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Original Research Article

A comparative study of efficacy of fractional carbon dioxide laser with and without platelet rich plasma in treatment of facial acne scars

Nikitha Reddy Mittamedi^{1,*}, Mukunda Ranga Swaroop¹, Priyanka Yogananda Yadav¹,
Shaila Shree Devendra¹, Taranpreet Kaur Kalra¹, Shaik Mohammed Obeidullah¹

¹Dept. of Dermatology, Adichunchanagiri Institute of Medical Sciences, B.G Nagara, Karnataka, India



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ABSTRACT

Background: Scarring and facial disfigurement caused by severe acne can cause significant physical and psychosocial distress, particularly in adolescents. In treating acne scars, dermatologists face a therapeutic challenge. Ablative lasers Erbium YAG lasers or carbon dioxide lasers are effective, but they are associated with erythema, post-inflammatory hyperpigmentation, a longer recovery time, and scarring. With the introduction of fractional carbon dioxide lasers, acne scar treatment has become much more effective. PRP contains growth factors, which helps to speed up the natural healing process. As a result, combining fractional CO2 laser with platelet rich plasma has resulted in significant improvement of acne scars with good cosmetic results and skin rejuvenation. Through this study, we intend to assess the efficacy of fractional carbon dioxide laser with platelet rich plasma versus fractional carbon dioxide laser alone in the improvement of facial acne scars.

Objectives: To compare the efficacy of fractional carbon dioxide laser with and without platelet rich plasma (PRP) in treatment of facial acne scars.

Materials and Methods: A total of 30 patients (18-40 years) with facial atrophic scars who attended the out-patient department at the Department of Dermatology, Venereology, and Leprosy, Adichunchanagiri Hospital and Research Centre, B.G. Nagara were randomly assigned to groups A (fractional CO2 with PRP group) and B (fractional CO2 group). Patients in both groups received four sequential treatments, with a four-week interval between each session. A side-by-side comparison of preoperative and post-operative photographs was used to assess the clinical improvement of atrophic scars one month after the last session, using Goodman and Baron's qualitative and quantitative grading system. Furthermore, patients were asked to provide feedback on scar improvement using the patient satisfaction Visual Analogue Score (VAS).

Results: Based on Goodman and Baron's qualitative assessment one month after the last session (4 sessions), 13.33 percent (2) of patients in group A showed reduction by three grades compared to 6.66 percent (1) patient in group B, and 60 percent (9) of patients in both groups showed scar reduction by two grades. Based on Goodman and Baron's quantitative assessment one month after the last session (4 sessions), 20 percent showed very good reduction in group A compared to 13.3 percent in group B, and 40 percent showed good reduction in group A compared to 33.3 percent in group B. [p=0.732, not statistically significant]. Patients treated with fractional carbon dioxide laser with PRP in group A had a slightly better mean percentage reduction of post acne scars at one month after the last session (4 sessions) compared to patients treated with fractional carbon dioxide laser in group B [75.83 vs 69.34 percent; p=0.72 which was statistically not significant]. At one month after the last treatment session (4 sessions), 66.67 percent (10) of patients in Group A were very satisfied with the treatment, compared to 46.67 percent (7) of patients in Group B. After four treatment sessions, the mean Patient Satisfaction VAS Score in Group A was 2.0, compared to 1.7 in Group B [p=0.000082, which was found to be statistically significant].

Conclusion: The result of this study shows that combination of fractional CO2 laser with intradermal PRP is slightly more efficacious than fractional carbon dioxide laser monotherapy in management of facial acne scars. Patients receiving fractional carbon dioxide laser with PRP were more satisfied with the treatment outcome.

