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Handling keloid and hypertrophic scars by long-pulsed Nd: YAG laser: Evaluating effectiveness

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Abstract---Background and objectives: Keloids and HTs appear to have an abundant healing response that sets a challenge for physicians. Patients and methods: Patients with keloids and HTs were handled by a long-pulsed 1064 nm Nd: YAG laser every 4 weeks for five sessions. The number of patients was twenty. The scars were rated by VSS, consisting of 4 ingredients: vascularity, pigmentation, pliability, and height. Moreover, histopathological assessment by hematoxylin and eosin stain and Masson trichrome stain. After 6 months of finishing the treatment, the lesion was estimated to evaluate the recurrence rate. Results: According to VSS, there was a considerable improvement in vascularity, pigmentation, pliability, and height after the treatment than before the treatment. The score of the scar assessment dropped off from 9.40 to 3.75 after treatment. Hematoxylin and eosin staining and Elastica Masson-Goldner staining appeared to change the structure of the tissue collagen. Collagen bundles lost their whirl structure, and the thickness of the collagen layer decreased. The Wall of blood vessels was thinner, and the number of blood vessels was decreased. Conclusion: The treatment of keloids and HTs showed great results with a long-pulsed Nd-YAG laser.

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Introduction

Hypertrophic scarring is a popular condition that manifests on a wound that rises by deep injury, burns, or poor recovery from surgical proceedings. [1] Clinical manifestations of the budding HTs appear that tissue is elevated than the surrounding skin stays within the boundaries of the main wound, it is dark red or purple in most cases, and it is firmer than normal skin in many lesions and sometimes attached by localburning soreness and pruritus. These symptoms may continue for many months or even years before imperceptible declination. [2] Keloids and HTs evolve from an inappropriate equilibrium between deposition and degeneration of extracellular matrix (ECM) ingredients, especially collagen. A defect produces the overflowing collagen in fibroblasts production due to increased density and activation of growth factor receptors. [3] Additionally, transforming growth factor- beta (TGF-β) is implicated in fibroblast proliferation and chemotaxis, collagen synthesis, and the deposition and remodeling of the novel ECM of the wound. Normally, TGF-β activity is stopped when wound healing is done. In keloids and HTs, TGF-β levels (especially TGF-β1 isoform) are raised and constant. [4]

The handling process of HTs stays a troublesome unsolved problem. Numerous therapeutic methods have been termed, including invasive and non-invasive medication. The invasive medication includes, eg. intralesional admission of steroid, 5- fluorouracil (5-FU), or bleomycin, cryotherapy, and laser [5]. The non-invasive medication usually includes e.g. Pressure therapy and silicone gel. These modalities are documented with different efficacy on HTs and keloid [6]. Non-ablative laser processes like pulsed dye laser, Nd: YAG, and Erbium glass can also be used in curing keloids and HTs. The Erbium glass fiber laser appears to be a curative therapy for atrophic scars, stretch marks, and acne scars. Oxyhemoglobin is the goal chromophore of the pulsed dye laser (PDL) that works by making intravascular coagulation and, therefore, the devastation of the microvascular lattice. Hypoperfusion and hypoxemia, therefore, lead to lowered tissue expression of pro-inflammatory factors such as TGF- β1 with each other; increase the effects of antiproliferative factors like matrix metallopeptidases (MMP), extracellular signal-regulated kinase (EPK) and p38 kinase. The mechanism of work of the Nd: YAG laser nearly matches that of PDL. Due to its wavelength (1,064 nm), the depth of penetration of the Nd: YAG laser is so good, an attribute shown to be valuable in the handling of HTs and keloids [7]. The influence of long-pulsed Nd YAG laser in the cure of keloids and HTs generates warmth, which initiates inflammation and lifts vascular permeability, matrix metalloproteinase (MMP) production, and decomposition of collagen fiber fascicle.[8]

Patients and Methods

Study layout

This randomized prospective study was performed in the Medical Laser Center, the National Institution of Laser Enhanced Science, Cairo University. Twenty patients with HTs or keloids yielded from multiple causes (burn, injury, trauma, etc.) were involved in the study and their pre-study approval was obtained for this work. Patients who had already been cured within the past 6 months, those under 18 years and pregnant and lactating patients were excluded from the study. The patients were cured with pulsed- 1064nm Nd: YAG laser. A laser regimen of the HTs or the keloids was performed using a long-pulsed Nd: YAG laser (1064 nm) (Cool Glide Excell; Altus Medical Burlingame, CA) on the lesion a whole. The parameters of laser therapy were made 4 weeks apart between sessions: the power of 45 J, the pulse duration of 5 ms, and the beam diameter of 5 to 10mm.

