

Cutaneous Resurfacing of the Pitted Acne Scars with the Erbium: YAG laser in 100 Patients

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Background : Laser resurfacing of cutaneous scars, rhytides, and photodamaged skin has become very popular. Pulsed erbium:YAG laser resurfacing has recently come into favor for the treatment of pitted acne scars.

Objective : This study was designed to investigate the efficacy and safety of pulsed erbium:YAG laser in cutaneous resurfacing of pitted acne scars.

Methods : 100 patients with pitted acne scars were enrolled in this study. All patients were treated by means of a pulsed erbium:YAG laser with a 2 mm handpiece at the setting of 500 to 1000mJ/pulse and fluences used varied between 5-15J/cm². Photographs of the face were obtained at baseline and 2 week postoperatively. Two weeks after treatment, postoperative care such as applying hydroquinone 4% and tretinoin 0.05% was recommended for 2 to 4 weeks.

Results: Out of 100 patients, 20% of patients showed an excellent response, 50% a good response, 21% a fair response and 9% a poor response. After 6 months, erythema had developed in two patients and and three patients had developed postinflammatory hyperpigmentation, hypopigmentation and delayed contact dermatitis.

Conclusion: Treatment with pulsed erbium:YAG laser shows high efficacy and low morbidity in pitted acne scar resurfacing. (Ann Dermatol 13(2) 71~75, 2001).

Key Words : Erbium:YAG laser, Pitted acne scar

Laser resurfacing of the face is a very popular, safe and efficacious method for improving acne scars, photodamaged skin and rhytides. In the past, dermabrasion and chemabrasion have been used for these purposes. In recent years, the high energy, short-pulsed carbon dioxide laser became a popular method for these purposes. Nevertheless, the operator's inexperience and the aggressive use of these instruments has shown to have increased the risk of adverse effects including prolonged recovery time, persistent erythema and pigmentary changes. Due to their side effects, there

are limitations in using this laser. Multiple studies have been published describing that the Er:YAG laser has more beneficial effects than the high energy, short pulsed CO₂ laser.

The Er:YAG laser, with a wavelength of 2940nm produces laser irradiation in the mid infrared invisible light spectrum, and is absorbed by water 10 times more readily than the CO₂ laser(wavelength 10,600nm).^{1,2} The ablation threshold for Er:YAG laser has known to be 1.5J, as compared 4 to 5J for the high energy, short-pulsed CO₂ laser. Also it ablates the tissue about 2μm/J/cm²/pulse. The thermal relaxation time is 50 μs for the Er:YAG laser and 1 msec for the CO₂ laser. The thermal injury is 5 to 10μm for the Er:YAG and 20 to 60 μm for the CO₂ laser.^{1,2,5,6,7} These features of the Er:YAG laser make possible both precise, superficial resurfacing of the skin and well controlled tissue ablation. Our experience with the Er:Yag laser had given us great satisfaction and also to the patients.

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Table 1. Results of resurfacing with a pulsed erbium:YAG laser for pitted acne scars

Improvement	No. of patients
<25 %	9
25- 50 %	21
50- 75 %	50
< 75 %	20

The purpose of this study is to evaluate the efficacy and safety of pulsed Er:YAG laser and to report our clinical experiences.

MATERIALS AND METHODS

One hundred patients with pitted acne scars were included in this study. There were sixty-six females and thirty-four males (Fig 1A, 2A, 3A). The patients' ages ranged from 16 to 36 years, with the mean age 23.4 years. All patients have Fitzpatrick skin phototypes III and IV. Prior to the laser surgery, all patients were encouraged to apply 0.05% tretinoin cream to the treatment area once daily for 2-4 weeks. Topical EMLA cream (2.5% lidocaine and 2.5% prilocaine hydrochloride; Astra, Westborough, Mass) was applied to the treatment area 1 hour before surgery. In addition, in some patients, local infiltration with 1% lidocaine with epinephrine (1:100,000) was used. The utilized laser was Er:YAG (Derma™ 20; ESC Medical Systems, Haifa, Israel), which produces a wavelength of 2940nm, pulse duration of 350microseconds, and a spot size of 2-5.0 mm. All patients were treated with a 2-mm hand piece at the setting of 500mJ-1000mJ/pulse and 5-15 J. Smoke evacuator was utilized to aspirate the airborne white ablated tissue. Saline-soaked gauze was utilized to remove tissue debris and to rehydrate the tissue.

The appropriate end point of stopping Er:YAG laser resurfacing procedure was decided when noticing the bleeding on the treated area, which happened after four to six passes. Postoperative wound care consisted of a topical antibiotics and an occlusive dressing with vasaline gauzes. Dressings were changed every 48 hours for 7 days. All treated patients were given oral levofloxacin 100 mg and prednisolone 10 mg three times and oral acyclovir 200mg five times daily for 5 days starting on the day of surgery. Two weeks after treatment, hydroquinone 4%, tretinoin 0.05% and hydrocortisone 1% cream was recommended for another 2-4 weeks. All patients were photographed

before treatment and 2 week intervals postoperatively. The results were evaluated for the changes of skin texture and color at 2 weeks, 1 month, 3 months and 6 months. All pictures were evaluated by two different blind observers who had to determine the before and after pictures, and had to categorize the quartile scale of improvement as follows: 0, poor improvement; 1, fair improvement; 2, good improvement; 3, excellent improvement. For histologic evaluation, skin biopsies were obtained immediately, at 2 weeks and 1.5 months after laser treatment in five patients.