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1. Introduction

Acne affects the face in a majority of cases, with many patients experiencing some degree of scarring, the severity of which correlates to acne grade. Acne scarring can reduce quality of life, and places a significant psychological and psychosocial burden on patients, including a lack of self-confidence and concerns over body image.¹⁻³ Scar management has benefited from the development of fractional photothermolysis in laser therapy. These laser devices deliver laser energy in a micro array pattern, resulting in small columns of tissue destruction in the epidermis and dermis referred to as micro thermal zones (MTZs), with intervening islands of healthy tissue. When compared to traditional ablative laser treatment, the tissue surrounding each column is spared with this technique, resulting in rapid epidermal regeneration with less downtime and adverse reactions. The fractional carbon dioxide laser is thought to be highly effective for treating acne scars.⁴

Platelet rich plasma (PRP) is a type of blood plasma that contains concentrated platelets. Concentrated platelets contain a large reservoir of growth factors, particularly epithelial growth factors, platelet-derived growth factors, and vascular endothelial growth factors, all of which initiate cellular growth, morphogenesis, and accelerate natural healing.⁵ As a result, combining fractional CO₂ laser with platelet rich plasma has resulted in significant improvement of acne scars with good cosmetic results and skin rejuvenation. However, there are few such studies in the Indian population. The purpose of this study was to compare the efficacy of fractional carbon dioxide laser alone versus combined fractional carbon dioxide laser and platelet rich plasma treatment in the improvement of facial acne scars.

2. Materials and Methods

The study was conducted on an out-patient basis for 18 months at the Department of Dermatology, Venereology, and Leprosy, Adichunchanagiri Hospital and Research Centre, B.G. Nagara, Nagamangala Taluk, Mandya District, with a study size of 30 patients.

2.1. Inclusion criteria

1. Patients who are willing to take part in the research.
2. Fitzpatrick's skin type III-V patients aged 18-40 years with moderate to severe facial acne scars.

2.2. Exclusion criteria

1. Patients who deny to participate in the study.
2. Patients under the age of 18 and over the age of 40.
3. Women who are pregnant or nursing.

4. Patients who have received oral retinoid treatment in the last 6 months and oral antibiotics in the last 3 months.
5. Patients who have received topical anti-acne treatment within the last month, such as retinoids, antibiotics, or anti-inflammatory agents.
6. Patients who have had ablative or non-ablative laser treatment in the previous 12 months.
7. Patients who have a history of photosensitive disorders such as lupus erythematosus or dermatomyositis.
8. Patients who have a history of active infections such as Herpes type I or II.
9. Patients with keloid and vitiligo history.

2.3. Group A: Fractional carbon dioxide laser and treatment protocol

Patients with acne scars had four sequential fractional carbon dioxide laser (DERMA INDIA FUTURA RF30) treatments, with a four-week interval between each session. The instrument characteristics are as follows:

1. Ultra pulse laser, 10600nm, CO₂ tube
2. Condenser focal length -f=50 mm
3. Spot size -0.2 mm
4. 33.3Hz pulse frequency
5. 0.1-10ms pulse duration
6. Interval-0.1-2.6mm
7. • Repetition -1-5000ms
8. Overlap-1-20times
9. Average power of 30 W or 30000 mJ/s
10. Scan graphics such as squares, rectangles, circles, triangles, ovals, and diamonds.
11. Maximum dot quantity-400
12. Mode-sequence, random, and maximum distance scanning modes
13. Each dot can have a pulse energy of -10milli-joule to 30milli-joule.

Prior to each treatment session, EMLA cream (lignocaine 2.5 percent & prilocaine 2.5 percent) was applied to the target areas of acne scars and left on for 40 minutes before gentle cleansing. The procedure area was painted with povidone iodine and disinfected with 70% isopropyl alcohol using sterile precautions, and eye shields were used to protect the eyes. Two passes were distributed during each session. The laser procedure was carried out with the following settings. Power: 50%, scanning size: 3mmx3mm to 10mmx10mm depending on the width of the lesion, distance: 1.1mm, duration: 2ms. The first pass was given in sequential mode, targeting only the acne scars, and the second pass was given in random mode, covering the entire face. Following the procedure, the site was gently wiped with cold water and an icepack was applied for 5 minutes to relieve discomfort and minimize swelling. This was followed by platelet-rich plasma at the scar site.

