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Research Article

A Comparative Study On Fractional Carbon-Dioxide Laser Versus Fractional Carbon-Dioxide Laser with Platelet Rich Plasma in Post-Acne Scars

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Abstract: Acne scars, irrespective of age and gender, can cause significant cosmetic problems with profound psychosocial impact. During the healing process, aberrant production and degradation of collagen lead to various types of acne scars. Facial acne scars can be safely and effectively treated with the help of high-energy, pulsed, or scanning carbon dioxide lasers with recent advances involving platelet-rich plasma as a modality. Their beneficial potential rests on delivering a high concentration of growth factors to the target tissues. The study aims to assess the outcome of fractional carbon dioxide laser alone and with platelet-rich plasma (PRP) in treating post-acne scars. This is a single-centre randomized study comparing the efficacy of fractional carbon dioxide laser resurfacing and fractional carbon dioxide + PRP in the treatment of post-acne scars involving 30 patients, with 15 patients in group 1 receiving only fractional carbon dioxide laser and 15 patients in group 2 receiving fractional carbon dioxide + PRP. In this study, though both groups exhibited significant improvement at final follow-up, patients in the fractional carbon dioxide with PRP group showed a more significant change in quantitative assessment from visit to visit compared to those in the fractional carbon dioxide laser group, indicating that topical PRP helped further diminish the scars and improved the texture of scars and also helped in reducing the incidence of side effects as patients in the fractional carbon dioxide laser group exhibited some side effects like hypopigmentation and hyperpigmentation. Our study has concluded that although fractional carbon dioxide laser alone and fractional carbon dioxide laser with platelet-rich plasma had significant results, the latter group had slightly better results with no side effects.

Keywords: Fractional carbon dioxide laser, Platelet-rich plasma, Acne scars, types of scars

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1. INTRODUCTION

Acne vulgaris is a chronic, self-limiting, inflammatory disease of the pilosebaceous unit, generally manifesting in adolescence, and though not commonly associated with any adverse effects, facial acne scars can be a complication, often with a severe psychosocial impact. Facial acne scars account for 95% of all acne scars, and this distribution is consistent regardless of gender[1]. Facial atrophic scars can be safely and effectively rejuvenated with the help of high-energy, pulsed, or scanning carbon dioxide lasers. Tissue vaporisation occurs due to the high energy density of these laser systems in extremely short pulses, with minimal thermal transfer to the surrounding skin. Due to the predictable and consistent quantity of tissue vaporization and residual thermal damage caused by each laser pulse, the amount of tissue that must be removed depends on the type of scar that needs to be resurfaced. The therapeutic advantages of resurfacing are immediate collagen shrinking and subsequent collagen remodelling. There are many treatment options available for resurfacing acne scars like chemical peels, microdermabrasion, subcision, derma roller, tissue augmentation, fractional carbon-dioxide laser, and platelet-rich plasma (PRP), to name a few, most of which target collagen remodeling. This study focuses on fractional carbon-dioxide lasers and the augmented effects of PRP in managing acne scars. Fractional carbon dioxide laser has minimal chances of serious, long-term adverse effects as vaporization of only a fraction of the skin leaves behind columns of untreated skin. This surrounding area of untreated skin helps in re-epithelialization and collagen remodeling.[2] According to previous research, the carbon dioxide laser's benefits outweigh the treatment's procedural complexity, making it the dermatologists' preferred therapy for acne scar removal. Current literature supports the notion that the fractional carbon dioxide laser is unquestionably a superior approach. According to Gold M[3], the scale for treating acne blemishes, wrinkles, and folds on the face deemed carbon dioxide laser therapy the best procedure in the early 1990s and early 2000s. Among the various laser therapy procedures available today, it is regarded as one of the most effective methods. Recently, with its multifaceted usage in dermatology, platelet-rich plasma (PRP) has also found a niche in managing acne scars, with better tolerance and reduced side effects. Platelet-rich plasma (PRP) is a concentrated plasma product derived from one's blood high in platelets, growth factors, and chemo/cytokines. The field of tissue repair and regeneration has shown considerable interest in PRP since the 1970s. It has recently been used for a wide range of dermatological purposes, such as wound healing, fat grafting, alopecia treatment, scar treatment, and soft-tissue volume augmentation. The musculoskeletal and craniofacial fields were the primary focus of early research. PRP can transport many growth factors to the tissues it is intended to heal because of the proteins found in the alpha and dense granules. Post-acne scarring has detrimental mental health consequences, including low self-esteem, and the authors, through this study, aims to compare the outcome of fractional carbon dioxide alone and in combination with PRP in the management of different types of acne scars and to bring forth any advantages of the addition of PRP to the standard treatment modality of fractional carbon dioxide laser monotherapy. The study aimed to assess the outcome of fractional carbon dioxide laser alone and with platelet-rich plasma in treating post-acne scars.

