives such as fabric softeners or bleaches.		Lay flat to dry. Do not use a drier. Do not dry clean or iron.	No recommendations
WRAPS	Solaris Ready Wrap Supplied By Lohmann and Lauscher	Hand wash	Do not machine wash	No recommendations		Lay flat to dry.	No recommendations
WRAPS	Haidenmen Easywrap	Hand wash	Wash Easywrap in a laundry bag.	Like a normal mild detergent. Do not use laundry additives such as fabric softener, optical brightener or stain remover. Rinse the garment well.	Liners are in direct contact with the skin and should be washed daily or at least every other day. Other Easywrap products should be washed when required. Sharp fingernails, rings and bracelets can damage the garment. Piling or loops must never be pulled out or cut off.	Dry between two towels, without wringing. Press out any excess moisture. Dry flat or hang up to dry. Do not dry on a radiator or in direct sunlight. Do not dry the garment in a dryer.	No recommendations

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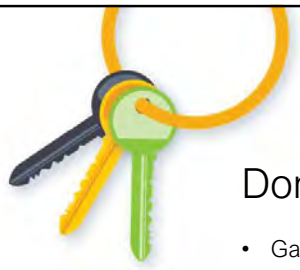
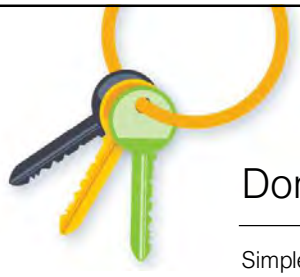


Donning and doffing

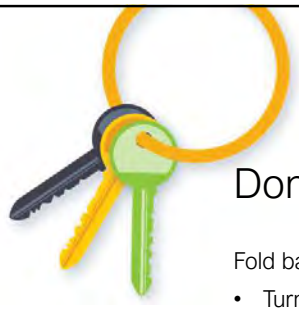
- Garments need to be firm fitting to do their job.
- This means putting garments on and taking them off may be difficult.
- This difficulty may prevent some people wearing garments.
- May need to compromise with lighter compression to enable donning and doffing.
- Flat knit is often easier to don and doff compared with circular knit.
- Layering garments may assist.



Donning and doffing

Simple tricks

- Use rubber gloves (check the tread on the gloves)
- Put on first thing in morning when limb at its smallest
- Some need to put the garment on before they get up
- Shower and moisturise at night
- Plastic bag, pouch of slippery fabric



Donning and doffing methods

Fold back

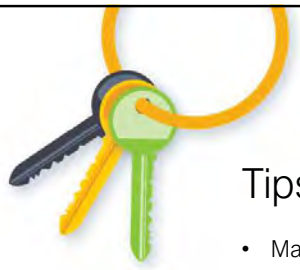
- Turn back until elbow
- Put garment on hand and ease up to elbow.
- Fold back the top part of sleeve.
- Ease garment over rest of the limb in stages
- Double compression when turn back

Ease on

- Begin at top of garment
- Smooth up over entire limb
- Put hand into position
- Even out fabric over limb

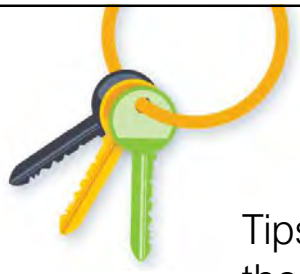
Donning and doffing

Devices to slide the garment on whilst wearing the rubber glove



Tips: The garment slips?

- Make sure the garment is the correct size, length and style.
- To help keep it up try :
  - Readjusting during the day, it will need to be pulled up.
  - Body glue. Use stripes and in various spots.
  - Moisturiser.
- Bunching /rubbing in the cubital fossa – check the length and make sure its not slipping, hypafix / fixomull. liner made into garment. No Sting Barrier Film, Naqi Bodyscreen.

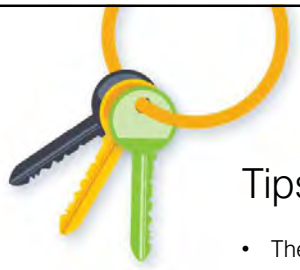


Tips: Garment not holding the oedema?

- If just completed bandaging may need to wean off bandaging slowly.
- Rebound effect.
- Bandage over top of garment and then slowly reduce compression
- Stronger compression garment
- Layering of garments
- Night-time compression

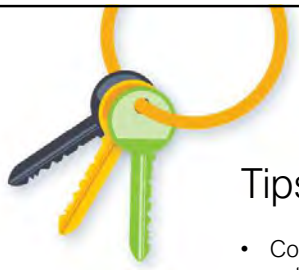
Tips: Out and about

- Some suppliers manufacture their garments in different colours.
- Take gloves to readjust



Tips: Garment and travel

- The evidence is still unclear.
- Risk profile – eg SNB versus ALND, obesity, radiotherapy to the nodes.
- Most practitioners recommend that anyone with lymphoedema should wear a compression garment whilst travelling.
- Those at risk it depends on their risk profile. If high risk some suggest greater than 4 hour flight duration but this is not based on any evidence.
- An ill fitting garment is worse than no garment.
- If wearing an arm sleeve always wear something on the hand eg gauntlet.



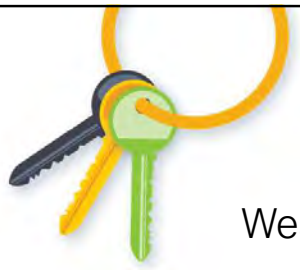
Tips for cellulitis

- Compression, if tolerated, it will control the potential increase in oedema due to the infection.
- Initially wear an older garment if tolerated.
- If the garment doesn't fit due to an increase in oedema initial options, if tolerated, include:
  - Night-time compression garment
  - Bandaging
  - Wraps

Effective communication

Education and support when the client starts to wear garments

- Expectation of need to pull up / adjust
- Support graded tolerance – couple of hours per day except following bandaging it must be all day
- Discuss progress/ success / difficulties

