Bio Stimulation Laser Therapy in Burn Injury

Emam. H. El-Negamy*., Adel A. Nossier., Ashraf A. Ahmed*** and Mohamed A. Khalaf****

* Dean of Faculty of Physical Therapy, Cairo University.

** Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University.

***Department of Plastic and Constructive Surgery, Faculty of Medicine Al-Azhar University.

ABSTRACT

The purpose of this study was designed to measure the changes of wound surface area in thermally burned patients following participation in program of infra Red Laser bio-stimulation. Thirty subjects, their ages ranged from 20 to 30 years with thermal burn injury participated in this study. The wound surface area was assessed before, after ten and twenty days of initiation of treatment (laser bio-stimulation) using metric graph paper method. A statistically significant improvement was observed after participation in the therapeutic program of laser bio-stimulation, from the obtained results of this study, it can be concluded that, infra Red laser bio-stimulation is a beneficial therapeutic modality to accelerate wound healing in thermally burned patients.

Key Word: Infrared laser, physical therapy, wound healing.

INTRODUCTION

Burn injury represents one of the most devastating calamities in human life[10]. This is readily understood if one realize the paramount physiological importance of the skin as the main shield protecting the internal body organs and as the mediator via which internal body systems communicating with the environment[25].

Skin can be considered as the mirror which reflect the mal function manifestations of different internal body organs, that is why maintaining healthy skin, correcting and regaining skin structural and functional integrity with its pre-injury anatomical and physiological condition are the main objectives of burn injury treatment[9].

The rich vascularity of the inflammatory phase of an acute burn, coupled with the vast amount of oedema formed, also destruction of defense mechanisms against bacteria, make the wound very susceplible to infection[20].

Thermal injury causes a great metabolic & catabolic challenge to the body. Most of the recent advances in burn treatment and rehabilitation have come directly from the increased understanding of the metabolic demands of a burn injury[14] and from the ability to improve the patients nutritional status to meet these demands[16].

Thermal injury primarily results in destruction of the skin and secondarily involves function of the musculoskeletel system, because of that it represents a challenge to the team dealing with such problems and affect greatly the rehabilitation

possibility in which physical therapist plays a crucial role.

Healing of wound is the main problem for physical therapist who deals with many functional problems of burn patients. The ultimate goal of wound management is to allow a wound to close as rapidly as possible, resemble the original tissue as much as possible and produce the least amount of scarring[23].

During the past 20 years, physiotherapists identified a variety of tools which positively facilitate wound healing process among which ultrasound, electrical stimulation and bio-stimulation laser (animal study) are among them, but limited information is available for treatment of patients who had thermal injury.

Most of Egyptian surgeons, have the idea that laser radiation at intensities too low that produce significant heating has beneficial therapeutic effects, may seem to them an absurd. Nevertheless, the treatment tool is in wide use and the concept is neither new nor completely bizarre because the electromagnetic spectrum has a well established role in medicine, as sunlight was used by the Ancient Greeks accelerate tissue healing. Today ultraviolet and visible light are used as bacteriocidal agents as well as in treatment of psoriasis and mood disorders.

Low intensity laser therapy is based on the belief that laser radiation is able to alter cellular and tissue function[3].

The usage of Helium Neon and Infrared biostimulation lasers on collagen in human fibroblasts cultures causes an approximately four fold increase in collagen production[13] Various studies indicated the potential of bio-stimulation laser in the facilitation of the wound healing process[4].

Patients with burn injuries are frequently referred to physical therapy for wound cleaning and enhancement of healing process. The healing process in most open wounds is very slow.

There is a scarcity of clinical studies related to the biostimulation effects of low energy lasers on human wound healing, relatively little well controlled and reported research has been completed to date in this area specially in burn patients.

The popularity of therapeutic laser in the clinical field reinforces the importance of well-controlled clinical research on human subjects.

However, the published studies that are available demonstrate the clinical potential of bio-stimulation laser in the treatment of various wounds. increased collagen synthesis, diminished cellular substance, significant vascularization and an increase in tensile strength were observed[3].

SUBJECTS, MATERIALS & METHODS

Subjects

Thirty burn patients ranging in age between 20 and 30 years old were selected to participate in this study, they were volunteered from burn units at Al-Azhar University Hospital (Egypt), as having burn at the upper extremities none of them was a smoker or has an associated injuries or pathological condition which may affect the results. They have been diagnosed as direct flame or scaled mixed burn, with percentage ranging from 15 to 35% of total body surface area according to the rule of nine. The subjects were assigned into two groups:

A- Control group: include 10 patients (5 male and 5 female) having mean age 23.7±3.56 year and affected area mean value of 24.5±6.95%.

B- Study group: include 20 patients (10 male and 10 female) with mean age of

24.4±3.39 year and affected area mean value of 24.35%.

