

APPLICATION OF SELF MADE SCANNED LASER SYSTEM FOR LOW LEVEL LASER THERAPY IN DERMATOLOGICAL AND RHEUMATIC AFFECTIONS

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The paper shows the advantages of a self-made scanned laser system for LLLT (Low Level Laser Therapy) treatments, and makes a comparison between the results obtained with LLLT and classic therapy methods. Usual laser machines are equipped with a pen laser system. This system is well known but very unhandy because the physician must hold the pen in place for the entire time of the procedure. Treatment times may last even 15 minutes, time on which the doctor is unnecessarily, permanently, involved in the procedure. With the new built scanned laser system the time in handling is reduced to maximum 2 or 3 minutes, independently of the total application time of the procedure. The scanned laser system consists of 3 major parts: the multi articulated holder arm, optical scanned system, and command console. Necessary PIC software was custom written for this device. Scanning and stopping are PIC controlled with no involving of the practicing doctor. The laser treatment as revealed in this study is very well tolerated by the patients with very good therapeutical results.

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1. Introduction

The low-level laser therapy (LLLT) has gained in the present a very large spreading between practician physicians. Low-level laser therapy at adequate wavelength, intensity, and dose can accelerate tissue repairing. However, there is still unclear information about light characteristics, such as coherence and polarization [1]. The healing time of surgical wounds and other types of wounds is of extreme importance and it is usually associated with a post-operative or post-traumatic period free of infection and with less pain and inflammation.

2. Material and method

Usual laser machines are equipped with a pen laser system. This system is well known but very unhandy because the doctor must hold the pen in place for the entire time of the procedure. Treatment times may last even 15 minutes, time on which the physician is unnecessarily, permanently, involved in the procedure.

With the new built scanned laser system the time in handling is reduced to maximum 2 or 3 minutes, independent of the total application time of the procedure. The scanned laser system consists of 3 major parts: the multi articulated holder arm, optical scanned system, and command console. The articulated arm is provided with 4 independent articulations. These articulations confer

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a free movement on 4 independent axes. This articulated arm provides the holding and the precise positioning of the optical scanned system over the patients body, in the desired place.

The optical scanned system is made of a metal chassis with a mounted stepper motor, motor who moves a controlled vibrating mirror system and the laser source. The controlled movement of the stepper motor and the controlled vibration of the mirror system are generating a rectangular laser projection; rectangle which is customized by the physician with the help of the control system [1]. The control system is provided with a LCD matrix screen HITACHI standard. The advantage of matrix LCD screens is that they can display any character or symbol, custom designed by the user, dot by dot. The matrix of this screen is 5/8 points for each character, 40 characters on each line, on 2 lines. Because two lines can be displayed simultaneously the physician can observe in real-time the functioning of the device and the functional parameters. The command instructions used for HITACHI HD 44780 are:

Instruction	Code									
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
<u>Clear Display</u>	0	0	0	0	0	0	0	0	0	
<u>Return Home</u>	0	0	0	0	0	0	0	0	1	*
<u>Entry Mode Set</u>	0	0	0	0	0	0	0	1	I/D	S
<u>Display ON/OFF</u>	0	0	0	0	0	0	1	D	C	B
<u>Cursor and Display Shift</u>	0	0	0	0	0	1	S/C	R/L	*	*
<u>Function Set</u>	0	0	0	0	1	DL	N	F	*	*
<u>Set CG RAM address</u>	0	0	0	1	A	A	A	A	A	A
<u>Set DD RAM address</u>	0	0	1	A	A	A	A	A	A	A
<u>Read busy flag and address</u>	0	1	BF	A	A	A	A	A	A	A
<u>Write data to CG or DD RAM</u>	1	0	D	D	D	D	D	D	D	D
<u>Read data from CG or DD RAM</u>	1	1	D	D	D	D	D	D	D	D

The form and size of the character is as in picture:

