Comparative study between nanofat injection with and without Platelet-Rich Plasma (PRP) in improvement of mature scar: clinical study

Nagat Mohamed Abdullah[a*], Mohammed Ahmed Omar[b], Mahmoud Abdullah Hifny[a], Abdelrahman Khairy Abdullah[a]

[a]Plastic Surgery Department, Faculty of Medicine, South Valley University, Qena, Egypt.
[b]General Surgery department, Faculty of Medicine, South Valley University, Qena, Egypt.

Abstract

Background: Traditional therapies generally fail on mature scars with fibrosis, discolouration, and poor suppleness. Regenerative therapy include nanofat, rich in stromal vascular fraction, and PRP, a concentration of autologous platelets releasing growth factors. The combination has been hypothesized to improve scar remodeling

Objectives: To compare nanofat injection with and without Platelet-Rich Plasma(PRP) in improvement of mature scar.

Patients and methods: This prospective, split-scar study at Qena University Hospital(August 2024–2025) included 15 adults with facial scars(>6 months old). The study was ethically approved under SVU-MED-SUR011-1-24-9-947. Each patient received nanofat on one half of the scar and nanofat+PRP on the other. Fat was harvested mainly from the abdomen, emulsified and filtered into nanofat; PRP was obtained by double centrifugation. Injections were superficial or subdermal, followed by standard wound care and medications. Scars were evaluated at 1, 3, and 6 months using Patient and Observer Scar Assessment Scale (POSAS), Vancouver Scar Scale (VSS), and pain scores.

Results: The nanofat + PRP group showed significantly lower POSAS scores at 1(34.67±4.71 vs. 41.87±6.28; p=0.0019), 3(25.2±3.66 vs. 31.27±6.48; p=0.0049), and 6 months(17.4±2.68 vs. 22.6±4.67; p=0.0012). VAS pain scores were also significantly lower at 3(3.6±0.95 vs. 5±0.89; p=0.0004) and 6 months(1.8±0.75 vs. 2.93±0.85; p=0.0009). VSS scores improved significantly at 3($p < 0.0001$) and 6 months(p=0.0438). Patient satisfaction was significantly higher with the combination therapy(p=0.0086).

Conclusion: Nanofat with PRP improves mature scar look, discomfort, and patient satisfaction more than nanofat alone without increasing side effects.

Keywords: Nanofat; Platelet-Rich Plasma (PRP); Mature scar; Scar treatment.

***Correspondence**: Nagatmohamed1996@gmail.com

DOI: 10.21608/SVUIJM.2025.413577.2242

Received: 14 August, 2025
Revised: 19 September, 2025.
Accepted: 20 September, 2025.
Published: 26 September, 2025

Cite this article as Nagat Mohamed Abdullah, Mohammed Ahmed Omar, Mahmoud Abdullah Hifny, Abdelrahman Khairy Abdullah. (2025). Comparative study between nanofat injection with and without Platelet-Rich Plasma (PRP) in improvement of mature scar: clinical study. *SVU-International Journal of Medical Sciences*. Vol.8, Issue 2, pp: 572-584.

Introduction

Mature scars, characterized by fibrosis, reduced elasticity, discoloration, and textural irregularities, are often resistant to conventional topical therapies and surgical revisions, which may cause additional scarring. Non-invasive approaches like nanofat and PRP have emerged as promising alternatives by activating natural tissue regeneration **(Jeschke et al., 2023).**

Nanofat is an autologous, mechanically emulsified fat graft enriched with stromal vascular fraction (SVF), which contains stem cells and growth factors. It improves skin texture, promotes neovascularization, and enhances dermal thickness, making it effective for treating wrinkles and mature scars **(La Padula et al., 2023; Atiyeh et al., 2021).** Nanofat is produced by harvesting fat with small cannulas to obtain microfat, which is then processed using Luer-Lock connectors and filtered through a 500 µm mesh.

The regenerative potential of nanofat is further enhanced when combined with Platelet-Rich Plasma (PRP), which is derived from the patient's centrifuged plasma and contains concentrated platelets. These platelets release growth factors like PDGF, EGF, and VEGF upon activation, stimulating cell proliferation and skin remodeling **(Pons et al., 2022).**

Together, nanofat and PRP act synergistically: nanofat delivers regenerative cells, while PRP boosts cellular activity and accelerates tissue repair. This dual therapy has shown superior outcomes in improving scar quality, reducing fibrosis, and enhancing collagen synthesis compared to nanofat alone, making it especially effective for resistant mature scars **(Jianu et al., 2022; Qari et al., 2023).**

The aim of the study is to compare nanofat injection with and without Platelet-Rich Plasma (PRP) in improvement of mature scar.

Patients and methods

The Plastic Surgery Department of Qena University Hospital, South Valley University, undertook this prospective study from August 2024 to August 2025. Adults 18–50 with hypertrophic, atrophic, or contracture scars at least 6 months old were included. If the washout period was 3 months, participants may have had non-invasive scar treatments. All patients had steady weight for 6 months.

The study was ethically approved under **SVU-MED-SUR011-1-24-9-947**.

Immature scars, keloids, pregnancy, breastfeeding, autoimmune diseases like lupus or scleroderma, uncontrolled diabetes or cardiovascular conditions, allergies to local anesthetics or PRP components, blood disorders affecting coagulation, and recent surgical scar revisions or dermabrasion within 6 months were excluded.

