The use of low level light therapy in the treatment of head and neck oedema

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Key words

LLLT, low level laser therapy, low level light therapy, lymphoedema, oedema

The focus of this article is to present evidence supporting the use of low level laser therapy (LLLT) as a specialist treatment for patients with head and neck oedema. Information obtained from a critique of relevant literature will be utilised to discuss the treatments available for those with head and neck oedema, highlighting how outcomes may be improved and quality of life enhanced, when LLLT is offered as part of a holistic treatment plan. A case study using LLLT is also presented.

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Low level laser therapy (LLLT) has been used in conjunction with other therapies such as intermittent pneumatic compression, manual / medical lymphatic drainage (MLD) and kinesiotaping for the treatment and management of limb lymphoedema. Evidence from practice and small scale studies demonstrates that LLLT can greatly influence outcomes and improve quality of life (QoL) in these groups of patients (Piller and Thelander, 1998). However, these studies have been conducted specifically on breast cancer-related lymphoedema (BCRL) of the arms.

This article aims to provide evidence for the benefits if its wider use including its role in the holistic care of a patient with head and neck oedema and the benefits observed by inclusion of LLLT as initial treatment for those with this type of oedema.

What is lymphoedema?

Lymphoedema is defined as a chronic progressive disease, which can manifest as a swelling of any part of the body (International Lymphoedema Framework [ILF], 2006). Swelling occurs as a result of lymphatic system insufficiency or failure, resulting in an inadequate clearance of lymph fluid and abnormal accumulation of interstitial fluid in the tissues (Lee et al, 2011). The lymphatic system acts as a one-way drainage system made up of vessels, nodes, and valves that transport fluid from the interstitial spaces through the lymphatic system back into the circulation at the heart, bypassing the venous system due to larger molecules, mainly proteins and fats, being too large to be transported by the venous microcirculation (Stanton, 2000).

Incidence and prevalence of lymphoedema following head and neck cancer

In their systematic review, Deng et al (2011) note that no reports are available on the incidence and prevalence of lymphoedema related to head and neck treatments in the USA, however four European studies that identified incidence rates were found. These studies used different criteria to ascertain the presence of oedema in patients who had received radiotherapy. Deng et al (2011) show that, due to the difference of the anatomical structures assessed, the incidence of head and neck oedema ranged from 12% to 54%. By contrast, Weissleder and Schuchhardt (2008) state that the incidence of head and neck oedema following bilateral neck dissection was between 30% and 60%, with head and neck oedema occupying 2% of the caseload at a local lymphoedema service (Rüger, 1993).

When examining statistics for cancer type, oral cancers are 15th in the 20 most common cancers in the UK, with 6236 cases reported in 2009, of which 2272 were laryngeal (Cancer Research, 2012). Cancer Research (2012) states that, between 2005 and 2009, 67% of patients survived more than 5 years after diagnosis, highlighting an increased risk to the patient of secondary complications, such as lymphoedema (Deng et al, 2011).

Head and neck lymphoedema has a huge impact on QoL; patients will often experience functional difficulties with speech, oral hygiene, swallowing, reduced food intake, often leaving patients feeling that they have been left with a constant reminder of their cancer diagnosis (Keeley, 2000). Current initiatives in clinical practice indicate that regional lymphoedema clinics utilise psychosocial assessment tools ,such as LymQoL, to measure the effectiveness of treatments and have adapted them more specifically to include questions related to midline and head and neck oedema (Keeley et al, 2010). Deng et al (2011) state that the incidence and severity of head and neck lymphoedema and related fibrosis are unknown, however the functional loss and physical symptom burden could be seen as a direct result of the alterations in tissues caused by lymphoedema and related fibrosis, arguing that more research specific to this area needs to be carried out.

