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Effect of autologous platelet-rich plasma gel application on meshed split- thickness grafts in burn wounds: A prospective study

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Abstract

Burn wound healing is a complex and challenging process. The use of platelet-rich plasma (PRP) is an emerging intervention in burn wound management that has been found to enhance the healing process. However, the benefits of PRP in the healing of burn wounds are still not well established. To evaluate the effect of PRP gel on the healing of meshed split- thickness skin grafts (STSG) and mesh appearance in burn wounds**.** A comparative prospective trial was conducted between December 2013 to December 2015 including 20 burn patients for meshed STSG of limited size about 10x10cm, aged between 18-50 years excluding all co-morbidities and immunodeficiency disorders. A comparison of the ordinary method in dressing with PRP gel was done in the same patient. We applied PRP gel intraoperative then on the third or fourth day then every other day three to five times. Healing time in PRP- treated areas was significantly reduced in comparison with non-PRP-treated areas (P=0.01) which was not significantly associated with age, gender, serum PRP concentration. Mesh appearance was better in PRP than non-PRP-treated areas in 64.7% of cases. Using PRP gel on meshed STSG in burn wounds could increase graft take, reduce healing time, improve mesh appearance.

Keywords: Platelet-rich plasma (PRP), Burn, Wound healing, Split thickness grafts.

Full length article **Corresponding Author*, e-mail: ptrservices2022@gmail.com

1. Introduction

Burns are regarded as the fourth most common injury type worldwide, with a high rate of morbidity and mortality due to inadequate and sluggish wound healing. Even with recent advancements, burn care remains difficult. The results of skin grafting operations and early removal of necrotic tissue have improved [1-2]. This in turn focuses research efforts on investigating treatments that have the potential to facilitate and expedite the process of wound healing. The therapeutic application of autologous PRP gel on STSG is one of these therapies. Platelets make up a larger concentration of PRP, a blood derivative that is rich in several growth factors and cytokines that are necessary for wound healing [3-4]. Over the past 20 years, autologous PRP has been extensively used for a variety of medical disorders. It is an appealing therapeutic option for illnesses where healing is necessary due to its availability, processing, and activation as well as its low risk of histocompatibility [5]. PRP has a special capacity to accelerate wound healing because it functions as a fibrin tissue glue with hemostatic and tissue-sealing qualities [6]. Since STSG is extensively applicable, simple to harvest, and compatible with a variety of tools, it is frequently utilized for soft-tissue covering. Three phases are involved in the healing process: maturation, inoculation, and anchoring. The entire success of the process depends on the first two phases going well [7]. Hemostasis, infection, and shearing are the main causes of graft loss. Recent descriptions and theories suggest that autologous PRP applied to STSG recipient sites can both inoculate the STSG and enable rapid skin graft anchoring. PRP treatment of STSG recipient sites appears to improve primary healing and shorten healing time, perhaps because it reduces shearing force and improves the wound environment by introducing growth factors [8-9].

While PRP has been applied extensively in several therapeutic contexts and its impact on burn wounds has been assessed, the benefits of PRP in wound healing remain uncertain. The purpose of the study was to investigate how PRP gel affected the appearance of mesh in burn wounds and how quickly meshed STSG healed.

2. Patient and methods

This prospective study included twenty adult patients of both sexes aged 18-50 years who were admitted to the burn unit, at Kasr Al-Ainy hospitals between December 2013 to December 2015. Meshed STSG application areas of limited size about 10x10cm were included in our study. Exclusions from the study included individuals with neurological or physiological disorders, large-sized meshed STSG application areas larger than 10x10 cm, immune compromised and severely incapacitating comorbidities, and recalcitrant patients. The local Ethics Research Committee authorized each experimental protocol. After a thorough explanation of the process, enrolled cases gave their informed permission. Due to their frequent blood withdrawals, eight individuals refused to participate in the study, and other patients took their place. Comparison of PRP gel treated areas in meshed STSG application areas with ordinary methods of dressings was done in the same patient to eliminate the biological and personal variables among the various treated areas distal or proximal, lateral, or medial part of wound areas were selected for dressing with PRP gel or ordinary methods of dressing. Antiseptics were not applied, only irrigation of the wound by saline. Observing the difference in speed of taking meshed STSG application areas, the process is assisted by photography and clinical by senior staff. Photography with measuring of the wounds was done to detect the appearance of the graft in meshed STSG and later, follow up of the patient after approximately three months.

