Volume 4, Issue 6, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

EVALUATING THE USAGE OF MICRO-NEEDLING AND PLATELET-RICH PLASMA IN THE TREATMENT OF POST-ACNE SCARS

Areeba Ashraf[1], Sadia Sabir*[2]

[1]*Faculty of Allied Health Science, The Superior University Lahore, Pakistan*
[2]*Department of Human Nutrition & Food Technology, Faculty of Allied Health Science, The Superior University Lahore, Pakistan*
sadia.sabir@superior.edu.pk

DOI: https://doi.org/10.5281/zenodo.20510893

Keywords
Acne scars, Microneedling, Platelet-rich plasma, Combined therapy, Atrophic scars

Article History
Received on 24 May 2026
Accepted on 06 June 2026
Published on 15 June 2026

***Corresponding Author:**
Sadia Sabir*
sadia.sabir@superior.edu.pk

Abstract

Background: *Acne vulgaris is a common global disorder, which usually results in permanent scarring of the atrophic type. Such scarring can lead to considerable psychological problems, and hence, the need for effective dermatological treatments to improve the texture of the skin and the quality of life of the patients.*

Objective: *To evaluate and compare the clinical efficacy and safety of microneedling, platelet-rich plasma (PRP), and combined therapy for the treatment of moderate to severe atrophic facial acne scars.*

Study Design: *A randomized controlled trial (RCT) was conducted involving subjects aged 18–45 years, divided into three treatment groups to evaluate comparative clinical outcomes.*

Materials and Methods: *A total of 84 participants (aged 18–45 years) were randomized into three groups: microneedling, PRP, or combined therapy. Participants received three treatment sessions at four-week intervals. Scar severity was assessed using Goodman and Baron grading, clinical photography, and patient satisfaction scores.*

Results: *The mean scar grades of all the groups were similar at baseline (Group A = 2.68 ± 0.48, Group B = 2.71 ± 0.45, Group C = 2.75 ± 0.50). At the end of Week 4, early signs of improvement were seen in 28.6% of Group A, 35.7% of Group B, and 42.9% of Group C. By the end of Week 8, the mean scar grades were 2.14 ± 0.50 for Group A, 1.89 ± 0.42 for Group B, and 1.57 ± 0.49 for Group C. By the end of Week 12, a reduction of scar grade by 1 or more was seen in 50% of Group A, 78.6% of Group B, and 85.7% of Group C. The patient satisfaction score was highest in the combined therapy group. The adverse effects experienced were mild and transient, including erythema, edema, and pain, but no serious adverse effects were reported.*

Conclusion: *The clinical results and patient satisfaction are better in combination microneedling and PRP therapy than in monotherapy. Combination microneedling and PRP therapy can be a safe and effective form of biological treatment for moderate to severe atrophic acne scars.*

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

INTRODUCTION

Acne vulgaris is a chronic inflammatory condition of the pilosebaceous unit, which affects about 9.4% of the global population. Acne vulgaris predominantly occurs in the teenage population, with the prevalence ranging between 85% to 90%. However, the condition may continue into adulthood [1]. Acne vulgaris develops due to several factors. These include the hypersecretion of sebum caused by androgens, abnormal keratin buildup, and the growth of *Cutibacterium* acnes. This leads to inflammatory spots, such as papules, pustules, and nodules [2]. In addition to physical effects, acne can have significant psychological impacts, leading to anxiety, depression, and increased social withdrawal [3].

Permanent scarring is a significant long-term complication of inflammatory acne and it occurs in close to 47% of the patients [4]. The most common type is atrophic scars, which form after failing to respond properly to inflammation and to deposit enough collagen in the course of wound-healing. They are clinically categorized as icepick (60-70%), boxcar (20-30%) and rolling scars (15-25%) [5]. The physical disfigurement that follows is usually accompanied by low self-esteem and poor quality of life that require effective dermatological interventions [6].

Recent innovation of the minimum invasive procedures has seen microneedling and platelet-rich plasma (PRP) as promising options to atrophic scars treatment. Percutaneous collagen induction therapy also known as microneedling employs fine needles to develop micro-channels at the dermis. This mechanical injury causes the wound-healing cascade, which activates the release of growth factors such as TGF-b and VEGF, which stimulates the proliferation of fibroblasts and collagen remodelling [7]. Platelet-rich plasma (PRP) is a biological stimulus that is autologous. It is rich in a high concentration of platelets that secrete growth factors that are vital to regeneration of tissues and angiogenesis such as PDGF and EGF [8].

Although the two modalities are good as monotherapies, there is clinical evidence of the synergistic effect of the two modalities in combination [9,10]. Micro-channels forming with the help of the microneedling help the PRP to penetrate deeper, maximizing the regenerative effect with the minimum level of downtime, and risk of pigmentary changes in comparison with ablative laser [11].