Based on **El-Sayed et al. (2020),** Epi Info was used to calculate the sample size, assuming a mean Vancouver Scar Scale score of 1.9 ± 1.4 in the nanofat + PRP group and 2.4 ± 1.3 in the nanofat-only group, with 95% confidence, 80% power, and 5% margin of error. The final sample size was 15 patients.

Scars were splitted into two halves and each half was randomly assigned to any group using a computer-generated randomization list. Group allocation was concealed in sequentially numbered, sealed opaque envelopes that were opened at the time of surgery. Group 1 received nanofat therapy alone, while Group 2 received nanofat with PRP.

A full medical history and general and local physical examination were performed on all research participants. Each mature scar was split in half: one half received autologous nanofat injections alone, and the other received nanofat with PRP **(Fig.1).** This design enabled intrapatient treatment efficacy comparison.

All patients had autologous fat harvesting from the belly, the most common donor region, followed by the flanks and inner knee for ease of access and contour improvement **(Gir et al., 2012).** The operation started with a 2 cm intradermal injection of 2% lidocaine hydrochloride at the entrance location. A No.11 scalpel blade was used to insert a 3 mm multiport harvesting cannula into the subcutaneous fat layer. A tumescent anesthetic of 500 ml of 0.9% saline, 0.5 mg/ml adrenaline, and 20 ml of 2% lidocaine (without adrenaline) was administered in numerous directions to anesthetize the area. After 20 minutes of numbness, subcutaneous fat was successfully collected using a 20 ml Luer-Lock syringe under slight negative pressure.

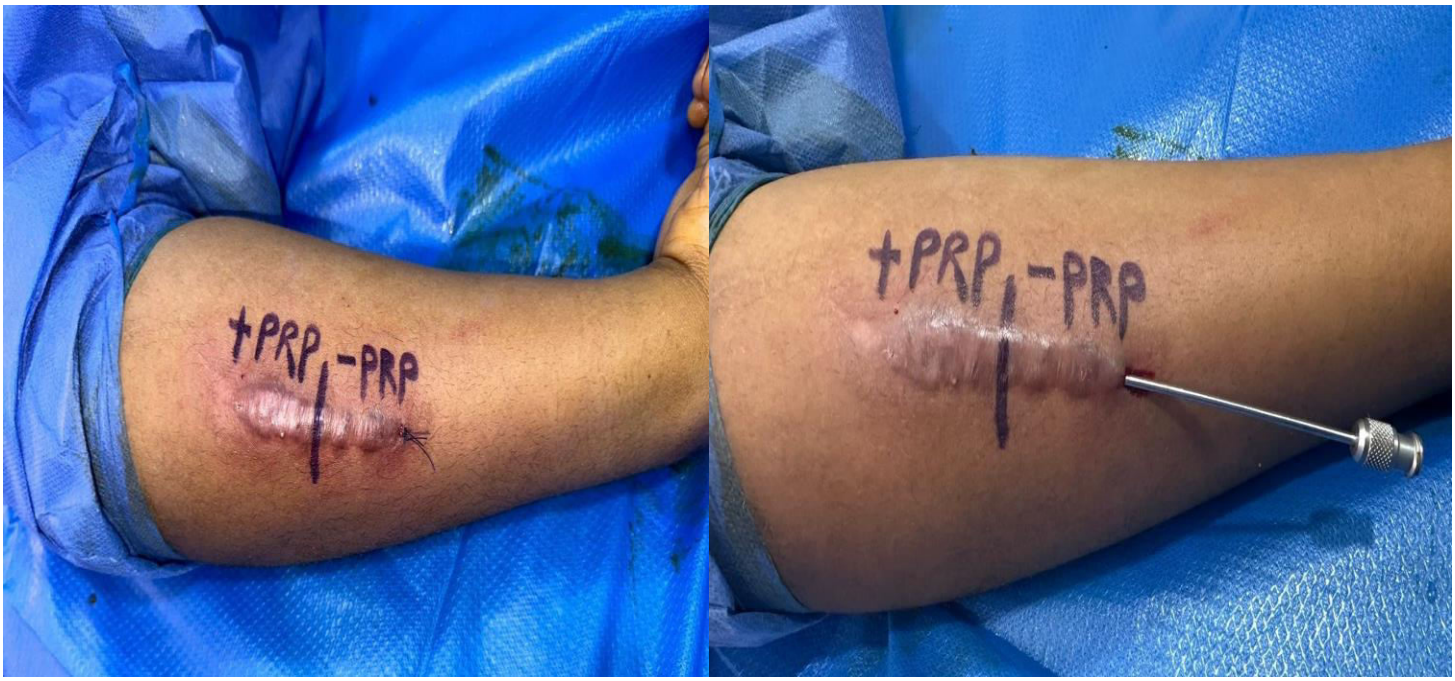

Fig.1. One half received autologous nanofat injections alone, and the other received nanofat with PRP

To eliminate blood and debris, Lactated Ringer solution was strongly irrigated over the lipoaspirate after harvesting. The fat was left to stand for 3 minutes and centrifuged at 3000 rpm for 3 more minutes to separate viable fat particles from the oil layer (ruptured lipocytes) and aqueous fluid layer with blood and cell debris. The top and bottom layers were removed, leaving the pure fat. Fat was mechanically emulsified by passing it 30 times between two 20 ml Luer-Lock syringes with a 2.4 mm Tulip connector to create macrofat. After converting to microfat with 30 runs via a 1.4 mm connector, it was emulsified with 30 passes through a 1.2 mm connector. After emulsifying the fat, it was filtered through a 600 µm nanofat filter to create the final nanofat product for injection.

