The Egyptian Journal of Hospital Medicine (July 2025) Vol. 100, Page 4397-4406

Staged Hair Transplantation in Face and Scalp Scars after Carbon Dioxide Laser or Platelets Rich Plasma-Assisted Scar Tissue Remodeling

Dalia Mofreh El-Sakka[1], Mohamed Ibrahim Shaban[2], Ahmed Fergany Saber[1], Ahmed Saeed Basuoni Salama[*1], Medhat Samy Ali Hasan[1]

[1]Department of Plastic Surgery, [2]Department of Pathology,
Faculty of Medicine, Menoufia University, Menoufia, Egypt

*** Corresponding author: Ahmed Saeed Basuoni Salama,**
Email: ahmedsaeedbasuoni@gmail.com **, Mobile:** +201006812072

ABSTRACT

Background: Thin epidermis, absence of vasculature, and, in rare cases, subcutis all make cicatricial alopecia hair transplantation a challenging procedure. Subcutis is required to support the grafts and provide nutrients to the transplanted follicles.

Objective: This study aimed to better understand how to treat alopecia with hair transplants by comparing the effectiveness of platelet-rich plasma (PRP) injections and carbon dioxide laser therapy in reshaping scar tissue on the scalp and face.

Patients and Methods: This prospective cohort study was carried out on sixty Egyptian patients with stable cicatricial alopecia, aged from 12 to 35 years, of both sexes, with the following clinical criteria of large surface area of alopecia with weak donor zone, keloids and hypertrophic scars, scars with minimal sub-cutaneous tissue thickness, and immature scars. Patients were followed up for 12 months. Cases were divided into two equal groups: Group A underwent hair transplantation by the FUE technique after scar bed preparation with platelet-rich plasma, and Group B underwent hair transplantation by the FUE technique after one or two sessions of CO_2 fractional laser.

Results: Regarding operative time and histopathological findings, comparison between baseline and post-treatment in both groups revealed highly significant differences ($P < 0.001$).

Conclusions: Scar preparation is vital for improving transplantation outcomes, whether by PRP or by fractional CO_2 laser.

Keywords: Staged Hair Transplantation; Face and Scalp Scars; Carbon Dioxide Laser; Platelets Rich Plasma; Assisted Scar Tissue Remodeling.

INTRODUCTION

One's facial hair is healthy, it says a lot about their confidence, health, and sense of self. Alopecia, or hair loss, can lead to serious mental health issues and low self-esteem. Because scarring is an inevitable consequence of cicatricial alopecia, hair transplantation is an essential reconstructive procedure for restoring hair and hiding scars. Because of the thin epidermis, lack of vasculature, and, in rare cases, subcutis—which is essential for holding the grafts in place and providing nutrients to the transplanted follicles—hair transplantation in cicatricial alopecia can be challenging[1].

Potential therapeutic options for hair disorders have been investigated, including platelet-rich plasma and micro needling. Laboratory research suggests that these treatments can increase the production of growth factors, which in turn can facilitate the development and cycling of hair follicles [2,3]. The concentrations of cytokines, growth factors, and proteins are increased by platelets rich plasma (PRP), which subsequently modulates inflammatory pathways and tissue repair [4].

Platelets release their contents of alpha granules during wound healing. These granules contain platelet-derived growth factor, transforming growth factor-β, epidermal growth factor, vascular endothelial growth factor, and IGF-1 [5]. Furthermore, micro needling has the potential to improve growth factors, boost collagen and elastin production, and create microchannels that enable the stratum corneum to be trans dermally delivered with medications [6]. The phrase "cicatricial alopecia" describes a condition in which scarring causes hair loss. In this disorder, scar tissue grows in place of the hair follicle, which leads to ongoing thinning and baldness [7].

Surgery to repair cicatricial alopecia is highly beneficial. The majority of patients who suffer from alopecia have their hair transplants done; however, other options include alopecia reductions, which involve cutting out the affected area, and flap procedures, which can be done alone or in combination with hair transplants [7].

The era of hair restoration operation was initiated in Japan with the development of methods to cure fire survivors. In the 1930s, Okuda published his method for transplanting hairs that were arisen from punch transplants [8].

Follicle unit extraction (FUE) is the first step in a hair transplant. It is performed by removing hair from a donor area, frequently the occipital or postero-parietal scalp, either by making a single strip excision or small punch excisions. Then, the harvested hair is grafted into the recipient site [9].

This research aimed to compare the effectiveness of Carbon Dioxide (CO2) Laser and PRP injection in the remodeling of scar tissue prior to hair transplantation for the management of alopecic lesions on the face and scalp.

