Eng. & Tech., Vol.25, No.10, 2007

The Biological Effects of Low Level Laser Therapy with Static Magnetic Field on Acute and Chronic Pain

Aseel A. Al-sharify*
Received on: 6/8/2006
Accepted on: 5/8/2007

Abstract

This paper presents the biological effects of the low level laser therapy (LLLT) with static magnetic field. The therapy was applied either alone or combined with conventional therapy for the treatment of acute and chronic pain. Two groups of volunteers with a variety of conditions were randomly selected from the patients who were usually treated by conventional therapy. The LLLT with static magnetic field was proposed to the first group as extension of the conventional treatment. The second group underwent only the LLLT with static magnetic field. LLLT was performed with an optical and magnetic system specially designed for this purpose. Short–term and long–term effects as well as conditions responding only to LLLT were recorded. Results indicate disappearing or stable reduction of pain in most cases, while partial restoration of mobility was noticed in some other cases. The success of the treatment was up to 70% for both groups

التأثير الحيوي للعلاج بالليزر ذي المستوي المنخفض والمجال المغناطيسي الثابت على الألم الحادِّ والمُزمن

الخلاصة

يقدم هذا البحث دراسة التاثير البايولوجي لليزر ذي المستوي المنخفض والمجال المغناطيسي الثابت في معالجة الالم الحاد والمزمن , حيث اخذت مجموعتان من المتطوعين وبحالات مرضية مختلفه وبشكل عشوائي حيث استخدمت المعالجه بالليزر ذي المستوي المنخفض و المجال المغناطيسي الثابت في المجموعه الاولى كامتداد للمعالجة بالطرق التقليدية اما المجموعه الثانيه فقد مرت بالعلاج بالليزر والمجال المغناطيسي الثابت كطريقه رئيسيه للمعالجه حيث يساهم المجال المغناطيسي الثابت في تعجيل عملية الاشفاء وتخفيف الالم داخل النسيج الحي الذي يتم معالجته .

تم تسجيل التاثيرات االجانبية و الحالات المرضيه التي استجابت للمعالجه بالطرق العلاجية التي ذكرت انفا واعتمدت طريقه المعاينه المستمرة للوصول الى التاثير الذي تظهره طريقه المعالجه على النسيج حيث لوحظ ان نسبه النجاح في المجموعتين هي ٧٠% وكما تظهر النتائج المدرجه داخل البحث.

1. Introduction:

The transmission of laser radiation in tissues is related to its wavelength [1]. Absorption and scattering of light through skin depend on many characteristics of tissue such as absorption and scattering coefficients at practical wavelength and cooling component of the tissue (i.e.) blood flow [2].

*Laser and Optoelectronics Engineering Department
University of Technology, Baghdad, IRAQ
as_eng2006@yahoo.com

https://doi.org/10.30684/etj.25.10.6
2412-0758/University of Technology-Iraq, Baghdad, Iraq

The absorption spectrum of different biological materials of the skin for different types of laser is shown in Fig. (1).

Lasers are of two types: hot and cold which can be distinguished by the amount of power they deliver .The hot lasers that have peak powers up to a thousand of watts are used in surgery and also in medical applications which require the removal of unhealthy tissue that surround it. The second type is the cold lasers which produce low average power of 100 mw or less and is used for therapeutic purpose. These are typically, although not always, pulsed and usually used in LLLT [2].

The LLLT is a non-invasive and well acceptable by the patients as a method of treatment of a variety of conditions.

The laser most frequently used in the LLLT is the He-Ne laser and the GaAlAs diode emitting in the therapeutic window between 600nm and 1100nm.

Another form of the therapy is the use of static magnetic field which has long been

used to speed up the healing of injuries in humans and animals.

The biological effects of different values of static magnetic field strength are listed in

Table [1], [3] – [10].

The use of the LED and lasers was the next step in the technical development of the LLLT to reduce pain and help to accelerate the healing process [2].

Fig. (2) presents schematically the types of light therapeutic devices, possible wavelength they can emit and maximum output power used in therapy.

2- **The Therapy and Description of Procedure:**

The LLLT for treatment of patients in different condition such as acute and chronic muscular pain, constrained mobility, limbs swelling, neuralgia, inflammation of joints, cervical pain is performed is made by using an optical and magnetic system specially designed for such treatments. [11].

The system combines the following simultaneous effects:

- Coherent IR radiation from a pulsed diode laser (904 nm) with frequencies of operation of (1,10,100,1000) Hz,
- Coherent visible radiation from pulsed diode laser (635 nm) with frequency of operation of (2) Hz,
- Incoherent radiation from pulsed IR LED's (780-950) nm with frequencies of operation of (1,10,100,1000) Hz ,
- Static magnetic field of different field strengths depending on distance above the treated area.