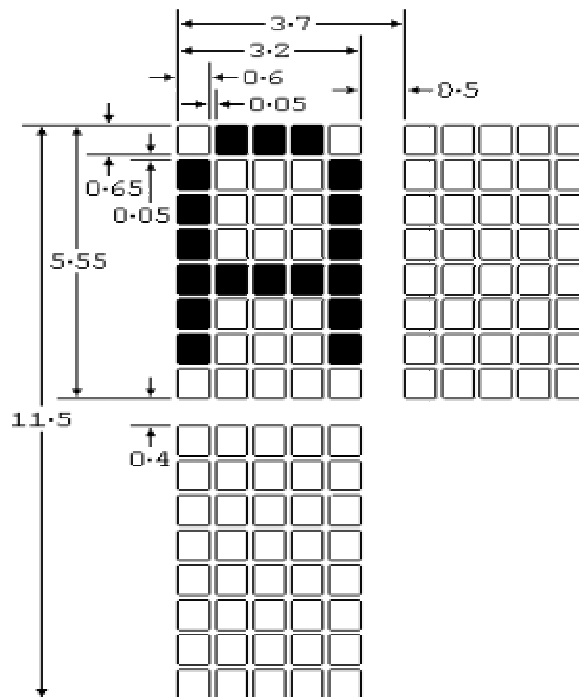


Fig. 1. Matrix schematics of Hitachi LCD display.

The PIC 16f84 is the brain in the control system.

PIC 16f84 is a multi-time programmable microcontroller made by Microchip. It is a 8 bit controller with 4 to 10 MHz clock frequency. Necessary PIC software was custom written for this device. The 4 MHz version was used in the described laser device. No higher speed is needed because the human factor in handling the control system is much slower than the processing speed provided by the 4 MHz PIC 16f84 version.

Two PIC 16f84 micro controllers sustain the control system. One PIC controls the screen and keyboard and the other one controls the optical scanned system. The programming language for PIC 16f84 is the RISC (reduced instruction set controller) language provided by the producer or INTEL PARALAX universal language. The software written in both languages must be converted in hex for programming the circuits. The controller is programmable with any pc with serial or parallel port. The serial port is more conveniently because the programming interface (also produced in our lab) is easier to manufacture. The programming software interface is written for nearly all known operating systems, Microsoft Windows any version, Microsoft DOS any version 4 ,5 and 6, Linux nearly any version, and some MAC OS.

PIC 16c84 or PIC 16f84 pinout:

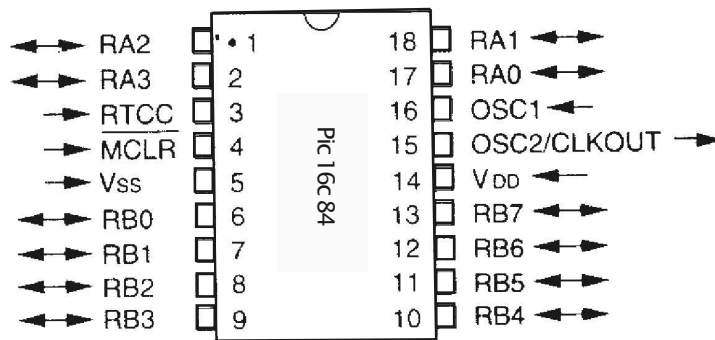


Fig.2. Pic 16c84 or Pic 16f84 schematics.

A study has been made for dermatological affections, wound and scar healing, all affections with extended skin damage, with large areas to treat and cover with laser irradiation. A 635 nm red scanned laser with 10mW power output/2mm²/s was used, because a big skin surface has to be covered with laser irradiation. The goal of this study was to prove the superiority of the scanned laser system, in handling and time involvement of the physician.

In the study 149 patients were involved.

The following table presents the dermatological affections treated in the first study and the number of patients for each affection.

Table 1. Dermatological affections treated in the first study and the number of patients for each affection.

Affection	Number of patients
Acneea vulgaris	42
Ulcus cruris	27
Burnings	45
Cheloid scars	35

The same distribution of patients was selected as a second witness group. The second group was treated only with classical methods, no laser treatment was applied.

