COMBINED INFRARED LASER AND LED THERAPY FOR POSTMASTECTOMY PAIN AND DISCOMFORT: A CASE REPORT

Mario A Trelles1 and R Glen Calderhead1,2

1: Instituto Médico Vilafortuny /Antoni De Gimbernat Foundation, Cambrils, Spain; and
2: LG Biomedical, Tsuchi, and Japan Phototherapy Laboratory, Tokyo, Japan

Mastectomies can sometimes be associated with prolonged pain and discomfort. Low reactive-level laser therapy (LLLT) at 830 nm has been reported as effective in pain attenuation. A new generation of quasi-monochromatic light emitting diodes at a nominal 830 nm has offered the clinician an alternative IR phototherapy source for the hands-off treatment of large areas. The combination of the LED therapy over a large area combined with punctal application of laser therapy is an interesting concept. The present study evaluated this combination phototherapy in a patient with comparatively long-term postmastectomy pain. A 44-year-old female had suffered from postmastectomy pain and discomfort for over 3 months, despite taking a nonsteroidal anti-inflammatory drug at high doses. A GaAlAs diode laser (60 mW, CW, 20 sec and 60 J/cm² per point) in punctal application was combined with an LED array (830 nm ± 5 nm, 20 min/irradiation, CW, 60 J/cm²) in the dermatomal approach. Three consecutive daily sessions were given at the above parameters. The Hospital Anxiety and Depression Scale (HADS) was administered one day before and one day after the treatment regimen. Range of movement (ROM) and pain relief scores were recorded. The pre- and posttreatment HADS scores for depression and anxiety were 14 and 9, and 4 and 4, respectively. Pain and discomfort decreased somewhat after the first session, and more rapidly with the subsequent 2 sessions. At 24 hours after the third session, the patient was completely pain free with a full ROM. After an 8-week follow-up, ROM was still good, but mild discomfort was noted around the right breast, and a single ‘top-up’ session with the LED array alone was required, which was effective. The combination of punctal laser and area LED therapy at 830 nm over three consecutive daily sessions improved postmastectomy pain and restored full ROM in this one patient, with good latency which was extended with a single ‘top-up’ IR LED session. Further controlled studies with larger patient populations and longer follow-ups are warranted.

Key words: Laser therapy; LEDs; LED therapy; postmastectomy sequelae; pain; ROM

Introduction

Mastectomies represent a major surgical intervention, and can result in prolonged postoperative discomfort and pain for the patient, particularly when a tissue expander is inserted at the time of the operation and partially or fully inflated. The use of low incident levels of laser energy in pain attenuation has been well documented in the literature, particularly at the near infrared (IR) wavelength of 830 nm. Recent advances in light-emitting diode (LED) technology have offered clinicians an alternative light therapy source, especially when the LEDs are precisely mounted in arrays to offer a large treatment area in a hands-off manner for the therapist or clinician. The authors present a case report describing the combination of punctal IR diode laser therapy in combination with area LED therapy successfully applied for postmastectomy pain and discomfort of approximately 3 months’ duration.

Case Report

A 44-year-old female, normally resident in Scotland, UK, had undergone a full right mastectomy for multifocal ductal CIS in the latter part of November 2004, and at that time the specialist had inserted and partly filled a saline-type tissue expander in a stretched skin pocket with a view to subsequent reconstructive surgery. At the same time a reduction mammoplasty was performed on the left breast. At a follow-up session at the end of December, 2004, the specialist advised the patient not to have any more saline in the tissue expander at that time, because the surgical scars from the mastectomy and subsequent reconstructive surgery were painful and tight, and the patient was very uncomfortable.
By February 2005, however, the patient was still in extreme discomfort with a very limited range of motion (ROM) in her right arm, extreme tightness to the point of severe pain all around the right breast which interfered with her sleeping pattern, and overall a very poor quality of life (QOL) and limited activities of daily living (ADL). The patient had been taking ibuprofen 400 mg three times daily from just after the operation, which had been tapered down to twice daily by the end of February.

