

Feasibility of Platelet Rich Plasma Use in Hair Transplantation in Treatment of Post Burn Scar

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ABSTRACT

Background: Management of post burn alopecia has been an obstacle to plastic surgeons nowadays, there is variable surgical methods which makes it difficult to choose the suitable treatment for each patient.

Objective: To assess the feasibility of platelet rich plasma use in hair transplantation in treatment of post burn scar alopecia to choose of the suitable treatment algorithm for this type of deformity to obtain the highest possible patient satisfaction rate with the least-possible complication rate.

Methods: This prospective clinical study was conducted in Benha University Hospitals, Plastic and Burn Surgery Department in the period between January 2021 and January 2022. 20 patients with post burn alopecia were included in the study. Patients were randomized using envelop method into two groups, where each group contains 10 patients as follows: Group A: Patients received local intradermal PRP injections one week before hair transplantation followed by two injections 2 and 4 weeks postoperatively. Group B (Control group): Patients underwent hair transplantation only without any kind of local injections.

Results: Using this procedure is less invasive, less expensive with less post-operative burden on the patients. However, it requires special skills for proper harvesting and inserting of follicular grafts. Operative time and number of sessions were reasonable and convenient to the patients. Complications were quite mild and acceptable to the patients.

Conclusion: It was concluded that using PRP in FUE is useful in treatment of post burn alopecia, hair transplantation has less hazards during anesthesia, less post-operative complications and shorter recovery time than the other procedures of hair restoration.

Key Words: Platelet rich plasma – Hair transplantation – Post burn scar.

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INTRODUCTION

Post burn scar alopecia refers to a disorder that causes irreversible hair loss and though negatively

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affects self-image and self-esteem of patients. Spontaneous regrowth of hair in cases of post burn scar alopecia can rarely occur [1].

Prior to hair restoration, it is necessary to clarify that post burn scar alopecia is not active and totally healed. However, decision of choosing treatment method depends on interdependent factors such as: Scalp laxity, the availability of donor hair, the patient's healing characteristics and vascular supply. Surgical treatment of stable post burn scar alopecia includes primary excision of alopecic area, hair transplantation and scar reduction with tissue expansion or flap surgery [2].

Hair transplantation in post burn scar alopecia is a challenging procedure because of degenerative changes and decreased vascularity of scarred tissues. Furthermore, when scarring affects the usual safe donor area of the scalp, there is a shortage of adequate amount of grafts for reasonable coverage [3].

Follicular Unit Extraction (FUE) method is preferred for hair restoration in post burn scar alopecia. FUE method is a preferred method for the patients with wide areas of scattered post burn scar alopecia in recipient region. The most determining factor for surgery success of post burn alopecia hair transplantation is the vascularity of the recipient region, because low blood flow can cause infection, tissue ischemia and necrosis after surgery [2].

The era of hair restoration surgery dated back to the beginning of the twentieth century in Japan with techniques which were developed for burn survivor treatment. In the 1930s, Okuda published his technique of hair transplantation derived from punch grafts [4].

Hair transplantation operation consists of harvesting hair from a donor area (usually the occipital and posterior-parietal scalp) by using a single strip excision or small punch excision and grafting them into the recipient site [5].

Follicular unit extraction (FUE) is a method of graft harvest by various punches of different size to remove individual FUs from the donor region. Two basic punch techniques are used in FUE, dull and sharp tip punch, and within each subtype, manual and power assisted instrumentation exists. Sharp techniques are of limited depth in punch insertion to decrease risk of follicle transection while attenuation the force on the graft site during harvest. FUE technique advantages includes prevention of a potentially undesirable donor site linear scar and shorter post-operative healing time [6].

Platelet rich plasma (PRP) is a rich source of growth factors, such as basic fibroblast growth factor (bFGF), insulin-like growth factor 1 (IGF-1) and vascular endothelial growth factor (VEGF). PRP injection has been established to promote cutaneous ischemic conditions and to increase vascularity around hair follicles [7].

Pay attention, consideration should be taken when performing hair transplantation on scarred tissue that the density in units/cm² must be less than on an area of normal scalp transplant (30-40 units/cm²), because of the risk of follicles competing for the reduced blood flow through the scar tissue [5].

