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The efficacy and safety of Er:YAG laser for treatment of atrophic acne scars

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Abstract

Objective: The efficacy of fractional erbium-doped yttrium aluminum garnet (Er:YAG) laser is well substantiated. This study aimed at comparing the efficacy and safety of Er:YAG laser for treatment of atrophic acne scars.

Methods: In this cross sectional study, 150 patients received four treatment sessions with Er:YAG fractional laser at 1-month interval. The laser parameters were kept constant for each of the four sittings in all patients. Qualitative and quantitative assessments were done using Goodman and Barron grading. Subjective assessment in percentage of improvement was also documented 1 month after each session. Photographs were taken before each treatment session and 1 month after the final session.

Results: Most patients showed at least fair improvement. Rolling and superficial box scars showed higher significant improvement when compared with ice pick and deep box scars. Patient's satisfaction of improvement was higher when compared to physician's observations. No serious adverse effects were noted with exacerbation of acne lesions forming the majority.

Conclusion: Er:YAG laser skin resurfacing was found to be a safe and effective treatment modality for treatment of atrophic acne scars.

Introduction

Acne scars are the most common causes of facial scarring. Because the cosmetic discomfort is important for patients, therapeutic approaches seem to be precious and indispensable. Laser skin resurfacing has become a popular treatment modality for patients with atrophic acne scars [1,2]. Years after outgrowing acne, the aftermath of acne scars persists. Advances in acne therapy and dermatologic surgery have made it unnecessary for acne patients, both current and past to endure acne scarring [3,4]. For the lucky majority, acne scarring is a minor annoyance, obvious to the one affected yet difficult for others to see. For some, however, acne scarring can cause devastating long-term emotional suffering [5,6]. Teens may deal with depression, become withdrawn and lose self-confidence. Because 95% of acne patients will develop scarring to some degree, the earlier the treatment appropriate for the severity of the outbreak is initiated, the better the odds are that scar formation will be mild [7,8]. Delaying acne therapy by 3 or more years is likely to increase one's risk of more significant acne scarring. Newer acne therapies make it needless for anyone to suffer from severe acne or develop scarring [9,10]. Early medical intervention is key to preventing unnecessary disfigurement. While this doesn't mean that everyone suffering a solitary blemish or minor premenstrual flare-up should rush to schedule an appointment with a dermatologist [11,12]. Many therapeutic measures such as chemical peeling, subcision, dermabrasion, fillers, and punch techniques have been performed to improve acne scarring but with suboptimal outcomes [13,14]. Although significant clinical improvements can be seen with ablative lasers, adverse effects such as prolonged post-procedure erythema and dyspigmentation impede their widespread use especially in patients with darker skin [15,16]. Erbium: yttrium–aluminum–garnet (Er:YAG) laser treatment was approved for cutaneous laser resurfacing by the US Food and Drug Administration in 1996 [4,5]. Once the surface skin is ablated layer by layer, the skin regenerates with increased collagen production [17,18]. The aim of this study was to compare the efficacy and safety of Er:YAG laser for treatment of atrophic acne scars.

Methods

This cross sectional study was designed using fractional laser resurfacing for the treatment of atrophic facial acne scars in 150 patients in Tabriz special clinic from April 2011 to April 2014. This study was approved by local ethic committee. Written consent was obtained from all the patients. Patients diagnosed with atrophic acne scarring aged 18 years or above were included. Exclusion criteria were patients with infectious diseases (hepatitis B and C, HIV), history of mkeloids or hypertrophic scarring, photosensitivity, unrealistic expectation of the patient and facial laser resurfacing, chemical peels, fillers, or botulinum toxin injection or usage of oral retinoids within the last 6 months. No regimen was prescribed prior to laser therapy. For the anesthesia, topical EMLA cream (Astra Zeneca, UK) was used prior to each laser procedure. After 30 minutes, the topical anesthetic was removed. Eyes were protected with eye shields. All 150 patients received four sittings of laser treatment at 1-month interval. They were treated with fractional ablative resurfacing module using 2940 nm Er:YAG

