EFFECT OF PULSED HIGH INTENSITY LASER THERAPY ON POST BURN HYPERTROPHIC SCARS

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Abstract:
Background: Scars can hurt, itch, and make people feel uncomfortable. Contractures can also limit mobility. It may also be challenging to integrate patients with hypertrophic scars into a culture that has come to value welfare, individuality, and outward attractiveness more and more.
Aim: to research the healing potential of pulsed high intensity laser therapy in situations with hypertrophic scarring following burns. **Subjects and Methods**: From Cairo University Hospitals, 40 patients—40 men and 40 women—with hypertrophic scars and ages ranging from 20 to 45 were chosen. Pulsed high intensity laser therapy together with conventional therapy will be administered to Group (A), the study group. The controlled members of Group (B) receive conventional therapy. Ultrasonography and the Vancouver Scar Scale were used to evaluate the patients. **Results**: Both traditional therapy (deep friction massage) and high intensity laser therapy had a substantial therapeutic effect in the management of post-burn hypertrophic scar, however high intensity laser therapy generated better improvements in scar thickness and cosmetic appearance. **Conclusion:** High-intensity laser therapy works well for treating post-burn hypertrophic scars.
Key words: Burn, deep friction massage, Hypertrophic Scar, High Intensity laser Therapy, Vancouver Scar Scale, Ultrasonography.

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INTRODUCTION:

The most common burn injury complication that results in functional and cosmetic impairment is scar development. After injuries, hypertrophic scars typically appear one to three months later **(Alster., 2008).**

Despite the use of many therapeutic techniques, scar control is a significant concern. Surgery, physical therapy, and pharmaceutical treatments are all used, with variable degrees of success **(Berman et al., 2006).**

Patients have a lot of concern about hypertrophic scarring following surgery, trauma, and especially burns, and practitioners have a difficult situation. Hypertrophic scars may significantly reduce one's quality of life in terms of functionality and appearance (**Ahn et al., 2009).**

High Intensity Laser Therapy (HILT) is a relatively new development in the realm of physical therapy. This technology is constantly evolving and was given FDA approval in 2004. High peak power pulsed neodymium-doped yttrium aluminium garnet (Nd:YAG) lasers are able to activate and access organs, such as the deep and/or large joints, that are difficult to approach with ordinary lasers. With outstanding outcomes, pulsed Nd:YAG laser therapy is becoming more and more popular today. Many studies describe the Nd: YAG Laser's anti-inflammatory, anti-oedemigenic, and analgesic actions, which support its usage in the treatment of pain **(Thabet et al., 2011).**

In numerous surgical procedures, tissue has been sliced and separated using powerful, tightly focused lasers. Recently, high power laser's therapeutic and bio-stimulating capabilities were found. Many metabolic processes, including cell division and proliferation, the manufacture of collagen and other proteins, and immunomodulation, are thought to be stimulated by laser radiation **(Monici M., 2008).**

Subjects and Methods:

Forty patients were clinically diagnosed with hypertrophic scar; they were selected from Cairo University Hospitals. Their age ranged from 20 to 45 years. They were assessed by Vancouver Scar Scale and Ultrasonography.

Patients will randomly divide into two equal groups in numbers (20 patients in each group).

Group (A): the study group will receive pulsed High intensity laser therapy plus traditional therapy.

Group (B): the controlled receive traditional therapy (deep friction massage).

Patients of both sexes who were between the ages of 20 and 45 were required to meet the inclusion criteria. Individuals with severe heart, liver, renal, and tumor conditions were excluded from the study. Individuals who were pregnant, those who

had tattoos or melanocytic nevi during treatment or close by, those with congenital anomalies, those who had skin cancer, smokers, those who were uncooperative, and those who had an open wound at or close to the treatment site.

Measurement procedures: The evaluation was conducted before and after the four weeks of treatment. These measurement procedures were conducted through 2 different methods.

(a) Vancouver scale procedure:

To evaluate the four scar characteristic variables of vascularity, thickness, pliability, and pigmentation.