Start PRP preparation by drawing 9 ml of venous blood into a tube with 1 ml of citrate dextrose as an anticoagulant. The mixture was gently mixed and centrifuged at 250 × g ("soft spin") for 10 minutes. The plasma supernatant with platelets was transferred to another sterile tube and spun at 750 × g ("hard spin") for 10 minutes. Lower one-third of the volume, rich in platelets, was collected as PRP, while the upper two-thirds, PPP, was discarded. Shook

gently to resuspend platelet pellets at the bottom in a small volume of plasma (2-4 ml). On average, 3.0 ± 0.5 ml of PRP was obtained per patient, corresponding to a 3–5-fold increase in platelet concentration over baseline, with minimal leukocyte contamination. The final PRP was then combined with nanofat by sliding between two syringes 3–4 times with a three-way connector.

Standardized injection was used. Nanofat alone or combined with PRP was superficially injected into each scar using 28G insulin syringes. In some circumstances, Luer-Lock syringes with 22–23G cannulas were used for subdermal injections. A standardized injection volume of 0.1–0.2 ml per cm^2 of scar tissue was used to ensure reproducibility, along with observing the skin turned yellow, suggesting fat accumulation. The recipient region was clothed and covered for a week after treatment. To prevent fat displacement, patients were told not to press or rub the spot. All treated regions received sunscreen. External elastic compression with steri-strips® reduced edema and hematoma development at donor sites.

NSAIDs for analgesic, oral corticosteroids for antiedematous effects, and cephalosporins or amoxicillin-clavulanate for 7 days were given to all patients after surgery. Post-injection scar examinations were undertaken at 1, 3, and 6 months to measure scar progress. Additional treatment sessions for each patients were provided to patients during the follow-up visits at 1 and 3 months.

Multiple established scales assessed scars. Scar features were rated using the Patient and Observer Scar Assessment Scale (POSAS) **(Bianchi et al., 2010).** Patients rated discomfort, itch, color, stiffness, thickness, and surface irregularity from 1 to 10, with 10 being the worst. Same scale was used to grade vascularity, pigmentation, thickness, relief, pliability, and surface area. Each assessed scar appearance overall. Higher POSAS scores indicated more serious scars.

A unidimensional scale from 0 to 10 was used to quantify pain severity, with 0 representing no pain and 10 representing the worst discomfort. **Chaves et al. (2021)** classified pain as mild (1–3), moderate (4–6), or severe (7–10).

Also assessed were vascularity, height, pliability, and pigmentation using the Vancouver Scar Scale (VSS) **(DeJong et al., 2020).** VSS ratings varied from 0 to 13, with higher scores indicating severe scarring.

Patients' satisfaction was assessed using 5-poitnt Likert scale. 1 = Very dissatisfied, 2 = Dissatisfied, 3 = Neutral, 4 = Satisfied, and 5 = Very satisfied, with higher scores indicating greater satisfaction **(Upadhyaya et al., 2025).**

Statistical analysis

Data were analyzed using SPSS version 25.0. Quantitative data were expressed as mean ± SD and qualitative data as number and percentage. Data normality was assessed using the Shapiro-Wilk test. Mann–Whitney and chi-square tests were used for comparisons, with univariate and multivariate analyses applied for correlations. A p-value < 0.05 was considered statistically significant.

Results

The study included 15 patients with a mean age of 37.33 ± 7.44 years. Males constituted 53.33% of the sample. The average scar age was 12.87 ± 4.01 months. Hypertrophic scars were the most prevalent (66.67%), followed by atrophic (26.67%) and contracture scars (6.67%). Scar location was most commonly the forehead (40%) and cheeks (33.33%), with fewer cases on the nose (13.33%), chin, and other facial areas (6.67% each). Prior non-invasive treatment was reported by 66.67% of patients,

primarily with creams (53.33%), followed by gels and laser therapy (33.33% each), and other methods (13.33%), as shown in (**Table.1**).

Table 1. Demographic Characteristics and Scar evaluation among Study Participants

Parameters	Value (n = 15)
Age (Years)	37.33 ± 7.44
Gender	
• Male	8 (53.33%)
• Female	7 (46.67%)
Scar Age (Months)	12.87 ± 4.01
Scar Type	
• Hypertrophic	10 (66.67%)
• Atrophic	4 (26.67%)
• Contracture	1 (6.67%)
Scar Site	
• Forehead	6 (40.00%)
• Cheek	5 (33.33%)
• Nose	2 (13.33%)
• Chin	1 (6.67%)
• Other	1 (6.67%)
Received Previous Non-Invasive Treatment	10 (66.67%)
Treatment Type	
• Creams	8 (53.33%)
• Gels	5 (33.33%)
• Laser Therapy	5 (33.33%)
• Other	2 (13.33%)

At 1 month, the Nanofat + PRP group showed significantly lower POSAS scores (34.67 ± 4.71) compared to Nanofat-only (41.87 ± 6.28; p = 0.0019), indicating earlier scar improvement. This significant difference persisted at 3 months (25.2 ± 3.66 vs. 31.27 ± 6.48; p = 0.0049) and 6 months (17.4 ± 2.68 vs. 22.6 ± 4.67; p = 0.0012), confirming the superior long-term aesthetic outcomes with PRP addition. VAS pain scores were not significantly different at 1 month (p = 0.4866). However, by 3 months, the Nanofat + PRP group had significantly lower pain scores (3.6 ± 0.95 vs. 5 ± 0.89; p = 0.0004), with further reduction at 6 months (1.8 ± 0.75 vs. 2.93 ± 0.85; p = 0.0009), indicating enhanced analgesic effect. VSS scores at 1 month showed no significant difference (p = 0.4773). At 3 months, the Nanofat + PRP group demonstrated significantly better outcomes (3.73 ± 1.18 vs. 5.47 ± 0.62; p < 0.0001), with continued superiority at 6 months (1.87 ± 1.02 vs. 2.6 ± 0.8; p = 0.0438), reflecting improved scar structure and maturation, as shown in (**Table.2**).

