ORIGINAL RESEARCH REPORT

Treatment of atrophic facial acne scars with fractional Er:Yag laser

MUHSIN AL-DHALIMI1 & AKEEL JABER2

1Department of Dermatology, Faculty of Medicine, University of Kufa, Njaf, Iraq and 2Department of Dermatology, Faculty of Medicine, University of Al-Qadysia, Ditoanya, Iraq

Abstract
Background: Acne scars are often a permanent disfiguring sequel of acne vulgaris. Although many treatment modalities are available, they are often non-satisfactory for all patients. Objective: To determine the effectiveness and safety of fractional 1540 nm erbium_glass laser treatment of facial acne scars in Iraqi patients. Patients and methods: Twenty one patients were enrolled in this prospective clinical study. Three sessions of the 1540 nm erbium glass laser were applied at 2-week intervals. The patients were assessed at 1, 3, and 6 months after the last session. The effect of treatment was assessed by objective (Sharquie scoring system for grading acne scarring and visual analog scale) and subjective (patient satisfaction) methods. Results: Two patients were defaulted. Eleven patients (57.9%) showed improvement from moderate to mild grade, and no grade changes were detected in eight patients (42.1%). The mean score of the visual analog scale prior to treatment was 8.61 ± 0.86 and decreased to 6.15 ± 1.28 (P = 0.037). Ten patients were satisfied to varying degrees. No significant side effects were noted. Conclusion: Non-ablative fractional 1540 nm erbium glass laser is an effective and safe method to treat acne scars and represent good alternative for patients who cannot use the ablative methods because of its longer downtime.

Key Words: lasers and light sources, surgery, Er:YAG laser, acne scars

Introduction

Atrophic acne scars are a common issue associated with acne vulgaris. They often cause significant disfigurement, especially on the face (1). The morphology and depth of acne scars varied from simple depressed “rolling” to deep “boxcar” and “ice pick” types (2,3). The depressed acne scar is the most common cosmetic concern and can be improved by many modalities, with varying degrees of success (1). Effective treatment of facial acne scar with current therapeutic modalities presents a major clinical challenge. Numerous approaches have been implicated to cure acne scarring, including surgical techniques such as subcision, punch grafts, excisions, and additional methods such as autologous fat transfer, injection of dermal fillers, dermabrasion, and chemical peels (4,5). Laser resurfacing is also an effective treatment that is easier to use than other treatment modalities (6). Ablative skin resurfacing with CO2 or erbium lasers is regarded as the standard method for laser intervention of atrophic acne scars (7). Even though, ablative lasers are efficient in recontouring the skin and improvement of scar feel, management measures using these lasers have been restricted by significant downtime, lengthened erythema, and unwanted adverse effects including postinflammatory hyperpigmentation, hypopigmentation, and scarring (8). Non-ablative lasers, on the other hand, generate dermal heat through variable absorption of the three main dermal chromophores: water, oxyhemoglobin within dermal vasculature, and melanin-containing structures such as hair follicles. This approach involves a restricted thermal damage to the dermis, with consequent neocollagenesis and remodeling of scarred tissue (9–15). This is evidenced by post-treatment histology and increased levels of dermal collagen N-terminal propeptide, collagen types I and II, elastin, and collagenase (MMP-1) (16). Most of these lasers use cryogen or contact cooling to achieve selective dermal heating while sparing the epidermis (17), and thus reduce adverse effects and almost leave no downtime (18).
1540-nm erbium glass laser is absorbed efficiently by water, but minimally by melanin. Its primary depth is within the papillary dermis where collagen tightening and neocollagenesis are achieved. Treatment with this type of laser results in progressive improvement and long-term benefit (17).

The purpose of the present work was to investigate the clinical outcome and safety of 1540 nm erbium-glass laser in treating of acne scars on the face of Iraqi patients.

Patients and methods

This prospective clinical trial study was carried out in the Laser Research Unit, Faculty of Medicine, University of Kufa between October 2012 and October 2013. Twenty-one patients (10 males and 11 females) who were randomly from the outpatient clinic and had bilateral, asymmetrical depressed acne scars on the face were enrolled in this study. The enrolled patients had mild to moderate atrophic acne scars without new active acne lesions. The age range of patients was 20–45 years with a mean $\bar{x} \pm SD$ of 27.61 $\pm$ 7.00. Exclusion criteria included the presence of prior therapy with isotretinoin in the last 6 months, filler substance injection or dermabrasion within previous year, personal history of hypertrophic scar and keloid formation, pregnancy, and lactation.

A full medical history was obtained from each patient including name, age, sex, lesion site, occupation, marital status, age of onset, and duration. Medical, drug, and family histories were also reported. Complete physical examination was performed to assess the site, type, and number of the lesions. Grading was completed for all patients enrolled in the study following the Sharquie system for grading scarring acne vulgaris (Table I).

