Journal of Pakistan Association of Dermatologists. 2026;**36(1)**:37-45.

Original Article

Evaluating the effectiveness of platelet-rich plasma as an adjunct to Fractional Carbon Dioxide Laser therapy in improving facial acne scar appearance: A randomized controlled trial

Yasaan Saaqib[1], Nabeela Shahzadi[1], Mahym Mansoor[1], Asma Tariq[1], Zahid Tahir[1], Maryam Wahla[1], Saira Riaz[1]

[1]Department of Dermatology, Gujranwala Medical College/ GMC Teaching Hospital, Gujranwala.

Abstract

Background Fractional carbon dioxide (CO_2) laser resurfacing is commonly used to treat atrophic acne scars, but treatment responses vary and adverse effects such as erythema and post-inflammatory hyperpigmentation are frequent. Platelet-rich plasma (PRP) has been proposed as an adjunct to enhance dermal remodeling and improve tolerability.

Objective To evaluate whether platelet-rich plasma (PRP) enhances the efficacy of fractional CO_2 laser resurfacing in reducing moderate-to-severe acne scars and minimises laser-induced complications such as erythema, oedema, and pain, thereby improving patient satisfaction.

Methods Seventy adults with moderate-to-severe atrophic acne scars were assigned to receive three sessions of fractional CO_2 laser with topical autologous PRP (35 participants) or laser alone (35 participants) at 4-week intervals. The primary outcome was change in scar severity at 12 weeks using the Goodman and Baron scale. Pain and satisfaction were assessed using the visual analogue scale (VAS).

Results Thirty-two participants in group A and 28 in group B completed the study. Scar severity improved significantly in both groups. In group A, scores decreased from 12.4±3.8 to 8.2±3.5; in group B, from 11.8±4.1 to 8.6±4.5. Although improvement was greater with PRP (4.2 vs. 3.2 points), it was not statistically significant ($p = 0.129$). Patient satisfaction was higher with PRP. Adverse-event rates were similar, but erythema, oedema, and pain were significantly less severe in the PRP group.

Conclusion The combination of fractional CO_2 laser with PRP showed greater, though not statistically significant, improvement in acne scars and a better safety profile, with greater satisfaction, than laser alone.

Keywords Fractional Carbon Dioxide Laser; PRP; atrophic scars; Goodman and Baron scale.

Article Received on 24.01.2026

Revised on 02.03.2026 15.03.2026

Accepted on 24.03.2026

Published on 30.03.2026

Citation: Saaqib Y, Shahzadi N, Mansoor M, Tariq A, Tahir Z, Wahla M, Riaz S. Evaluating the effectiveness of platelet-rich plasma as an adjunct to Fractional Carbon Dioxide Laser therapy in improving facial acne scar appearance: A randomized controlled trial. *J Pak Assoc Dermatol*. 2026;**36(1)**:37-45.

Doi- https://doi.org/10.66344/jpad.v36i1.3326

Introduction

Acne scars are a common and distressing consequence of acne vulgaris, affecting 47% of the affected individuals.[1] Their pathogenesis is multifactorial, involving inflammatory processes, collagen degradation, and abnormal wound healing processes.[2] Acne scars can be classified as atrophic scars, hypertrophic scars, or keloid scars.[3] Atrophic scars are by far the most common type and can be subclassified into ice-pick, rolling, and boxcar scars.

Current treatment options for acne scars include various modalities such as chemical peels,

Address for correspondence
Dr. Yasaan Saaqib,
Department of Dermatology,
GMC/Gujranwala Teaching Hospital, Gujranwala.
Email: saani1992222@gmail.com

microneedling, and laser therapies.[4] Among these, fractional carbon dioxide (CO_2) laser therapy has emerged as one of the most effective treatments because of its ability to stimulate collagen remodelling and improve skin texture by delivering microbeams of energy, sparing surrounding tissue and promoting healing.[5] Despite its efficacy, fractional CO_2 laser can cause side effects such as erythema, oedema, pain, and prolonged recovery.[6] Additionally, some patients may experience suboptimal results.[7]