- For each patient, the Vancouver scale was described.
- For every patient, the overall score was estimated. **(Srivastava et al. 2019).**

(b) Ultrasound scanner:

To measure scar thickness using an ultrasound radiologist who provides a report on scar thickness for each patient who has been evaluated.

Therapeutic procedures:

(a) High intensity laser therapy procedure in addition to traditional therapy:

• With the patient seated, run the programme, connect the 5 mm hand piece to the smart cooler applicator, and place the hand piece in contact with and perpendicular to the treated area.

• Transverse and longitudinal manual scanning was done at the site of the post-burn hypertrophic scar.

Three treatment phases totaling 835 J in energy dosage were carried out.

• The initial phase was performed by fast manual scanning for a total of 375 J. For the first phase, the laser fluency was adjusted to three successive sub phases of doses of 510, 610, and 710mJ/cm2, for a total of 417J.

- The hand piece was used to apply a total of 25.4 J, fluencies of 360, 510, and 610 mJ/cm2, and times of 6 s to the trigger point location using an intermediary phase.
- The application time for all three steps is roughly ten minutes, with the exception of the third phase's use of sluggish manual scanning. The total energy provided to the patient throughout the treatment session was determined by the HILT device based on the energy received during each phase. For a total of 12 therapy sessions, HILT was used. (3 sessions per week).
- **(b) Traditional therapy (in form of Deep friction massage) procedures for both groups:**

- The deep friction massage should be performed as follows:

• Before beginning the massage, ensure sure the patient has cleaned the region and there is no bleeding.

To prevent skin damage, the skin of the patient and the physical therapist must move simultaneously.

• The massage was given perpendicular to the tissue's fibers to reduce the visibility of the scar.

• It was a massage performed thoroughly to ensure that the entire scar was addressed.

• The scar should be blanched by applying sufficient pressure. But be careful not to press too hard to protect your skin.

• Within the patient's pain threshold, a deep friction massage was used. Throughout the massage, the pain subsided.

• If there was a skin break, extreme discomfort, or an infection, the massage was halted.

•Each session last 30 minutes (6 sessions) for four weeks. **(Callaghan., 1993).**

STATISTICAL ANALYSIS

Data were checked for homogeneity of variance and the normality assumption test. After removing outliers identified by box and whiskers plots, the Shapiro-Wilk test was used to determine the normality of the data, which revealed that the data were not normally distributed (P>0.05). More evidence of a significant difference was provided by Levene's test for homogeneity of variance (P>0.05). These results made it possible to undertake both parametric and non-parametric analyses. Analyses using parametric data are done, and the data is normally distributed. The statistical analysis was carried out using the SPSS Package programme for Windows, version 25. (SPSS, Inc., Chicago, IL). The mean and standard deviation are used to convey numerical age, Vancouver Scale, and U.S. data, whereas number and % are used to represent categorical gender data. The Vancouver Scale and U.S. variables were compared using a paired-t test among the laser group and massage group. For the Vancouver Scale and U.S. variables, an independent (unpaired) t-test was utilised to compare the laser group and the massage group before and after treatment. Chi-square test to compare the gender variable between the laser group and the massage group. At the level of significance (P 0.05), all statistical analyses were significant and accepted.

RESULTS

The goal of the current study was to examine the effects of deep friction massage and high power laser on post-burn hypertrophic scars. Forty patients suffering from post-burn hypertrophic scares represented the sample of the study. The patients were assigned randomly in two groups (study group and control group). The age of patients ranged from 20-45 years old.

1. General characteristics of subjects

In this study, 40 patients were distributed randomly into two groups (20 patients/group).The

mean values of age (year) in high power laser therapy group (study group) and traditional therapy group (control group) were 30.13 ±6.01 and 30.69 ±6.71year, respectively (Table 1 and Figure 1). The statistical analysis showed that there was no significant difference in the mean ages between the study group and the control group (P>0.05; P=0.804).

Table (1): Age mean values between the study group and the control group are compared.

