Original Article
DOI: https://doi.org/10.70749/ijbr.v3i3.1945

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Comparison of Outcome of Microneedling with Autologous Platelet Rich Plasma versus Microneedling with Topical Insulin in the Treatment of Post-Acne Atrophic Scars

Mohib Ullah[1], Tahir Hassan[1], Farah Humera[1], Anum Mushtaq Khan[1], Nazish Rani[1]

[1]Department of Dermatology, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan, Punjab, Pakistan.

ARTICLE INFO

Keywords: Microneedling, Platelet-rich Plasma, Topical Insulin, Acne Scars, Randomized Controlled Trial, Patient Satisfaction.

Correspondence to: Mohib Ullah Postgraduate Trainee, Department of Dermatology, Sheikh Zayed Medical College/Hospital, Rahim Yar Khan, Punjab, Pakistan.
Email: mohibzahidi.123@gmail.com

Declaration
Authors' Contribution
All authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 26-12-2024 Revised: 04-03-2025
Accepted: 17-03-2025 Published: 30-03-2025

ABSTRACT

Background: Post-acne atrophic scars are a common cosmetic concern with significant psychological impact. Microneedling is a minimally invasive technique that stimulates collagen remodeling. Platelet-rich plasma (PRP) and topical insulin have both been used as adjuncts to enhance its efficacy, but limited comparative data exist. **Objective:** To compare the outcomes of microneedling with autologous PRP versus microneedling with topical insulin in the treatment of post-acne atrophic scars. **Material and Methods:** This randomized controlled trial was conducted at the Dermatology Department of Sheikh Zayed Hospital, Rahim Yar Khan, over six months. A total of 60 patients aged 18–40 years with post-acne atrophic scars were enrolled and randomly divided into two groups: Group A received microneedling with 2 ml topical insulin, and Group B received microneedling with 2 ml autologous PRP. Each patient underwent four monthly sessions. Outcomes were assessed using scar severity scores before and after treatment, patient satisfaction scores, adverse effects, and blood glucose levels. Data were analyzed using SPSS v25.0, and independent samples t-tests were applied. **Results:** Both groups had comparable pre-treatment scar scores ($p = 0.924$). Post-treatment scar scores were significantly lower in the PRP group (4.23 ± 1.30) compared to the insulin group (4.98 ± 1.13) ($p = 0.021$). Patient satisfaction was also significantly higher in the PRP group (4.27 ± 0.79 vs. 2.77 ± 0.68, $p < 0.001$). No significant changes in blood glucose levels were noted in either group. **Conclusion:** Microneedling with PRP is more effective and better tolerated than microneedling with topical insulin for treating post-acne atrophic scars.

INTRODUCTION

Acne vulgaris is a chronic inflammatory skin condition primarily affecting the pilosebaceous units, characterized by comedones, papules, pustules, nodules, and in severe cases, cysts. It is highly prevalent among adolescents and young adults, and its impact extends beyond the acute phase of active acne, often leading to the development of post-acne scarring, especially in individuals with a history of severe or nodulocystic acne [1,2]. Among the various types of acne scars, atrophic scars are the most frequently encountered and are further categorized into ice pick, boxcar, and rolling scars based on the shape, depth, and extent of tissue loss [3,4]. These scars result from an imbalance between tissue injury and repair during the healing phase of inflammation and can have significant psychological and social implications for affected individuals.

Several interventional techniques are currently available for the management of atrophic acne scars, including chemical peels, dermal fillers, punch excision, subcision, laser resurfacing (such as fractional CO_2 and Er:YAG lasers), and energy-based devices. While many of these methods offer varying degrees of clinical improvement, they are often associated with side effects such as post-inflammatory hyperpigmentation, epidermal damage, and even exacerbation of scarring, particularly in patients with darker skin types [5]. This has led to growing interest in minimally invasive and safer alternatives for scar remodeling, among which microneedling therapy has gained significant attention.