To overcome these limitations, researchers are exploring adjunctive therapies. Platelet-rich plasma (PRP), derived from the patient's blood, offers a promising avenue due to its high concentration of growth factors and cytokines that promote tissue healing and regeneration.[8] Preliminary studies suggest that combining PRP with fractional CO_2 laser therapy may improve clinical results, shorten recovery, and increase patient satisfaction.[9,10] For instance, Galal *et al*. (2019) demonstrated significant improvement in atrophic acne scars with combined therapy compared with laser alone, with greater reductions in scar depth, pigmentation, and redness in 70% of patients.[9] A meta-analysis by Chen *et al*. corroborated these findings, revealing a 1.63 times greater likelihood of achieving over 50% scar reduction with combined treatment and a 2.98-fold increase in positive patient experience.[10] The rationale for using PRP as an adjunct to laser therapy lies in its potential to enhance collagen production and modulate inflammation, thereby optimizing the laser's effectiveness.[11] This study evaluated the combined efficacy of these two treatment modalities in a randomized trial in which platelet-rich plasma (PRP) was administered only to the combination-therapy group, while laser therapy served as the control intervention in both groups, with the aim of improving clinical outcomes in patients with acne scars.

Methods

This assessor-blind, randomized controlled trial was conducted at the Department of Dermatology, Gujranwala Medical College Teaching Hospital, Gujranwala, from April 3, 2025, to January 28, 2026. The trial was registered with ClinicalTrials.gov ID: NCT07352215. The study protocol was approved by the Institutional Ethics Committee (IRB.22/GMC dated 03.04.2025).

Participants aged 18 to 40 years, of any gender, and having Fitzpatrick skin types III, IV, or V with moderate-to-severe acne scarring were enrolled. Exclusion criteria included the use of topical anti-acne treatment within the past month, predisposition to keloid formation, active inflammation at the treatment site, diabetes mellitus, photosensitive disorders such as lupus erythematosus and dermatomyositis, melasma, recent history of infections (e.g., herpes simplex virus type I), recent laser resurfacing procedures, outdoor occupations involving prolonged sun exposure, vitiligo, pregnancy or lactation, bleeding diathesis, and unrealistic expectations regarding treatment outcomes.

Sample size was calculated using G*Power statistical software. Data from a relevant peer-reviewed split-face clinical trial titled “Efficacy of autologous platelet-rich plasma combined with fractional ablative carbon dioxide resurfacing laser in treatment of facial atrophic acne scars: A split-face randomized clinical trial” was used for reference. In that study, Group A (n=12) had a mean score change of 4.17 (SD=1.528), while Group B (n=13) had a mean score change of 3.15 (SD=1.676). A two-tailed t-test with an alpha level of 0.05 and equal group sizes yielded a required sample size of 32 participants per group (64 total), and to compensate for an anticipated 10% attrition rate, the final target sample size was set at 70 participants (35 per group).

Participants were selected using convenience sampling from the outpatient department. Those fulfilling the inclusion criteria were randomly assigned to the control group (FCL alone) or the intervention group (FCL+PRP) using simple random numbers generated from the internet. Informed

consent was obtained after explaining the study's objectives, procedures, potential risks and benefits, and the right to withdraw at any point. Treating physicians, research staff and patients were aware of the allocations. The outcome assessor was blinded.

The treatment protocol included three sessions for both groups, performed at four-week intervals. The parameters for each FCL session were as follows: Session 1 used 6.2 watts, Fine-pulse mode, 0.5 ms pulse duration, 190 µm spot size, and 0.5 mm spot separation; Session 2 used 12 watts, Fine-pulse mode, 3 ms pulse duration, 500 µm spot size, 0.5 mm spot separation and 50% target coverage; Session 3 used 20 watts, Fine-pulse mode, 0.5 ms pulse duration, 0.5 mm spot separation, and 50% treated surface area.