* Corresponding author.

E-mail address: nikithareddy0706@gmail.com (N. R. Mittameddi).

2.4. Group B: Autologous platelet rich plasma preparation and method of administration

Autologous platelet rich plasma was obtained by a two-stage centrifuging process. 10ml of patient's whole blood sample was drawn from the median cubital vein and collected in four sterile tubes each containing 1ml anticoagulant (Sodium citrate). The tubes were centrifuged at 1500 rotations per minute for 10 minutes in the centrifugal machine. At the end of first spin, three layers were formed. The bottom layer consisting of RBCs, the middle layer consisting of platelets and WBCs and the top layer consisting of platelet-poor plasma. Only the supernatant plasma containing platelets were transferred into another sterile tube without anticoagulant. This tube was subjected to a second spin at 3000 rotations per minute for 20 minutes to obtain a platelet concentrate. At the end of second spin, the lower 1/3rd was platelet rich plasma, upper 2/3rd was platelet poor plasma and platelet pellets were formed at the bottom of the tube. The platelet poor plasma was removed, tube was gently shaken to suspend the platelet pellets in platelet rich plasma which was withdrawn for treatment purpose. After fractional carbon dioxide laser treatment, autologous platelet rich plasma was injected into the scar with insulin syringe having 30 G needle. Patients were advised to apply broad spectrum sunscreen, emollients and to avoid sun exposure for 48 hours post treatment. Any post treatment erythema was treated with topical steroid antibiotic cream provided by investigator and post procedure pain was managed with non-steroidal anti-inflammatory drugs for 2-5 days.

2.5. Clinical evaluation

Facial acne scars were graded at the initial visit (week 0) using Goodman and Baron's qualitative acne scar grading system. Goodman and Baron's qualitative and quantitative acne scar grading system will be used to determine objective physician scores of improvement through a side-by-side comparison of preoperative and post-operative photographs taken at their first visit and 1 month after the last session.

Furthermore, patients were asked to provide feedback on the improvement of acne scars using the patient satisfaction score (0- Not satisfied, 1- Slightly satisfied, 2- Satisfied, 3- Very satisfied, 4-Extremely satisfied).

Adverse events were thoroughly documented at each treatment session and follow-up visit.

The data was collected and entered into Microsoft Excel 2016 before being analyzed with SPSS 20.0. Data was presented as percentages, means, and standard deviations. Wherever possible, the Chi square and t tests were used. At the 95 percent confidence level, a p value of 0.05 was considered significant.

3. Results

Based on Goodman and Baron's qualitative assessment one month after the last session (4 sessions), 13.33 percent (2) of patients in group A showed scar reduction by three grades compared to 6.66 percent (1) patient in group B, and 60 percent (9) of patients in both groups showed scar reduction by two grades. According to Goodman and Baron's quantitative assessment, 20% of patients in group A showed very good reduction compared to 13.33 percent in group B, 40% showed good reduction compared to 33.33 percent in group B, and 26.7 percent patients showed moderate reduction in both groups A and B. [p=0.732, not statistically significant]. At one month after the last treatment session (4 sessions), 66.67 percent (10) of patients in Group A were very satisfied with the treatment, compared to 46.67 percent (7) of patients in Group B. The VAS score for patient satisfaction in Group A patients was higher than in Group B patients [p=0.000082, which was found to be statistically significant]. All patients in both groups experienced transient oedema and erythema following treatment, which resolved quickly. There were no other significant adverse effects observed.



