Journal of Surgical Sciences (2014) Vol. 18 (1) : 38-42

JOURNAL OF SURGICAL SCIENCES

Case Report

LOW LEVEL LASER THERAPY (LLLT) ON SOFT TISSUE HEALING: A CASE REPORT

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Abstract:

Tissue that is damaged and poorly oxygenated as a result of swelling, trauma or inflammation has been shown to have a positive response to laser therapy irradiation. At present, cutaneous lesions represent a dilemma of global proportions and instigate great clinical interest because of the high morbidity associated with changes in the normal healing process. Among the clinical aspects involving this issue, we emphasize tissue repair time in an effort to make the process quicker and more harmonious, reduce possible complications in lesion resolution, and allow an adequate choice of therapy. Laser light energy is highly absorbed by skin and subcutaneous tissue and therefore penetration is key to therapeutic results. Among the methods currently available, low-level laser therapy (LLLT) stands out. Here we present a case of 78 years old lady with multiple variable non healing ulcers on back. Appropriate antibiotics and regular dressing failed to heal the lesions. So we have decided to apply low level laser therapy. At the end of 8th week the wound looked pretty healthy. No untoward reaction or side effect was reported by the patient.

Key Words: LLLT, Biostimulation, wound healing.

Introduction:

Allied health professionals regularly care for a variety of skin wounds, such as abrasions, turf burns, surgical incisions, and ulcerations, which are perhaps the most difficult to treat. At present, cutaneous lesions represent a dilemma of global proportions and instigate great clinical interest because of the high morbidity associated with changes in the normal healing process[1]. Among the clinical aspects involving this issue, we emphasize tissue repair time in an effort to make the process quicker and more harmonious, reduce possible complications in lesion resolution, and allow an adequate choice of therapy. To do this, familiarity with the pathogenesis of tissue healing is necessary, as well as an understanding of the factors affecting the process and the role each one plays in its progress and the various clinical treatment that optimizes skin lesion care. Among the methods currently available, low-level laser therapy (LLLT) stands out. From acute wound management to augmentation of scar tissue remodeling, the clinician seeks to optimize wound care to promote healing. Experimental *in vitro* and *in vivo* studies have been under development since the 1960s, and in the early 1990s, LLLT was approved by the Food and Drug Administration (FDA) as an important method for treating healing processes[2,3,4]. Recent results of a study demonstrated that LLLT is an effective method to modulate tissue repair, thus significantly contributing to a faster and more organized healing process[5,6]. Nevertheless, in spite of the large number of studies involving this technique and its wide use in clinical

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Received 13 September 2013 **Accepted** 20 October 2013

practice, the principles of its action in cells and tissues are still not well understood. The objective of this study is to review pathogenetic aspects of soft tissue repair and to understand the major complications in skin lesion healing. In addition, it aims at forming a concise compilation of published data from scientific literature to date to verify whether the use of low-level laser influences wound healing though its mechanisms of action are not fully clear yet.

Case report:

A 78 year old female bedridden patient with spastic neurological disorder and with recurrent multiple large/ small (approximately 1-2cm deep, 6 -8cm in diameter) wounds on the back, with inflammation and profuse purulent discharge was referred to this tertiary hospital from a local hospital for long lasting (persisting for more than 6 months despite local management with all efforts) *(Fig. 1)* non- healing chronic open wound. At the time of admission, patient's vital signs revealed a heart rate of 68/min, respiratory rate of 26/min, and rectal temperature of 36.5°C. General examination- the patient was bedridden for years, all the system revealed normal except musculoskeletal & nervous system, which showed spastic muscular disorder and Parkinson's disease. The wound was surrounded by large ulcerative skin lesion almost confluent with the spine. The surrounding areas of the lesion revealed slough and blackish necrotic debris.

The total wound area covered about 6 by 8 inches *(Fig. 1)*.