Microneedling, also known as percutaneous collagen induction therapy, is a technique that involves the use of fine needles to create controlled micro-injuries in the skin. This mechanical stimulation promotes the release of growth factors, stimulates neocollagenesis, and enhances the absorption of topically applied agents. In atrophic acne scars, there is an excess of type I collagen and a relative deficiency of type III collagen. Microneedling helps restore this balance by stimulating the production of type III collagen and improving the dermal architecture [6,7]. The technique is relatively safe, cost-effective, and suitable for

all skin types, with minimal downtime and low risk of complications.

To enhance the therapeutic outcome of microneedling, it is often combined with adjuvants such as platelet-rich plasma (PRP). PRP is an autologous concentrate of platelets derived from the patient's own blood and is rich in growth factors, including platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor-beta (TGF-β). These bioactive molecules accelerate tissue regeneration, promote angiogenesis, and stimulate fibroblast activity, thereby improving scar texture and appearance [8]. The combined use of microneedling and PRP has shown promising results in multiple studies and is now considered a well-established synergistic approach in scar management.

Another innovative and less explored adjunct is topical insulin, which is a natural, readily available agent known to enhance wound healing. Insulin acts through the PI3K/AKT pathway, leading to increased cellular proliferation and collagen synthesis, particularly type III collagen. It also upregulates VEGF, thereby improving vascularization and tissue repair. Due to its affordability, non-invasive nature, and established safety profile, topical insulin represents a potentially effective treatment for acne scars, although limited data exist on its comparative efficacy with standard treatments such as PRP.

Given the growing interest in alternative, safe, and affordable options for acne scar treatment, this study aims to compare the clinical outcomes of microneedling combined with PRP versus microneedling combined with topical insulin in patients with post-acne atrophic scars. While both PRP and insulin have demonstrated regenerative potential, no local comparative studies have been found in the literature. This research seeks to provide evidence on the relative efficacy and safety of these two modalities, offering insight into whether topical insulin can serve as a viable, cost-effective alternative to PRP in routine dermatological practice.

MATERIAL AND METHODS

This randomized controlled trial was conducted at the Outpatient Department of Dermatology, Sheikh Zayed Hospital, Rahim Yar Khan, over a period of six months. (May 31, 2024 to November 30, 2024. Stud approval No. CPSP/REU/DER-2022-110-19249). Patients aged between 18–40 years of both genders presenting with post-acne atrophic scars and not having received any prior treatment in the last 1–2 months were included in the study. Exclusion criteria included pregnancy and lactation, bleeding disorders, platelet count less than 100,000, hypersensitivity to insulin or PRP, keloidal tendency, active herpes simplex, warts, molluscum contagiosum, and unrealistic treatment expectations.

A non-probability consecutive sampling technique was employed. Although the sample size calculated using the WHO calculator based on a 5% level of significance, 95% power, population SD of 14.77%, test value of population mean 55.42%, and anticipated population mean 23.33 yielded a very small sample size of 6, for adequate power and better clinical relevance, a sample size of 60 was selected, with 30 participants in each group [8]. Group A received microneedling with topical application of 2 ml of human Actrapid insulin, while Group B received microneedling with topical application of 2 ml of autologous platelet-rich plasma (PRP). Patients were instructed to wash their faces 30 minutes after the procedure and were strictly advised to follow sun protection measures for at least one day post-procedure. Blood glucose levels were monitored before and 30 minutes after the procedure to ensure safety.

Each patient underwent four treatment sessions at monthly intervals, followed by a final follow-up visit two months after the last session to assess treatment outcomes. Data collection was performed using a structured form and included baseline demographics, scar grading, treatment responses, and any adverse effects. Data analysis was conducted using SPSS version 25.0. Chi-square test was used for analyzing qualitative variables, and independent sample t-test was applied to compare quantitative variables between the two treatment groups.

RESULTS

A total of 60 patients were included, with 30 patients in each group. The average duration of acne scars in the insulin group was 28.57 ± 15.62 months, while in the PRP group it was 31.80 ± 14.90 months. Before treatment, the average scar severity score was 6.39 ± 1.07 in the insulin group and 6.42 ± 1.09 in the PRP group, showing that both groups had similar scar conditions at the start. After treatment, the average scar severity score decreased to 4.98 ± 1.13 in the insulin group and 4.23 ± 1.30 in the PRP group, indicating better improvement in the PRP group. Patient satisfaction was also higher in the PRP group, with a mean score of 4.27 ± 0.79, compared to 2.77 ± 0.68 in the insulin group. Blood glucose levels were measured only in the insulin group. The average blood sugar before the procedure was 88.88 ± 13.46 mg/dL, and after the procedure, it was 90.82 ± 13.99 mg/dL, showing no major changes.

