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Treatment of facial acne scar using Fractional Er: YAG laser

Ali S. toama[(1)] Wasan M. Saleh[(2)] and **Ali Abdul J. Kadhem[(3)]**

(1) Balad General Hospital, Salahaldin, Iraq. alisadiq625@gmail.com
(2) Al-Numan Teaching Hospital, Baghdad, Iraq
(3) Al-Karkh General Hospital, Baghdad, Iraq.

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Abstract Background: Acne is a common disorder experienced by adolescents and persists into adulthood in approximately 12%–14% of cases with psychological and social implications of high gravity. Fractional resurfacing employs a unique mechanism of action that repairs a fraction of skin at a time. The untreated healthy skin remains intact and actually aids the repair process, promoting rapid healing with only a day or two of downtime. **Aims**: This study, was designed to evaluate the safety and effectiveness of fractional photothermolysis (fractionated Er: YAG laser 2940nm) in treating atrophic acne scars. **Methods**: 7 females and 3 males with moderate to severe atrophic acne scarring were enrolled in this study that attained private clinic for Dermatology and Laser in Baqubah city of Diyala - Iraq during the period from 1st of June 2019 to 10th of October 2019. Fractional Er:YAG laser 2940 nm wavelength was delivered to the whole face with a single pass treatment and for the acne scar areas with two passes. Therapeutic outcomes were assessed by standardized digital photography. **Results**: Three patients (30%) reported excellent improvement, five patients (50%) significant improvement, one patient (10%) moderate improvement, and one patient (10%) mild improvement in the appearance of the acne scars. **Conclusion**: Fractional Er: YAG a safe and effective option for the treatment of acne scars in Iraqi patients by offering faster recovery time with no or mild side effects in comparison to other traditional modalities **.**

Keywords: Atrophic acne scar, Fractional Er: YAG laser**.**

Introduction

Acne has a prevalence of over 90% among adolescents and persists into adulthood in approximately 12%–14% of cases with severe psychological and social implications of high gravity [Rasha I. Mohamed 2019]. Several factors are incriminated in the pathogenesis of acne including increased sebum production, follicular abnormal keratinization, colonization with Propionibacterium acnes, and a lymphocytic and neutrophilic inflammatory response. All body areas with high concentrations of pilosebaceous glands are involved, but in particular the face, back and chest. Inflammatory acne lesions can result in permanent scars, the severity of which may depend on delays in treating acne patients [Ertuğrul H. Aydemir 2014]. Scarring can occur as a result of damage to the skin during the healing of active acne. There are two basic types of scar depending on whether there is a net loss or gain of collagen (atrophic and hypertrophic scars). 80% to 90% of people with acne scars have scars associated with a loss of collagen (atrophic scars) compared to a minority

who show hypertrophic scars and keloids ,atrophic scars have been subclassified into icepick, boxcar, and rolling [Deirdre Connolly 2017]. Their treatment options include excision, cryosurgery, pulsed dye laser treatment, compression with silicone sheeting, and various other modalities [Rory Boyd McG. 2017]. Goodman proposed qualitative global scarring grading system (table 1) [Tatyana A. Petukhova 2016]

Table (1) Goodman's qualitative global scarring grading system.

Grades	Disease Level	Clinical feature
1	**Macular**	These scars can be erythematous, hyper-or hypo pigmented flat marks. They do not represent a problem of contour like other scar grades but of color.
2	**Mild**	Mild atrophy or hypertrophy scar that may not be obvious at social distances of 50 cm or greater and may be covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extra facial
3	**Moderate**	Moderate atrophic or hypertrophic scar that is obvious at social distances of 50 cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or normal body hair if extra facial, but is still able to be flattened by manual stretching of the skin
4	**Sever**	Sever atrophic or hypertrophic scar that is evident at social distances greater than 50 cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or normal body hair if extra facial, and is not able to be flattened by manual stretching of the skin.