Items	Age (Year)
Study group (n=20)	30.13 ±6.01
Control group (n=20)	30.69 ±6.71
t-value	0.250
P-value	0.804
P<0.05	NS

Information is presented as mean and standard deviation. P-value: probability measure Non- significant (NS)

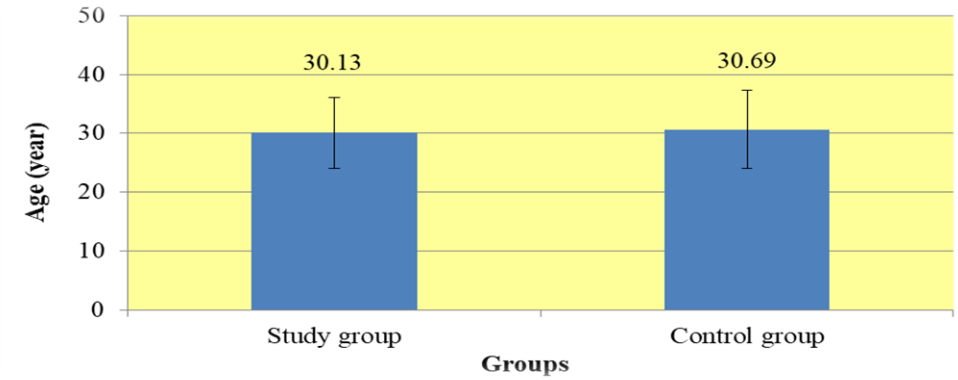

Figure 1: shows the average age (year) for the study group and the control group.

The percentages of male and female patients in the study group were 9 (45.00%) and 11 (55.00%), respectively, while they were 9 (45.00%) and 11 (55.00%) in the control group, according to Table 2 and Figure 2. The statistical analysis showed that the gender distribution between the study group and control group did not change significantly (P>0.05; P=1.000).

Table (2): Gender comparisons between the study group and the control group

Items	Gender	
	Males	**Females**
Study group (n=20)	9 (45.00%)	11 (55.00%)
Control group (n=20)	9 (45.00%)	11 (55.00%)
Chi-square-value	0.00	
P-value	1.000	
P<0.05	NS	

Data is presented as number (percentage) P-value: probability value NS: non-significant

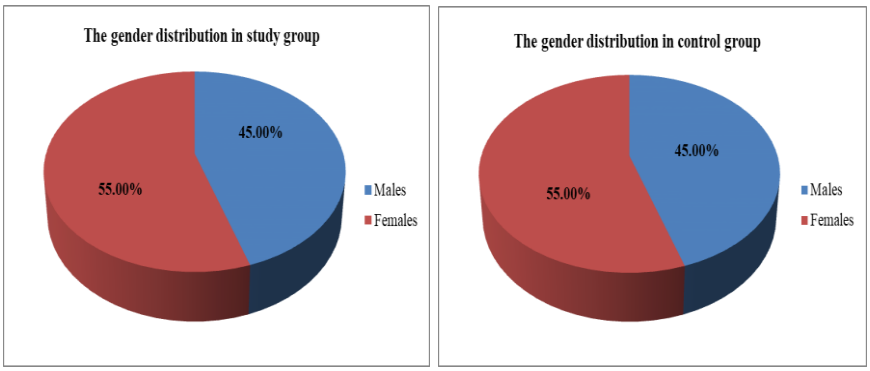

Figure (2): The gender distribution in study group and control group.

2. Vancouver scale

Results of Vancouver scale between before- and after-treatment within each group

In study group (high power laser therapy group), the mean ±SD values of Vancouver scale at before- and after-treatment were 9.56 ±2.56 and 6.63 ±2.47, respectively. The statistical analysis showed that the Vancouver scale had decreased significantly (P=0.0001; P0.05) from before therapy to after treatment, with an improvement percentage of 30.65%. (Table 3 and Figure 3).

The mean SD values of the Vancouver Scale at pre- and post-treatment in the control group (conventional therapy) were 9.25 2.49 and 8.25 2.46, respectively. The statistical analysis showed that the Vancouver Scale had dropped significantly (P=0.0001; P0.05) from before therapy to after treatment, with an improvement percentage of 10.81%. (Table 3 and Figure 3).