Table 2. Different evaluative scales Scores at 1, 3, and 6 Months post treatment

Time Point	Nanofat (n = 15)	Nanofat + PRP (n = 15)	p-value
POSAS			
• 1 Month	41.87 ± 6.28	34.67 ± 4.71	**0.0019**[MWU]*

• 3 Months	31.27 ± 6.48	25.2 ± 3.66	**0.0049**[MWU]*
• 6 Months	22.6 ± 4.67	17.4 ± 2.68	**0.0012**[MWU]*
VAS score			
• 1 Month	7.4 ± 1.54	7 ± 1.46	0.4866[MWU]
• 3 Months	5 ± 0.89	3.6 ± 0.95	**0.0004**[MWU]*
• 6 Months	2.93 ± 0.85	1.8 ± 0.75	**0.0009**[MWU]*
VSS Score			
• 1 Month	8.07 ± 2.17	8.73 ± 2.69	0.4773[MWU]
• 3 Months	5.47 ± 0.62	3.73 ± 1.18	**<0.0001**[MWU]*
• 6 Months	2.6 ± 0.8	1.87 ± 1.02	**0.0438**[MWU]*

At 6 months, patient satisfaction was significantly higher in the Nanofat + PRP group, with more patients reporting satisfaction (p = 0.0086), while the Nanofat group had significantly more patients who were highly satisfied (p = 0.0312). No significant differences were observed in dissatisfaction (p = 0.5589) or neutrality (p = 0.4814) between groups. Adverse events were comparable between groups. Mild pain (p = 0.1054), edema (p = 0.4814), bruising (p = 0.1299), and acneiform eruptions (p = 0.99) showed no significant differences. Hyperpigmentation was less frequent in the combination group and approached significance (p = 0.0719), as shown in (**Table.3**).

Table 3. Patient Satisfaction and adverse events at 6 Months post treatment

Variables	Nanofat (n=15)	Nanofat + PRP (n=15)	p-value
Satisfaction Level			
• Highly dissatisfied	0 (0%)	0 (0%)	-
• Dissatisfied	2 (13.33%)	1 (6.67%)	0.5589[X]
• Neutral	6 (40%)	8 (53.33%)	0.4814[X]
• Satisfied	3 (20%)	10 (66.67%)	**0.0086**[X]*
• Highly Satisfied	6 (40%)	1 (6.67%)	**0.0312**[X]*
Adverse Event			
• Mild Pain	13 (86.67%)	9 (60%)	0.1054[X]
• Transient Edema	9 (60%)	7 (46.67%)	0.4814[X]
• Bruising	7 (46.67%)	3 (20%)	0.1299[X]
• Hyperpigmentation	5 (33.33%)	1 (6.67%)	0.0719[X]
• Acneform Eruption	1 (6.67%)	1 (6.67%)	0.99[X]

Cases presentation

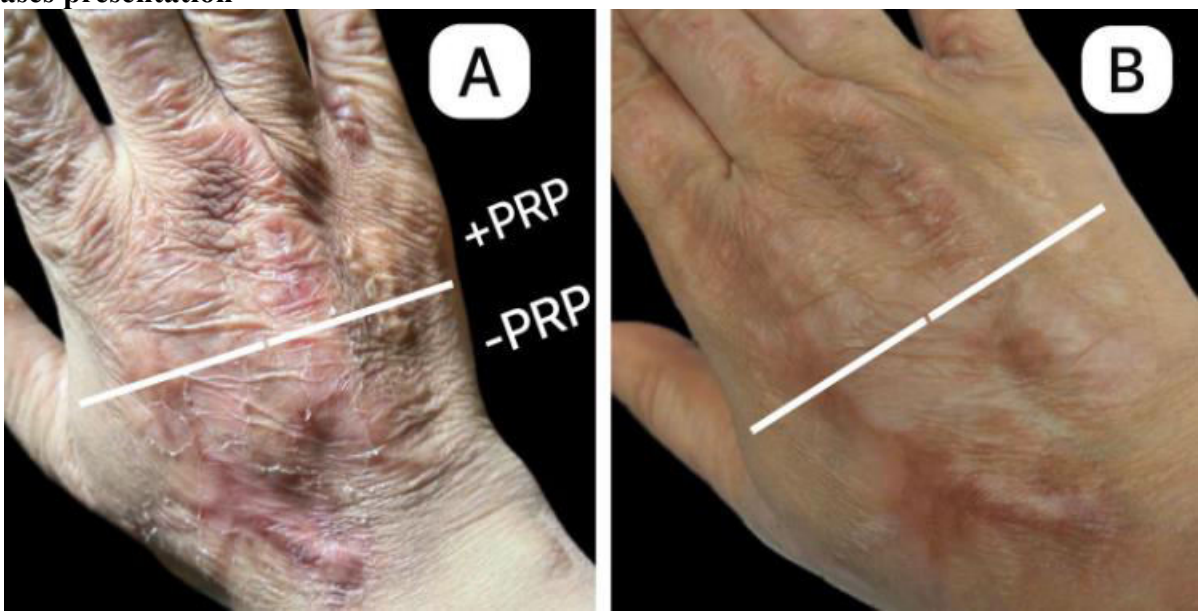

Fig.2. Case (1): Female pt 40 Yrs, Post burn scar over dorsum of Rt hand from 6 months
A: Pre-injection, **B:**After 6 months Pt recoverd 3 Sessions at 1 month, 3 month, 6 month.

