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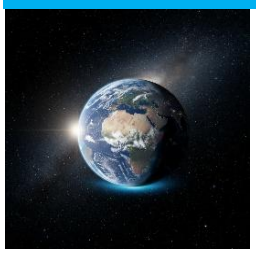

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**Short Article**

# The Use of Platelet-Rich Fibrin in the Treatment of Burn Wounds: A Literature Review

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**Abstract**

**Background.** Platelet-rich fibrin (PRF) is an autologous fibrin-based biomaterial prepared from the patient's blood by centrifugation. After tissue injury, such as a burn, platelets become activated and accumulate within the wound site, where they release chemokines, cytokines, and growth factors that are essential for regulating and supporting the wound healing process [1].

**Aim.** In this literature review, we summarize the available evidence regarding the use of PRF in burn wound management.

**Materials and methods.** A literature search was conducted in PubMed and Google Scholar using combinations of the keywords "platelet-rich fibrin" and "burn wounds". English-language meta-analyses, systematic reviews, clinical trials, original studies, case series, and case reports were screened without date restrictions, and studies reporting human data on PRF

use in burn wound healing were included. Reference lists of eligible articles were also manually reviewed.

**Results.** The available literature suggests that platelet-rich fibrin may influence burn wound healing, indicating its potential as a beneficial adjunct in burn wound management.

**Conclusions.** PRF is a promising adjunct in burn wound management. However, further well-designed studies are required to establish standardized protocols and confirm efficacy.

Keywords: platelet-rich fibrin, burn wounds

## 1. Introduction

Platelets serve as a key store of growth factors and are essential in numerous physiological processes, including coagulation, angiogenesis, immune response, and tissue regeneration [2]. Platelet concentrates are generally categorized according to their fibrin content into platelet-rich plasma (PRP) and platelet-rich fibrin (PRF), with further subdivision based on their leukocyte composition [2]. PRF is a second-generation platelet concentrate that has attracted growing interest in recent years for its application in regenerative procedures [3]. PRF is an autologous, fibrin-based biomaterial obtained from the patient's blood through centrifugation [1]. Following tissue injury, such as a burn, thrombocytes become activated and accumulate within the wound site. They release chemokines, cytokines, and growth factors. These factors play a key role in regulating and promoting the wound healing process [1]. Burns may result from a variety of causes, including exposure to flames, hot liquids, chemicals, electric sources, and radiation [4]. They may cause death or permanent disability, severely affecting patients' quality of life [4]. All burn injuries are caused by energy transfer to tissues, however the resulting physiological and pathophysiological responses can depend on the cause [4]. Burn injuries may be classified according to several criteria, including depth, etiology, and the percentage of total body surface area involved. The combination of these factors defines the degree of the burn injury [5]. In this literature review, we aim to summarize the current evidence on the use of PRF in the treatment of burn wounds.

## 2. Research materials and methods

This literature review was performed in PubMed and Google Scholar electronic databases using combinations of the keywords “platelet-rich fibrin” and “burn wounds”. Multiple categories of articles were considered, including meta-analyses, systematic reviews, original studies, clinical trials, case series and case reports published in English, without restrictions on publication date. Studies were eligible for inclusion if they reported human data on the use of PRF therapy in burn wound healing. Moreover, a manual search of the reference lists of all included studies was performed to identify further relevant literature.

## 3. Research results

Several studies have provided data on the use of PRF in burn wound healing. In a single - center prospective observational trial Schulz et al. reported data on 10 patients with partial-thickness to deep dermal burn wounds that were enzymatically debrided and then treated with PRF. Treatment areas included the face and head (three cases), hands (five cases) and upper extremity (two cases). No signs of infection were noted during healing in any patient. Nevertheless, differences in wound regimens affected both the course and duration of healing across the ten patients. Following PRF application, seven wounds were covered with Suprathel® dressing and healed without complications. The mean healing time in these seven cases was 18 days (range: 9–21 days), with two facial burns resolving more quickly (9 and 17 days) compared to the upper extremity wounds. The authors reported that all patients received treatment following a standardized protocol (however two wounds underwent debridement on the second day after admission, and final treatment was postponed in three cases due to management of comorbidities, while the wound beds were kept moist with Prontosan®). All cases demonstrated favorable long-term functional and aesthetic outcomes [1]. Skin grafting was required in two early treatment cases: in one, the dressing was removed prematurely, and in the other, the period allowed for spontaneous wound healing was insufficient. The authors concluded that PRF may be beneficial in reducing the healing time of partial-thickness to deep dermal burns after enzymatic debridement and may lead to better scar outcomes [1].