For the first study we have quantified the results as following: unsatisfactory, good, and very good. Also for the burnings we considered the time of pain vanishing, time until edema retraction, and disappearance of infection.

For the mentioned affections the applied laser treatment scheme was: three treatment sessions per week, minimum 4 weeks, and the irradiation time for each session was minimum 15 minutes [3].

The results of the first study, for each affection, will be displayed in the tables that will follow.

Patients with acnea vulgaris:

Table 2. Results for acnea vulgaris.

Results:	Studied group	Witness group
Unsatisfactory	0	14-34%
Good	11-27%	22-53%
Very good	31-73%	6-13%

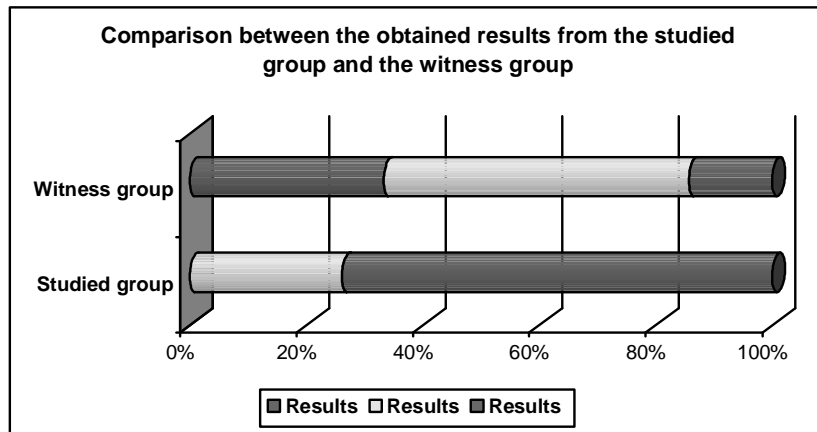


Fig. 3. Comparison between the obtained results from the studied group and the witness group.

For statistic comparison we have used the χ^2 test. In this case the differences were highly statistically relevant ($\chi^2 = 12.56$, $p = 0.001$).

Patients with ulcus cruris:

Table 3. Results for patients with ulcus cruris.

Results	Studied group	Witness group
Unsatisfactory	0	0
good	0	18-66.7%
Very good	27-100%	9-33.3%

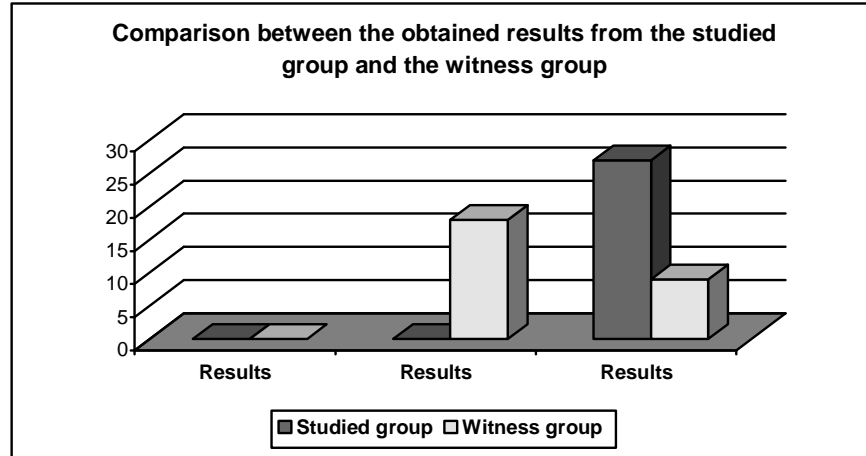


Fig. 4. Comparison between the obtained results from the studied group and the witness group.

The differences were also highly statistically relevant ($\chi^2 = 6.00, p = 0.014$).

