

Fractional erbium: YSGG laser compared to the combination of fractional erbium: YSGG laser and topical autologous platelet-rich plasma for treatment of atrophic acne scars: a case report



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ABSTRACT

Background: Acne scar is the most common complication in acne that occurs in about 49% of acne individuals. Fractional resurfacing lasers such as CO₂ laser and erbium-doped yttrium aluminum garnet (Er: YAG) have been widely used for acne scar treatment and give satisfying results have complications such as pain, hyperpigmentation, infection, prolonged erythema, and scarring. Fractional erbium: yttrium scandium gallium garnet (Er: YSGG) laser solves previous laser techniques' disadvantages. It has an ideal wavelength of 2790 nm, which balances the epidermis layer's vaporization and thermal damage in the dermis's superficial layer. Platelet Rich Plasma (PRP) is an autologous concentration of human platelets in a small plasma volume that secreted various growth factors that can speed up the scar healing process.

Case report: A-24 years old male student came with a chief complaint of acne scars on his face four years before the examination. The patient's condition is classified as moderate-severe acne scarring based on Goodman and Baron's criteria (qualitative global acne scarring system). Acne scars treatment plan was single fractional erbium: YSGG laser for the left side of the face and combined fractional Er: YSGG laser with topical autologous PRP on the right side. This procedure was performed in 2 sessions with an interval of 4 weeks, the final evaluation at 12 weeks after the first procedure. Clinical improvement of acne scars was assessed using qualitative and quantitative scales based on Goodman and Baron's, patient and observer scar assessment scale (POSAS), quartile grading scale, and patient satisfaction level.

Conclusion: In the final evaluation, there was an improvement on the entire grading scale on the right side of the face (Er: YSGG laser + PRP) and the face's left side (Er: YSGG laser only). Post-treatment erythema was found on both sides of the patient's face but disappeared within three days on the face's right side and five days on the face's left side.

Keywords: Acne scars, Fractional Er: YSGG laser, PRP

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INTRODUCTION

Acne is the most common skin disorder, affecting around 80% of people in the young age group and up to 5% in the older age.¹ The most common complication of acne is acne scarring, which occurs in about 49% of acne individuals.² Acne scars occur due to inflammation of the dermis layer surrounding the hair follicles. The prevalence and severity of acne scars in the population have not been widely studied, although the existing literature shows a correlation between acne severity and acne scars.³ Acne scars can cause negative impacts on a person psychologically,

decreased self-confidence, and quality of life, especially in adolescence.⁴ Generally, acne scars could be classified into three types, atrophic, hypertrophic, and keloid scars. Atrophic scars are the most common type of scar (80-90%) and can be further classified according to the depth, width, and three-dimensional architecture into icepick, rolling, and boxcar types.¹

Until now, there has been no standard treatment option for acne scarring yet. Various therapeutic modalities have been reported in previous studies with varying complications and clinical responses. They are surgical techniques (punch graft,

punch excision, subcision), resurfacing techniques (dermabrasion, ablative lasers, chemical peels), nonablative lasers, autologous fat grafting, and fillers. Fractional resurfacing lasers such as CO₂ laser and erbium-doped yttrium aluminum garnet (Er: YAG) are lasers that have been widely used for acne scar treatment and give satisfying results.⁵ However, both techniques require a long recovery time, with complications such as pain, hyperpigmentation, infection, prolonged erythema, and scarring. Erbium: yttrium scandium gallium garnet (Er: YSGG) laser solves previous laser

techniques' disadvantages. Er: YSGG laser has an ideal wavelength of 2790 nm, which balances the epidermis layer's vaporization and thermal damage to the superficial layer and upper layer of the dermis.⁶

Platelet Rich Plasma (PRP) is an autologous concentration of human platelets in a small plasma volume. Various growth factors such as platelet-derived growth factor (PDGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF), and insulin growth factor (IGF) are secreted by alpha granules from platelets (thrombocytes). These growth factors regulate various processes, including migration, attachment, proliferation, and differentiation of cells, and trigger the accumulation of extracellular matrix by binding to specific cell surface receptors.⁷ Recently, PRP use both topical and intradermal injection after the laser is widely used for acne scar treatment. These studies demonstrated a major clinical improvement by adding PRP after laser treatment and also shorten recovery times and post-treatment erythema.^{8,9}

Based on our literature review, there has been no literature that studies the combination of fractional Er: YSGG laser with PRP for acne scar treatment. This paper aims to analyze the use of fractional ER: YSGG laser as a single treatment and fractional Er: YSGG laser and topical PRP as a combined treatment and compare the effectiveness of both treatments for atrophic acne scar treatment.