For the PRP group, 10 ml of venous blood was collected aseptically into four sterile tubes, each containing 1 ml of sodium citrate as anticoagulant. PRP was prepared through a standardized two-step centrifugation process. The first centrifugation was performed at 1500 RPM for 10 minutes, resulting in separation into erythrocytes, buffy coat (platelets and leukocytes), and plasma. The second centrifugation was performed at 3000 RPM for 20 minutes using the buffy coat layer and plasma just above the buffy coat, yielding a lower 1/3 PRP portion and upper 2/3 platelet-poor plasma, which was decanted. The PRP was re-suspended and topically applied immediately after FCL treatment. Before each laser session, topical anaesthesia was achieved using EPINUM cream (2.5% lignocaine and 2.5% prilocaine), applied for 40 minutes. The area was then cleansed with povidone-iodine and 70% isopropyl alcohol. Protective eye shields were used during all procedures. Post-treatment care instructions included the application of broad-spectrum sunscreen and emollients, and strict avoidance of direct sun exposure.

Participants underwent evaluations at four visits: Visit 1 included baseline assessment and the first session; Visits 2 and 3 included outcome assessments and subsequent treatment sessions; and Visit 4 involved final assessment. The primary outcome was the severity of acne scars, assessed using the Goodman and Baron Quantitative Acne Scar Scale. This system categorized scars into five grades: A (mild macular or pigmented atrophic), B (moderate shallow punched-out or dish-like), C (severe deep or broad atrophic), D (hyperplastic papular hypertrophic), and E (keloidal or hypertrophic thickened scars). Points were assigned based on the number of scars per category (1-10, 11-20, >20), and the surface area affected (<5 cm^2=6 points, 5-20 cm^2 = 12 points, >20 cm^2 = 18 points). Total scar severity scores were calculated by summing lesion-based and area-based points.

Secondary outcomes included both objective and subjective assessments. Redness and oedema were rated using a 4-point Likert scale (none to very severe) by the outcome assessor at each visit. Patient-reported outcomes included pain and satisfaction with treatment, both assessed using Urdu-translated scales and measured using an 11-point visual analogue scale (VAS). Standardized photographs of the affected areas were taken before and after treatment using the 50 MP camera of a Samsung A55 smartphone under consistent lighting and camera settings. Participants self-rated their photographs. For those with low literacy, questions were read aloud in a neutral tone, and participants marked their responses on paper forms in a private room, with assistance from research staff as needed (without influencing responses).

Any adverse events were immediately reported to the Study Management Committee, including the Study Supervisor (Head of Department) and the Hospital Research Committee. In the event of serious adverse effects such as worsening of acne scars, the trial was promptly discontinued.

The hypothesis guiding the study proposed that combining PRP with fractional CO_2 laser therapy would reduce scar severity and mitigate laser-induced side effects (such as erythema, oedema, and pain) more effectively than CO_2 laser monotherapy, thereby enhancing both clinical outcomes and

patient satisfaction. This hypothesis was supported by previous literature, including studies by Chen *et al*. (2021) and Galal *et al*. (2019). All assessors were trained in using the outcome measurement tools accurately. Detailed documentation of all procedures and conditions including photography settings was maintained to ensure methodological consistency.

All collected data was transferred in coded envelopes to an independent statistician for analysis, preserving blinding and participant confidentiality. Statistical analysis was conducted using SPSS version 23. Frequencies and percentages were used for categorical variables (e.g., gender, scar type). Continuous variables such as scar severity scores, VAS scores for pain, and satisfaction ratings were analysed using independent-samples t-tests between groups, and paired t-tests for within-group comparisons (pre- vs. post-treatment). Ordinal data (e.g., redness and swelling) were analysed using the Mann–Whitney U test. Binary outcomes such as adverse events were assessed using the Chi-square test or Fisher's exact test when cell counts were below five. A p-value of less than 0.05 was considered statistically significant.

All participants received comprehensive information about the study and provided written informed consent before enrolment.

Goodman and Baron Quantitative Acne Scar Scale objectively quantified acne scars by assigning points based on scar type, number of lesions, and affected area. The total score reflected the severity of scarring and aided in clinical decision-making and treatment planning **(Table 1)**. Total score = lesion-based points (Step 2) + area points (Step 3). For Grade E, add 3 points per lesion and then add the appropriate area points.

Result

From April 3, 2025, through January 28, 2026, a total of 86 patients were assessed for eligibility. Sixteen patients were excluded (12 did not meet inclusion criteria and 4 declined participation). Seventy patients underwent randomization, with 35 assigned to fractional CO_2 laser plus platelet-rich plasma (PRP) and 35 assigned to laser monotherapy. In the combination group, 3 participants were lost to follow-up, and 32 completed all three treatment sessions and the 12-week assessment. In the laser-only group, 7 participants were lost to follow-up, and 28 completed the study. No participants discontinued treatment because of adverse events. The final analysis included 32 participants in the combination group and 28 in the laser-only group **(Figure 1)**.