Body hair from the beard areas could be used alone or in combination with donor scalp hair if there is extended distribution of the post burn scar alopecia in the scalp producing shortage of adequate donor hair. The beard hair grafts have similar features to grafts from the scalp and compare favorably with scalp hair in growth characteristics and can be considered a viable backup for scalp hair in hair transplantation procedures with paucity of donor grafts [9].

This work aimed to assess the feasibility of platelet rich plasma use in hair transplantation in treatment of post burn scar alopecia to choose of the suitable treatment algorithm for this type of deformity to obtain the highest possible patient satisfaction rate with the least-possible complication rate.

PATIENTS AND METHODS

This prospective clinical study was conducted in Benha University Hospitals, Plastic and Burn

surgery department in the period between January 2021 and January 2022. 20 patients with post burn alopecia were included in the study.

The research ethical committee of Benha Faculty of medicine approved the study. All the patients gave Informed consent before any procedure.

Inclusion criteria:

All patients with post burn alopecia of both sexes with age between 15 to 50 years.

Exclusion criteria:

- Those with 1ry alopecia or 2ry cicatricial alopecia due to causes other than burn.
- Recent post burn alopecia less than 6 months (immature scar).
- Patients with unrealistic expectations or body dysmorphic disorder.
- Patient with active infection at site of alopecia.
- Patient with history of keloid.
- Patients with autoimmune disease or chronic diseases e.g. hepatic or renal.
- Patients using systemic chemotherapy, anticoagulation therapy, or steroid.
- Patients with active vascular disease, bleeding disorders or platelet abnormalities.
- Systemic diseases including hemodynamic instability, sepsis.
- HIV, viral hepatitis or immunocompromised patients.

Pre-operative preparations:

All patients were instructed to the following:

- Informed consent was taken for all patients.
- Digital photography for each case.
- History taking: Included medical condition, drug intake especially antipsychotic and anticoagulant drugs, previous surgeries, mechanism of burn and special habits as smoking.
- General examination: Included chest condition, cardiac condition and neurological condition.
- Local examination:

1- *The alopecic area:* Regarding its location, size and shape, maturity of the scars and tissue laxity and viability.

2- *The donor area:* Regarding hair density and hair direction.

Routine investigations:

- 1- CBC.
- 2- APTT, PTT and INR.

- 3- Kidney functions and liver functions.
- 4- HIV antibodies and Hepatitis markers.

Patients were randomized using envelop method into two groups, where each group contains 10 patients as follow:

- Group A: Patients received local intradermal PRP injections one week before hair transplantation followed by two injections 2 and 4 weeks post-operatively.
- Group B (Control group): Patients underwent hair transplantation only without any kind of local injections.

Surgical plan and techniques:

Follicular unit extraction procedure:

1- Preparation of the donor area and graft harvesting:

Patients were instructed to cut their hair 1-2mm in length and to take a shower in the night before the operation and operation is done under complete aseptic condition. Patients should wash their head completely with Betadine Shampoo just before surgery and drying it with dry sterile towels. Pre-operative photography and vital signs of the patients (blood pressure, pulse) are recorded 1 hour before operation to record the base line and to discover any changes in vital signs during operation.

The patient was placed sitting with head flexed in a comfortable position adjusted by the patient him/herself.

Under complete aseptic condition, occipital and postauricular nerve blockage was done by 0.1% lidocaine hydrochloride. Anesthesia infiltration was done with a solution containing 70ml normal saline 0.9%, 30ml of 0.1% lidocaine hydrochloride and 1ml of adrenalin (1mg/ml). After waiting for the adrenaline action, graft harvest was initiated with the help of 2.5 x magnification, and using a micro motor which works at 1500-3000 rpm, with the micro punch ranging from 0.8 to 1 mm attached to the hand piece (Fig. 1).

Grafts were mainly taken from the occipital area of scalp, while thin supra-auricular and temporal hair was used to a lesser extent to simulate the natural appearance of hair. Punch size was chosen ranging from 0.8 to 1mm based on follicular unit density. The more closely alignment of hair follicle, the smaller the punch required. The epidermis and dermis around the hair follicle were cut by the punch which advanced about 3-4mm deep into the skin till the deep dermal layer. And

then the grafts were released. The released grafts were collected manually using an extraction jeweler's forceps (Fig. 2).