CASE REPORT

A-24 years old male student came with a chief complaint of acne scars on his

face for about four years before the examination. He admits that the acne appears intermittently and sometimes as a large-sized and nodular inflammatory acne. He has a habit of squeezing the acne himself. He also admitted that he had seen a doctor for this problem, then the acne got better, but the problem came back when he stopped the treatment. Currently, he admits that acne appears less frequently. However, he complains of scarring, especially on both cheeks, which interferes with his appearance, and makes him not confident and wants to get it eliminated.

Dermatological examination showed that he had Fitzpatrick skin type V. In the facial region, there were multiple papules, well defined, round-shaped, size Ø 0.1-0.4 cm, closed comedones (+). There are multiple atrophic acne scars in the forehead, right, and left cheek regions, with varying shapes (rolling, icepick, and boxcar types) visible from a distance of more than 50 centimeters (cm). When stretched, some parts of the skin with the acne scar were flat with the skin surface, but there were also acne scars that did not flatten with stretching (**Figure 1**).

This condition is classified as moderate-severe acne scarring based on Goodman and Baron's criteria (qualitative global acne scarring system). The qualitative score for acne scars was grade 3-4 (moderate-severe), while the quantitative score for acne scars was 13 points on the right side of the face and 12 on the left side of the face. Acne scars treatment plan for this patient was a single fractional Erbium: YSGG laser for a left side of the face and combined fractional Er: YSGG laser with topical autologous PRP on the right side

of the face to compare the effectiveness of the two treatments on lesion repair and patient satisfaction with atrophic acne scars. Laser procedure begins with the preparation of the equipment, materials, patient, and operator.

Autologous PRP was prepared by drawing ten ml of patient blood, placed in a tube containing anticoagulant, and initial centrifugation at high speed of 3000 rpm for 3 minutes. Plasma supernatant containing platelets was taken, placed in a tube, and then second centrifugation was carried out at low speed 1500 rpm for 12 minutes. The lower third component in the tube is PRP. Before application, PRP was activated using CaCl_2 (0.2 cc CaCl_2 for every one cc of PRP). The patient is being prepared with facial cleansing and application of topical anesthesia. The patient's face was cleaned using a milk cleanser and toner. Local anesthesia was then applied by applying anesthetic cream (lidocaine 2.5% + prilocaine 2.5%) and occluded using a plastic covering for \pm 45 minutes. After the anesthetic cream starts to take effect, the patient's face is cleaned again using gauze. The patient's eyes were closed using dry gauze and the patient's glasses, and then laser procedures were performed. The fractional Er: YSGG 2790 nm laser used a power parameter of 60 mJ, a delay of 3 seconds, a square pattern with a density of 2 (8%). Laser treatment is performed on the entire face. Then, autologous PRP was applied topically on the right side of the face, while only laser treatment was performed on the face's left side. After the procedure, a post-laser cream was applied to his face. Facial treatments done at home include face cleaning with a special facial cleanser (vinegar), using SPF 15 sunscreen gel during the day, and he was not allowed to use a night cream for seven days after the procedure. The patient is advised to avoid exposure to direct sunlight, not wash his face with tap water for 5-7 days, and if there are signs of infection, he was advised to control his condition immediately.

The procedure is carried out in 2 sessions, with intervals of 4 weeks. The final evaluation of acne scar improvement was carried out 12 weeks after the first procedure using the qualitative and quantitative criteria for the global acne



Figure 1. Patients' clinical picture before the procedure. The facial region shows multiple atrophic acne scars, consisting of the rolling, icepick, and boxcar types.

scarring grading system by Goodman and Baron, the patient and observer scar assessment scale (POSAS), a quartile grading scale consisting of 1 (mild improvement response, 0-25%), 2 (moderate improvement response, 26-50%), 3 (good response, 51-75%) and 4 (excellent/very good response, 75-100%) and the level of patient satisfaction (satisfaction score above 6 is excellent, between 4-6 is good and less than 4 is poor)