Fig. 1: Pre and post procedure photographs of fractional CO2 laser with prp patients

4. Discussion

Scarring and facial disfigurement caused by severe acne can cause significant physical and psychosocial distress, particularly in adolescents.³ Acne scarring can be atrophic or hypertrophic. Atrophic acne scars are more common on the face as a result of collagen destruction following inflammatory acne. Acne scar management is a therapeutic challenge for dermatologists. Ablative lasers such as Erbium YAG lasers and carbon dioxide lasers have improved the condition but have been associated with morbidity such as erythema, post-inflammatory hyperpigmentation,



Fig. 2: Pre and post procedure photographs of fractional CO₂ laser

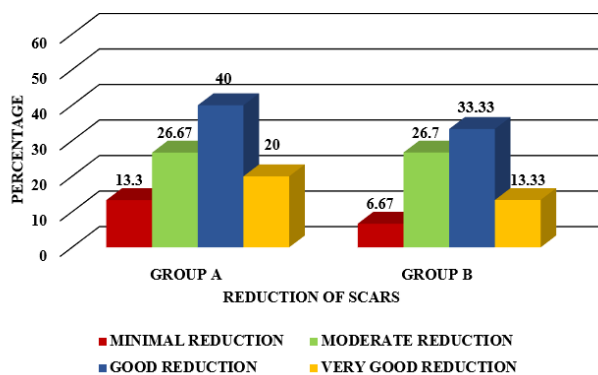


Fig. 3: Goodman and Baron's quantitative assessment of post treatment reduction of scars, comparing group A and group B.

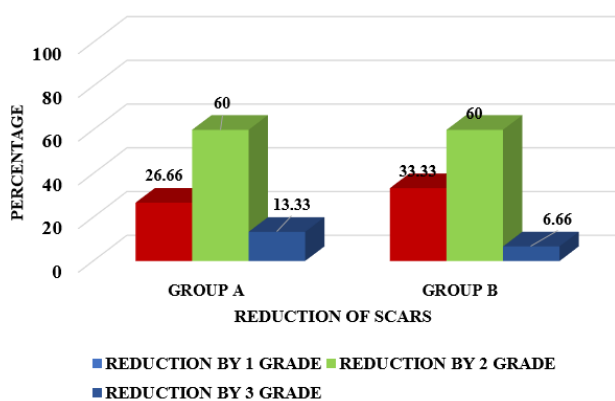


Fig. 4: Goodman and Baron's qualitative assessment of post treatment reduction of scars comparing group A and group B

hypopigmentation, and scarring.² As a result, there is a need for newer therapeutic modalities that are more effective, safe, and require less downtime. The introduction of fractional carbon dioxide lasers has proven to be very effective in treating acne scars. PRP contains growth factors that help to speed up the natural healing process. As a result, combining fractional CO₂ laser with platelet rich plasma has resulted in significant improvement of acne scars with good cosmetic results and skin rejuvenation. However, there are few such studies in the Indian population. We hoped to compare the efficacy of fractional carbon dioxide laser alone versus combined treatment with fractional carbon dioxide laser and platelet rich plasma in the improvement of facial acne scars with this study.

4.1. Group A: Fractional carbon dioxide laser with platelet rich plasma

The majority of the patients in this group were between the ages of 20 and 30. (66.67 percent). The patients' average age was 25.3 years. In a similar study, Kar BR et al found that the majority of patients (60 percent) were between the ages of 18 and 25, with a mean age of 25.06 years. In the current study group, males outnumbered females with a male to female ratio of 1.14:1, whereas in a study done by Gawdat et al., females outnumbered males with a male to female ratio of 1:2.⁶ The majority of patients (66.67 percent) had acne scars that lasted less than 5 years. In a similar study, Kar BR et al found that the majority of patients (73.33 percent) had acne scars that lasted less than two years.⁷ Based on Goodman and Baron's qualitative assessment one month after the last session, 13.33 percent (2) of patients had scars reduced by three grades, 60 percent (9) had scars reduced by two grades, and 26.66 percent (4) had scars reduced by one grade. However, because the assessment tool for scar improvement was different, our findings could not be compared to those of other similar studies. According to Goodman and Baron's quantitative assessment, 20% (3) of patients had very good reduction, 40% (6) had good reduction, 26.67% (4) had moderate reduction, and 13.33 percent (2) had minimal reduction. In a similar study, Gawdat et al found that 66.7 percent of patients who received fractional CO₂ with intradermal PRP improved significantly.⁶