Waldner et al. reported a retrospective case study of patients with deep partial-thickness burns treated with enzymatic debridement and autologous cell therapy combined with PRF or fibrin glue (BroKerF). BroKerF was used to up to 15% total body surface area (TBSA), while more extensive burns were combined with surgical excision and skin grafting. 20 patients with burns covering a mean of 16.8% ± 10.3% TBSA and a mean Abbreviated Burn Severity Score of 5.45 ± 1.8 were included. 13 patients (65%) received PRF, while 7 (35%) were treated with fibrin glue. The mean TBSA treated with BroKerF

was 7.5% ± 0.05%. Mean time to complete epithelialization was 21.06 ± 9.2 days. 7 patients (35%) required secondary split-thickness skin grafting (of whom 3 (43%) had biopsy-confirmed wound infections). No significant difference in time to complete epithelialization was reported between PRF (17.8 ± 8.4 days) and fibrin glue (23.1 ± 7.9 days) in patients without secondary grafting (P = 0.12). Complete healing time of BroKerF-treated areas did not differ significantly between BroKerF alone (19.7 ± 7.3 days) and patients who underwent surgical excision and STSG in other areas of the body (19.7 ± 9.62 days; P = 0.73). The authors suggested that BroKerF represents an innovative approach to burn treatment, and is likely to demonstrate its efficacy once higher standardization is achieved [6].

In 2019 Andreone et al. reported a retrospective study on the use of dermis micrografts in PRF for the resurfacing of massive and chronic full-thickness burns. Five patients, including two with extensive burns and three with chronic burn wounds, were treated. The autologous micrografts were combined with PRF and applied to the wound bed using a Spraypen. before application, the wound site was covered with an Integra® dermal template, and a layer of antimicrobial dressing was placed over the silicone layer. The wounds were assessed as ready for grafting once the silicone layer began to separate. Rapid and complete skin graft was reported in all cases, on average after 7–10 days by PRF/micrograft spray-on treatment. Notably, the two patients with extensive burns exhibited rapid reepithelialization, while the three patients with chronic burn wounds - including two with previous graft failures - achieved complete wound healing within a week. The authors suggest that these findings indicate that PRF/micrograft spray-on therapy may be a promising strategy for treating both burns and chronic burn wounds [7].

In a randomized, placebo-controlled, triple-blind study Vaheb et al. evaluated the effect of PRF on patients with burn wounds requiring split-thickness skin grafting during treatment of donor wounds. The donor site was randomly assigned to two groups: PRF and control (Vaseline petrolatum gauze). In the PRF group, the wound was treated with PRF gel and covered with Vaseline gauze and a wet dressing, whereas the control group received only Vaseline gauze and a wet dressing. Outcomes were assessed on days 8 and 15 using paired t-tests and Wilcoxon signed rank-sum tests, as appropriate. The mean healing time was 11.80 ± 3.51 days in the PRF group versus 16.30 ± 4.32 days in the control group (P < .001). The PRF group demonstrated significantly higher wound healing rates at both time points (P < .001). Additionally, assessments by two specialists showed higher mean wound healing for all wound healing indices in the PRF group on days 8 and 15 (P < .001). Pain levels were also significantly lower in the PRF group at both evaluations (P < .001). These findings indicate that PRF significantly accelerates donor site healing and reduces pain compared with conventional treatment [8].

In a study by Naef et al., 13 patients with deep partial-thickness burns (DPTBs) or mixed-pattern burns (MPBs) received combined topical stromal vascular fraction (SVF) and PRF treatment. The mean TBSA

burned was 29.6%, and 6.3% of this area was managed using SVF and PRF. Additional surgical intervention was required in five patients to address residual defects. Complete healing was achieved within 20 days in patients without residual defects, and in cases with residual defects within 51 days. Patients requiring further surgery also exhibited higher Manchester Scar Scale scores. The authors reported no adverse events. The authors concluded that topical application of SVF and PRF represents a potentially less-invasive option for the treatment of MPB and DPTB. However, the authors suggest that because of frequent occurrence of residual defects and regulatory concerns associated with SVF, this approach cannot yet be considered a standard therapy [9].