2.1. PRP Preparation and application

PRP was prepared from the patient's blood (autologous PRP) using Bechman AllergaX12u series as a centrifuge that is shown in Figure 1, where 40 ml were aspirated from the patient into sterile tubes containing 5 ml CPDA-1 solution using needle diameter larger than 17 gauges. Whole blood was centrifuged at 1000 RPM for ten minutes at 18°C. The upper fraction PRP was separated about (3-5ml), without disturbing the buffy coat, and was transferred into a sterile 10ml tube. PRP was centrifuged at 1200 RPM for 10 minutes at 18°C. The platelet pellet obtained from PRP was re-suspended in the lower one-third of the tube, and discarding the upper two-thirds of the plasma so we would have about (1-1.5) ml. $CaCl_2$ added to the PRP (0.5ml to every 1ml of PRP). After ten minutes, the formed PRP gel was applied intraoperatively to the area included in the research then on the third or fourth day then every other day three to five times.

2.2. Data analysis

For quantitative variables, the data were statistically reported as mean ₱ standard deviation (SD) and range, and for categorical variables, as a number and percentage. Wilcoxon signed rank test for paired (matched) samples was used to compare the study groups. A P-value of less than 0.05 was deemed statistically significant. The statistical software SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 22 was used for all statistical computations.

3. Results

The included patients were aged from 18 to 50 years old with a mean of 33.25 years and most of them were males (70%). Demographic data, platelet count in whole blood, and serum PRP concentration are shown in Table 1. The mean percentage of graft take was higher in PRP than in non-PRP-treated areas (82.06 vs 73.89) with a significant difference (P=0.05). There was significant difference between PRP and non-PRP-treated areas in time of healing (P=0.018) where quicker healing was among PRP- treated areas as shown in Table 2. There were three cases of lost grafts. Grafts within 11 cases out of the remaining 17 (64.7%) had shown better meshing appearance in PRP than non-PRP- treated areas while the appearance of meshed grafts within the rest of the cases was the same in PRP and non-PRP-treated areas. There were non-significant correlations of healing time neither in PRP nor non-PRP treated areas with age, serum PRP concentration/ml as shown in Table 3 & Figure 3. We found that gender is not effective in the enhancement of healing of STSG where the mean of healing in PRP gel treated areas in females was 11.8 days ranging between 8 - 21 days compared with males mean of 11.58 days ranging between 8 -20 days, P value =0.915, and in non PRP treated areas mean in females was 13.6 days ranged between 9-21 days comparing to males mean 14.85 days ranged between 8-24 day, p-value =0.656. Images of PRP-treated meshed grafts in some of our cases are shown in Figure 3 & 4.

4. Discussion

Research to hasten the wound healing process in burn patients is motivated by factors such as impaired wound healing, lengthy treatment courses for severe burns, and secondary problems resulting from open wounds [10]. Because autologous PRP has been shown to promote wound healing in several surgical specialties, interest in this endogenous therapeutic approach is growing. PRP is thought to facilitate tissue regeneration because it contains vital cytokines and numerous growth factors. It is also easily made and has a low immunogenicity [11-13]. The evidence about the benefits of PRP use in burn wound healing is still inconclusive. Therefore, this study was done to evaluate the effect of PRP gel on the healing of meshed STSG and mesh appearance where burn wound recipient sites were chosen as a model of our trial. We performed our study on 20 burn patients with meshed STSG application areas, comparing the ordinary method in dressing with PRP gel, comparing areas about 10x10cm in all cases. Our patients were aged between 18-50 years of both sexes, avoiding most situations affecting wound healing as immune-compromised or debilitating comorbidities. We tried to standardize all the biological factors affecting wound healing, so we did the comparison on the same patient. Extract of platelet from patient's blood is being used in our study as not all patients can afford available recombinant PRP for skin graft. We applied PRP gel intra-operative then on the third or fourth day then every other day three to five times.

Our study revealed that the use of PRP gel in the treatment of meshed STSG achieved a better percentage of graft take (82.06 for PRP-treated areas vs 73.89 for non-PRP treated areas, P=0.05) with more rapid healing time/ days (11.6 for PRP treated areas vs 14.5 for non-PRP treated areas, P=0.018) and 64.7% had shown better meshing appearance in PRP than non PRP treated areas. We didn't find a previous study comparing the of use PRP gel in enhancing the healing of meshed STSG with ordinary methods in the same patient of burn wound, but we found studies that evaluated the role of PRP on STSG for improving wound healing with different methods. To manage their wounds, 60 patients were hospitalized as inpatients by Thimmanahalli and colleagues [8]. Of these, 30 cases were randomly selected to receive autologous PRP for study, while the remaining 30 cases underwent conventional techniques as a control group. In addition to Dhua and colleagues, carried out a trial with 40 cases (20 in the PRP group and 20 in the control group) [14].

