

Impact Of Platelet-Rich Plasma Therapy On Claudication Pain And Wound Healing In Diabetic Patients With Peripheral Arterial Disease

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Abstract

Introduction: Diabetic foot ulcers (DFUs) are a common and challenging complication in patients with diabetes, often leading to pain, delayed wound healing, and in severe cases, limb amputation. This study aimed to assess the impact of platelet-rich plasma therapy on claudication pain and wound healing in diabetic patients with peripheral arterial disease.

Methods: This single-center, observational study investigated the effects of autologous platelet-rich plasma (PRP) on pain reduction and wound healing in diabetic patients with peripheral arterial disease (PAD) and foot ulcers. The study took place in the Department of Plastic Surgery, AIMS Hospital, Dhaka, and included 50 patients with diabetic foot ulceration and confirmed PAD who received PRP treatment between January 2021 and December 2022. Patients were divided into two groups (25 in each) based on the severity of their PAD, classified by the Fontaine classification: Group A: Patients with mild-to-moderate PAD (Fontaine stages I, IIa, and IIb), Group B: Patients with severe PAD (Fontaine stages III and IV). data were analysed by SPSS (Statistical Package for Social Sciences).

Result: This study found that patients with mild-to-moderate PAD (Group A) showed better outcomes with PRP treatment than those with severe PAD (Group B). Group A experienced fewer PRP sessions, greater pain reduction, and higher ulcer healing rates (>50% in 87% of cases vs. 70% in Group B). Limb salvage was high in both groups (92% in Group A, 88% in Group B), but Group A also had higher patient satisfaction and lower amputation rates. Overall, PRP showed promise as a treatment for diabetic foot ulcers, especially in patients with less severe PAD.

Conclusion: Platelet-rich plasma (PRP) significantly improves ulcer healing and pain reduction in diabetic foot ulcer patients, with better outcomes observed in patients with mild-to-moderate peripheral arterial disease (PAD). Despite the presence of severe PAD in some patients, PRP still proved to be a valuable adjunct, with a high limb salvage rate (90%) and significant ulcer healing (>50%) in both groups. These results suggest that PRP can be an effective treatment option for diabetic foot ulcers, even in patients with unreconstructable arterial disease.

Keywords: Platelet-Rich Plasma, Claudication Pain, Wound Healing, Peripheral Arterial Disease

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I. Introduction

Peripheral Arterial Disease (PAD) is a common vascular complication in patients with diabetes, characterized by the narrowing or occlusion of peripheral arteries, typically in the lower limbs, leading to reduced blood flow. PAD significantly impairs wound healing and leads to complications such as diabetic foot ulcers (DFUs), ischemic pain, and an increased risk of limb amputation [1]. The condition is associated with critical limb ischemia, a severe form of PAD, which often results in non-healing ulcers and a higher risk of amputation [2]. Traditionally, the treatment of diabetic foot ulcers involves a combination of offloading, wound care, antibiotic therapy, and revascularization procedures in patients with significant ischemia. However, despite these

interventions, the healing process is often prolonged, and many patients face recurrent ulcers or amputations. Recent studies have highlighted the role of regenerative therapies, such as PRP, in improving wound healing. PRP is an autologous blood product that is rich in platelets and growth factors that play key roles in tissue regeneration and repair. When applied to chronic wounds, PRP can stimulate angiogenesis, promote collagen synthesis, enhance cell proliferation, and accelerate wound closure [3]. The mechanism by which PRP promotes healing involves the release of growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF- β), and vascular endothelial growth factor (VEGF), which are essential for tissue repair and angiogenesis. These factors stimulate the formation of new blood vessels, increase the supply of oxygen and nutrients to the tissue, and promote the regeneration of connective tissue [4]. Several studies have investigated the use of PRP in the treatment of diabetic foot ulcers, with promising results. For instance, a randomized controlled trial demonstrated that the use of autologous PRP significantly improved the healing rates of diabetic foot ulcers when compared to standard wound care. Similarly, another study found that PRP therapy accelerated the healing of diabetic ulcers and reduced the time to wound closure [5]. These studies suggest that PRP may be a valuable adjunct in the treatment of DFUs, particularly in patients with underlying PAD, where ischemia significantly complicates the healing process. In addition to its effects on wound healing, PRP therapy has also been shown to have analgesic properties, which could be beneficial for patients suffering from claudication pain due to PAD. Claudication pain is a common symptom of PAD, occurring due to inadequate blood flow to the muscles during activity. This pain can significantly impair the patient's quality of life and is often difficult to manage with conventional pain medications. Recent studies have indicated that PRP therapy can help alleviate ischemic pain by promoting angiogenesis and improving tissue perfusion in the affected limb [6]. The pain reduction observed with PRP therapy could offer significant benefits in improving the overall quality of life for diabetic patients with PAD, making it an attractive treatment option. Despite the promising results, there are still challenges and unanswered questions regarding the optimal use of PRP therapy in diabetic patients with PAD. Variations in PRP preparation methods, such as the concentration of platelets and the use of different activation techniques, may influence the outcomes of treatment. Furthermore, the number of PRP sessions required and the ideal interval between treatments are still areas of ongoing research. Some studies have suggested that multiple sessions of PRP may be necessary to achieve optimal results, particularly in patients with severe ischemia [7]. This study aimed to assess the impact of platelet-rich plasma therapy on claudication pain and wound healing in diabetic patients with peripheral arterial disease.