Assessment of head and neck oedema

Deng et al (2011) state that it is challenging to obtain measurements for head and neck oedema and argue that, although tape measures have traditionally been used to assess lymphoedema, there is difficulty in establishing anatomical reference points to ensure reproducible measurements. The research examined highlighted inconsistencies in reference points, and sample sizes that were too small to demonstrate a clear evidence for the accuracy of this type of measurement. However, Deng et al (2011) state that these have limitations for assessment as they do not assess skin changes that commonly manifest in later stages of lymphoedema. Weissleder and Schuchhardt (2008) state the use of inspection and palpation are most beneficial during the assessment of oedema, especially midline oedema. The use of photography, facial movements and mobility, and skin changes (e.g. peau d'orange) also need to be assessed.

Laryngeal cancer commonly involves the central compartment of the neck, which is rich in lymphatics, with lymph nodes that are most commonly removed during surgery for cancers of the head and neck.

Mascagni (1787; cited in Browse et al [2003]) was able to show in detail the normal lymphatics of the head, neck, and axilla, which highlighted that the lymphatics of the face drain into the groups of lymph nodes in the occipital, mastoid, and parotid regions. The superficial lymphatics of the neck consist of lymph vessels that drain to the submental, submandibular, and cervical areas, then drain into the deep cervical glands lying near the internal jugular vein.

Lack of specific information on referral often presents therapists with confusion as where to direct lymphatic flow when performing MLD, as in many cases the nature of any surgery or subsequent radiotherapy will have damaged lymph nodes resulting in lymphoedema. Clinicians usually have limited information regarding the level of damage caused during surgery or radiotherapy, or on which lymph nodes and drainage pathways are still viable. Weissleder and Schuchhardt (2008) explain that ultrasound, computed tomography, and magnetic resonance imaging are not sufficient to safely assess the lymph nodes of the neck, although they do prove useful in the diagnosis of recurrent disease and for the assessment of interstitial fluid or existing oedema.

Lymphoscintigraphy involves injection of a radio-labelled colloid protein that is tracked along the lymphatics with a gamma camera. This helps to identify lymphatic insufficiency (Todd, 2010), but is not usually performed in the lymphoedema clinic and requires referral to a specialist centre, which may delay treatment for lymphoedema and is seen as an invasive technique for patients.

Evidence is emerging to support the use of bio-impedance, which is more sensitive than circumferential measurements in the assessment and prevention of lymphoedema (Vicini et al, 2013). It is commonly used for limb oedema, but is being used in experimental settings for assessing midline oedema. Bio-impedance involves attaching electrodes to specific points on the body, then passing an electrical current that transmits through the water component of the tissues to measure the resistance, providing a reading to indicate extracellular fluid volume (ILF, 2006). This process is a less time-consuming method of assessing lymphoedema and, if developed further for midline assessment, will provide a more objective measurement for clinicians. By contrast, the use of dielectric constant analysis, using the MoistureMeter DC (MMDC; Delfin Technologies), which assesses local tissue water by placing a small probe onto the affected area, could prove invaluable in the monitoring of head and neck oedema. The MMDC is simple to use allowing for data to be obtained from any area and at various depths at that site of the body, using a single measurement (Mayrovitz et al, 2009; *Figure 1*).

The use of the MMDC on six patients with head and neck oedema has shown reductions of facial oedema ranging from 45–85% water and reducing following LLLT to 37–54% showing a vast improvement in all patients. This suggests that the MMDC has the potential to provide objective measurement for facial oedema and other regions of oedema.

LLLT

What is LLLT?

LLLT is the application of light (usually a low-power laser or light emitting diode [LED]) to promote tissue repair, reduce inflammation, reduce oedema, and induce analgesia. LLLT has been the subject of several systematic reviews for a range of musculoskeletal pathologies with favourable conclusions reported by Chow et al (2009), Bisset et al (2011), International Association for the Study of Pain (2009), and Haldeman et al (2009).