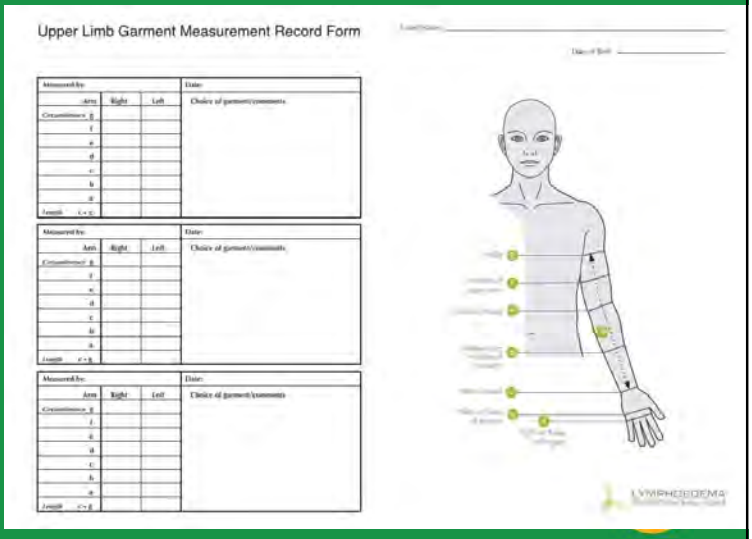


Weaning Compression Garments

- Some clients can wean off their compression garments (usually mild lymphoedema).
- May still require garment in summer or if doing heavy work.
- Trial of weaning only in cooler weather.
- Trial leaving off garment for a couple of hours.
- Client needs to self monitor:
  - Subjective symptoms.
  - Objective – measure limb at a certain landmark.

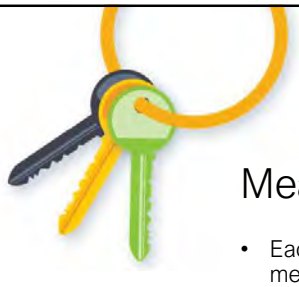
What You Will Need

- ✓ Narrow tape measure
- ✓ Skin pencil and pen
- ✓ Garment Record Form
- ✓ Alcohol wipe



Getting Started Tips

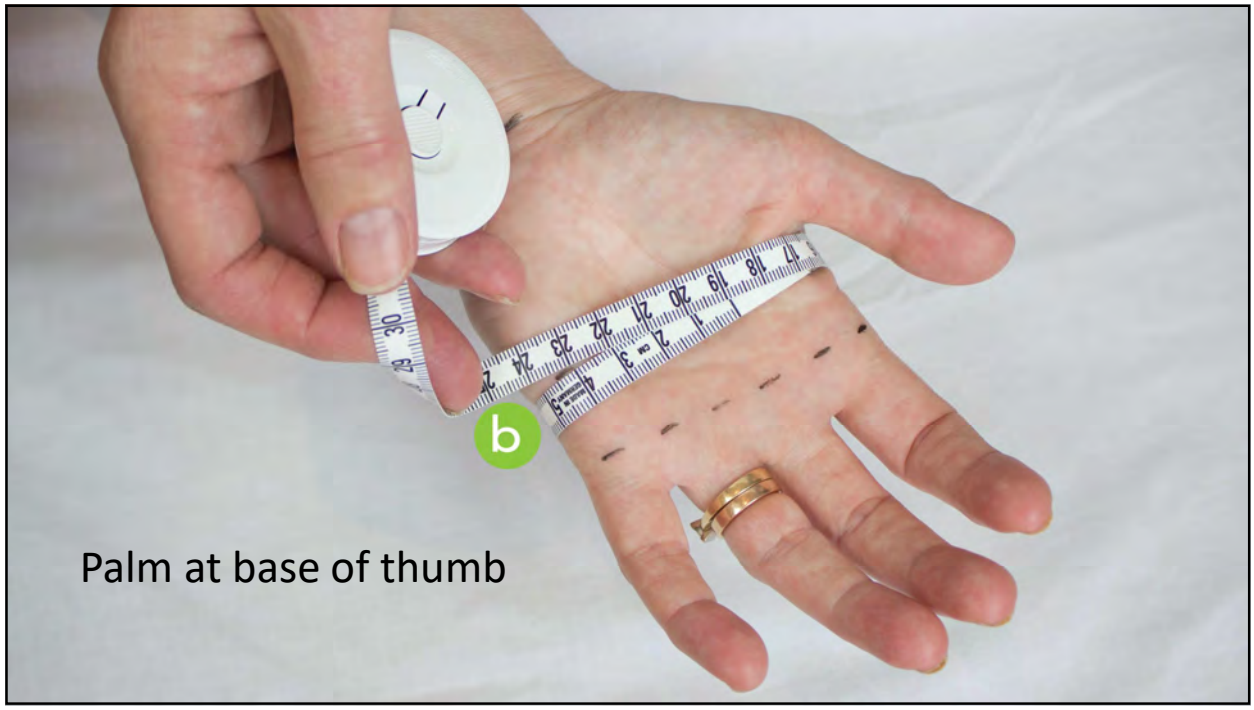
- ✓ Use a narrow tape measure
- ✓ Measure in the morning
- ✓ Measure in a sitting position with arm supported on a table or adjustable bed.
- ✓ Skin tension at wrist, elbow and top of the arm
- ✓ Take into account what you are trying to achieve
  - e.g reduction versus maintenance



Measuring for garments

- Each company has their own technique for measuring garments.
- May vary between off the shelf and custom made.
- It is essential to follow the companies instructions when measuring for garments.
- Order one garment at a time.