According to Aal AMA et al, in 30 patients with post-acne scars, fractional CO₂ laser treatment was performed on both sides of the face, followed by PRP injection on the right side. PRP with fractional CO₂ laser treated side resulted in excellent improvement in 4 patients (13.3 percent), marked improvement in 12 patients (40 percent), moderate improvement in 8 patients (26.6 percent), and mild improvement in 6 patients (20 percent).⁸ Thirty patients underwent split face therapy in a study conducted by Shah SD et al. On one half of their face, they received ablative fractional carbon dioxide laser treatment combined with

autologous platelet rich plasma treatment, and on the other, they received ablative fractional CO₂ with intradermal normal saline. On the PRP-treated site, 33.33 percent (10) of patients improved significantly, 40 percent (12) improved significantly, and 23 percent (7) improved moderately. At one month after the last treatment, 66.67 percent (10) of the current group were very satisfied with the treatment, 20 percent (3) were moderately satisfied, and 13.33 percent (2) were slightly satisfied.⁹ The mean VAS score for patient satisfaction was 2.0. Aal AMA et al conducted a similar study evaluating the synergistic effects of autologous PRP with fractional CO₂ laser resurfacing in the treatment of acne scars, and 13 percent (4) of 30 patients were highly satisfied and 40 percent (12) were satisfied with the treatment outcome. All patients in this group experienced transient oedema and erythema following treatment, which resolved quickly. There were no other significant negative effects observed. Our findings were similar to those of Gawdat et al.⁶

4.2. Group B: Fractional carbondioxide laser

The majority of the patients in this group were between the ages of 21 and 30. (86.67 percent, 13 patients). The patients' average age was 27.33 years. In a similar study, Majid I et al found that the majority of patients (63.33 percent) were between the ages of 21 and 30, with a mean age of 22.1 years.¹⁰ In the current study group, males outnumbered females by a ratio of 1:0.87, whereas in a study done by Gawdat et al., females outnumbered males by a ratio of 1:2.8. In the current group, the majority of patients (60 percent, 9 patients) had acne scars that lasted 5-10 years.⁶ In a similar study, Majid I et al found that the majority of patients (46 percent) had acne scars that lasted 5 to 10 years.¹⁰ Based on Goodman and Baron's qualitative assessment one month after the last session, 6.66 percent (1) of patients had scars reduced by three grades, 60 percent (9) had scars reduced by two grades, and 33.33 percent (5) had scars reduced by one grade. However, because the assessment tool for scar improvement was different, our findings could not be compared to those of other similar studies. According to Goodman and Baron's quantitative assessment, 13.3 percent (2) of patients had very good reduction, 33.33 percent (5) had good reduction, and 26.7 percent (4) had both moderate and minimal reduction. Petrov et al. conducted a similar study in which the physician assessment of improvement revealed that out of 40 patients, 33 percent (13) had excellent improvement, 44 percent (17) had good improvement, 16 percent (6) had moderate improvement, and 5 percent (2) had mild improvement.¹¹

In a study conducted by Qiah H et al, 12.9 percent (4) of 31 patients who received three sequential fractional CO₂ treatment sessions over a 6-month period showed excellent improvement, 25.8 percent (8) showed good improvement,

41.9 percent (13) patients showed fair improvement, and 19.4 percent (6) patients showed poor improvement.¹² Majid I et al discovered that out of 25 patients treated, the majority of patients (76 percent (19) were highly satisfied with the treatment and 24 percent (6) were dissatisfied. All patients experienced transient oedema and erythema following treatment, which resolved quickly.¹⁰ There were no other significant negative effects observed. In contrast, in a study conducted by Ochi H et al, 6.4 percent (7) of 107 patients treated for acne scarring developed post-inflammatory hyperpigmentation.¹³

4.3. Comparison of goodman and baron's qualitative assessment in group A and group B

Based on Goodman and Baron's qualitative assessment, 13.33 percent (2) of patients in group A showed reduction by 3 grades compared to 6.66 percent (1) patient in group B, and 60 percent (9) of patients in both groups A and B showed reduction by 2 grades.