In early March, the patient happened to be on holiday near the principal author’s clinic and contacted the second author with whom she was acquainted to see if treatment of her condition might be possible. Because the patient was only in the area for 5 days, a combined laser and light-emitting diode (LED) therapy regimen was planned once daily for three consecutive days. 

**ROM and pain**

On the day before the first treatment, March 4th, 2005, the patient had extremely limited range of motion in her right arm, and was unable to raise the arm much above shoulder height in both forwards and lateral directions (Figure 1). When standing at rest, she tended to lean slightly forwards and to the right, holding her right arm slightly away from her side to ease the tightness (Figure 2). She reported that she was almost totally unable to drive her car for any distance, because her car was not equipped with power-assisted steering and she had great difficulty in turning the steering wheel with her right hand. Both breasts were tender to the touch, particularly so along the scar lines under the right breast, and painful trigger points could be palpated along the dermatomes involving the right breast. The patient took a computer-based version of The Hospital Anxiety and
Depression Scale (HADS). She scored 9 for anxiety and 14 for depression, putting her into the 'clinical case' category for both subscales.

Treatment
The LED system (Omnilux Plus, Photo Therapeutics, Altrincham, UK) emits at 830 nm ± 5 nm in CW, irradiance 55 mW/cm², active area approx. 20 x 22 cm. The LEDs are mounted in arrays set in a rectangular head consisting of hinged panels, and attached to the control console by an adjustable articulated arm. Each exposure time was 20 min and approximately 60 J/cm² over an area of tissue roughly corresponding to the active area, with the head set approximately 4-8 cm from the target tissue. The diode laser system (OhLase-3D1, JMLL, Tokyo, Japan) delivers 60 mW in continuous wave (CW) at 830 nm in the near infrared (IR) at an incident irradiance (power density) of 3 W/cm². The system consists of a probe-type handpiece attached to a control console from which parameters can be set. The probe was applied in contact mode with mild pressure for 20 sec and the incident radiant flux was thus 60 J/cm² per point.

With the patient in the prone position, treatment was started at the above parameters with the treatment head positioned over the spine, from C1/2 down to approximately T8/T9, with the longitudinal axis of the head transverse to that of the vertebrae. (Figure 3a) While that was in progress, the diode laser was applied to the C1/C2 zone at the above parameters, working bilaterally under the base of the skull from the spine out towards just behind the ears with approximately 0.75 cm between points. Both the patient and the therapist wore protective eyewear appropriate for the 830 nm energy.

The patient then adopted the supine position. The LED IR head was next applied over the breasts at the same parameters as above, with the longitudinal axis of the treatment head transverse to that of the patient’s body (Figure 3b). At the same time, punctal diode laser therapy was applied at the same parameters as before working proximal to distal along the thoracic dermatomes (approx. T2-T5) towards the right breast, and then on either side of the surgical scars on the breast itself. There appeared to be adhesion formation between the scars and the underlying tissues. After the first session, ROM was slightly improved, and the patient scored her post-treatment pain as 6 on the pain relief score (PRS), with an initial value of 10. She described the feeling around her right breast as ‘different’ after the treatment, but at least more comfortable than the pre-treatment findings.

Before the second session, the patient reported that the pain and discomfort had eased considerably, and she could lift her right arm almost level with her shoulder, higher than the previous day. Treatment was repeated as for the first session. The PRS post-treatment was 4 with further improvement in right arm ROM, which had improved even further by the start of the third and final treatment session. After the third session, with the same regimen as the preceding two treatments, the PRS was 1, and the patient could lift her right hand completely above her head. (Figure 4) Twenty-four hours later without any further treatment the situation had improved even more, and the patient was completely pain- and discomfort free with full right arm ROM. The HADS was administered again, with the order of questions randomized by the computer. She scored 4 in both subscales, a ‘normal’ (0-7) rating, with improvement in particular noted in the depression subscale.

Eight weeks after the final treatment session, the patient reported that she had completely discontinued her ibuprofen since the treatment sessions, that good right arm ROM had been maintained and that she could...
drive her car without any discomfort. Her QOL had dramatically improved. Mild pain and tightness had returned to the right breast, however. Because the patient is resident in the UK, a further ‘top-up’ treatment session was administered, with the IR LED array only, at another institution. Four weeks thereafter, the patient remains completely pain-free with excellent QOL and ADL.