a
Palm at base of fingers

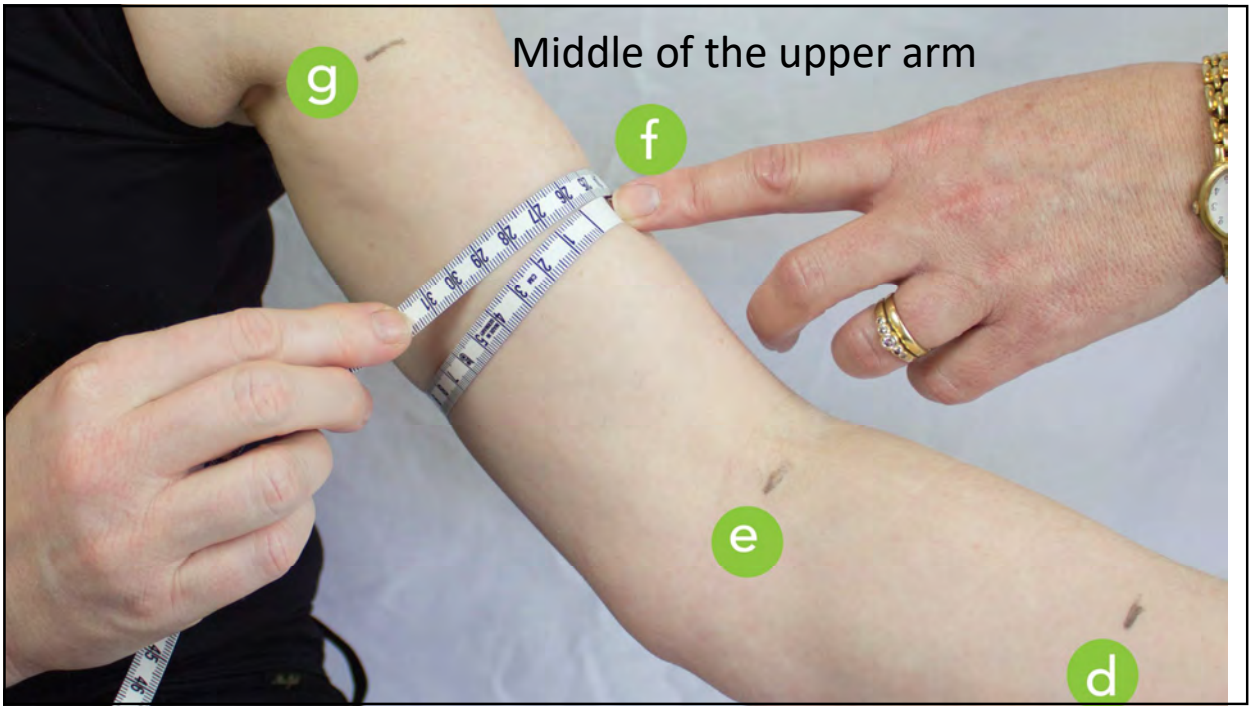

b
Palm at base of thumb

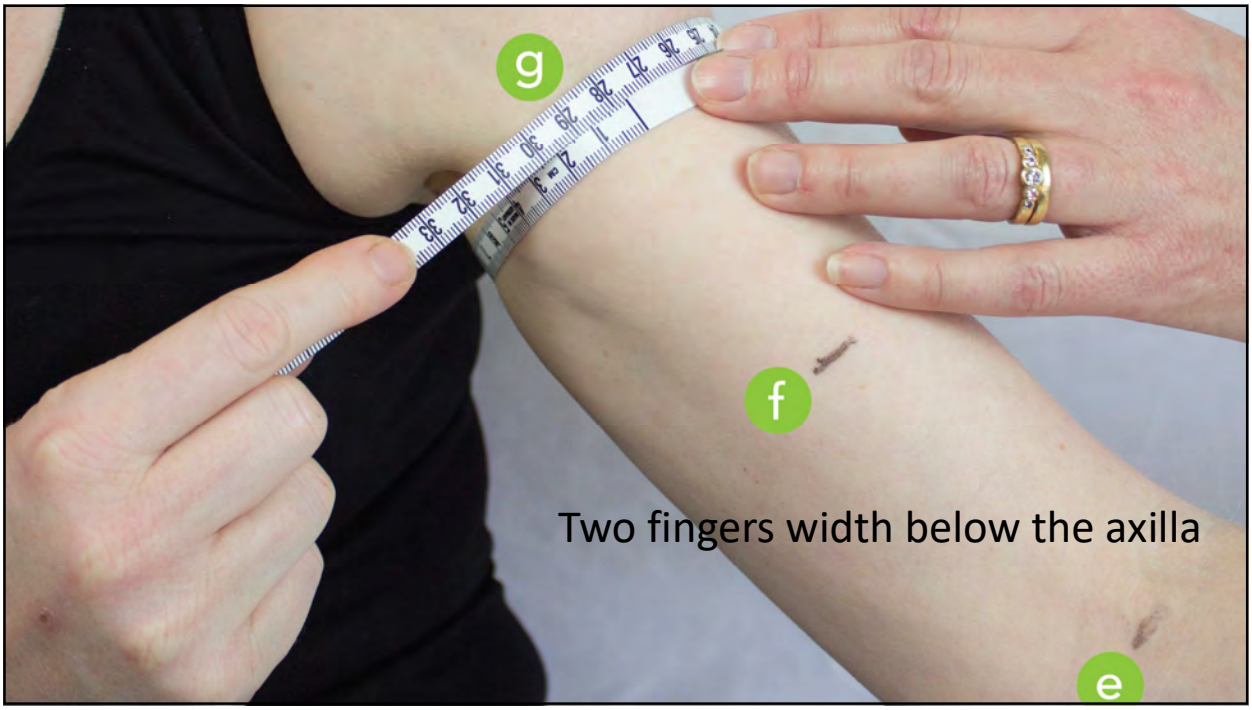
Recording Measurements

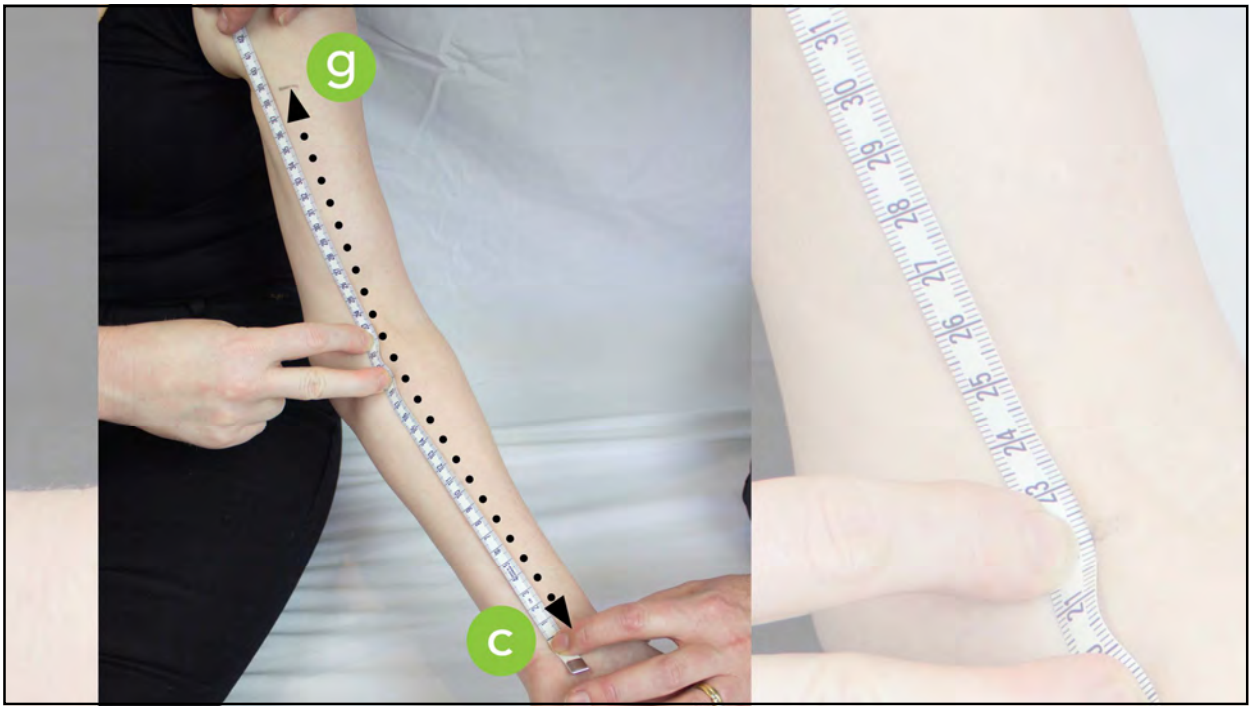
Measured by:			Date:
Leg	Right	Left	Choice of garment/comments
Circumference g			
f			
e			
d			
c			
b			
a			
Length c - g			