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handpiece. A cooling device delivering cold air was used to reduce pain sensation during and after treatment. Parameters for each sitting were kept constant in all patients. First and second sessions were performed using 9×9 tips with fluence of 1,200 and 1,400 mJ, respectively. Third and fourth sessions were performed using 7×7 tips with fluence of 1,200 and 1,400 mJ respectively. Long pulse mode (2 Hz) was used for all four sessions. Three passes in vertical, horizontal, and oblique directions with upto 50% overlapping between the adjacent pulses and stacking was done over scar areas where five pulses were given in exactly same place without moving the tip. Strict photo protection was advised as a routine and topical antibiotic-steroid combination was applied for 3 days post-procedure. Qualitative assessment was done using Goodman and Barron (GB) qualitative global scarring grading system which has four grades viz., macular, mild, moderate and severe. Quantitative assessment was done using GB quantitative global scarring grading system. Different types of scars were given increasing scores and multiplied depending on the number of scars in each type giving a maximum score of 84. The patients were asked to quantify their percentage of improvement 1 month after each treatment session and their subjective assessment of improvement of scars was also documented. Serial photographs were assessed by two unbiased, certified dermatologists. Physician evaluations and patient satisfaction were graded on a four-point scale viz., none, fair, good, and excellent improvement The patients were evaluated for the development of side effects including: duration of erythema; itching; pain; edema; vesicles; bullae; erosion; crust; pigmentary changes (hypo/hyperpigmentation); bacterial, viral and fungal infection; acne flare-up; and any other adverse effects at 3 months. SPSS version 16 was used as statistical analysis. In our study, ANOVA was used to test whether there was a significant difference between the means of the data obtained from more than two independent groups. At the end of our study, ANOVA was performed between the data and the datasets. By means of single-factor ANOVA (Student's t-test), the changes were observed. The standard deviation coefficient has been calculated as the measure of the central dispersion, which determines the distance of the available datasets from the mean value. The purpose of the applied statistical method was to clarify the data and was called a "descriptive statistical method". By classifying the data, summary tables were created, and the mean value, standard deviation and dispersion measurements obtained. P<0.05 was regarded as significant.

Results

A total of 150 patients with acne scars participated in the study comprising of 100 males (66.6%) and 10 females (33.3%). Mean age of the patients was 38.12 ± 8.53 years. The duration of scars ranged from as less as 4 months to 18 years. Most patients had grade 4 acne scars constituting 45.3% (68 cases) of the study population followed by grade 2 (40 cases), grade 3 (30 cases), and 12 in grade 1. Superficial box, deep box, rolling, ice pick scars were present predominately in fifty, forty four, forty two, and six cases, respectively. Analysis of covariance was performed and results were evaluated using GB quantitative score-before treatment value of 26.48 as covariate. The difference in mean values between rolling and ice pick scars after adjusting for the GB-before scores at was statistically significant (p=0.032). The superficial box also showed a statistically significant (p=0.036) difference in the mean as compared to the ice pick scar (Table 1). There was no statistically significant difference in the mean values between deep box and ice pick scars (p=0.084). There was no statistically significant variation of improvement with respect to duration as well as grade of acne scars. The patient's satisfaction between first, second, third, and fourth sittings was computed using general linear model. Higher significant improvement was seen after the third sitting with the mean improvement in the GB quantitative score increasing to 16.6 after third sitting. Patient's satisfaction scores were higher in comparison to both observers' rating with a relatively higher proportion of improvement grading in the good and excellent categories (Table 2). The kappa statistic was used to monitor the agreement between observers, patient and observer-1, and patient and observer-2. The observers showed statistically significant substantial agreement between each other (κ=0.58-0.79), whereas the patient's agreement with observer-1 and observer-2 was only slight (κ=0-0.22). Most common side-effect seen after 600 sittings (150 patients×4 sittings each) of Er:YAG 2940 nm fractional laser resurfacing was exacerbation of acne lesions (16%) which was treated with oral antibiotics. Post-treatment pigmentation was seen only in 4% and was effectively treated with demelanizing creams. Prolonged crusting (more than 7 days) was seen after 5% of the sittings. None of the patients had prolonged erythema (more than 4 days) after undergoing treatment sessions. The mean erythema duration was less than 2 days and mean crusting was around 5 days in all sitting, shows the appearance immediately after the laser treatment showing the stamping effect of pixel laser, 1 day post-treatment showing erythema, 3 days post-treatment showing crusting, and 7 days post-treatment with complete clearance of erythema and crusting.

Table 1. Goodman Barron-after treatment scores: using Goodman Barron-before treatment value of 27.60 as covariate.

Scar type	GB score after treatment	P value
Rolling	16.9	0.032
Superficial box	16.24	0.036
Deep box	17.66	0.084
Ice piak	20.32	

GB: Goodman Barron grading score

Table 2. Grading of improvement by patient and observers.