The proposed study was compared and contrast the clinical effectiveness of microneedling and PRP, as well as their combination, to offer a more evidence-based method of treating moderate to severe atrophic acne scars.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

METHODOLOGY

Study Design: This study was a prospective, randomized, controlled clinical trial conducted at the Aesthetic Clinic in Dera Ghazi Khan between January and June 2022. After receiving ethical permission of the Institutional Ethical Review Committee and signed informed consent, 84 volunteers of different ages between 18 and 45 years old with moderate-severe atrophic acne scars were recruited. In order to make the results valid, inclusion criteria were to have scars at least six months after resolution of acne, whereas exclusion criteria were active acne, history of keloidal scarring, pregnant, lactating, blood disorders, or scar treatment during the last six months. With the help of computer-generated random number table, the participants were randomly grouped into three cohorts of 28 (Group 1) where they were given microneedling alone using a 1.5 mm derma roller, Group 2 where they were given platelet-rich plasma (PRP) only, and Group 3 where they received a combination therapy of microneedling and PRP.

Treatment Protocol:

- **Microneedling Procedure:** Topical anesthetic with lidocaine/prilocaine was used on the patients in a period of 30 minutes. A sterile 1.5 mm stainless-steel dermaroller was subsequently applied to make controlled micro-injuries in horizontal, vertical and diagonal and gave the same pinpoint bleeding. Three therapy sessions were given to each subject with a four weeks separation between the sessions.
- **PRP Preparation:** Platelet-rich plasma was developed by using 10 mL of vacutainer tubes of anticoagulant-containing venous blood. A dual spin centrifugation test was used (spin number 1: 3,000 RPM, 10 minutes, spin number 2: 4,000 RPM, 10 minutes). Calcium chloride (0.1 mL of PRP) was used to activate the resultant 1-2 mL of PRP.
- **Combined Therapy:** In the combined group, microneedling was performed first to create micro-channels, followed immediately by the topical application of freshly prepared activated PRP to enhance dermal penetration.

Assessment Methods:

- **Scales of grading:** Trained dermatologists graded the severity of acne scars at baseline and at the end of each treatment session using the Goodman and Baron scar grading system and the Manchester scar scale by following the procedure of Jaweria *et al* with minor modifications (12).
- **Patient Satisfaction:** The patient-reported satisfaction with the

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

clinical outcomes was evaluated using a structured questionnaire and Visual Analog Scale (VAS).

- **Photographic Analysis:** To record the alterations in the appearance of scars and the instant effects of treatment, standardized facial photographs were taken at baseline, in between sessions and follow-up visits (3 and 6 months).

Statistical Analysis:

The SPSS software version 29.0 was used to analyze the collected data. The paired t-test was conducted to compare scar improvement within each group before and after treatment. One-way analysis of variance (ANOVA) was used to compare differences among the three groups. A p-value below 0.05 was considered statistically significant.

RESULTS

A total of 84 (mean age = 27.6 ± 4.8 years) patients including overwhelming majority of females (77.4% n = 65) versus males (22.6% n = 19) were enrolled in the study. The age, gender, residence, and family history of acne were statistically analyzed to determine differences between the three conditions and the results indicated that there were no significant differences in these variables at the beginning of the trial (p = 0.473, p = 0.745, p = 0.558, p = 0.477 respectively). Grade 4 (Severe) scars were the most common ones at baseline, in Group C (50.0) and Group B (46.5) as compared to Group A (32.1). Although there was a difference in distribution, the difference in baseline scar severity between the groups was statistically nonsignificant (p = 0.606), which offered a level playing field to assess the relative treatment effectiveness of Microneedling and PRP over 12 weeks follow-up.

Table 1: Demographic and Baseline Clinical Profile of Participants (n=84)

Variables	Group A (n=28)	Group B (n=28)	Group C (n=28)	p-value
Age (years, Mean±SD)	27.12 ± 4.55	28.13 ± 5.11	27.54 ± 4.80	0.473*
Gender (Male/Female)	6 / 22	7 / 21	6 / 22	0.745**
Residence (Urban/Rural)	15 / 13	16 / 12	15 / 13	0.558**
Family History (+ve)	20 (71.4%)	18 (64.3%)	19 (67.9%)	0.477**
Scar Duration (Years)	8.10 ± 3.43	7.81 ± 3.90	8.00 ± 3.70	0.786*
Baseline Grade (G&B)				0.606
— Grade 2 (Mild)	9 (32.1%)	6 (21.4%)	4 (14.3%)	
— Grade 3 (Moderate)	10 (35.7%)	9 (32.1%)	10 (35.7%)	
— Grade 4 (Severe)	9 (32.1%)	13 (46.5%)	14 (50.0%)	

Baseline Acne Scar Severity

At the baseline, the distribution of acne scar severity revealed that moderate to severe scars predominated across all three groups. Group A (microneedling) patients were fairly distributed with 35.7% (n = 10) of

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

them having Grade 3 scars and 32.1% (n = 9) having Grade 4, Group B (PRP) was distributed with a higher number of severe cases as 46.5% of the patients (n = 13) were Grade 4. Similarly, Group C (combined therapy) demonstrated the greatest baseline severity, where 50.0% (n = 14) of patients had Grade 4 scars and 35.7% (n = 10) had Grade 3 scars. Despite these variations in distribution, the differences in baseline scar severity among the groups were not statistically significant (p = 0.606), indicating comparability at the start of the study for subsequent evaluation of treatment outcomes.