Patients post burn hypertrophic scares were in high power laser therapy group (study group) improved higher Vancouver Scale (30.65%) than those in control group which treated by deep friction massage (10.81%).

Table (3): Within each group, a comparison of the vancouver scale before and after therapy

Items	Vancouver scale (Mean ± SD)	
	Study group (n=20)	Control group (n=20)
Before-treatment	9.56 ±2.56	9.25 ±2.49
After-treatment	6.63 ±2.47	8.25 ±2.46
Mean difference (change)	2.93	1.00
Improvement %	30.65%	10.81%
t-value	15.222	5.477
P-value	0.0001*	0.0001*
Significance (P<0.05)	S	S

Data is presented as as mean ±standard deviation P-value: probability value S: significant * Significant (P<0.05)

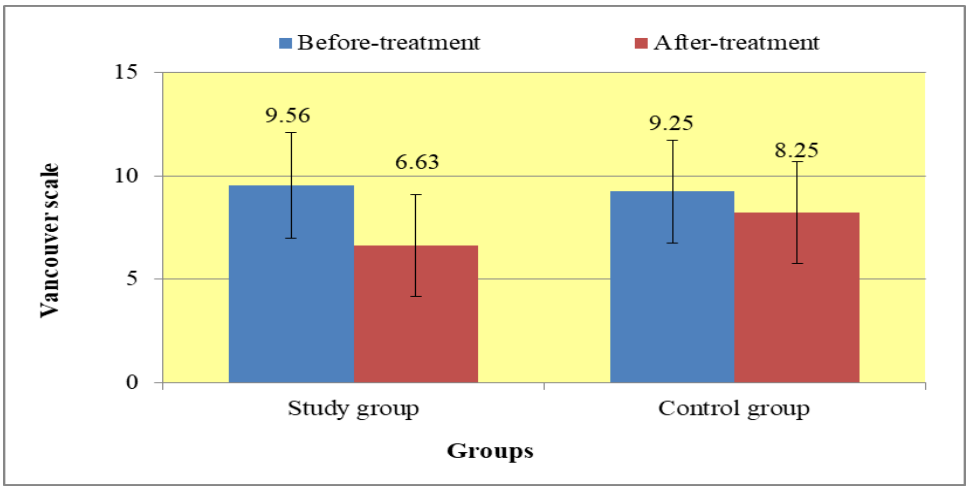

Figure (3): Mean Vancouver Scale values for each group before and after treatment.

U.S.

Results of U.S. between before- and after-treatment within each group

In study group (high power laser therapy group), the mean ±SD values of U.S. at before- and after-treatment were 12.04 ±5.10 and 9.04 ±5.36, respectively . The statistical analysis showed a substantial (P=0.0001; P0.05) drop in the United States at the end of treatment compared to the beginning of treatment, with an improvement percentage of 24.92%. (Table 4 and Figure 4).

The mean and standard deviation (SD) values for Americans in the deep friction massage control group were 12.31 5.59 and 12.85 4.96, respectively, before and after treatment. The statistical analysis showed that there was no difference between the U.S. before and after treatment, with an improvement percentage of 4.39% (P=0.632; P>0.05) (Table 4 and Figure 4).

Patients post burn hypertrophic scares were in high power laser therapy group (study group) improved higher U.S. (24.92%) than those in

control group which treated by deep friction massage (4.39%).

Table (4): Comparison of the U.S. within each group before and after treatment

Items	U.S. (Mean ± SD)	
	Study group (n=20)	Control group (n=20)
Before-treatment	12.04 ±5.10	12.31 ±5.59
After-treatment	9.04 ±5.36	12.85 ±4.96
Mean difference (change)	3.00	0.54
Improvement %	24.92%	4.39%
t-value	11.078	0.489
P-value	0.0001*	0.632
Significance (P<0.05)	S	NS

Data is presented as mean ±standard deviation; P-value: probability value; S: significant; * Significant (P<0.05); NS: non-significant