Both investigations discovered that, in contrast to conventional mechanical fixation techniques using sutures and staples, PRP in wound beds on graft take is effective regardless of the etiology. Previous research revealed a mean total healing time of 20.1±7.3 days for 13 complex soft-tissue defects that underwent application of STSG with the addition of PRP in patients deemed high risk due to their co-morbidities. This retrospective observational cohort study suggested that adding PRP to STSG recipient sites may shorten the healing period [7]. Additionally, research conducted on burn patients have shown that PRP's adhesive properties make it an efficient skin graft fixation method; the results are superior to using sutures, staples, or glue to secure skin grafts to wound edges or beds [9,15]. Our findings are corroborated by research on PRP treatment to recipient site wounds, which supports and encourages its use due to its advantageous influence on wound healing.

Table 1: Baseline characteristics of studied cases (n=20).

Variables	Mean ± SD	Range
Age/years	33.25±10.4	18-50
Basic platelet count in whole blood	326.5±77.38	200 -473
Serum PRP concentration/ml	627±149.27	378-826
Variables	**No.**	**%**
Gender: Male Female	 14 6	 70 30

Table 2: Comparison between PRP and non-PRP treated areas.

Variables	PRP-treated areas	Non-PRP treated areas	Wilcoxon signed test	P value
Percentage of take Mean ± SD Median (IQR)	 82.06±13.35 90 (77-90)	 73.89±18.35 80 (61-90)	1.93	0.05*
Time of healing/days Mean ± SD Median (IQR)	 11.647±4.09 10 (9-14)	 14.5±4.78 13 (11-20)	2.36	0.018*

(*) significant difference.

Table 3: Correlation of time of healing in treated areas and clinical data.

Variables	Time of healing in PRP treated areas		Time of healing in non-PRP treated areas	
	r	**P**	**r**	**P**
Age	-0.048	0.855	-0.095	0.709
Serum PRP conc.	-0.381	0.131	-	-

(r) Spearman correlation.

Figure 1: Bechman AllergaX12u series.