The treatment procedure and the need for pre- and post-treatment photographs were fully described to each patient and informed consent was obtained. Further, this work got approval from the ethical scientific committee of Dermatology and Venereology of the Faculty of Medicine- University of Kufa.

Treatment

Twenty-one patients were treated with fractional 1540 nm erbium glass laser (Mattise, Quanta System SPA, Italy) with fluence of 6.9 J/cm², flat hand piece, spot size of 10 mm, and pulse duration of 7 ms with repetitive rate of 1 Hz. Each patient was treated for 3 sessions at 2-week intervals. For each session, overlapping pulses were delivered to scan the affected area horizontally, vertically, and obliquely. No local anesthetic was needed during laser therapy.

Patients were instructed to avoid sun exposure as much as possible throughout the study, and were instructed to use sunscreen for the exposed treated areas. Patients who complained of discomfort and persistent redness were prescribed 1% hydrocortisone skin cream combined with fucidin cream twice daily until discomfort ceased.

Clinical data regarding improvement of the acne scar were assessed prior to each treatment session, and to 1, 3, and 6 after the last treatment.

Evaluation

All treated patients were evaluated objectively and subjectively with regard to their response to treatment by the following methods:

Objective methods

Sharquie score for grading scarring acne vulgaris. This system gives a score ranging from 5 to 20 points as follows:
- Mild (5–9) points
- Moderate (10–14) points
- Severe (15–20) points

2-Photographic assessment

Color photographs for each patient were taken in the same place with fixed illumination and distance at the base line, 1 month after the third treatment session, and at 6 months from last session using a Sony-digital, high sensitivity, 9.1 mega pixel, DSC-HX1 still camera. The photographs were blindly assessed for degree of improvement using a visual analog scale from 0 to 10 at study completion by two independent dermatologists.

Subjective methods

Patient satisfaction. This method depended on recording the degree of patients’ satisfaction regarding

<table>
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<tr>
<th>Table I. Sharquie score (19).</th>
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<tr>
<td>Score parameter</td>
</tr>
<tr>
<td>1 No. of scars</td>
</tr>
<tr>
<td>2 Area involved</td>
</tr>
<tr>
<td>3 Type of scars</td>
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<td>4 Color of scars</td>
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<td>5 Effect on psyche</td>
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the improvement of acne scars during the course of intervention and graded from 0 to 3 as follows:

Grade 0: not satisfied.
Grade 1: moderately or partially satisfied.
Grade 2: greatly but not fully satisfied.
Grade 3: fully or completely satisfied.

Statistical analysis

Statistical analysis has been done by using SPSS (statistical package for social sciences) version 17 establishing \( P < 0.05 \) as the lowest limit of significance. Paired T-tests were used to compare between the results before and after treatment.

Results

Two patients were defaulted during the present work after the first laser application due to schedule conflicts, and the remaining 19 patients completed the study. The baseline grade of acne vulgaris scarring was moderate in all participants (Table I). Eleven patients (57.9%) improved from moderate to mild, and no grade changes were observed for the other eight patients (42.1%).

The mean score value of the visual analog scale of photographic assessment before treatment was 8.61 ± 0.86, which decreased to 6.15 ± 1.28 after treatment, representing a statistically significant difference \( (P = 0.037) \) (Figures 1 and 2).

Furthermore, 6 months after the last treatment, 4 patients (21.4%) reported being greatly satisfied regarding the results of their treatment, 6 patients (31.6%) were partially or moderately satisfied, while 9 patients (47.3%) reported no satisfaction.

No significant side effects apart from mild erythema and burning sensation were noted after treatment session.

Discussion

Acne scarring is a common clinical challenge for the affected patients. When severe, it may cause great cosmetic and psychological embarrassment to affected individuals. Many interventions have been used to improve acne scars, including surgical methods (punch graft, punch excision, and subcision), resurfacing techniques (dermabrasion, ablative laser treatment, and chemical peels), non-ablative laser treatment, autologous fat transfer, and injection of dermal fillers. In spite of that, treatment of acne scarring is still a challenging condition for many dermatologists, emphasizing the need for improved methods to effective treatment.

Fractional photothermolysis, used for the first time by Manstein et al. (20) in 2004, is a great addition for the improvement of the acne scarring. This technique produce multiple non-contiguous columns of thermal insult leading to a characteristic injury.
patterns called microthermal treatment zones (MTZ), and sparing the tissue around each MTZ. Because healthy tissue is spared, this method promotes rapid epidermal proliferation and dermal collagen remodeling. Although there are some complications associated with this approach similar to other ablative techniques, they look to be less severe due to the discriminating spare of tissue adjacent to the MTZ, rather than entire ablation (7). In the present study, we evaluate the effectiveness and safety of a non-ablative fractional laser device (1540 nm erbium glass laser) for the treatment of acne scars in Iraqi patients.