At the beginning of the harvesting process, ten to twenty follicular units were harvested and assessed whether they were collected easily or not and to be sure that there is no hair follicle transection. If all follicles were collected with noticeable transection, the advancing angle and depth was modified.

The grafts were then aligned into five rows, with ten grafts in each row (a total of 50 grafts) on a piece of wet gauze over a cold saline (Fig. 3).

Graft harvesting was continued till a sufficient number of untransected follicles had been reached. On completing the harvesting step, occipital and postauricular nerves were re-blocked to decrease the expected pain in the donor area during the harvested graft transplantation process. Dressing of the donor area was done with sterile non adhesive Vaseline gauze, and the patient was turned supine. The donor area where the grafts were collected is shown in Fig. (4).

2- Preparation of the recipient area and graft insertion:

The recipient area was marked, and the same infiltration anesthesia used in the donor area was performed. If the alopecia in the frontal area, we have to block supraorbital and supratrochlear nerves too. Then the recipient site was prepared using micro blades of different sizes varying from 1 to 1.5mm taking into account the natural hair direction to simulate the most natural looking results. Grafts were placed using an implantation jeweler's forceps with a density of 20-30 follicular unit (FU) per cm².

Technique of platelet rich plasma preparation:

PRP was prepared under complete aseptic conditions as follow:

20ml of venous blood was obtained from each patient and the collected blood was put in the PRP kit containing anticoagulant sodium citrate and separation gel (Figs. 5,6).

Centrifugation was done at 1000 rpm for 10 minutes. The whole plasma, the buffy coat and the superficial RBCs were aspirated from all the tubes in a 5ml syringe then redistributed into 2 plain tubes. Re-centrifugation at 2000 rpm for another 10 minutes was done. The lower 1/4 of plasma was then withdrawn into syringe.



Fig. (1): The micro motor system.

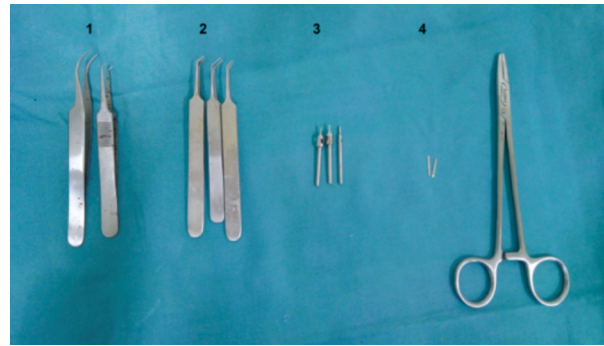


Fig. (2): Surgical equipment (1: Extraction jeweler's forceps, 2: Implantation Jeweler's forceps, 3: Micro punches, 4: Micro blades).

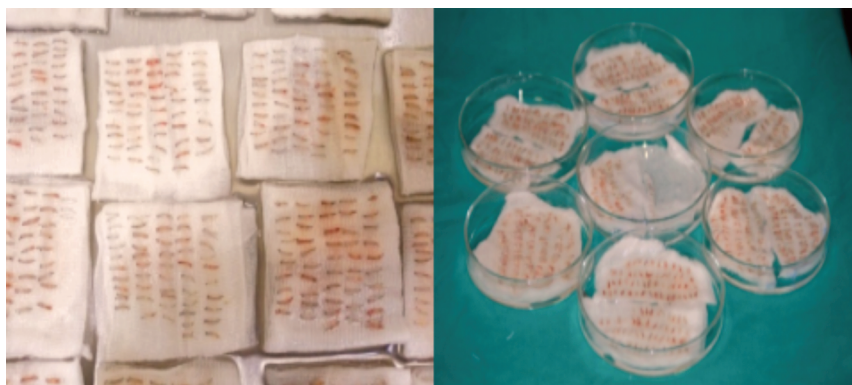


Fig. (3): Grafts were aligned in five rows, with 10 grafts in each row.



Fig. (4): The donor area.