d
Widest part of middle of the forearm


e
Elbow crease


Middle of the upper arm
g
f
e
d


g
f
Two fingers width below the axilla
e



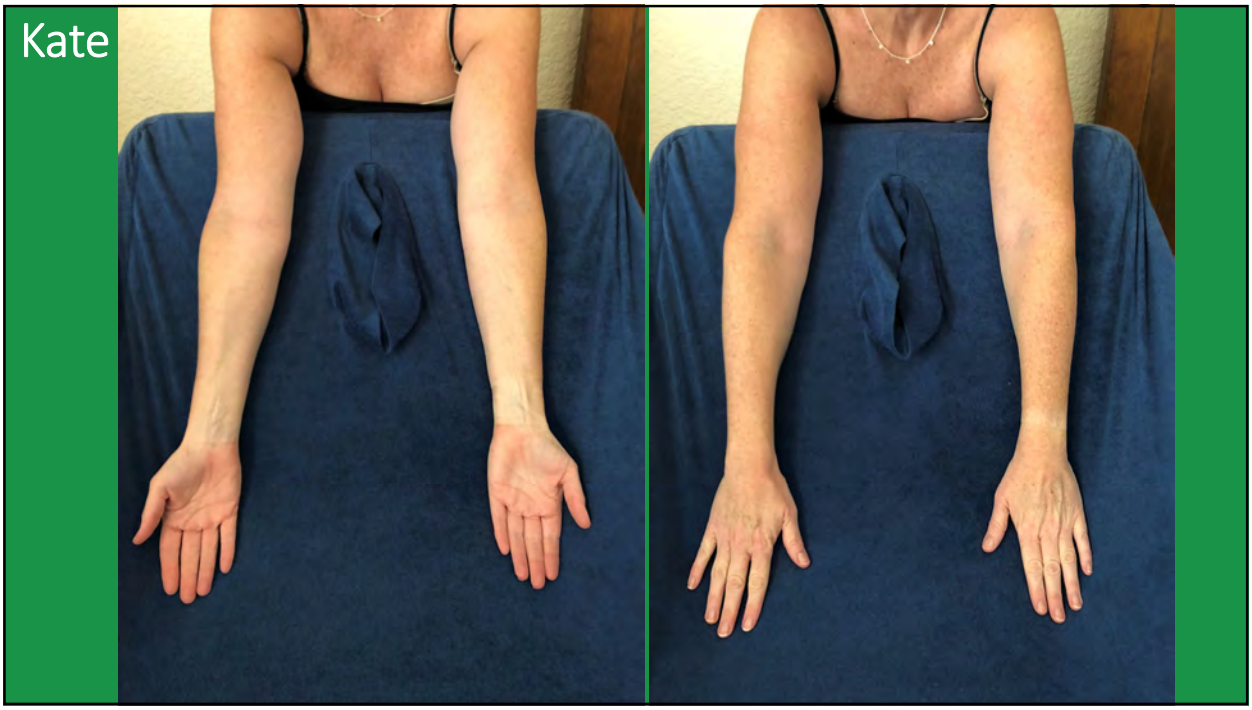
Garment Sizing

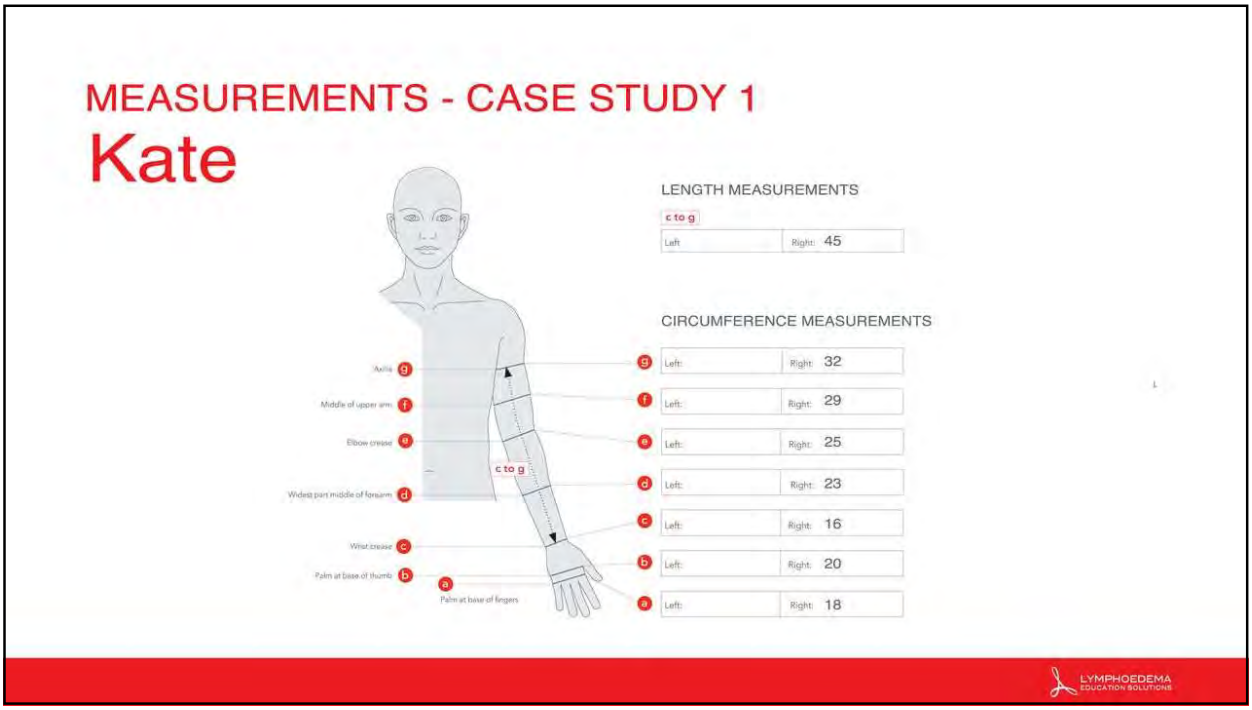
Location	Circumference
g	27.7
f	26.0
e	25.0
d	20.1
c	15.9
b	19.0
a	18.6
Length c-g	38.5

Measurement Point	Circumference in cm's		
	Small	Medium	Large
C (Wrist)	16 - 18	18 - 20	20 - 23
D (Forearm)	23 - 26	26 - 28	28 - 30
E (Elbow)	24 - 26	26 - 29	29 - 32
F (Mid Upper arm)	26 - 29	29 - 33	33 - 37
G (Axilla)	31 - 34	34 - 38	38 - 44

Size	Wrist (C)	Mid Forearm (D)	Axilla (G)
1	14-18 cm	17-21 cm	22-31 cm
2	14-18 cm	17-21 cm	31-41 cm
3	14-18 cm	21-25 cm	25-34 cm
4	16-19 cm	21-25 cm	28-38 cm
5	17-20 cm	21-25 cm	34-43 cm
6	14-18 cm	25-29 cm	29-38 cm
7	17-20 cm	25-29 cm	33-43 cm
8	18-21 cm	25-29 cm	38-48 cm
9	16-19 cm	29-33 cm	32-42 cm
10	19-22 cm	29-33 cm	36-46 cm

Size	Palm (B)	Wrist (C)
1	15-17 cm	14-18 cm
2	17-19 cm	14-18 cm
3	17-19 cm	18-21 cm
4	19-21 cm	14-18 cm
5	19-21 cm	18-21 cm
6	21-23 cm	16-19 cm
7	21-23 cm	19-22 cm
8	23-26 cm	19-22 cm


Kate


MEASUREMENTS - CASE STUDY 1
Kate
LENGTH MEASUREMENTS