In the final evaluation, it was found that the entire grading scale was improved on the right side of the face (Er: YSGG laser + PRP) and the left side of the face (Er: YSGG

laser only) (Figure 2). Based on Goodman and Baron's qualitative criteria, there was an improvement in acne scar level on the right and left, from 3-4 (moderate-severe) before treatment to 2 (mild) at the time of the final evaluation. Based on Goodman and Baron's quantitative score, it was found that the severity score of acne on the right side of the face decreased from 13 to 9, while on the left face from 12 to 9. Based on the POSAS scale, the assessment carried out by the observer (doctor), there was a decrease in the score on the patient's right face, from 15 to 2, while the left face from 13 to 4. Based on the patient's assessment, there was a decrease in the

right face score, from 17 to 3, and the left face from 16 to 4. Overall, we also assessed the response to treatment based on the quartile grading scale and assessed patient satisfaction based on the VAS. At the end of the evaluation, there was an excellent therapeutic response (75-100%) on both sides of the patient's face, besides that the patient's satisfaction level was 8 (very satisfied) on the right side of the face and 7 (very satisfied) on the left side of the face.

DISCUSSION

Acne is a disorder that often occurs in the pilosebaceous unit, which is often seen especially in adolescents and young adults (ages 12-25 years), with a prevalence of about 85%. Family history with acne is reported in about 62.9-78% of patients. Patients with this family history are generally male, have an early onset of acne, affect the body, and cause scarring.^{10,11} Acne lesions can be either inflammatory or noninflammatory, especially on the face but can also appear on the upper arms, trunk, and backs.¹⁰

Active acne lesions can cause irreversible damage to the skin's microscopic structure, changes in color, texture, or both, which are clinically visible as acne scars. Acne scars commonly appear after healing of nodular type acne or acne with severe inflammation, prolonged duration, and acne cysts. Acne scars are more prone to occur in individuals with the Fitzpatrick IV-VI skin type. The location where active acne occurs can also predict the type of acne scar that will appear. Acne on the forehead, upper and middle cheeks generally causes icepick scars red (in light skin individuals) or dark brown (in dark skin individuals). Acne that occurs on thicker skin, such as on the lower cheeks, lower jaw, and chin, often causes rolling or boxcar scars. Acne at the jaw, upper chest, and sternum angle often result in hypertrophic or keloid scars.¹⁰

Other factors that influence and exacerbate acne scars are acne's physical treatment, old age, delay in acne treatment, and sun exposure. Physical treatment or trauma to the acne such as squeezing, scratching, and popping the acne can increase the risk of infection and acute inflammation resulting in tissue damage, longer wound healing, and acne