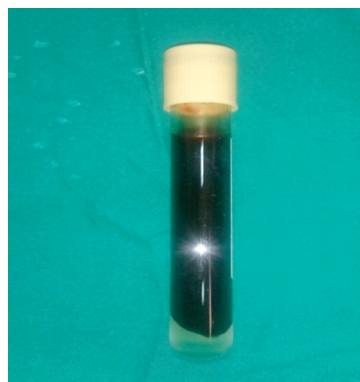


Fig. (5): Collected venous blood in the PRP kit (before centrifugation).

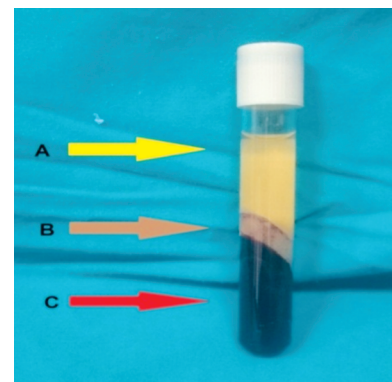


Fig. (6): After centrifugation (A: Plasma, B: Separation gel, C: Erythrocytes).

The collected PRP was injected intra-dermally at the alopecic area one week before the operation, followed by two injections 2 and 4 weeks post-operatively.

Data analysis:

Statistical data analysis was done by Statistical Package for the Social Sciences (SPSS) version 22. Qualitative data were presented as number and percentage. Chi Square test of association was used for comparison between the two groups.

Quantitative data were presented as mean \pm SD. Paired *t*-test was used for comparison within the two groups. Student *t*-test was used to compare between both groups. *p*-value <0.05 was considered to be statistically significant.

RESULTS

There were ten patients in group A with mean age 27.40 ± 9.54 years (age range was from 18 to 50 years). Gender distribution of this group was eight male patients and two female patients. Scald

burn was the most common cause of alopecia. The mean time passed between burn and surgery was 9.85±8.89 years (ranging from one year to 22 years) (Table 1).

Table (1): Demographic data of group A patients.

Case	Gender	Age (years)	Affected site	Etiology	Time passed (years)
1	Male	18	Scalp	Scald Burn	5
2	Male	24	Left eye brow	Scald Burn	1
3	Male	50	Beard	Scald Burn	20
4	Male	21	Scalp	Scald Burn	4
5	Male	24	Right eyebrow	Flame Burn	5
6	Male	29	Mustache	Scald Burn	20
7	Female	27	Scalp	Flame Burn	1.5
8	Male	23	Scalp	Scald Burn	18
9	Male	37	Mustache	Scald Burn	22
10	Female	21	Right eyebrow	Scald Burn	2

There were ten patients in group B with mean age 24.50±8.36 years (age range was from 16 to 42 years). Gender distribution of this group was seven male patients and three female patients. Scald burn was the most common cause of alopecia. The mean time passed between burn and surgery was 9.40±9.87 years (age range was from one year to 34 years) (Table 2).

Table (2): Demographic data of group B patients.

Case	Gender	Age (years)	Affected site	Etiology	Time passed (years)
1	Male	35	Scalp	Scald Burn	8
2	Male	26	Scalp	Scald Burn	10
3	Male	18	Beard	Scald Burn	5
4	Male	22	Scalp	Scald Burn	7
5	Female	17	Left eyebrow	Flame Burn	1
6	Male	24	Left eyebrow	Flame Burn	4
7	Female	16	Right eyebrow	Scald Burn	3
8	Male	26	Mustache	Scald Burn	18
9	Male	42	Scalp	Scald Burn	34
10	Female	19	Scalp	Scald Burn	4

The mean time passed between burn and surgery was 9.85±8.89 years for group A and 9.40±9.87 years for group B which was statistically insignificant (*p*-value: 0.321) (Table 3).

Table (3): The mean time passed between burn and surgery.

	Group A	Group B	F	<i>p</i>
Time elapsed (years)	9.85±8.89	9.40±9.87	1.187	0.321

The mean follicular units count on transplantation in group A was 26.80±3.39 units, which became 22.40±3.13 units after the follow up period, showing an average survival rate of 83.76%.

While in group B, the mean transplanted follicular units count was 26.20±2.10 which became 23.00±2.16 after the follow-up period, showing the average survival rate of 83.7% (Table 4).

Table (4): Transplanted follicular units.