Table 1 Goodman and Baron Quantitative Acne Scar Scale.[12]

Guidance (by step)	*Criteria / Points*
Step 1: Identify the type of scars (Grade)	
A - Milder scarring	Macular erythematous/pigmented, mildly atrophic dish-like scars.
B - Moderate scarring	Moderately atrophic dish-like scars; punched-out scars with shallow bases; atrophic areas < 5 mm.
C - Severe scarring	Deep punched-out scars (normal/abnormal bases); linear/troughed scars; deep and broad atrophic areas.
D - Hyperplastic papular scars	Raised papular hypertrophic scars.
E - Keloidal/hypertrophic scars	Thickened, raised keloidal or hypertrophic scars.
Step 2: Assign points based on the number of lesions	
A - Milder	1-10 = 1 pt; 11-20 = 2 pts; >20 = 3 pts
B - Moderate	1-10 = 2 pts; 11-20 = 4 pts; >20 = 6 pts
C - Severe	1-10 = 3 pts; 11-20 = 6 pts; >20 = 9 pts
D - Hyperplastic papular	1-10 = 2 pts; 11-20 = 4 pts; >20 = 6 pts
E - Keloidal/hypertrophic	3 points per lesion (no category totals)
Step 3: Assign points based on affected area	
< 5 cm²	6 pts
5–20 cm²	12 pts
> 20 cm²	18 pts

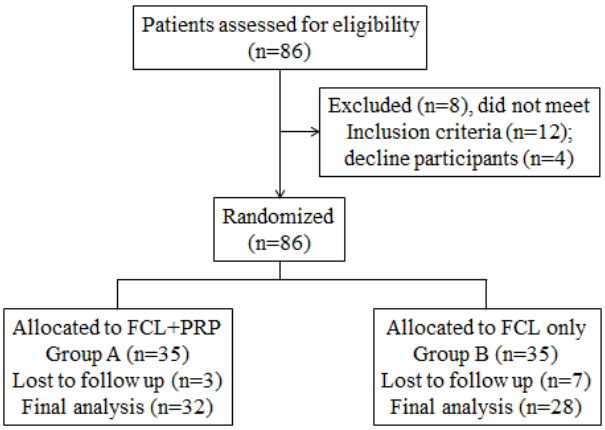

Figure 1 CONSORT flow diagram of participant recruitment and follow-up.

All patients completed baseline assessments and initiated treatment. Participants receiving fractional CO_2 laser with platelet-rich plasma (Group A) had a mean age of 24.5±4.2 years, whereas those receiving laser monotherapy (Group B) had a mean age of 24.1±4.6 years. There was no significant difference between groups (p=0.74; 95% CI -1.9 to 2.7). Other baseline characteristics were comparable between groups. Detailed baseline data are shown in **Table 2a**.

Assessments were conducted at baseline, before each session at 0, 4, and 8 weeks, and at the final assessment at 12 weeks by an independent expert assessor blinded to group allocation. Both treatment groups demonstrated significant improvement in scar severity during the 12-week treatment period (p<0.001 for both groups). Within-group paired analysis of baseline and week-12 scar severity scores is shown in **Figure 2**. The mean reduction in scar severity was greater in the combination therapy group, but the between-group difference was not statistically significant (p=0.129; 95% CI −0.3 to 2.3). Changes in scar severity scores over time are summarized in **Table 2b**.

Table 2a Baseline characteristics.