The laser or LED device typically emits light in the red and near-infrared light spectrum (600 nm–1 000 nm), the power output is usually in the range of 1 mW–500 mW and the irradiance is generally the range of $5\,mW/cm^2$–$5\,W/cm^2$. Treatment time per point is typically the range of 30–60 seconds per point and most pathologies require the treatment of multiple points (Huang et al, 2009). Treatments can be weekly, though more frequent treatments may be more effective. For acute and postoperative pathologies as little as one treatment may be all that is necessary, but for chronic pain, degenerative conditions, and lymphoedema ten or more sessions may be necessary.

Figure 1. The MoistureMeter DC (Delfin Technologies).

How LLLT works

Most of the effects of LLLT can be explained by light absorption in mitochondria (Eells et al, 2004; Karu, 2008; 2010). Every cell in the body contains hundreds or thousands of mitochondria. Mitochondria make cellular energy (ATP) from oxygen and pyruvate. In stressed or ischemic tissues, mitochondria make their own nitric oxide (mtNO; Cleeter et al, 1994; Antunes et al, 2004; Palacios-Callender et al, 2004) that competes with oxygen. mtNO binds to cytochrome c oxidase (CcO; the terminal enzyme in the electron transport chain) and displaces oxygen (Galkin et al, 2007). This displacement of oxygen has two negative effects:

- Reduced ATP synthesis.
- Increased oxidative stress (leading to inflammation via the inflammatory "master switch", NF-kB; Bolanos et al, 1994; Cleeter et al, 1994; Antunes et al, 2004; Palacios-Callender et al, 2004; Lane, 2006; Chen, 2011).

The effect of LLLT on hypoxic / stressed tissues can be described in four stages:

1. *Primary effect: Absorption by CcO*
   CcO absorbs red and near infrared light, the transfer of light energy by this enzyme triggers a series of downstream effects (Yu et al, 1997; Karu and Kolyakov, 2005; Karu, 2008).
2. *Secondary effect: Modulation of ATP, nitric oxide, and reactive oxygen species*
   Changes in ATP, reactive oxygen species, and nitric oxide follow light absorption by CcO. These effects are redox state and dose dependent. In hypoxic or otherwise stressed cells it has been shown that, following LLLT, nitric oxide is released, ATP is increased, and oxidative stress is reduced (Zhang et al, 2009; Servetto et al, 2010; Sharma et al, 2011; de Lima et al, 2012; Lim et al, 2012).
3. *Tertiary effect: Downstream intracellular responses (gene transcription, and cellular signalling*
   The downstream effects of LLLT released nitric oxide, increased ATP, and reduced oxidative stress are many. They are context and cell type specific. Either directly or indirectly these biochemical intermediates affect components in the cytosol, cell membrane, and nucleus that control gene transcription and subsequently cell proliferation, migration, necrosis, and inflammation (Zhang et al, 2009; Servetto et al, 2010; Sharma et al, 2011; de Lima et al, 2012; Lim et al, 2012).
4. *Quaternary effect: Extracellular, indirect, distant effects*
   Tissues that have not absorbed photons can also be affected indirectly via secretions from cells that have absorbed light. Cells in blood and lymph can be activated and they travel significant distances from the treatment area to have distant (i.e. systemic) effects (Hopkins et al, 2004). These can be autocrine, paracrine, and endocrine effects (sometimes known as a "bystander" effects).

Oedema / lymphatic flow

LLLT has been used for the treatment of BCRL and is the subject of two systematic reviews: Omar et al (2011) found five trials suitable for review and concluded that there was moderate to strong evidence for the effectiveness of LLLT in the management of BCRL. Lima et al (2012) found four trials suitable for inclusion and concluded that LLLT showed favourable results in reducing limb volume. However, studies comparing LLLT with the standard approach were not reported. A laboratory trial on Carrageenan-induced oedema in the mouse paw found that treating lymph nodes alone was enough to reduce oedema (Meneguzzo et al, 2013). The mechanism of action is unknown.

Impact of treatment on QoL

A study by Wigg (2010) demonstrated that the use of LLLT improved outcome measures in the patients studied. Improvements were seen in QoL and other reported effects, such as improvement in scars, and tissues feeling less tight. Wigg (2010) also reported a 33% improvement in movement in the group; mobility was one of the seven main themes from the analysis of the 12-month study. This led to staff from the clinic where the study took place using LLLT in combination with soft tissue massage and myofascial release to further improve mobility.

