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Evaluation of Clinical Outcome of Hair Restoration by the Follicular Unit Extraction (FUE) Technique With Versus Without Adding (PRP)

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Abstract

Background: Technique of adding versus not adding (PRP) is a very useful tool in the hair restoration field, particularly when used in conjunction with hair transplantation in preoperative preparation for the recipient site and postoperative follow-up monthly injections for recipient and donor site as it encourages graft survival, donor site healing, reduces graft loss, improving overall final cosmetic result and patient satisfaction with results.

Objectives: To evaluate clinical outcome and efficiency of hair restoration by the follicular unit extraction (FUE) PRP.

Methods: A preliminary prospective study carried out on 24 patients at Menoufia University Plastic Surgery Department outpatient clinics and other private clinics, from April 2019 to July 2022. They were operated with FUE method of hair restoration, half of them were pre and post treated with PRP, the other half was not treated with PRP. Postoperative assessment of graft survival and density, natural appearance and patient satisfaction, donor site morbidity in the form of scarring, hypopigmentation, or depletion in case of overharvesting. Followed-up periodically at 3, 6, 9 and 12 months postoperative and monthly for PRP for injection.

Results: 24 patients were asking for hair transplantation, aged between 22 and 43ys with mean age of the non-injected group is 33ys, the injected group pretreated and postoperatively treated with PRP injections mean age is 35.17ys. No cases of donor or recipient site necrosis, AV fistula or moth-eaten appearance of donor. Poor graft growth after 1 year of follow-up in the injected group was 0 while in non-injected group was 0.08 level. Aesthetic outcome was assessed and compared where the excellent in PRP-injected group was 6 (50%) and satisfactory was 6 (50%) and there is no poor satisfaction results were recorded. In non-injected PRP group excellent satisfaction was observed in 3 (25%), satisfactory was observed in 7 (58.33%) and poor observed in 2 (16.67%) of the operated patient with overall superior patient satisfaction in PRP injected group.

Conclusion: FUE technique of hair transplantation is emerging popular and is more patient friendly. With respect to hair transplantation, PRP role in treating the donor site, promotes the growth of transplanted hairs.

Key Words: *Hair transplantation – Follicular unit excision-extraction – Platelet rich plasma – Follicular unit transplantation – Strip method.*

Ethical Committee: Approval: The ethics committee of Menoufia University's Faculty of Medicine gave its authorization before the investigation was carried out (33336/09/19). All patients provided written consent after being fully informed.

Disclosure: No disclosure.

Introduction

Throughout history, humans have placed considerable emphasis on caring for their hair, recognizing its dual role in enhancing beauty and providing protection **[1]**. Hair serves various physiological functions, including shielding against ultraviolet (UV) rays, insulation from cold, mechanical defense, sensory and tactile functions, as well as fulfilling aesthetic and gender-defining roles. Hair development is essential for both social and sexual interactions **[2]**.

Androgenetic alopecia (AGA), telogen effluvium, alopecia areata, and cicatricial alopecia stand out as common causes of hair loss **[3]**. AGA, a widespread chronic condition, is characterized

List of Abbreviations:

FUE : Follicular Unit Extraction.
FUT : Follicular Unit Transplantation.
PRP : Platelet Rich Plasma.
UV : Ultraviolet.
AGA : Androgenetic Alopecia.
LLLL : Low Level Laser Light.
CBC : Complete Blood Count.
SDA : Safe Donor Area.
DM : Diabetes Mellitus.
BDD : Body Dysmorphic Disorder.
FML : Front median Line.

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by gradual hair loss, particularly on the scalp, with distinct patterns differing between men and women. The most severe impact is typically felt on the central scalp, starting around adolescence and significantly affecting self-esteem [4,5]. The term "androgenic alopecia" reflects the role of androgens and genetic factors in its etiology [6].

While medical therapies can promote the growth of miniaturized hairs, they cannot replace hair in bald areas. Hair transplantation surgery offers a permanent solution for restoring bald areas [7]. The inception of hair restoration can be traced back to Dr. Norman Orentreich's discovery that hair follicles from nonbalding scalp areas could be transplanted into bald areas, continuing to grow terminal hair [8]. Over the last two decades, the cosmetic standard for hair transplantation has focused on creating naturally appearing transplanted hair. The outpatient procedure, performed with local anesthesia, boasts a low rate of medical and surgical complications, with continuous improvements in technique for enhanced efficiency, safety, and patient satisfaction [9].

Follicular Unit Extraction (FUE) has emerged as a popular cosmetic procedure for harvesting hair follicles from the scalp donor area [10]. FUE is considered more patient-friendly, leaving minimal scars compared to the strip method, which results in visible linear scars at donor sites [11]. The trend in medicine towards minimally invasive surgery is mirrored by FUE [9].

Advancements in the art of hair restoration extend beyond surgical techniques to instrumentation and methods promoting growth. Platelet Rich Plasma (PRP), an autologous plasma preparation with over one million platelets per milliliter, plays a crucial role in hair transplantation. Platelets release growth factors that stimulate angiogenesis, signal resting telogen hairs to enter the anagen phase, promote dermal papilla cell proliferation, and inhibit apoptosis. all contributing to the promotion of the anagen phase. In hair transplantation, PRP is utilized to treat the donor, encourage the growth of removed hairs, serve as a storage solution, and apply to recipient sites for early regeneration and higher yields [9].

