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Original Research Article

Clinical Evaluation of Topical Platelet-Rich Plasma (PRP) in Enhancing Split-Thickness Skin Graft Survival and Reducing Graft-Related Complications: An Observational Study

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Abstract

Background: Split-thickness skin grafting (STSG) is one of the most commonly performed reconstructive procedures for the management of traumatic wounds, burns, chronic ulcers, and post-excisional soft tissue defects. Despite its widespread use, graft failure due to hematoma, seroma, infection, or inadequate vascularization remains an important clinical challenge. Platelet-rich plasma (PRP), an autologous concentrate of platelets containing multiple growth factors, has emerged as a promising biological adjunct to improve graft adherence and wound healing. Recent studies suggest PRP may improve graft healing and reduce complications, although further clinical evidence is needed.

Objectives: To evaluate the effectiveness of topical PRP in improving split-thickness skin graft survival and reducing graft-related complications.

Materials and Methods: A prospective observational study was conducted in the Department of Plastic Surgery of a tertiary care teaching hospital, PMCH, Patna. Fifty consecutive patients requiring split-thickness skin grafting were included. Autologous PRP was prepared using a standardized double-spin centrifugation technique and applied over the recipient wound bed immediately before graft placement. Patients were followed for four weeks. Primary outcome was percentage graft uptake. Secondary outcomes included postoperative infection, hematoma, seroma, graft loss, duration of wound healing, and hospital stay.

Results: The mean age of the patients was 41.8 ±13.2 years. The mean graft uptake at postoperative Day 14 was 95.2 ±5.4%, with complete graft uptake (>95%) achieved in 42 (84%) patients. At Day 28 follow-up, satisfactory graft survival was maintained, with no additional graft loss or late graft failure observed**.** Partial graft loss occurred in 6 (12%) patients, while complete graft failure was observed in 2 (4%). Infection developed in 8%, hematoma in 6%, and seroma in 4% of patients. No PRP-related adverse events were recorded.

Conclusion: Topical PRP appears to be a safe and effective adjunct in split-thickness skin grafting. It promotes excellent graft uptake, accelerates wound healing, and reduces graft-related complications. Larger controlled studies are required to validate these findings and establish standardized protocols for PRP use.

Keywords: Platelet-Rich Plasma, Split-Thickness Skin Graft, Graft Survival, Wound Healing, Plastic Surgery, Chronic Wounds.

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Introduction

Split-thickness skin grafting (STSG) is one of the most commonly performed reconstructive procedures for the management of traumatic wounds, burn injuries, chronic ulcers, diabetic foot ulcers, and post-excisional soft tissue defects. Successful graft healing depends on rapid adherence of the graft to the recipient wound bed, early revascularization, and the absence of complications such as hematoma, seroma, infection, and graft necrosis. Despite advances in surgical techniques, partial or complete graft failure remains a significant challenge in reconstructive surgery [1,2]. Skin graft survival occurs through the sequential phases of plasmatic imbibition,

inosculation, and angiogenesis. Several local and systemic factors, including poor wound bed vascularity, bacterial contamination, diabetes mellitus, peripheral vascular disease, malnutrition, smoking, and excessive wound movement, may adversely affect these processes and result in graft failure. Such complications increase patient morbidity, prolong hospital stay, and often necessitate additional surgical procedures [2–4].

Platelet-rich plasma (PRP) is an autologous platelet concentrate prepared from the patient's own blood by centrifugation. It contains a high concentration of platelets that release several biologically active growth factors, including platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), transforming growth factor-beta (TGF-β), epidermal growth factor (EGF), fibroblast growth factor (FGF), and insulin-like growth factor (IGF).

These growth factors stimulate angiogenesis, fibroblast proliferation, collagen synthesis, epithelialization, and extracellular matrix formation, thereby accelerating tissue repair and wound healing [5,6].

In recent years, PRP has emerged as an attractive biological adjunct in reconstructive surgery because it is autologous, inexpensive, easy to prepare, and associated with minimal adverse effects. When applied over the recipient wound bed before graft placement, PRP acts as a biological adhesive that enhances graft fixation, reduces dead space, minimizes hematoma formation, and promotes early neovascularization, thereby improving graft survival [6,7].