Scar tightness and pain following surgery are particularly prevalent in those patients who have oedema and reduced movement following treatments for head and neck cancer. When analysing data of head and neck patients only, Wigg (2010) found that 62% of patients reported increased range of movement following treatment with LLLT. In turn, this improvement has a positive effect on patients' QoL in all groups as reduced movement and function are well documented as a side effect of surgery and lymphoedema (Piller and Thelander, 1998).

The rationale for treating other symptoms with this modality is based on the theory that LLLT boosts healing by promoting tissue regeneration, reducing inflammation, and relieving pain (Hung et al, 2009). Practitioners are reporting the positive effects LLLT has on lymphoedema (Carati et al, 2003). Tilley (2009) reports that there are over 2500 titles in scientific literature that relate to the therapeutic use of LLLT, with over 300 of these being double-blind studies. However, much of the LLLT research for lymphoedema reports only on BCRL and there is limited evidence to support its use in head and neck oedema (Tilley, 2009). Patients treated with LLLT in Wigg (2009) reported a reduction in the thickness of tissues, with 83% reporting improved range of movement.

Irradiation parameters and dose

The effects of LLLT are dependent on irradiation parameters, treatment location, and treatment time. Too little irradiance (beam intensity) or too little treatment time may have no significant effect on the cells in the tissues treated; too much irradiance or too much treatment time may inhibit cellular function (*Table 1*).

There is no agreement on how to report dose. It is sometimes reported as joules (J) per point, but also as J/cm^2 (fluence). It has been argued that wavelength and irradiation are the "medicine", and time applied is applied is the "dose" (Haung et al, 2011; *Table 2*).

LLLT and cancer: Does treatment contribute to recurrence?

Clinicians are often reluctant to implement LLLT as part of treatment where there is active cancer, or where the patient has not had confirmation of remission. This is often due to the knowledge that LLLT has a direct effect on cell function and clinicians are concerned that it could cause disease recurrence or progression. However, the European Society of Oncology have revised guidelines that now state that LLLT may be considered for reducing the incidence

Table 1. Low level laser therapy (LLLT) irradiation parameters

Parameter	Unit	Explanation	Notes
Wavelength	Nanometer (nm)	Colour of the light	LLLT has been successful in the range 600–1000 nm but wavelengths outside these ranges have been effective. The peak penetrating wavelengths are in the range 700–900 nm. Wavelengths used in published lymphoedema research include lasers and LEDs at 632.8, 660, 808, 890, 904 and 905 nm.
Power	Watt (W)		LLLT devices typically in the range 5–500 mW though power outside this range have been successful. Powers used in published lymphoedema research include lasers and LEDs 5–30 mW. Because these are low power lasers and LEDs the power is usually expressed in milliwatts (mW, Watts^{-3}).
Beam area	Centimetre squared (cm^2)	The surface area of the beam on the skin	The two devices referenced in this paper (104 Diode Cluster Probe [THOR]; LTU-904 [RianCorp]) both have emitters that when used in contact use produce a beam area of approximately 0.2 cm^2. The RianCorp device has one beam and the THOR device has 104 beams.
Irradiance	Watts per centimetre (W/cm^2)	Power divided by the area of the beam. Sometimes referred to as "power density"	For superficial pathologies (e.g. Achilles tendinopathies or later epicondylitis) LLLT only been successful in the range 5–100 mW/cm^2. Unfortunately none of the lymphoedema studies reported the irradiance despite its critical relevance as shown in other pathologies. However, some trials provide enough data for irradiance to be calculated: LTU-904 delivers 25 mW/cm^2 104 Diode Cluster Probe delivers 49 mW/cm^2 Irradiance can be calculated by dividing fluence by treatment time.

and severity of oral mucositis in cancer patients (Peterson et al, 2011). In 2012, the Multinational Association for Support in Cancer Care also revised their guidelines to recommend LLLT (Migliorati et al, 2013).