	Group A	Group B
Approximate immediate count	26.80±3.39	26.20±2.10
Approximate post-operative count	22.40±3.13	23.00±2.16
The average survival rate	83.76%	83.7%

The mean survival rate for group A was 83.76 ±7.06% after the follow-up period and 83.70±3.29 for group B which was statistically insignificant (*p*-value: 0.927) (Table 5).

Table (5): Survival rate.

	Group A	Group B	F	<i>p</i>
Survival rate (%)	83.76±7.06	83.70±3.29	0.076	0.927

The mean count of transplanted FU was 281.50 ±245.22 for group A and 127.00±87.28 for group B which was statistically insignificant (*p*-value: 0.057) (Table 6).

Table (6): The mean grafts count per session.

	Group A	Group B	F	<i>p</i>
Total number of grafts per session	281.50±245.22	127.00±87.28	3.194	0.057

In group A, 281.50±245.22 mean follicular units (FU) (from 55 to 800 units per area) were transplanted in 166.50±95.63 minutes mean operative time (ranging from 40 to 800 minutes) with the mean density was 26.80±3.39 FU (ranging from 20 to 30 FU per cm²). After 8.80±1.93 months mean follow up period (from 6 to 12 months), the mean transplanted FU were 22.40±3.13 (ranging from 17 to 27 FU per cm²). The average blind study was 1.60±.35 (ranging from one to two) showing a significant improvement in three cases while other cases showed grades of improvement. Two cases were highly satisfied while others showed grades of satisfaction (Table 7).

Table (7): Clinical outcomes of group A (PRP group).

Case	Follow-up period (months)	Operative time (minutes)	Approximate no/cm ² (immediate) (FU)	Approximate no/cm ² (post) (FU)	Total no of grafts per session (FU)	Blind study average	Patient satisfaction
1	11	360	30	26	800	2	4 (highly)
2	8	150	26	23	200	2	3 (moderate)
3	10	170	30	23	300	1.33	2 (mild)
4	7	150	25	20	200	1.67	3 (moderate)
5	9	150	28	20	160	1.67	3 (moderate)
6	6	55	30	25	100	2	4 (highly)
7	10	150	24	20	200	1.33	2 (mild)
8	12	300	30	23	650	1	1 (unsatisfied)
9	7	60	30	27	55	1.33	2 (mild)
10	8	120	25	17	150	1.67	2 (mild)

In group B, 127.00±87.28 mean follicular units (FU) (ranging from 45 to 300 units per area) were transplanted in 84.50±32.78 minutes mean operative time (ranging from 50 to 150 minutes) with the mean density was 26.20±2.10 FU (ranging from 25 to 30 FU per cm²). After 8.20±1.93 months mean follow-up period (ranging from 6 to 11

months), the mean transplanted FU were 23.00±2.16 (ranging from 21 to 27 FU per cm²). The average blind study was 1.43±0.32 (ranging from one to two) showing a significant improvement in one case while other cases showed grades of improvement. One case was highly satisfied while others showed grades of satisfaction (Table 8).

Table (8): Clinical outcomes of group B (control group).

Case	Follow-up period (months)	Operative time (minutes)	Approximate no/cm ² (immediate) (FU)	Approximate no/cm ² (post) (FU)	Total no of grafts per session (FU)	Blind study average	Patient satisfaction
1	11	100	25	22	200	1	1 (unsatisfied)
2	11	150	25	20	300	1.33	2 (mild)
3	8	85	28	25-23	150	1.67	2 (mild)
4	9	120	28	25-24	200	1.33	2 (mild)
5	7	65	25	23-21	65	1.67	3 (moderate)
6	6	55	24	22-21	50	1.67	3 (moderate)
7	6	50	24	21	45	2	4 (highly)
8	7	60	28	23	50	1.33	2 (mild)
9	10	100	25	21-20	150	1	1 (unsatisfied)
10	7	60	30	27-24	60	1.33	2 (mild)

The mean age for group A was 27.40±9.54 years, and 24.50±8.36 for group B which was statistically insignificant (*p*-value: 0.769) (Table 9).

Ten percentage (1 patient) of the patients of group B showed high satisfaction, 20% (2 patients) were moderately satisfied, 50% (5 patients) showed mild satisfaction and 20% (2 patients) were unsatisfied which were statistically insignificant (*p*-value: 0.971) (Table 10).