Received: 30/04/2025
Accepted: 30/06/2025

PATIENTS AND METHODS

This prospective cohort study was conducted on 60 Egyptian patients with stable cicatricial alopecia, aged 12 to 35 years**,** of both sexes, who presented to the Department of Plastic Surgery, Menoufia University Hospitals**.** This study was conducted between (mention period e.g., June 2022 and January 2025).

Eligible patients were those with the following clinical criteria: large areas of alopecia with a weak donor site, presence of keloids or hypertrophic scars, scars with minimal subcutaneous tissue thickness, or immature scars. Follow up of patients was done for 12 months.

The cases were divided into two equal groups: **Group A:** patients who underwent hair transplantation using the FUE technique after bed preparation with platelet-rich plasma (PRP) and **Group B:** patients who underwent hair transplantation using the FUE technique after one or two sessions of fractional CO_2 laser therapy.

All cases were subjected to: full history, involving personal history, [age-sex and occupation], current history, past history and scar status [wound dehiscence and delayed wound healing, post scarring intervention like corticosteroids injection, antiscar application or CO_2 laser], family history [specially for androgenic with large surface area of scarring alopecia], general examination: important specially in auto-immune causes of alopecia as Systemic Lupus Erythematosus and assessment of primary scarring alopecia [Local Examination: Position: All patients with hair issues should be seated in a chair. You need good lighting if you want to look at the scalp and hair from above. It is advised to use a dermatoscope and a magnifying light. It is important to take note of the existence of hair extensions and remove any hair pieces, pins, clips, or braids. It is important to take note of the affected scalp's color; abnormalities such as redness, pustules, crusts, telangiectasia, atrophy, hypo- or hyperpigmentation can be indicated by pink or peach tones. To confirm cicatricial alopecia, a digital microscope should be used to examine the distribution and extent of hair loss.

Group A (PRP Preparation and Application):
Biopsies were taken before and after PRP sessions. A 10 mL blood sample was drawn from the cubital vein and centrifuged (OPTO-EDU model: 80-2) in two spins: the first for 15 minutes at 3200 rpm using an ACD anticoagulant (violet tube), and the second for 10 minutes at 1500 rpm in a red tube. The prepared PRP was injected intradermally with a 31-gauge needle at 1 cm intervals and an oblique angle. Patients received two to three sessions at one-week intervals prior to hair transplantation. PRP was shown to reduce inflammation, remodel scar tissue, enhance fibroblast proliferation, stimulate collagen and elastin synthesis, and improve the extracellular matrix, thereby supporting wound healing.

Group B (Fractional CO_2 Laser Preparation):
Biopsies were taken before and after CO_2 laser sessions. Fractional CO_2 laser therapy was applied in most cases using the following parameters: depth 2–3, power 35–45, one or two passes, and two to three sessions performed at two-week intervals prior to hair transplantation. Fractional CO_2 laser stimulated hair regrowth through activation of the wound-healing process. It enhanced local growth factor delivery, modulated the inflammatory response, and promoted cell proliferation and differentiation within the target tissue.

Pre-operative investigations:
Baseline laboratory tests included complete blood count (CBC), serum ferritin, thyroid-stimulating hormone (TSH), and vitamin D (25-OH) were performed. Routine pre-operative investigations and viral screening (CBC, PT, INR, HBV, HCV, and HIV) were also performed following confirmation of cicatricial alopecia.

Surgical Instruments and aiding tools:
A micro-motor with adjustable speed (Marathon micro-motor, maximum speed 35,000 rpm, foot-controlled) was used. Magnifying glasses with a headlight provided visualization. Sterile punches (extraction needles) of different sizes and brands (mainly Ertip, 212, and Guru) were used, most commonly 0.7–0.9 mm sharp or serrated punches held in a punch holder. Sterile forceps (for extraction, arrangement, and implantation) were placed in a silicone autoclavable tray. Grafts were stored in autoclavable glass Petri dishes. Additional instruments included a needle holder for slits, a sapphire pen with diamond blades, sterile incision blades (1.1–1.5 mm), a silicone bowl for protection of tweezer tips, and a spray bottle filled with saline for moistening during implantation. Violet gentian dye was occasionally applied to enhance slit visibility.

Surgical Steps
Pre-operative Preparation:
Hair was trimmed with an electric trimmer to approximately 1 mm, followed by scalp washing and drying. The donor area was marked, sometimes divided into 2 cm^2 squares to distribute extraction and minimize post-extraction scarring in cases requiring a large number of grafts. The recipient area was marked, and surface area was calculated to determine the required follicular units. The anterior hairline or frontotemporal angles were designed using measurements or mirror symmetry.

