



UNVEILING THE THERAPEUTIC POTENTIAL OF AUTOLOGOUS PRP IN WOUND REPAIR

Orthopaedics

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ABSTRACT

Background: Traumatic wounds, especially those affecting the upper and lower limb, pose significant health challenges worldwide, impacting individuals personally, professionally, and socially while draining substantial resources. The emergence of autologous Platelet Rich Plasma (PRP) therapy provides a potential solution. PRP, rich in cytokines and growth factors, accelerates the natural healing process, reducing healing time and enhancing tissue regeneration. The purpose of this study was to assess the role of PRP in treating wounds. **Methodology:** A prospective study was conducted at Krishna Mohan Medical College to evaluate the way autologous PRP contributes to wound healing. On the basis of density gradient centrifugation, it was made from whole blood using a quick intraoperative point-of-care technique. The research was given approval by the institutional Scientific Research and Ethics committee, and it included 31 Patients who met the specific inclusion and exclusion of which 28 completed all treatment sessions and were included in the study. PRP injection at the site of wound base and subcutaneous surrounding in addition to PRP applied topically. **Results:** The patients who received treatment had a mean age of 40.56 ± 19.09 years. and they were followed up for 3 weeks. Sessions 0 to 4 demonstrated significant worsening in wound characteristics with higher Bates-Jensen scores, while the lower scores indicated better healing progression. Every patient displayed indications of wound healing, including a decrease in the size of their wounds. **Conclusion:** The study revealed that higher wound assessment scores correlated with worse wound characteristics but over time there was an improvement in wound progression, suggesting Bates-Jensen scaling as an effective tool for assessing wound progression and healing.

KEYWORDS

wound healing; Platelet Rich Plasma; Bates-Jensen wound Assessment; Tissue Regeneration

1. INTRODUCTION

A wound occurs when the normal anatomical structure and functional integrity of the skin are disrupted. The process of wound healing is a coordinated, dynamic tissue repair that includes interactions between many cell types, cytokines, chemokines, and growth factors (GFs). An arrest in the chronic inflammatory phase may result from the development of excessive granulation tissue or chronic, non-healing wounds if this mechanism is disrupted^[1]. In chronic wounds, a high concentration of inflammatory cells and the development of biofilms hinder the return of tissue homeostasis. Increased neutrophil counts result in elevated levels of matrix metalloproteinases (MMPs) and reactive oxygen species (ROS), which can degrade GFs and extracellular matrix (ECM) proteins, cause fibroblast senescence and inhibit the conversion of macrophage phenotypes. These procedures result in a feed-forward loop that stops the progression of wound healing.^[2]

Platelets are essential for the first stage of the healing of wounds. To regulate and improve the migration, growth, and activities of keratinocytes, endothelial cells and fibroblasts, they adhere, aggregate, and release a variety of GFs, adhesion molecules, and lipids^[3]. Platelets offer a concoction of numerous elements that are essential for wound healing and tissue regeneration techniques. Platelets and mesenchymal stem cells discharge their complicated contents in a wound site during the wound-healing process once a clot forms. About eight weeks after the injury, the tissue reaches its maximal tensile strength.^[4]

PRP is a cutting-edge treatment for wounds that are both acute and chronic^[9]. PRP has been utilized in injectable or gel form for over ten years, and numerous Research has indicated that it promotes the regeneration of both hard tissues (bones and tendons) and soft tissues (fat, skin, and mucosa)^[10-12]. PRP releases growth factors, micro-RNAs, and antimicrobial peptides to aid in wound healing^[13]. Furthermore, according to clinical evidence, the existence of infection is decreased in wounds treated with PRP, and platelets have antibacterial activity against some skin germs^[17]. The current study aimed to assess the role of autologous PRP to wound healing.

2. Methodology

The study was conducted at the Orthopaedics department of Krishna Mohan Medical College Mathura, Uttar Pradesh, a tertiary care

hospital, from September 2022 to March 2024. The research was given approval by the institutional Scientific Research and Ethics committee, and it included 31 Patients who met the specific inclusion and exclusion of which 28 completed all treatment sessions and were included in the study.