Table (9): The mean age for the two groups.

Age	Group A (N=10)	Group B (N=10)	F	<i>p</i>
Mean ± SD	27.40±9.54	24.50±8.36	0.265	0.769
Range	18-50	16-42		

In group A, 20% of the patients (2 patients) were highly satisfied, 30% (3 patients) were moderately satisfied, 40% (4 patients) showed mild satisfaction and 10% (1 patient) was unsatisfied.

Table (10): Patient satisfaction.

	Group A		Group B		χ^2	<i>p</i>
	No.	%	No.	%		
<i>Patient satisfaction:</i>						
I (unsatisfied)	1	10	2	20	1.304	0.971
II (mild)	4	40	5	50		
III (moderate)	3	30	2	20		
IV (highly satisfied)	2	20	1	10		

Cases



Fig. (7): Case (1) (A): Pre-operative (B): Immediately post-operative. (C): One week post-operative. (D): 3 months post-operative.



Fig. (8): Case (2) (A): Pre-operative. (B): Immediately post-operative. (C): 3 weeks post-operative. (D): 6 months post-operative.

DISCUSSION

We selected 20 patients in this study who were suffering from post-burn alopecia, they were 15 males (75%) and 5 females (25%). Patient age ranged from 16 to 50 years old.

In our study we studied 20 patients operated by FUE in a period of 6 to 12 months. Shau et al., carried their study on 37 patients who were suffering from secondary cicatricial alopecia in a period of 5 years [10], decreased numbers in our study might be due to decreased patient's presentation and longtime of follow-up.

Mean age of patients was 27.40 ± 9.54 in our study, while Shau et al., [10] showed mean age of 24.68 ± 5.88 . This variation may be due to larger sample number in their study.

In our study the mean surface area of alopecia (Cm^2) was 17.15 ± 9.92 , which differs from results published by Shau et al., [10] as their mean surface area of recipient site was 10.08 ± 19.55 . This might be due to their case selection (choosing patients with small scalp scars).

The mean duration of hair transplantation in our study was 3.05 ± 1.40 , Shau et al., [10] has a quite like range of procedure duration which was (3.61 ± 1.32) .

In our study, the mean follicular unit density per recipient area was 26.80 ± 3.39 Fu/ cm^2 , while Shau et al. [10] had the mean density of 36.28 ± 6.44 Fu/ cm^2 the difference was due to our precaution of the decreased vascularity of the alopecic areas so we didn't overcrowd the follicular units during implantation.

While the donor sites showed insignificant complications (white scar, pseudo-syphilitic appearance or necrosis) there was minor complications in the recipient sites (15%), Hair thinning (5%, one case), un-satisfaction (15%, three cases).

In our study, complication rate was 15% while Shau et al., [10] had only 5.6% complication rate, this difference might be because they only mentioned long-term complications.

There were no significant association between the size of alopecia and incidence of complication (p -values of Fisher's exact test was 0.59 and 0.64 respectively). In addition, p -values of Pearson Chi-square were 0.08 and 0.55 respectively).

Furthermore, no association could be detected between incidence of complication and operative

duration, as p -value of Fisher's exact test is 0.076 and p -value of Pearson Chi-square is 0.08 (not significant).

Regarding patient satisfaction: 15% of the patients (3 patients) were highly satisfied, 25% (5 patients) were moderately satisfied, 45% (9 patients) showed mild satisfaction and 15% (3 patient) were unsatisfied. Hassan et al., [11] showed excellent results in 10%, good results in 70%, and satisfactory results in 20% of patients, while Shau et al., [10] stated that patient Satisfaction at their study was 100% for 30 patients, 90% to 100% for five patients and <90% for two patients.

Conclusion:

In the current study, FUE is used for hair restoration either alone or combined with PRP injection. Although adding PRP to the FUE procedure provides an excellent improvement in the texture and quality of scarred tissues compared to other cases underwent FUE alone, there are no significant differences in the clinical outcomes of hair restoration regarding hair growth density. It was concluded that using PRP and FUE is very useful in the field of post burn alopecia treatment as hair transplantation has few hazards during anesthesia, few post-operative complications and short recovery time than the other method of hair restoration as tissue expansion or flap surgery.

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