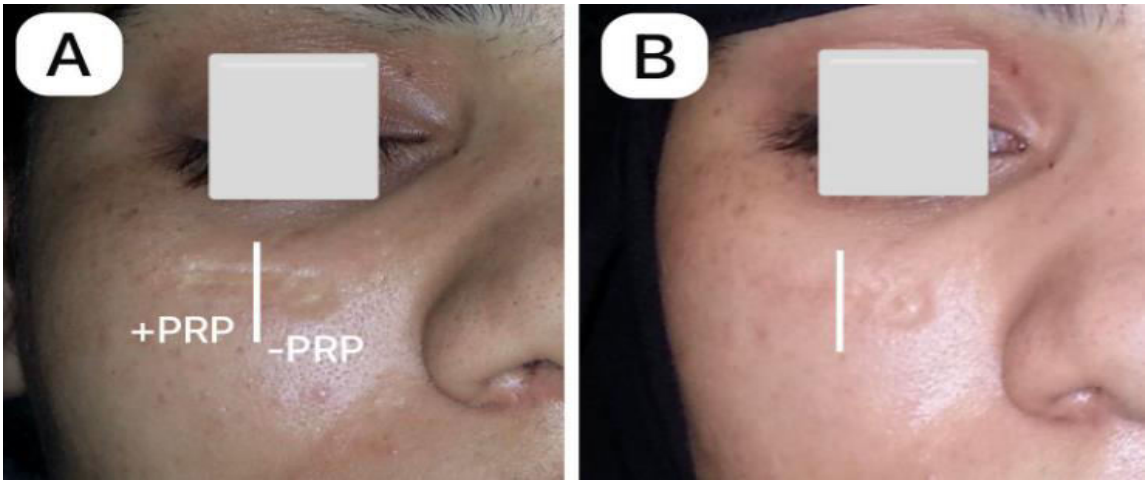

Fig.3. Case (2): Female pt 30 Yrs, Post traumatic atrophic scar over Rt cheek from 8 months.
A: Pre-injection, **B:** After 6 months

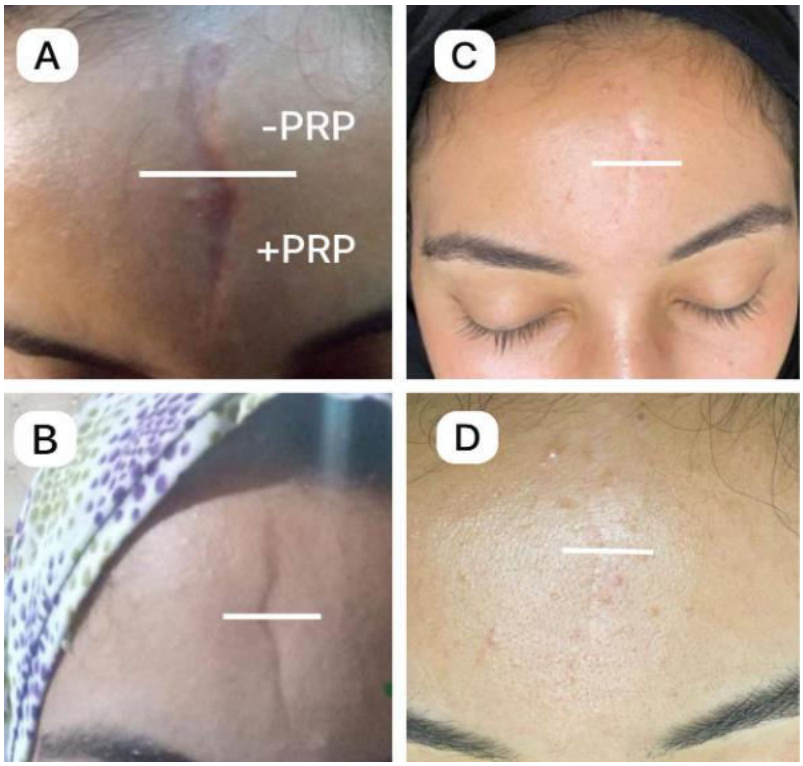

Fig.4. Case (3): Female pt 28, Yrs Post traumatic depressed scar over forehead from 1 yrs.
A: Pre-injection, **B:** After 1 months, **C:** After 3 months, **D:** After 6 months.

Discussion

Our study included 15 patients with a mean age of 37.33 ± 7.44 years, 53.33% of whom were males. The average scar age was 12.87 months. Hypertrophic scars were most common (66.67%), particularly on the forehead (40%) and cheeks (33.33%). Most patients (66.67%) had previously received non-invasive scar treatments, primarily topical creams (53.33%), followed by gels and laser therapy (33.33% each).

Our findings are supported by **Kant et al. (2019),** who studied 361 patients with hypertrophic scars and reported scar maturation durations ranging from 23 to 46 months, with younger adults exhibiting longer maturation times (~35–44 months) compared to older individuals (~22–29 months). Similarly, **Amici et al. (2022)** reported a mean patient age of 43 ± 14.9 years, nearly equal gender distribution (48.5% males), and scar age averaging 12.4 ± 12.7 years, with 77.8% of scars older than one year—comparable to our patient profile in terms of scar chronicity.

