ORIGINAL ARTICLE

Applied Effectiveness of Platelet Rich Plasma on Partial Thickness Facial Burn Healing in Comparison to Conventional facial burn care

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ABSTRACT

Keywords: Platelet-rich plasma, second-degree burn, facial burn, wound healing.

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Background: The standard treatment of partial-thickness facial burns has a slow healing time and unsatisfactory outcome. Applying platelet-derived growth factors to the burn wound has been shown to accelerate the healing process and prevent unsatisfactory outcomes. **Objective:** To evaluate clinical usefulness and wound healing progress after applying Platelet Rich Plasma (PRP) to second-degree facial burn patients. **Patients and Methods:** We included patients with second-degree recent facial burns not exceeding 20 % of TBSA. Patients were randomly allocated to receive topical PRP application (Group A), PRP intradermal injection (Group B), and conventional facial burn care (Control group).**Results:** We recruited 60 patients whose ages ranged from 19 to 37 years. The time needed for complete healing for groups A, B, and the control group was 8.7, 7, and 11 days, respectively. Group A and B showed the best satisfaction rate (90% and 80%, respectively). Group A showed less early complications, while group B showed a less rate of late complications. **Conclusion:** Platelet-rich plasma, topical or intradermal injection, is a safe and effective option for wound healing in second-degree facial burn patients.

Introduction

Facial burns, as a part of general burn trauma, are considered one of the most devastating injuries reflected on a patient's psychological condition. Variable etiologies can cause significant burns in Egypt in domestic and nondomestic life activities. It leads to high morbidity and mortality. (1) The incidence rate is considered high but, unfortunately, without documented statistics in the middle east region.

Partial-thickness facial burn wounds can be severely complicated if neglected, infected, or poorly managed **(2)**. The principle of the management regimen is to prevent infection, promote wound healing, and avoid unsightly scars. Some cases showed poor results were complicated by scarring with conventional wound care **(3)**. Researchers are still looking for alternative modalities to gain the best outcomes. Innovative stem cell treatment techniques and other modalities have been recently applied with promising variable outcomes **(4,5)**.

Moreover, the wound pathology, including inflammatory reaction, growth factors, and extracellular matrix modulation, is still to be investigated **(6).** Applying external blood platelet product to the burn wound allows the biochemical effect of its growth factors and

anti-inflammatory products. Additionally, platelets are known to participate in the host defense system that plays a role in preventing the infection **(7, 8).**

These results have increased the interest in PRP and led to its use clinically by different applications method **(5)**.

This study evaluates wound healing progress after applying PRP on second-degree facial burn patients through different techniques.

PATIENTS AND METHODS

Three groups were randomized in serial case patterns for received burn-injured patients in the Burn Unit, Plastic Surgery Department at Aswan university hospital, between February 2019 and April 2020. The research had been approved by the institutional review & Ethical committee board (IRB) of the Faculty of Medicine, Aswan University.

We included 60 patients whose ages ranged from 19 to 37 years with the second-degree recent facial burn. The burn body surface area does not exceed 20 % of TBSA. We excluded patients with Electric and chemical burns, poor general condition, uncontrolled systemic diseases, or pregnancy.

For all patients, history: onset, etiology, cause, associated injuries, received management, medical diseases & medications. The *examination* included the size of the surface area of the burn, depth, distribution, intraoral, ocular, and nasal examination, and excluding other symptoms and signs of inhalation injury.

The patients were randomly allocated to three equal groups to receive topical PRP application (Group A), PRP intradermal injection (Group B), and conventional facial burn care (Control group C).

The patients' data were collected in a pre-structured questionnaire.

Group A & B patients were managed with PRP that were processed following ***Shen et al.*** **(9,12)**; single centrifuge method. The ten cc of fresh blood was withdrawn from the same patient on a heparinized tube. Then the tube was immediately centrifuged with a single spinning technique for 15 minutes at 3,200 pm. This should separate into three layers of different densities; a deep layer of red blood cells, a middle layer containing white blood cells and platelets (buffy coat layer), and the top layer platelet-poor plasma layer. The separated acellular plasma and red cell layers were extracted and removed. Only the "buffy coat" layer, which contained dense platelet and white blood cells, was obtained. PRP becomes ready for use after adding calcium and thrombin to activate thrombocytes.

In Group A, PRP was just topically applied on the surface of facial burn after cleaning. A 5-7 cc PRP was collected in insulin syringes and applied directly to the patient facial burns. This application was repeated twice weekly for two weeks. In Group B, 5-7 cc of PRP was injected intradermal, with an insulin needle twice weekly for two weeks underneath the burned surface.