Carbon dioxide laser and Er YAG laser are the most commonly used ablative lasers for the treatment of acne scars; these abrade the surface and also help tighten the collagen fibers beneath. Nonablative lasers do not remove the tissue, but stimulate new collagen formation and cause tightening of the skin resulting in the scar being raised to the surface. The ablative lasers are technologies with a high selectivity for water [Sonia Shah, B.A. 2012]. The Er: YAG laser, with its 2940-nm wavelength, produces energy in the midinfrared invisible light spectrum. This wavelength has 10 -15 times greater water absorption than a CO2 laser at the 10,600-nm wavelength. The Er: YAG laser produces a pulse of 250-350 microseconds that is less than the thermal relaxation time of the skin, which is 1 millisecond. Because the Er:YAG laser is so exquisitely absorbed by water, it causes l0-40 µm of tissue ablation and as little as 5 µm of thermal damage (depending on the parameters used). ln contrast, the high-energy, short-pulse CO2 lasers cause l00-120 µm of tissue damage, which is composed of 50-60 µm of apparent tissue desiccation (ablation or coagulation) and an additional 50-75 µm of thermal damage [Subhango C. 2015]. The aim of this work to evaluate the safety and effectiveness of fractional photothermolysis (fractionated Er: YAG laser 2940nm) in treating atrophic acne scars.

Patients & Methods

This study was done in private clinic in Baqubah city of Diyala Governorate- Iraq for the periods from 1st of June 2019 to 10th of October 2019. Ten patients (7females and 3 males) with acne scars, their age ranged from 20 years old to 50 years old with mean age was 28.9 years. Inclusive criteria ;Patients should be 20-50 years of age; have Fitzpatrick skin types of I-IV; and have at least mild acne scars. Exclusive criteria: The patient should not be receiving any additional systemic, topical, or intralesional treatment of the scars during the study; Fitzpatrick skin type of V-VI; A history of keloids or hypertrophic scars; Photosensitivity; Botulinum toxin injection, facial laser resurfacing, chemical peels, fillers, or usage of oral retinoid within the last 6 months; Subjects with a known history of herpes simplex. Research approval was taken from institute of Laser for post graduate studies/ University of Baghdad and written informed consent was taken from patient before being enrolled in the study. The preoperative evaluation included a complete history and physical exam, whole procedure; information; and possible complications were
discussed with patients, then topical anesthesia (EMLA, a eutectic mixture of local anesthesia of 2.5% lidocaine and 2.5% prilocaine) was applied under an occlusive dressing for 1 hour

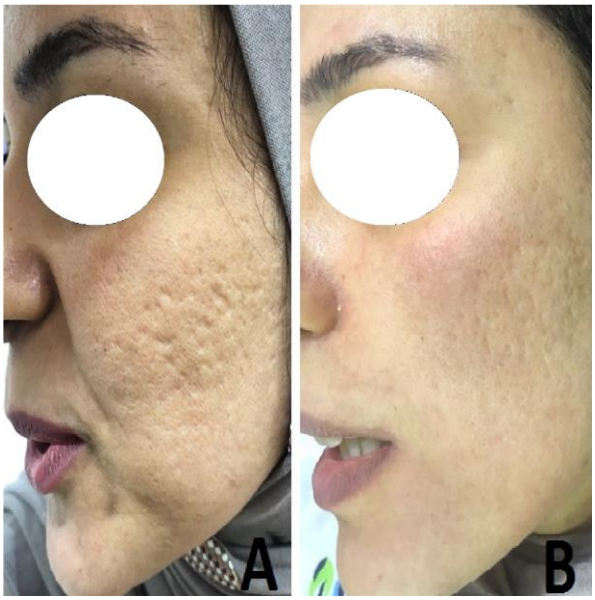
and subsequently washed off with gauzes soaked in 70% isopropyl alcohol to obtain completely dry skin surface. All patients were photographed before treatment with a digital camera and 1 week; 4weeks; 8 weeks; and 12weeks after procedure using identical camera settings, lighting, and patient positioning. Fractional Er: YAG laser 2940 nm wavelength was delivered to the whole face with a single pass treatment and with two passes for the acne scar areas with a fluence (40J/cm2) interval of 1.5 second, and the window of the laser hand piece was 13 x 13 mm supporting 169 micro beams. Therapeutic outcomes were assشessed by standardized digital photography by the patient himself and by two blinded dermatologists. The dermatologists' evaluation and self-assessment level of improvement of the patients were evaluated using the following five-point scale :

0 = no change; 1= slight improvement (0–25%);
2 = moderate improvement (26–50%);
3 = significant improvement (51–75%);
4 = excellent improvement (>75%).

