Effectiveness and Safety of 2940nm MultifractionalEr: YAG Laser on Acne scars

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Abstract:

Introduction:

Er: YAG laser treatment has been used in resurfacing the acne scars for a long time, however**,** we could not find any study reporting the recovery rates after each session of the treatment. In this study, we aimed to report the improvement rates after each session.

Materials and Methods:

We retrospectively analyzed the data of 35 patients with acne scars treated with fractional ablative Er: YAG laser. The patients received 1 to 4 sessions of treatment, with 4-week

intervals and improvement rates were recorded after each session.Data is available on request from the authors.

Results:

The improvement rate of the lesions varied between 1% and 25% in 34 patients at the end of the first session, while in one patient, the improvement rate was detected as 26-50%. At the end of the 4th. session, the rate of improvement was 26-50% in 14 out of 24 patients and 51-75% in ten patients. None of the patients showed a 76% -100% improvement at the end of the 4th. session, whereas 48.6% of the patients were satisfied with the treatment.

Conclusion:

In patients with a high expectation of an excellent improvement, a higher number of sessions of the laser treatment and/or combination treatments with different treatment methods should be planned.

Keywords: Acne scars, Er: YAG laser, CO^2 laser, acne scar treatment, laser scar treatment, scar remodeling

Introduction:

Acne is a chronic inflammatory disease of the pilosebaceous unit. Approximately, 1% of acne lesions result in scar formation. Acne lesions with severe inflammation result in dysregulation in collagen biosynthesis. Increased or decreased collagen synthesis leads to hypertrophic or atrophic scars, respectively (1). Individuals with acne scars deal with decreased self-confidence, the feeling as though they are outcasts, and stigmatization implemented on by others. These problems also may affect the quality of life negatively. Furthermore, a

presentable appearance is considered to be advantageous in the competitive field of modern business life. Consequently, the treatment of acne scars has become one of the most studied areas of aesthetics. Lasers (ablative, non-ablative, fractional, and non-fractional), dermabrasion, chemical peels, needling, subcision, radiofrequency, stem-cell therapy, fat transplantation, platelet-rich plasma, and hyaluronic acid fillers are the safe and effective treatment methods (2). CO^2 and Er: YAG lasers are the most preferred type of lasers in the treatment of acne scars. Er: YAG laser emits 2940 nm wavelength which is highly absorbed by the water content of the skin and provides ablation in the superficial cutaneous layer. Also, collagen structure acts as a chromophore for 3030 nm, and the 2940 nm-wavelength of Er: YAG laser is a quite close wavelength to the 3030 nm (3). The wavelength of 2940 nm is absorbed by water and collagen. Controlled heating of the tissue by this wavelength results in the stimulation of collagen synthesis and remodeling. Fractional Er: YAG laser exerts its effects by stimulating collagen synthesis and resurfacing the superficial skin. In this study, we aimed to present our treatment results with a 2940 nm multifractional laser in patients with acne scars. There is a very limited number of studies on multifractional laser, in the literature. We think that our results will guide clinicians in this field.,

Materials and Methods:

Patient selection

The study was conducted retrospectively by analyzing the data of 35 patients with acne scars who underwent Er: YAG laser treatment between January 2017 and January 2019. The diagnoses of the patients were made clinically. Patients who received systemic isotretinoin

therapy in the last 6 months, patients with a history of keloid or hypertrophic scar formation, and those receiving immunosuppressive therapy were excluded from the study. This study was performed according to the ethical standards and in compliance with the 1975 Helsinki Declaration. Informed consent forms were obtained from all the patients included in the study.

Laser Therapy

Topical anesthetic cream (2.5% lidocaine hydrochloride and 2.5% prilocaine [both wt / vol] [EMLA]; Astra Zeneca, Sodertalje, Sweden) was applied to the lesions 30 minutes before the treatment. Antisepsis with octenidine dihydrochloride solution and cooling with an ice battery were provided just before the treatment. The whole face was treated with 2940 nm multifractional Er: YAG laser (MCL 31 Asclepion Laser Technologies) by using the parameters of 300 µs, 40j / cm^2, 4 Hz with 0,35 mm spot size in E25 mode. Sessions were repeated 4 weeks apart with 10-joule increases, up to a maximum dose of 70 j / cm^2 as long as the treatment was well-tolerated. The patients were prescribed dexpanthenol cream to use for 10 days after the procedure and were strictly advised to use sunscreens regularly and not to wear make-up for a week.