Measurement materials

Sterilized transparency film, fine-tipped transparency marker, carbon paper, metric graph paper and white paper were used for WSA measurement.

Methods of evaluation

Measurement of WSA was conducted for all patients by the same examiner, before starting the treatment program and after 10 and 20 days of treatment. Three trails were used for each measurement and the mean score was reported.

The measurements of burn wound surface area were taken before the first session and after 10 days and 20 days post initiation of treatment. The investigator placed plastic sheet over the burn (after cleaning with antiseptic solution) and traced the burn's perimeters with a fine tipped transparency marker. The carbon paper was placed over the metric graph paper, then the traced transparency film was placed over carbon paper with a white paper in between and transcribed the tracing onto the metric graph paper and counting the number of square millimeters on the metric graph paper with in the wound tracing.

Laser application

The laser head was routinely cleaned and sterilized using Betadine solution before and after application in each session.

Every patient was placed in a comfortable sitting or supine position according to the site of burn in the upper extremities.

The burn area was divided into zones, each zone equal to the LTU904H retro-reflective shield size, 10 minutes laser application was used for each zone, on daily bases for 20 days.

All patients in both groups received equivalent nursing care and physiotherapy program which include positioning, splinting and exercises.

RESULTS

In the current study, the effectiveness of I.R. laser on burn healing was observed and recorded. This part is intended to present the collected data (WSA), before, during and after application of I.R. laser therapy in the study group and at the same period of the control group to detect the therapeutic efficiency of the I.R. laser in burn healing. The units of this part are presented as follows:

1- Results of the control group

The control group, pre application the WSA was ranging from 9.50 to 19cm^2 with 13.84±3.26cm^2 mean value. After 10 days of wound care the mean value of WSA become 11.3±2.81 cm^2 with mean difference of 2.54cm^2 represents 18.35% reduction of WSA. After 20 days of wound care the WSA mean value become 9.07±2.65 cm^2 with mean difference of 4.77 cm^2 from pre application value, represents 34.46% reduction of WSA (Table 1 and Fig. 1).

2- Results of the study group

In the study group, pre-application, the WSA was ranging from 6.72 to 30.02 cm^2 with 13.59±5.94 cm^2 mean value. After 10 days of laser application and wound care the mean value reduced to 8.24±4.46 cm^2 giving

difference of 5.35 cm^2 which represents 39.36% reduction in WSA. After 20 days of application the mean value of WSA reached $2.92 \pm 3.31 cm^2$ giving mean difference of 10.67 cm^2 which represents 78.51% reduction of WSA (Table 2 and Fig. 2).

As shown in Table 3 significant improvement was recorded in both groups when results collected pretreatment was compared against the results collected after 10 and 20 days of treatment in each groups. Also significant WSA reduction was recorded when results collected after 10 days was compared against the results collected after 20 days in each groups.

3- Comparison between two groups of the study

In comparison between the mean values of the control and study group, no significant difference was recorded in WSA between the two groups pre application but significant difference was recorded between the two groups was recorded after 10 (3.06 cm^2) and 20 ($6.15 cm^2$) days of treatment (Fig. 3) in favor of the study groups.

Table (1): The percentage of change of burn area from pre-treatment, after 10 days and 20 days of application (control group).

Time of evaluation / Statistical Parameter	Pre-treatment value	Post 10 days	Post 20 days
Mean	13.84	11.30	9.07
% of change from pre	.....	↓ 18.35%	↓ 34.46%