Investigations revealed hemoglobin- 10.7g/dl; TLC - 4700 cells/cu mm; DLC- N60 and L40; absolute Neutrophil count- 2820 cell/cu mm; ì, ESR - 16 mm; and adequate platetets. Peripheral smear revealed microcytic red cells and mild leucopenia. Liver and Kidney profile revealed normal limit, Urine microscopy and cultures were positive repeatedly. Blood culture was sterile. Chest X-ray and Spine showed severe osteoporotic change. ECG showed old MI, Echocadiography showed mild LVH. Pus culture and sensitivity was performed at weekly intervals which yielded Pseudomonas initially. Subsequent cultures showed *Staphylococcus aureus* and *E-coli* species which was supposed to be from contamination with urine. Appropriate antibiotics were given time to time, throughout the hospital stay including intravenous Ciprofloxacillin (100 mg/ kg/day) and Amikacin (15 mg/kg/day) for 15 days. Antibiotics were subsequently changed both for wound and urine infection, to Netilmycin (6 mg/kg/day for 7 days), Cefotaxime (100 mg/kg/day for 10 days), Kenamycin (500 mg 12 hourly for 7 days) and Clindamycin (300mg 12 hourly for 10 days duration). Alternate day cleaning and dressing of the wound was done with Betadine, EUsol and Hexisol but failed to be healed. So we have decided to apply low level laser therapy on wound. 90 sec/ cm^2 of open wound surface, with the laser beam set at a pulsed rate of 40-80 pulses per second (PPS), as the lesion was chronic. The more chronic the lesion, the slower the pulse rate is suggested. The optimum distance from probe tip to target surface was 1-4 mm. Probe motion during lasing was a slow, circling movement over each square centimeter of open lesion, timed to permit the suggested dosages. As the lesion was large, i.e., 4-6 cm in diameter, a change in technique was adopted which involves a slow, traversing of the perimeter of the lesion, allowing approximately 90 sec per linear centimeter of the perimeter, at the suggested distances (1-4 cm). This technique apparently provides sufficient exposure to the laser beam to stimulate healing effectively, compared with non-treated areas and previously experienced wound management of a similar nature.

Low energy Ga-Al laser provides infrared rays in the wave length of around 660 nm by continuous mode.

An average power of 5-8 mw was provided through a fiber optic delivery system around the wound margin for about 8-10 min at each point at a distance of one cm. Since the center of the ulcer was deep, it was decided to give laser therapy concentrating maximum irradiance there *(Fig. 1)*.

At the end of 2^{nd} week there was an improvement in laser irradiated side with respect to ulcer size and wound margin and there was serous discharge after eight exposures *(Fig. 2)*.

Surgical debridement was done 2 times: at 3^{rd} & 5^{th} week *(Fig. 3a, 3b & 5)* and finally secondary closure given at the end of 8^{th} week, within the treatment period (two and half months).

A healthy granulation tissue appeared by 6-7^{th} week (*Fig. 6, 7)* reveals the post laser therapy ulcer on 6-7^{th} week. At this stage, the center of the ulcer was still unhealthy and significant signs of healing. It was decided to irradiate the center of ulcer also with maximum permitted irradiance dose. At the end of 8^{th} week the wound looked healthy, we decided to do secondary closure instead of skin grafting, as because of old age, we could mobilise the adjacent skin without tension and closed the wound by four point suture.