Evaluation of Patients

The patients were photographed with a digital camera before and 4 weeks after the treatment, and the rate of improvement in the scars was evaluated by two different dermatologists. Evaluations were made based on a 5-item scale (0:no improvement, 1:1% -25% improvement, 2:26-50% improvement, 3:51-75% improvement, and 4 :76-100% improvement). The patients

were evaluated after each session and their satisfaction with the treatment was questioned. The patients were asked to select a score between 0 and 4 to express their satisfaction (0:not satisfied at all, 1:not very satisfied, 2:moderately satisfied, 3:satisfied, and 4:highly satisfied). The patients were also questioned about their complaints related to the treatment such as pain, erythema, edema, and pigmentation.

Statistical analysis:

Qualitative data were expressed as numbers and percentages. A continuity-corrected chi-square test was used for comparisons. In all analyses, a two-sided significance level was considered as 0.05. IBM SPSS Statistics for Windows version 22.0 (New York, USA) was used for analysis.

Results:

This study has included 35 patients, 23 women (65.7%) and 12 men (34.3%). The average age was 28.71 ± 7.44 (min. 20 years, max.58 years). Eleven patients had Fitzpatrick type-2 (31.4%), 19 patients had Fitzpatrick type-3 (54.3%) and 5 patients had Fitzpatrick type-4 (14.3%) skin type. A total of 16 patients (45.7%), eleven women and five men had received systemic retinoid therapy previously, while 19 (54.3%) patients had not used systemic retinoid treatment at all. Patients who had used systemic retinoids in the last six months were not included in the study. There was no statistical difference between the genders in terms of retinoid usage (P = 1.00). After the laser therapy, the patients were questioned about any decrease in sebum level of their skin. While 15 patients (42.9%) felt a decrease in sebum

levels, 20 (57.1%) patients did not realize any change in the sebum level. There was no statistically significant difference between female and male patients in terms of sebum decrease (p: 0.64). As for patient satisfaction, we found that 2 patients were not satisfied with the treatment, while 17 patients were satisfied. Satisfaction rates by gender have been shown in Table-1.

We observed 1% to25% improvement in 34 patients and 26% to 50% in one patient, at the end of the first session. One of the patients is illustrated in the figure 1. As for the second session, 1% to 25% improvement was seen in 12 patients and of 26% to 50% for 18 patients, respectively. At the end of the third session, the rate of improvement in scars was between 1 and 25% in 3 patients, 26% and 50% in 20 patients, and, 51 and 75% in 5 patients. The rate of improvement was between 26% and 50% in 14 patients and 51% and 75% in 10 patients at the end of the fourth session. One of the patients who completed the fourth session is illustrated in figure 2 and the rates of improvement among the sessions have been shown in Table-2.

The adverse effects of the therapy were pain and erythema. In one patient post-inflammatory hyperpigmentation (PIH) developed and lasted for 1 year after the laser therapy. Post-laser PIH develops mostly in patients with dark skin types, however, it was observed in a patient with Fitzpatrick skin type-2 in our study. Adverse effects observed after the laser treatment has been shown in Table-3.

Discussion:

Although the acne scar is not a life-threatening problem, it can still lead to negative psychosocial effects including lack of self-confidence, anxiety disorder, depression, and a

decreased quality of life. There are many invasive and non-invasive methods in the treatment of acne scars. However, a standard treatment approach for acne scars is still lacking. (4). Despite various treatment methods available in acne scars, treatment results are often unpredictable. The introduction of light-based laser devices after the 2000s has been a breakthrough in the treatment of acne scars (1).

Atrophic acne scars can be classified by rolling, ice-pick, and boxcar types. Traditional full-ablative laser systems are proven methods in the treatment of acne scars. However, the most important disadvantages of ablative laser systems include a long recovery period, longlasting erythema, and post-inflammatory hyperpigmentation in patients with dark skin types(5). Therefore, non-ablative laser systems have become one of the popular treatment methods in acne scars. Non-ablative laser systems are especially effective in atrophic lesions by stimulating dermal collagen production and providing a dermal reconstruction while sparing epidermal tissue from damage (6). In the literature, it has been shown also histopathologically that the fractional lasers not only reduce the severity of scar but also increase the dermal collagen and contribute to the skin quality and rejuvenation (7).

Er: YAG lasers and fractional CO^2 lasers are the most preferred laser systems in the treatment of acne scars. The advantage of Er: YAG lasers over fractional CO^2 lasers is providing a superficial ablation on the epidermis with the 2940 nm wavelength which is also quite close to 3030 nm peak absorption wavelength of collagen. By this way, it stimulates dermal collagen synthesis and provides dermis reconstruction. Also, complications like erythema and crusting after Er: YAG laser last 3-5 days enabling a short-downtime (8). Fractional CO^2 lasers with a wavelength of 10600 nm penetrate deeper tissues and have more destructive effects, thereby,

they stimulate and rejuvenate dermal collagen synthesis more evidently. However, the most important disadvantages of these systems include serious crusting that lasts approximately 2 weeks, increased risk of hyperpigmentation in individuals with darker skin tones, and long-lasting erythema which means a prolonged downtime. The most important advantage of CO^2 lasers is providing successful results in deeper scars, thanks to the wavelength penetrating deeper. Another advantage of fractional CO^2 laser systems is also providing better coagulation during laser surgery (9). A combination with platelet-rich plasma treatment may help to increase the effectiveness of laser therapy by accelerating wound healing and reducing the risk of hyperpigmentation (10).