  The exposure times of treatment are (1 or 5) min.

Two groups of volunteers of different ages with a variety of conditions shown in Table [3] were randomly selected for the treatment. The LLLT was proposed to the patients in the first group (GI: male 13, female 26) as extension to the conventional method of treatment. The second

group (GII.: 19male ,15 female) underwent only the laser and static magnetic field therapy .

The total number of procedures for the LLLT with static magnetic field was approximately the same in both groups as shown in Table [4]. Irradiation parameters and required number of procedures for each case were determined from a protocol recommended for the given condition. A third group of volunteers was treated only by conventional therapy (GIII.: male 16 , female 12) for comparison purposes. The number of treated conditions was slightly greater than the number of volunteers due to the fact that some patients were treated for more than one indication. The number of treated conditions for the combined therapy was 40, for the LLLT was 41, and for the conventional therapy was 29.

As a rule, for a painful or other "subjective" conditions, it is inherently difficult to establish valid measurement tool and outcome criteria . In our case, the effectiveness of the therapy is graded under four categories, given in Table [5]. The evaluation is based on objective criteria (e.g. restoration of mobility and improved range of motion observed after several laser sessions) as well as on a subjective self-assessment.

Results

GI,GII demonstrated significant improvement and reduction in pain over the duration of the study. Approximately in 25% of cases patients were treated with low level laser light with static magnetic field felt immediate pain relief .In the most cases however , disappearing or stable reduction of pain was observed at the end of treatment besides the pain relief , in several cases we observed partial restoration of mobility of the patients that had come with a complaint of chronic pain and restricted mobility .In two of the cases old posttraumatic pain successfully treated that had existed over 15-20 years. Also noticeable decreasing in limbs swelling as well as accelerated resolving of inflammations was also registered.

Conclusion:

Our result indicates that LLLT has a significant , positive effect on treatment of a variety of conditions. Although this preliminary study is incomplete, it is believed that empirical evidence gathered proves that the LLLT is a useful modality for acceleration of the healing process and pain attenuation. This is further supported by the absence of harmful side effects of this therapy ,reasonable equipment and operating cost , and the fact that there are few effective alternative treatments for many conditions. the spatial distribution of the absorbed dose depends to a larger degree on the diameter of the beam at its entrance and to a smaller degree on the angle of its divergence, especially for highly scattering tissue .

The absorption of low intensity laser light by biological systems is of a purely non-coherent (i.e.,photobiological) nature .at the cellular level , biological

responses are determined by the absorption of light photo acceptor molecules . Coherence of the laser light is unimportant when the cellular monolayer, the thin layer of cell suspension, and the thin layer of tissue surface are irradiated. In these cases, the coherent and noncoherent light with the same wavelength, intensity, and the doses provide the some biological response .Some biological effects from coherent radiation can occur only in deeper layers of bulk tissue.

References :

[1] Kouta M.,Janisch R.Veseleskar. "Effects of low-power irradiation on cell proliferation". Scripta Medica (BRNO)-79(3):163-172, June 2003. www.med.muni.cz/biomedjournal/pdf.com .

[2] Tiina I.Karu,Institute of Laser and Information Technologies , "Low power Laser therapy" 1116 ch48 frame. Page 1 Monday, February 3, 2003. www.isan.troitsk.ur.com .

[3] Riccardo Pratesi "Diode laser in photomediocine" IEEE .QE. Vol. 20,No.12, 1984.

[4 John A. Dixon, M.D "Surgical application of laser". Second edition, Year Book Medical publishers, Inc, RD73.L3S97, 1978.

[5] Thomas F.deutsch, "Medical application of lasers", Physics Today, American Insititude, Oct, 1998.

[6] Donald F."Effect of static magnetic on osteoblasts and fibroblasts in vitro". Bioelectromagnetics,1993; 14:187-96.

[7] Canada QS. Brown, Pham D "Efficacy of static magnetic field on the Chronic pelvic pain" .volume 187, number 6 .PP 34-45 www.bioflexmagnets.com.

[8] Junes D.B, Ryaby, J.T., 1987. Low energy time varying electromagnetic Field interactions with cellular control mechanisms. In :Blank M , Findl E, Mechanistic approaches to interactions of electric and electromagnetic Fields with living systems. Plenum Press ,NY,PP.389-97.

[9] Honmura A , et al ." therapuitic effect of GaAsAl diode laser irradiation on experimentally induce inflammation in human" Laser in Surgery & Medicine 1992 ; 12:441-449

[10] Trock DH. Electromagnetic fields and the magnets: investigational treatment for musculoskeletal disorder s .2000. www.ncbi.nlm.nih.gov/entrez/query.com .