Characteristic	*Group A (n=32)*	*Group B (n=28)*	*P value*
Age (years), mean ± SD	24.5±4.2	24.1±4.6	0.74
Scar duration (years), mean ± SD	2.8±1.5	2.7±1.6	0.81
Fitzpatrick Skin Type - no. (%)			
Type III	3(9.4)	2 (7.1)	
Type IV	19(59.4)	17(60.7)	
Type V	10(31.2)	9 (32.1)	
Scar Morphology - no. (%)			
Rolling	14(43.8)	11(39.3)	
Boxcar	13(40.6)	11(39.3)	
Ice-pick	5 (15.6)	6 (21.4)	

Table 2b Acne Scar Severity Scores

Time Point	*Group A Mean ± SD*	*Group B Mean ± SD*	*P value*
Baseline	12.4 ± 3.8	11.8 ± 4.1	0.57
Week 4	10.7 ± 3.7	10.2 ± 3.8	0.63
Week 8	8.9 ± 3.6	8.6 ± 3.9	0.71
Week 12	8.2 ± 3.5	8.6 ± 4.5	0.69

Group	*Baseline*	*Week 12*	*Mean Change*	*P value*
Group A	12.4 ± 3.8	8.2 ± 3.5	4.2	<0.001
Group B	11.8 ± 4.1	8.6 ± 4.5	3.2	<0.001

Scar improvement differed by morphology, with rolling scars showing the greatest improvement (mean reduction 4.20), followed by boxcar scars (3.89), while ice-pick scars showed the least improvement (2.33); these scar-type–specific differences were statistically significant (p<0.05)

Patients receiving FCL combined with PRP experienced lower redness, swelling, and pain scores compared with those receiving laser alone (p≤0.01 for all comparisons). Patient satisfaction at week 12 was also higher in the combination group (p = 0.004; 95% CI 0.5-2.5). Tolerability outcomes are summarized in **Table 2c**. Immediate adverse effects included erythema, erythema with oedema, and procedural pain, whereas post-inflammatory hyperpigmentation and acne flare were observed as delayed complications. Adverse effects occurred more frequently in the laser-only group, although between-group differences were not statistically significant (p>0.05). These outcomes are presented in **Table 2c**.

Values are presented as mean ± standard deviation or number of patients. Continuous variables were analysed using the independent-samples t-test, and within-group comparisons were performed using the paired-samples t-test.

Table 2c Treatment tolerability and adverse events.

Outcome	*Session 1*	*Session 2*	*Session 3*
Pain (A/B), p-value	5.78±0.65/ 7.56±0.62, p=0.002	5.69±0.60/ 7.43±0.56, p=0.0005	5.72±0.64/ 7.53±0.60, p<0.001
Redness (A/B), p-value	0.66/3.00, p<0.001	0.33 / 2.66, p < 0.001	0.25 / 2.58, p < 0.001
Swelling (A/B), p-value	0.00/2.14, p<0.001	0.25 / 2.38, p = 0.001	0.08 / 2.20, p < 0.001
Patient satisfaction (A/B), p-value	-	-	8.5±1.1 / 7.0±1.2, p=0.004

Adverse Effect	*Group A*	*Group B*	*P value*
Erythema	18	22	0.31
Erythema + oedema	6	10	0.24
Pain	8	9	0.79
Post-inflammatory hyperpigmentation	2	4	0.39
Acne flare	1	3	0.30

Ordinal variables were analysed using the Mann–Whitney U test. Categorical variables were analysed using the chi-square test of independence. Confidence intervals represent 95% confidence intervals. A p-value<0.05 was considered statistically significant.

Discussion

In this randomized trial, participants received three sessions of fractional CO2 laser alone (Group B) or combined with topical PRP (Group A), with the final evaluation four weeks after the last treatment (total follow- up 12 weeks). Both groups achieved clinically meaningful scar-severity reductions, but the combination group's absolute mean improvement (4.2 points) did not differ significantly from the laser- only group (3.2 points; p = 0.129).

Arsiwala *et al*. conducted a comparative study involving 30 patients and reported that, while both fractional CO2 laser alone and in combination with topical PRP improved acne scars, the combination group showed faster improvement and better patient satisfaction, especially for boxcar and rolling scars13. Our trend toward greater scar-severity reduction with PRP + laser concurs with Chang *et al*.'s 2019 meta-analysis, which pooled multiple RCTs and found nearly threefold higher odds of clinical improvement and significantly shorter crusting, erythema, and oedema durations in the combination group compared with laser alone14. Galal *et al*. also compared fractional CO2 laser with and without intradermal PRP and found improved outcomes in scar depth, pigmentation, and patient satisfaction with the combination approach[9]. A separate meta-analysis by Wu *et al*. further supported the efficacy of combining PRP with fractional CO2 laser, noting significantly enhanced clinical improvement and patient satisfaction, as well as reduced recovery time[15]. Additionally, Rahman *et al*. compared microneedling + PRP with fractional CO2 laser + PRP and concluded that, while both methods were effective in treating acne scars, the addition of PRP contributed to faster recovery and better subjective satisfaction across treatment types.[16]