Clinical Estimation

The echo of the pathological scars to the medication was subjectively evaluated by Vancouver Scar Assessment Scale (VSS), which owned four ingredients; vascularity, pigmentation, pliability, and height. Histological Estimation:To demonstrate the mechanism by which this treatment modality works, punch biopsies were acquired from volunteer patients before treatment as a baseline and after 3 days from termination of the treatment. In addition, the histopathology of the specimens was checked up by hematoxylin and eosin staining (H&E) and Masson trichrome staining.

Results

In this random work, twenty patients with HTs and keloids were involved in the standing work. The average age of patients was 28.40 ± 9.79. The average lesion duration; per month; was 3.60 ± 2.19. The scars were solitary (55%) and denovo (85%) in many patients. According to VSS, there was a considerable improvement in vascularity, pigmentation, pliability, and height than before the treatment. The vascularity was normal before the treatment in 0 (0%), pink in 5(25.0%), red in 5 (25.0%) and purple in 10 (50.0%). After the treatment, the vascularity was normal in 10(50.0%), pink in 10(50.0%), red in 0 (0%) and purple in 0 (0%). There was significant difference (p=0.001).

Before the treatment, the pigmentation was normal in 13 (65.0%), hypopigmented in 1 (5.0%), hyperpigmented in 1(5.0%) and mixed hyper pigmented in 5 (25.0%). After the treatment, the pigmentation was normal in 8 (40.0%), hypopigmented in 6 (30.0%), hyperpigmented in 6(30.0%) and mixed hyperpigmented in 0 (0%). here was a significant difference (p=0.004). Before the treatment, the pliability was normal in 0 (0%), supple in 1(5.0%), yielding in 1 (5.0%), firm in 4 (20.0%), ropes in 9 (45.0%) and contracture in 5 (25.0%). After the treatment, the pliability was normal in 5 (25.0%), supple in 8(40.0%), yielding in 4 (20.0%), firm in 3 (15.0%), ropes in 0 (0%) and contracture in 0 (0%). There was significant difference (p=0.001). Before the treatment, the height was flat in 0(0%), < 2mm in

1 (5.0%), 2-5 mm in 19 (95.0%) and > 5mm in 0 (0%). After the treatment, the height was flat in 4(20%), < 2mm in 10 (50.0%), 2-5 mm in 6 (30.0%) and > 5mm in 0 (0%). There was a considerable difference (p=0.001). The average value of VSS total score pre-treatment was 9.40, and that post-treatment was 3.75, with a significant difference (P=0.001).

Table 1: score of VSS before and after the treatment

		Scope			Mean	±	S. D	t. test	p. value
Tot VSS	Before	4	–	14	9.4	±	2.76	53.545	0.001*
	After	0	–	7	3.75	±	2.07		

Clinical Results

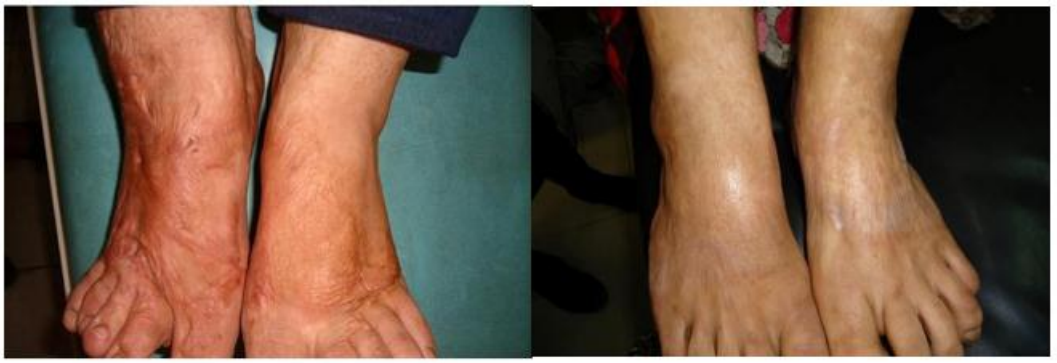

Figure 1: Keloid scar on foot of female patient showed good recovery after treatment