Control Group: are managed with conventional facial wound burn care. The open dressing was recommended with topical emollients **(2,8).** It included cleaning facial burns and applying emollient and wet gauze. This was repeated every 2 hours for the first 24 hours and every 6 hours for 48 hours.

The wound's clinical assessment included determining healing progress, rate and timing of stable epithelialization.

The ***Photography*** documented the wound condition at admission, every week for two weeks, then every two months for six months.

Follow up assessment:

The follow up included to record early and late complications. The early complication was reported within the first two weeks in the forms of delayed wound healing, persistent pain, infection, prolonged edema or erythema. The late complications up to 6 months included scar hypertrophy, dyschromic changes, or chronic persistent unstable ulceration.

Statistical Analysis:

Data were analyzed using SPSS version 24. Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency. Independent Student t-test and paired t-test were used to compare parametric quantitative variables. At the same time, Mann-Whitney tests and Wilcoxon matched-pairs tests were used to compare non-parametric quantitative variables. Chi-square test or McNemar-Bowker tests were used to analyze categorical variables. A p-value < 0.05 is considered statistically significant.

RESULTS

Most of the three groups had uneventful healing. Regarding the healing time till complete stable epithelialized wound, the Group B showed the shortest time of an average of 7 days (5-15 days), group A with an average of 8.7 days (8 – 17 days), while the control group needed 11 days (9-20 days). There was significant statistical difference in healing time between group A and B in comparison to control group C *(p-value= 0.02)*.

Group B showed 90% of patients' satisfaction on management course and outcome, and close to that, group A; 80%. This was compared significantly with Group C that had (60%) patients' satisfaction. This was mainly reflected from patient complaint of long healing time and dyschromic scars outcome. *(p-value= 0.032)*.

Regarding early complications **(Table 2)**, group A showed the least rate of early complications in the form of one case with subcutaneous pustular encrustations in comparison to one case in Group B. At the same time, the control group showed 8 cases with early infection (subcutaneous pustular vesicles) and relatively delayed healing time **(Figure 3-B)**. The late complications were the least in group B in form of two cases with dyschromic changes. The group A had four late complications with dyschromia, scar hypertrophy **(Figure 4)**, and erythema. On the other hand, the control group had 8 cases with late complications; four cases with dyschromic changes, 3 cases with hypertrophic scars, and one case with remained superficial ulceration. The **Figure 1**; A, B, & C shows serial photographs of a case in group A. The **figure 2; A, B, & C** shows serial photographs in group B. **The figure 3; A, B, C** in group C.

DISCUSSION

Management protocols with Platelet-rich plasma (PRP) are considered a new era of adjunct management in wound healing protocols. It is increasingly used to boost the treatment of soft and hard tissue defects to accelerate bone formation, especially in oral and maxillofacial reconstructive surgery, and manage chronic non-healing wounds **(10)**

Most studies that used PRP were limited to experimental studies and its effect on animal models (3,5). Recently, few available studies assessed the effectiveness of PRP in facial burn healing. They reported promising results of improved burn healing with PRP management. **(5,12).** This study conducted a randomized clinical trial to evaluate the clinical usefulness. Applying PRP to second-degree facial burn patients is a wound healing process either by topical application or injection.

This proved a significant difference between the studied groups regarding healing time *(p=0.02)* by about four days less in cases injected with PRP. Applying the PRP method in group (A) was relatively more manageable and less painful than the method in the group (B).

However, it took a relatively insignificantly longer time (average of two days) in group A than in B. Post-treatment outcome showed better results regarding the return of skin quality (i.e., skin texture and color) with significantly fewer complications in both groups A & B than control group C *(p=0.04)*. In agreement with our results, **Liu et al.** found that the healing time and rate of the healed area improved, with less frequency of dressing changes and less bacterial culture load in the burned area when compared with open conventional facial care *(P <0.001)* **(13)**

These outcomes have been explained by many theories and results in the literature. First, growth factors have been implicated in mediating the normal healing process and playing a role in impaired wound healing. Specific growth factors, such as platelet-derived endothelial cell growth factor (PDGF) and insulin-like growth factor-I (IGF-I), inhibit the apoptosis pathways necessary for the rapid turnover of cells required to facilitate the different stages of physiologic wound healing. The growth hormone (GH) wound healing effects appear to be directly and indirectly associated with IGF-1 expression. Studies reported that a glycoprotein nonsuppressible insulin-like activity (NSILA) exhibits insulin-like activity on fibroblasts in tissue and modulates the fibroblastic response in wound healing **(13,14,17,19).** Secondly, PRP contains a variety of growth factors and fibrin proteins in high concentration, which can effectively compensate for the low level of growth factors in wounds, speed up the initiation of repair mechanisms and provide a better micro-environment for wound repairing **(4,15,20).**