Table 2: Distribution of Acne Scar Severity at Baseline (n=84)

Scar Grade (G&B)	Group A (n=28)	%	Group B (n=28)	%	Group C (n=28)	%	p-value
Grade 2 (Mild)	9	32.1	6	21.4	4	14.3	0.606
Grade 3 (Moderate)	10	35.7	9	32.1	10	35.7	
Grade 4 (Severe)	9	32.1	13	46.5	14	50.0	

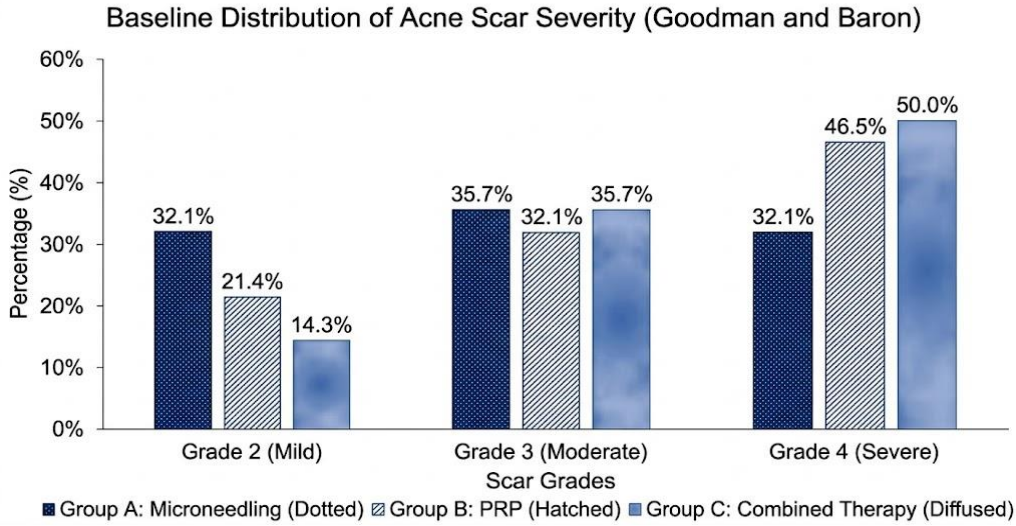

Figure 1: Baseline Scar Severity Distribution.

A clustered bar chart representing the percentage of patients in each treatment group categorized by Goodman and Baron grades at Week 0. Data shows a higher prevalence of Grade 4 (Severe) scars in Group C (50.0%) compared to Group A (32.1%) and Group B (46.5%) prior to intervention.

Therapeutic Efficacy Across Follow-up Visits (Weeks 4, 8, and 12)

All three treatment groups showed gradual improvement in acne scars over the 12-week follow-up period. By Week 4, a clear reduction in scar severity was observed. In Group C (combined therapy), 10.7% of participants achieved Grade 1 scars,

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

whereas Group B (PRP alone) showed early improvement with 39.3% of patients remaining at Grade 3 and 32.1% at Grade 2. At this stage, the difference between groups was statistically significant (p = 0.001), suggesting that the combination therapy produced faster initial improvement.

At Week 8, Group C continued to demonstrate the greatest progress, with 42.9% of patients in Grade 2 and only 10.7% remaining at Grade 4. In comparison, 28.6% of participants in Group A (microneedling alone) continued to present with Grade 4 scars.

By the final assessment in Week 12, the highest therapeutic benefit was observed in Group C. In this group, 64.3% of participants showed improvement to Grade 1 and Grade 2. In Group B, 50 % of the subjects went to category 1 and 2, but 57.2 % of the Group A participants attained the lower scar categories. The statistically significant findings provided at the 12-week follow-up (p = 0.001) indicate that all three treatment procedures were successful but the combination of microneedling and PRP produced the strongest and most immediate reduction in the severity of the acnes scar.