The results of the present study encourage the use of the 1540 nm erbium glass laser as a safe and effective treatment for facial atrophic acne scarring. We report scar improvement in all enrolled subjects with little discomfort and no downtime. There was a statistically significant difference in objective scores regarding number, type, and color of scars before and after treatment, as well as a positive effect on psyche. These changes persisted up to 6 months following the final treatment session.

The differences in treatment protocols as well as in the evaluation scales used to determine the severity of acne scarring in many clinical trials make it difficult to compare efficiency of the different fractional lasers existing for treatment of acne scars. Additionally, the most recent results of non-ablative dermal remodeling have traditionally been limited by small sample size, lack of control, and lack of objective measurements. We aimed to overcome these conflicts by increasing the patient number and incorporating the use of an objective scale to assess improvement. The use of the Sharquie scoring system, a new objective standardized scale for grading acne scars provided a more solid objective assessment than reported for other studies. The use of a visual analog scale performed by more than one independent dermatologist, allowed for the determination of scar improvement by assessment of each patients’ photographs greatly limited observer bias. This is supported by a previous study (21) that assessed clinical improvement using a more broad quartile grading scale prior to and 12 weeks after the last session (Grade 1, 25%; Grade 2, 25–50%; Grade 3, 51–75%; Grade 4, >75% improvement). Their results showed a mild to moderate change in enrolled individuals (mean score: 2.75).

Using a 10-point grading scale to assess scar texture, Hedelund et al showed that prior to treatment, scars were moderately atrophic and uneven in consistency (median score 6.5). However, 12 weeks after the last treatment, scars appeared mild, even, and smooth (median score 4.5; \( P = 0.016 \)), in agreement with our results (22).

Further, photographic assessment by a visual analog scale showed that the 1540 nm erbium glass non-ablative laser served as an effective method for treating acne scars, as indicated by the statistically significant decrease in score after its use, providing an additional objective scoring approach. The results of photographic assessment from the previously published studies showing significant clinical improvement is consistent with our results.

Our means of subjective assessment utilizing the patient satisfaction scores revealed that slightly more than half of the patients were satisfied to varying degrees. Six patients from the remaining study group that reported being unsatisfied with the results of this treatment method perhaps points to the cultural expectation often observed in Iraqi patients of the need for complete cure, rather than recognition of improvement. Conversely, Kwang Ho Yoo et al determined in a previous study that all the patients indicated satisfaction with the results of their treatment and stated that they would undergo treatment again. This satisfaction indicated a great effect of the improvement of their facial appearance on their psyche, which was dramatically adversely affected prior to intervention (21).
The 1540 nm wavelength used in the fractional non-ablative photothermolysis done in this work interact with water in the tissue as chromophore. As the stratum corneum contains little water, it gets minimal dysfunction after treatment with this type of laser. This may greatly reduce the probability of infection or other adverse effects.

Despite the rarity of side effects with this treatment modality, another study reported that some patients developed bullae, crusts, and pain in the irradiated region (22) because of the higher fluence levels in three to four passes, requiring administration of anesthesia. Our study, however, did not require topical anesthetic cream because this laser device had cooling plate at the hand piece with different grades of cooling.

Although the specific optimal parameters have not yet been fully determined for the 1540 nm fractional non-ablative laser for treatment of acne scars, we suggest that the depth of penetration be maximized (high energy) and the MTZ be decreased (low density). It is possible to minimize the skin’s unnecessary bulk heating to reduce the side effects.

The simple procedure described here does not require extensive preparation, topical anesthesia, and is not complicated by infection, hypo-, or hyperpigmentation as often observed in other treatment modalities such as chemical peel, dermabrasion, and subcision. The effects of delayed, long lasting, ongoing collagen remodeling continue well beyond the last treatment session, perhaps indicating a need for longer follow-up past 6 months. A limited number of patients and the unavailability of more sensitive methods to detect the collagen remodeling, such as skin biopsies, may be a limitation in our study. However, the new objective method (Sharquie scoring system for grading scarring acne vulgaris) and visual analog scale used for evaluation of improvements in facial acne scars, provide strong support for our results.

This study demonstrated that a non-ablative 1540 nm fractional laser is an effective and safe way to treat acne scars in Iraqi patients, and could be used for individuals who look for good cosmetic results and avoid the longer downtime associated with traditional ablative methods. Our work supports the need for more extensive clinical trials to assess the persistence of the attained results.

Declaration of interest: The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper.

References