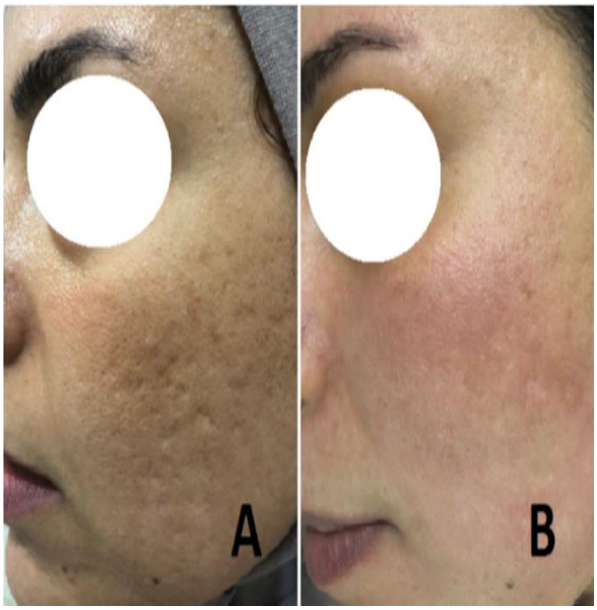
As a simple, an easy, and reliable tool for assess the changes resulting from using the procedures. The used Laser system specification show in the following table2.

Table (2) shows the Laser system specifications.

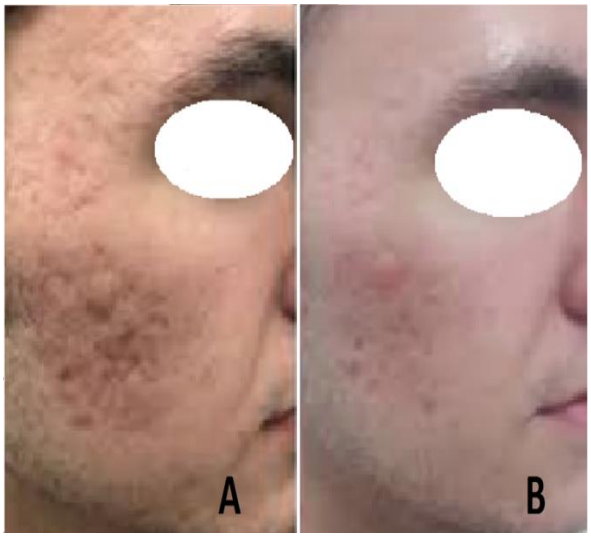
Patients Number	Type of scar
3 (30%)	significant rolling
4 (40%)	shallow boxcar
2 (20%)	Deep boxcar
1 (10%)	icepick scars



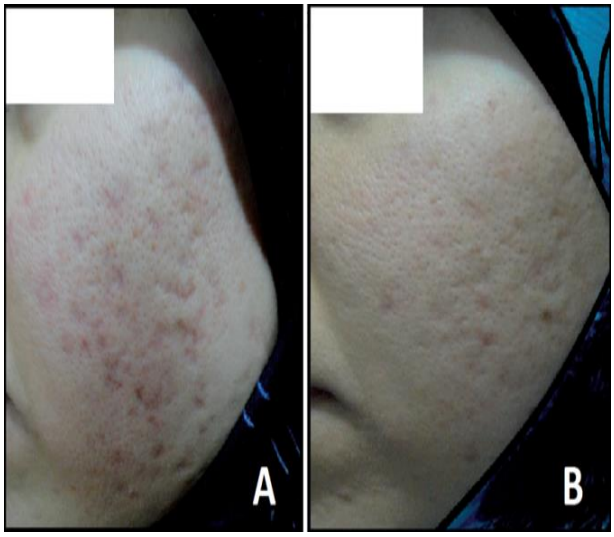
Patient No.1 (A) before & (B) after treatment.



Patient No.2 (A) before & (B) after treatment



Patient No.3 (A) before & (B) after treatment.



Patient No.4 (A) before & (B) after treatment

Results

All patients had mixed types of atrophic acne scars, including ice pick, boxcar, and rolling scars, although, some particular type predominates and therefore is used to classify the patients accordingly (Table3). By using five-point scale mentioned previously in chapter two under the title evaluation criteria.