2.1. Selection Criteria

Inclusion Criteria

- Patients aged >18 years with lower extremity and upper extremity nonhealing Wound.
- **Comparators:** any alternative wound treatment method that does not use autologous platelet lysate or platelet-rich plasma.
- **Outcomes:** fully healed or closed wound time and setting – ≈ 3 weeks and 4 settings.

Exclusion Criteria

- Wound with other co-morbidities and diabetic ulcers
- Patient with immunodeficiency disease
- **Intervention** – Allogeneic PRP patient with thrombocytopenia

Pre-treatment assessments included Routine investigations and Pre-treatment photograph of the wound.

2.2. PRP Preparation And Application

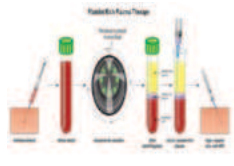
- PRP was prepared by Centrifuge the tubes at 2500 RCF (Relative Centrifuge Force) or 4000 RPM (Revolutions Per Minute). (Please check the rotor diameter And calculate require CF before use) for 10 minutes, of 10ml of blood, with the buffy coat (upper layer of gel) properly to get a good growth factor and high platelet concentration. The PPP-containing top layer was disposed away, and the PRP-containing bottom layer was put into an insulin syringe.

The treatment region was covered with anesthetic cream one hour before PRP was administered and the wound area was cleaned with the help of NS, Spirit, and povidone-iodine. In a minor operation room, PRP was injected using the nappage technique— many tiny injections periphery to the wound and base of the wound with the subcutaneous area —with the use of an insulin syringe and appropriate aseptic precautions. A total of two to three cc or according to wound size, or 0.1 ml/cm², were injected. four sessions of the therapy were conducted on the first day of dressing then the third day, then the next 2 sessions

weekly.

2.3. Post Procedure And Follow-up

Patients were monitored using the Bates-Jensen wound assessment tool (BWAT) at each follow-up session. After the procedure, some patients were complaining of pain and burning sensation at the local side of the PRP injection and it was managed with OPIOID derivatives like Tramadol/paracetamol, while the use of NSAIDs and corticosteroids was restricted.



3. RESULTS

Table 1 presented the demographic profile of patients concerning a Bates-Jensen Wound Assessment Score. In terms of age, the data showed that most of the patients fell within the 18-35 years age group, represented 46.4% of the total with 13 patients, and was the only group with a statistically significant p-value of 0.022. In terms of Gender there was a significant gender disparity, with males constituted the vast majority, encompassing 89.3% of the sample, indicated by a highly significant p-value of 0.000 while, Females were in the minority, constituted of just 10.7% of the sample. In terms of Occupation, Laborers represented the largest occupation group accounted for 28.6% of the sample, followed closely by farmers who make up 25%, both showed statistical significance with a p-value of 0.000.

In terms of mode of injury, Road traffic accidents (RTA) were the most frequent reason for injury which constituted 53.6% of the patients. while Falls from height (FFH) constituted the remaining cause of injury. In terms of type of fracture, Compound III B fractures were the most prevalent, making up 64.3% of the sample, with a statistically significant p-value of 0.021. in terms of bone involvement, the tibia was the most frequently involved bone, which represented 53.6% of the sample and had a notable p-value of 0.002, suggested a statistical significance. In terms of the type of implant Intramedullary (IM) nails were the most common implant type, used in 12 patients, Kirschner Wire (K Wire) was used in 5 patients (17.9%), limited contact dynamic compression plate (LC DCP) plates in 4 patients (14.3%), and Proximal femoral nail (PFN) in 3 (10.7%) patients. (Table 1)