c to g
Left
Right: 45
CIRCUMFERENCE MEASUREMENTS
Axilla g
Middle of upper arm f
Elbow crease e
Widest part middle of forearm d
Wrist crease c
Palm at base of thumb b
Palm at base of fingers a
c to g
g Left: Right: 32
f Left: Right: 29
e Left: Right: 25
d Left: Right: 23
c Left: Right: 16
b Left: Right: 20
a Left: Right: 18
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SEARCH RESULTS - CASE STUDY 1

Product comparison of viable options

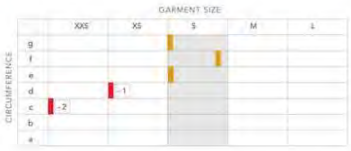
Below are some products to compare and consider. The shaded grey column indicates where the majority of measurements fit within the product size range.

1 Product 1 Circular Knit

Size: Medium
Style: Armsleeve
Compression: Class 2 (23 - 32 mmHg)
Length: Long (43cm+)

2 Product 2 Circular Knit

Size: Small
Style: Sleeve
Compression: Class 2 (23 - 32 mmHg)
Length: Long (44 - 50cm)



3 Product 3 Flat Knit

Size: Small
Style: Sleeve
Compression: Class 1
Length:

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Treatment Planning
Keys to success
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Guided by Assessment
and Re-Assessment