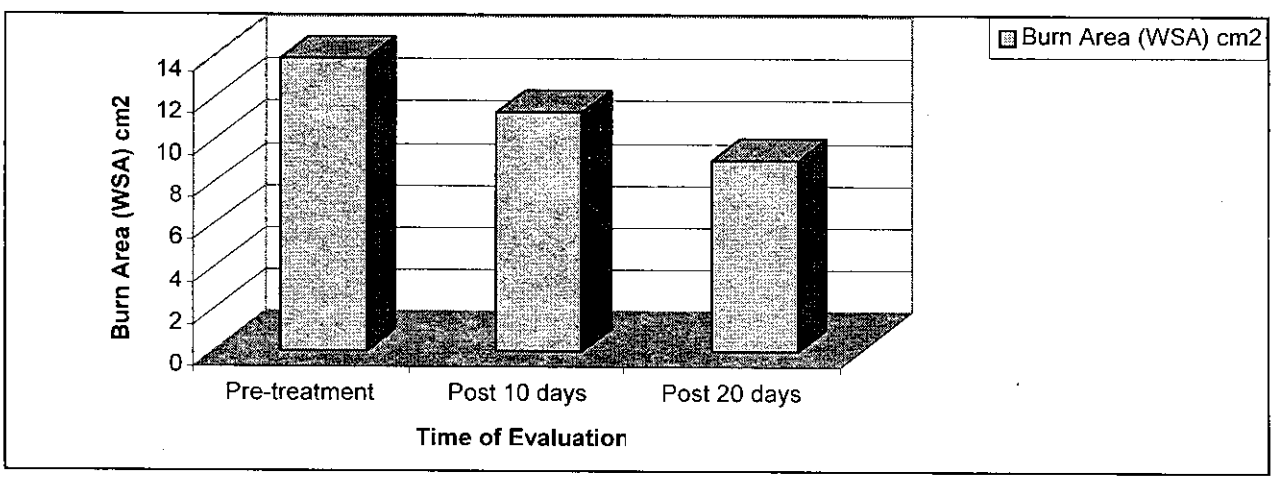

Fig (1): The mean values of 3 measurements of burn area (WSA) in control group.

Table (2): The percentage of change of burn area (WSA) from pre-treatment, post 10 days and 20 days after treatment (study group).

Time of evaluation / Statistical Parameter	Pre-treatment value	Post 10 days	Post 20 days
Mean	13.59	8.24	2.92
% of change from pre	.....	↓ 39.36%	↓ 78.51%

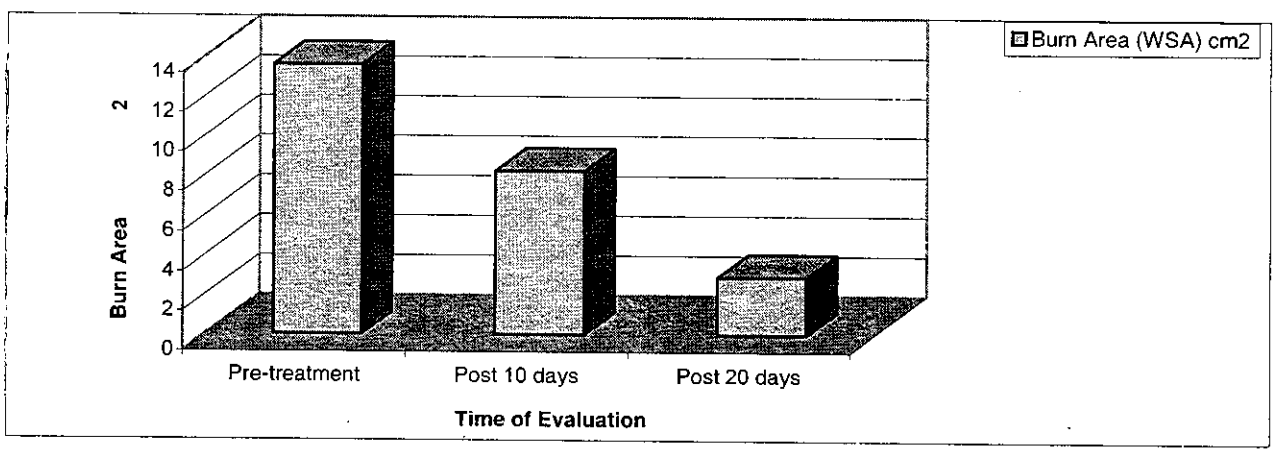

Fig (2): The mean values of 3 measurements of burn area (WSA) in the study group (IR laser group).

Table (3): The percentage of change of burn area (WSA) from pre-treatment, post 10 days and 20 days after treatment (Both groups).

Statistical Group	Burn Area (Cm^2)											
	Treatment Group						Control Group					
	Pre	Post1	Pre	Post2	Post1	Post2	Pre	Post1	Pre	Post2	Post1	Post2
Mean	13.59	8.24	13.59	2.92	8.24	2.92	13.84	11.30	13.84	9.07	11.30	9.07
Mean Difference	5.33		10.67		5.32		2.54		4.77		2.23	
T-Value	12.57		13.590		12.583		5.596		8.404		10.092	
P-Value	6.42^{-11}		1.45^{-11}		5.78^{-11}		1067^{-4}		7.44^{-6}		1.65^{-6}	
Level of Significan	↓ S		↓ S		↓ S		↓ S		↓ S		↓ S	

16- Mancusi-Ungaro, H.R.; Van Way, C.W. and McCool, C.: Caloric and Nitrogen Balance as predictors of Nutritional Outcome in Patients with Burns. J. Burn. Care. Rehabil, 13:695-702, 1992.

17- Mester, E.; Mester, A.F. and Mester, A.: The Biomedical Effects of Laser Application, 1985.

18- Morimoto, y.; Arai, T. and Kikuchi, M.: Effect of low-Intensity Argon Laser irradiation on Mitchondrial Respiration, Laser Surg. Med., 15: 191-199. Laser surg. Med., 5:31-39, 1994.