Table (3) Patients predominant scars types

Patients Number	Type of scar
3 (30%)	significant rolling
4 (40%)	shallow boxcar
2 (20%)	Deep boxcar
1 (10%)	icepick scars

Table (4) Response to Er:YAG laser for the level of improvement assessed by dermatologists

	Scores	0	1	2	3	4
Weeks	1 wk		3(30%)	3(30%)	3(30%)	1(10%)
	4 wk		2(20%)	3(30%)	4(40%)	1(10%)
	8 wk		2(20%)	2(20%)	4(40%)	2(20%)
	12 wk		1(10%)	1(10%)	5(50%)	3(30%)

Table (5) Response to treatment by Er:YAG laser for the level of improvement assessed by the patient

	Scores	0	1	2	3	4
Weeks	1 wk		3(30%)	4(40%)	2(20%)	1(10%)
	4 wk		3(30%)	4(40%)	2(20%)	1(10%)
	8 wk		2(20%)	3(30%)	3(30%)	2(20%)
	12 wk		1(10%)	2(20%)	4(40%)	3(30%)

According to the dermatologists' assessment (Table 4) the results were elevated dramatically from 10% in 1st week to 30% for excellent improvement after 3 months; although, this group is not the major group who shows improvement. Significant improvement group shows increase from 30% after 1 week to 50% after 3 months, it gives us a strong indicator of the overall results. The improvement scale was so obvious from the first week (30% mild to 10% significant) through 4th – and 8th -week to become more satisfactory (10% mild to 30%) after three months of operation. The final results after (3) months were as follows: three patients (30%) reported excellent improvement, five patients (50%) significant improvement, one patient (10%) moderate improvement, and one patients (10%) mild improvement in the appearance of the acne scars. On the other hand, the patients' self-assessment for improvement

(Table 5) was also remarkable and showed a great amount of satisfaction the results were almost comparable to the dermatologists' assessment.

The suspected adverse effects arise after Er: YAG laser skin resurfacing marked X as shown in (Table 6). All participants underwent treatment-related pain to prevent any level of pain and discomfort of the patients, but there was no need for extra anesthesia. All participants reported mild erythema for approximately 2-3 days, and 80% of patients experienced edema for <24 hours following laser treatment this mostly due to inflammatory response to trauma. Peeling occurs from the second day and completed in the fifth day in 90% of the patients and in 10% last for 7 days. Social activity could commence as early as 3 days after the laser treatment and this one of the benefit of this type of treatments. Other possible adverse events are related to laser treatment in general, like pigmentary alterations; bleeding; prolonged erythema; crust; scarring; and infection were not observed .

Table (6) adverse effects related to treatment by Fractional Er: YAG Laser.

Adverse effects	Pt 1	Pt 2	Pt 3	Pt 4	Pt 5	Pt 6	Pt 7	Pt 8	Pt 9	Pt 10	%
treatment-related pain	X	X	X	X	X	X	X	X	X	X	100
mild erythema	X	X	X	X	X	X	X	X	X	X	100
Edema	X	X	O	X	O	X	X	X	X	X	80
Prolong Erythema	O	O	O	O	O	O	O	O	O	O	0
Severe peeling	O	O	O	O	O	O	O	O	O	O	0
Bleeding	O	O	O	O	O	O	O	O	O	O	0
Crust	O	O	O	O	O	O	O	O	O	O	0
Dermatitis	O	O	O	O	O	O	O	O	O	O	0
Hyperpigmentation	O	O	O	O	O	O	O	O	O	O	0
Hypopigmentation	O	O	O	O	O	O	O	O	O	O	0
Infection	O	O	O	O	O	O	O	O	O	O	0
Scaring	O	O	O	O	O	O	O	O	O	O	0