2. MATERIALS AND METHODS

The study was a prospective, single-centre, randomized study comparing the efficacy of fractional carbon dioxide laser resurfacing and fractional carbon dioxide + PRP in treating post-acne scars, conducted after obtaining ethical clearance.

2.1. Method of Study

2.2. Inclusion Criteria

1. Patients with acne scars
2. Patients above 18 years and < 40 years
3. Patients willing for the procedure

2.3. Exclusion Criteria

1. Patients with active acne
2. Predisposition to keloid formation
3. Patients' active herpes infection
4. Pregnant and lactating mothers
5. Patients with high expectations
6. Platelet dysfunction patients
7. Patients with active infection.
8. Anaemia

2.4. Equipment

1. The fractional carbon dioxide laser system with a wavelength of 10,600nm was used with treatment settings of pulse energy of 40-50 mJ,with a peak power of 50w; the single pass was delivered to the entire area containing acne scars.
2. Two-stage centrifugation process (double-spin method) was used to prepare PRP. Whole blood samples (10mL) were drawn from the patient and transferred into a tube prefilled with citrate anticoagulant solution. The mixture was centrifuged at 2500 rpm for 7min (first spin). After the first spin, the lower red blood cell portion was discarded, and the supernatant containing platelet-poor plasma and buffy coat was centrifuged again at 4000 rpm for 5min (second spin). The lower one-third of this solution provided approximately 2mL of autologous PRP for topical application.

2.5. Treatment Procedure

After giving their informed consent, all patients in the study had a thorough history taken and a general physical, systemic, and dermatological examination. Each patient had an objective and subjective baseline assessment using the Global Acne Scarring Classification. The study population was divided into two groups: patients in Group 1 received only fractional carbon dioxide, while those in Group 2 received both fractional carbon dioxide and PRP. Before the procedure, a mild cleanser was used to prepare the face. Topical anesthetic containing lidocaine 2.5% + prilocaine 2.5% was applied under occlusion and left for 1 hour. Patients in both groups had their fractional carbon dioxide laser treatment performed with the same standard parameters after completely removing the topical anesthetic. Patients in Group 2 were given a topical application of autologous PRP after their laser treatment. A centrifuge was used in a two-step centrifugation process to obtain PRP. Patients had 10 mL of whole blood collected from the medial cubital vein and transferred to a vial with an anticoagulant in a sterile

environment. The sample was centrifuged at 2500 rpm for 10 minutes. Aspirating plasma with few red blood cells (PRP) and platelets into a new tube and centrifuging it at 4000 rpm for 8 minutes yielded PRP. After applying PRP, the patient stayed supine until the area was dried. Sessions were repeated at 4-week intervals. Patients were subjected to a total of 4 similar sittings. Digital photographs of the face were taken at baseline and every sitting up to 4 weeks after the 4th sitting. The scars were graded using the Goodman and Baron qualitative[3] (Figure 1) and quantitative[4] (Figure 2) acne scar grading system at baseline and 4 weeks after each session (Week 0, Week 4, Week 8, Week 12 & Week 16).