Anesthesia and Tumescence:
Most patients underwent local anesthesia, while children were treated under general anesthesia. Tumescence of the donor area was achieved using a solution of normal saline, lidocaine 2%, and

epinephrine 1 mg/mL (1:150,000), injected into the subcutaneous tissue to ensure painless extraction.

Follicular Unit Extraction (FUE):
Patients were placed in a prone position with neck flexion for easier access. FUE was performed using a Korean Marathon micro-motor (maximum speed 35,000 rpm, foot-controlled) and 0.8–0.9 mm punches, aided by 3.5× magnifying glasses. Punch sizes ranged from 0.5–1.6 mm, with sharp Ertip punches (0.8 mm) most commonly used. Smaller punches minimized scarring but required greater skill to reduce transection, while larger punches lowered transection rates but increased scarring.

Graft Storage:
Extracted grafts were stored in cooled physiological saline in autoclavable glass Petri dishes or trays lined with non-woven gauze, preventing dehydration.

Recipient Site Creation:
Recipient incisions were created in the same direction as existing hair to achieve a natural appearance. The incision depth matched follicle length, ensuring the hair bulb and dermal papilla were positioned within the subcutaneous tissue for optimal revascularization. Guru slits (1.2–1.4 mm) were used, with blade widths 0.05 mm wider than single or double grafts, and 0.1 mm wider for triple or quadruple grafts. Slits were made in sagittal or vertical orientations; sagittal slits were easier for graft insertion. 21-gauge needles were occasionally used for eyebrow transplantation. Densities ranged from 20–35 FUs/cm².

Implantation Procedure:
Grafts were gently placed into pre-made slits using forceps, grasped just above the bulb, and inserted without excessive force. Grafts were kept moist with saline spray throughout. Post-implantation, perifollicular white tissue formed and transformed into scabs that fell off within 10–13 days.

Post-operative Care:
The transplanted area was left uncovered and sprayed with saline every 2–3 hours for the first 4–5 days. Hair was washed with baby shampoo twice daily, continued for one month. Patients received oral antibiotics (e.g., Augmentin 1 g twice daily), oral anti-inflammatory (Alphintern three times daily), and oral analgesics. The donor area was treated with topical Fucidin ointment and dressed daily for two weeks. Follow-up visits were scheduled monthly, with key evaluations at 4, 6, and 12 months using dermoscopy to assess graft survival.

Post-operative Instructions:
Patients were advised to avoid touching, scratching, or direct pressure on grafts, to wear wide shirts/jackets instead of tight T-shirts, and to avoid direct water jets, smoking, or strenuous exercise for two weeks. In temporal hairline cases, patients followed a soft diet for 3–4 days. Caps or turbans could be worn after one week, provided they were loose. Camouflage products were avoided for two weeks, especially in eyebrow transplantation.

Post-operative Course and Education:
Transplanted hairs typically shed within 2 weeks–2 months, with regrowth starting after 3–4 months and reaching maximum density by 12–18 months. Patients were advised to use hair tonics and receive monthly PRP sessions starting one month post-surgery. In eyebrow cases, transplanted hair required trimming due to faster growth. Because scar tissue has reduced vascularity, a second transplantation session was sometimes needed after 8–12 months.

Expected Consequences and Management:

- **Edema:** Common, especially after eyebrow or large frontal sessions, and subsided spontaneously.
- **Pain:** Usually minimal, controlled with paracetamol or NSAIDs.
- **Bleeding:** Mild donor site bleeding on day one, managed with compression.
- **Crusting:** Appeared within 2–10 days, resolving within 10–20 days. Persistent crusts beyond one month required evaluation but generally did not affect graft survival.

***Ethical Consideration*:**
This study was ethically approved by Menoufia University's Research Ethics Committee. After outlining the purpose of the research, written informed consent was obtained from participants and the participants' guardians. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human subjects.

Statistical analysis
We used SPSS v26 (IBM Inc., Armonk, NY, USA) for our statistical analysis. The quantitative variables were analysed using an ANOVA (F) test with a Tukey post hoc test, and the results were provided as means and standard deviations (SD). Unpaired Student's t-tests have been utilized for comparisons between the two groups. When applicable, we utilized Fisher's exact test or a chi-square test to analyse qualitative parameters, that were given as percentages and presented as frequencies. Statistical significance has been determined by a two-tailed P value below 0.05.

CASE PRESENTATION

Case 1: Male patient 18 years old presented with post nevus excision and graft application on the right parietotemporal area after 6 months patient underwent hair transplantation. 3 PRP sessions were done before FUE session. **Figure 1**

Figure 1: A) Pre-operative, B) intra-operative, C) 3 days post-operative, D) one-month post-operative, and E) five months post-operative.