4.4. Comparison of goodman and baron's quantitative assessment in group A and group B

Based on Goodman and Baron's quantitative assessment one month after the last session (4 sessions), 20 percent showed very good reduction in group A compared to 13.3 percent in group B, and 40 percent showed good reduction in group A compared to 33.3 percent in group B. [p=0.732, not statistically significant]

4.5. Comparison of post treatment mean percentage reduction of postacne scars in group A and group B

Patients treated with fractional CO₂ laser with PRP in group A had a slightly better mean percentage reduction (75.83 percent) of post acne scars one month after the last session (4 sessions) than patients treated with fractional CO₂ laser in group B. (69.34 percent) [75.83 percent versus 69.34 percent; p=0.72, statistically insignificant]. The combination of fractional CO₂ laser and PRP produced slightly better results than the fractional CO₂ laser alone. 116 Galal O et al. randomized 30 patients to receive fractional CO₂ laser therapy to one side of the face while the other side of the face received fractional CO₂ laser therapy followed by intradermal PRP injection. According to the Goodman global score, there was a greater reduction on the sides of the face treated with combined laser and PRP, as well as a significant improvement in scar depth. As a result, they concluded that the combination of fractional CO₂ laser and PRP was the most effective.⁴ Aal AMA et al conducted a study to assess the synergistic effects of autologous PRP with fractional carbon dioxide laser resurfacing in the treatment of acne scars in 30 patients. The Tanzi and Alster quartile grading scale was used to assess

the degree of improvement in skin texture, number, size, and depth of lesions. The right side of the face (PRP treated side) improved significantly in 13.3 percent of patients, while the left side of the face did not improve significantly. As a result, they concluded that the combination of fractional carbon dioxide laser resurfacing and intradermal PRP was superior to carbon dioxide laser alone in the treatment of acne scars.⁸

4.6. Comparison of patients satisfaction score in group A and group B

At one month after the last treatment session (4 sessions), 66.67 percent (10) of patients in Group A were very satisfied with the treatment, compared to 46.67 percent (7) of patients in Group B. The VAS score for patient satisfaction in Group A patients was higher than in Group B patients [$p=0.000082$, which was found to be statistically significant]. As a result, patients who received combined fractional CO₂ laser and PRP were more satisfied with the treatment outcome than those who received fractional CO₂ monotherapy. Our findings were similar to those of Galal O et al and Aal AMA et al.^{4,8}

4.7. Comparison of side effects seen in group a and group b patients

All patients in both groups experienced transient oedema and erythema following treatment, which resolved quickly. There were no other significant side effects reported. Our findings were similar to those of Galal O et al. In a study conducted by Aal AMA et al., 16.6% of patients developed PIH in the fractional CO₂ laser treated site of the face, whereas none of the patients developed PIH in the combined fractional CO₂ laser and PRP treatment site.^{4,8}

5. Conclusion

The result of this study shows that combination of fractional CO₂ laser with intradermal PRP is slightly more efficacious than fractional carbondioxide laser monotherapy in management of facial acne scars. Patients receiving fractional carbon dioxide laser with PRP were more satisfied with the treatment outcome.

6. Conflicts of Interest

None.

7. Source of Funding

None.

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Author biography

Nikitha Reddy Mittamedi, Senior Resident

Mukunda Ranga Swaroop, Professor and HOD

Priyanka Yogananda Yadav, Senior Resident

Shailla Shree Devendra, Junior Resident

Taranpreet Kaur Kalra, Junior Resident

Shaik Mohammed Obeidullah, Junior Resident

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