Table 2 characterized Session 0 by comparing Bates-Jensen Wound Assessment scores across two score ranges 21.7 to 43.2 and 43.3 to 65. It illustrated that all assessed wound characteristics had significantly worse outcomes in the higher score range. Wound size, Depth, edges, Necrotic Tissue, exudate, Surrounding skin condition, Peripheral Tissue Edema, induration, and Epithelialization all showed increased severity with statistically significant p-value. (Table 2)

Table 3 showed the wound characteristic, and it varied significantly across score ranges (0 to 21.6, 21.7 to 43.2, and 43.3 to 65), in both the 1 and 2 sessions. The higher score reflected worse wound conditions. Table 4 summarized the detailed significant variations in the wound characteristics in sessions 3 and 4 across score ranges (0 to 21.6 and 21.7 to 43.2). Session 3 illustrated significant variations in wound characteristics across the session and reflected the dynamic nature of wound healing processes while in session 4 higher scores indicated the more severe wound characteristics and the statistical analysis using p-values revealed significant disparities between the two ranges for all parameters, emphasizing the varying degrees of wound progression and healing. Figure 1 visually documented the wound healing process of patients.

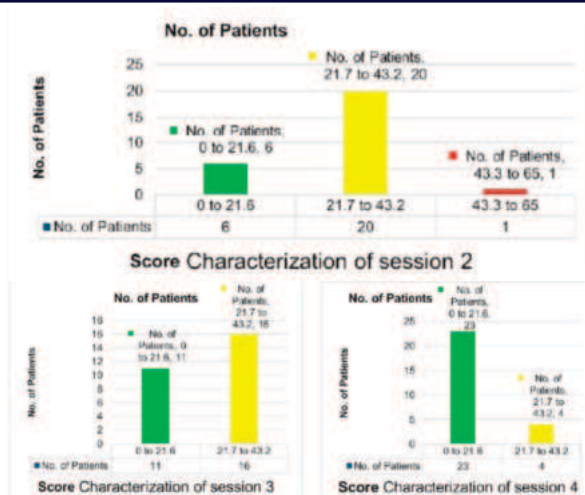
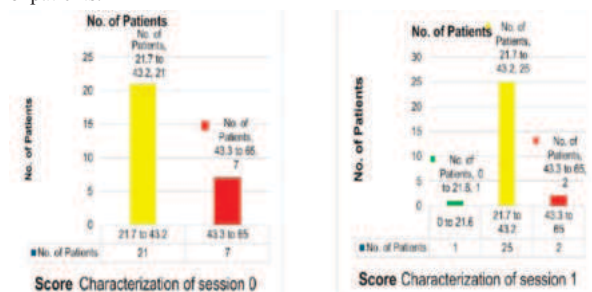


Figure 1: Pictures of patient's wounds healing process.



4. DISCUSSION

This prospective study investigated the potential of autologous PRP in wound healing. PRP is a concentrated form of platelets obtained from the patient's blood. The study aims to explore how PRP can accelerate and enhance the wound-healing process.

The average age of the entire group was determined to be 40.56 years, with an SD of ± 19.09 . The male population constituted a significant majority, accounting for 89.3% of the total, while the female population represented a minority at 10.7%. The study found that the largest proportion of injuries, specifically 53.6%, were caused by RTA. The average fracture type score was 1.815, with a SD of ± 0.557 , indicated that complicated fractures were the most common in the sample. The findings of our investigation are similar to those of Gamal WM et al.'s study, which included 40 patients of both sexes, of whom 28 (70%) were men and 12 (30%) were women. The patients' mean age was 45.7 years, and they all had chronic wounds, and PRP helped repair previously chronic nonhealing ulcers.^[18]

Bone involvement can make wound healing more difficult and necessitate specialist care. The tibia was the most often affected bone,

representing 53.6% of all cases. The average bone involvement score was determined to be 4.074, with an SD of ± 1.466 , indicating the wide range of bone injuries found in the study. Implants are essential for stabilizing fractures and facilitating the healing process. The IM NAIL was the most often utilized implant, representing 42.9% of cases. In other studies, Hom et al. assessed the impact of PRP on acute traumatic injuries such as open tibia fractures and full-thickness skin punch wounds, respectively.^[19]