Rates of PIH development after laser treatment are controversial in the literature. In one study, it was reported that 5% of patients had PIH after fractional CO^2 laser (11). In our study, one patient developed PIH which lasted one year. Although PIH has been mostly seen in individuals with dark skin, interestingly, only one patient with Fitzpatrick type-3 skin type developed PIH in our study. It was reported that the rates of improvement in acne scars were similar among the patients treated with CO^2 and Er: YAG lasers. In another study, ablative fractional lasers were found to be superior to non-ablative fractional lasers in the treatment of the acne scars. It was emphasized that the downtime after Er: YAG laser lasted 1 week, whereas this period could be even 1 month after CO^2 laser treatment. Besides, it was also emphasized that CO^2 and Er: YAG lasers were the most painful laser devices (12). Treatment-related pain and crusting were the most common side effects. The most prominent complaint was pain in 45.7% of our patients during the laser treatment. In a study conducted by Gold et al, a dual-wavelength laser was used for acne scartreatment . The improvement rate in the

scars after 4 sessions of the laser treatment was between 14% and 42%. It was stated that complications like crusting and erythema were seen lesser in this laser than the other lasers. Although dual-wavelength laser treatment had afavorableside effect profile, improvement in the scarswere no better thanthe good results with fractional lasers(13). In our patients, at the end of the first session, we observed up to 25% improvement in the scars, in 97.1% of the patients. We also observed that the improvement increased gradually by the following sessions. Although we didn't evaluate the rate of improvement by the types of scars, we observed that rolling and boxcar type of scars showed better improvement than the ice-pick type of scars. We did not face with serious side effects after the treatment, except one patient who developed PIH, lasting for 1 year.

Whan managing cosmetic problems, patients' satisfaction with the treatment is an important issue. Generally, patients start treatment with high expectations of an excellent improvement, however, the satisfaction rate is almost always low in these patients. In our study, 48.6% of our patients were moderately satisfied with the results of laser treatment, whereas only 11.4% of the patients were satisfied with the treatment. We think that it had better inform the patient in detail before the treatment and combine Er: YAG laser with different methods such as subcision, filler applications, or PRP treatment in patients with high expectations.

Conclusion

We think that Er: YAG laser is a safe and effective method in the treatment of acne scars. Similar to the adverse effects seen with other fractional lasers; erythema, pain, and crusting were among the most common adverse effects also in our patients. Patients who have a high

expectation of a perfect improvement had better undergo a higher number of consecutive sessions of laser treatment or combined treatment with different methods. Besides reducing the scars, Er: YAG laser also improves the skin quality, tightens the pores, and regulates the sebum levels in the skin.

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Table1: Satisfaction rates by gender has been shown in detail.

			Patients' satisfaction				
			1,00	2,00	3,00	4,00	Total
Gender	Female	Count	2	8	11	2	23

		% within gender	8,7%	34,8%	47,8%	8,7%	100,0%
	Male	Count	0	4	6	2	12
		% within gender	0,0%	33,3%	50,0%	16,7%	100,0%
Total		Count	2	12	17	4	35
		% within gender	5,7%	34,3%	48,6%	11,4%	100,0%

1= “not very satisfied“, 2 = “moderately satisfied“, 3 = “satisfied”, 4 = “highly satisfied”.

Table-2. The rates of regression among to the sessions

Sessions	%1-%25 regression in the scars	%26-50 regression in the scars	% 51-75 regression in the scars	%76-100 regression in the scars
1st session (n:35)	34 (%97.1)	1 (%2.9)	0	0
2nd session (n: 30)	12 (%40)	18 (%60)	0	0
3rd session (n: 28)	3 (10.7)	20 (%71.4)	5 (%17.9)	0
4th session (n: 24)	0	14 (%58.3)	10 (%41.7)	0

Table-3. Adverse effects seen after laser sessions

Adverse effectsof the laser therapy	Frequency	Percentage (%)
Pain	16	45,7
Erythema	14	40,0
Edema	4	11,4
Pigmentation	1	2,9
Total	35	100,0

Figure-1 A regression between 1% and 25% in the scars is seen, at the end of the 1st session.

Figure-2: A regression between 51% and 75% after the 4th session is seen in a patient. In addition, the improvement in the skin quality and lightening of skin color is noteworthy.