

*Original Article***Comparing the effects of conventional method, pulse dye laser and erbium laser for the treatment of hypertrophic scars in Iranian patients***Mahmood Omranifard\*, Mehdi Rasti\*\****Abstract**

**BACKGROUND:** Hypertrophic scar is an elevated scar with ugly appearance that isn't acceptable even in reconstructive surgery. Unfortunately, there is no standard and effective treatment for it. Conventional treatments such as corticosteroid injection and garment usage have limited effectiveness. In recent year, laser is suggested for reduction of the volume and height of these scars. But in different studies, different results from very effective to ineffective were reported for this type of treatment.

**METHODS:** This study was a single blind randomized clinical trial that was done on three groups. In each group, 40 patients with hypertrophic scar were included. In group one PDL, group 2 Erbium laser and in group 3 corticosteroid were used. Scar improvement was assessed by the amount of decrease in Vancouver burn scar (VBS) score; the higher the decrease, the better the improvement.

**RESULTS:** Although the mean VBS score significantly decreased in all three groups after treatment, the decrease in mean VBS score in group 3 was significantly lower than the decrease in mean VBS scores of groups 1 and 2 (P values were 0.037 and 0.041, respectively).

**CONCLUSIONS:** Some types of laser such as PDL and erbium can improve elevation and vascularity of hypertrophic scar. These types of treatment can use in hypertrophic scar management when vascularity and elevation of scar are unfavorable.

**KEY WORDS:** PDL, hypertrophic scar, erbium laser, conventional treatment.

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Any change in normal wound healing process can lead to chronic wounds or wound dehiscence; aberrant healing results in hypertrophic scar and keloid formation<sup>1</sup>. Significant scarring causes functional and cosmetic deformities, discomfort and psychological stress. Scar prevention and management, both surgical and nonsurgical, continue to be important issues for the plastic surgeon. Hypertrophic scars are not only disfiguring but also functionally disabling. Previous treatments with different modalities have

shown various responses<sup>2,3</sup>. Injection of corticosteroids, commonly triamcinolone acetonide at 5-10 mg/ml, is a mainstay in the management of hypertrophic scars and keloids and has been used either alone for small lesions or with a combination of pressure therapy or surgical excision for larger lesions. Steroid injections can be commenced at 1 month postoperatively and be repeated every month based on serial assessments<sup>4</sup>. Laser therapy for hypertrophic scars is based on the principle that vascular proliferation plays a key role in the early

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phase of scar formation<sup>5</sup>. Because of the production of collagen and other extracellular matrices, tissue needs nutrients that are normally supplied by new vessel proliferation. This particularly applies to hypertrophic scars, which have enhanced blood flows<sup>6</sup>. It seems that vascular laser can alter the natural history of hypertrophic scars with decreasing blood vessels. Alster used a 585-nm pulsed dye laser (585 nm, 450 μs) and showed the improvement of hypertrophic scars<sup>7</sup> but she only selected light-skinned patients (Fitzpatrick skin type I to III) for her intervention. Laser effects depend on the degree of skin pigmentation, race and kind of laser. The flash lamp pulsed-dye laser wavelength is selectively absorbed by oxyhemoglobin<sup>8</sup>. It destroys blood vessels within target lesions, thus rapidly decreasing size, height and erythema with less damage to surrounding tissues<sup>9</sup>. Kuo et al. were able to demonstrate keloid regression after flash lamp pulsed-dye laser treatment, concurrent with suppression of TGF-β1 expression and increased keloid fibroblast apoptosis<sup>10</sup>. Interestingly, they found that scars with less than 1 year old responded better than older scars<sup>10</sup>. Nevertheless, they did not specify the skin type of their patients. Although many articles have been published on the management of hypertrophic scars, there is no universally accepted treatment protocol<sup>11</sup>. Previous overseas studies have reported success with laser therapy, in only light skin patients and in limited areas. Even some authors believe that laser has not more efficacy compared to traditional methods<sup>12</sup>. Unlike patients with lighter skin types, Iranian patients have different specification. In this study we want to compare the efficacy of three modality treatments (traditional method of corticosteroid injection with two type of lasers N-Lite PDL and Erbium) in Iranian patients.