Recent Indian studies have reported encouraging outcomes with topical PRP during split-thickness skin grafting. Chigurupati et al. demonstrated that PRP significantly improved graft uptake, reduced hematoma and seroma formation, accelerated donor-site healing, decreased postoperative pain, and shortened hospital stay compared with conventional graft fixation [8]. Similarly, Divyang et al. reported significantly better immediate graft adhesion, higher graft uptake, and fewer postoperative complications in patients treated with topical PRP than with conventional methods [9]. Another prospective observational study from a tertiary care centre in Maharashtra also showed improved graft survival and reduced graft-related complications with topical PRP application [10].

Although the available evidence is promising, prospective observational data from Indian tertiary care hospitals remain limited. Variations in patient characteristics, wound etiology, PRP preparation techniques, and outcome assessment also make it difficult to establish standardized recommendations [8–10].

Therefore, the present study was undertaken to evaluate the clinical effectiveness of topical platelet-rich plasma in enhancing split-thickness skin graft survival and reducing graft-related complications. The study also assessed graft uptake, wound healing, postoperative infection, hematoma, seroma, graft loss, and duration of hospital stay.

Materials and Methods

Study Design and Setting: This prospective observational study was conducted in the Department of Plastic and Reconstructive Surgery at PMCH, Patna after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 12 months from July 2025 to June 2026. Written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the principles of the Declaration of Helsinki [11,12].

Study Population: Adult patients requiring split-thickness skin grafting (STSG) for reconstruction of skin and soft tissue defects were screened for eligibility. Patients with traumatic wounds, post-burn raw areas, chronic non-healing ulcers, diabetic foot ulcers, post-infective defects, and post-excisional soft tissue defects were included in the study.

Sample Size: A total of 50 consecutive eligible patients were included using a convenient sampling technique during the study period. All patients fulfilling the inclusion criteria and providing written informed consent were enrolled.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients requiring split-thickness skin grafting for wound coverage.
- Healthy recipient wound bed with adequate vascularity.
- Patients willing to provide written informed consent and comply with follow-up.

Exclusion Criteria

- Age below 18 years.
- Active wound infection not adequately controlled before grafting.
- Severe peripheral vascular disease.
- Platelet disorders or coagulopathy.
- Current anticoagulant therapy that could not be discontinued.
- Hemoglobin <8 g/dL.
- Platelet count <100,000/mm³.
- Malignancy at the recipient site.
- Pregnancy or lactation.
- Patients unwilling to participate or lost to follow-up.

Preparation of Platelet-Rich Plasma: Immediately before surgery, 20–30 mL of autologous venous blood was collected under aseptic precautions into anticoagulant-containing tubes. PRP was prepared using the double-spin centrifugation technique. The first centrifugation (soft spin) separated plasma from red blood cells, followed by a second centrifugation (hard spin) to concentrate platelets. The platelet-rich fraction was collected under sterile conditions and activated immediately before application using calcium gluconate according to the institutional protocol [5,8,9].

Surgical Procedure: All procedures were performed under appropriate anaesthesia according to the site and extent of the wound. After meticulous wound bed preparation and adequate haemostasis, topical PRP was evenly applied over the entire recipient wound bed. A split-thickness skin graft of appropriate thickness was harvested from the selected donor site using a Humby's knife. The harvested graft was then placed over the PRP-treated recipient bed and carefully spread to avoid folds or wrinkles. The graft was secured using skin staples or interrupted sutures, as required, followed by application of a non-adherent and compressive dressing. Standard postoperative care was provided to all patients.

Postoperative Follow-up: Patients were evaluated on postoperative Day 4, Day 7, Day 9, Day 14, and Day 28. At each follow-up, the graft was clinically assessed for adherence, viability, percentage of graft uptake, infection, hematoma, seroma, partial graft loss, and complete graft failure. Overall wound healing and the requirement for any additional intervention were also recorded.

Outcome Measures

Primary Outcome

- Percentage of graft uptake on postoperative Day 14.

Secondary Outcomes

- Complete graft survival.
- Partial graft loss.
- Complete graft failure.
- Postoperative wound infection.
- Hematoma formation.
- Seroma formation.
- Duration of wound healing.
- Duration of hospital stay.
- Requirement for regrafting or additional intervention.