Improvement (%)	Patient	Observer 1	Observer 2
None (0-25)	6	6	
Fair (26-50)	84	114	102
Good (51-75)	42	30	36
Excellent (76-100)	18	0	0

Discussion

Ablative resurfacing needs removal of the epidermis and partial thickness dermis, and is considered by most as the gold standard for pitted scars and some box-car scars. Particular attention was given to acne scar morphology, making ablations over the scar in most of the patients [19,20]. The Er:YAG laser may be used following full-face resurfacing to sculpt and smoothen the edges of the box-car scars. It selectively vaporized irregular surface contours, resulting in a flatter surface. A focused beam of laser ablated the edges of acne scars. The response of the acne scars and feathering was a simple subjective evaluation of whether the response was better or not [21,22]. Low-fluence Er:YAG lasers have been shown to be effective and safe for the treatment of acne scarring, rhytides, and inflamed cystic acne [23,24]. This study demonstrated that Er:YAG 2940 nm fractional resurfacing laser effectively improves acne scars with minimal downtime and a low risk of adverse reactions. After four treatments with Er:YAG 2940 nm fractional laser, 144 out of 150 subjects rated themselves as having at least 25-50% overall satisfaction which was similar to the physicians' grading. The difference in agreement was noticed when observing the number of patients reporting more than 50% improvement (good to

excellent) as compared with the observers' rating. Forty percent of the subjects noticed good to excellent improvement as opposed to 20-24% in the observers. Patients felt better probably because of the additional benefits of fractional laser in decreasing pigmentation, decreasing fine lines, skin tightening, and pore reduction. This is the reason why though the patients had only a fair improvement after pixel laser, they felt the laser's efficacy to be good or excellent. Although laser therapy has become the first choice for many dermatological conditions, evaluations of laser systems for the treatment of atrophic scarring have been limited. Moreover, no objective study criteria have been used to determine the degree of improvement produced by laser treatment. Tay *et al*. reported mild to moderate clinical improvement in all patients 2 months after minimally ablative Er:YAG laser treatment (6-mm spot size, 400 mJ fluence, 300 msec pulse duration and a repetition rate of 2 Hz) [25]. Jeong *et al.* reported that resurfacing with a long-pulse Er:YAG laser is a safe and very effective treatment modality for atrophic acne scars. The investigators noted the results of clinical improvement as follows: excellent in 10 patients (36%), good in 16 patients (57%), fair in two patients (7%) and a 71% clinical improvement on average.26 Kutlubay *et al*. treated 128 patients (53 male, 75 female) aged 22-42 years (mean age, 29.3) with atrophic facial acne scars with Er:YAG laser in a Turkish population. Their treatment parameters were a 6-mm spot size, 0.6-1.7 J fluence, 350 msec pulse duration of and a repetition rate of 8-10 pulses/s. At 3 months after the treatment, moderate to good clinical improvement was noted in most of the patients compared to baseline. Results were reported as excellent in 18 patients (14.1%), good in 67 patients (52.3%), moderate in 40 patients (31.3%) and minimal in three patients (2.3%) [27]. Our results compare favorably with those studies. The controlled thermal damage applied by the physician in the dermis during laser resurfacing triggers the formation of new collagen. Also, the release of basic fibroblast growth factor is increased, while the release of transforming growth factor-b1 is decreased. The healing of acne scars are eventuated with those mechanisms [28,29]. Post-inflammatory hyperpigmentation (PIH) was the most common side-effect as observed by Manuskiatti *et al.* in most patients [30]. In our experience, PIH was low (4%) in Er:YAG ablative fractional resurfacing, suggesting that it can be safely performed in iranian skin. Our findings were consistent with that observed by Hu *et al.,* where also the incidence of PIH was less, seen only in 3% of the cases in 34 patients with Fitzpatrick skin types III and IV using ablative fractional Er:YAG laser [31]. Downtime was also acceptable in our study with mean value less than 7 days in all four sittings. Prolonged erythema was seen in none of the sittings and only 5% showed prolonged crusting. Exacerbation of acne lesions was the most common adverse effect of fractional laser in our study which developed after 16% of the sittings which could be due to the steroid-antibiotic cream used for 3 days after treatment. This was comparable to the observations by Hu *et al.* in his study of 34 patients using Er:YAG laser for atrophic facial acne scars in Asian skin where acne eruption was seen in 24.2% of patients [31].

Conclusion

Ablative fractional photothermolysis is both effective and safe treatment for atrophic acne scars in Iranian skin.

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