In contrast to the widespread occurrence of Androgenetic Alopecia (AGA), there are limited authorized therapeutic options [4]. While hair transplantation effectively addresses bald spots, it does not tackle the gradual thinning observed in affected areas over time. The final cosmetic outcome is determined by the total number of transplanted grafts minus ongoing hair loss, emphasizing the importance of using medication to halt continued hair loss [12]. FDA-approved medical treatments for this type of hair loss include topical minoxidil, oral finasteride, and low-level laser therapy [13]. A new nonsurgical approach involves Low-Level Laser Light (LLLL), which was initially discovered to ironically promote hair growth [9].

Reducing the risk of disease transmission, platelet-rich plasma (PRP) is prepared by centrifuging the patients' venous blood, releasing cytokines and growth factors when platelets are activated [5]. Compared to whole blood, PRP contains these elements in significantly higher concentrations (five to eight times) [14]. While PRP does not replace FUT or FUE hair transplantation, grafts prepared with PRP solution have shown increased density and durability when used as an adjuvant to hair restoration surgery [15]. Despite promising indications, there is a lack of extensive human clinical trials for PRP injections in the context of hair loss [12].

PRP preparation lacks standardization and can be achieved through commercially available kits, automated technologies, or human methods, with the two-step centrifugation process being widely utilized [15]. PRP is injected into areas of hair loss using a small-gauge needle, and topical application has also been reported in the literature [16]. The frontal, parietal, and occipital regions of the scalp can be treated, commonly using PRP treated with calcium chloride to stimulate platelets [17].

Frontal hairline restoration is crucial for a natural and precise outcome, as the hairline is a prominent aspect of the transplant result [18]. The hairline, a 5mm broad band of hair forming the front of the forehead, is pivotal for facial aesthetics, and its restoration aims to counteract the undermining effect of frontal hairline recession on the face's framework [19,23].

Follicular Unit Excision (FUE), officially adopted by the International Society of Hair Restoration Surgery in 2017, is a minimally invasive procedure that avoids the linear scar associated with elliptical donor harvesting [24]. Evolving since its introduction in the early 2000s, FUE has significantly reduced wounding and transaction through advancements in punch and device designs [24].

Following FUE treatment, patients wear a pressure dressing overnight and are prescribed prednisone and pain management medication to address frontal edema [27]. The challenging waiting period for hair growth after transplantation involves the emergence of small scabs around the grafts, peeling off within 7-10 days, with new hair shafts visible after 3-4 months and final results observable after 10 months, considering an average hair growth rate of 1.5cm per month [28,29].

The objective of this study was to assess the clinical outcomes and efficiency of hair restoration through the Follicular Unit Extraction (FUE) with Platelet-Rich Plasma (PRP).

Patients and Methods

This prospective randomized study was carried out after approval of the ethical committee of Menoufia Faculty of Medicine (IRB approval no, 2/2019 PLAS) included 24 male patients presented with variable degrees of androgenic alopecia asking for hair restoration surgery at Menoufia University Plastic Surgery Department outpatient clinics and other private clinics, from April 2019 to July 2022. All patients were operated on with FUE method of hair restoration, half of them were pre and post treated with PRP, and the other half was not treated with PRP.

In our study we included all patients presented with variable degrees of androgenetic alopecia (AGA), no previous attempts with hair restoration surgery and age group (from 21 to 50 years old). While, we excluded previous hair restoration surgery, weak donor area (low density and thin hair), patients with significant comorbidities (diabetic, hypertensive, or cardiac patients) and less than 21 years or older than 50 years old.

Preoperative photography (pre and serial postoperative) was taken for all patients in different photographic angles such as front bend and roof view, back, left lateral and right lateral, left anterior oblique and right anterior oblique, and left posterior oblique and right posterior oblique. This was done to obtain the required density, which may require more than one session of hair restoration surgery.

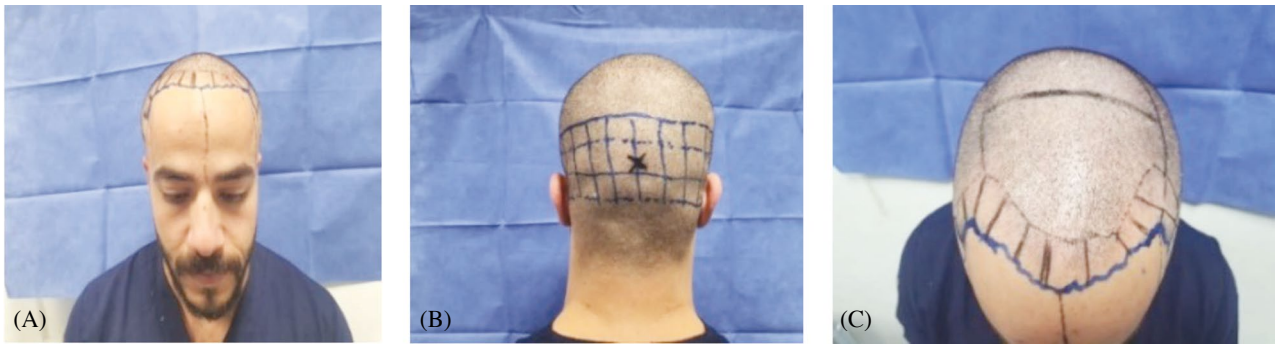

Fig. (1): Images showing examples of different views of preoperative images: From left to right (A): Front view, (B): Back view and (C): Front bend view.