Définitions

- Complete graft uptake: >95% viable graft.
- Partial graft uptake: 50–95% viable graft.
- Complete graft failure: <50% viable graft requiring further intervention [8,10].

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ±standard deviation (SD), while categorical variables were presented as frequency and percentage. The independent Student's t-test was used for continuous variables where applicable, and the Chi-square test or Fisher's exact test was used for categorical variables. A p-value <0.05 was considered statistically significant (13).

Ethical Considerations: Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from every participant. Patient confidentiality was maintained throughout the study, and participation was entirely voluntary. All procedures followed the ethical principles of biomedical research involving human participants [11,12].

Results

A total of 50 patients who underwent split-thickness skin grafting (STSG) with topical platelet-rich plasma (PRP) application were included in the study. All patients completed the scheduled follow-up of four weeks.

The mean age of the study participants was 41.8 ± 13.2 years (range: 18–68 years). The majority of patients were males (34, 68.0%), while females accounted for 16 (32.0%). Traumatic wounds were the most common indication for skin grafting (44.0%), followed by chronic non-healing ulcers (24.0%), post-burn raw areas (18.0%), diabetic foot ulcers (10.0%), and post-excisional defects (4.0%) (Table 1).

The mean recipient wound size was 63.4 ±24.7 cm^2. The lower limb was the most frequently grafted site (56.0%), followed by the upper limb (24.0%), trunk (12.0%), and head and neck (8.0%).

At postoperative Day 14, the mean graft uptake was 95.2 ±5.4%. Complete graft uptake (>95%) was achieved in 42 (84.0%) patients, partial graft uptake (50–95%) in 6 (12.0%), while complete graft failure was observed in 2 (4.0%)patients.

On Day 28 follow-up, the grafts were reassessed and the satisfactory graft uptake observed at Day 14 was maintained, with no additional graft loss or late graft failure noted. (Table 2).

Postoperative complications were uncommon. Wound infection occurred in 4 (8.0%) patients, hematoma in 3 (6.0%), seroma in 2 (4.0%), and partial graft necrosis in 4 (8.0%) patients. No allergic reaction or PRP-related adverse event was observed during the study period (Table 3). The

mean duration of complete wound healing was 18.6 ±3.8 days, while the average duration of hospital stay was 8.4 ±2.1 days. Only 2 (4.0%) patients required regrafting because of complete graft failure. Overall, topical PRP demonstrated excellent graft adherence and satisfactory wound healing with a low incidence of postoperative complications. All tables and figure are mentioned.

Table 1: Baseline demographic and clinical characteristics of the study population (n = 50)

Variable	Number (%)
Age (years), Mean ± SD	**41.8 ± 13.2**
Male	34 (68.0)
Female	16 (32.0)
Traumatic wound	22 (44.0)
Chronic ulcer	12 (24.0)
Burn wound	9 (18.0)
Diabetic foot ulcer	5 (10.0)
Post-excisional defect	2 (4.0)
Wound size (cm^2), Mean ± SD	63.4 ± 24.7

Table 2: Skin graft outcome after topical PRP application

Outcome	Number (%)
Complete graft uptake (>95%)	42 (84.0)
Partial graft uptake (50–95%)	6 (12.0)
Complete graft failure	2 (4.0)
Mean graft uptake (%)	95.2 ± 5.4

Table 3: Postoperative graft-related complications

Complication	Number (%)
Infection	4 (8.0)
Hematoma	3 (6.0)
Seroma	2 (4.0)
Partial graft necrosis	4 (8.0)
Complete graft failure	2 (4.0)
PRP-related adverse event	0 (0.0)

Table 4: Clinical outcome measures

Variable	Mean ± SD
Graft uptake (%)	95.2 ± 5.4
Wound healing time (days)	18.6 ± 3.8
Hospital stay (days)	8.4 ± 2.1

Table 5: Graft uptake according to wound etiology

Wound etiology	Number of patients (n=50)	Mean graft uptake (%)
Traumatic wounds	22	96.5 ± 3.8
Chronic non-healing ulcers	12	94.1 ± 5.7
Burn wounds	9	95.0 ± 4.9
Diabetic foot ulcers	5	91.8 ± 6.5
Post-excisional defects	2	97.2 ± 2.4