An original research article by Yang et al. explored the clinical effect of PRF in combination with narrow-band ultraviolet B treatment in patients with small area deep burn wounds. 86 patients with small-area deep burn wounds were assigned to either a control group or a study group (n = 43 per group). The control group received standard pharmacological treatment combined with NB-UVB therapy, while the study group was treated with a combination of PRF and NB-UVB. Serum levels of TNF-α and IL-8 were measured before and after treatment. In the study group, TNF-α decreased from 222.75 ± 4.86 to 65.42 ± 5.33 ng/L, and IL-8 from 120.75 ± 4.53 to 45.39 ± 8.26 ng/L, compared with reductions from 221.45 ± 6.84 to 114.68 ± 2.53 ng/L and 122.38 ± 2.65 to 79.52 ± 2.34 ng/L in the control group, respectively. Both inflammatory factors were significantly down-regulated in both groups after treatment, with lower levels observed in the study group ($p < 0.001$). Wound healing time and the frequency of dressing change were also significantly reduced in the study group (20.6 ± 3.6 days and 7.1 ± 2.5 times) compared with the control group (40.3 ± 10.7 days and 20.5 ± 5.6 times, $p < 0.001$). Additionally, the incidence of scar hyperplasia was higher in the control group than in the study group ($p < 0.05$).These results suggest that combining PRF with NB-UVB shows potential for clinical use, but further trials are needed to validate these findings [10].

## 4. Discussion

In this review, we provide an overview of the available data regarding the use of PRF for treating burn wounds. In a recent study, Li et al. suggested synergistic effects of PRF and CTLA4Ig gene-transfected porcine skin on accelerating wound healing in a rat model of deep second-degree burns. A standardized deep second-degree burn was created on the dorsum of 32 Sprague-Dawley rats, randomly assigned to four groups (Vaseline, PRF, pigskin, and PRF+pigskin; n=8 each). Wound closure was monitored for 21 days, and histological, immunohistochemical (CD31, VEGF, IL-6, TNF-α), and immunofluorescence (antioxidant enzymes CAT, SOD1) analyses were performed on days 4, 7, 14, and 21. The combination of PRF and pigskin significantly accelerated wound closure (compared to all other groups), with near-complete reepithelialization by day 14. Histological analysis showed denser, more organized collagen fibers with the most marked effect in the combination group. Immunohistochemistry and immunofluorescence showed a marked upregulation of CD31-positive vessels, VEGF expression, and

antioxidant enzymes (CAT, SOD1) in the combination group, suggesting enhanced angiogenesis and improved protection against oxidative stress [11].

Another study investigated the effects of platelet-rich plasma (PRP) and PRF on burn wounds infected with dual-species biofilms of Pseudomonas aeruginosa and Staphylococcus aureus in a rat model. Following infection, wounds were treated with PRF, PRP, or ionized silver (Ag). Wound size reduction was observed from day 8 after burn injuries in the PRF and PRP groups, while Ag significantly accelerated healing at day 12. Collagen deposition occurred fastest in the PRF and PRP groups compared to Ag and control. Both PRF and PRP markedly decreased bacterial numbers in biofilm-infected wounds, whereas Ag exhibited only weak bacteriostatic effects. Ag, PRF, and PRP treatments reduced inflammatory mediators and induced VEGFA, although Ag increased TNF-α levels. The authors concluded that PRF and PRP not only promote burn wound healing in the presence of dual-species biofilm infection but also exhibit strong antibacterial activity against S. aureus and P. aeruginosa, suggesting their potential as effective therapies for burn wounds with dual-species biofilm infection [12].

Chai et al. reported a study where lyophilized horizontal platelet rich fibrin (Ly-H-PRF), exhibited strong antibacterial activity against Staphylococcus aureus and Escherichia coli, protected macrophages and fibroblasts from LPS-induced apoptosis, promoted M2 polarization, and enhanced fibroblasts migration. The authors concluded that Ly-H-PRF promoted the healing of wounds, decreased inflammatory cell infiltration, and increased collagen synthesis [13].

## 5. Conclusions

In this literature review we aimed at summarizing the available data on the use of PRF in the treatment of burn wounds. Platelet-rich fibrin has been reported to influence burn wound healing and may be a promising adjunct in burn wound management. Further studies are needed to establish standardized protocols for clinical application and confirm efficacy.

## Disclosure

## Author's Contribution

**Conceptualization:** Łukasz Szymański, Natalia Gołąbek, Milena Mordarska, Jan Łozowski

**Methodology:** Łukasz Szymański, Przemysław Piątek, Artur Merc, Julia Białas, Joanna Paluchowska

**Software:** Not applicable.

**Check:** Milena Mordarska, Jan Łozowski, Artur Merc, Przemysław Piątek, Łukasz Szymański, Alicja Kodura, Alicja Piwowarczyk

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**Conflict of Interest**

The authors declare no conflict of interest.

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