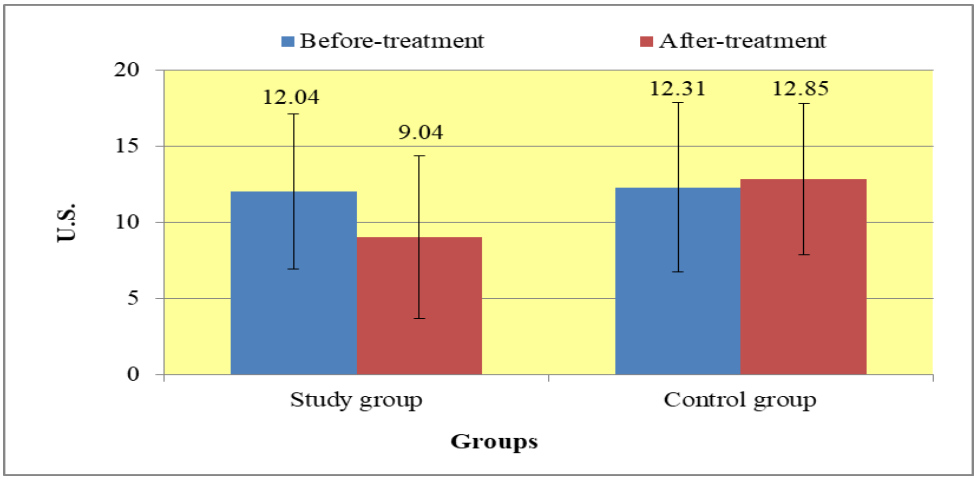

Figure (4): Mean values of before- and after-treatment of U.S. within each group.

DISCUSSION

High-intensity laser therapy's effects on hypertrophic scars following burns were examined in the current study. This study included 40 participants who had post-burn hypertrophic scars. They were split into two equal groups by chance. They were between the ages of 20 and 45. Participants had no additional health issues, such as current kidney or hepatic illness, diabetes mellitus, thyroid disease, bleeding, or malignancies, which could have impacted the study's findings.

In this study, the patients were assigned into 2 equal groups, 20 patients for each group. Groups I: (high intensity laser therapy): this group received high intensity laser therapy plus traditional therapy). Group II: (traditional therapy):

According to reports, the Neodymium Yttrium Aluminum Garnet (Nd: YAG) laser is effective in treating deep vascular conditions such hypertrophic scarring **(Koike S et al., 2014).**

In these pathological scars, which may be identified by vessel overgrowth, collagen, and nerve fibers in the dermal reticular layer, it has been postulated that it functions by preventing neovascularization **(Koike et al., 2014).**

Non-ablative lasers, like Nd:YAG, are one of the ones used to treat hypertrophic scars. It was shown that using long-pulsed Nd:YAG lasers to treat scars reduced the amount of collagen produced **(AL-Mohamady et al., 2016).**

In situations with PIH, laser therapy can have positive results, although it may take multiple sessions, especially if the afflicted area is large. Lasers break down the melanosome, which stops further melanogenesis and melanin transfer **(Chadwick S et al., 2012).**

The Nd: YAG laser generates inflammation when used to treat hypertrophic scars, which in turn raises the levels of matrix metalloproteinase (MMP) and collagen fibre fascicle disintegration **(S.Akaishi et al., 2012).**

A highly significant reduction in VSS was observed after Nd: YAG laser treatment. An increase in pliability, height, and thickness was the primary contributor **(Koike et al., 2014).**

The heating of the water molecules in the treatment area is how it basically functions. Low-power infrared lasers heat cells just enough to activate them but not enough to kill them. Infrared lasers can quickly and completely destroy the target tissue when employed at high power. In order to repair

scars and resurface the skin, A common procedure is Nd: YAG ablative laser treatment. Repairing severe scars with infrared lasers like Nd: YAG can be quite successful because they penetrate deeper into the skin and tissue **(Riveria, 2008).**

Using the 1064 nm Nd: YAG laser to treat atrophic scars is a safe and successful nonablative procedure, especially for people with darker skin, according to a 2007 Brazilian study on the topic **(Raquel and Walter, 2007).**

Nd: YAG laser treatment with a 1064 nm wavelength is beneficial in improving hypertrophic scars, according to a Japanese study **(Koike and Sachiko, 2014).**

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