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Original Article

Efficacy of Long-Pulsed 1064 nm Nd:YAG Laser for Hypertrophic Scars: A randomized controlled trial

Asmaa F. Attalla[1], Salah Eldin Bassit Elsayed[2], Taher Salah El-Din Taha[3*] ,Nisreen Abbas[4]

[1]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, May University, Egypt.
[2]Department of Basic Science, Faculty of Physical Therapy, Cairo University, May University, Egypt.
[3]Fellow of Physical Therapy, Sohag Teaching Hospital, Department of Pediatric, Faculty of Physical Therapy, May University, Egypt.
[4]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, May University, Egypt.

***Correspondence:** Taher Salah El-Din Taha; **Email**: Taher.taha@muc.edu.eg

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Abstract

Background: In the industrialized world, a hypertrophic scar is a major health risk.

Purpose: Investigating the impact of a 532 nm wavelength Nd-YAG laser on hypertrophic scar was the aim of this study.

Materials and Methods: 40 patients with hypertrophic scars, both male and female, between the ages of 18 and 40, were selected from the burn patients' clinic at Cairo University's Faculty of Physical Therapy. They were divided randomly into two equal groups. During the course of treatment, 20 patients in Group A (control group) received regular medical care, nursing, physical therapy, and a sham laser. On the other hand, 20 patients in Group B (the study group) received 532 nm laser radiation in addition to regular medical care, nursing, and physical therapy. 14 sessions of treatment were held every two weeks. Among the outcome measures were the Vancouver Scar Scale score grading system and scar volume measurements for every subject. The evaluation methods were used prior to the start of treatment (Pre), three months later (Post1), and seven months later (Post 2) after the start of treatment.

Results: Significant differences were observed in scar volume and Vancouver Scar Scale scores before, after, and after treatment in the two groups (control and study) with greater improvement in study group than control group.

Conclusion: the study's findings indicate that hypertrophic scar healing is accelerated with Nd-YAG laser.

Keywords: Hypertrophic scar; keloid and Nd-YAG laser.

Introduction:

Hypertrophic scars (HTSs) are human dermal fibro-proliferative defects of injured skin. They are typically accompanied by itching, pain, and a contraction sensation, and they can also result in functional limitations like contracture **(1).**

Inadequate wound healing, which may be brought on by abnormalities in cellular, proteolytic, growth factor, or cytokine profiles, can cause the production of scars. The depth of the injury, the presence of bacteria, the length of the inflammation, the rate of re-epithelialization, and the patient's age are all factors that affect the severity of the scar **(2).**

Hypertrophic scars (HTS) are larger, unobtrusive scars that don't extend beyond the wound's original borders, less common than keloids. They can develop at any age and location, often healing independently. Treatment success rates are higher for HTS **(3).**

One kind of phototherapy, "laser" refers to "Light Amplification by the Stimulated Emission of Radiation," and it works by delivering monochromatic light to living things in order to influence those tissues' biomodulation **(4).**

Less invasive skin resurfacing options than ablative laser are gaining attention due to potential risks. Within three to six months, popular 1320 nm Neodymium:Yttrium-Aluminum-Garnet (Nd:YAG) and 1450 nm diode lasers produce noticeable alleviation by selective thermal injury without causing damage to the epidermis**(5).**

For the treatment of hypertrophic scars, inflammatory neovascularization scars, and skin rejuvenation, the 1064 nm Nd:YAG laser is essential. Patients should receive self-management and scar management education, with a focus on the use of steroid tape and plasters in the early phases of scar formation. To lessen inflammation and enhance attractiveness, various treatments such as laser therapy, anti-inflammatory and anti-allergy medications, bleaching lotions, and cosmetic procedures may be employed on an individual basis **(6).**

Laser light works through selective photothermolysis, where different colors attract different wavelengths, allowing targeted heating of specific-colored objects. Red tattoo ink, for example, can be precisely targeted on normal skin and various skin colors, minimizing its effect on healthy skin **(7).**

Materials and Methods:

40 patients with hypertrophic scars participated in that blinded randomized clinical trial that ran from December 2022 to August 2023 at the Department of Surgery at Cairo University Hospitals. Patients gave their permission to take part in the trial by the signature of an informed consent form prior to the collection of any data. Following clearance from the Physical Therapy Faculty 's Ethics Committee at Cairo University and clinical trials (P.T. REC /012/004429-NCT06347081) enrollment could begin.