Our predominance of hypertrophic scars aligns with **Mony et al. (2023),** who documented hypertrophic scarring in 32–72% of general scar populations, particularly after burns and surgeries. However, our results differ from **Kim et al. (2024),** who reported atrophic scars as most prevalent (42.8%), followed by flat (38.7%) and hypertrophic (18.5%) types, with atrophic scars especially common on the forehead, while hypertrophic forms were more common around the chin and mouth. Similarly, **Tan et al. (2017)** observed that atrophic facial scars were present in over 55% of subjects, suggesting that scar type distribution may vary by population and etiology.

Regarding previous treatments, our study's high prevalence of prior non-invasive modalities is consistent with global trends. These treatments, including creams,

gels, and laser therapy, target hydration, collagen remodeling, and vascular changes. However, their superficial action may account for limited efficacy, pushing patients toward deeper regenerative options like Nanofat and PRP, which enhance cellular repair and tissue remodeling **(Nunez et al., 2023; Yuan et al., 2023). Jin et al. (2013)** reported success rates of 68–72% for hypertrophic/keloid scars using laser therapy, especially pulsed-dye and fractional CO_2 lasers. Additionally, silicone remains a guideline-recommended first-line treatment for hypertrophic and keloid scars **(Monstrey et al., 2014),** though its effectiveness varies with scar characteristics.

Nanofat + PRP improved scars more than Nanofat alone, as shown by reduced POSAS scores at 1 month ($p = 0.0019$), 3 months ($p = 0.0049$), and 6 months ($p = 0.0012$). The study suggests that combining Nanofat components like adipose-derived stem cells and extracellular matrix with PRP's high growth factor concentration, such as PDGF and TGF-β, can enhance angiogenesis, fibroblast activation, and collagen remodeling. This combination improved scar remodeling over time. **Elmarakby et al. (2024)** found that Nanofat + PRP improved height, pigmentation, and vascularity in atrophic scars more than Nanofat alone. **Jafarzadeh et al. (2024)** found that PRP-enhanced Nanofat improved POSAS ratings. **Gu et al. (2018)** found significant POSAS improvement in atrophic facial scars treated with condensed Nanofat, with patient score decreasing from 28.80 ± 1.02 to 12.20 ± 0.80 ($p < 0.001$) and observer score decreasing from 18.00 ± 0.71 to 9.20 ± 0.37 ($p = 0.001$). **Yasseen et al. (2022)** found Nanofat outperformed fractional CO_2 laser for post-burn scars, with better POSAS observer scores for pigmentation and pliability, and better patient-reported scores for itching, color, stiffness, and overall outcome.

However, **Elallan et al. (2023)** found no significant difference in POSAS scores between enriched and conventional Nanofat for acne scars, suggesting that PRP's benefit may vary by scar type. Their findings differ from ours, but scar pathology may affect treatment response.

Pain reduction was also significantly better in the Nanofat + PRP group at 3 months ($p = 0.0004$) and 6 months ($p = 0.0009$), although no significant difference was detected at 1 month ($p = 0.4866$). PRP's anti-inflammatory and neuro-regenerative effects are supported. PRP's TGF-β and IL-1 receptor antagonists lower inflammation and modify nociceptor signaling, while Nanofat aids structural repair through stem cells, resulting in better neurological recovery and persistent analgesia. In infected wounds, **Segreto et al. (2020)** found 100% pain alleviation in re-epithelialized cases and a mean pain reduction of $42\% \pm 33.3\%$ after 3 months in non-re-epithelialized patients. **Ali et al. (2022)** also documented significant pain and pruritus reduction on PRP-treated donor sites, along with faster epithelialization by day 7 and 14, though final healing time matched the control group by day 21. These findings support PRP's analgesic effects in our trial.

At 1 month, there was no significant difference in Vancouver Scar Scale (VSS) scores ($p = 0.4773$), but at 3 months ($p < 0.0001$) and 6 months ($p = 0.0438$), the Nanofat + PRP group showed improved scar pliability and height. This parallels findings by **El-Sayed et al. (2020),** who noted that Nanofat + PRP reduced mean VSS from 4.6 ± 1.7 to 2.4 ± 1.3, with significant improvements in height and pliability, while vascularity and pigmentation showed no significant change. Similarly, **Yasseen et al. (2022)** observed VSS improvements in vascularity, pliability, and height after Nanofat grafting, however pigmentation remained statistically unaffected. **Rageh et**

al. (2021) found that scar pliability and height increased VSS total score.

Our study demonstrated significantly higher overall satisfaction in the Nanofat + PRP group compared to Nanofat alone ($p = 0.0086$), although paradoxically, the proportion of patients reporting high satisfaction was significantly lower in the Nanofat + PRP group ($p = 0.0312$). No significant differences were noted in other satisfaction levels between the groups. These findings suggest that while combined therapy enhanced general satisfaction, it did not necessarily increase the proportion of those extremely satisfied.

This is in agreement with **Elmarakby et al. (2024),** who reported significantly higher total satisfaction scores in patients treated with Nanofat + PRP compared to Nanofat alone after 6 months. Similarly, a systematic review by Jafarzadeh et al. (2024) covering eight trials on regenerative therapies for hypertrophic and keloid scars noted generally favorable patient satisfaction in PRP-treated individuals. A single-case report by **Pons et al. (2022)** on acne scars described noticeable subjective comfort and reduced distress in a patient following Nanofat + PRP treatment. **Mandili et al. (2022)** also confirmed this trend in a study using combined modalities (microfat, nanofat, PRP, microneedling, and CO_2 laser), reporting significant scar improvement and good patient satisfaction in all eight cases by 3 months.