Grade	Level of disease	Characteristics	Examples
1	Macular disease	Erythematous, hyper- or hypo pigmented flat marks visible to patient or observer irrespective of distance	Erythematous, hyper- or hypo pigmented flat marks
2	Mild disease	Mild atrophy or hypertrophy that may not be obvious at social distances of 50 cm or greater and may be covered adequately by make-up or the normal shadow of shaved beard hair in males or normal body hair if extrafacial	Mild rolling, small soft papular
3	Moderate disease	Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50 cm or greater and is not covered adequately by make-up or the normal shadow of shaved beard hair but is still able to be flattened by manual stretching of the skin	More significant rolling, shallow "boxcar,"mild to moderate hypertrophic or opular scars
4	Severe disease	Severe atrophic or hypertrophic scarring that is obvious at social distances of 50 cm or greater and is not covered adequately by make-up or the normal shadow of shaved beard hair in males or body hair (if extrafacial) and is not able to be flattened by manual stretching of the skin	Punched out aerophic (deep "boxcar"), "ice pick," bridges and tunnels, gross atrophy, dystrophic scars, significant hypertrophy or keloid

Fig 1: Goodman and Baron Qualitative Scale[4]

Figure showing characteristics of different grades of acne scars.

Grade (type)		No. of lesions		
		1-10	11-20	>20
A	Milder scarring - Macular erythematous, pigmented, mildly atrophic dish-like	1pts	2pts	3pts
B	Moderate scarring - moderately atrophic dish like, punched out small scars with, shallow bases but atrophic areas (<5mm)	2pts	4pts	6pts
C	Severe scarring – punched out with deep but normal bases, punched out with deep abnormal bases, linear or troughed dermal scarring, deep and broad atrophic areas	3pts	6pts	9pts
D	Hyperplastic papular scars	2pts	4pts	6pts
E	Hyperplastic keloidal or hypertrophic scars	Area < 5 cm^2 – 6pts	Area 5-20 cm^2 – 12pts	Area > 20 cm^2 – 18pts

Assessment of improvement using Goodman and Baron's quantitative acne scar grading system:

Grades	Improvement status
0-5	Minimal reduction in GSGS scores
5-10	Moderate reduction in GSGS scores
10-15	Good reduction in GSGS scores
>15	Very good reduction in GSGS scores

Fig 2: Goodman and Baron Quantitative Scale[5]

2.6. *Post Procedure Care*

Patients were advised to use ice cubes after the procedure. They were informed about the persistence of erythema and edema for up to 48 hours, followed by oozing and scabbing for another 48 hours. They were also advised about the importance of sun protection, both physical and regular sunscreen usage, and the avoidance of scrubs or abrasive cleansers on the treated skin for at least 1 week after the procedure.

2.7. *Assessment Parameters*

1. Using the above scale, the Goodman and Baron Qualitative grading system graded Acne scars before and after treatment.
2. Using the above scale
3. , the Goodman and Baron Quantitative grading system graded Acne scars before and after treatment.

2.8. Efficacy Evaluation

1. Change in the baseline score of acne scars and at the end of 16 weeks using Goodman and Baron qualitative grading system.
2. Change baseline scores at the end of 16 weeks using Goodman and Baron quantitative grading system.

2.9. Statistical Analysis

Data were analyzed statistically by Mean, Median, Standard deviation, and proportion. Inferential statistics was done by Chi-square test; appropriate statistical tests were applied using SPSS version 21.0. p-value

3. RESULTS AND DISCUSSION

The majority of the participants in this study (76.7%) were young adults in their twenties to thirties, with a mean age of 24.50 + 4.7 years. (Table 1) Males accounted for 66.6% of participants, while females comprised 33.4 % of the population (table 1). According to the Fitzpatrick scale, most participants in this study (33.3%) had skin type IV, with another 30% each having skin types V and VI. Based on the acne duration, 80% had a history of acne for less than 2 years, and only 20% suffered from acne for more than 2 years. (Table 2).

Table 1: Profile of Study Population

Age/Gender	Number	Percentage
<20	5	16.7
21-30	23	76.7
31-40	2	6.7
Male	20	66.7
Female	10	33.3

Table showing the number of patients in different age groups and male and female patients in the study.

Table 2: Patient Characteristics

Age	24.50 ± 4.798
Gender	
Male	20 (66.7%)
Female	10 (33.3%)
Mean Duration Of Scars	1.48 ± 1.08
Fitzpatrick Skin Stype	
III	2
IV	10
V	9
VI	9
Type Of Scar:	
Box	1
Ice Pick	4
Rolling	25

Table showing mean age, mean duration of acne scars, Fitzpatrick skin type, and different types of scars.