Patients with a history of photosensitivity, skin defects, active skin disorders in the treatment areas (e.g., psoriasis, cancer, or autoimmune disease), or those who had taken oral retinoid within the previous year were excluded.

Researchers defined criteria, assigned treatments randomly, stratified groups, balanced characteristics, concealed allocation, documented processes, and monitored compliance.

The assessment sheet was given to the patients during the first meeting. All patients had their scar volume and grading system evaluated using the Vancouver Scar Scale. Patients underwent an initial evaluation before being randomized to either the Nd-YAG laser (study group) or the placebo group (control group).

Treatment Procedures

The treatment began three months after the wounds had healed. Before starting, patients reviewed the treatment details and signed a consent form. Patients were positioned comfortably, and both the therapist and the patient wore protective eyewear. A 532 nm laser probe was positioned horizontally, with the laser beam directed perpendicularly at the hypertrophic scar, keeping a 2 cm distance from the scar surface.

The treatment area was divided into zones matching the size of the retroreflective shield. No topical preparation was used on the skin beforehand. A chilled, clear coupling gel was applied to protect the skin during the procedure. Twenty patients in the second group received

treatment with 532 nm laser irradiation at an energy density of 7 J/cm² and an output power of 15 mW. Each zone received 8 minutes of laser exposure per cm², with the entire treatment lasting 16–40 minutes. Sessions were conducted every two weeks for a total of 14 sessions.

After treatment, patients followed a skincare routine that included a mild cleanser, moisturizer, sunscreen, and Elocon (mometasone ointment). Additionally, regular physiotherapy was provided, incorporating non-invasive techniques such as splinting, massage therapy, ultrasound, stretching exercises, hydrating creams, and antihistamine medications.

Outcome measures:

1- ***Grading system:*** Scars were assessed for color, vascularity, height/elevation, and pliability using the Vancouver Scar Scale, a clinical evaluation tool. A score was assigned based on this assessment, with lower scores indicating better scar quality. These scores were then compared across different treatment methods and time periods. Four essential elements are assessed by the Vancouver Scar Scale: height (thickness), pliability, and pigmentation, and vascularity, with healthy skin serving as the baseline reference. a score of 0 is ideal as shown in **(Table 1) (8).**

Table 1. The Vancouver Scar Scale

Parameter	Score	Description
Vascularity	0	Normal blood flow (normal skin color)
	1	Pink
	2	Red
	3	Purple (markedly hyperemic)
Pliability	0	Normal
	1	Supple (minimal restriction)
	2	Yielding
	3	Firm
	4	Banding
	5	Contracture (severe restriction)
Height/ Thickness	0	Flat
	1	<2 mm
	2	2-5 mm
	3	>5 mm
Pigmentation	0	Normal (matches surrounding skin)
	1	Hypopigmentation (lighter than surrounding skin)
	2	Hyperpigmentation (darker than surrounding skin)

2- The negative-positive moulage method was used to calculate the scar volume:

A dental compound was softened in warm water (70°C) and applied to the scar for 5 minutes to create a negative impression. After cooling, this impression was used to form a cupped model of the scar. The scar's outline and the impression's edges were traced onto semi-transparent paper. After that, soft plaster was applied to the impression, left to dry for 48 hours at room temperature, and weighed. The plaster's weight, found by subtracting the original weight of the impression, was used to calculate the volume of scar **(9).**

The evaluation methods were used prior to the start of treatment (Pre), and three months later (Post1) as well as following 7 months (Post2) from the beginning of the treatment

Sample size: For the present study, a preliminary power analysis utilizing the G power program yielded a sample size of 40, with parameters such as power (1α error P) = 0.85, α = 0.01, and effect size = 0.5. A reasonable sample size was achieved with this effect size.

Statistical Analysis

The SPSS for Windows version 20 was used to perform the analysis. Group B (study group) received 532 nm laser radiation, regular medical treatment, nursing, and physiotherapy, while Group A (control group) physiotherapy, sham laser treatments, and routine medical and nursing care were provided. The study measured scar volume and Vancouver Scar Scale scores at three intervals: before treatment, three months (Post1), and seven months (Post2). Statistical tests, including independent t-tests, Mann-Whitney U tests, Friedman tests, and the Wilcoxon Signed Ranks Tests were utilized to compare the outcomes of the groups.