Table 3: Comparative Efficacy of Treatments at Week 4, 8, and 12 (n=84)

Visit Week	Grade (Goodman & Baron)	Group A (n = 28)	Group B (n = 28)	Group C (n = 28)	p-value
Week 4	Grade 1 / 2	13 (46.4%)	9 (32.1%)	13 (46.4%)	0.001
	Grade 3 / 4	15 (53.6%)	19 (67.9%)	15 (53.6%)	
Week 8	Grade 1 / 2	15 (53.6%)	12 (42.9%)	17 (60.7%)	0.001
	Grade 3 / 4	13 (46.4%)	16 (57.1%)	11 (39.3%)	
Week 12	Grade 1 / 2	16 (57.1%)	14 (50.0%)	18 (64.3%)	0.001
	Grade 3 / 4	12 (42.9%)	14 (50.0%)	10 (35.7%)	

Volume 4, Issue 6, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

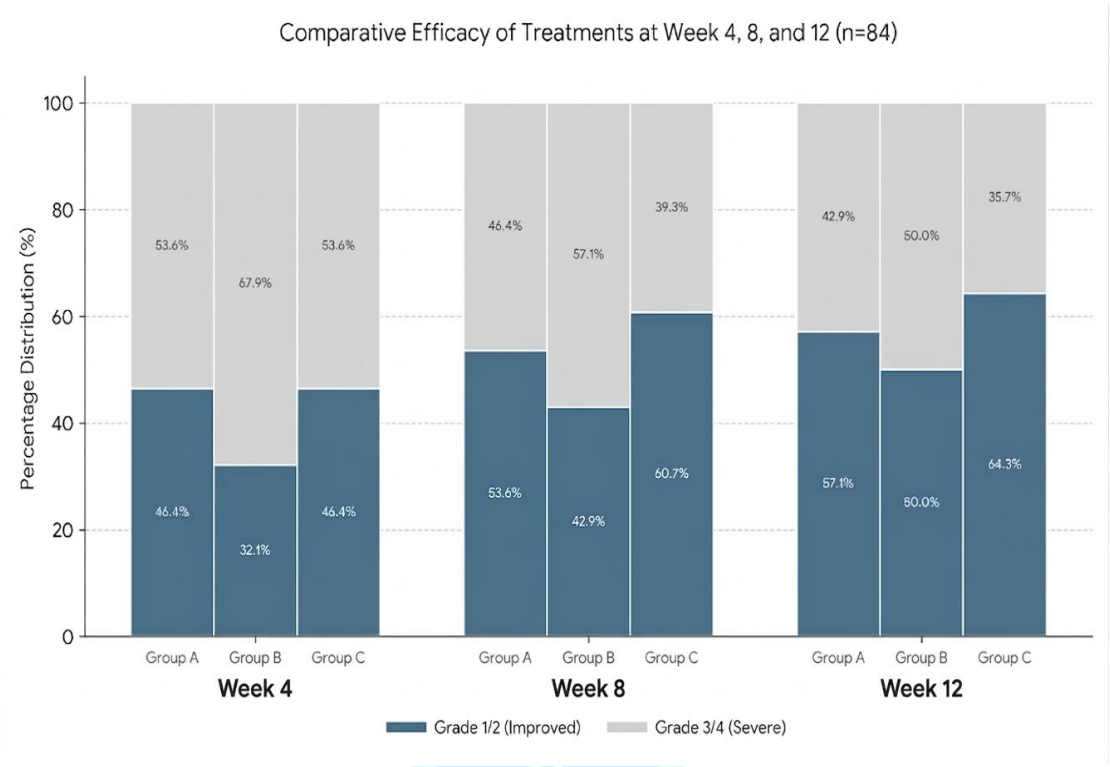

Figure 2: Distribution of Acne Scar Severity Across Follow-up Visits (n=84)

The stacked bar chart illustrates the shift from higher grades (3/4) to lower grades (1/2) across Group A (Microneedling), Group B (PRP), and Group C (Combined). Group C consistently demonstrates the most rapid and significant clinical improvement at Weeks 4, 8, and 12 (p = 0.001).

Patient-Reported Satisfaction Scores

The study also indicated a progressive rise in patient satisfaction for all three groups over the 12-week period. The patients in Group C, i.e., "Combined Therapy," indicated the highest level of patient satisfaction, as the mean score rose to 60.0 ± 14.2% by the 12th week, as opposed to 58.67% for Group B and 56.67% for Group A. Even though Group C indicated superior clinical trends and a greater number of "Good" to "Excellent" improvements in scar severity, as indicated by expert photographic analysis, the intergroup differences in patient satisfaction were statistically non-significant (p = 0.476). The results indicate that, while all three modalities are effective, the combination of microneedling and PRP offers the most enhanced patient results and clinical reduction in scar severity.