Preoperative investigations: All patients were investigated with baseline investigations for fitness (CBC-Coagulation profile-Liver and kidney functions). No ECG was done as no patients above 45 years old age were operated.

Operative techniques: Harvesting follicular units by the follicular unit technique (FUE) method from safe donor area (SDA) and we used (PRP) injection monthly in one group and the other one was not following this protocol.

Follow-up of the outcome measures as Follow-up of the patients done at 3, 6, 9 and 12 months postoperative evaluated as graft survival and density, the natural appearance of the patient, patient satisfaction as regard (excellent, satisfactory, or poor), donor site morbidity in the form of scarring, hypopigmentation, or depletion in case of large number of grafts harvested and patient compliance postoperative to PRP session.

Preoperative evaluation:

Personal history as A proper and full history was taken from all patients enrolled in this study. Age of patients ranged from 22 to 43 years old age with mean age of the non-injected group was 33 years and the injected group pretreated and postoperatively treated with PRP injections mean age was 35.17 years with no comorbidities (DM, hypertension, or cardiac issues). Family history of androgenic alopecia: Detailed hair loss history at what age androgenic alopecia started, what medical advice he asked before, did he used any FDA approved medications (topical Minoxidil or oral Finasteraide) to stabilize the hair loss, current hair density, noorwood's degree of male pattern baldness, did he use any off-label medications or maneuvers, and did he have hair restoration surgery before? To be excluded from our study.

Examination of scalp: Detection of what degree of hair loss according to Noorwood classification. We had operated on patients with Noorwood type 2, 3, 4 and 5.

The donor area examined for density, skin colour and hair characteristics including (colour, curl, caliber), the recipient area was examined whether totally bald or containing miniaturized hair. Psychological evaluation of all patients was mandatory to exclude body dysmorphic disorder (BDD) and obsession as these patients are always well known to be dissatisfied with any results in the long term regardless of the quality of the operation.