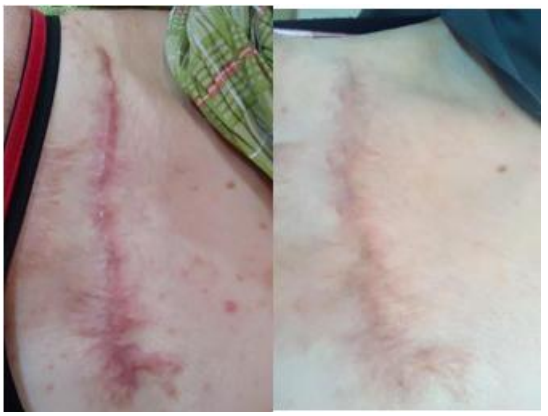

Figure 2: Hypertrophic scar on female patient's chest appeared to have a partial reduction after treatment

Histopathological result

Hematoxylin and eosin staining (H&E) and Elastica Masson-Goldner staining (EM) of keloids and HTs explained that treatment induced a change in the

structure of the collagen of tissue (illustrated in the following pictures). (From figure 3 to 6)

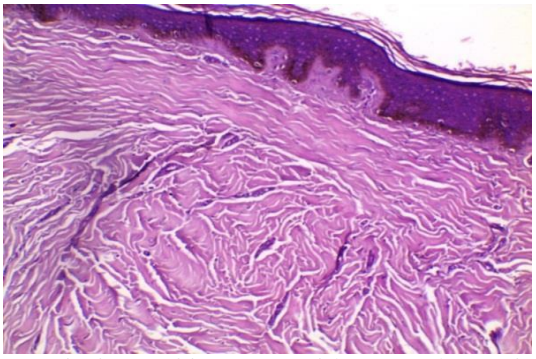

Figure 3: The histopathology of hypertrophic scar tissue before treatment is identified by alteration of the papillary and reticular dermis by lesion tissue with distinguishedperpendicularly oriented blood vessels. The fibrous bundles are analogous and horizontal in the upper dermis. (H&E,200×)

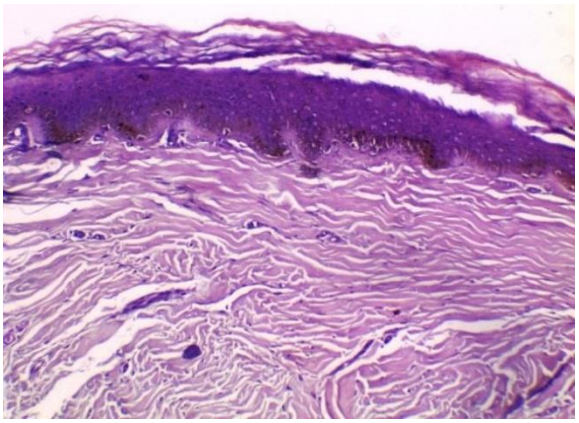

Figure 4: Hypertrophic scar tissue after treatment is recognized by fewer blood vessels, and collagen bundles become more coordinated. (H&E, 200×)

