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Efficacy and Safety of Using a Fractional Picosecond 1064-nm Laser for Treatment of Atrophic Acne Scars in Asian Skin Types

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Introduction

Acne Scars are the most likely to develop after healing inflammatory acnes which often create physical and psychological impact (1, 2). Many modalities have efficacy to treat atrophic acne scars but still be reported complications such as post-inflammatory pigmentation abnormalities and scarring (3, 4). Currently, ablative fractional laser resurfacing (AFR) with different types of source become popular, with a great deal of fewer side effects and shorter recovery times than conventional laser (5, 6). Even though thermal injury produced by AFR can stimulate collagen synthesis and remodeling (7), it also can cause the post-inflammatory hyperpigmentation (PIH), especially in dark skin types (6, 8).

Picosecond laser received The Food and Drug Administration (FDA) approved for removing tattoos (9, 10), pigmented lesions (11, 12), wrinkles (13) and also acne scarring (14). Because of the ultra-short pulse duration quality in picoseconds range, it can deliver significant photoacoustic effect and less photothermal effect (15). The development of diffractive lens array (DLA), an optical hand piece for picosecond laser, can redistribute high fluence of energy into focus low influence background, thus reduce collateral damage (16). High energy cause the production of laser-induced optical breakdown (LIOB) (17, 18), inducing stimulation of dermal collagen production. Although, some studies have been demonstrated efficacy of using picosecond 755 nm laser for treatment acne scar (14, 19), but studies in 1064 nm wavelength are still limited. Nowadays, there is picosecond 1064-nm with fractional lens array, which can be used as ablative fractional laser resurfacing (AFR) and deliver high energy, novel reduce risk of adverse events especially PIH, due to less heat production.

This is the first study to evaluate the efficacy and safety of using fractional picosecond 1064-nm laser for the treatment of atrophic acne scar as a fractional ablative laser in Asian patients.

Materials and Methods

Target Population

This prospective, evaluator-blinded, therapeutic trial enrolled 10 Asian men and women age between 18 and 50 years with Fitzpatrick skin types III through V and mild to moderate atrophic facial acne scars, grading by Qualitative scarring grading system (19). Patient had to be otherwise healthy without active acne, pregnancy, lactation, history of active or systemic infections, skin cancer, keloid or hypertrophic scar formation, hypersensitivity to lights or recent isotretinoin use in the past 6 months and any facial surgeries. Patients who have history of resurfacing procedures such as laser, medium, or deep chemical peel to the face within the previous 6 months were also excluded.

Study protocol was approved by Human Ethics committee Thammasat University (Faculty of Medicine) including Human Ethics committee Samitivej Sukhumvit hospital, and conducted according to the current versions of the Declaration of Helsinki. All patients were provided written informed consents.

Laser Treatment

Our study was performed at dermatology clinic, Samitivej Sukhumvit hospital. Before treatment, each patient face was cleaned by gentle cleanser and applied topical anesthetic cream (EMLA®; AstraZeneca, Wilmington, DE, USA) for 40 minutes with occlusion.

After that, picosecond 1064-nm laser with fractional lens array (Discovery PICO®; Quanta system S.p.A., Samarate (VA), Italy) was used with same standardized parameter for all patients. Two passes of laser treatment were applied to whole faces of all patients with fixed spot size of 8 mm, fluence of 0.8 J/cm^2 and repetitive rate of 5 Hz. The clinical endpoint will be moderate erythema. Cooling device was used during the laser procedure. Every patients received one treatment session.

Immediate after treatment, all patients were asked to determine their level of pain by using the visual analogue scale (0-10) and level of burning and stinging sensation (0-10). For post-operative care, patients were advised to avoid sun exposure and to use a broad-spectrum sunscreen and moisturizing cream on treated areas.

Outcome Measurements

Efficacy

Treatment results were objectively assessed by clinical photographs which captured before (baseline), 1 month and 3 months after treatment from five angles at full frontal (0^o), profile from the left (45^o and 90^o) and from the right side (-45^o and -90^o) by using digital camera. Photos were standardized in magnification, lighting and positioning. Two blinded dermatologist evaluated improvement in (1) skin texture and (2) atrophy by using 5-point quartile grading scale from 4 to 0, 4=excellent improvement (76-100%), 3=significant improvement (51-75%), 2=moderate improvement (26-50%), 1=slight improvement (0-25%) and 0=no change (0%).