In this study, according to the Goodman and Baron quantitative scoring, the fractional carbon dioxide group showed mean scores of 12±4 at the time of the first evaluation and 7.20±3.19 at the time of the last evaluation. The fractional carbon dioxide + PRP group showed 13.60±3.89 at the time of the first evaluation and 7.73±2.81 at the time of the last evaluation (Figure 3).

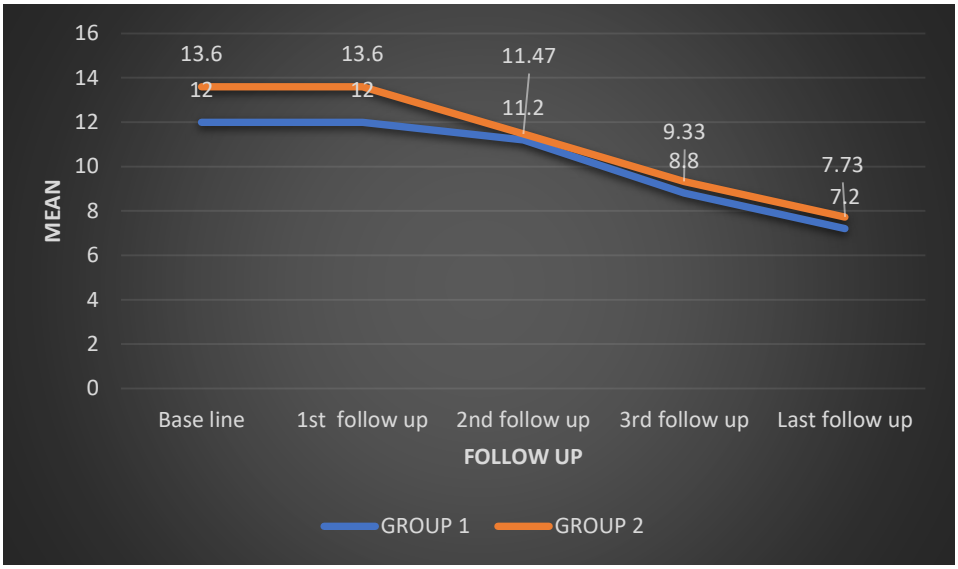

Fig 3: Assessment of Both Groups of Study Participants using Goodman and Baron Quantitative score (Group 1: Fractional carbon dioxide laser alone; Group 2: Fractional carbon dioxide + PRP)

As seen in the above figure, there was a drastic reduction in the quantitative assessment of the 2 groups of study participants. The association was statistically significant between the quantitative assessment during the 1st and the last sitting in the first and second groups.[8] patients (53.3%) showed minimal improvement, and 7(46.7%) showed moderate improvement in the fractional carbon dioxide group. In comparison, 5 patients (33.3%) showed minimal improvement, 9(60%) showed moderate improvement, and 1(6.7) showed good improvement in fractional carbon dioxide + PRP group (Figure 4).

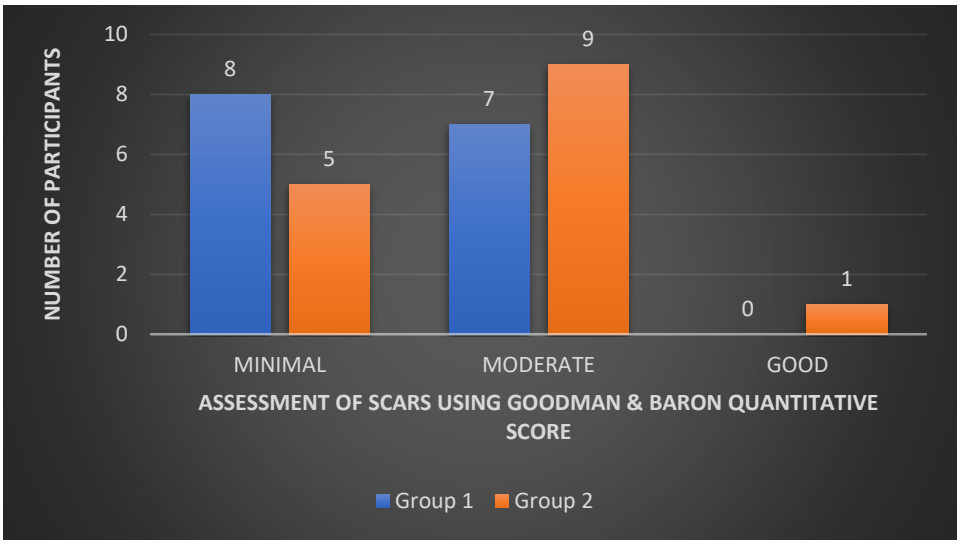

Fig 4: Assessment of the 2 Groups of Study Participants using Goodman and Baron Quantitative Score (Group 1: Fractional carbon dioxide Laser alone; Group 2: Fractional carbon dioxide + PRP)