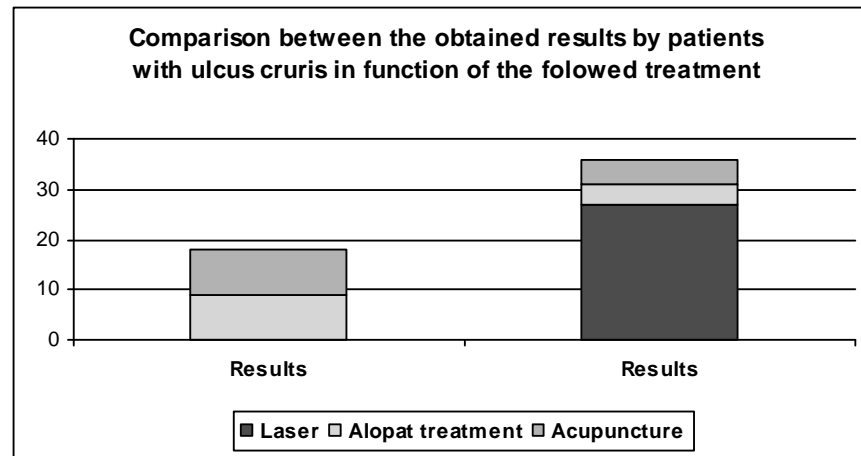


Fig. 5. Comparison between the obtained results by patients with ulcer cruris in function of the followed treatment.

The differences between the applied treatments are highly statistically significant, ($\chi^2 = 6.00, p = 0.049$).

Patients with cheloid scars:

Table 4. Results for patients with cheloid scars.

Results:	Studied group	Witness group
Unsatisfactory	0	0
Good	8-22%	20-56%
Very good	27-78%	15-44.4%

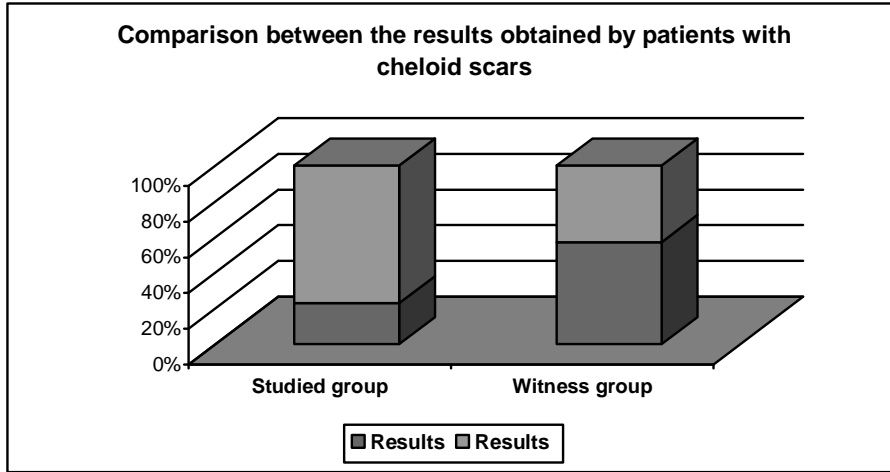


Fig. 6. Comparison between the results obtained by patients with cheloid scars.

The differences are statistically significant ($\chi^2 = 6.31, p = 0.012$).

Patients with burnings:

Table 5. Results for patients with burnings.

Results:	Studied group	Witness group
Unsatisfactory	0	0
Good	9-20%	30-66.7%
Very good	36-80%	15-33.3%