Chronological Picture View
1st day was on 24th October 2009

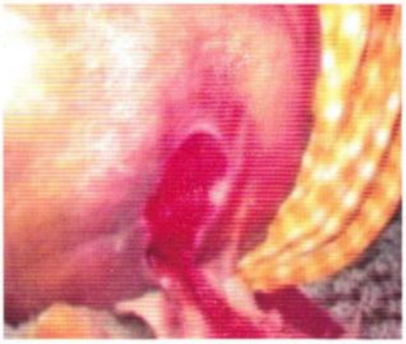

Fig.-1: *At the end of 1st week*

Fig.-2: *At the end of 2nd week*

Fig.-3a: *At the end of 3rd week*

Fig.-3b: *At the end of 3rd week*

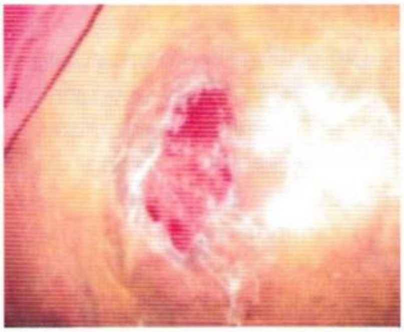

Fig.-4: *At the end of 4th week*

Fig.-5: *At the end of 5th week*

Fig.-6: *At the end of 6th week*

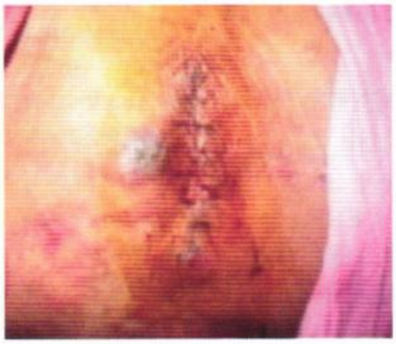

Fig.-7: *At the end of 7th week*

Fig.-8: *At the 9th week*

Fig..-9a: *At the 10th week*

Fig.-9b: *At the end of 10th week*

Fig.-9c: *At the end of 10th week*

Next two weeks we observed the wound surface and continued to two days interval laser therapy (Total treatment 25), and medications properly. Enhancement of healing processes with open lesions is described. The effective parameters were determined to be a pulsed beam at 40-80 PPS, administered at a target distance of 4 mm, for 90 sec/cm^2 of open lesion surface. In addition, lasing along the perimeter of the larger wound was indicated to overcome the diminished penetration of the laser beam through the hardened eschar overlaying the lesion. No untoward reactions or side effects were reported by the patient.

Discussion:

Our patient demonstrated a significant benefit of Ga-Al-As 660 laser for rapid healing of skin wound. The comparison between the laser and conventionally treated wounds of the same patient at about same size clearly highlighted that despite uniformity of host factors, local factors and systemic state, the wound healing process was stimulated on the laser exposed side. Healing of wounds is an important issue faced by general & orthopedic surgeons. The possible biostimulatory role of laser light in wound healing is of recent interest[7]. Small sub destructive repetitive doses of laser light are claimed to be useful for trophic ulcers and indolent wounds[8]. The proposed mechanisms of action include local leukocyte proliferation), neovascularization, fibroblastic proliferation and rapid epithelialization[9,10]. All these mechanisms possibly lead to more rapid closure of wounds and stronger scar formation. In an experimental study, wounds treated with Ga-Al-As 660 laser revealed significantly more granulation tissue. This study established the biostimulatory effects of low intensity laser radiation[11]. Many reports now indicate benefit to non healing wounds and trophic ulcers by low-intensity laser irradiation. Out of 351 patients thus treated, 236 showed complete epithelialisation of the wound surface[12]. Nussbaum *et al*[13] in a study compared-the effect of ultraviolet-C and laser for treatment of pressure ulcers in adults with spinal cord injury. They used 660-980 nm wave length light at an energy density of 4 J/cm2. Weekly percentage changes in wound area were compared. The authors concluded exposure to UV-C decreased healing time and allowed faster return to rehabilitation programs. The UV-C light was better than the laser. Another nonrandomized study of laser and UV lamp on chronic skin ulcers suggested that wounds which fail to respond to topical treatments benefit from either modality[14]. Evaluations of different approaches to wound healing are complicated by the large number of factors that influence wound healing. Although there are anecdotal reports of successful therapy, there are few well controlled studies. The use of lasers for healing wounds is becoming increasingly attractive to surgeons. A number of animal and *in vitro* studies[15,16] have demonstrated that laser irradiation has a significant effect on components of tissue repair.

Conclusion

This study shows the efficacy of LLLT on wound healing in human model, and indicates that it can be a very important adjective tool /modality for chronic intractable wound management, and in any way it is not harmful to human being. Probably laser/ LED Irradiation parameters are vital for its Biostimulative effects. We used an optimal dose of irradiance which proved to be most effective biostimulation on human application. Application and research of LLLT on cell responses of wounded skin fibroblasts demonstrate that correct energy density or fluence and number of exposures can stimulate cell responses of wounded fibroblast and promote cell migration and cell proliferation by stimulating mitochondrial activity and maintaining viability without causing additional stress or damage to wounded cells. Results indicate that the cumulative effect of lower doses determines the stimulatory effect, whereas multiple exposure at higher doses result in an inhibitory effect with more damage[6]. Although various studies have extensively covered the effects of laser radiation on tissue, many unanswered questions remain. Therefore, we noted that there is a need for research on the action and parameters of low-intensity laser use in cutaneous lesions during the different stages of repair. In addition, experimental studies indicated that the LLLT may be an important therapeutic tool to stimulate wound healing in decubitus ulcer patients. In conclusion, the present report highlights the possible utility of Galliium-Aluminium laser at 660 wavelengths is as effective as Helium-Neon laser as an adjunctive modality for wound healing in skin/general & orthopedic practice.

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