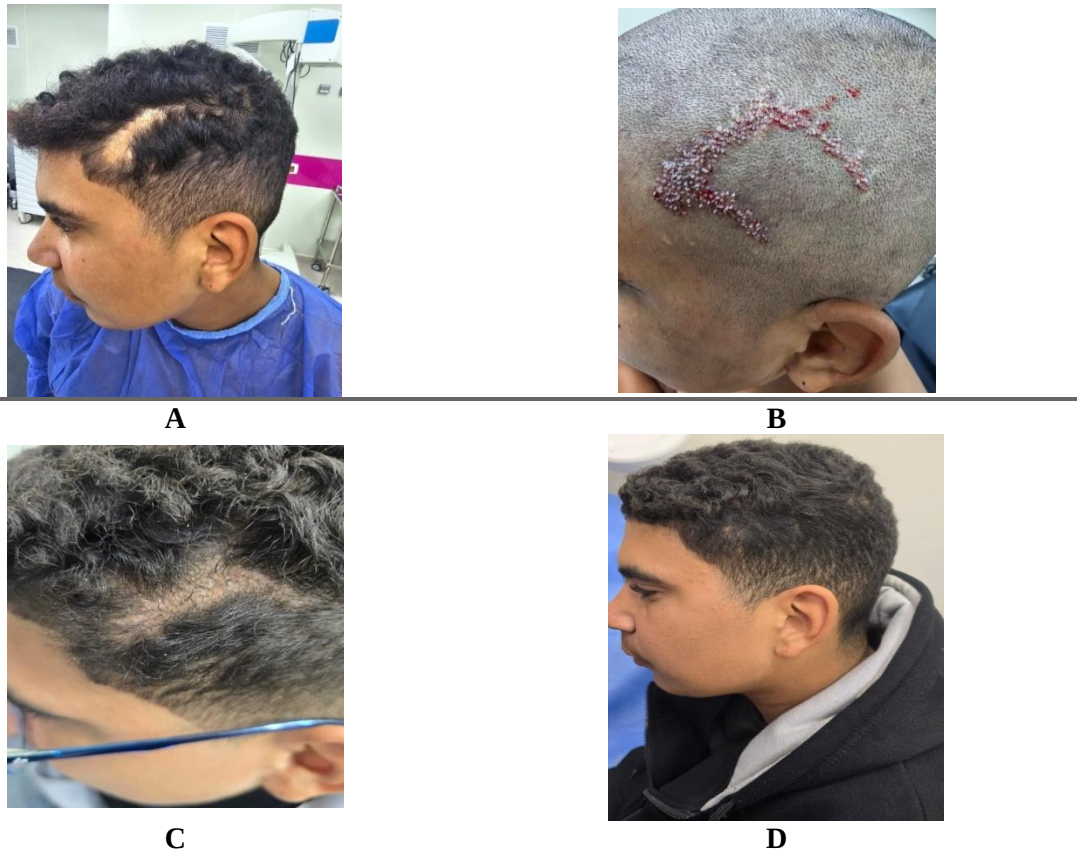
Case 2: Male patient 31 years old presented with post traumatic scar on the left side of beard with alopecia 3 PRP sessions were done with FUE after that. **Figure 2**

A **B**

C

Figure 2: A) Pre-operative, B) intra-operative, and C) 8 months post-operative.

Case 3: Male patient 17 years old presented with post traumatic scar 4 years ago, underwent 6 fractional laser sessions, then performed hair transplantation FUE technique. **Figure 3**