Treatment Planning

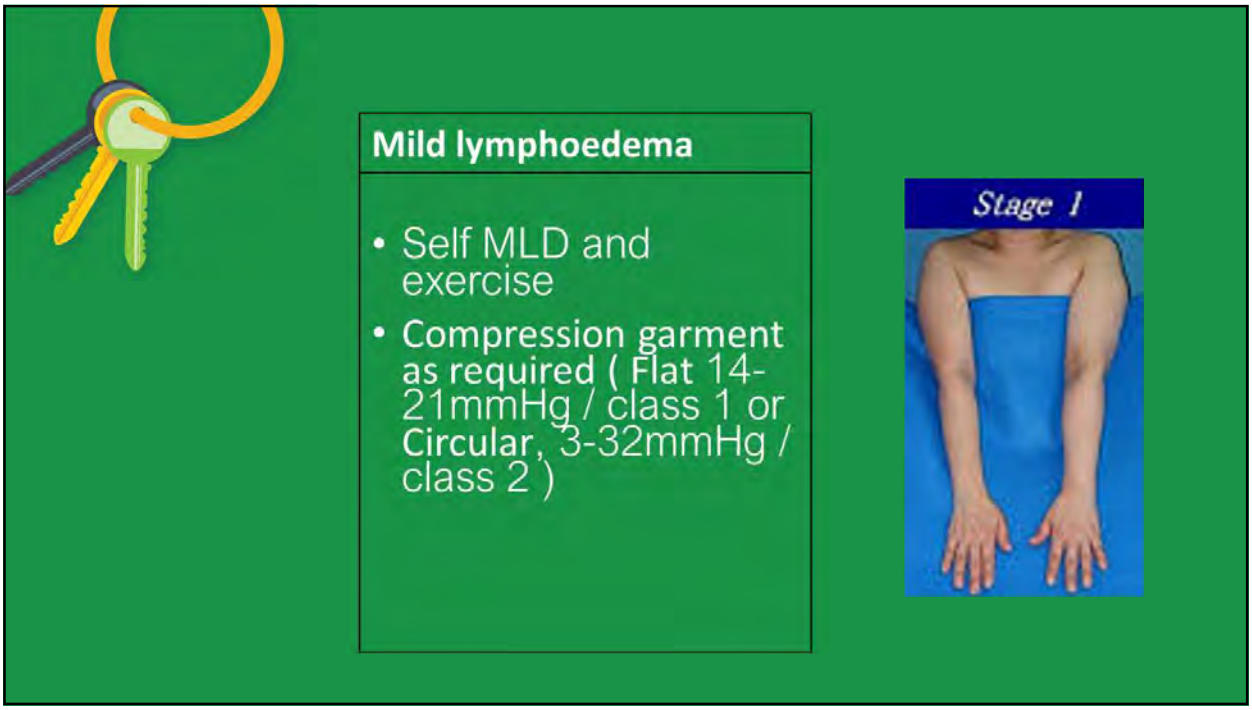
All clients receive education (skin care and activities of daily living) and exercise

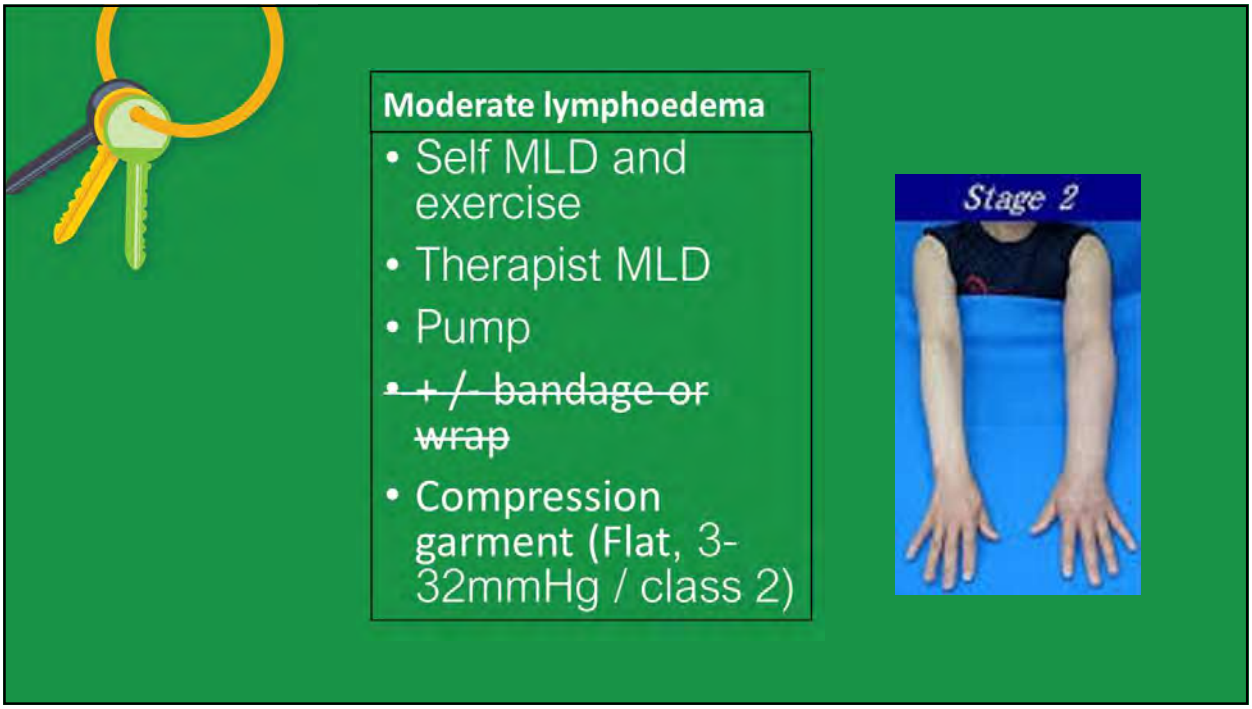
At risk clients monitor with assessment tools