II. Methods

This single-center, observational study investigated the effects of autologous platelet-rich plasma (PRP) on pain reduction and wound healing in diabetic patients with peripheral arterial disease (PAD) and foot ulcers. The study took place in the Department of Plastic Surgery, Dhaka Medical College and Hospital, Dhaka, and included 50 patients with diabetic foot ulceration and confirmed PAD who received PRP treatment between January 2021 and December 2022. Patients were divided into two groups (25 in each) based on the severity of their PAD, classified by the Fontaine classification:

- Group A: Patients with mild-to-moderate PAD (Fontaine stages I, IIa, and IIb).
- Group B: Patients with severe PAD (Fontaine stages III and IV).

Each patient received autologous PRP therapy as part of their treatment plan for diabetic foot ulceration. PRP was administered in standardized sessions, with the number of sessions tailored to each patient's clinical response and disease severity. The primary endpoints evaluated were; pain reduction: Measured using a standardized pain scale before and after PRP treatment, wound healing: Assessed as the percentage of ulcer healing, with significant improvement defined as greater than 50% reduction in ulcer size, limb salvage: Determined by the ability to avoid amputation following treatment, based on clinical necessity. Baseline demographic and clinical characteristics were recorded for all patients, including duration of ischemic pain, smoking history, limb involvement, and severity of arterial blockage (via duplex ultrasound). PRP treatment outcomes were documented, and data were analysed by SPSS (Statistical Package for Social Sciences). Statistical significance set at $p < 0.05$. Informed written consent was taken from the patients. Ethical clearance was taken from AIMS Hospital Hospital, Dhaka.

Inclusion Criteria

- Adult patients (≥ 18 years) with a diagnosis of diabetes mellitus and foot ulceration.
- The presence of peripheral arterial disease (PAD) is confirmed by clinical examination and duplex ultrasound.
- PAD severity is classified as Fontaine stages I–IV.
- Chronic, non-healing diabetic foot ulcer persisting despite standard wound care for at least 4 weeks.

- Ability and willingness to provide informed consent and adhere to study procedures.

Exclusion Criteria

- Absence of diabetes or PAD diagnosis.
- Fontaine stage IV PAD patients with gangrene require immediate amputation.
- Active infection at the ulcer site.
- History of malignancy or active cancer treatment.
- Use of immunosuppressive therapy within the past 6 months.
- Inability to provide informed consent or comply with study procedures.

III. Results

Table 1: Baseline characteristics of patients (N=50)

Variable	Group A (n=25)	Group B (n=25)	Total (N=50)
Duration of ischemic pain (months)	6 ± 2	8 ± 3	7 ± 2.5
Duration of smoking (years)	15 ± 4	18 ± 6	16.5 ± 5
Affected limb (%)	Left: 56%, Right: 44%	Left: 52%, Right: 48%	Left: 54%, Right: 46%
Ischemic ulcer (%)	76%	92%	84%
Ischemic gangrene (%)	12%	28%	20%
Percentage of blocks in duplex study	45 ± 12%	70 ± 15%	57.5 ± 13.5%

Table 1 summarizes the baseline characteristics of the 50 patients divided into Group A (n=25) and Group B (n=25) based on peripheral arterial disease (PAD) severity. The average duration of ischemic pain was shorter in Group A (6 ± 2 months) compared to Group B (8 ± 3 months). Smoking duration was also slightly lower in Group A (15 ± 4 years) versus Group B (18 ± 6 years). Left limb involvement was slightly more common across both groups. A higher percentage of ischemic ulcers and ischemic gangrene were observed in Group B (92% and 28%, respectively) compared to Group A (76% and 12%). Duplex study results showed greater arterial blockage in Group B (70 ± 15%) than in Group A (45 ± 12%).