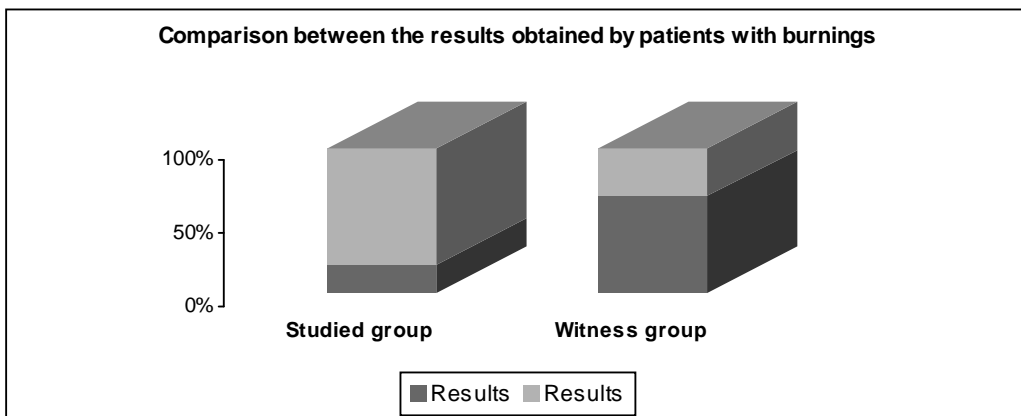


Fig. 7. Comparison between the results obtained by patients with burnings

The differences are statistically significant ($\chi^2 = 13.30, p = 0.0007$).

As mentioned for the patients with burnings we have considered the time until pain is vanished, time until edema retraction, and disappearance of infection [4,5].

The two groups are compared in function of frequency (χ^2 test) and average value (T Student Test).

Table 6. Comparison of how quick pain is disappearing in the studied group and witness group.

The disappearing of pain took place after	Patients in:	
	Studied group	Witness group
48 h	37-83.3%	21-46.7%
48-60 h	0	21-46.7%
>60 h	8-16.7%	3-6.7%

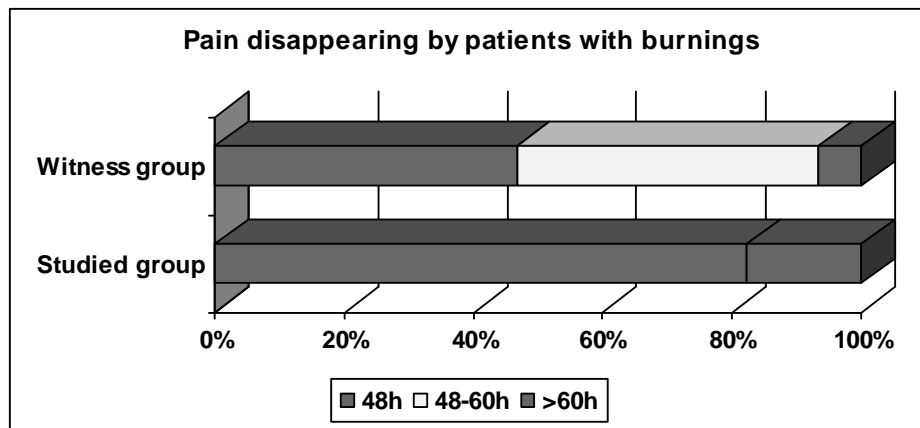


Fig. 8. Pain disappearing by patients with burnings.

The appliquence of Student test for average values shows:

Table 7. Appliquence of Student test for average values.

	Average values for:	
	Studied group	Witness group
Pain disappearing	52.00 h	53.00 h
Edema retraction	53.47 h	52.93 h
Disappearing of infection	5.9 days	6.2 days

3. Conclusions for the study

Time in handling is very reduced with the new scanned laser system. The physician needs just to put the optical system in right position, to program the scanned surface dimensions and lasting time of the procedure. After that, scanning and stopping are PIC controlled with no involving of the practicing physician. The laser treatment method has proved its superiority over the classical treatment methods in the studied affections. No side effects for laser treatment were found [6].

4. General conclusions

By analyzing the results from the above studies we can say that laser treatment facilitates the obtaining of better results for most of the treated patients with the studied affections. Also laser treatment shows better results as the classical treatment in most affections. For laser treatment no side effects were observed. Because no special side effects were observed at the patients with administrated combined treatment methods we can say that laser treatment has no negative interactions with other type of treatments or medical substances.

The laser treatment is a non-invasive treatment; it causes no pain, and the patient exhibits an excellent tolerance. The laser treatment confers to the patient a supplement of physical and psychic comfort [7].

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