The pre-treatment scar severity scores were nearly identical between the two groups, with a mean of 6.40 in the insulin group and 6.42 in the PRP group. The p-value of 0.924 indicates no statistically significant difference, confirming both groups were comparable at baseline. Post-treatment scar scores showed a significant difference between groups. The PRP group had a lower (better) mean score of 4.23 compared to 4.98 in the insulin group, with a p-value of 0.021. This demonstrates a statistically significant improvement in scar severity among patients treated with microneedling and PRP. The satisfaction score was also significantly higher in the PRP group, with a mean of 4.27 compared to 2.77 in the insulin group ($p < 0.001$). This highly significant result suggests that patients found PRP treatment more effective and were more satisfied with their cosmetic outcomes. For blood glucose levels, although the PRP group had slightly higher means both before (91.15 mg/dL) and after the procedure (92.46 mg/dL) compared to the insulin group (88.88 and 90.82 mg/dL, respectively), the differences were not statistically significant ($p = 0.488$ for pre-procedure and $p = 0.627$ for post-procedure levels). This confirms that topical application of insulin did not significantly affect systemic blood glucose levels, supporting its safety in this context.

In conclusion, the t-test results support the superior effectiveness of microneedling with PRP in reducing acne scar severity and improving patient satisfaction. Additionally, insulin use appears safe, with no significant impact on blood glucose, but was less effective than PRP in achieving clinical and patient-reported outcomes. (Table 1)

The mean post-treatment scar score in the insulin group was 5.16 ± 1.28, compared to 4.09 ± 1.17 in the PRP group. The p-value for this comparison was 0.063, which is slightly above the threshold for statistical significance. This suggests that while there is a noticeable trend toward better scar improvement in the PRP group among male patients, the difference is not statistically significant, possibly due to the smaller sample size (only 8 males in the insulin group and 13 in the PRP group). In contrast, the satisfaction score showed a highly significant difference between the two groups. Male patients in the PRP group reported a significantly higher mean satisfaction score of 4.23 ± 0.73, while those in the insulin group had a mean score of 2.75 ± 0.71. The p-value was <0.001, indicating a statistically significant and clinically meaningful difference. This suggests that male patients were much more satisfied with the results of PRP treatment than with insulin. For female participants, the post-treatment scar score was 4.91 ± 1.10 in the insulin group and 4.34 ± 1.41 in the PRP group. The p-value was 0.164, again indicating no statistically significant difference. As with the male subgroup, the PRP group had better average outcomes, but the difference did not reach significance—likely due to sample size limitations. However, as seen in males, the satisfaction score among females also differed significantly between groups. The insulin group had a mean satisfaction score of 2.77 ± 0.69, while the PRP group reported a higher score of 4.29 ± 0.85. The p-value was <0.001, confirming a highly significant difference. This shows that female patients, like males, were significantly more satisfied with PRP treatment. (Table 2)

The subgroup analysis based on Fitzpatrick skin types (I–V) was conducted to evaluate whether skin type influenced the treatment outcomes of microneedling with PRP versus microneedling with insulin. Two main outcomes were assessed: post-treatment scar score and patient satisfaction score. For Skin Type I, although the PRP group showed slightly better post-treatment scar scores (mean 4.51 ± 1.45 vs. 4.94 ± 0.90 in the insulin group), the difference was not statistically significant (p = 0.553). However, the satisfaction score was significantly higher in the PRP group (4.27 ± 0.65 vs. 2.80 ± 0.45; p < 0.001), indicating that patients with Skin Type I perceived better results and were more satisfied with PRP treatment. In Skin Type II, no significant difference was found in post-treatment scar scores (p = 0.525), but again, satisfaction scores were significantly higher in the PRP group (4.40 ± 0.89 vs. 2.33 ± 0.58; p = 0.012). This reflects a consistent pattern of improved patient satisfaction with PRP, even when scar score differences were not statistically significant. (Table 3)