Out of the initial 84 patients, 72 patients (n = 24 per group) completed the full 12-week period for evaluation of patient satisfaction and evaluation of adverse effects. 12 patients were lost to follow-up.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

Table 4: Patient Overall Satisfaction Scores Regarding Scar Improvement (%)

Follow-up	Group A (n = 24)	Group B (n = 24)	Group C (n = 24)	*p*-value
Week 4	42.67 ± 17.8	43.33 ± 18.45	45.0 ± 17.2	0.813
Week 8	52.0 ± 17.69	56.67 ± 15.16	57.33 ± 16.0	0.103
Week 12	56.67 ± 16.05	58.67 ± 13.58	60.0 ± 14.2	0.476

Adverse Effects of Treatment Modalities

All treatment modalities were well tolerated, and only mild side effects were encountered. The most common side effects among all patients were mild pain (66.7-75.0%), erythema (33.3-50.0%), and edema (16.7-25.0%). However, all side effects were self-limiting and resolved within a few hours to three days without the need for pharmacological intervention or treatment termination. Statistical analysis showed no significant differences in the side effects among all patients in the three groups ($p > 0.05$), proving that this combination is as safe as monotherapy.

Table 5: Comparison of Adverse Effects Across Treatment Groups (n=72)

Adverse Effect	Group A (n=24)	%	Group B (n=24)	%	Group C (n=24)	%	p-value
Pain	17	70.83	16	66.67	18	75.00	0.652
Erythema	11	45.83	8	33.33	12	50.00	0.431
Edema	4	16.67	6	25.00	5	20.83	0.712

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

Photographic Analysis:

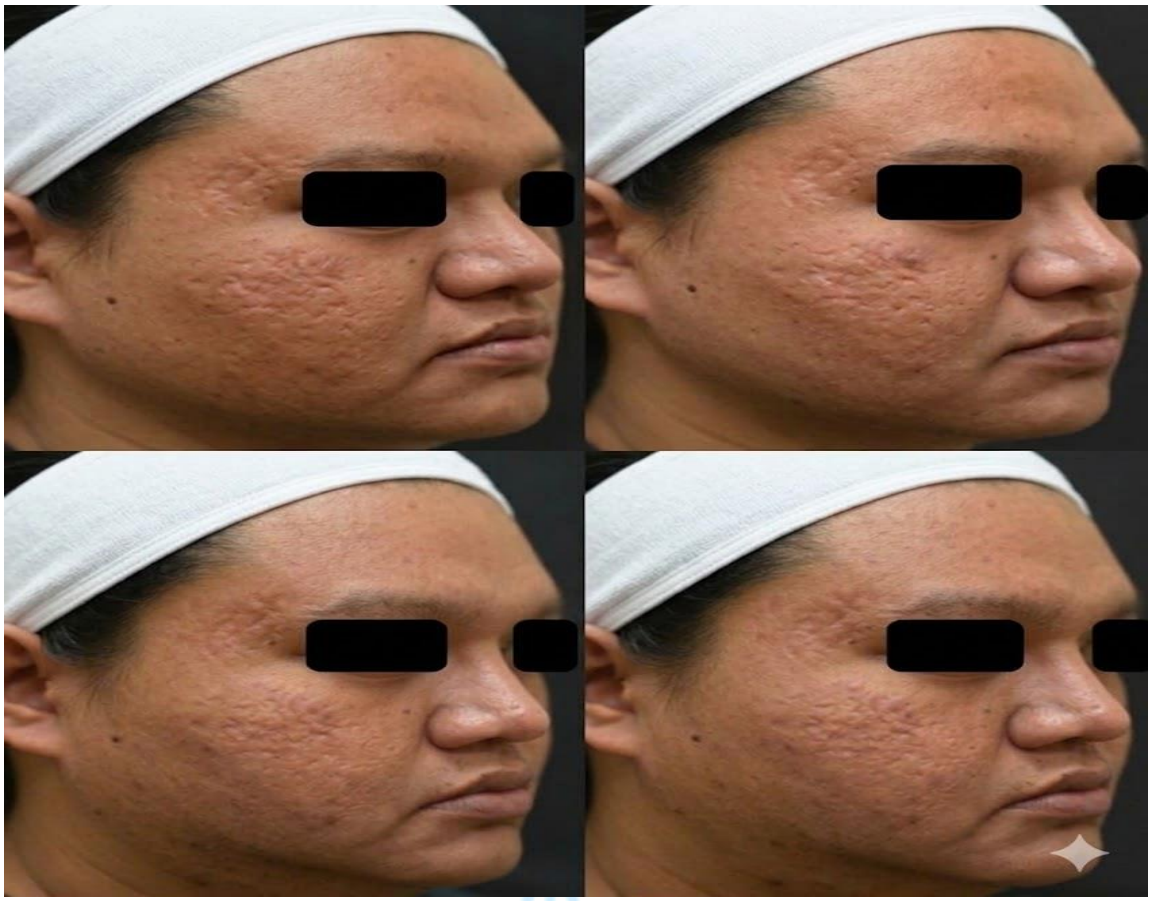

Figure 3: Digital images showing clinical progression of acne scars following microneedling (right cheek): Baseline (A), Week 4 (B), Week 8 (C), and Week 12 (D), showing progressive improvement in scar severity and skin texture.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