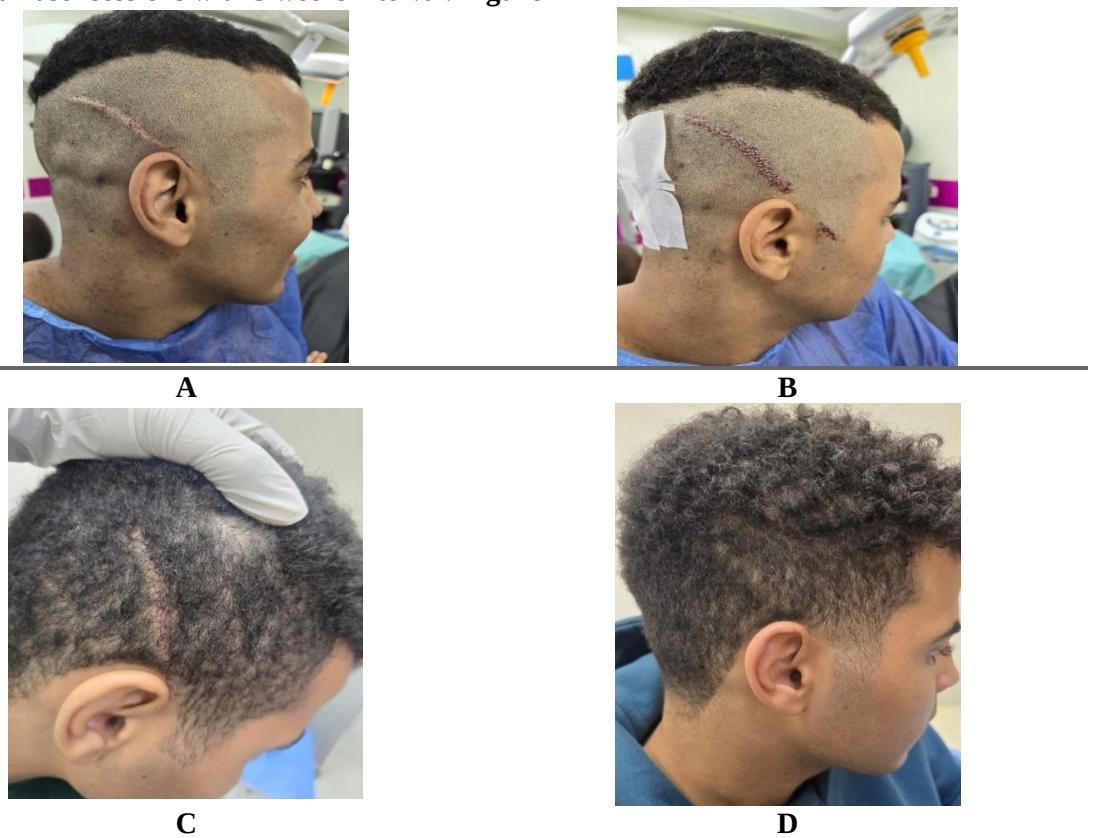


A **B**

C **D**

Figure 3: A) Pre-operative, B) intra-operative, and C) After 4 months, D) After 7 months.

Case 4: Male patient 20 years old presented with post traumatic scar on scalp right temporal area 3 years ago. Underwent 5 fractional laser sessions with 3 weeks interval. **Figure 4**



A **B**

C **D**

Figure 4: A) Pre-operative, B) intra-operative, and C) After 4 months, D) After 6 months

RESULTS

Patient characteristics (age and sex) showed no statistically significant differences between the two groups (Table 1).

Table 1: Patient characteristics of the studied patients

		Group (A) (n=30)	Group (B) (n=30)	P Value
Age		29.77±7.934	29.17±7.178	0.760
Gender	**Male**	14 (46.7%)	16 (53.3%)	0.797
	Female	16 (53.3%)	14 (46.7%)	

Data are presented as mean ± SD or frequency (%).

Regarding operation time, there were highly statistically significant differences between baseline and post-treatment within both groups (P < 0.001). However, there was no statistically significant difference between the two groups either before or after treatment **(Table 2)**.

Table 2: Comparison between the two studied groups according to number of terminal hair follicles per section

	Group (A) (n=30)	Group (B) (n=30)	P
Baseline	4.03±1.273	3.90±1.398	0.728
After treatment	13.87±3.137	14.97±3.146	0.158
P Value	**<0.001***	**<0.001***	

Data are presented as mean ± SD. *: Statistically significant as P <0.05.

Regarding biopsy findings, there were highly statistically significant differences between baseline and post-treatment within both groups (P < 0.001). However, there were no statistically significant differences between the two groups at baseline or after treatment (Table X). **Table 3.**

Table 3: Comparison between two groups as regard to patient's biopsy finding

	Group (A) (n=30)		Group (B) (n=30)		P value	
	Baseline	**After treatment**	**Baseline**	**After treatment**		
Follicular Plugs	13 (43.3%)	2 (6.7%)	16 (53.3%)	3 (10%)	P_1=0.606 P_2=1.000	**P_3<0.001*** **P_4<0.001***
Hypergranulosis	18 (60%)	4 (13.3%)	19 (63.3%)	3 (10%)	P_1=1.000 P_2=1.000	**P_3<0.001*** **P_4<0.001***
Atrophy	9 (30%)	1 (3.3%)	11(36.7%)	0 (0%)	P_1=0.785 P_2=1.000	**P_3<0.001*** **P_4<0.001***
Rete Pegs	14 (46.7%)	2 (6.7%)	16 (53.3%)	2 (6.7%)	P_1=0.797 P_2=1.000	**P_3<0.001*** **P_4<0.001***
Interface Dermatitis	15 (50%)	2 (6.7%)	16 (53.3%)	3 (10%)	P_1=1.000 P_2=1.000	**P_3<0.001*** **P_4<0.001***
Dermal Melanophages	18 (60%)	1 (3.3%)	15 (50%)	3 (10%)	P_1=0.604 P_2=0.612	**P_3<0.001*** **P_4<0.001***