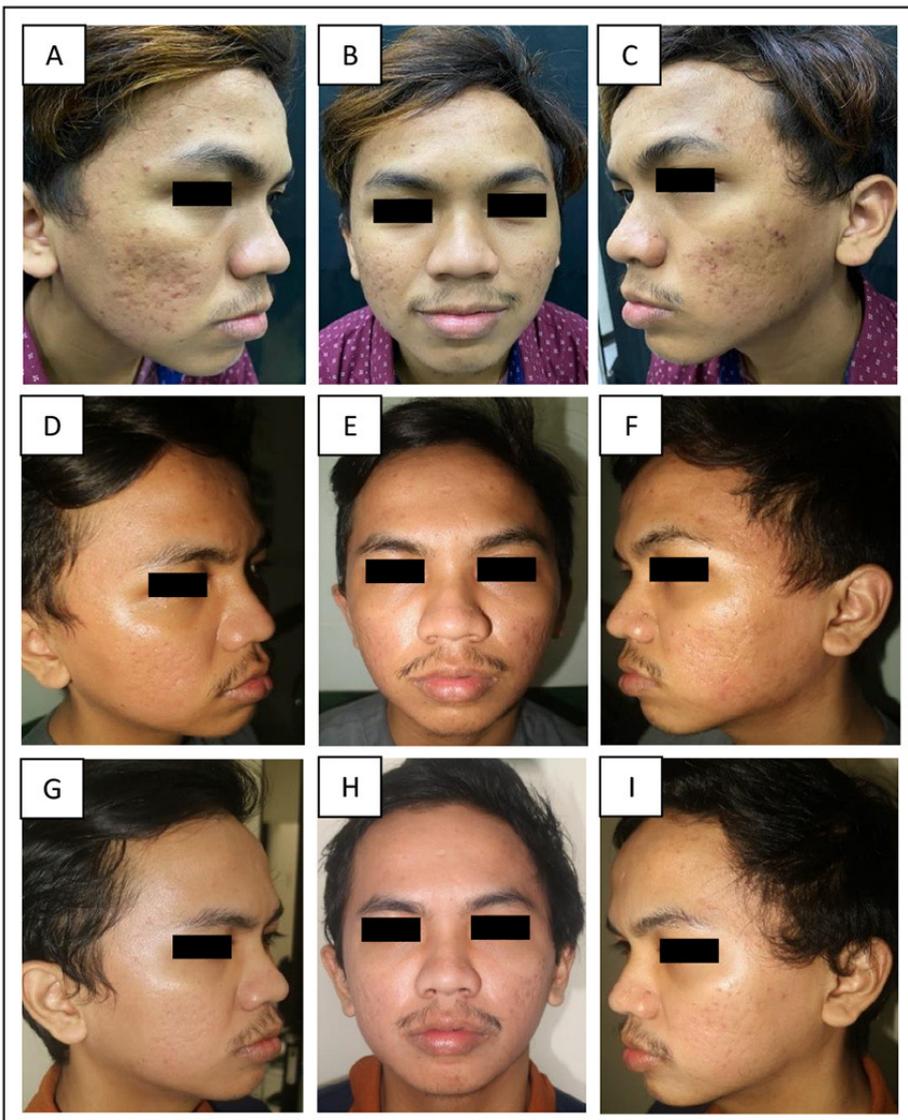


Figure 2. Patient's clinical picture before and after the procedure. A-C. Clinical photos of patients before treatment (baseline). D-F. Follow up six weeks after the first procedure. G-I. Final follow up 12 weeks after the first procedure

scar formation.¹⁰ In this case, the patient was a 24 years old man with the skin type Fitzpatrick V. He previously had a history of severe acne with large size and nodular inflammatory acne intermittently in the last five years. Complaints of acne have been treated but not completely and regularly. Besides, he also has the habit of manipulating the acne that appears by squeezing them himself. He is often exposed to sunlight in his daily life and rarely uses sunscreen while doing outdoor activities. There is a family history of acne and acne scar in the patient's father. These various risk factors cause acne and lead to acne scars' formation on the patient's face.

There are currently available various therapeutic modalities to improve atrophic acne scars. In recent decades the use of lasers and fillers has become more popularly used to repair acne scars.¹² CO₂ laser and Er: YAG laser has been a treatment technique for years to treat complaints of aging, wrinkles, skin dyspigmentation, and acne scars. Both types of lasers require a long healing time with possible complications such as prolonged pain, infection, hyperpigmentation, persistent erythema, and scarring. The Er laser: YSGG 2790 nm overcomes the drawbacks of previous fractional ablative laser techniques. This laser has an ideal wavelength, balancing evaporation of the epidermis and thermal damage to the superficial layer and upper dermis. This laser can remove the epidermal layer as deep as 10-30 µm to control the epidermal layer's evaporation and coagulation by applying sufficient heat. The coagulated layer acts as a natural dressing and provides comfort for the patient, and provides protection during the initial healing period. Thermal damage in the dermis triggers the wound healing process with neocollagenesis and elastinogenesis in the proliferative stage of wound healing, followed by a remodeling process that produces the dermis firmer, better alignment, and removal of wrinkles in the epidermis.¹³ The Er: YSGG laser with a wavelength of 2790 nm was introduced for aesthetic purposes under the trade name Pearl[®] by Cutera for the first time in 2007. In clinical practice, the superficial Pearl[®] laser resurfacing is effective and well-tolerated for correcting superficial brown epidermal dyschromia and fine

wrinkles. Meanwhile, the fractional Pearl[®] laser significantly improved dyschromia and improved deeper wrinkles and moderate-to-severe acne scars. These two types of lasers can be combined in one treatment session on a specific face area or the entire face, depending on the patient's needs and desires, where 2-3 sessions of combination therapy give the same results as 5-6 fractional laser sessions.¹⁴

Intradermal and topical injection of PRP after fractional ablative with CO₂ laser treatment accelerated post-laser wound healing and improved clinical acne scarring compared to a control group.^{9,15} A study focusing on the benefits of using PRP for post-fractional CO₂ laser wound healing reported that after evaluation for 28 days, wound healing occurred faster at sites treated with CO₂ lasers and PRP compared to those receiving only CO₂ laser. Also, there was a faster recovery of TEWL, lower melanin index, and erythema index in areas treated with fractional CO₂ laser and PRP.¹⁶ Another study by Lee et al. supported the use of fractional CO₂ resurfacing laser and PRP treatment in 14 patients with acne scars. In Lee's study, one side of the face received fractional CO₂ laser treatment followed by PRP intradermally. In contrast, the other side received a CO₂ laser followed by an intradermal injection of normal saline solution. The final evaluation results showed the decreasing duration of erythema, edema, and crusting on the side of the face receiving CO₂ and PRP laser treatment. There was also an overall clinical improvement after four months of treatment on the side receiving PRP.¹⁵ The study by Gawdat et al. shows similar results. They also compared the effectiveness of topical and intradermal PRP use after fractional CO₂ laser treatment. There was no significant difference in clinical improvement and downtime between the two PRP administration methods. However, topical PRP administration was more acceptable to patients because it did not cause pain at the application time.⁹ The combination of Er: YAG laser with PRP for acne scar is also reported to provide satisfying clinical results. Zhu et al. reported 22 patients receiving Er: YAG laser treatment followed by PRP, showing clinical improvement and high