Results:

Table 2 shows the demographic data of the sample. Non-significant differences were noted between both groups study and control groups in age (p-value =0.96). Male and female were equally distributed between study and control groups.

Table 3 and figure 1 shows the scare volume in both study and control group, while there was no significant difference between the groups in pre-evaluation measures of scare volume, significant difference was found in post 1 evaluation measures of scare volume (p-value=0.001) and post 2 evaluation (p-value=0.0001). By comparing means of pre-evaluation results, post1 evaluation results and post 2 evaluation results, significant difference was found within control group (p-value= 0.0001) and within control group (p-value= 0.0001).

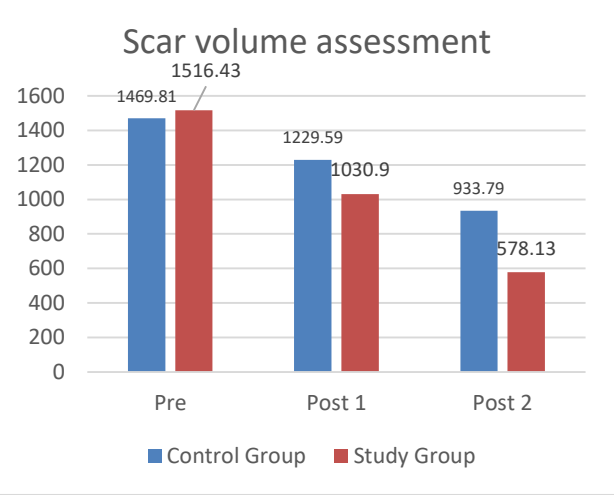

Figure 1 Scare volume

Table 4 and figure 2 display the variations in the Vancouver scar scale between the study and control groups. Pre-evaluation data showed a non-significant difference between the two groups. (p-value =0.87), The results of the post-1 examination showed a substantial difference between the two groups. (0.0001) and post 2 (p-value=0.0001). By comparing pre-evaluation results, post 1-evaluation results and post 2 -evaluation results within control and study groups significant difference were found within control group (p-value=0.0001) and within study group (p-value=0.0001)**.**

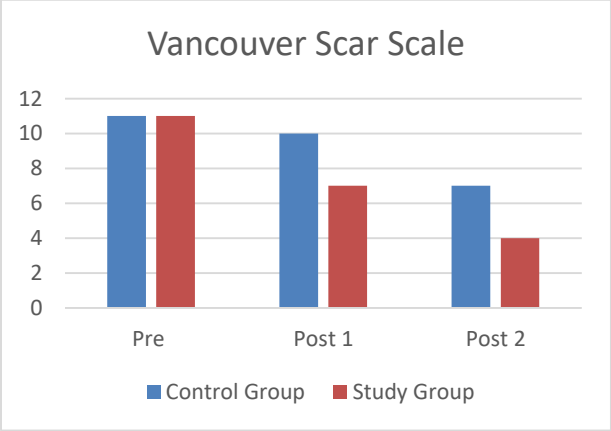

Figure 2 Vancouver score scale (control and study groups)

Table 2. Demographic Data

	Control Group	Study Group	p-value	Sig.
Age (mean and Standard Deviation)	29.25 ± 10.4	29.3 ± 11.28	0.96	NS
Sex Distributions				
Male %	30%	30%		
Female %	70%	70%		
NS non-significant	S significant	Significance level =0.05		

Table 3. Scar volume assessment

	Mean ± Standard deviation			
	Control Group	**Study Group**	**p-value**	**Significance**
Pre	1469.81 ± 210.81	1516.43 ± 217.85	0.49	NS.
Post 1	1229.59±184.38	1030.9±153.53	0.001	S
Post 2	933.79±167.83	578.13±97.46	0.0001	S
F- value	131.18	403.43		
p- value	0.0001	0.0001		
Significance	S	S		
NS non-significant	S significant	Significance level =0.05		

Table 4. Vancouver Scar Scale

	Median		U- value	p-value	Sig
	Control Group	**Study Group**			
Pre	11	11	194	0.87	NS
Post 1	10	7	9	0.0001	S
Post 2	7	4	2.5	0.0001	S
$\chi 2$	39.51	40			
p- value	0.0001	0.0001			
Sig	S	S			
NS non-significant	S significant	Significance level =0.05			