## Methods

This was a randomized clinical trial carried out on three groups of Iranian patients that were referred to laser clinic by dermatologists or plastic surgeons. Patient who met all of the fol-

lowing characteristics were included in the study: linear erythematous hypertrophic scar of ≥4 cm on the head and neck and less than 1 year old, Fitzpatrick class III and finally, trauma or surgical excision as the etiology of scar. Patients were randomly divided in three groups of 40 patients. Exclusion criteria included patients who had previously been treated with steroid injections, laser therapy, the application of pressure garments or silicone gel sheeting within the past 6 months. This eliminated any residual long-term effects of the above-mentioned treatments. Patients who were not able to afford the charge of laser therapy were also excluded from the study. The study protocol was compatible with the guidelines of the 1975 Declaration of Helsinki and was approved by our institutional review board. The study was explained for the patients, and the possible side effects such as pain in the initial few days, redness, oozing and even the worsening of the scars were clarified for them. Treatment sessions were performed at 4-week intervals for a maximum period of 12 months, but were terminated sooner if the scar resolved or when the patients were satisfied with the improvement or refused any further treatment.

## Treatment protocol

Group 1 treated with N-lite PDL application of 585 nm flash lamp-pumped pulsed dye laser to the hypertrophic scars with max 9 J/cm<sup>2</sup> fluence, a 5-mm spot size and a 1.5-μsec pulse duration. The fluence was decreased to 7.0 to 7.5 J/cm<sup>2</sup> if patients developed blisters after the first treatment session (visible laser radiation class 4). Group 2 received Erbium laser application of 2940 nm and a 0-1 msec pulse duration and repetition of 30 Hz with max 2 j/cm<sup>2</sup> (carl busel BLM 10005). Group 3 received conventional treatment as corticosteroid injection (triamcinolone acetonide at 5-10 mg/ml monthly) and pressure garments<sup>13</sup>.

## Evaluation of the results

To minimize the inter-observer errors, all measurements were done by three trained general physicians throughout the study.

Measurements were performed before each laser therapy or corticosteroid treatment. Gross changes after treatment were evaluated by inspection and photography. All patients were photographed before and four weeks after the last treatment session. Digital Photographs were taken by one photographer with one camera in exactly similar settings such as resolution, magnification and angle. Treatment outcome was evaluated by Vancouver Burn Scar (VBS) assessment scale. Four components were considered as pigmentation, vascularity, pliability and height. Severity of scar was determined by numeric value from 0 as minimum to 13 as the most severe form in this scale<sup>14</sup>. For assessment of pigmentation and vascularity, we used a transparent tool for blanching the scar. A caliper was used to determine the scar height by measuring the maximum vertical elevation of the scar above the normal skin. Other values and complications, such as textural or discoloration (hypo- or hyperpigmentation) and patient satisfaction, were also assessed by a simple questionnaire.

## Results

One hundred twenty patients in three groups were evaluated. Mean age had not significant difference among the three groups ( $P = 0.67$ ). In group 1 (PDL), 31 patients were female and 9 patient were male, in group 2 (Erbium) 33 were female and 7 were male and in group 3 (conventional therapy) 32 were female and 8 were male. The patients' ages ranged from 10 to 35 years (mean of  $27.2 \pm 4.8$ ). The mean duration of scars was  $8.9 \pm 2.6$  (mean  $\pm$  SD) months. Sex ratio, age and duration of scar had not significant difference among the three groups. All patients tolerated the laser and conventional treatment well, and all scars showed clinical improvement after 3 sessions at 4-week intervals in laser groups. No complication such as permanent pigmentary change, ulceration or infection was observed in treatment course. The mean VBS score of scars significantly decreased from  $9.2 \pm 1.7$  to a post-treatment value of  $4.2 \pm 1.6$  in group1; the difference was statistically significant ( $P < 0.01$ ;