19- Nussbaum, E.L.; Biemann, I. and Mustard, B.: Comparison of Ultrasound, Ultraviolet and Laser for Treatment Pressure Ulcer in Patients with Spinal Cord Injury, Phys. Ther., 74(9): 812-825, 1994.

20- O' Sullivan, S.B. and Schmitz, T.J.: Physical Rehabilitation, Assessment and Treatment. Eds., 3. F.A. Davis Company, Philadelphia, pp. 511-515, 1994.

21- Passarella, S.; Casamassima, E. and Molinari, S.: Increase of Proton Electrochemical Potential and ATP Synthesis in Rat Liver Mitchondria Irradiated in Vitro by Helium Neon Laser. FEBS lett., 175:95-99, 1984.

22- Patterson, J.W. and Blaylock, W.K.: Dermatology. Medical Examination Publishing, New York, pp. 1-15, 1987.

23- Richard, R.L. and Staley, M.J.: Burn Care and Rehabilitation: Pathologic Manifestations of Burn Injury. eds., 1. F.A. Davis Company, Philadelphia, PP.: 30-79, 1994.

24- Santoianni, P. and MonfreCola, D.: Inadequate Effect of Helium Neon Laser on Venous Leg Ulters. Photodermatology, 1: 245-249, 1984.

25- Tuffery, A.A.: Laboratory Animals: An introduction for experiments. Second Edition. Johan Wilkey & Sons. UK., PP. 233-237, 1995.

26- Yu, W.; Naim, J.O. and Langafame, R.J.: Effects of Photostimulation on Wound Healing in Diabetic Mice. Lasers Surg. Med., 20:56-63, 1997.

الملخص العربي

التنبيه الحيوي لليزر العلاجي في إصابات الحروق

الهدف الرئيسي من إجراء هذه الدراسة لتقييم وقياس مدى تأثير أشعة الليزر التحت الحمراء على سرعة التئام الحروق السطحية والعميقة. وقد أجريت الدراسة على ثلاثين مريضاً من مرضى الحروق ممن تتراوح أعمارهم بين العشرين والثلاثين عاماً (ذكور/ إناث) تم اختيار تلك العينات من مستشفى الحسين الجامعي طبقاً لمواصفات خاصة تخدم العملية البحثية مما يضمن ثبات معظم العوامل المؤثرة على النتائج وهذه المواصفات كالآتي:

1- نسبة الحروق تتراوح من 15% إلى 35% من إجمالي مساحة الجسم .

2- ليسوا مصابين بمرض السكر أو فقر الدم .

3- تم تقسيمهم عشوائياً إلى مجموعتين:-

المجموعة الأولى:-

تكونت هذه المجموعة من عشرين مريضاً ممن تلقوا أشعة الليزر التحت الحمراء خلال عشرين يوما لمدة عشر دقائق .

وتسهيلا لتلقى العلاج تم تقسيم الحرق إلى مقاطع ثابتة مساحة كل مقطع خمسة سنتمترات مربعة وكل مقطع يتعرض لأشعة الليزر التحت الحمراء لمدة عشرة دقائق .تم علاج هذه المجموعة بجانب تعرضهم لأشعة الليزر بالغيار التقليدي لمرضى الحروق وسميت هذه المجموعة (مجموعة الاختبار أو الدراسة) .

المجموعة الثانية :-

تكونت هذه المجموعة من عشرة مرضى مما كانوا يتلقون الغيار التقليدي للحروق فقط دون التعرض لأشعة الليزر العلاجية وسميت هذه المجموعة (بالمجموعة الحاكمة)

وسيله القياس :

أستخدم طريقة الرسم البياني لقياس مساحة الحرق قبل بداية العلاج وبعد بداية العلاج بعشرة أيام وعشرون يوماً لكل مريض من المجموعتين وهى من أدق الوسائل القياسية طبقاً لما ورد في الدراسات السابقة والتي تخدم هذا الموضوع .

نتائج وتوصيات البحث :

أثبت هذا البحث أن هناك فروق ذات دلالة إحصائية بالنسبة للمجموعة الأولى (مجموعة الدراسة أو الاختبار) في سرعة التئام مساحة الحرق بالمقارنة بالمجموعة الثانية الحاكمة وهذا دليل واضح على وجود تحسن ملحوظ في سرعة معدل التئام الحرق .

وفقاً للنتائج والدراسات السابقة توصى هذه الدراسة باستخدام أشعه الليزر التحت الحمراء وأضافتها كوسيلة فعالة في علاج مرضى الحروق من الدرجة الثانية السطحية والعميقة مما يعطى أبلغ الأثر في سرعة معدل التئام الحروق مما يقلل مدة بقاء المريض بالمستشفى وزيادة سرعة تمام وكمال الشفاء والرجوع إلى الحالة الطبيعية في أسرع وقت .