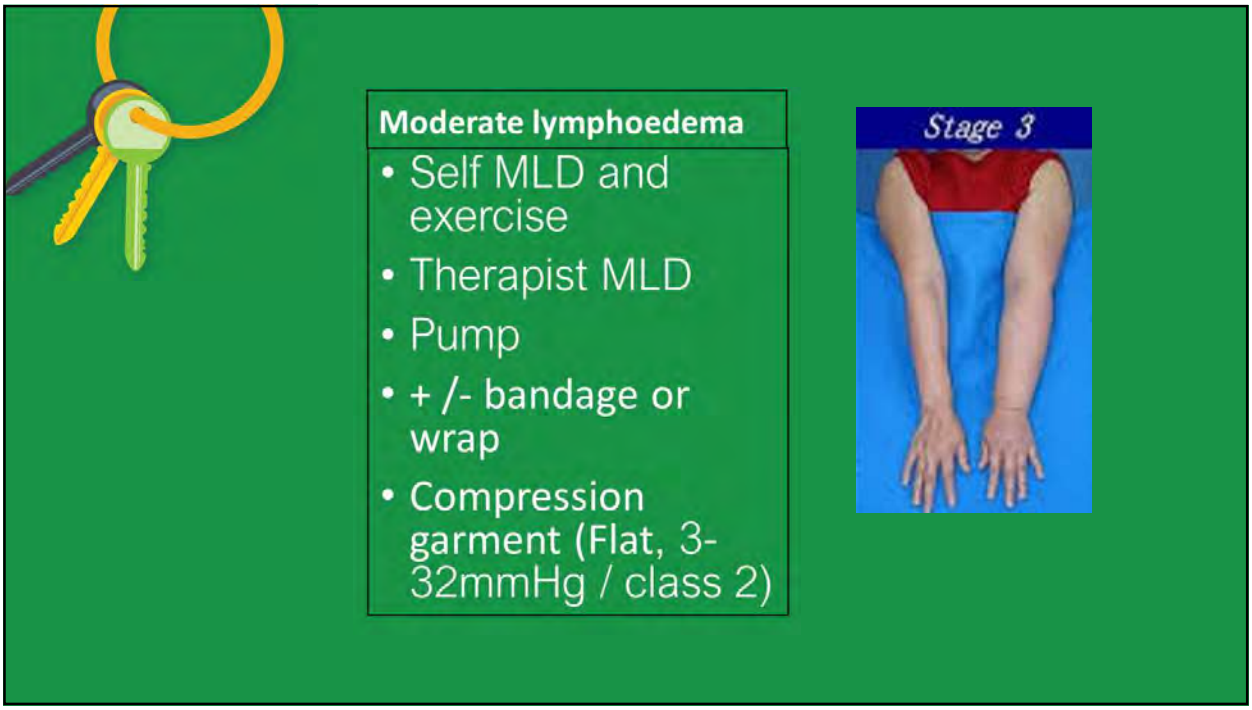
You must take into consideration the clients medical history, comorbidities etc, goals and ADL

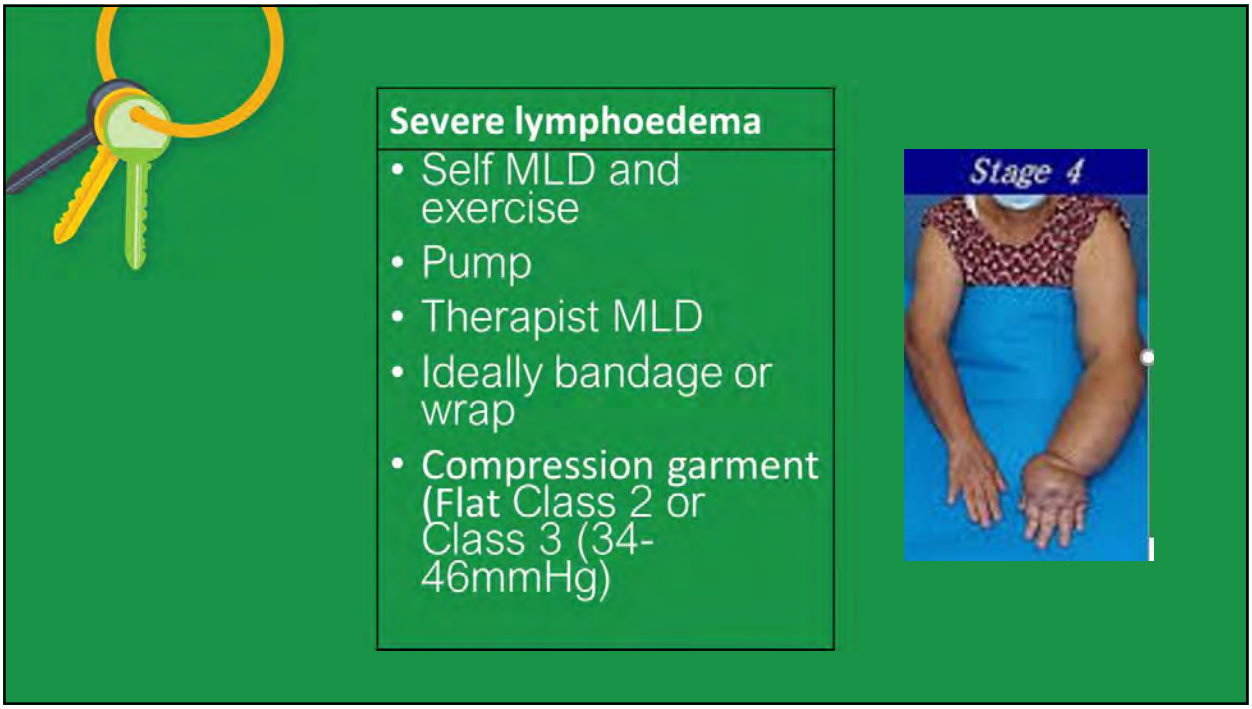
Mild lymphoedema	Moderate lymphoedema	Severe lymphoedema
• Self MLD and exercise • Compression garment as required (Flat 14-21mmHg / class 1 or Circular, 3-32mmHg / class 2)	• Self MLD and exercise • Therapist MLD • Pump • + /- bandage or wrap • Compression garment (Flat, 3-32mmHg / class 2)	• Self MLD and exercise • Pump • Therapist MLD • Ideally bandage or wrap • Compression garment (Flat Class 2 or Class 3 (34-46mmHg)