statistical significance (p = 0.411 and p = 0.067, respectively). This may be due to the smaller number of patients in this subgroup, limiting the power to detect significant differences. In summary, while the difference in post-treatment scar scores was statistically significant only in Skin Type IV, the satisfaction score was consistently and significantly higher for the PRP group across almost all skin types (I–IV). These findings suggest that PRP offers superior perceived and, in some cases, objectively better outcomes compared to insulin, regardless of skin type, with the most robust effects seen in patients with Skin Type IV. (Table 4)

In patients who experienced adverse effects, the PRP group showed a lower (better) mean post-treatment scar score (4.23 ± 1.07) compared to the insulin group (5.32 ± 0.82), but the difference did not reach statistical significance (p = 0.091). However, the satisfaction score was significantly higher in the PRP group (4.33 ± 0.58) than in the insulin group (2.67 ± 0.71), with a p-value of 0.004, indicating a meaningful difference in perceived benefit despite the occurrence of adverse effects. Among patients without adverse effects, the mean post-treatment scar score again favored the PRP group (4.23 ± 1.34 vs. 4.83 ± 1.23 in the insulin group), though this difference was not statistically significant (p = 0.116). However, similar to the adverse effects group, the satisfaction score was significantly better in the PRP group (4.26 ± 0.81) than in the insulin group (2.81 ± 0.68), with a highly significant p-value of <0.001. These findings suggest that patient satisfaction with PRP was consistently higher, regardless of whether adverse effects occurred. While the clinical improvement (scar score) showed a favorable trend toward PRP in both groups, statistical significance was not achieved, possibly due to limited sample sizes. Overall, PRP remains the preferred modality in terms of patient-reported satisfaction, even in those who experienced mild side effects. (Table 5)

Table 1

Comparison of Outcomes Between Microneedling with Insulin vs. PRP

Variable	Group	Mean ± SD	p-value
Pre-Treatment Scar Score	Insulin	6.40 ± 1.07	0.924
	PRP	6.42 ± 1.09	
Post-Treatment Scar Score	Insulin	4.98 ± 1.13	**0.021**
	PRP	4.23 ± 1.30	
Satisfaction Score	Insulin	2.77 ± 0.68	**<0.001**
	PRP	4.27 ± 0.79	
BG Before Procedure	Insulin	88.88 ± 13.46	0.488
	PRP	91.15 ± 11.66	
BG After Procedure	Insulin	90.82 ± 13.99	0.627
	PRP	92.46 ± 11.97	

Table 2

Gender-Wise Comparison of Post-Treatment Scar Score and Satisfaction Score Between Groups

Gender	Variable	Group	Mean ± SD	p-value
Male	Post-Treatment Scar Score	Insulin	5.16 ± 1.28	0.063
		PRP	4.09 ± 1.17	
	Satisfaction Score	Insulin	2.75 ± 0.71	**<0.001**
		PRP	4.23 ± 0.73	
Female	Post-Treatment Scar Score	Insulin	4.91 ± 1.10	0.164
		PRP	4.34 ± 1.41	
	Satisfaction Score	Insulin	2.77 ± 0.69	**<0.001**

		PRP	4.29 ± 0.85	

Table 3
Skin Type-Wise Comparison of Post-Treatment Scar and Satisfaction Scores Between Groups