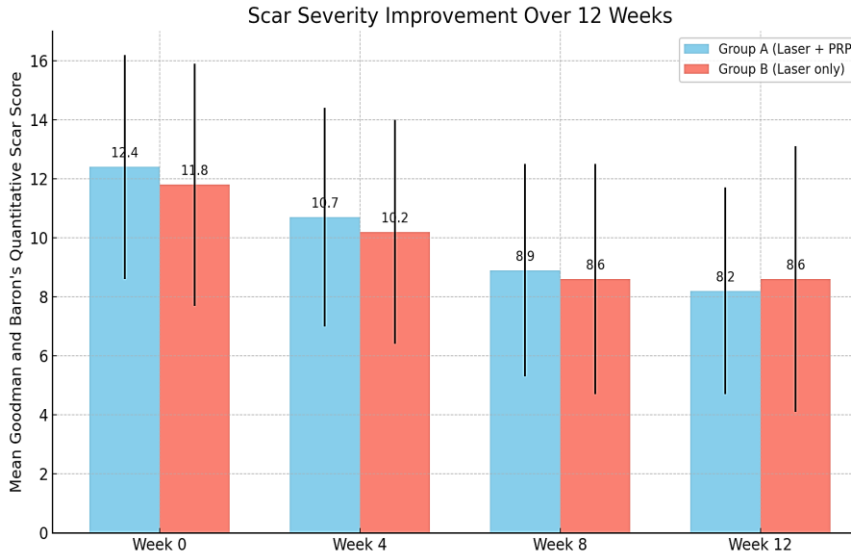

Figure 2 Paired t-test analysis comparing acne scar severity scores within each group from baseline to 12 weeks post-treatment. Both groups showed statistically significant improvements in scar severity scores.

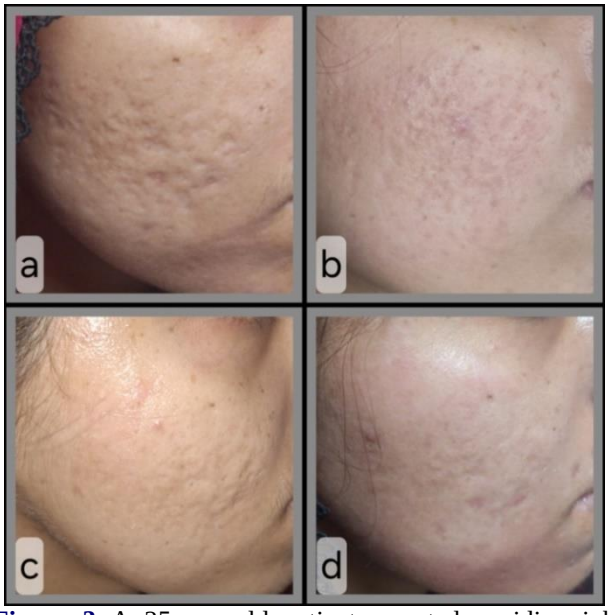

Figure 3 A 25-year-old patient reported avoiding job interviews due to acne scars. After three sessions of FCL+PRP therapy, visible improvement in scar appearance was observed.