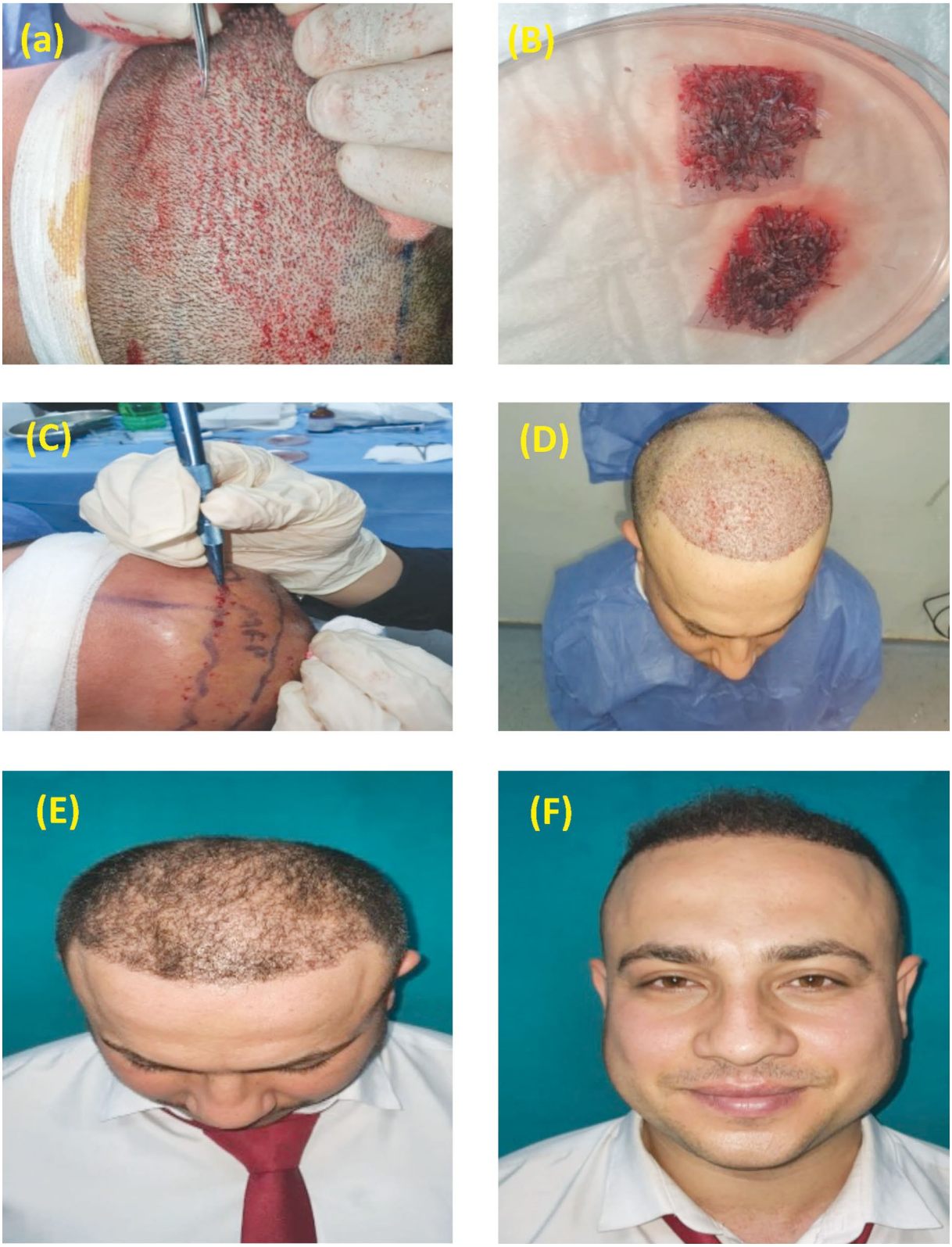

Fig. (2): Image (A) Showing graft harvesting from the safe donor area with jeweler while patient is in prone position with bandage applied. (B) Harvested grafts immersed in wet gauze in petri dishes filled with saline or ringer. (C) Showing use of sapphire pen in making slits in the implantation process while patient is in supine position with bandage applied to minimize the forehead oedema. (D) Left image showing immediate postoperative view, (E) Right one shows 6 months appearance. (F) Image shows the appearance of the transplanted hair after one year postoperative.

Patient education was hair loss is evolving and ongoing process, medical treatment, PRP and LLLL are not substitute to hair transplantation surgery but are needed to stabilize the hair loss or can be used as adjunct to hair transplantation surgery. Hair restoration is only available with hair from same person with limited donor area, need to cover larger area with accepted density achievement even if achieved will require multiple sessions, without overharvesting of donor area to avoid depletion, importance of adjuvant therapies whether topical minoxidil and PRP injection and patient education of the importance of hairline design which is reframing of the face, proper design of the hairline to be age appropriate is crucial to give natural appearance and always remember that high hairline can be lowered, but low hairline cannot be elevated.

Surgical technique:

Under local anesthesia, the procedure was carried out with the patient lying in several positions: prone for donor harvesting, supine for implantation, and more upright if a vertex implant was intended. First, using a flexible ruler and the patient's skin, the frontomedian line (FML) was drawn. Then, using the same ruler that has been extended vertically from a lateral canthus parallel to the (FML), both canthus lines are drawn. The most anterior point of the hairline, called the apex. gridding the safe donor area into 1cm^2 so that the donor site can be harvested uniformly. Before beginning the local anesthesia injection, a bandage is used to reduce the anticipated frontal and forehead oedema.

To inject ring blocks and tumescent solutions into the donor and recipient sites-loaded into 3-cc syringes with insulin on a 30-gauge needle, we used local anesthesia. Tumescent was supplemented with 40mg of triamcinolone acetate (Kenacort) to lessen postoperative oedema. While the patient is in the prone posture, the safe donor area is harvested. Depending on the size of the hair shaft and the quantity of hairs in each follicular unit, we used motorized FUE procedures with serrated punches ranging from 0.8mm to 1mm. We lowered the punch until the graft was scored and the erector pili muscle was cut. Before shifting into the supine position for graft implantation, fucidin ointment and pressure dressing were used as a temporary dressing.

Results

Our findings indicate no statistically significant differences ($p>0.05$) in the Norwood degree between the PRP-injected group (Norwood degree 3.25) and the PRP-non-injected group (Norwood degree 3.58). However, significant differences ($p<0.01$) in Norwood degree level occurrences were observed among the examined patients. The 3rd degree level had the highest incidence, noted in 12 cases (50%), followed by the 4th degree (33.34%), the 2nd degree (8.33%), and the 5th degree (8.33%) (Table 1).

Table (1): Age level and Norwood degree level among PRP injected group and PRP non-injected group.

PRP injection	Non-injected (N=12) Mean ± SD	Injected (N=12) Mean ± SD	*t*-test	*p*-value
Age/year	33.00±6.28	35.17±5.34	0.91	0.37
Norwood degree	3.58±0.79	3.25±0.75	1.05	0.30

- Means within the same column of different litters are significantly different at ($p<0.05$).

Furthermore, a significant difference ($p<0.05$) was found between the PRP-injected and non-injected groups. In the injected group, the highest incidence was observed in the 4th Norwood degree, with 6 cases (50%), followed by the 3rd degree with 4 cases (33.33%). In the non-injected group, the highest incidences were in the 3rd degree, with 8 cases (66.67%), followed by the 4th degree with 2 cases (16.67%), and the 2nd and 5th degrees with 1 case each (8.33%). All patients had no prior interventions. Additionally, there was a significant difference ($p<0.01$) in the degree of graft survival between the PRP-injected group and the non-injected group. All patients (100%) in the non-injected group showed ++ degree, while in the PRP-injected group, 66.67% had +++ degree, and 33.33% had ++++ degree.

Moreover, there were no reported cases of donor site morbidity in either the PRP-injected or non-injected group. The level of natural appearance differed significantly ($p<0.01$) between the two groups. In the PRP-injected group, 50% showed +++ degree, 41.67% showed ++++ degree, and 8.33% showed ++ degree. In the non-injected group, 75% showed ++ degree, 16.67% showed +++, and 8.33% showed ++++. Additionally, a significant difference ($p<0.05$) was observed in the poor growth graft level between the injected and non-injected groups with PRP. The growth level in the injected group was 0, while in the non-injected group, it was 0.08. The incidence of poor graft growth in the non-injected group was 1595.83, higher than the 1529.17 observed in the injected group. Furthermore, there was a significant difference ($p<0.05$) in the number of grafts, with the non-injected group having 18.17, higher than the 17.58 observed in the injected group (Table 2).