paired t test). In group 2, VBS score decreased from  $9.1 \pm 1.7$  to  $4.6 \pm 1.9$  ( $P < 0.024$ ) and in group 3 from  $8.9 \pm 1.9$  to  $6.7 \pm 1.6$  ( $P > 0.043$ ). Before treatment, VBS differences were not significant among the three groups. After treatment, although VBS significantly decreased in all three groups, the differences of mean VBS scores in groups 1 and 2 (laser) with that of group 3 (conventional methods) were significant ( $P$  values were 0.037 and 0.041, respectively). Tables 1 and 2 show the magnitude of improvement in term of vascularity and height in all 3 groups. For both groups of laser therapy (groups 1 and 2), there were significant improvements in scar height after laser treatment. Seventy percent of patients in the PDL laser group and 65% of patients in the treatment group with erbium and 30% in conventional group were considered their scars better or much better after treatment.

**Table 1.** The mean vascularity scores before and after treatment in each group.

Vascularity score	Before treatment	After treatment
Group1	2.3	1.1 ( $P=0.03$ )
Group2	2.4	1.15 ( $P=0.032$ )
Groyp3	2.3	1.95 ( $P=0.53$ )

**Table 2.** The mean height score before and after treatment in each group.

Height score	Before treatment	After treatment
Group1	2.16	1.32 ( $P = 0.023$ )
Group2	2.18	1.39 ( $P = 0.031$ )
Group3	2.18	1.93 ( $P = 0.054$ )

## Discussion

Hypertrophic scar can be disabling for patients because of ugly appearance and creation of social stress. In the past several years, pulsed dye laser has been used for the treatment of hypertrophic scars, based on the principle that the vascular proliferation plays a key role in the early phase of scar formation<sup>5</sup>. The PDL is recently recognized as an excellent first-line treatment option for treatment of hypertrophic

scars, although 5 years ago this treatment option might have been considered a viable choice only after all other methods failed <sup>15</sup>. Many reports are present about effectiveness of PDL but good results in special race patients do not guarantee the same in other races. Also scientific experience of pulsed dye laser in the treatment of keloid and hypertrophic scar resulted in equivocal conclusion <sup>16</sup>. However, few studies have reported that the effectiveness of PDL treatment is limited to alleviation of symptoms such as intense pruritus and it has no beneficial effects on scar redness, height and texture <sup>17,18</sup>. Because of these challenging results we decided to design a randomized clinical trial for assessment of effectiveness of two types of laser on natural history and outcome of hypertrophic scars in Iranian patients and compare the results with that of conventional methods. Alster and Williams performed a controlled study that examined 16 patients with sternotomy scars treated with pulsed dye laser. They detected significant degrees of improvement in terms of color and skin thickness when compared with the baseline and controls <sup>19</sup>. Although others have since demonstrated similar degrees of improvement, such observation is by no means uniform. In another prospective, single blind, randomized, controlled study, 20 patients with hypertrophic scars did not demonstrate any significant degree of improvement of the scar section treated

with silicone gel or pulse dye laser compared to the control section <sup>20</sup>. Chan and Wong evaluated PDL effects on prevention of hypertrophic scar on 56 patients. Their study indicated that although most of the patients reported improvement, objective assessment did not indicate significant changes once the changes in the control sections were taken into consideration <sup>21</sup>. In conclusion, our study of pulse dye laser and erbium in the treatment of hypertrophic scars indicated that laser treatment, both PDL and erbium, can improve scar appearance more than that of conventional methods. Our findings are in line with several previous controlled studies and contradict the results of several others. Such differences can be due to differences in methodology, assessment scale, laser settings and skin type. For example, different laser settings in different studies demonstrated different results. Dierickx et al. <sup>22</sup> did not detect any significant differences in treatment outcome with different flounces of the laser but Reiken et al showed that the higher laser fluence is associated with a better tissue response <sup>23</sup>. However, it seems that some types of laser can improve appearance of hypertrophic scar and can alter natural history of these scars. But we must always clearly explain to the patient the benefits and limitations of laser therapy to realize the patient expectations before treatment.

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