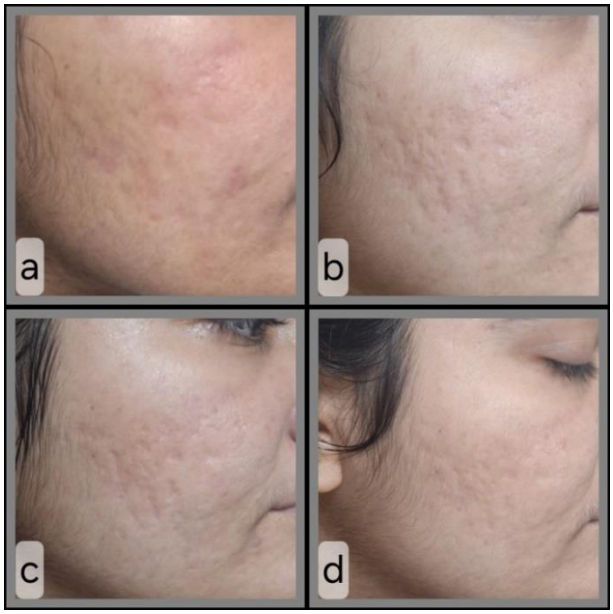

Figure 4 Following combination therapy with fractional CO_2 laser and topical PRP, a 22-year-old female patient showed noticeable improvement in acne scar severity over 12 weeks.

Representative clinical photographs from patients treated with fractional CO_2 laser plus PRP showed visible improvement in acne scar appearance after treatment **(Figures 3 and 4)**. No sex- based differences in treatment response were observed, supporting the generalizability of fractional CO2 ± PRP across genders.

Topical PRP added to fractional CO2 laser therapy produced greater but not statistically significant scar severity improvements and significantly higher patient satisfaction, with a trend toward fewer and milder adverse effects. These findings suggest that PRP may enhance both the efficacy and tolerability of laser- based acne- scar treatments. Further large-scale, long- term trials are warranted to confirm these benefits and refine treatment protocols.

The study has several limitations that warrant consideration. First, the sample size was relatively small, which may limit the statistical power and generalizability of the findings. Second, the follow-up duration was restricted to one month after the final treatment session, which may not capture the full extent of scar remodelling or the potential for delayed adverse effects such as post-inflammatory hyperpigmentation (PIH). Since scar remodelling is a gradual process, longer-term follow-up is essential to assess the durability of improvements. Third, the number of treatment sessions was limited due to the time-bound nature of the study. Additionally, a more diverse cohort including a wider range of skin types and acne scar severities would enhance the applicability of the results to broader populations. Future studies should employ larger sample sizes, extended follow-up periods, and explore the use of different PRP formulations—such as activated versus non-activated and leukocyte-rich versus leukocyte-poor preparations—as well as compare PRP with other potential adjunctive therapies to determine the most effective combinations for acne scar management.

Conclusion

In this study, adjunctive PRP with fractional CO_2 laser is associated with greater scar improvement and higher patient satisfaction but did not demonstrate statistically significant superiority over laser monotherapy. In practice, dermatologists may consider the fractional CO_2 laser plus PRP approach to improve tolerability and satisfaction. Future work should use standardized PRP preparation and consistent laser settings, and it should also look at practical post-procedure steps such as patient

education and supportive care to reduce downtime. For ongoing quality improvement, we suggest routinely using validated visual analogue scale (VAS) and Likert-scale questionnaires. Further research with larger sample sizes and long-term follow-up is needed to confirm these findings and explore the optimal use of this combination therapy.

Acknowledgements We are deeply grateful to Dr. Shazia Saaqib, Assistant Professor, Department of Gynaecology and Obstetrics, Jinnah Hospital, Lahore, for her invaluable guidance and continuous support throughout this research.

Declaration of patient consent Authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship None.

Conflict of interest No conflict of interest.

Author's contribution

YS,NS,MM,ZT,MW,AT,SR: Substantial contributions to the study design, acquisition of data, manuscript writing.

Every author has given final approval of the manuscript version to be published and agreed to be accountable for all aspects of the work.