[11] Mouayed A. Hasan, Aseel A. Al-Sharify " Design and Construction of an Optical and Magnetic System for Medical Applications" , Presented at the 15th International Biophysics Congress, Cairo, Egypt, Sept 2005.

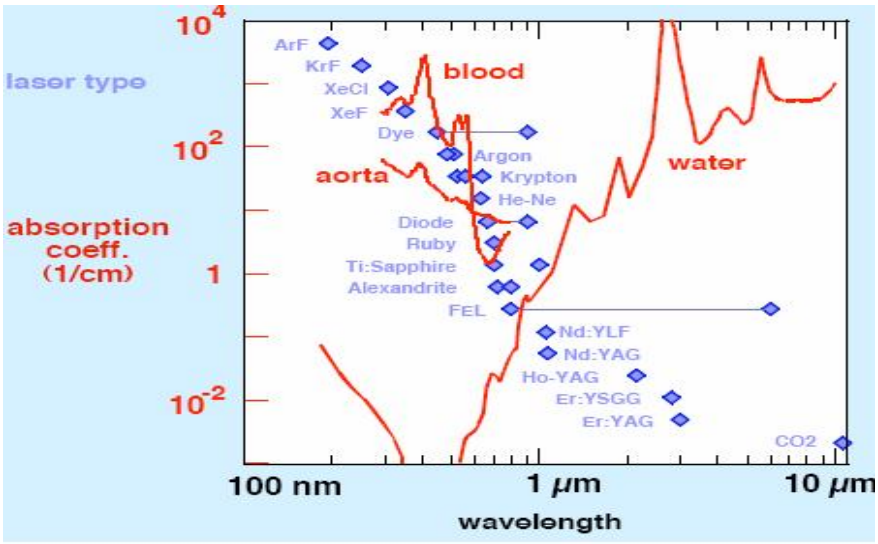

Fig. (1) Laser wavelength as a function of absorption coefficient parameter for different biological constituents [2] .

Table [1] Biological effect of different values of static magnetic field strength

Magnetic field strength(G)	Biological effect
23-3500 Field ranging from	Alter the electrical property of solutions as well as their physiological effects.
100-400	Stimulate the tissue for the healing process.
80-250	Modulate blood pressure via endocrine regular systems.
4300-4800	Significantly increase the turnover rate and synthesis of fibroblasts.
10	Could significantly affect coetaneous microcirculation in a rabbit model.
500	Improve disability and may reduce the pain .

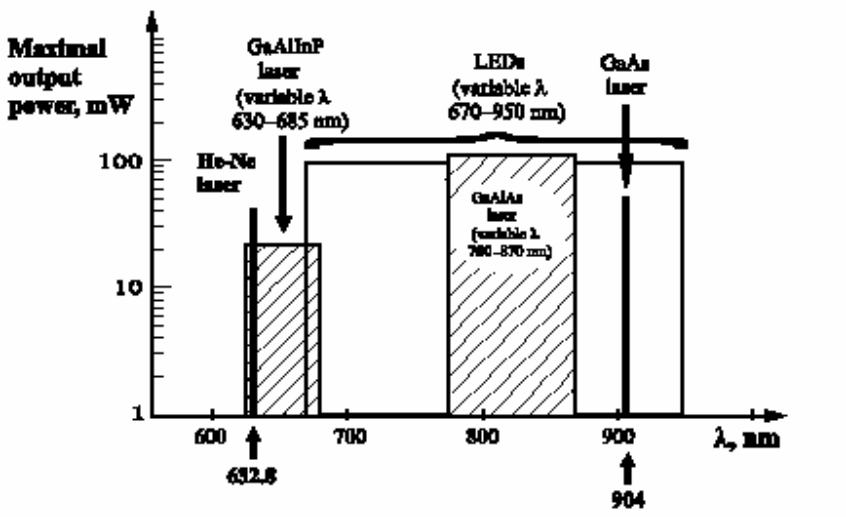

Fig. (2)Wavelength and maximum output power of laser as a function of wavelength [5]

Fig. (3) The medical system with its main units (head power supply and control unit)