Skin Type	Variable	Group	Mean ± SD	p-value
I	Post-Treatment Scar Score	Insulin	4.94 ± 0.90	0.553
		PRP	4.51 ± 1.45	
	Satisfaction Score	Insulin	2.80 ± 0.45	**<0.001**
		PRP	4.27 ± 0.65	
II	Post-Treatment Scar Score	Insulin	3.70 ± 0.87	0.525
		PRP	4.40 ± 1.63	
	Satisfaction Score	Insulin	2.33 ± 0.58	**0.012**
		PRP	4.40 ± 0.89	
III	Post-Treatment Scar Score	Insulin	5.00 ± 0.92	0.179
		PRP	3.93 ± 1.40	
	Satisfaction Score	Insulin	2.60 ± 0.55	**0.014**
		PRP	4.00 ± 0.89	
IV	Post-Treatment Scar Score	Insulin	5.53 ± 1.06	**0.010**
		PRP	3.98 ± 0.59	
	Satisfaction Score	Insulin	2.80 ± 0.79	**0.004**
		PRP	4.40 ± 0.89	
V	Post-Treatment Scar Score	Insulin	4.76 ± 1.35	0.411
		PRP	3.93 ± 1.45	
	Satisfaction Score	Insulin	3.00 ± 0.82	0.067
		PRP	4.33 ± 1.16	

Table 4
Scar Type-Wise Comparison of Post-Treatment Scar and Satisfaction Scores Between Groups

Scar Type	Variable	Group	Mean ± SD	p-value
Ice Pick	Post-Treatment Scar Score	Insulin	5.41 ± 1.05	**0.017**
		PRP	4.10 ± 1.11	
	Satisfaction Score	Insulin	2.89 ± 0.78	**0.001**
		PRP	4.50 ± 0.85	
Rolling	Post-Treatment Scar Score	Insulin	4.98 ± 0.99	0.088
		PRP	3.95 ± 1.41	
	Satisfaction Score	Insulin	2.90 ± 0.74	**0.002**
		PRP	4.13 ± 0.64	
Boxcar	Post-Treatment Scar Score	Insulin	4.63 ± 1.29	0.859
		PRP	4.53 ± 1.42	
	Satisfaction Score	Insulin	2.55 ± 0.52	**<0.001**
		PRP	4.17 ± 0.84	

Table 5
Comparison of Treatment Outcomes Based on Presence or Absence of Adverse Effects

Adverse Effects	Variable	Group	Mean ± SD	p-value
Yes	Post-Treatment Scar Score	Insulin	5.32 ± 0.82	0.091
		PRP	4.23 ± 1.07	
	Satisfaction Score	Insulin	2.67 ± 0.71	**0.004**
		PRP	4.33 ± 0.58	
No	Post-Treatment Scar Score	Insulin	4.83 ± 1.23	0.116
		PRP	4.23 ± 1.34	
	Satisfaction Score	Insulin	2.81 ± 0.68	**<0.001**
		PRP	4.26 ± 0.81	

DISCUSSION

This study aimed to compare the efficacy and patient satisfaction of microneedling with autologous platelet-rich plasma (PRP) versus microneedling with topical insulin in the treatment of post-acne atrophic scars. Our results show that both treatments were effective, but microneedling with PRP provided significantly better clinical outcomes and higher patient satisfaction.

The superior performance of PRP can be attributed to its high concentration of growth factors such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), vascular endothelial growth factor (VEGF), and epidermal growth factor (EGF), all of which stimulate collagen production and dermal remodeling [9,10]. This synergistic effect when combined with microneedling results in enhanced neocollagenesis and skin regeneration [11,12].

Our findings align with existing literature. A meta-analysis demonstrated that the combination of PRP with microneedling led to significantly better outcomes in acne scar treatment compared to microneedling alone, particularly in patient satisfaction and scar score reduction [10]. Similarly, clinical trials have consistently shown improved qualitative and quantitative scar scores when PRP is added to microneedling protocols [11,13,14].

In contrast, while topical insulin also promotes collagen synthesis by stimulating fibroblasts and enhancing protein metabolism, its clinical efficacy appears to be more limited [9,15]. One study reported better scar improvement with topical insulin compared to PRP, but this finding contrasts with most published data and may reflect methodological differences or patient selection bias [9]. In our study, insulin showed a statistically significant but lower improvement in scar scores and satisfaction ratings than PRP, particularly among male patients and those with Fitzpatrick Skin Type IV.

Notably, insulin did not cause significant changes in blood glucose levels pre- and post-procedure, confirming its safety as a topical agent [15]. This echoes previous reports which support the safe use of insulin in dermatological applications without systemic metabolic effects [15].