Data were presented as frequency (%). P1: p value for comparing the two studied groups at baseline. P2: p value for comparing between the two studied groups after treatment. P3: p value for comparing between baseline and after treatment in group (A). P4: p value for comparing between baseline and after treatment in group (B). *: Statistically significant as P <0.05.

Complications to recipient site: Folliculitis occurred to transplanted beard after one week and the condition was treated with antibiotics and anti-inflammatory medications. Complications to donor area: post-operative donor hair effluvium may occur, and patient is reassured about spontaneous resolving in three to four months post operatively and minoxidil can fasten the resolving procedure.

DISCUSSION

Cases of cicatricial alopecia caused by diseases such as trauma, burns, infections, or follicular destruction were included in this study.

Hair restoration surgery in scars is a challenging procedure due to low vascularity and high tissue stiffness that in turn provide a low survival rate of transplanted grafts [1]. There were a lot of attempts to fix it, one of which was the increasingly popular hair transplant procedure [10] .

As a permanent technique to restore hair loss, **Anany *et al*. [10]** reported that patients with cicatricial alopecia must wait for the condition to stabilize before undergoing hair restoration procedures, to ensure adequate blood supply for graft survival. It was recommended to use a lower concentration of epinephrine (1:200,000) in recipient site preparation compared to donor area preparation, as higher concentrations may compromise blood flow and reduce graft survival [10].

In contrast, **Saxena *et al***. [1] reported a case of hair transplantation for cicatricial alopecia in which no adrenaline-based anesthetic or tumescent fluid was used in either the donor or recipient area.

For the purpose of this study, the adrenaline concentration used for preparing the donor and recipient areas was 1:150,000. To maintain the haemostatic effect of adrenaline during implantation, it was important to have a clear view of the prepared slit sites. In this study, adrenaline was administered to both the donor and recipient sites, and neither vascularity nor hair growth was adversely affected.

The current study found that the rate of follicle transection could be reduced by infiltrating more tumescent fluid into the donor areas right before micro punctures were used. This helped to sustain the tumescent influence of the fluid and keep the hair follicles in place. The haemostatic adrenaline effect and the supplementary effect of the injected tumescent anaesthesia gradually fade away during large-scale graft harvesting, according to our findings. Hence, it is recommended to progressively re-infuse adrenaline-containing tumescent fluid (1:150000) into the donor area over time. So far as we are aware, no study on FUE harvesting has recommended this additional step. The literature offered conflicting recommendations regarding the best location for graft harvesting, such as Jung, **Lizardi *et al*. [11]** conducted a research on 25 cases of hair follicle transplantation using scar tissue, while the majority of the grafts were harvested from the occipital and posterior auricular regions. **Watts [12]** suggested utilizing the occipital scalp as a donor area, with a smaller amount from the temporal and supra auricular regions.

Liu *et al*. [13] claimed that graft harvesting is easiest in the occipital region. In this study, the occipital scalp was used as a donor site for the majority of cases due to its accessibility and low transection rate. To a lesser extent, we utilized temporal and thin supra-auricular hair to simulate areas with typically thinner hair growth.

According to **Pathomvanich and Imagawa *et al*. [14]**, the density of the transplanted FUE per cm2 differed across the literature. It is suggested to transplant scar tissue at a density of twenty FU/cm2 due to the areas' limited vascular supply.

Lizardi *et al*. [15] advised that, when working with scarred tissue, a density of twenty to thirty grafts per cm2 is considered reasonable.

Anany *et al*. [10] suggest a follicle concentration of up to 15-20 FU/cm2 in regions with insufficient blood supply, and they agreed with previous studies that concluded it was generally safe to increase the concentration to twenty to thirty FU/cm2 in regions with sufficient perfusion. Nevertheless, a density of only eighteen units/ cm2 has been applied and suggested by **Manole *et al*. [1].**

Our present study's FUE density was 25 to 30 FU per cm2, which is in line with the literature's recommendations for cicatricial alopecia cases; variations within this range were used in rare instances to replicate the patient's original hair pattern. Follicular grafts transplanted in this study had an average survival rate of 82.5%.