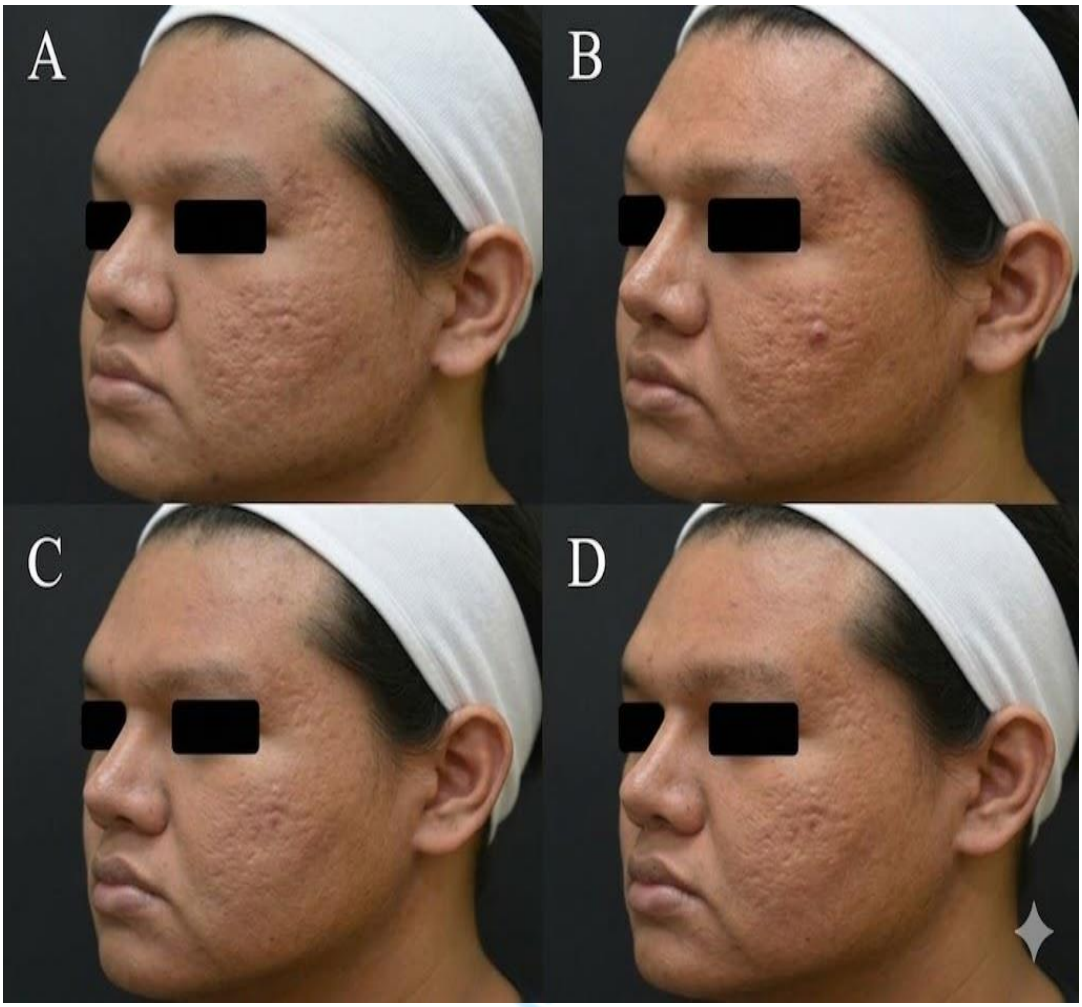

Figure 4: Digital images showing clinical progression of acne scars following PRP treatment (left cheek): Baseline (A), Week 4 (B), Week 8 (C), and Week 12 (D), demonstrating gradual reduction in scar depth and overall skin improvement.