Interestingly, in all Fitzpatrick skin types (I–IV), PRP was associated with higher patient satisfaction scores, even when scar score differences were not statistically significant. This trend has been reported in prior studies, emphasizing the psychological and cosmetic satisfaction derived from PRP treatment [16,17]. The most prominent benefits were observed in patients with Skin Type IV, suggesting a potential skin-type-related differential response to PRP therapy [16].

Our subgroup analysis by gender also showed that PRP led to higher satisfaction in both males and females, even in cases where scar severity improvements were not statistically significant. This highlights the importance of subjective outcomes in aesthetic dermatology, where visible improvement and patient perception often carry greater weight than objective measurements [18,19].

Regarding adverse effects, both groups tolerated treatments well. However, satisfaction scores remained significantly higher in the PRP group regardless of side effects. This finding is consistent with other studies that report minimal adverse events and high satisfaction with PRP-based therapies [20,21].

In summary, while microneedling with topical insulin is safe and moderately effective, microneedling with PRP consistently demonstrates superior outcomes in both scar reduction and patient satisfaction. These findings are corroborated by recent literature, reinforcing PRP's role as a preferred adjuvant to microneedling in the management of post-acne atrophic scars.

CONCLUSION

In conclusion, this study demonstrated that while both microneedling with insulin and microneedling with platelet-rich plasma (PRP) were safe and showed some degree of clinical improvement in post-acne atrophic scars, PRP was significantly more effective in reducing scar severity and achieving higher patient satisfaction. The groups were comparable at baseline, and no significant differences were observed in pre-treatment scar scores or blood glucose levels, indicating the safety of both interventions. However, the PRP group showed superior outcomes post-treatment, making it a more effective and patient-preferred modality for acne scar management.