The occurrences of forehead edema among all examined patients displayed significant differences in degree ($p<0.01$). The higher incidence was observed in the (++) degree, with 11 cases (45.84%), followed by the (+) degree with 6 cases (25%), and the (+++) degree with 6 cases (25%), while the severe degree (++++) was observed in 1 case (4.16%) (Table 3).

Table (2): Incidences of Norwood degree, graft survival level, donor site morbidity, Natural appearance level, and Poor graft growth among injected and non-injected patients with PRP.

Norwood degree	Degree level	PRP injection				X^2	*p*-value
		Non-injected		Injected			
		No	%	No	%		
Degree of graft survival	2	1	8.33	1	8.33	12.55	<0.001**
	3	4	33.33	8	66.67		
	4	6	50.00	2	16.67		
	5	1	8.33	1	8.33		
Donor site morbidity	++	12	100	0	0	9.44	<0.001**
	+++	0	0	8	66.67		
	++++	0	0	4	33.33		
	++	7	58.33	2	16.67		
	+++	3	25	7	58.33		
	++++	2	16.67	3	25		
Degree of natural appearance	No	12	100	12	100	0.11	<0.001**
	Yes	0	0	0	0		
	++	9	75	1	8.33		
	+++	2	16.67	6	50	14.46	<0.001*
	++++	1	8.33	5	41.67		
Poor graft growth	Mean± SD	1595.83±242.57		1529.17±293.45		2.04	0.04*
Number of grafts	Mean± SD	18.17±2.98		17.58±2.81		0.49	0.520

Table (3): Incidences of forehead oedema, postop pain, AV fistula, necrosis, numbness, and anagen effluvium among injected and non-injected patients with PRP.

	PRP injection						X^2	*p*-value
	Non-injected		Injected		Total			
	No	%	No	%	No	%		
Forehead oedema:								
+	3	25.00	3	25. 00	6	25.00	13.45	<0.001*
++	4	33.33	7	58.34	11	45.84		
+++	5	41.67	1	8.33	6	25.00		
++++	0	0.00	1	8.33	1	4.16		
Post-operation pain:								
+	6	50.00	6	50.00	12	50.00	9.60	<0.001*
++	4	33.33	5	41.67	9	37.50		
+++	2	16.67	1	8.33	3	12.50		
AV fistula (Bleeding incidences):								
No	12	100.0	12	100.0	24	100.00	0.11	0.981
Yes	0	0.00	0	0.00	0	0.00		
Necrosis incidences:								
No	12	100.0	12	100.0	24	100.00	0.11	0.981
Yes	0	0.00	0	0.00	0	0.00		
Numbness:								
–ve	9	75.00	11	91.67	20	83.34	7.26	<0.001*
+ve	3	25.00	1	8.33	4	16.66		
Anagen effluvium:								
–ve	10	83.34	12	100.0	22	91.67	6.24	<0.001*
+ve	2	16.66	0	0.00	2	8.33		

Table (4): Incidences of hypertension, hypotension, bradycardia, tachycardia, nausea, body ache, motheaten donor over harvesting, postoperative folliculitis and anxiety among injected and non-injected patients with PRP.

	PRP injection						X^2	*p*-value
	Non-injected		Injected		Total			
	No	%	No	%	No	%		
Hypertension:								
–ve	9	75.00	11	91.67	20	83.34	7.26	<0.001*
+ve	3	25.00	1	8.33	4	16.66		
Hypotension:								
–ve	12	100.0	11	91.67	20	83.34	9.70	<0.001*
+ve	0	0.00	1	8.33	4	16.66		
Tachycardia:								
–ve	12	100.0	10	83.34	22	91.67	6.42	<0.001*
+ve	0	0.00	2	16.66	2	8.33		
Bradycardia:								
No	12	100.0	12	100.0	24	100.00	0.11	0.981
Yes	0	0.00	0	0.00	0	0.00		
Nausea incidences:								
No	12	100.0	12	100.0	24	100.00	0.11	0.981
Yes	0	0.00	0	0.00	0	0.00		
Degree of bodyche:								
–ve	10	83.34	11	91.67	21	87.50	7.26	<0.001*
+ve	2	16.66	1	8.33	3	12.50		
Motheaten donor over harvesting:								
No	12	100.0	12	100.0	24	100.0	0.11	0.981
Yes	0	0.00	0	0.00	0	0.00		
Postoperative folliculitis:								
–ve	12	100.0	11	91.67	20	83.34	9.70	<0.001*
+ve	0	0.00	1	8.33	4	16.66		
Postoperative Anxiety:								
–ve	11	91.67	9	75.00	20	83.34	9.25	<0.001*
+ve	1	8.33	3	25.00	4	16.66		