As seen in the above figure, most of the study participants from Group 2 had moderate and good improvements in terms of acne scar reduction. The association between the 2 groups of study participants and acne scar reduction was not statistically significant. Regarding improvement using Baron and Goodman qualitative scale, group 1 had 9 patients (60%) who showed a reduction by 1 grade, and 1 patient (6.7%) had a reduction by 2 grades. In group 2, 11(73.3%) patients had a reduction by 1 grade, and 2 patients (13.3%) had a reduction by 2 grades (Table 4).

Table 4: Improvement in both groups of study participants using the Goodman and Baron qualitative scale. (Group 1: Fractional carbon dioxide Laser alone; Group 2: Fractional carbon dioxide + PRP)

Improvement From Baseline To Last Follow-up	GROUP 1	GROUP 2
Reduction By 1 Grade	9(60%)	11(73.3%)
Reduction By 2 Grades	1(6.7%)	2(13.3%)

The above table showed that while both groups displayed a grade reduction, group 2 had better results than Group 1.Regarding the response to specific types of scars, 12 patients (80%) with rolling scars from group 1 and 10 patients (66.7%) from group 2 showed a reduction by 1 grade. In addition, while a reduction by 2 grades was seen in 3 patients (20%) from group 2, no patient in group 1 showed a reduction by 2 grades. In patients with box scars, a

reduction by 1 grade was seen in five patients (33.3%) from group 1 and four patients (26.7%) from group 2. In patients with ice pick scars, there was no reduction in grades. Thus, based on the results, rolling scars responded very well to both forms of therapy, with the fractional carbon dioxide + PRP group showing a slightly better response. On the other hand, ice pick scars showed no improvement in either therapy (Figure 5).

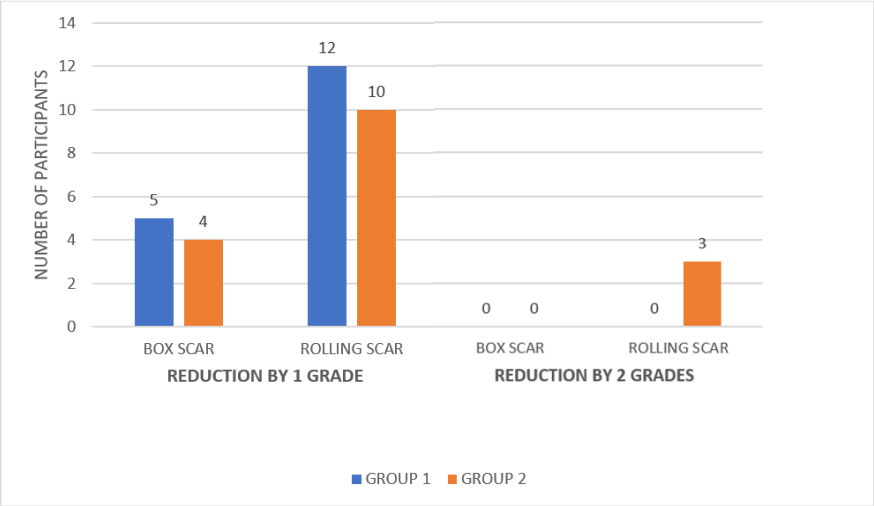

Fig 5: Improvement in different types of scars in both groups of study participants using the Goodman and Baron qualitative scale. (Group 1: Fractional carbon dioxide laser alone; Group 2: Fractional carbon dioxide + PRP)