RESULTS

In 100 patients treated with Er:YAG laser, 9 patients showed poor improvement (9%), 21 patients showed fair improvement (21%), 50 patients showed good improvement (50%), and 20 patients showed excellent improvement (20%) after 6 months of laser treatment. Erythema on the irradiated area appeared and was aggravated after use of hydroquinone, tretinoin and hydrocortisone cream in all patients. But the erythema had gradually disappeared within two months after discontinuing the topicals. After three months of laser treatment (Fig. 1B, 2B, 3B), mild erythema was observed in eighteen patients (18%). And after six months, two patients (2%) still had erythema on their laser-irradiated area. Post-inflammatory hyperpigmentation was apparent in seven patients (7%) immediately after treatment. After three months of treatment, five patients were observed with post-inflammatory hyperpigmentation and after six months one patient still remained with hyperpigmentation.

Hypopigmentation was observed in one patient throughout the follow up period, and one patient had developed delayed contact dermatitis. Histological findings immediately after treatment, showed the epidermis had completely ablated. And minimal thermal damage was noted beneath ablated layer (Fig. 4). At 2 weeks, the epithelium had completely been re-epithelialized with edema on the upper papillary dermis, new collagen and new vessel formation (Fig. 5). At 1.5 months after the laser surgery, the epidermis had formed complete new epithelium and vessels. Meanwhile, the dermis showed slight edema with new collagen formation in progress (Fig. 6).

Fig. 1-A, 2-A, 3-A) Before and 1-B, 2-B, 3-B) 3 months after treatment with a pulsed erbium:YAG laser.

DISCUSSION

Over the years, laser resurfacing had been the most effective method in treating cutaneous irregularities such as facial rhytides, acne scars, and posttraumatic scars. With this increasing interest, it had triggered a rapid technological development in variety of lasers. For instance, high energy, short pulsed char free CO₂ laser is known to many physicians, and some consider it as a better tool for well-controlled removal of thin layers of skin than chemical peeling and dermabrasion^{6,8,9,10,12}. The major differences between CO₂ and Er:YAG lasers are the difference in ablation depth and tissue effect. The thermal effect of the CO₂ laser produces a relatively wide zone of coagulation necrosis affecting hemostasis and collagen shrinkage^{5,7,10,11,16}, which will gradually delay the wound healing, however in Er:YAG laser, it has less thermal diffusion, coagulation necrosis, hemostasis and collagen shrinkage^{2,3,5,14-17}. Owing to this

circumstance, the Er:YAG laser has greater safety and controllability than the CO₂ laser. According to the histological findings, the effects on papillary dermis for pulsed Er:YAG laser are almost equal to that of CO₂ laser resurfacing and chemical peeling. However, the pulsed Er:YAG laser does not show any hemostatic effect. During laser ablation, bleeding does therefore occur, saline soaked wet gauze is required for hemostasis. The only problem with the Er:YAG laser is with bleeding, where it is difficult to keep the field clear which makes the procedure more messy. The resurfaced skin re-epithelializes in 5 to 7 days, as for CO₂ lasers it takes about 10 to 14 days. The quicker healing is probably due to the superficial nature of ablation and the minimally induced thermal damage. Because of the superficial nature of ablation, it is necessary to perform multiple passes to obtain maximal effect, which makes the procedure slower than the CO₂ laser. The other limitations with Er:YAG laser is the noise and the

Fig 4. Histological findings immediately after treatment, shows the epidermis has completely ablated. And nonspecific thermal damage is noted beneath ablated layer.

plume caused by the laser-tissue interactions during the procedure, which necessitates the operator to wear appropriate protective shields, and to suck out the plume a smoke evacuator is necessary. When the patient has active skin lesions it is inappropriate to perform this procedure or when the acne scar is too deep or pitted, a combination of applying trichloroacetic acid on the pitted area or punch biopsy (2mm) could be recommended. With the operator's aggressive use of this instrument for deeper pitted scars, the side effects are more likely.

The duration of erythema is presumably proportionate to the depth of the skin ablation. Post-inflammatory pigmentary changes are also a frequently recurring side effect in skin resurfacing. In our study, 7% of treated individuals showed post-inflammatory hyperpigmentation and 1% showed hypopigmentation. Hypopigmentation is probably as a result of a greater number of passes to a certain area of the acne scar. Hyperpigmentation had resolved after an average of 1 to 2 months. Among the patients with hyperpigmentation, one patient had contact dermatitis with a topical EMLA cream, leaving hyperpigmentation. On reviewing the reports of laser resurfacing, one has compared the effects of Erbium: YAG and Carbon Dioxide lasers and the result of improvement scores were not significantly different. But the recovery time and posttreatment erythema has been shown to exist much longer period¹⁷. There was 100% individual perceived improvement and 91% improvement in acne scars at the completion of the study.

To reduce such complication and to gain maximal results (for pigmented skin), proper pre- and post-

Fig 5. At 2 weeks, the epithelium has completely been re-epithelialized with edema on the upper papillary dermis, new collagen and new vessel formation.

Fig 6. At 1.5 months, the epidermis has formed complete new epithelium and vessels. Meanwhile, the dermis shows slight edema with new collagen formation in progress.

treatments are required. The Er:YAG laser allows precise layer by layer skin ablation with minimal thermal damage. Though it has side effects, these are minimal compared to CO₂ laser. Therefore, in addition to minimal residual thermal damage, rapid healing, and minimal erythema, the tightening of the skin following Er:YAG laser resurfacing makes this laser a most appropriate tool in the field of laser resurfacing.

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