Similarly, the incidences of post-operative pain among all examined patients showed significant differences in degree ($p<0.01$). The higher incidence was in the (+) degree, with 12 cases (50%), followed by the (++) degree with 9 cases (37.50%), and the (+++) degree with 3 cases (12.50%). Additionally, the post-operative pain incidences differed significantly ($p<0.01$) between the Non-injected PRP and injected groups. In the injected group, the higher degree (+++) was observed in 1 case (8.33%), while the (++) degree was observed in 5 cases (41.67%), and the (+) degree was observed in 6 cases (50%). In the non-injected group, the higher degree (+++) was observed in 2 cases (16.67%), while the (++) degree was observed in 4 cases (33.33%), and the (+) degree was observed in 6 cases (50%). All patients did not experience necrosis, bleeding incidences, or suffer from numbness. The incidences of numbness significantly differed ($p<0.05$) between the PRP injected and non-injected groups. In the injected group, –ve numbness was observed in 11 cases (91.67%), and +ve numbness was observed in 1 case (8.33%). In the non-injected group, –ve numbness was observed in 9 cases (75%), and +ve numbness was observed in 3 cases (25%). Additionally, the incidences of anagen effluvium significantly differed ($p<0.05$) between the PRP injected and non-injected groups. In the injected group, -ve Anagen Effluvium was observed in 12 cases (100%), and +ve Anagen Effluvium was not recorded. In the non-injected group, –ve hypertension was observed in 10 cases (83.34%), and +ve Anagen Effluvium was observed in 2 cases (16.66%) (Table 3).

In our investigation, the incidence of hypertension exhibited significant differences ($p<0.05$) between the PRP-injected and non-injected groups. In the injected group, –ve hypertension was observed in 11 cases (91.67%), while +ve tachycardia was observed in 1 case (8.33%). Conversely, in the non-injected group, –ve hypertension was observed in 9

cases (75%), and +ve tachycardia was observed in 3 cases (25%). None of the patients in either group suffered from bradycardia. Additionally, the incidence of hypotension in the PRP-injected group was observed in 11 cases (91.67%), with 1 case (8.33%) experiencing hypotension. In contrast, all patients in the non-injected group (100%) did not suffer from hypotension. Tachycardia also displayed significant differences ($p<0.05$) between the injected and non-injected groups. In the injected group, –ve tachycardia was observed in 10 cases (83.34%), while +ve tachycardia was observed in 2 cases (16.66%). Meanwhile, all patients in the non-injected group (100%) exhibited –ve tachycardia, and no patients in either group experienced bleeding. Body ache incidences significantly differed ($p<0.01$) between the injected and non-injected groups with PRP. In the injected group, body ache was observed in 11 cases (91.67%), while 1 case (8.33%) suffered from body ache. In the non-injected group, most patients (83.34%) did not show signs of body ache, and 2 cases (16.66%) experienced body ache. Patients in both groups did not exhibit Motheaten donor overharvesting, nausea, or post-operative folliculitis. The anxiety incidence in the PRP-injected group was not recorded in 9 cases (75%), with 3 cases (25%) experiencing anxiety. In the non-injected group, 11 cases (91.67%) did not suffer from anxiety, while 1 case (8.33%) did not experience anxiety (Table 4).

Furthermore, post-operative patient satisfaction significantly differed between the injected and non-injected groups with PRP ($p<0.01$). In the injected group, 50% of patients had excellent and satisfactory satisfaction grades, while 25% had poor satisfaction. In the non-injected group, 58.33% had excellent satisfaction, 16.67% had satisfactory satisfaction, and 16.67% had poor satisfaction (Fig. 3).

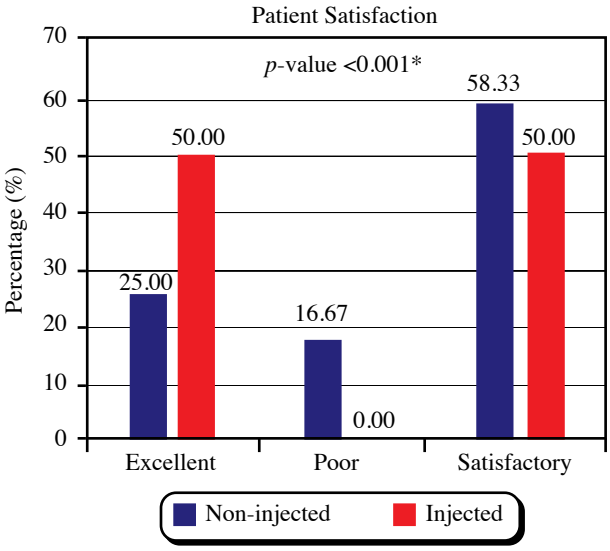

Fig. (3): Patients' satisfaction distribution among injected and non-injected patients with PRP.

Discussion

While androgenetic alopecia (AGA) is commonly associated with elderly individuals, it can also onset during puberty. It is crucial not to automatically attribute hair loss in men to male pattern baldness (MPB) without considering other potential indicators of an underlying disease process [31].