As **Manole *et al*. [1]** After using PRP injection in conjunction with hair transplantation in a case of scalp cicatricial alopecia, the researchers found that eighty percent of the transplanted grafts survived and demonstrated optimum growth in a 10-month follow-up study. Micro needling and three to five PRP treatments resulted in a scarring alopecia survival rate of 82.5% in the present research.

Using the magnification power of a digital microscope, this study counted the transplanted FUE immediately after the operation and after the follow-up period. An abundance of research has shown that platelet-rich plasma (PRP) adjuvant therapy, when administered alongside hair transplantation, significantly improves the efficacy of FUE.

Rodriguez, Mayrovitz [16] treated male pattern baldness with a combination of PRP therapy and hair transplants by immersing follicular grafts in the solution for fifteen minutes prior to implantation. In comparison to traditional hair transplants that do not use platelet-rich plasma (PRP), they discovered that platelet-growth factor treatment significantly increased FUE yield.

Phoebe *et al*. [17] were able to alleviate cutaneous ischemia and increase vascular structures surrounding hair follicles after receiving PRP injections. A successful hair transplant was achieved in a case of cicatricial lichen planus of the scalp by injecting PRP intradermally into the recipient area just before graft implantation. The same study also found that scarred tissue quality improved after the transplant [1].

Rosenthal *et al*. [18] was found to be effective in FUE transplant patients with androgenic alopecia in a number of ways, including accelerating density,

decreasing catagen loss, speeding skin recovery, and activating follicles, when administered immediately after slits are made over the recipient area. In this study, platelet-rich plasma (PRP) was administered intradermally via micro needling with a derma pen device for three to five sessions, with the last session occurring one week prior to hair transplantation. Results from this study indicated that scar texture and skin laxity could be improved. There was no statistically significant enhancement in the percentage of hair follicle growth, even though there were documented improvements in results with PRP injection in the literature. Thus, it can be concluded that PRP enhances FUE procedures for cicatricial alopecia, but it is not a necessary component in and of itself.

Additionally, retrospective review studies and case studies have shown that PRP alone [1] Patients suffering from scarring alopecia saw an improvement in hair density when using this medication in conjunction with intralesional steroids and topical steroids [19].but there was no study that used combined therapy(micro needling and PRP) as current study.

Nano fat grafting and fractional laser scar improvement are two other tissue bed preparation methods that have been mentioned in the literature as ways to improve vascularity, laxity, and texture. The literature discussed and demonstrated nano fat injection as a skin rejuvenating technique and a practical means of scar maturation and improvement.

Ao *et al*. [20] because of its tiny size and stem cell content, has utilized nanofat grafting for skin rejuvenation goals.

Using of nano fat in improving hair follicle survival after hair transplantation has been stated by **Lizardi *et al*. [15]** The use of fat grafting prior to hair follicle placement has been observed to potentially aid in the correct placement and optimum growth of the grafts in this diminished tissue.

Krizanova *et al*. [21] had documented the utilization of nano fat grafting beneath a split-thickness skin graft, leading to improved outcomes with increased graft take. The rationale behind these results was attributed to the presence of stem cells, which promote angiogenesis and collagen stimulation, as well as endothelial cells, which aid in graft healing. Akdag, Sadeghi et al. [22] explained how to hide a cleft lip scar using a FUE hair transplant and autologous fat graft obtained with a multiproduction harvesting cannula. Twenty patients had fat grafting three months before their transplant, and both the graft survival rate and patient satisfaction were higher after the procedure. The literature suggests that patients with cicatricial alopecia should undergo multiple sessions in order to achieve the best possible outcomes, as identified by **Lizardi *et al*. [15]** that in order to attain the most desirable cosmetic outcomes, it will be necessary to undergo one to three sessions of hair transplantation. Therefore, it is critical to inform the patient of the potential for additional surgeries. in advance [11]. To ensure statistical significance of the procedures' outcomes, only one session has been documented in the research, even though we informed patients that multiple sessions were an option so they could adjust their expectations and get the most satisfying and aesthetically acceptable results.

Limitations: The sample size was relatively small. The investigation was in a single center. The monitoring of cases has been restricted for relatively short time.

CONCLUSIONS

Scar preparation is vital for improving transplantation outcomes, whether by PRP or by fractional CO_2 laser.

DECLARATIONS

- **Consent for publication:** I certify that each author granted permission for the work to be submitted.
- **Funding:** No fund
- **Availability of data and material:** Available,
- **Conflicts of interest:** None
- **Competing interests:** None.

REFERENCES

1- Manole C, Soare C, Ceafalan L, Voiculescu V(2023): Platelet-rich plasma in dermatology: new insights on the cellular mechanism of skin repair and regeneration. Life, 14(1):40. doi: 10.3390/life14010040.