Discussion:

The Vancouver Scar Scale (VSS) and a negative-positive moulage tool were used in this study to evaluate the impact of a 532 nm Nd:YAG laser on hypertrophic scars. Forty patients with elevated scars on their upper extremities were divided into two groups at random: the study group received laser treatment in addition to standard care, while the control group received standard care and a sham laser. At baseline, three months, and seven months after treatment, scar volume and VSS scores were assessed. In comparison to the control group, the study discovered that the laser-treated group had significantly lower scar volume and VSS scores.

This study's findings corroborate those of **Joseph (2001), Bowes et al., (2002), Ostovari et al., (2007), Cho et al., (2010), Victor et al., (2006), Bloisi et al., (2004), Daniel and Guglielmo, (2003), Mi et al., (2004), Satoshi et al., (2007), Berlin et al., (2007), Cho et al., (2010), Cassuto et al., (2010), Yun et al., (2011), Min-Wei Christine, (2003)** about the hypertrophic scar-promoting effects of 532 nm Nd-YAG lasers on human skin **(1,10,11,12,13,14).**

Studies have shown that the 532nm wavelength can effectively treat facial telangiectasia, small vascular lesions, and certain pigmented lesions. Pulsed dye lasers (585 nm Laser) and 532 nm Nd:YAG laser both effectively treat pigmented hypertrophic scars. The pigmentation level of macular amyloidosis patches was significantly reduced by both lasers, with 532 nm demonstrating more efficacy than

1064 nm. 90% of people treated with 532 nm had good or very good reactions, according to photometric studies, whereas 60% of patches treated with 1064 nm had the same result. In comparison to Intense Pulsed Light (IPL) devices, the 532 nm Nd:YAG laser therapy also resulted in thicker collagen within the papillary dermis **(15,16,17,18,19,20)**

Ogawa et al. investigated the effects of Nd:YAG lasers with wavelengths of 532 nm and 1064 nm on skin smoothing and resurfacing. Redness, pigmentation, skin tone, tightness, texture, and rhytidosis were all significantly improved by the 532 nm laser, according to the results, but when used alone, the 1064 nm laser performed better **(6)**

Berlin et al. (2007) and Bjerring et al. (2000) While nonablative resurfacing lessens fine wrinkles and improves skin texture, it does not totally eliminate them. On a smaller scale, it provides cumulative aesthetic improvements comparable to ablative resurfacing. Over the course of three to six treatment sessions, results usually become apparent. **(21,22)**

Limitations of the study:

There was an intensive attempt with each participant to lessen the effect of any study errors. The following factors limited this study: the patient's physical as well as mental health throughout treatment, the potential for human errore when administering tests or using therapeutic methods, the degree of cooperation from the patient, the patient's lifestyle choices (including the way they exercise), and the variation between patients and their reactions to the effects of recovery.

Conclusion:

The study's findings indicate that hypertrophic scar healing is accelerated with Nd-YAG laser

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References

1. **Leszczynski R, Da Silva CA, Pinto ACPN, Kuczynski U, Da Silva EM.** Laser therapy for treating hypertrophic and keloid scars. Cochrane Wounds Group, editor. Cochrane Database of Systematic Reviews [Internet]. 2022 Sep 26;2022(9). Available from: http://doi.wiley.com/10.1002/14651858.CD011642.pub2
2. **Ramírez O, Pomareda F, Olivares B, Huang YL, Zavala G, Carrasco-Rojas J, et al.** Aloe vera peel-derived nanovesicles display anti-inflammatory properties and prevent myofibroblast differentiation. Phytomedicine. 2024 Jan;122:155108.
3. **Sedaghat ES, Gold MH. Skin care for scars:** Where we have been and what's new. Dermatological Reviews. 2023 Dec;4(6):278–83.
4. **Benincá IL, De Estéfani D, Pereira De Souza S, Weisshahn NK, Haupenthal A.** Tissue heating in different short wave diathermy methods: A systematic review and narrative synthesis. Journal of Bodywork and Movement Therapies. 2021 Oct;28:298–310.
5. **Tanzi EL, Alster TS.** Laser treatment of scars. Skin Therapy Letter. 2004;9(1).
6. **Ogawa R, Akaishi S, Kuribayashi S, Miyashita T.** Keloids and hypertrophic scars can now be cured completely: recent progress in our understanding of the pathogenesis of keloids and hypertrophic scars and the most promising current therapeutic strategy. J Nippon Med Sch. 2016;83(2):46–53.