Table 6: Clinical outcome following topical PRP application

Clinical outcome	Number (%)
Complete graft uptake (>95%)	42 (84.0)
Partial graft uptake	6 (12.0)
Complete graft failure	2 (4.0)
Regrafting required	2 (4.0)
Uneventful wound healing	44 (88.0)
Overall successful outcome	48 (96.0)

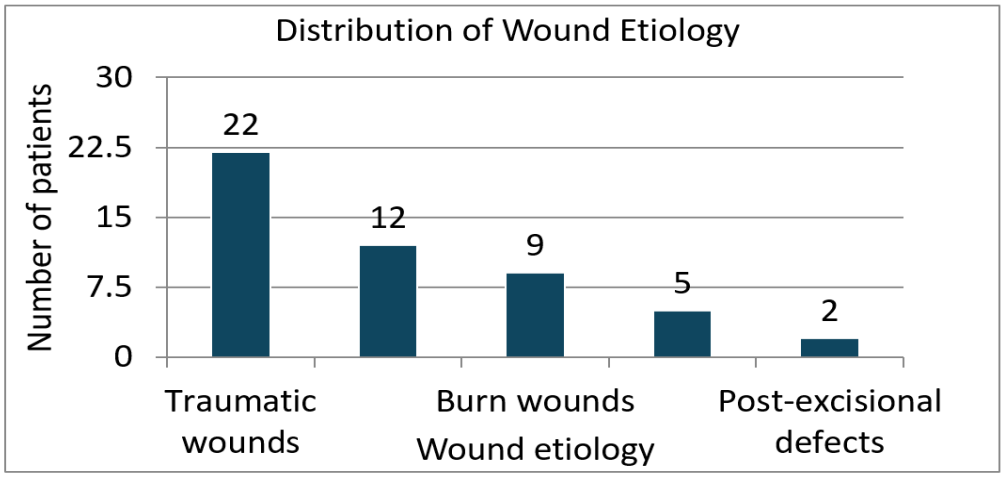

Figure 1: Distribution of Wound Etiology among the Study Participants

Distribution of wound etiology among patients undergoing split-thickness skin grafting with topical platelet-rich plasma (PRP). Traumatic wounds constituted the most common indication for skin grafting.

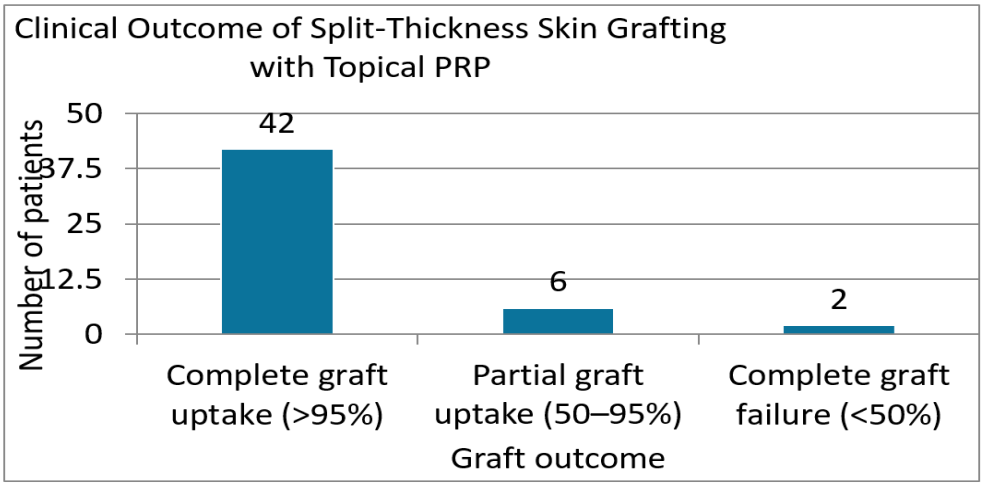

Figure 2: Clinical Outcome of Split-Thickness Skin Grafting Following Topical PRP Application

Clinical outcome of split-thickness skin grafting following topical PRP application. Complete graft uptake (>95%) was observed in 42 (84%) patients, partial graft uptake in 6 (12%), and complete graft failure in 2 (4%) patients.