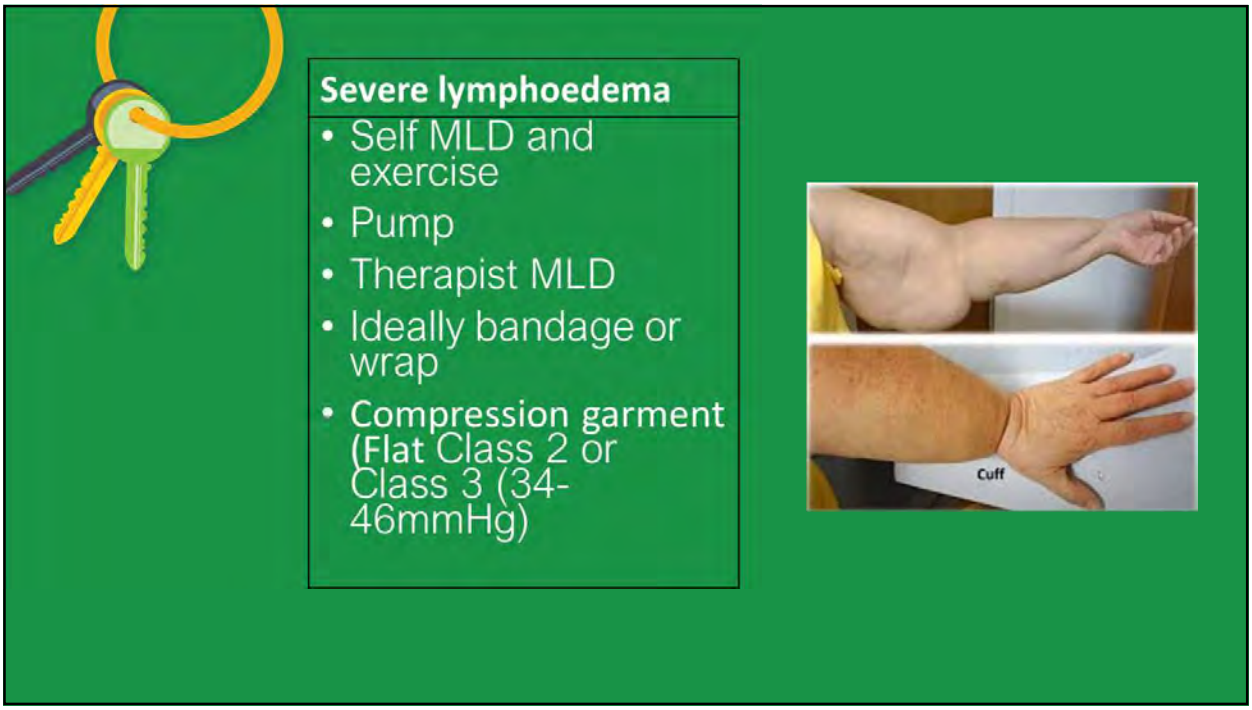
Severity, Shape of Limb and Location of Swelling


Mild lymphoedema
• Self MLD and exercise
• Compression garment as required (Flat 14-21mmHg / class 1 or Circular, 3-32mmHg / class 2)
Stage 1

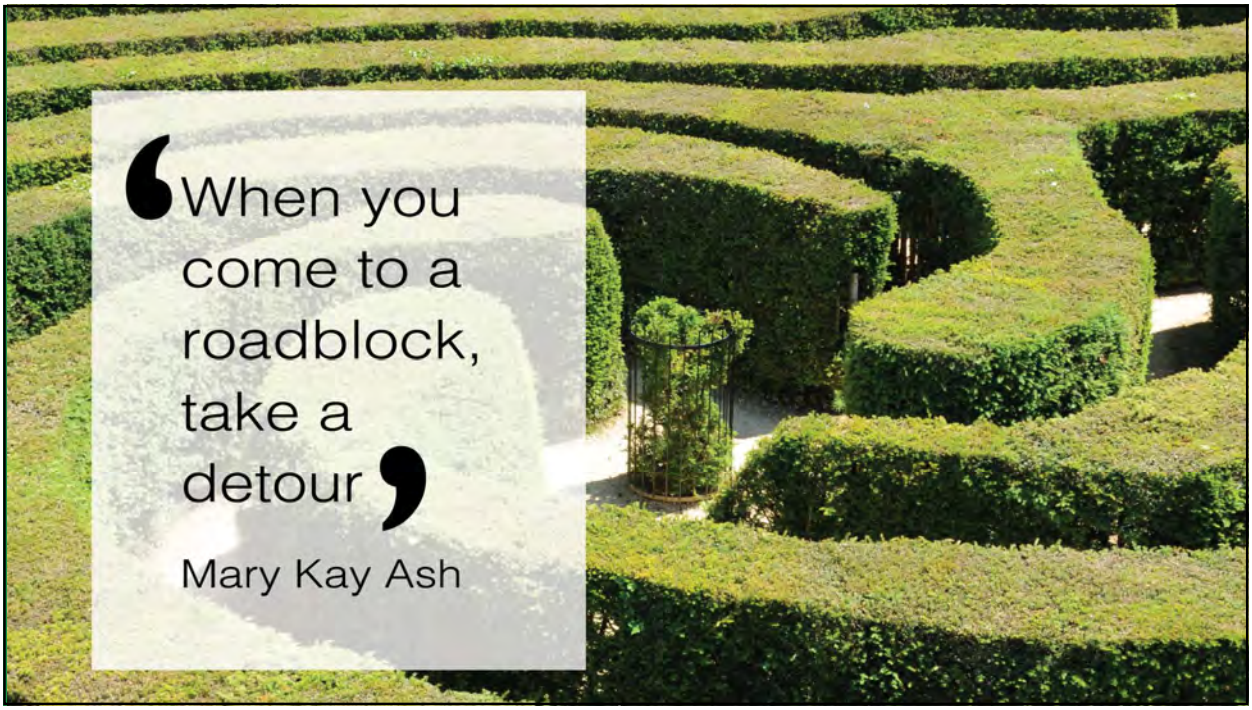

Moderate lymphoedema
• Self MLD and exercise
• Therapist MLD
• Pump
• ~~+ / - bandage or wrap~~
• Compression garment (Flat, 3-32mmHg / class 2)
Stage 2


Moderate lymphoedema
• Self MLD and exercise
• Therapist MLD
• Pump
• + /- bandage or wrap
• Compression garment (Flat, 3-32mmHg / class 2)
Stage 3


Severe lymphoedema
• Self MLD and exercise
• Pump
• Therapist MLD
• Ideally bandage or wrap
• Compression garment (Flat Class 2 or Class 3 (34-46mmHg)
Stage 4


Severe lymphoedema
• Self MLD and exercise
• Pump
• Therapist MLD
• Ideally bandage or wrap
• Compression garment (Flat Class 2 or Class 3 (34-46mmHg)
Cuff


Guided by Assessment and Re-Assessment


‘When you come to a roadblock, take a detour’
Mary Kay Ash

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Lymphoedema Education Solutions work with health professionals to enable them to further their training and skills in lymphoedema management and care.

Phone: 0407 011730
Email: info@lymphoedemaeducation.com.au
Web: lymphoedemaedu.com