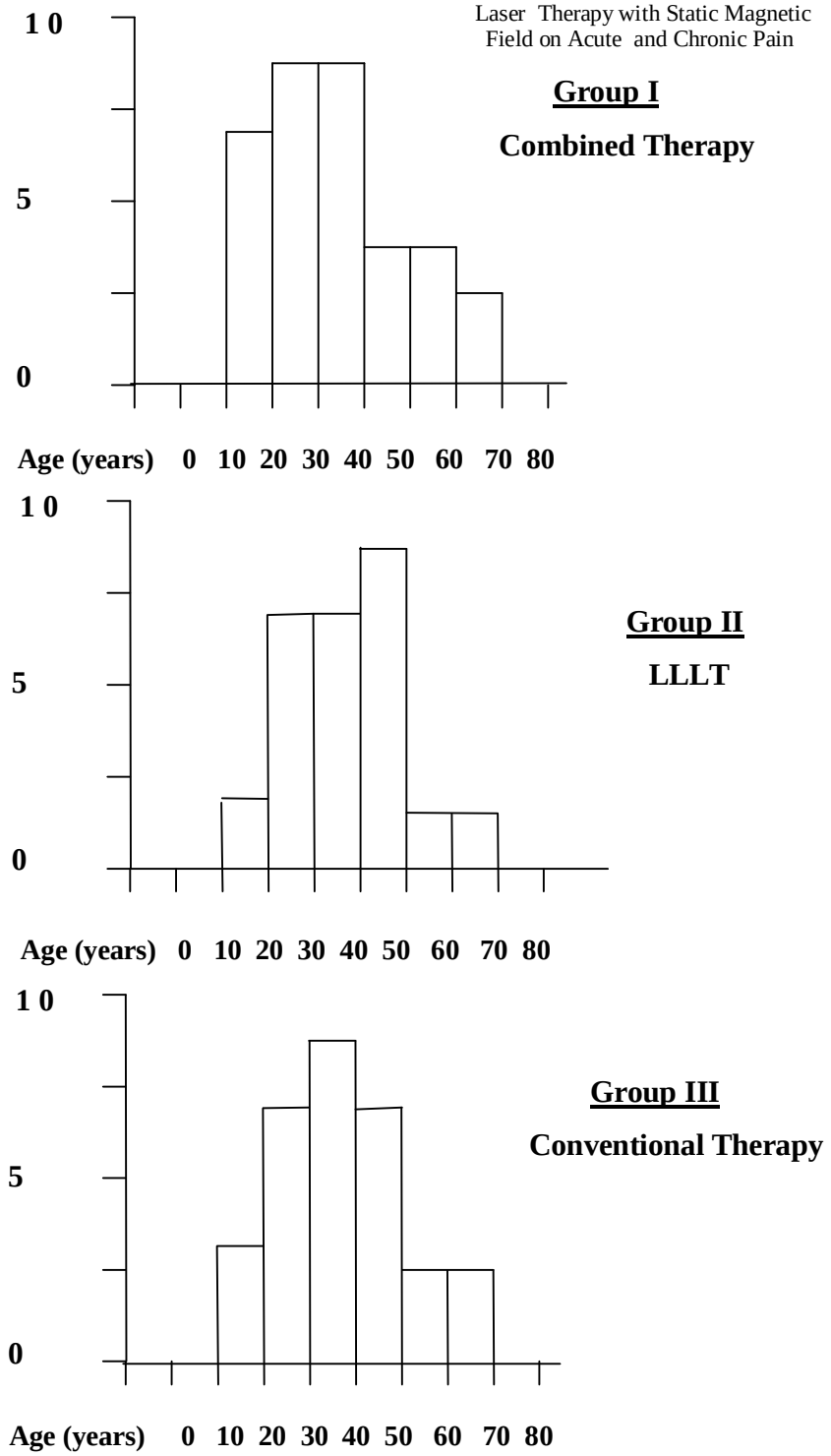

Figure (4)Age - distribution of volunteers over decades

Table (3) Number of treated cases in different groups

Indication	*Conventional therapy G I*	*Combined therapy (conventional +Laser and magnetic therapy)*	*LLLT*
Muscle pain	*9*	*2*	*4*
Posttraumatic and postoperative pain	*1*	*3*	*5*
scoliosis	*6*	*1*	*2*
Acute and chronic lumbalgia		*5*	*4*
Hip joint problems	*6*	*4*	*3*
Joint inflammation	*1*	*3*	*3*
Wounds , fractures ,decubitus			*3*
Discopathy	*3*	*1*	*2*
Immobility ,swelling		*3*	*1*
Neuralgia		*4*	*3*
Cervical pain		*2*	*2*
Soft tissue in the oral cavity			*3*
Rheumatoidal arthritis	*1*	*1*	*1*
Sinusitis		*2*	*1*
cellulites		*3*	
Laser acupuncture		*4*	*4*

Table [4] Average number of procedure per patient with number of volunteers related to it

Average number of Procedure per patients		*Number of volunteers*	
Massage	*27*	*I.G. GI*	*39*
LLLT	*20*	*C.G. GIII*	*29*

Table [5] Undesired side effect for each evaluation

Evaluation	Undesired side effect
Very good (significant improvement ,free of pain)	Missing
Good (clearly apparent improvement)	Short- term pain syndrome in the treated area
Satisfactory (little improvement , less pain)	Long-term pain syndrome in the treated area
Unchanged (practically no improvement)	-