**Discussion**

Postmastectomy pain and discomfort can be extremely debilitating, disrupting everyday activities and sleep patterns and leading to a lowered QOL as was the case in the current patient over a period of approximately 3 months postoperatively. Diode laser therapy at 830 nm has been well-reported to be effective in alleviating pain of a large number of entities, both acute and chronic, musculoskeletal and neuronal, and has also been shown to reduce postoperative pain and analgesic requirements following major surgery. As a spin-off from space research from NASA in the USA, a new generation of extremely powerful and quasimonochromatic visible red LEDs was recently reported by Whelan and colleagues and these are now available at various wavelengths in the near infrared, including a nominal 830 nm.

Diode laser therapy is usually applied on a point by point basis, with mild pressure to enhance the penetration of the near IR energy and is thus comparatively clinician or therapist-intensive. The LED system, on the other hand, is set up with the head molded over the target tissue, and is thus operated in a hands-off mode allowing the clinician or therapist to attend to other patients during the comparatively long exposure time.

The depth of penetration of 830 nm into tissue is very good, due that wavelength’s being at the bottom of the water absorption curve. The much higher incident photon density associated with the diode laser (irradiance of 3 W/cm² compared with 55 mW/cm², an approximately 60-fold difference) means that deeper penetration of a clinically useful photon density can be achieved, but on a punctal basis. This is particularly useful for reaching deeper-sited targets, such as those in the C1/C2 zone, namely the cerebellum, pons and medulla, or for penetrating fibrotic tissue, such as postoperative scars. The IR LED head, however, still delivers a very useful irradiance of around 55 mW/cm², and the manner in which the LEDs are mounted ensures an extremely intense beam of nominally 830 nm photons over the entire target area. Penetration is still good due to the deep-penetrating characteristics of this wavelength, but less photons will be delivered to the deeper targets than with a laser beam. Superficial targets, such as the intervertebral dorsal root entry- and exit zones of the spine, intercostal nerves and intercostal muscles, will certainly receive a clinically useful photon density.

Treatment on this patient was performed following the proximal to distal dermatomal approach. While the LED head was treating the intervertebral points on the cervical and thoracic spine, the laser was being used to target the various pain control centers known to be located in the base of the brain, including the descending inhibitory pathway, with the aim of replacing sympathetic with parasympathetic dominance. Treatment then moved to the breasts themselves, and the surrounding area. While the LED head was irradiating the breasts and upper thorax, the laser was used in punctal mode along the dermatomes innervating the breasts and surrounding tissues, and then also directly onto the tissue on both sides of the postoperative scars. The authors believe that this is an extremely effective combination modality, complementing the penetrative capacity of the 830 nm LED treatment with deeper penetration from the laser energy, but in a much less therapist-intensive manner than the use of laser therapy alone.

The capacity of 830 nm to increase local blood flow is also well-reported, and this is an important consideration in the treatment of chronic inflammation in addition to improving the blood supply to compro-
mised or somewhat stretched tissues.

By far the biggest limitation of the current study is that only one patient was treated. However, taking into consideration the plethora of data from the previous literature on the efficacy of near IR phototherapy at 830 nm, the good results of the treatment can be well understood.

Because the current patient was not resident near the principal author’s clinic, but just happened to be there on holiday, the consecutive daily treatments regimen was applied for only these three days. The authors are certainly not trying to claim that this is the ideal approach. However the eight-week latency period achieved in the current patient with the maintenance of good ROM, but with the return of mild discomfort which was completely alleviated by a single LED-only ‘top-up’ treatment, suggests that a regimen of perhaps 2 treatments per week for the first two weeks with the combination therapy, starting immediately postoperatively if possible, and then another set of 4 single LED-only sessions at 2-weekly intervals might be the ideal regimen.

Naturally, further controlled trials with larger populations will be necessary before this combination laser and LED therapy can be suggested as a treatment of choice for postmastectomy pain and discomfort, or indeed acute and even chronic pain and discomfort following any major surgical procedure.

References