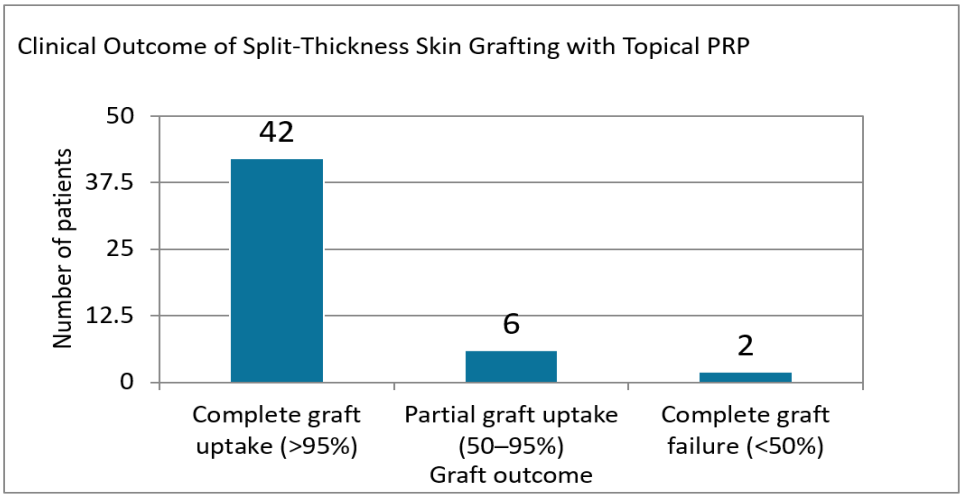

Figure 3: Postoperative Graft-Related Complications Following Topical PRP Application

Distribution of postoperative graft-related complications following topical PRP application. Infection and partial graft necrosis were observed in 8% each, hematoma in 6%, seroma in 4%, and complete graft failure in 4% of patients.

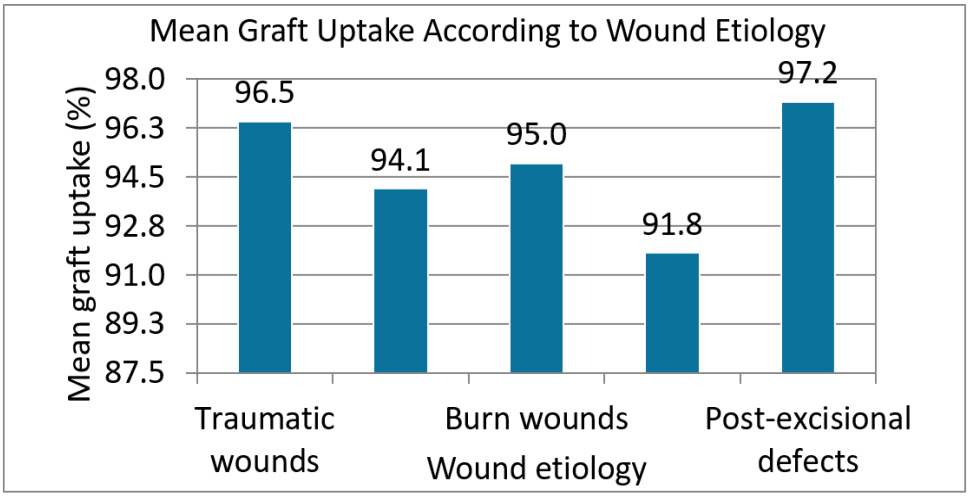

Figure 4: Mean Graft Uptake According to Wound Etiology

Mean percentage of graft uptake according to wound etiology. Graft uptake remained high across different wound types, ranging from 91.8% in diabetic foot ulcers to 97.2% in post-excisional defects.

Discussion

Split-thickness skin grafting (STSG) remains one of the most reliable techniques for the reconstruction of skin and soft tissue defects. However, successful graft healing depends on rapid graft adherence, early neovascularization, and prevention of complications such as hematoma, seroma, infection, and graft necrosis. Platelet-rich plasma (PRP), because of its high concentration of growth factors, has emerged as a promising biological adjunct for improving graft survival and wound healing [5,6].