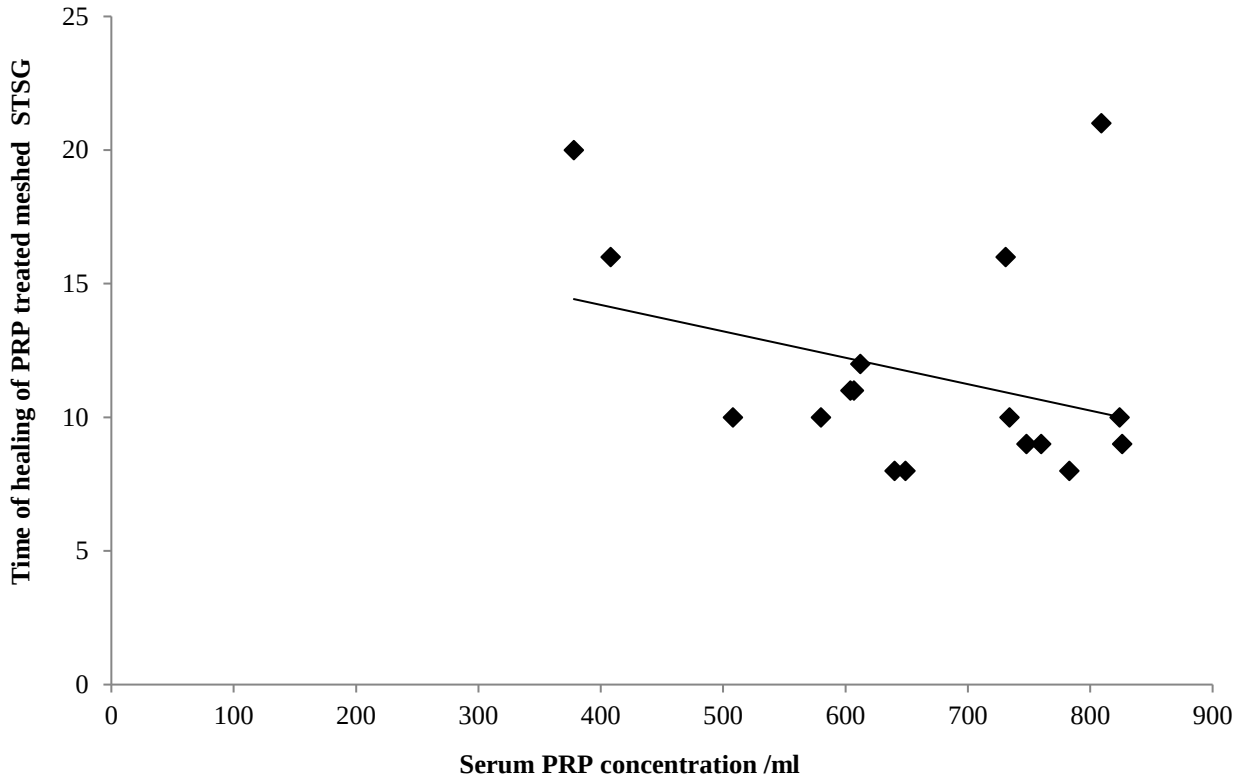

Figure 2: Correlation between serum PRP concentration/ml and time of healing

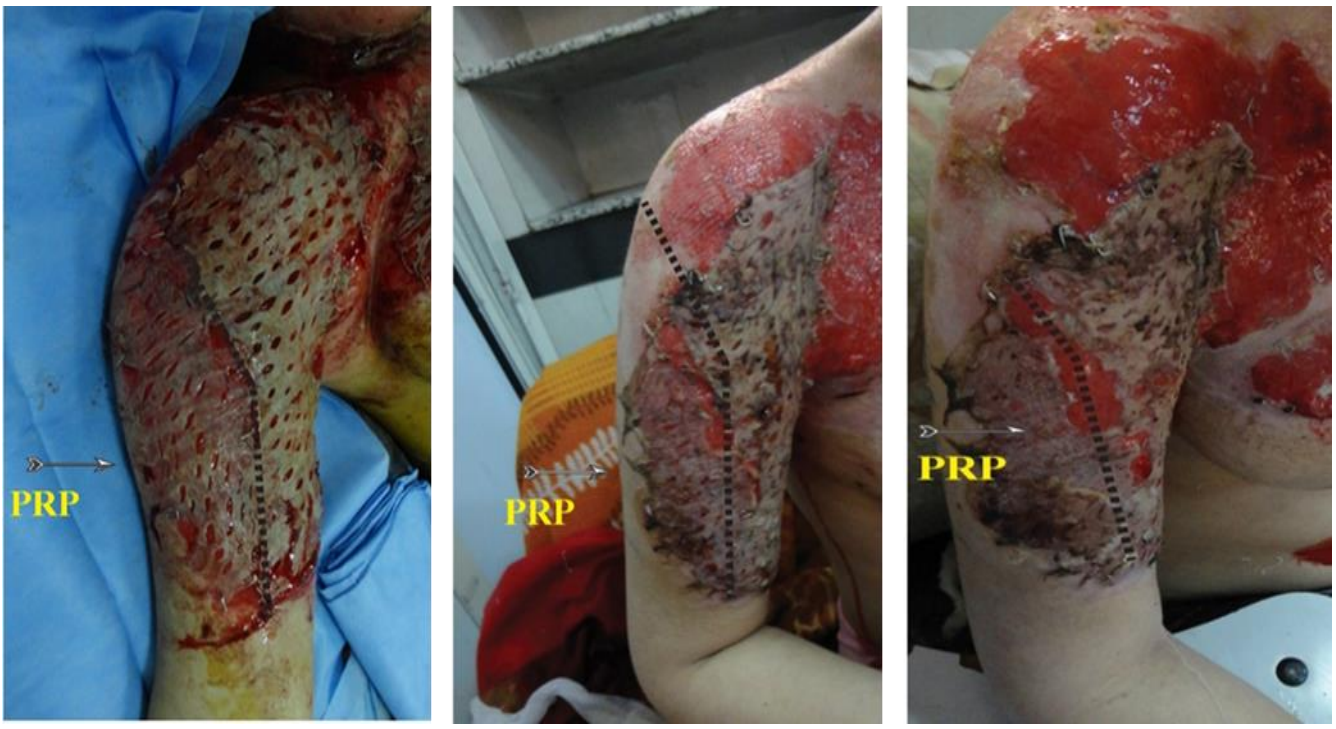

Figure 3: Photographs of PRP-treated meshed graft case at days 0,4,10 (from left to right).

Figure 4: Photographs of PRP-treated meshed graft case at days 0,4,8,11,45 (from left to right).

5. Conclusions

Using PRP gel on meshed STSG in burn wounds could increase graft take, reduce healing time, and improve mesh appearance.

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