Discussion

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 studies that investigate the role of Er: YAG laser as a sole option in the treatment of atrophic acne scars are very limited. The present study showed that mean age of studied patients was 28.9 years, which is the age when most of people seek for modern expression of an ancient desire to attain beauty and recapture a youthful appearance with predominance of female over male 70%-30%respectively due to the women anywhere more than men have the desire to attain beauty. These findings are close to results of Kutlubay et al. in a Turkish population ,which included 128 patients (53 male, 75 female) aged 22–42 years (mean age, 29.3) with atrophic facial acne scars with Er:YAG laser. 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%).These findings look similar to our result which show 30% excellent improvement; 50% significant; 10% moderate and 10% slight improvement [Kutlubay Z 2010]. Results of Shakir J. Al-Saedy et al study in Iraq included 40 patients which based on the same evaluation score of five-point scale that used in our study, they are reported that 25% of cases show excellent improvement; 50% significant improvement; 15% moderate improvement; and 10% slight improvement its very comparable to our results [Shakir J. Al-Saedy 2014]. In a series of 78 patients, Weinstein reported 70-90% improvement of acne scarring in the majority of patients treated with a modulated Er: YAG laser. He proposed that pitted acne scars may require ancillary procedures, such as subcision or punch excision, for optimal results. These procedures can be performed either prior to or concomitant with Er: YAG laser resurfacing this study is also comparable to our results [Weinstein C. 2000]. 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 [Yoo KH 2009]. Regarding the adverse effects or complication arise after Er: YAG laser skin resurfacing Elizabeth L. Tanzi, et al study on 50 patients showed prolonged erythema6%, hyperpigmentation 40%, dermatitis 6%, infection 18%, hypopigmentation 0% and scarring 0% [Elizabeth L. 2003]. In the recent study there has not been any of these effects.There are many explanations, may be due to good management; or low number of cases.

Conclusion

1.Fractional Er:YAG 2940nm photo-thermolysis can be a safe and effective option for the treatment of acne scars in Iraqi patients by offering faster recovery time with no or mild side effect.

2.Fractional Er: YAG photothermolysis is associated with substantial improvement in the appearance of all types of acne scar, which includes the softening of scar contours as well as the reduction of scar depth.

3.Most patients began to show a visible improvement following only one session. According to visual assessments of patients and dermatologists, patients' improvement continues to occur even after 3 months of operation. 4. 90% of patient had good satisfy to the result.

4.The full clearance of the lesion is not obvious or we can say complete eradication of acne scars is not attainable, But there is very good improvement after treatment with Laser.

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معالجة حب الشباب في الوجه بإستخدام ليزر Er:YAG المجزء

علي صادق طعمة[1] وسن محي صالح[2] علي عبد الجليل كاظم[3]

1- مستشفى بلد العام ، صلاح الدين ، العراق
2- مستشفى النعمان التعليمي، بغداد ، العراق
3- مستشفى الكرخ العام ، بغداد ، العراق

الخلاصة:الخلفية: حب الشباب مرض شائع بين الشباب ويستمر الى مرحلة البلوغ عند حوالي 12%-14% من الحالات مع عقد نفسية وإجتماعية شديدة . تقشير الجلد المجزء يمنح ميزة فريدة حيث يسمح بتقشير جزء من الجلد ويبقي الجزء الاخر طبيعي مما يسمح بشفاء الجلد بسرعة خلال يوم او يومين . **الهدف**: هذه الدراسه اجريت لتقيّم درجة الامان وفعالية العلاج الضوئي المجزء بالليزر ،Er:YAG 2940 nmعلاجا لآثار حب الشباب المضمحل. **طرق العلاج**: سبعة نساء و ثلاثة رجال يعانون من حب الشباب المتوسط والشديد شاركوا في هذه الدراسة اللتي اجريت في العيادة الخاصة للامراض الجلدية والليزر في مدينة بعقوبة-محافظة ديالى- العراق خلال الفترة من الاول من حزيران الى العاشر من تشرين الاول. تمت معالجة الوجة بصورة كاملة بداية بضربة مفردة باستخدام ليزر Er:YAG, 2940 nm المجزء ثم اعيد علاج المناطق المصابة بأثار حب الشباب بمرحلة ثانية بضربة ثانية في نفس الجلسة نتائج العمل قيّمت باستخدام الصور الفوتوغرافية. **النتائج**: ثلاث من المشاركين كانت نتائج علاجهم تحسن ممتاز، خمسة أخرين كانت نتائجهم تحسن جيد، وأحد الحالات نتائجها كانت تحسن متوسط و وأحد الحالات الاخرى كانت نتائج التحسن ضعيف في مظهر آثار حب الشباب. **الاستنتاج**: ليزر Er:YAG المجزء آمن وفعال في علاج حب الشباب عند العراقيين ويمتاز بسرعة الشفاء و قلة الاعراض الجانبية مقارنة بطرق علاج حب الشباب التقليدية .