

An Overview on Application of Platelet Rich Plasma in Chronic Diabetic Foot Ulcer

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Abstract:

PRP therapy involves the centrifugation of autologous blood to concentrate platelets, which are then activated to release growth factors such as platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor-beta (TGF- β). These factors play a pivotal role in stimulating cell proliferation, collagen synthesis, and tissue regeneration. Initially developed in the 1970s for hematologic applications, PRP has since expanded into multiple medical specialties. However, the lack of standardized preparation methods and inconsistent clinical trial results have led to debates regarding its true therapeutic potential.

Keywords: Platelet-rich plasma, PRP, growth factors, regenerative medicine, tissue repair, wound healing, orthopedics, sports medicine.

Introduction:

Platelet-rich plasma (PRP) is an autologous concentration of platelets suspended in plasma, obtained by centrifugation of whole blood. It contains a high concentration of growth factors that play a crucial role in tissue repair, regeneration, and modulation of inflammation (1).

The therapeutic potential of PRP lies in its ability to release platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor-beta (TGF- β), which stimulate angiogenesis, collagen synthesis, and cell proliferation. These biological effects make PRP a promising treatment for musculoskeletal injuries, osteoarthritis, chronic wounds, and aesthetic applications (2).

Despite its wide use, there is significant variability in PRP preparation methods, platelet concentrations, and activation protocols, leading to heterogeneity in clinical outcomes. This variability remains a challenge in establishing standardized guidelines for PRP therapy across medical specialties (3).

Recent research emphasizes the importance of patient selection, optimization of platelet concentration, and combination therapies to enhance PRP effectiveness. High-quality randomized controlled trials are still needed to define the best practices for PRP use in specific conditions (4).

Platelet-rich plasma is produced by centrifuging heparinized whole autologous blood for 15 min and separating the platelets from the other blood components. Later, the platelets are diluted with a normal saline solution to obtain optimal concentration. This represents an emerging regenerative therapy for injuries in the orthopedic field with encouraging results showing anti-inflammatory, analgesic and antibacterial properties (5).

PRP has recently been considered as an orthobiological adjuvant treatment. It also restores intra-articular hyaluronic acid, increases glycosaminoglycan chondrocyte synthesis, balances joint angiogenesis, and provides a scaffold for stem cells migration. Basic scientific studies have indicated that PRP stimulates cell proliferation and the production of cartilage matrix by chondrocytes and bone marrow-derived mesenchymal stromal cells and increases the production of hyaluronic acid by synoviocytes (6).

He et al. divided PRP into Autogenous PRP (au-PRP) and allogeneic PRP(al-PRP), and found that PRP in both groups could effectively and safely promote wound healing in DFU compared with conventional dressing treatment, suggesting that al-PRP could be used as a ready solution for DFU when au-PRP was limited (7).

Application of Platelet rich plasma in chronic diabetic foot ulcer:

DFU is one of the most common, serious, and costly complications of diabetes and the leading cause of hospitalization for people with diabetes worldwide. DFU is also the main cause of lower limb amputation in diabetic patients, which often leads to disability, emotional disorders, socio-economic problems, and severely impaired quality of life, and even death in severe cases. Studies have found that about 15%-25% of people with diabetes have experienced DFU during their lifetime (8).

The use of PRP in DFU can effectively improve the ulcer healing rate compared with conventional or standard care, and shorten the ulcer healing time (9).

A study has found that PRP can still effectively promote the healing of DFU and shorten the healing time after excluding factors such as age, gender, smoking status and blood pressure status of diabetic patients, but had no significant effect on reducing the need for amputation, the level of amputation, or the need for further treatment (such as graft or angioplasty) (10).

The efficacy of PRP is also different among ulcers of different sizes (11).

A prospective study grouped diabetic foot wounds according to the size of ulcers and found a significant difference in wound healing time, which was related to the size of ulcers. Patients with the smallest ulceration group (2-5.5cm²) had faster wound healing time than those with the largest ulceration group (8.5-12.5cm²) (9).

According to this study, PRP is not recommended for large, non-healing ulcers in DFU, and skin graft must be used as the final method of wound healing (9).

PRP had a positive effect on promoting ulcer healing in the treatment of chronic skin ulcers, including DFU, venous ulcers of lower extremities and pressure ulcers (12).

PRP treatment of DFU increased the possibility of wound healing, reduced the ulcer volume, and reduced the time of complete wound healing (13).

In terms of safety, platelet-rich plasma and standard treatment had no difference in the probability of wound complications or recurrence, but overall reduced the incidence of adverse events (9).

It has been found in related studies that the overall amputation rate of DFU patients in PRP group is lower (14).

PRP alone is used to treat DFU, which can effectively increase the healing rate of ulcers and shorten the healing time. In addition, when PRP is combined with other treatment modalities, it can also work to a certain extent (15).

- The addition of PRP to fat grafts resulted in increased angiogenesis in fat grafts and thus improved the viability of fat graft cells (16).
- The addition of PRP to mesenchymal stem cells also observed significant neovascularization and more significant wound reduction (17).
- Vacuum Sealing Drainage combined with PRP could also significantly shorten the healing time and improve the healing rate of ulcers (18).

The activity of PRP is related to many factors in the preparation process, which to some extent affects the efficacy of PRP in the treatment of diabetic foot (13).

- An important factor affecting the preparation of PRP is the centrifuge conditions, such as force and duration, which are significantly different in different studies (19).

- Another important factor is the difference in activators, and different activators may affect the release of bioactive molecules and the cleavage of fibrinogen (20).
- In addition, PRP preparation is mostly extracted from patients' peripheral blood, and there are individual differences among different patients, which may also cause different PRP activities prepared under the same preparation conditions (19).

PRP for diabetic foot can reduce the infection rate of the wound and reduce the occurrence of complications (21).

PRP's effect on wound healing is mainly through the release of various bioactive molecules stored in platelets, including PDGF, transforming growth factor β (TGF- β), VEGF, epithelial growth factor (EGF), and adhesion molecules such as fibrin, fibronectin, and hyalenin (22).

These factors are known to regulate processes such as cell migration, attachment, proliferation, and differentiation, and to play an important role in wound healing and regeneration by binding to specific cell surface receptors to promote the accumulation of extracellular matrix (ECM) (23).

In addition to growth factors, PRP include many important proteins, such as fibrin, which not only provide scaffolds for tissue regeneration, but also promote wound contraction, blood clotting, and wound closure (22).

In addition, activated PRP contains a variety of antibacterial proteins. Activated PRP can inhibit staphylococcus aureus, staphylococcus epidermidis, escherichia coli, klebsiella pneumoniae, and methicillin-resistant staphylococcus aureus, without drug resistance, and has synergistic effects with antibacterial agents. The combination of these action characteristics makes PRP more promising than conventional antibiotic prescribing (24).

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