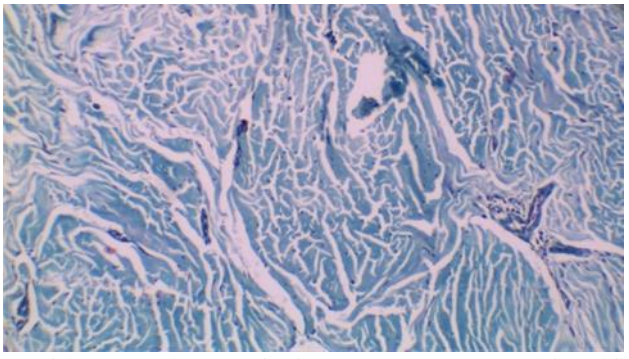

Figure 5: Hypertrophic scar tissues before treatment are identified by horizontal fibrous bundles and parallel with distinguished vertically oriented blood vessels (Elastica masson, 200×)

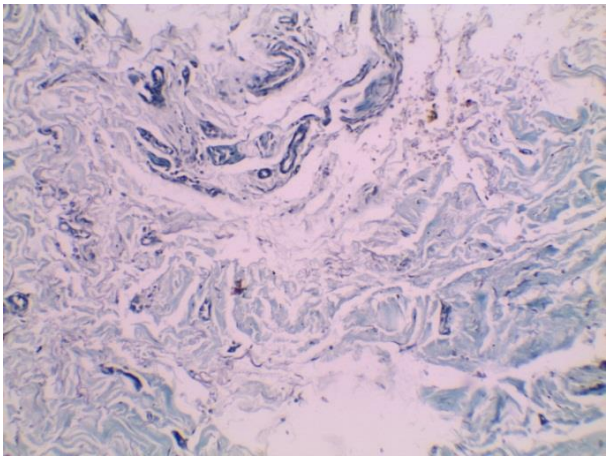

Figure 6: Hypertrophic scar tissue after treatment displayed that wall of blood vessels and collagen bundles became thinner. (Elastica Masson, 200×)

Recurrence

The recurrence rate was 9 (45.0%) in a lesion evaluated after 6 months of termination of the therapy

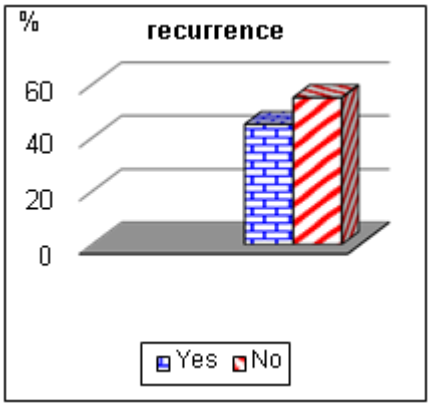

Figure 7: recurrence after the treatment.

Discussion

The deep-seated inflammation recognizes keloids and HTs, and capillary vessels are massive, making erythematous scars. [9]. Pathological scar evolution is probably caused by interactions between mechanical power capacity and inflammation, collagen output, and angiogenesis; this proves that 1064 nm Nd: YAG laser therapy is likely helpful in handling pathological scars. [10] There has been a significant advance in lasers over the last three decades in the treatment of keloids and HTs. The vascular lasers work by getting absorbed by haemoglobin which produces heat and coagulation necrosis resulting in hypoperfusion and tissue hypoxia; this leads to neocollagenesis. In addition, the Nd: YAG laser gets absorbed by the haemoglobion and transforms it into black methaemoglobin, which acts like a chromophore for the Nd: YAG laser

Kumar et al. [11] handled 17 keloids by Nd: YAG laser and proved that 10 scars (58.8%) were treated, and 7 lesions (41.2%) appeared with only a little reduction. Sherman and Rosenfeld; 1988 treated 17 keloids by Nd: YAG laser and said that there were hopeful outcomes in all the keloids. Also, Abergel et al. [12] produced research in 8 patients with keloids utilization Nd: YAG laser and showed perfect outcomes. Numerous laser sessions are recommended for an excellent reaction, but lower fluences are proposed to prevent adverse effects in patients with dark skin. However, some authors have documented that a better tissue response supports higher fluences. [13,14,15] In another review study by Bouzari et al., it was concluded that various lasers are efficient in curing and the prohibition of HTs and keloids. [16]. Akaishi S (2012) [17] said that the average total scar estimation score improved significantly. To conclude, hopeful results have been provided in treating keloids and HTs by the long-pulsed Nd-YAG laser.

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