References

1. Liu L, Xue Y, Chen Y, Chen T, Zhong J, Shao X, *et al*. Prevalence and risk factors of acne scars in patients with acne vulgaris. *Skin Res Technol*. 2023 Jun;**29(6)**:e13386. doi: 10.1111/srt.13386.
2. Connolly D, Vu HL, Mariwalla K, Saedi N. Acne Scarring-Pathogenesis, Evaluation, and Treatment Options. *J Clin Aesthet Dermatol*. 2017 Sep;**10(9)**:12-23.
3. Fabbrocini G, Annunziata MC, D'Arco V, De Vita V, Lodi G, Mauriello MC, *et al*. Acne scars: pathogenesis, classification and treatment. *Dermatol Res Pract*. 2010;**2010**:893080.
4. Rullan PP, Olson R, Lee KC. A Combination Approach to Treating Acne Scars in All Skin Types: Carbolic Chemical Reconstruction of Skin Scars, Blunt Bi-level Cannula Subcision, and Microneedling-A Case Series. *J Clin Aesthet Dermatol*. 2020 May;**13(5)**:19-23.
5. Omi T, Numano K. The Role of the CO2 Laser and Fractional CO2 Laser in Dermatology. *Laser Ther*. 2014 Mar 27;**23(1)**:49-60. doi: 10.5978/islsm.14-RE-01.
6. Shah SD, Mehta BD, Borkar MA, Aswani RC. Study of safety and efficacy of autologous platelet rich plasma combined with fractional CO2 laser in the treatment of post acne scars: a comparative simultaneous split-face study. *Int J Res Med Sci*. 2017 Mar. 28;**5(4)**:1344-51.
7. McGoldrick RB, Theodorakopoulou E, Azzopardi EA, Murison M. Lasers and ancillary treatments for scar management Part 2: Keloid, hypertrophic, pigmented and acne scars. Scars *Burn Heal*. 2017 Mar 14;**3**:2059513116689805. doi: 10.1177/2059513116689805.
8. Pavlovic, V., Ciric, M., Jovanovic, V. & Stojanovic, P. Platelet Rich Plasma: A short overview of certain bioactive components. *Open Med*. 206;**11**;242-7.
9. Galal O, Tawfik AA, Abdalla N, Soliman M. Fractional CO2 laser versus combined platelet-rich plasma and fractional CO2 laser in treatment of acne scars: Image analysis system evaluation. *J Cosmet Dermatol*. 2019 Dec;**18(6)**:1665-71. doi: 10.1111/jocd.12909.
10. Chen J, Wan Y, Lin Y, Jiang H. Fractional Carbon Dioxide Laser or Erbium:Yttrium-Aluminum-Garnet Laser Assisted by Topical Application/Intradermal Injection of Platelet-Rich Plasma for Postacne Scars. *Plast Reconstr Surg*. 2021 Dec 1;**148(6)**:915e-927e. doi: 10.1097/PRS.0000000000008513.
11. Min S, Yoon JY, Park SY, Moon J, Kwon HH, Suh DH. Combination of platelet rich plasma in fractional carbon dioxide laser treatment increased clinical efficacy of for acne scar by enhancement of collagen production and modulation of laser-induced inflammation. *Lasers Surg Med*. 2018 Apr;**50(4)**:302-10. doi: 10.1002/lsm.22776.
12. Goodman GJ, Baron JA. Postacne scarring--a quantitative global scarring grading system. *J Cosmet Dermatol*. 2006 Mar;**5(1):**48-52. doi: 10.1111/j.1473-2165.2006.00222.x.
13. Arsiwala NZ, Inamadar AC, Adya KA. A Comparative Study to Assess the Efficacy of Fractional Carbon Dioxide Laser and Combination of Fractional Carbon Dioxide Laser with Topical Autologous Platelet-rich Plasma in Post-acne Atrophic Scars. *J Cutan Aesthet Surg*. 2020 Jan-Mar;**13(1)**:11-7.
14. Chang HC, Sung CW, Lin MH, Hu S, Hsiao YC, Cheng YC. Efficacy of autologous platelet-rich plasma combined with ablative fractional carbon dioxide laser for acne scars: a systematic review and meta-analysis. *Aesthet Surg J*. 2019;**39(7)**:NP279–NP287.
15. Wu N, Sun H, Sun Q, Cong L, Liu C, Zheng Y, *et al*. A meta-analysis of fractional CO_2 laser combined with PRP in the treatment of acne scars. *Lasers Med Sci*. 2021;**36(1)**:1–12.

16. Rahman S, Naveed T, Afridi IU, Suhail MA, Khan DD, Khan M, *et al*. Comparison of efficacy of micro-needling plus platelet-rich plasma and fractional CO_2 laser plus platelet-rich plasma in the treatment of post-acne scars. *J Pak Assoc Dermatol*. 2024;**34(4 Suppl)**:S83–S88.