Regarding safety, our study found no statistically significant differences in adverse events between groups, but the Nanofat + PRP group had numerically fewer cases of pain, edema, bruising, and hyperpigmentation, suggesting a better tolerability profile. These results align with **Fakih-Gomez et al. (2021)** which noted that facial rejuvenation with Nanofat alone caused 100% bruising, while the addition of PRP helped shorten recovery time and reduce discomfort. This favorable safety enhancement with PRP was further supported by **Arkoubi (2025),** whose meta-analysis found PRP-enriched treatments led to shorter recovery periods, attributed to PRP's anti-inflammatory and pro-angiogenic effects.

However, contrasting data were observed in the study by **Kadry et al. (2023),** where 30 patients with infraorbital dark circles were randomized to PRP (Group A) versus emulsified fat transfer (Group B). They found significantly milder postoperative ecchymosis and bruising in the PRP-only group, implying that PRP alone might be even more favorable in terms of immediate adverse event profiles than when combined with fat derivatives.

The limitations of this study include its relatively small sample size and single-center design, which restrict the generalizability of the findings. The paradoxical result of higher overall satisfaction but fewer "highly satisfied" responses in the combination group may be attributed to the limited sample size. Neither patients nor surgeons could be blinded, and outcome assessments were also unblinded, which may introduce bias. Moreover, a longer follow-up period is needed to better assess scar remodeling and provide a more comprehensive evaluation of outcomes.

Conclusion

We found that Nanofat plus PRP improved POSAS and VSS scores, pain reduction, and patient satisfaction at 6 months in mature scar therapy. Both medications were safe, but the combo group had fewer side effects. This suggests Nanofat + PRP is a safer and more successful treatment for hypertrophic and atrophic face scars, making it a recommended strategy.

References

- **Ali SS, Ahmad I, Khurram MF, Chaudhury G, Karad S, Tripathi S, et al. (2022).** The role of platelet-rich

plasma in reducing pain, pruritis, and improving wound healing of skin graft donor site. Indian Journal of Plastic Surgery, 55(4): 376–382.

- **Amici J, Taïeb C, LeFloc'h C, Demessant-Flavigny AL, Seité S, Cogrel O. (2022).** Prevalence of scars: an international epidemiological survey in adults. Journal of the European Academy of Dermatology and Venereology, 36(10): e799.
- **Arkoubi AY. (2025).** A meta-analytic review of platelet-rich plasma in fat grafting: enhancing clinical outcomes. Indian Journal of Surgery, 1–16.
- **Atiyeh B, Ghieh F, Oneisi A. (2021).** Nanofat cell-mediated anti-aging therapy: evidence-based analysis of efficacy and an update of stem cell facelift. Aesthetic Plastic Surgery, 45(6): 2939–2947.
- **Bianchi FA, Roccia F, Fiorini P, Berrone S. (2010).** Use of Patient and Observer Scar Assessment Scale for evaluation of facial scars treated with self-drying silicone gel. Journal of Craniofacial Surgery, 21(3): 719–723.
- **Chaves IA, Baêta T, Dolabella GB, Barbosa LR, Almeida NM, Oliveira FR, et al. (2021).** Pain scores at the insertion of the 52 MG levonorgestrel-releasing intrauterine system among nulligravidas and parous women. The European Journal of Contraception & Reproductive Health Care, 26(5): 399–403.
- **Colares MC, Thirupathi A, Beirão ME, Zaccaron RP, de Roch Casagrande L, Venturini LM, et al. (2025).** Platelet-rich plasma and IL-1β antagonist receptor peptide attenuate the inflammatory process of muscle injury in Wistar rats. Scientific Reports, 15(1): 14219.
- **DeJong H, Abbott S, Zelesco M, Spilsbury K, Ziman M, Kennedy BF, et al. (2020).** Objective quantification of burn scar stiffness using shear-wave elastography: Initial evidence of validity. Burns, 46(8): 1787–1798.
- **Elallan N, Albrad B, Al Kurdi S, Alzoubi H. (2023).** Unfiltered nanofat or conventional nanofat graft as a solution to acne scars.
- **Elmarakby MA, Khattab RF, Dahy AA, Elmesiry AM. (2024).** Comparative study between nanofat and platelet rich plasma injections in the treatment of recent scars. Al-Azhar International Medical Journal, 5(8): 1.
- **El-Sayed M, Ibrahim SMA, Hassanin MNA. (2020).** Nano fat combined with platelet-rich plasma injection versus nano fat injection alone in the treatment of atrophic scar. Al-Azhar Medical Journal, 49(2): 611–620.
- **Fakih-Gomez N, Steward E, Orte Aldea MC. (2021).** Nanofat in facial rejuvenation: step-by-step procedure, patient evaluation and recovery process. The American Journal of Cosmetic Surgery, 38(1): 27–35.
- **Gir P, Brown SA, Oni G, Kashefi N, Mojallal A, Rohrich RJ. (2012).** Fat grafting: evidence-based review on autologous fat harvesting, processing, reinjection, and storage. Plastic and Reconstructive Surgery, 130(1): 249–258.
- **Gu Z, Li Y, Li H. (2018).** Use of condensed nanofat combined with fat grafts to treat atrophic scars. JAMA Facial Plastic Surgery, 20(2): 128–135.
- **Jafarzadeh A, PourMohammad A, Goodarzi A. (2024).** A systematic review of the efficacy, safety and satisfaction of regenerative medicine treatments, including platelet-rich plasma, stromal vascular fraction and stem cell-conditioned medium for hypertrophic scars and keloids.