Myakishev-Rempal et al (2011) conducted a nonmelanoma UV-induced skin cancer study of the effects of LLLT on tumor growth and found that after 60 LED treatments (twice a day for 30 days) there was no measurable effect on tumor growth. de Vries et al (2011) found that, after assessing records for 1298 patients treated for breast cancer between 2000 and 2008 – of whom 52 had laser and MLD for lymphoedema and were extracted, as well as those with records of cancer recurrence between 2000 and 2010 – there was no statistically significant differences between those receiving MLD / laser combination versus those receiving none.

Several studies have been conducted into the effect of LLLT on cancer cells. Myakishev-Rempal et al (2011) showed that there was no measurable effect on 330 squamous cell tumours in mice. Satana-Blank et al (2002) evaluated the relationship between toxicity levels and LLLT in patients who had advanced neoplasms and clinical evidence of progressive disease reporting improvement in QoL index and Karnofsky performance status in all patients at the first two intervals. This further highlights that LLLT may be useful in the treatment of certain multidrug resistant tumours (Lanzafame, 2011).

Evidence suggests that caution should be exercised when using higher irradiance laser sources, as stimulation directly over melanomas can increase tumour growth in mice. However there is no evidence to suggest that LLLT used at low levels, such as those used for lymphoedema and other therapies, will produce the same stimulation of cells (Frigo et al, 2009).

Safety considerations

There are few safety considerations for clinician or patient from the 104 Diode Cluster Probe (THOR) as it is an LED probe, and not a laser. However, the LTU-904 (RianCorp) is a class one laser. Lasers are classified in order of hazard to the eye; a class 1 laser is a low output laser in the visible to infrared wavelengths (670 nm–950 nm) and no additional safety procedures are required as there is no risk of eye damage as defined by the standards set by the International Electrotechnical Commission (www.iec.ch).

Of course the laser should not be directly emitted to the eye. In the case of the LED probe, which flashes at a frequency of 2.5 Hz, patients with photosensitive epilepsy should close and shield their eyes with a towel or wear appropriate glasses to avoid observing the flashing light (THOR, 2012).

Availability of LLLT

Data from the British Lymphology Society (BLS, 2012) directory reveal that LLLT is not widely offered in UK. Of 252 clinics data observed only seven offered LLLT as a treatment; two of these clinics were private, the remaining five offered treatment through the NHS. However, these data are reliant on clinicians updating the directory, and figures obtained from a company that distributes two types of LLLT devices shows that 24 clinics in the UK have purchased units, suggesting more clinics are using LLLT than have reported that use to the BLS, or LLLT devices have been purchased but not used.

Clinics may not have access to LLLT equipment, or having equipment that is not being used, due to a lack of acceptance of the therapy from governing bodies, the extensive testing and writing of protocols needed due to concerns regarding safety of the equipment, in addition to issues for funding to purchase expensive equipment.

Treating with LLLT: A case study

Mr Graham [pseudonym] underwent a total laryngectomy, excluding lymph node dissection, for advanced carcinoma of the

Table 2. Low level laser therapy (LLLT) dose

Parameter	Unit	Explanation	Notes
Time	Second (s)		For the two devices* reference in this paper the treatment times are 60 s per point.
Fluence	Joules per centimeter squared (J/cm^2)	Power × time divided by beam area	For the two devices* reference in this article: LTU-904 delivers 1.5 J/cm^2 04 Diode Cluster Probe delivers 3.0 J/cm^2
Energy	Joules	Power × time	For the two devices* reference in this article: LTU-904 device delivers 0.03 J per point 04 Diode Cluster Probe delivers 1.2 J per point

*The RianCorp device covers one point, the THOR device covers 104 points at once.

larynx. He subsequently had a tracheostomy and was to have a speaking valve fitted, but his is postoperative recovery was marred by a serious myocardial infarction.