REFERENCES

1. Simpson, N. B., & Cunliffe, W. J. (2004). Disorders of the sebaceous glands. *Rook's textbook of dermatology*, 2121-2196. https://doi.org/10.1002/9780470750520.ch43
2. Goodman, G. J., & Facd. (2000). Postacne scarring: A review of its pathophysiology and treatment. *Dermatologic Surgery*, *26*(9), 857-871. https://doi.org/10.1046/j.1524-4725.2000.99232.x
3. Jacob, C. I., Dover, J. S., & Kaminer, M. S. (2001). Acne scarring: A classification system and review of treatment options. *Journal of the American Academy of Dermatology*, *45*(1), 109-117. https://doi.org/10.1067/mjd.2001.113451
4. Lee, W., Jung, H., Lim, H., Jang, Y., Lee, S., & Kim, D. (2011). Serial sections of atrophic acne scars help in the interpretation of microscopic findings and the selection of good therapeutic modalities. *Journal of the European Academy of Dermatology and Venereology*, *27*(5), 643-646. https://doi.org/10.1111/j.1468-3083.2011.04330.x
5. GOODMAN, G. J., & BARON, J. A. (2006). Postacne scarring: A qualitative global scarring grading system. *Dermatologic Surgery*, *32*(12), 1458-1466. https://doi.org/10.1111/j.1524-4725.2006.32354.x
6. Alster, T. S., & Graham, P. M. (2018). Microneedling: a review and practical guide. *Dermatologic Surgery*, *44*(3), 397-404. https://doi.org/10.1097/DSS.0000000000001248
7. Kaushik, S., Hord, A. H., Denson, D. D., McAllister, D. V., Smitra, S., Allen, M. G., & Prausnitz, M. R. (2001). Lack of pain associated with Microfabricated microneedles. *Anesthesia & Analgesia*, *92*(2), 502-504. https://doi.org/10.1213/00000539-200102000-00041
8. Mubeen, S., Gardezi, S. A. A., Ghias, A., Shaheen, E., Chaudhry, Z. S., & Aman, S. (2023). Comparison of outcome of microneedling with autologus platelet rich plasma verses microneedling with topical insulin in the treatment of post-acne atrophic scars. *JPAD, 33*(4), 1461-1468. https://jpad.com.pk/index.php/jpad/article/view/2378
9. Pawar, M., & Singh, M. (2021). Microneedling with autologous platelet-rich plasma versus microneedling with topical insulin in the treatment of postacne atrophic scars: A simultaneous split-face comparative study. *Journal of the American Academy of Dermatology*, *84*(3), 810-811. https://doi.org/10.1016/j.jaad.2020.05.152
10. Kang, C., & Lu, D. (2022). Combined effect of Microneedling and platelet-rich plasma for the treatment of acne scars: A meta-analysis. *Frontiers in Medicine*, *8*. https://doi.org/10.3389/fmed.2021.788754
11. Abdin, R., Gaumond, S. I., Yaghi, M., Mahmoud, R. H., Rodriguez, M., Issa, N. T., & Jimenez, J. J. (2025). Utility of Adding Platelet-Rich Plasma to Microneedling vs Microneedling Alone in the Treatment of Acne Scarring. *Journal of drugs in dermatology: JDD*, *24*(1), 41-46. https://doi.org/10.36849/jdd.8585
12. Shah, A., Shah, K., Solanki, R., & Raval, R. (2017). A comparative study of microneedling with platelet-rich plasma plus topical minoxidil (5%) and topical minoxidil (5%) alone in androgenetic alopecia. *International Journal of Trichology*, *9*(1), 14. https://doi.org/10.4103/ijt.ijt_75_16
13. Mohta, A., Yadav, M. K., & Ghiya, B. C. (2023). Microneedling with autologous platelet-rich plasma versus topical insulin for treating postacne scars: A split-face comparison. *Journal of Cutaneous and Aesthetic Surgery*. https://doi.org/10.4103/jcas.jcas_20_23
14. Amer, A., Elhariry, S., & Al-Balat, W. (2020). Combined autologous <scp>platelet-rich</scp> plasma with microneedling versus microneedling with non-cross-linked hyaluronic acid in the treatment of atrophic acne scars: Split-face study. *Dermatologic Therapy*, *34*(1). https://doi.org/10.1111/dth.14457
15. Mohamed, A. A., Attwa, E. M., & Fawzy, M. M. (2023). Use of Microneedling with platelet rich plasma for management of atrophic post-acne scars: Review article. *The Egyptian Journal of Hospital Medicine*, *91*(1), 5251-5255. https://doi.org/10.21608/ejhm.2023.305062
16. Tawfik, K. M., Makki, M. A., & Mahmoud, F. E. (2023). Microneedling with platelet-rich plasma versus microneedling with vitamin C in treatment of acne scars: Comparative study. *Al-Azhar Assiut Medical Journal*, *21*(2), 63-67. https://doi.org/10.4103/azmj.azmj_79_21
17. Saleh, L. H., & Alkhayer, A. E. (2022). Skin microneedling alone versus skin microneedling plus platelet rich plasma PRP in the treatment of atrophic post acne scars (A split face comparative study). *مجلة العلوم الطبية و الصيدلانية 6*(2), 68-75. https://doi.org/10.26389/ajsrp.e170122
18. Deepika, M., Chittla, S., Swetha, D., Dheeraj, S., & Sougandhika, B. (2024). The efficacy of the combination of Microneedling with Jessner's plus 35% Trichloroacetic acid peel versus the efficacy of the combination of Microneedling with platelet-rich plasma therapy for the treatment of atrophic acne scars: A comparative study. *Journal of Dermatology and Dermatologic Surgery*, *28*(1), 19-23. https://doi.org/10.4103/jdds.jdds_15_23
19. Mohamed, H., Hassan, H., Nasif, G., & Ahmed, S. (2022). Combined microneedling and platelet-rich plasma in management of post-acne scars: A comparative study. *Minia Journal of Medical Research*, *30*(1), 132-134. https://doi.org/10.21608/mjmr.2022.222870
20. Kolhal, C., & Laul, R. (2024). Cross technique with 100 % TCA versus MICRONEEDLING with platelet rich plasma in treatment of atrophic acne scars –a comparative study. *GLOBAL JOURNAL FOR RESEARCH ANALYSIS*, 24-26. https://doi.org/10.36106/gjra/9700950
21. Yaseen, U., Shah, S., & Bashir, A. (2017). Combination of platelet rich plasma and microneedling in the management of atrophic acne scars. *Int J Res Dermatol*, *3*(3), 346-50.