The majority of the parameters showed significant differences in mean scores in Session 0; they ranged from 1.29 ± 0.56 for undermining to 4.57 ± 0.60 for epithelization. There were continuously significant differences in the mean scores throughout the majority of metrics in the following sessions. As an example, Session 1 displayed average scores ranging from 1 ± 0.00 for undermining to 4.5 ± 0.71 for the skin tone around the incision. Similarly, in Session 2, for epithelization. During Session 3, the average scores ranged from 1.00 ± 0.00 for undermining to 4.3 ± 0.6 for epithelization. In Session 4, the mean scores varied from 1.00 ± 0.00 for necrotic tissue type to 3.50 ± 0.58 for epithelization.

The results of our investigation are like several studies. Based on a meta-analysis, PRP therapy increased the likelihood of healing chronic wounds and decreased the size of the ulcer, while also decreasing the duration of the healing process. In addition, PRP significantly reduced the risk of adverse events, despite this, no statistically significant variation was seen in the risk of wound complications or recurrences between PRP and conventional therapy. Based on this meta-analysis, there is sufficient data to demonstrate a statistically significant benefit of PRP compared to alternative treatment methods.^[20]

An Indian study found that PRP therapy resulted in an average reduction of 91.7% in ulcer area, and a 95% reduction in ulcer volume^[21] Furthermore, research by Scimeca et al. showed how PRP therapy successfully treated a 49-year-old man for three months who had a severe, non-healing plantar diabetic ulcer. This highlights the potential effectiveness of PRP in treating diabetic foot ulcers^[22]. Other researchers have also reported similar data that indicate the analgesic and bactericidal effects of PRP.

According to research by Suthar et al., all the patients displayed symptoms of wound healing, including a decrease in the size of their wounds. The healing period for ulcers was 8.2 weeks. Additionally, the final PRP product created using the rapid point-of-care method showed an average fivefold increase in platelet concentration, and the average platelet dose given to the patients was 70.10×10^5 . The study has shown that autologous PRP may be safe and effective in treating chronic ulcers that fail to heal.^[23]

Several investigations on the promotion of wound healing by PRP have demonstrated that the utilization of PRP alone or in conjunction with biomaterial scaffolds can enhance collagen deposition and significantly reduce the time required for healing^[24,25]. In our study, we arrived at the same conclusion. Myofibroblasts are believed to have a significant impact on wound contraction. During the middle and late stages, there is a progressive rise in the transformation of fibroblasts into myofibroblasts, which leads to the creation of granulation tissue. This tissue is responsible for effectively contracting the wound margin.^[26]

5. CONCLUSION

A medical procedure called autologous PRP therapy makes use of concentrated amounts of growth factors that are generated by platelets. This therapy can enhance and accelerate the healing process by stimulating the regeneration of epithelial tissue. This article outlines the successful treatment of 28 patients at our institution who experienced difficult-to-heal wounds following major traumatic wounds, specifically RTA and FFH. These patients were effectively and satisfactorily treated with PRP, resulting in excellent outcomes. Additionally, we examined the literature regarding the mechanisms, advantages, and constraints of PRP.

PRP, derived from the patient's autologous blood, has exhibited its ability to enhance wound healing rates, alleviate inflammation, and promote tissue regeneration by releasing crucial growth factors. In the study patients were given autologous PRP injections at the base of the wound and peripheral subcutaneous tissue at fixed time intervals at day 1, day 3, and thereafter 2 sessions one-week apart assessment done according to BWAT, and score give at b-wat scale out of 65. This study

represents a significant advancement in the field as the prospective to assess autologous PRP's safety in preventing wound gaps and infections after traumatic wound patients. The results provide strong evidence that PRP not only enhances wound healing but also dramatically reduces postoperative pain. These findings provide encouraging knowledge about possible medical treatments to enhance surgical results and patient well-being in this vulnerable group.

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