The above figure shows a reduction in scar grades in rolling and box types of scars. Ice pick scars did not show any reduction in grades. Regarding side effects experienced by the patients, hypopigmentation and hyperpigmentation were seen in two patients each from Group 1 (13%); no side effects were reported in patients in Group 2. All patients showed signs of erythema, oedema, and burning, but none reported itching. Temporary erythema that lasted for about two to three days after all patients reported the procedure. None reported erythema that lasted longer than 7 days.The current study did not show any significance in comparing the age, gender, skin type, and duration of acne scars with the outcome.The purpose of this study was to compare the efficacy of fractional carbon dioxide laser therapy alone and in combination with platelet-rich plasma in the treatment of post-acne scars, and it involved 30 patients who visited the dermatology outpatient department at a tertiary Hospital in Chennai.The majority of the participants in our study (76.7%) were young adults in their twenties to thirties. According to the data, the mean age of the subjects who participated in the study was 24.50 $\pm$ 4.798 years. In our study, 73.3% of Group 1 and 80% of Group 2 patients belonged to the 21 - 30 age group (table 1). The average age in the study by*Sanad EMet al.,*[6]was 30.5 $\pm$5.9 years. In addition, *Sundaram Get al.* [7] found that most participants were between 18 and 25 (73.3 percent). In a study by *Arsiwalaet al*., the [8] mean age was 24.36 $\pm$ 4.37 years, and the majority belonged to the age group of 20 -30 years. The results of the current study were consistent with these previous ones. No significant difference was found between the groups concerning age distribution. In the present study, males accounted for 66.6% of participants, while females comprised 33.4 % of the population. Most males (60.0%) belonged to Group 2, whereas most females belonged to Group 1 (70%). *Sundaram G, et al.,*[7] found male predominance among the participants (60% male). In a study by *Arsiwala NZet al.,*[8] men made up a slightly larger proportion of the sample, similar to this study. In a study by *Sanad et al.,*[7] females accounted for 66.6%, and in a study by *Majid et al*., [9] females accounted for 58.3%, similar to this study. Females are more likely to experience acne than males among Asians, with a male-to-female ratio of about 1/ 1.1 - 1.25[9-10]. A similar study by Dao and Kazin,[11]reported that estrogen can help in better wound healing. However, they also concluded that the patient's gender does not always require radical alteration of the treatment approach. Also, there is a lack of randomized controlled trials regarding gender differences in wound healing.[11] The difference in gender distribution between the groups was insignificant in the present study.Among the people who participated in this study, 80% had a history of acne for <2 years and only 20% suffered from acne for > 2 years. A lesser proportion of people (50%) suffered from acne for 1– 4 years in a study by *Sundaram Get al*.,[7] than seen in the current study. The mean duration of acne in this study was 1.48 $\pm$ 1.08, whereas in a study by *Arsiwalaet al*.,[8] 2.74 $\pm$ 1.57 years, slightly more than the present study. According to the Fitzpatrick scale, most participants in this study (33.3%) had skin type IV, with another 30% each having skin types V and VI (table 4). The results of this study are consistent with those of a previous study by *Arsiwala NZet al*.,[8], in which 30.3% of participants had type V skin according to the Fitzpatrick classification scale. In a study by *Majidet al*.,[9], the most common skin type was type III (60%), whereas, in the present study, it was less frequent (6.7%). An almost similar distribution of skin type inboth groups was observed in this study. Our study showed a statistically significant correlation between the Fractional carbon dioxide therapy group and the improvement in quantitative assessment from baseline to follow-up. 46.7 % (7 patients) showed moderate improvement, and 53% (8 patients) showed minimal improvement in the scores after the last sitting. *Sundaram G et al.,*[7] found that 11.1% of participants had an excellent