Patients were also asked to grade the overall satisfaction score using a 5-point scale (4=extremely satisfied, 3=moderately satisfied, 2=slightly satisfied, 1=not satisfied and 0=dissatisfied) at 1 month and 3 months after treatment.

Safety

Tolerability of the treatment were quantified immediately post-procedure. All subjects were asked to determine their level of pain by using 10-point visual analog scale and level of burning/stinging sensation which was also grading in 10-point scale.

Adverse events after treatment (erythema, edema, petechiae, dyschromia, PIH, infection, oozing and crusting) were evaluated by single physician immediate after treatment, at 1 week, 1 month and 3 months after treatment and were recorded as patient adverse event data.

Statistical Analysis

In this study, the descriptive data were presented as mean values with standard deviation, SD. The Wilcoxon signed rank test were used for two paired comparisons. *P* value < 0.05 were considered significant.

Results

Ten Asians with Fitzpatrick skin types III through V were enrolled, with 3 patients (30%) categorized as having Fitzpatrick skin type III, 4 patients (40%) as having skin types 4 and the rest as having skin types 5. Six women and 4 men with mild (3 patients) to moderate (7 patients) atrophic acne scars were all completed the study. Patient age ranged from 23 to 37 years, with a mean age of 29 years. Fifty percent of patients have only rolling scar type, while mixed type of rolling and boxcar scars was 40% of patients. Only one patient has combination of ice pick, boxcar and rolling scars.

Efficacy Evaluated by Physician

At the 1 and 3-month follow-up, average physician improvement scores for atrophy grading by 2 blinded dermatologists were 0.4±0.37 and 1.2±0.45, respectively. Improvement significantly progressed from the 1-month follow up to the 3-month follow-up (*P*-value 0.005). At 3-months follow-up, 30% of patients were graded 26-50% improvement in atrophy of scars (Table 1). For skin texture, significant improvement (*P*-value 0.006) from the 1-month follow up (average texture improvement 0.3±0.35) to the 3-month follow-up (average texture improvement 1.5±0.51) were noted correlating to improvement in atrophy (Figure 1, 2).

Table 1 Average Physician Evaluation of Texture and Atrophy from Clinical Photographs taken at Baseline, 1 and 3-months Post-Treatment

	1 month post-procedure physician assessment	3 months post-procedure physician assessment	*P*-value
Atrophy	0.4±0.37	1.2±0.45	0.005
Texture	0.3±0.35	1.5±0.51	0.006

Figure 2. Blinded Photoscoring for atrophy and skin texture. The improvement in atrophy is correlated to the improvement in skin texture.