2- Wall D, Meah N, Fagan N *et al*. (2022): Advances in hair growth. Fac Rev., 11:1. doi: 10.12703/r/11-1.

3- Paichitrojjana A, Paichitrojjana A (2023): Platelet Rich Plasma and Its Use in Hair Regrowth: A Review. Drug Des Devel Ther., 16:635-645. doi: 10.2147/DDDT.S356858.

4- Vasalou V, Kotidis E, Tatsis D *et al*. (2023): The effects of tissue healing factors in wound repair involving absorbable meshes: a narrative review. Journal of Clinical Medicine, 12(17):5683. doi: 10.3390/jcm12175683.

5- Cioce A, Cavani A, Cattani C, Scopelliti F (2024): Role of the skin immune system in wound healing. Cells, 13(7):624. doi: 10.3390/cells13070624.

6-Chen W, Jian X, Yu B (2025): Review of Applications of Microneedling in Melasma. Journal of Cosmetic Dermatology, 24(1):e16707. doi: 10.1111/jocd.16707.

7-Li J, Berry C, Wan D, Longaker M (2024): Clinical, mechanistic, and therapeutic landscape of cutaneous fibrosis. Science translational medicine, 16(766):eadn7871. doi: 10.1126/scitranslmed.adn7871.

8- Kohlhauser M, Tuca A, Kamolz L (2024): The efficacy of adipose-derived stem cells in burn injuries: a systematic review. Cellular & Molecular Biology Letters, 29(1):10. doi: 10.1186/s11658-023-00526-w.

9- Evin N, Evin S (2024): Camouflage of postburn scarring alopecia using nanofat grafting and follicular unit hair transplantation. Plastic and Reconstructive Surgery, 154(1):207-15.

10- Anany R, Ibrahim Y, Nasr M, El-Anwar M (2025): Role of Nanofat Injection Before Hair Transplant in Cicatricial Alopecia. Zagazig University Medical Journal, 31(5):1758-67.

11- Lizardi J, Treger D, Braud S *et al*. (2024): The Most Influential Publications Regarding Hair Transplantation: A Bibliometric Review. Aesthetic Plastic Surgery, 48(23):5189-99.

12- Watts J (2025): Innovations in follicular unit extraction: The future of hair transplants. Journal of Dermatological Case Reports, 18(1):29-38.

13- Liu R, Xu L, McCarty J *et al*. (2025): A Scoping Review on Complications in Modern Hair Transplantation: More than Just Splitting Hairs. Aesthetic Plastic Surgery, 49(3):585-95.

14- Pathomvanich D, Imagawa K (2010): Hair restoration surgery in Asians: Springer, https://download.e-bookshelf.de/download/0000/0160/54/L-G-0000016054-0002348219.pdf

15- Lizardi J, Treger D, Braud S *et al*. (2024): The Most Influential Publications Regarding Hair Transplantation: A Bibliometric Review. Aesthetic Plastic Surgery, 48(23):5189-99.

16- Rodriguez M, Mayrovitz H (2024): The History and Current Status of Platelet-Rich Plasma Therapy in Dermatology. Cureus, 16(8):e68306. doi: 10.7759/cureus.68306.

17- Phoebe L, Lee K, Chan L *et al*. (2024): Use of platelet rich plasma for skin rejuvenation. Skin Res Technol., 30(4):e13714. doi: 10.1111/srt.13714.

18- Rosenthal A, Conde G, Greco J, Gharavi N (2024): Management of androgenic alopecia: a systematic review of the literature. Journal of Cosmetic and Laser Therapy, 26(1-4):1-6.

19- Valdez-Zertuche J, Ramírez-Marín H, Tosti A (2025): Efficacy, safety and tolerability of drugs for alopecia: a comprehensive review. Expert opinion on drug metabolism & toxicology, 21(4):347-71.

20- Ao Y, Yi Y, Wu G (2024): Application of PLLA (Poly-L-Lactic acid) for rejuvenation and reproduction of facial cutaneous tissue in aesthetics: A review. Medicine, 103(11):e37506. doi: 10.1097/MD.0000000000037506.

21- Krizanova O, Penesova A, Hokynkova A *et al*. (2024): Chronic venous insufficiency and venous leg ulcers: Aetiology, on the pathophysiology-based treatment. International Wound Journal, 21(2):e14405. doi: 10.1111/iwj.14405.

22- Sadeghi S, Ghane Y, Hajizadeh N, Goodarzi A (2024): Autologous adipose tissue injection in the treatment of alopecia: A mini-review. Journal of Cosmetic Dermatology, 23(3):758-65.