Third, PRP can reduce wound exudative swelling, stimulate blood vessel regeneration and reduce the pain of the wound **(18)**. Fourth, recent studies have also confirmed that the concentration and proportion of diverse growth factors in autologous PRP are similar to the physiological level in the body, which can ensure the better coordination of growth factors, the inflammation immune balance, and avoid the occurrence of immunological rejections **(18,19).** Fifth, PRP has a good effect on increasing collagen deposition and early wound strength, accelerating wound soft tissue repair, wound epidermalization growth, and decreasing late complications such as dyschromia and hypertrophy **(10,13)**

Although this study had many limitations, it proved that PRP could be a secure treatment armamentarium tool in facial burn management to preserve cosmetics and regain their texture relatively quickly. This also accompanies fewer adverse effects like infection or hypersensitivity reactions .this comes in agreement with many trials and experimental studies **(13-16).** These limitations can be concluded in a small sample size with unavailable multicentre regional support and sometimes patient refusal to participate in the new study. These can be overcome in the future with rigorous design, a large sample size, histopathological examination, and a long follow-up period assessment.

CONCLUSION

Among patients with second-degree facial burn, Platelet-rich plasma (PRP), either by topical application or intradermal injection, showed a safe and effective practice that can accelerate the healing process and provide good outcomes with minor complications. Intradermal injection added painful experience to some patients, although it ensured PRP delivery to the subdermal areas compared with only its topical application. Infection prevention with good hygiene is paramount beside physician instructions to avoid disruption of epithelialization, dyschromia, or skin scar hypertrophy.

Conflict of Interest: The authors declare no conflict of interest.

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Table 1: *The demographic of patients and the burn characteristics.*

Variables	Control Group (N =20)	Group A (N =20)	Group B (N =20)	P-value
Age in years				
- **Mean ±SD**	26.5 ±5.3	25.3 ±4.8	25.2 ±4.7	0.65
- **Median (range)**	26.5 (19 - 37)	24.5 (19 - 37)	24.5 (19 - 35)	
Gender, No. (%)				
- **Male**	10 (50%)	9 (45%)	12 (60%)	0.62
- **Female**	10 (50%)	11 (55%)	8 (40%)	
Etiology				
- **Flamed**	9 (45%)	9 (45%)	13 (65%)	0.34
- **Scaled**	11 (55%)	11 (55%)	7 (35%)	
Affected areas (%)				0.86
- **5.00%**	1 (5%)	2 (10%)	1 (5%)	
- **6.00%**	1 (5%)	0	1 (5%)	
- **7.00%**	0	2 (10%)	2 (10%)	
- **9.00%**	5 (25%)	3 (15%)	3 (15%)	
- **10.00%**	5 (25%)	5 (25%)	5 (25%)	
- **12.00%**	4 (20%)	4 (20%)	2 (10%)	
- **15.00%**	3 (15%)	3 (15%)	3 (15%)	
- **20.00%**	1 (5%)	1 (5%)	3 (15%)	

*Data are presented as mean ±SD, median (Range), or number (%)

Table 2: *The efficacy endpoints and complications' incidence at early and late stages of management period.*

Variables	Control Group (N =20)	Group A (N =20)	Group B (N =20)	*P-value*
Time to heal in days				
- **Mean ±SD**	11.8 ±3.2	8.9 ±3.4	7.8 ±4.5	0.02
- **Median (range)**	11 (9- 20)	8.5(8 - 17)	7 (5 - 15)	
Satisfaction, No. (%)				
- **Satisfied**	12 (60%)	16 (80%)	18 (90%)	0.032
- **Not**	8 (40%)	4 (20%)	2 (10%)	
Early Complications				
- **No**	12 (54.3%)	19 (95%)	18 (90%)	0.022
- **Infection**	7 (40%)	1 (5%)	2 (10%)	
Erythema	1 (5.7%)	0	0	
Late complications, No. (%)				
- **No**	12 (60%)	16 (80%)	18 (90%)	
- **Hypertrophic scar**	3 (10%)	1 (5%)	1 (5%)	0.04
- **Pigmentation**	5 (30%)	3 (15%)	1 (5%)	

Data are presented as mean ±SD, Median (Range), and number (%)