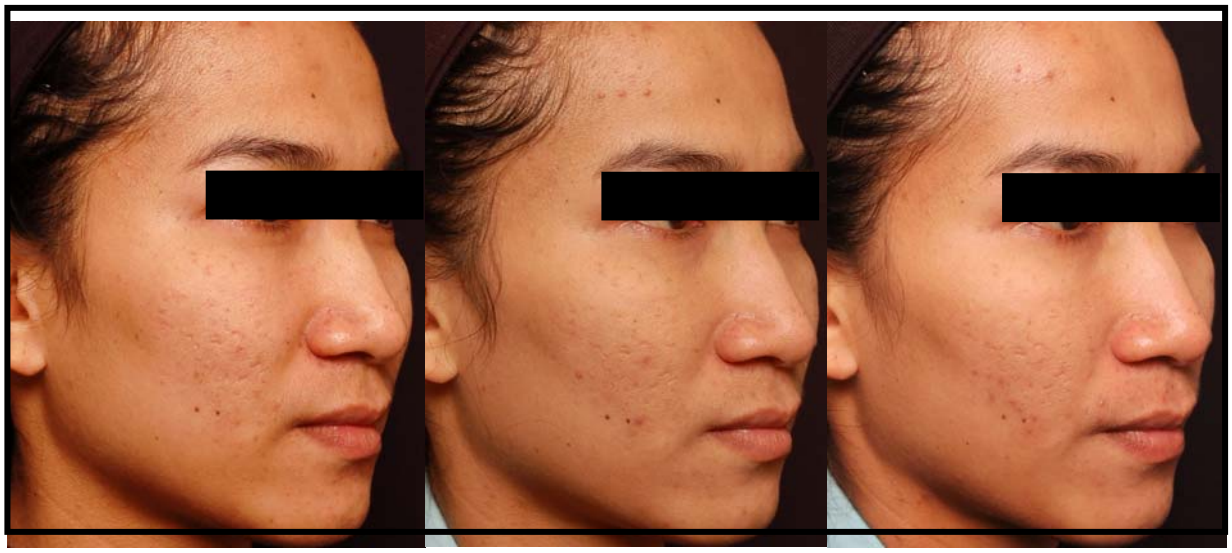

Figure 3. Clinical Photograph taken before treatment and at 1 and 3-month follow-up. Notice reduction of scar volumes and improvement in overall texture**.**

Efficacy Evaluated by Patients

Overall patient satisfaction ratings (0-4) indicated that 10%, 30% and 50% of patients were extremely satisfied, moderately satisfied, and slightly satisfied, respectively, with their results. This was sustained at 3-month follow-up, where 20% were extremely satisfied, 10% were moderately satisfied and 60% were slightly satisfied. The mean patient satisfaction scores at 1-month follow-up was equal to 3-month follow-up (2.4±0.6).

Evaluated of Safety

Immediate post treatment erythema, presented in all patients, were graded as mild (10% of patients) to moderate (90% of patients) severity. Pinpoint skin hemorrhage and mild degree of edema were also noted in 100% of patients. At 1-week follow-up, the patients who had erythema were left only 30% (10% had mild erythema and 90% had trace erythema) and diminished to 0% at 1 and 3-month follow-up. No report of petechiae, edema, dyschromia, PIH, oozing or crusting from patients at 1 week, 1 month and 3-month post treatment. No sign of skin infections were observed throughout the experiment.

The pain scores rated by patients immediate after treatment ranged from 0.5 to 4. The average pain scores were 2.1±1.12. While the average burning and stinging scores were 1.5±1.13 (ranged from 0-5).

Discussion

Picosecond 755-nm laser was found to be effective in removing tattoos (9), treating pigmented lesions (11), photoaging (20), wrinkle (13), and acne scarring (14). Also, it has been proved the safety for use in the dark skin types (21).

This prospective study of 10 subjects were the first study to demonstrated results of fractional picosecond 1064-nm laser for treatment of atrophic acne scars in Asian skin types. Laser treatments were performed safely in individuals with Fitzpatrick skin type III through V. The mean pain scores (2.1) and burning and stinging scores (1.5) indicated that the procedures were well tolerated by patients. Adverse events found throughout the experiment were post-operative edema, erythema and pinpoint hemorrhage that were decrease in 1 week after treatment. No serious side effects were reported in this study.

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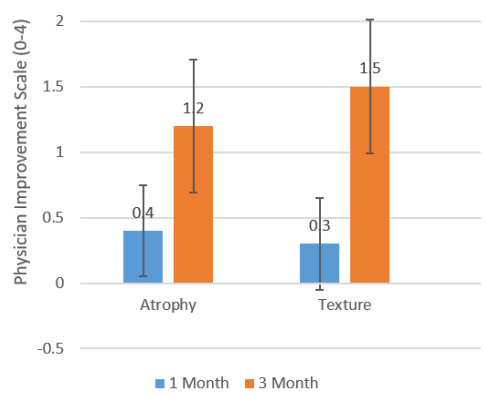

Clinical studies, using subjective measurements, suggested that picosecond 1064-nm laser can be used effectively in mild to moderated atrophic acne scars and maintain the improvement to 3 months after treatment. Delivering high energy, this device could novel produce photoacoustic wave rather than photothermal effect to minimize risk of developing complication, while altering collagen and stimulating wound healing process. This correlated to the previous studies, purposed by Bruaer al.(14), which effectively use picosecond 755-nm alexandrite laser as non-ablative laser for treatment of

atrophic acne scars. In their study, the clinical efficacy was revealed as the increase of elastic fibers density and the increase of dermal collagen and mucin deposition.

Our study was limited by a treatment session of only 1 session, small sample size, and lack of a control (split-face design), objective assessment and histological analysis.

Conclusion

The fractional picosecond 1064-nm laser is a safe and effective modality for acne scars management. Larger sample size, comparative study and histological analysis may be necessary for the further studies.

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