patient satisfaction rates.⁸ Study by Ross et al. (2009) in 9 patients who received Er: YSGG laser treatment on the entire face for two sessions with an interval of 1 month, shows good results, and reepithelialization occurred within four days after treatment.¹⁷

According to the author's literature review through a trusted database site (Pubmed), there are no reports of similar cases or studies that use fractional Er: YSGG laser alone or in combination with PRP for the treatment of atrophic acne scar. This case report can be used as a reference for further study with a larger number of patients, a longer duration of follow-up, more treatment sessions, and a more objective evaluation technique to determine the effectiveness of the combination Er: YSGG and PRP treatment compared to fractional Er: YSGG laser only for atrophic acne scar treatment.

There is no widely accepted standard measurement method for assessing acne scars' severity and evaluating acne scar treatment. Nomenclature for describing individual acne scars is inconsistent among dermatologists, given the subjectivity of the classification system. Some of the standardized measurement methods for acne scars are Leeds, *Echelle d'Evaluation Clinique des Cicatrices d'Acne* (ECCA), global qualitative acne scarring system, quantitative global acne scarring system, patient and observer scar assessment scale (POSAS) and global aesthetic improvement scale (GAIS).¹⁸ Several studies analyzing fractional lasers for acne scar treatment used a quartile grading scale to assess the response to acne scar improvement, consisting of 1 (mild improvement, 0-25%), 2 (moderate, 26-50%), 3 (good, 51% -75%) and 4 (very good, 75-100%).¹⁹

In this case, the patient was treated with fractional Er: YSGG laser and PRP treatment on the right side of the face and only Er: YSGG laser on the face's left side. The final evaluation was carried out 12 weeks after the first procedure (baseline). The clinical improvement of acne scars in this patient was evaluated using a qualitative and quantitative global acne scarring system based on Goodman and Baron, the patient and observer scar assessment scale (POSAS), the quartile

grading scale, and the level of patient satisfaction. The final evaluation found that the entire grading scale was improved on the right side of the face (Er: YSGG + PRP laser) and the face's left side (Er: YSGG laser only).

The risk of overheating, which can lead to scarring and loss of melanin pigment, appears lower in Er: YSGG laser than fractional ablative CO₂ lasers and fractional ablative Er: YAG laser when operated with high coagulation rates. Rhie et al. reported that only one patient had contact dermatitis complications in 20 patients who received Er: YSGG laser treatment.²⁰ Scarring and pigment loss were reported after using a CO₂ fractional laser, but not after using a fractional Er: YSGG laser, perhaps because this laser transmits less heat to the skin. All fractional ablative lasers can cause superficial skin pitting that can last months to years after treatment. The risk of pitting increases with the laser spot size parameter.²¹

In this case, the patient did not experience any side effects from the fractional Er: YSGG laser treatment or PRP combination. Post-treatment erythema was found on both sides of the patient's face but disappeared within three days on the face's right side and about five days on the face's left side. Signs of postinflammatory hyper or hypopigmentation, pitting, contact dermatitis, and secondary infection were not found on both sides of the patient's face. Further studies with larger sample sizes, longer observation time, more treatment sessions, and more objective evaluation techniques are needed to assess the effectiveness of the combination Er: YSGG laser and PRP treatment for acne scarring.

CONCLUSION

There was an improvement on the entire grading scale both on the right side of the face (Er: YSGG + PRP laser) and the left side of the face (Er: YSGG laser only). Fractional Er: YSGG laser and topical PRP work synergistically to improve the overall acne atrophic scar. The laser acts as a drug delivery system thereby facilitating the penetration of PRP which contains various growth factors that help in the wound healing process.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTION

The authors contributed in drafting, collecting patient data, and preparing the publication manuscript.

ETHICAL STATEMENT

This case report has approved by Ethical Commission of Faculty of Medicine, Universitas Sebelas Maret and the patient has given the informed consent.

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