Following recovery from myocardial infarction, Mr Graham underwent 35 fractions of radiotherapy over 5 weeks that resulted in a permanent lymphoedema throughout his submandibular region. Mr Graham felt that the oedema would intermittently block his tracheostomy. His rehabilitation was further delayed due to not being able to have his speaking valve fitted.

Mr Graham was referred to the lymphoedema clinic. Referral documents did not provide details of how many lymph nodes had been removed at surgery and, although palpation and inspection clearly confirmed a lymphoedema present, more information involving lymph nodes removal or metastasis would have assisted in the planning of treatment.

Current practice for the treatment of lymphoedema

According to the BLS (1999), following a holistic assessment and diagnosis, treatment of lymphoedema should involve a combination of interventions including skin care, exercise, support with compression bandaging or hosiery, simple or manual lymphatic drainage to promote maintenance of oedema and prevent complications such as infection.

In cases of head and neck oedema resulting from radiotherapy, skin care is important as further damage to lymphatics and trauma to skin increases the risk of infection due to a build-up of protein and other molecules in the interstitial space (ILF, 2006). Mr Graham was advised to perform daily skin care and used an electric razor to minimise the risk of cuts from wet shaving.

Quere and Sneddon (2012), state that low-compression, made-to-measure garments can prove useful in the management of head and neck oedema, but care needs to be taken as oedema can increase in areas where there are openings, such as the eye sockets (Weissleder and Schuchhardt, 2008). Mr Graham was issued with a chin strap that was helped maintain his submandibular oedema. Compression garments may not always be appropriate due to the effect they have on the patients' psychosocial wellbeing, being a visible reminder of the patients' cancer diagnosis.

MLD is the mainstay of treatment in head and neck oedema forming part of the treatment regime during the intensive phase of decongestive therapy, before fitting hosiery and as part of maintenance treatment (Leduc, 2012). According to Williams (2010), there are various MLD techniques used to stimulate lymphatic flow and contraction of the lymphangions. Various techniques and specific hand movements are used to encourage protein and fluid uptake into the initial lymphatics, without increasing capillary filtration (Williams, 2005). The Leduc method was undertaken twice daily for Mr Graham.

LLLT for lymphoedema

LLLT can be particularly beneficial when tissues are fibrosed as a result of radiotherapy or surgical scaring (Carati et al, 2003; Piller, 2006). The ideal treatment programme for patients with lymphoedema is to treat daily.

The 104 Diode Cluster Probe (*Figure 2*) is set to deliver treatment over the area targeted in 60 seconds at a frequency of 2.5 Hz. As this is a large probe, covering 44.2 cm^2, it is suggested that clinicians treat over lymphatic pathways before treating localised regions of fibrosis.

A smaller probe, such as the 904-LTU (*Figure 3*), on a "high" setting will deliver treatment to an area and depth of 2 cm^2 and should be used at positions 4 cm apart for 60 seconds at each position. As this covers a smaller area, time constraints may dictate that a region of fibrosis is treated rather than lymphatic pathways. To document treatment, protocols have been developed that ensure the dose is recorded accurately and registers the device used. The use of an evaluation tool allows for the clear and concise recording of the application of LLLT and outcomes.

In combination with MLD, compression garments, and self-care activities (skin care, facial exercises), Mr Graham commenced daily LLLT for 3 weeks, with reducing sessions over 3 months. His progress was recorded using an evaluation chart of the type shown in *Appendix I*.

Following his first week of treatment, Mr Graham experienced a significant reduction in oedema and an improvement in swallowing. At his final review (3 months), Mr Graham reported that, although there had been a slight refill in his oedema, it was still a vast improvement compared with pretreatment. He reported reducing his self-massage sessions as the oedema had reduced, which may have led to the slight refill. Mr Graham reported that he had an improvement in movement and that he could lift his chin to see better in the mirror for shaving. The speech and language therapist involved in Mr Graham's care stated that she would like to perform investigations to evaluate internal structures in a patient with head and neck oedema who had undergone LLLT.