response of greater than 75%, 59.2% had a good response with an improvement of 51% to 75%, and 29.7% had a fair response of 26% to 50%, all while using fractional carbon dioxide laser as monotherapy. The results of the current study are consistent with this. In concordance with our study, the average first-session improvement score in the study by *Sanad EM et al.,*[6] was 32.3. The improvement score increased significantly over time (p<0.001), rising from 45 after the second session to 63.3 after the third. They also discovered that the most common adverse reactions to fractional carbon dioxide laser treatment were erythema (100%) and edema (20%), but neither scarring nor hyperpigmentation occurred. After receiving Fractional carbon dioxide + PRP therapy, 60% of our study participants showed moderate improvement. Quantitative evaluations in the treatment group that received Fractional carbon dioxide + PRP therapy showed statistically significant improvement between the baseline and follow-up evaluations. This was consistent with a study by *Arsiwala NZ et al.,*[8] where the mean scar score after receiving Fractional carbon dioxide + PRP therapy reduced significantly from 11.5 to 4. Though the associations were found to be statistically significant in both groups, patients in the fractional carbon dioxide with PRP group showed a more significant change in quantitative assessment from visit to visit compared to those in the fractional carbon dioxide laser-only group, indicating that topical PRP helped further diminish the scars. These results were in agreement with those of *Leeet al.,*[12] who compared the effect of fractional carbon dioxide laser plus PRP on one side versus fractional carbon dioxide laser alone on the other side, and concluded that the overall degree of clinical improvement was significantly better on the PRP-treated side. In a study by *Gawdat et al.,*[13] combined PRP and Fractional carbon dioxide treated areas had a significantly better response (p = .03), fewer side effects, and shorter downtime (p = .02) than areas treated by fractional carbon dioxide alone. *Faghihi et al.*,[14] used fractional carbon dioxide laser with PRP in 16 patients with acne scars in a split-face study and observed no significant difference in treatment response over both sides, with patients being more satisfied over the side treated by combination with PRP with an insignificant statistical difference over both the sides of the face. According to research by *Pa-FanHsiao et al.,*[15] only 6 of the 25 patients (24%) had post-inflammatory hyperpigmentation, and by 3 months of follow-up, it had faded in 5 of the 6 cases. When compared to other studies, the current study had fewer complications. Figures 6 and 7 demonstrate the clinical outcome of patients treated with fractional carbon dioxide laser alone and fractional carbon dioxide laser in combination with PRP.

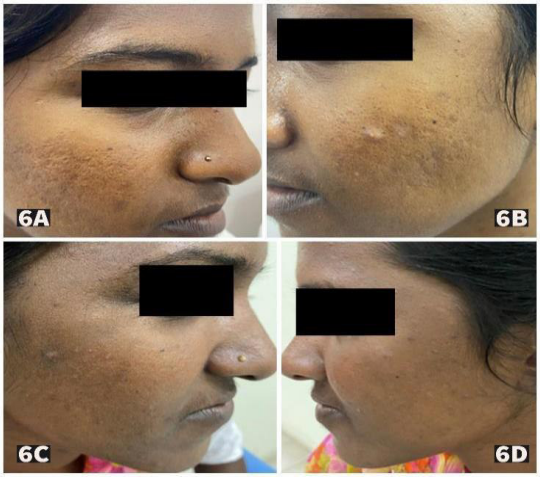

Fig 6: Clinical images of a fractional carbon dioxide monotherapy patient. (6A & B – Baseline; 6C & D – Last Follow-up)

Fig 7: Clinical images of a patient who received fractional carbon dioxide therapy + PRP. (7A & B – Baseline; 7C & D – Last Follow-up)

4. CONCLUSION

Post-acne scarring is a common complication of acne, which can have detrimental mental health consequences. In the current dermato-surgical procedures, fractional carbon dioxide laser and platelet-rich plasma have found a niche in managing acne scars. Our study has concluded that while fractional carbon dioxide laser alone and fractional carbon dioxide laser with platelet-rich plasma had significant results in terms of improvement, the latter group had slightly better results with no side effects. The lack of side effects like hypopigmentation and hyperpigmentation in the second group could be attributed to the addition of platelet-rich plasma. This study also concluded that rolling scars showed better improvement among the three types of acne scars, whereas ice-pick scars showed no improvement. Thus, based on the results of this study, fractional carbon dioxide laser in combination with platelet-rich plasma can be considered a better modality in treating acne scars.

5. AUTHORS CONTRIBUTION STATEMENT

Dr. Geo Danny C and Dr. Shreya Srinivasan conceptualized and designed the study. Dr. Harsha Rupak curated the data and prepared the original draft; Dr. Sivaramakrishnan.S, Dr. Ashok Kumar N, and Dr. D. Manoharan discussed and analyzed the methodology. All authors read and approved the final manuscript.

6. CONFLICT OF INTEREST

Conflict of interest declared none.

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