In our study, we took a comprehensive approach by gathering detailed personal and hair history information, including the onset age of the condition and any potential contributing factors such as acute illnesses or major surgeries indicating telogen effluvium. We conducted investigations, focusing on ruling out other causes of hair loss through assessments like iron profiles and thyroid function tests. Scalp examinations were performed to identify the characteristic pattern of androgenic alopecia in men, where a receding anterior hairline with frontotemporal recessions is indicative of male pattern hair loss, distinguishing it from female pattern baldness or androgenic alopecia where the anterior hairline is preserved. Furthermore, we utilized Norwood's classification to estimate the number of hairs needed, achieving density goals through multiple operations. Thorough assessments were conducted on the donor site, and while hair loss affects both genders, our study exclusively focused on male patients aged 22 to 43. Surgeons typically refrain from operating on individuals under 25 years old, particularly those with significant hair loss, as anticipating unknown future hair loss is a consideration in the decision-making process [32]. Importantly, age alone should not be the sole determinant in selecting candidates for hair transplantation. The key lies in managing expectations and planning both short- and long-term considerations regarding where to transplant and where not to transplant [9]. Wong's findings [33] underscore the challenge of satisfying patients under 25 years old across all age groups, prompting experienced hair surgeons to advise against or delay hair transplantation for young patients [33].

In our study, similar to Wong's findings [33], we did perform hair transplantation on patients under 25 years old. However, we observed that this age group was among the least satisfied, even after being educated about the ongoing nature of androgenic alopecia and having realistic expectations about anticipated hair density. Consequently, we share the opinion advocated by Wong [33] and others to avoid or postpone hair transplantation for patients under 25 years. During this period, our approach involved attempting to stabilize the ongoing androgenic alopecia using medical treatments such as minoxidil, finasteride, and PRP.

As highlighted by Avram et al. [9], two primary techniques for removing donor hair are elliptical donor harvesting and follicular unit extraction

(FUE). Elliptical donor harvesting, in use for over two decades, is performed under local anesthesia. On the other hand, FUE involves the direct removal of individual follicular units using manual punches ranging from 0.8 to 1.2mm, mechanically assisted devices, or robotics. In our study, we opted for the FUE technique, utilizing motorized tools with serrated punches (Ertip) ranging from 0.8 to 1mm in diameter, tailored to the patient's hair shaft diameter and the number of hairs per follicular unit to minimize transection risks.

Achieving adequate anesthesia is crucial, as explained by Elliott **[35]**, who outlined basic techniques such as nerve blocks, ring blocks, and field infiltration. Typically, lignocaine or bupivacaine with adrenaline is preferred for its vasoconstrictive properties and ability to provide a bloodless field during the procedure. Bupivacaine, with its longer duration of action, is especially useful during the lengthy hair transplantation process, which lasts at least 4-6 hours. Additionally, studies like that of Abhinav Kumar et al. **[22]** have incorporated the use of oral benzodiazepines to induce patient relaxation while maintaining consciousness and causing retrograde and anterograde amnesia.

In line with the findings of Alfonso Barrera et al. **[36]**, our tumescent solution consisted of 120ml of normal saline solution, 20ml of 2% plain lidocaine, 1ml of epinephrine 1:1000 [1mg], and 40mg of triamcinolone (Kenalog) to optimize the surgical environment.

Unlike Abhinav Kumar et al., **[22]** study in our study we did not use any preoperative form of sedation or nerve block technique of scalp antihazing, but we do agree in using ring and infiltration anesthesia then tumescent solution (containing NS+ Xylocaine 2%, bupivacaine, adrenaline, and triamcinolone acetate) injection in both donors to facilitate harvesting and in recipient as well before implantation. We used bupivacaine to prolong the duration of action like Abhinav Kumar et al., **[22]** study. If the patient sustained pain, we add more local taking care not to reach toxic doses of local anesthesia with monitoring of the patient. We used triamcinolone acetate (Kenacort 40mg) and same adrenaline concentration in tumescent solution of Alfonso Barrera. William **[19]** showed that the design of the hairline is the heart of hair restoration surgery. Many factors must be considered, including age and donor supply **[37]**. Pradeep Sethi et al., **[38]** showed that five types of anterior hairline shapes, include the round, M type, rectangular, bell-shaped, and triangular. Males usually have M type hairline **[38]**.

In our study, we agree and directed much care to this pivotal step of the procedure as it frames the face and share in achieving the aesthetically natural result that makes the anterior hairline with irregular irregularity, age appropriate and as high as possible after discussion with the patient as high hair line can be lowered always, but low hair line can't be elevated. We had been always using the M type of hairline like in Pradeep Sethi et al., **[38]**. In his study Carlos Oscar Uebel et al., **[39]**, twenty male patients aged 22 to 54 years with male pattern baldness in the frontal, parietal, or occipital area were selected for this surgical and clinical trial. Two symmetrical 2.5cm^2 bald areas were delineated. On the right side of the patient's head, FUs imbibed with platelet plasma growth factors were implanted; on the left side, standard FUs were implanted as a control. In all patients, both areas were implanted with an equal number of micrograft's. It was noticed that the treated side with PRP showed better survival and density, he showed also that normally between 15% and 30% of the implanted grafts will either be eliminated or absorbed by the scalp. Therefore only 70% to 85% of the implanted hair will sprout **[39]**.