Volume 4, Issue 6, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

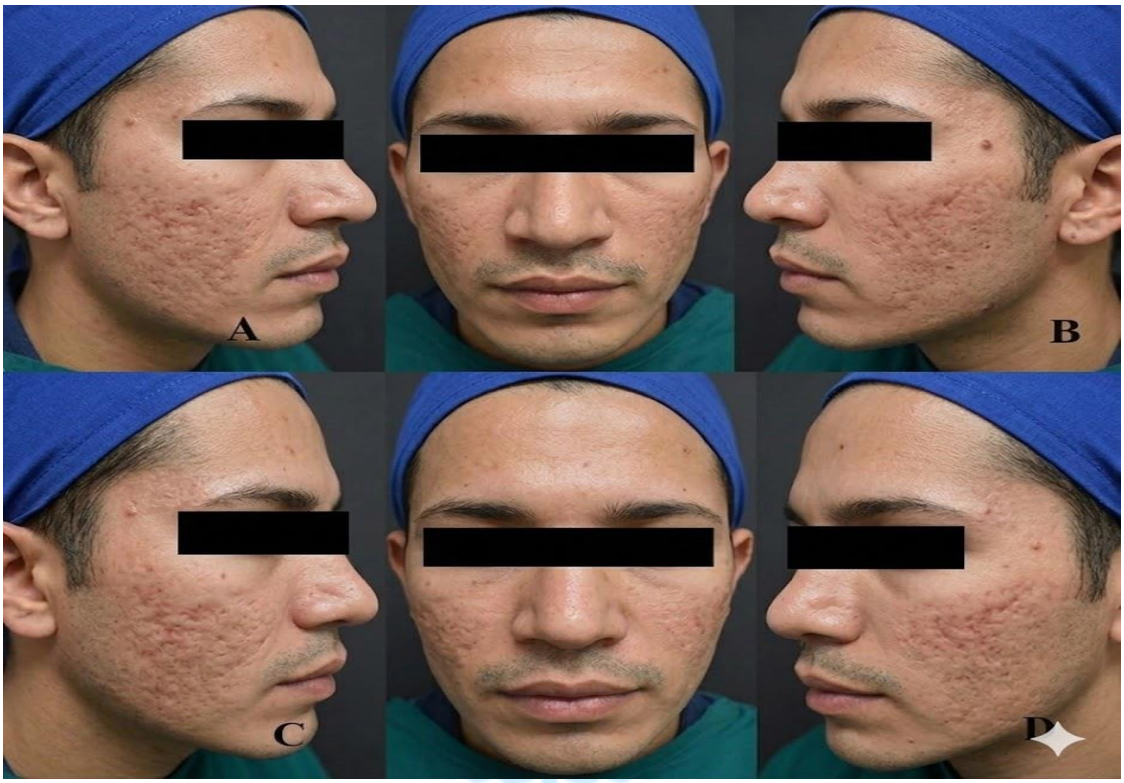

Figure 5 Digital images showing acne scar improvement following combined Micro + PRP treatment at (A) Baseline, (B) Week 4, (C) Week 8, and (D) Week 12, demonstrating progressive reduction in scar severity and improvement in skin texture.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

DISCUSSION

Acne vulgaris is a common inflammatory condition of the skin that leads to atrophic scarring. This scarring can be categorized into ice pick, boxcar, and rolling types [12]. Treating this scarring is often difficult due to its different shapes and depths. It typically requires a team approach. Traditional treatments have included chemical peels, dermabrasion, and laser resurfacing. However, microneedling, also called collagen induction therapy (CIT), has become a safe and effective [13,14]. This technique creates micro-injuries in the dermis. This process stimulates collagen production and triggers natural wound healing, without damaging the epidermis.

Microneedling can also be enhanced by the presence of Platelet-Rich Plasma (PRP) that is isolated out of platelets and carry growth factors such as platelet-derived growth factor (PDGF) [15], vascular endothelial growth factor (VEGF) and transforming growth factor- beta (TGF- beta) that can activate fibroblasts, stimulate tissue regeneration [16,17] and remodel the matrix. This is notably critical in such countries as Pakistan because of the lack of information and guidelines [18].

In this study, the mean age of the participants was found to be 27.6 ± 4.8 years, with a majority of females (77.4%, n = 65), consistent with previous findings that young women are more likely to seek treatment for aesthetic concerns. To moderate to severe acne scarring was common at baseline, with the highest percentage of Grade 4 scarring found in Group C, where combined therapy was used. Although there were significant differences in the severity of scarring at baseline between groups ($p = 0.01$), the overall baseline characteristics were similar ($p = 0.606$), allowing for a valid comparison of treatment outcomes.

The results of this study indicated that the combination of microneedling and PRP resulted in the fastest reduction in scar severity. By Week 4, there was significant improvement in patients in Group C. This improvement was sustained in Weeks 8 and 12. At the end of the study, 64.3% of patients in Group C were able to attain Grade 1 or 2 scars. This was significantly better than those in Group A who were given microneedling therapy alone and Group B who were given PRP therapy alone. These results support previous studies showing that combination therapy is more effective. Additionally, it was found that although microneedling therapy is most effective in moderate scars of Grade 2-3, even in severe scars of Grade 4, combination therapy was able to attain a 28% better success rate.

Although the clinical evaluation indicated a notable variance between the groups ($p = 0.001$), the patient satisfaction score was similar for all the modalities of treatment (p

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

= 0.476), which indicated that the patients experienced a positive change irrespective of the modality of treatment used. All the treatments were well-tolerated, with mild and transient side effects, including erythema, edema, and pain, which were seen to resolve within 72 hours. This confirms the fact that the treatments are safe and can be used clinically.