In the present study, the mean age of the patients was 41.8 ±13.2 years, and most participants were males (68%). Similar demographic findings have been reported by Chigurupati et al. (2024), who observed that traumatic wounds requiring skin grafting were more common among middle-aged male patients because of their greater occupational exposure to injuries [8]. Comparable findings were also reported by Divyang et al. (2025) in a prospective comparative study from India [9].

Traumatic wounds were the most common indication for skin grafting in the present study (44%), followed by chronic non-healing ulcers and burn wounds. Similar patterns have been reported in previous Indian studies, where trauma and chronic ulcers accounted for the majority of cases requiring STSG [8–10]. This reflects the increasing burden of road traffic accidents, diabetic wounds, and chronic ulcers requiring reconstructive procedures in developing countries. The principal finding of the present study was the excellent graft uptake achieved following topical PRP application. The mean graft uptake was 95.2 ±5.4%, and complete graft survival was observed in 84% of patients. These findings are consistent with those of Chigurupati et al., who demonstrated significantly improved graft uptake and faster graft adherence following topical PRP application compared with conventional fixation methods [8]. Similarly, Divyang et al.reported superior graft fixation, higher graft uptake, and improved early wound healing in patients treated with topical PRP [9]. An observational study conducted in Maharashtra also demonstrated excellent graft survival and enhanced epithelialization following PRP application during split-thickness skin grafting (10).

The beneficial effect of PRP can be explained by the release of several growth factors, including platelet-derived growth factor, vascular endothelial growth factor, transforming growth factor-beta, epidermal growth factor, and fibroblast growth factor. These biologically active mediators stimulate angiogenesis, fibroblast proliferation, collagen synthesis, and epithelial regeneration, thereby accelerating wound healing and improving graft integration [5–7].

Postoperative complications were infrequent in the present study. Infection was observed in 8% of patients, hematoma in 6%, and seroma in 4%. Only two patients experienced complete graft failure. Similar reductions in postoperative complications have been reported by several investigators. Chigurupati et al. observed significantly lower rates of hematoma, seroma, and graft displacement in the PRP group than with conventional graft fixation [8]. Likewise, Divyang et al. reported fewer

postoperative infections and improved graft stability following topical PRP application [9]. These observations support the role of PRP as a biological adhesive that minimizes dead space beneath the graft, thereby reducing fluid collection and improving graft adherence.

The average wound healing time in the present study was 18.6 ±3.8 days, with a mean hospital stay of 8.4 ±2.1 days. Faster wound healing associated with PRP has also been reported by Marck et al. and Piccolo et al., who demonstrated accelerated epithelialization and earlier graft maturation following PRP application [14,15].

Earlier wound healing may reduce hospital stay, improve patient comfort, and decrease healthcare costs.

No PRP-related adverse reactions were observed in this study. Similar findings have been consistently reported in the literature because PRP is an autologous biological product prepared from the patient's own blood, making immunological reactions and disease transmission extremely uncommon [5,8,15]. This favorable safety profile further supports its routine clinical application.

Overall, the findings of the present study are consistent with both Indian and international literature demonstrating that topical PRP enhances split-thickness skin graft survival while reducing postoperative complications. The simplicity of preparation, low cost, autologous nature, and excellent safety profile make PRP an attractive adjunct in reconstructive surgery. Nevertheless, differences in PRP preparation protocols, platelet concentration, activation methods, and outcome assessment among published studies continue to limit direct comparison of results. Therefore, larger multicentric randomized controlled trials with standardized PRP preparation techniques and longer follow-up are recommended to establish definitive clinical guidelines [8–10,14,15].

Limitations of the Study

- Single-centre study with a relatively small sample size.
- Lack of a control group for direct comparison.
- Short follow-up period limited assessment of long-term graft quality and scar outcomes.
- Variability in wound etiology may have influenced healing outcomes.
- Platelet concentration in PRP was not quantitatively measured before application.

Conclusion

Topical platelet-rich plasma is a safe, simple, and effective biological adjunct in split-thickness skin grafting. It was associated with excellent graft uptake, satisfactory wound healing, and a low incidence of graft-related complications in the present study. Routine use of PRP during STSG may improve clinical outcomes and reduce postoperative morbidity. However, larger randomized controlled studies with longer follow-up are required to confirm these findings and establish standardized treatment protocols.

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