Cases presentation

Case 1

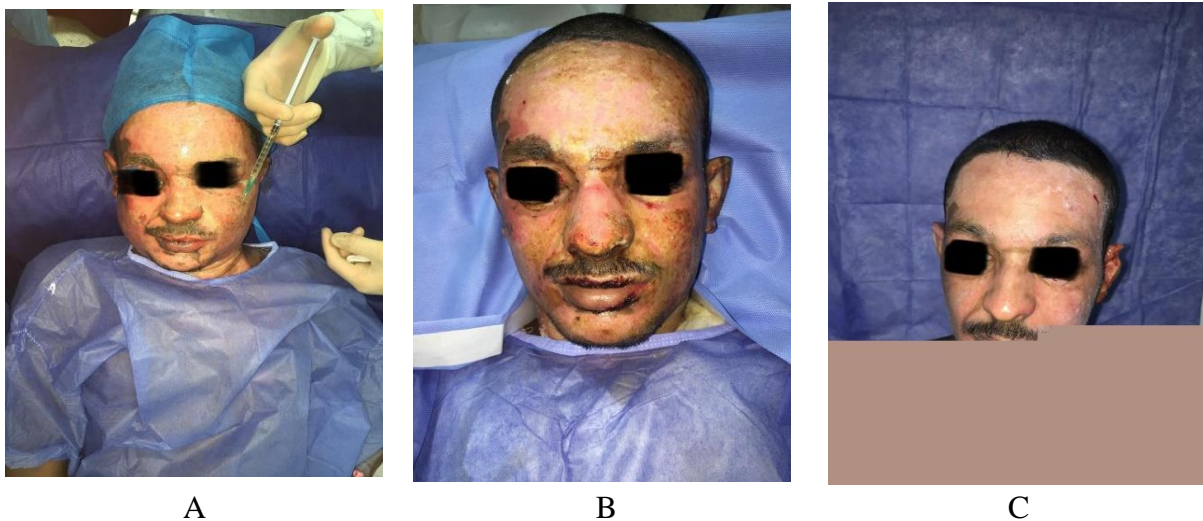| A | B | C |
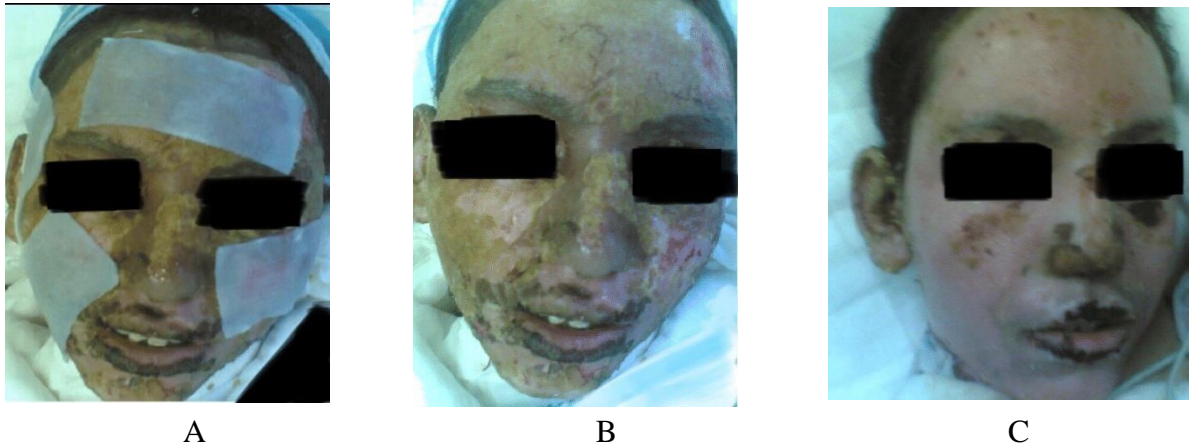
Figure (2): Female patient 30 years old with flame second-degree facial burns **[Group A]**
(A) on admission, Fig. (B) One-week post-burn. (C) Two weeks post-burn.
The lady received only topical wound care with twice-weekly PRP application on the skin. Note the improved outcome and total healing after 11 days in picture C.

Case 2

| A | B | C |

Figure (3): Male patient 33 years old, flame second-degree facial burn **[Group B]**
(A) on admission, (B) Week 1 post-burn, (C) Week 2 post-burn. The male patient showed rapid healing with accepted skin quality time in a short period after nine days of management course with PRP injection. He had regained his social activities shortly after the incident.

Case 3

| A | B | C |

Figure (3): Female patient 24 years old with flame second-degree facial burns **[Group C]**
(A) on admission, (B) Week 1 post-burn, (C) Week 2 post-burn.

This lady showed poor healing power 9as shown in the submental burn region) with longer edema and epithelialization time than patients in groups A &B (extended to 15 days).

Figure (4): An adult male 27 year-old was managed with conventional skin care (Group C) showed active facial scar hypertrophy following relatively prolonged facial wound healing. The photo is after 6 weeks.