International Wound Journal, 21(4): e14557.

- **Jeschke MG, Wood FM, Middelkoop E, Bayat A, Teot L, Ogawa R, et al. (2023).** Scars. Nature Reviews Disease Primers, 9(1): 64.
- **Jianu DM, Ghiurco I, Jianu S. (2022).** Combined Fat, PRP, and Laser for Skin and Soft Tissues Regeneration. Clinical Applications. In: Plastic and Aesthetic Regenerative Surgery and Fat Grafting: Clinical Application and Operative Techniques. Springer: 559–578.
- **Jin R, Huang X, Li H, Yuan Y, Li B, Cheng C, et al. (2013).** Laser therapy for prevention and treatment of pathologic excessive scars. Plastic and Reconstructive Surgery, 132(6): 1747–1758.
- **Kadry A, Gamal A, Alkhalifah A, Ibrahim SMA. (2023).** Efficacy of platelet-rich plasma versus autologous fat transfer with nanofat in the treatment of infraorbital dark circles: a single-blinded randomized comparative clinical trial. Dermatologic Surgery, 49(3): 247–252.
- **Kant S, van den Kerckhove E, Colla C, van der Hulst R, de Grzymala AP. (2019).** Duration of scar maturation: retrospective analyses of 361 hypertrophic scars over 5 years. Advances in Skin & Wound Care, 32(1): 26–34.
- **Kim GH, Lee WJ, Jung JM, Won CH, Chang SE, Lee MW, et al. (2024).** Morphological characteristics of facial scars: a retrospective analysis according to scar location, onset, age, and cause. International Wound Journal, 21(4): e14453.
- **La Padula S, Ponzo M, Lombardi M, Iazzetta V, Errico C, Polverino G, et al. (2023).** Nanofat in plastic reconstructive, regenerative, and aesthetic surgery: a review of advancements in face-focused applications. Journal of Clinical Medicine, 12(13): 4351.
- **Mandili A, Alsadi HHS, Khamis S, Alharbi Z. (2022).** Nanofat, Microfat, platelet rich plasma (PRP), microneedling and fractional CO2 laser: a regenerative multimodality approach and protocol in scar management. Archives of Clinical and Medical Case Reports, 6(4): 511–516.
- **Monstrey S, Middelkoop E, Vranckx JJ, Bassetto F, Ziegler UE, Meaume S, et al. (2014).** Updated scar management practical guidelines: non-invasive and invasive measures. Journal of Plastic, Reconstructive & Aesthetic Surgery, 67(8): 1017–1025.
- **Mony MP, Harmon KA, Hess R, Dorafshar AH, Shafikhani SH. (2023).** An updated review of hypertrophic scarring. Cells, 12(5): 678.
- **Nunez JH, Strong AL, Comish P, Hespe GE, Harvey J, Sorkin M, et al. (2023).** A review of laser therapies for the treatment of scarring and vascular anomalies. Advances in Wound Care, 12(2): 68–84.
- **Pons S, Jammet P, Galmiche S, Damecourt A, Las D, Blatière V, et al. (2022).** Nanofat and platelet-rich plasma injections used in a case of severe acne scars. Journal of Stomatology, Oral and Maxillofacial Surgery, 123(5): 572–575.
- **Qari S, Bader M, Farran E, Borrah R, Khamis S, Alharbi Z. (2023).** Combined synergetic effect of lipoconcentrate fat grafting, nanofat transfer, platelet-rich plasma, microneedling, and CO_2 fractional laser for plastic regenerative and esthetic surgery and cosmetic care. Cureus, 15(8).
- **Rageh MA, El-Khalawany M, Ibrahim SMA. (2021).** Autologous nanofat injection in treatment of scars: A

clinico-histopathological study. Journal of Cosmetic Dermatology, 20(10): 3198–3204.

- **Segreto F, Marangi GF, Nobile C, Alessandri-Bonetti M, Gregorj C, Cerbone V, et al. (2020).** Use of platelet-rich plasma and modified nanofat grafting in infected ulcers: Technical refinements to improve regenerative and antimicrobial potential. Archives of Plastic Surgery, 47(3): 217–222.
- **Tan J, Bourdès V, Bissonnette R, Eng LPB, Reynier P, Khammari A, et al. (2017).** Prospective study of pathogenesis of atrophic acne scars and role of macular erythema.
- **Upadhyaya P, Mirocha J, Fuleihan K, Agbelemose B. (2025).** The Use of Virtual Reality During Arterial Puncture and Evaluating Its Impact on Patient-Reported Pain Scores, Anxiety Scores, and Patient Satisfaction. Respiratory Care. 1(1): 1-12.
- **Yasseen YA, Mohamed EN, Aboul Fotouh SM, Sayed Mahmoud AM. (2022).** A Comparative Study between Autologous Nanofat Graft and Fractional CO2 Laser in the Management of Post Burn Scars. The Egyptian Journal of Plastic and Reconstructive Surgery, 46(3): 211–221.
- **Yuan B, Upton Z, Leavesley D, Fan C, Wang XQ. (2023).** Vascular and collagen target: a rational approach to hypertrophic scar management. Advances in Wound Care, 12(1): 38–55.