7. **Seago M, Shumaker PR, Spring LK, Alam M, Al-Niaimi F, Rox Anderson R, et al.** Laser Treatment of Traumatic Scars and Contractures: 2020 International Consensus Recommendations. Lasers Surg Med. 2020 Feb;52(2):96–116.
8. **Draaijers LJ, Tempelman FR, Botman YA.** The patient and observer scar assessment scale: a reliable and feasible tool for scar evaluation. Plast Reconstr Surg. 2004;113(7):1960-5.
9. **Wang ZY, Zhang J, Lu S.** Objective evaluation of burn and post-surgical scars and the accuracy of subjective scar type judgment. Chin Med J (Engl). 2008;121(24):2517-20.
10. **Archer KA, Carniol P.** Diode Laser and Fractional Laser Innovations. Facial plast Surg. 2019 Jun;35(03):248–55.
11. **Bowes LE, Nouri B, Jimenez G, Pardo R, Rodriguez L, Spencer JM.** Treatment of pigmented hypertrophic scars with the 585 nm pulsed dye laser and the 532 nm frequency-doubled Nd:YAG laser in the Q-switched and variable pulse modes: a comparative study. Dermatol Surg. 2002;28(8):714-9.
12. **Ostovari N, Mohtasham N, Shahidi Oadras M, Malekzad F.** 532-nm and 1064-nm Q-switched Nd:YAG laser therapy for reduction of pigmentation in macular amyloidosis patches. J Eur Acad Dermatol Venereol. 2007;22(4):442-6.
13. **Mi XQ, Chen JY, Cen Y, Liang ZJ, Zhou LW.** A comparative study of 632.8 and 532 nm laser irradiation on some rheological factors in human blood in vitro. J Photochem Photobiol B Biol. 2004;74(1):7-12.
14. **Cassuto DA, Scrimali L, Siragò P.** Treatment of hypertrophic scars and keloids with an LBO laser (532 nm) and silicone gel sheeting. J Cosmet Laser Ther. 2010;12(1):32-7.
15. **Koike S, Akaishi S, Nagashima Y, Dohi T, Hyakusoku H, Ogawa R. Nd:YAG** laser treatment for keloids and hypertrophic scars: an analysis of 102 cases. Plast Reconstr Surg Glob Open. 2015;2(12):e272.
16. **Cho S, Lee J, Lee S, Bang D, Oh S.** Efficacy and safety of 1064-nm Q-switched Nd:YAG laser with low fluence for keloids and hypertrophic scars. J Eur Acad Dermatol Venereol. 2010;24(9):1070-4.
17. **Victor G, Diwan A, Shea CR, Zhang P, Sadick NS.** Effects of intense pulsed light and the 1064 nm Nd:YAG laser on sun-damaged human skin: histologic and immunohistochemical analysis. Dermatol Surg. 2006;31(5):522-5.
18. **Bloisi F, Vicari L, Barone AC, Martuscelli E, Gentile G, Polcaro C.** Effects of Nd:YAG (532 nm) laser radiation on 'clean' cotton. Appl Phys a Mater Sci Process. 2004;79(2):331-3.
19. **Paquet P, Hermanns JF, Pierard GE.** Effect of the 585nm flashlamp-pumped pulsed dye laser for the treatment of keloids. Dermatol Surg. 2001; 27:171-4.
20. **Yun JS, Choi YJ, Kim WS, Lee GY.** Prevention of thyroidectomy scars in Asian adults using a 532-nm potassium titanyl phosphate laser. Dermatol Surg. 2011;42:131-9.
21. **Berlin AL, Hussain M, Goldberg DJ.** Cutaneous photoaging treated with a combined 595/1064 nm laser. J Cosmet Laser Ther. 2007;9(4):214-7.
22. **Bjerring P, Clement M, Heickendorff L, Egevist H, Kiernan M.** Selective non-ablative wrinkle reduction by laser. J Cutan Laser Ther. 2000;2(1):9-15.