In our study, we noticed the same survival rate in our FUE technique with better results in PRP treated group, so we do agree with this conclusion. In Rupak Bishwokarma Ghimire, **[40]** study, it was noticed that Peri operative complications were recorded with 60.53%, out of which 34.87% had pain requiring diclofenac injection, 1.32% with increased blood pressure more than 140/90mm of Hg, hypotension with blood pressure less than 90/60mm of Hg was recorded in 1.97%, anxiety in 5.26%, bleeding requiring tranexamic acid 500mg intramuscular in 1,97%, Nausea in 9.21%, Body ache in 3.95%, Tachycardia in 0.66%, Bradycardia with pulse less than 60 in 1.32%. All complications with immediate postoperative complications were noted from patients at follow up on two days while shampooing and removal of bandage. 71.68% developed complications, including swelling of forehead in 69.74%, pain in 3.29% and infection with yellowish discharge at recipient site in one patient (0.66%) **[40]**.

In our study, Patients were taught about early warning indications of local anesthetic toxicity, such as tinnitus, headache, metallic taste, or ringing in the ears, which fortunately we had not experienced, and their blood pressure, pulse rate, and oxygen saturation were regularly monitored. Prednisolone and alfa amylase were beneficial in lowering this forehead oedema, which occurred postoperatively in roughly 16 patients with varying degrees and for varying lengths of time. Two occurrences of hypotension and tachycardia were also reported. Pain was experienced by all patients, and oral analgesia with injection form PRN were sufficient to control it in all but one incidence of folliculitis, which was treated with an oral antibiotic. Fortunately, there were no instances of bleeding that required tranexamic acid injection, only two instances of subpar graft growth in the non-PRP group, and no instances of scalp loss or AV fistula **[41]**.

In our study, we adopted this maneuver and technique in our study in using calcium gluconate in activation of the PRP, [43]. Dhurat and Saraogi [44] found the optimal methods for outcomes reporting have not been established and results have been documented using a variety of techniques. In general, these methods are grouped as noninvasive, semi-invasive and invasive methods. Patient Surveys which list patient satisfaction as a survey outcome [44].

In our investigation, we employed a patient survey methodology to convey the results and satisfaction rates, encompassing achieved density, natural appearance, and alignment with the patient's goals. Notably, there exists a significant contrast in patient satisfaction levels between the PRP-injected and non-injected groups. The PRP-injected group displayed no instances of poor satisfaction, while the non-injected group exhibited excellent satisfaction in 3 (25%), satisfactory in 7 (58.33%), and poor in 2 (16.67%) of the participants. In the study conducted by Kachhawa et al. [45], 70% to 80% of patients reported improvements in hair quality, thickness, and appearance, aligning with the results reported in our study, thereby supporting their findings.

Our study adopted a separation and preparation technique for PRP as described by Takikawa et al. [46], wherein the PRP was manually separated in two steps from 15ml of blood. The platelet yield was estimated to be 6.13 times greater than the platelet concentration in whole blood. We chose this method as it is theoretically considered the most effective in platelet yielding. Additionally, in accordance with Marc et al. [9], our study involved the creation of incision sites in the frontal scalp using blades and sapphire blades for density, along with the use of jeweler microvascular forceps for implanting hair follicles.

Regarding graft viability, Marc et al. [9] emphasized the absence of firm data on how long grafts can remain in a holding solution while remaining viable. Anecdotal evidence suggests that graft survival tends to decrease consistently when the out-of-body time exceeds 2 hours. While normal saline has historically been widely used as a cost-effective and effective fluid at room temperature, optimizing other aspects such as temperature, osmotic balance, pH, and electrolyte balance may be beneficial. Chilling the grafts, as demonstrated by Limmer's study in 1992, may confer a survival advantage, with enzymatic activity decreasing by 1.5- to 2-fold for each 10°C drop in temperature.

In our investigation, we aligned with the recommendation from Elghblawi [47] and, accordingly, employed cold saline to fully immerse the grafts in petri dishes. This was done to maintain continuous graft hydration, and the solution was changed every hour to sustain a cold temperature. Our aim was to minimize the time between grafts outside the body, even within the holding solution. Elghblawi's study highlighted the angiogenic effect of platelet-rich plasma (PRP) on the hair follicle, promoting hair growth by preventing dermal papilla apoptosis and extending the anagen phase. PRP, either as a stand-alone therapy or in conjunction with hair transplant, can enhance the survival rate of implanted follicular units and increase density. Some advocated immersing the hair follicle in PRP for about 15 minutes before implantation, while others opted for interfollicular PRP injections during and after transplantation. Although these were observational and not clinically blinded trials, the observed induction of hair growth and improved hair density were attributed to the growth factors from activated platelets in the bulge area where stem cells are located [47].

In our study, we incorporated PRP as an adjunct to hair transplantation, treating both donor and recipient areas pre- and post-operatively with PRP. However, we did not use it as a graft-holding solution, opting for either normal saline or Ringer's solution. Nevertheless, our observations were consistent with better graft survival, resulting in improved hair density, natural appearance, and overall patient satisfaction.

Conclusion:

FUE technique of hair transplantation is an emerging popular cosmetic hair restoration method and is more patient friendly as it leaves tiny scars, compared with the strip method (FUT) which leaves visible linear scars at the donor sites. With respect to hair transplantation, PRP role in treating the donor site, promotes the growth of hairs transected during the procedure, use as a storage solution, treatment of the recipient sites to promote earlier regrowth and overall higher yields with eventually better results considering density, graft survival, natural appearance, and patient satisfaction. We had this study preliminary prospective study carried on a random small number of cases so we recommend an increase in the number of cases in further study to get good statistical data.

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