Mr Graham continued to wear his chin strap during the evenings to maintain the results. Following the improvement in his oedema he was successfully fitted with a speaking valve and is enjoying an improved QoL.

Mr Graham's neck post-treatment is shown in *Figure 4*; his pretreatment photos were deleted due to a computer error and therefore the before and after evaluation of photos could not be undertaken. However, discussion with clinicians involved in his care confirmed how much his oedema had reduced.

Figure 2. The 104 Diode Cluster Probe (THOR).

Figure 3. The LTU-904 (RianCorp).

Figure 4. Mr Graham post-treatment.

Conclusion

Although there is limited research to support the use of LLLT in those patients with head and neck oedema, studies conducted in BCRL suggest it may be a useful modality in treating all types of lymphoedema. The small studies evaluated here, along with a number of consensus statements by oncology groups, support the use of LLLT in the prevention of oral mucositis in head and neck cancer; it is clear that when LLLT at the correct dose does not cause reoccurrence or mutations in cancer cells.

New objective assessment tools will allow for better monitoring of outcomes and provided evidence to aid increased acceptance of LLLT. It is clear from clinical practice and the literature that LLLT is a cost-effective modality for lymphoedema, due to the lasting effects that the therapy has on the cells, and on ensuring maintenance of oedema. The initial cost for equipment should be outweighed by improved outcomes and patient QoL and reduced treatment times.

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Appendix I. Evaluation form.

	Day 1 (baseline)	Day 3 (end of week 1)	Day 6 (end of week 2)	Day 9 (end of week 3)	Day 13 (end of weekly sessions)	Day 15 (end of fortnightly sessions)	Day 17 (on completion of monthly sessions)
Date							
Flexion							
Extension							
Rotation							
Lateral bend							
Tissues							
Tissues 1							
Tissues 2							
Sensation							
Pain							
Comfort level							
Colour							
Scars							
Oedema							
MLD Response							

Comments

Tissues	0= Normal, 1= soft/non pitting, 2 = soft/ pitting, 3= fatty/Doughy, 4= Firm/ non pitting 5= Firm/Dense, 6= Firm/Woody
Skin assessment	1. Intact, 2 Dry, 3 Fragile, 4 Rash/Redness, 5 Taut/Shiny, 6 Broken/Ulcerated, 7 warm/hot, 8 Infected, 9 Hyperkeratosis, 10 papillomatosis/severe
Pain	Using a scale of 1 to 10, 1 being no discomfort to 10 being the worst
Comfort	0 I feel Ok, 1 I feel slightly better, 3 I feel better, 4 I feel a lot better
Colour	Using a subjective measurement state if skin colour is not normal on the affected area and state yes or no to indicate improvement. Photographs to assess are useful
Scar	Using subjective measurement to indicate improvements by either stating yes or no, comments from patient and clinician can be added in the comments section.
Oedema reduction	Using either tissue dielectric constant (Moisture Meter D Compact) or Bodystat Quadscan as Gold standard to measure oedema reduction in midline oedema. For arm and leg oedema Limb Volume Measurements should be documented
MLD response	0= MLD not part of treatment plan 1 = responded as expected, 2=an improved response to MLD, 3= a quicker response from MLD, 4= a great improvement in MLD response Please state in the comments box if MLD response was better with the inclusion of LLLT if patient was previously treated without LLLT

Flexion	The ability to bend the head towards the chest, starting from a neutral position. 100% when touching the chest.
Extension	The ability to tilt the head backwards to look up at the ceiling. 100% when looking directly upwards.
Rotation	The ability to turn the head to either side, looking over the shoulder. 100% when positioned over the shoulder.
Lateral bend	The ability to tilt the head side wards so that the ear nearly touches the shoulder whilst looking forward.

Use the following numbers to document changes on the Outcomes Chart.
Good = 1, Fair = 2, Poor= 3, Unable to Move = 4 or percentage achieved