CONCLUSION

In conclusion, all the three procedures, i.e., microneedling, PRP, and the combination of the two, were found to be effective for the treatment of atrophic acne scars. Among the three procedures, the combination of microneedling and PRP was found to have the best clinical results, especially for patients with higher-grade scars. All the procedures were found to be safe and well-tolerated, with the combination of microneedling and PRP showing the best results, especially in terms of patient satisfaction.

REFRENCES

1. Bhat YJ, Latief I, Hassan I. Update on etiopathogenesis and treatment of Acne. Indian J Dermatol Venereol Leprol. 2017;83(3):298–306.
2. Fabbrocini G, Annunziata MC, D'Arco V, De Vita F, Lodi G, Mauriello MC, et al. Acne scars: Pathogenesis, classification and treatment. 2010. Hindawi Publishing Corporation.
3. Soliman YS, Horowitz R, Hashim PW, Nia JK, Farberg AS, Goldenberg G. Update on Acne Scar Treatment. 2018.
4. Sutaria AH, Masood S, Saleh HM, Schlessinger J. Acne Vulgaris. 2024.
5. Bhate K, Williams HC. Epidemiology of acne vulgaris. Br J Dermatol. 2013;168(3):474–85.
6. El-Khateeb EA, Khafagy NH, Abd Elaziz KM, Shedid AM. Acne vulgaris: prevalence, beliefs, patients' attitudes, severity and impact on quality of life in Egypt. Public Health. 2014;128(6):576–8.
7. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012;380(9859):2163–96.
8. Asif M, Kanodia S, Singh K. Combined autologous platelet-rich plasma with microneedling verses microneedling with distilled water in the treatment of atrophic acne scars: a concurrent split-face study.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

Journal of cosmetic dermatology. 2016 Dec;15(4):434-43.

9. Ejaz A, Amiruddin MU, Aslam S, Khan S, Zahid T, Gull S. Efficacy and safety of combining micro-needling with platelet-rich plasma (PRP) for the treatment of post-acne scars: a clinical outcome analysis. InMedical Forum Monthly 2025 Apr 12 (Vol. 36, No. 3).
10. Fabbrocini G, Fardella N, Monfrecola A, Proietti I, Innocenzi D. Acne scarring treatment using skin needling. Clinical and experimental dermatology. 2009 Dec 1;34(8):874-9.
11. Kang C, Lu D. Combined effect of microneedling and platelet-rich plasma for the treatment of acne scars: a meta-analysis. Frontiers in medicine. 2022 Feb 14;8:788754.
12. Comparative Analysis Of Herbal And Synthetic Shampoos For Malassezia Furfur-Induced Dandruff: A Cross-Sectional Study In Lahore, Pakistan. JMHSR [Internet]. 2026 Mar. 11 [cited 2026 May 30];3(1):399-406. Available from: https://jmhsr.com/index.php/jmhsr/article/view/1099
13. Hafeez R, Ilyas S, Sheikh FZ, Hafeez R, Malik LM, Rasheed T. Outcome of combination of microneedling with platelet rich plasma in the treatment of patients with post acne scarring. Journal of Pakistan Association of Dermatologists. 2024 Jan 1;34(1).
14. Sharma S, Kaur T, Bassi R. A split face comparative study to evaluate the efficacy of skin microneedling and platelet rich plasma (PRP) combination versus skin microneedling alone for treatment of post acne scars.
15. Amer A, Elhariry S, Al-Balat W. Combined autologous platelet-rich plasma with microneedling versus microneedling with non-cross-linked hyaluronic acid in the treatment of atrophic acne scars: split-face study. Dermatologic therapy. 2021 Jan;34(1):e14457.
16. Mubeen S, Gardezi SA, Ghias A, Shaheen E, Chaudhry ZS, Aman S. Comparison of outcome of microneedling with autologus platelet rich plasma verses microneedling with topical insulin in the treatment of post-acne atrophic scars. Journal of Pakistan Association of Dermatologists. 2023 Oct 12;33(4):1461-8.
17. Ghaus I, Mashhood AA, Yousaf F, Rathore HS, Yasmin G, Khan S. Comparison of Microneedling with Platelet-Rich Plasma versus Distilled Water for Atrophic Acne Scar. Pakistan Armed Forces Medical Journal. 2025 Aug 31;75(4):778.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p)3007-1593

18. Xiao H, Xu D, Mao R, Xiao M, Fang Y, Liu Y. Platelet-rich plasma in facial rejuvenation: a systematic appraisal of the available clinical evidence. Clinical, Cosmetic and Investigational Dermatology. 2021 Nov 16:1697-724.

19. Albalat W, Ghonemy S, Saleh A, Elradi M. Microneedling combined with botulinum toxin-A versus microneedling combined with platelet-rich plasma in treatment of atrophic acne scars: a comparative split face study. Archives of Dermatological Research. 2023 May;315(4):839-46.