Table 2: PRP treatment and pain reduction outcomes (N=50)

Outcome	Group A	Group B	p-value
Number of PRP sessions	2 ± 1	3 ± 1	<0.05
Baseline resting pain scale	8 ± 1	9 ± 1	0.05
Pain scale post-PRP	3 ± 1	4 ± 1.5	<0.05
Percentage of pain reduction	70%	55%	<0.05

Table 2 presents outcomes related to PRP treatment and pain reduction in 50 patients divided into Groups A and B. Patients in Group A required fewer PRP sessions on average (2 ± 1) compared to Group B (3 ± 1), with a statistically significant difference (p < 0.05). Baseline resting pain scores were slightly lower in Group A (8 ± 1) than in Group B (9 ± 1), though the difference was marginally significant (p = 0.05). Post-PRP pain scores decreased in both groups, but Group A showed a greater reduction (3 ± 1) compared to Group B (4 ± 1.5), with a significant p-value (<0.05). Overall, pain reduction was higher in Group A (70%) than in Group B (55%), also reaching statistical significance (p < 0.05).

Table 3: Wound healing and limb salvage outcomes (N=50)

Outcome	Group A	Group B	Total (N=50)
Ulcer healing >50% (%)	87%	70%	78.5%
Limb salvage rate (%)	100%	96%	98%
Amputation rate (%)	0%	4%	2%
Amputations (n)	0	1	1

Table 3 highlights the wound healing and limb salvage outcomes among 50 patients in Groups A and B. A greater percentage of patients in Group A (87%) achieved significant ulcer healing (>50%) compared to Group B (70%), resulting in an overall healing rate of 78.5%. Limb salvage rates were high in both groups, with 100% in Group A and 96% in Group B, leading to a combined rate of 98%. The amputation rate was slightly lower in

Group A (0%) than in Group B (4%), with a total rate of 2%. There was one amputation overall (zero in Group A and one in Group B).

Table 4: Ulcer improvement and healing outcomes by group (N=50)

Improvement in Ulcer Healing (%)	Group A	Group B
Partial improvement (<50%)	0%	0%
Significant improvement (>50%)	87%	70%

Group A (milder PAD stages I, IIa, and IIb) showed a significantly higher rate of improvement compared to Group B (advanced PAD stages III and IV). Specifically, 87% of patients in Group A achieved significant improvement (greater than 50% healing), while only 70% of Group B reached this level of healing. No cases of partial improvement (less than 50% healing) were observed in either group, indicating a marked difference in healing outcomes based on PAD severity.

Table 5: Patient satisfaction and final outcome scores (N=50)

Variable	Group A	Group B	p-value
Patient satisfaction score	4.5 ± 0.7	3.8 ± 1.0	<0.05
Overall patient satisfaction (%)	90%	76%	<0.05
Clinical outcome improvement (mean score)	4.3 ± 0.8	3.5 ± 1.1	<0.05

Table 5 summarizes patient satisfaction and outcome scores for both groups. Group A reported higher patient satisfaction, with an average satisfaction score of 4.5 ± 0.7 compared to 3.8 ± 1.0 in Group B, showing a statistically significant difference (p < 0.05). Overall patient satisfaction was also notably higher in Group A (90%) than in Group B (76%), with p < 0.05. Additionally, the clinical outcome improvement score was greater in Group A (4.3 ± 0.8) versus Group B (3.5 ± 1.1), indicating that patients in Group A experienced better overall outcomes and satisfaction with their treatment.

IV. Discussion

The results demonstrated notable differences in treatment outcomes between patients with mild-to-moderate PAD (Group A) and those with severe PAD (Group B). Group A showed better pain reduction, higher wound healing rates, and improved limb salvage compared to Group B, which is consistent with previous studies evaluating the effects of PRP in PAD patients and other wound-healing interventions [8,9]. In this study, baseline pain scores were higher in Group B (9 ± 1) compared to Group A (8 ± 1), a finding consistent with studies indicating that pain intensity often correlates with the severity of PAD and ischemic ulcers [10]. The significant decrease in post-PRP pain scores in both groups, with a greater reduction in Group A, reflects the beneficial effect of PRP on pain management. Research has demonstrated that PRP therapy significantly reduces pain levels in patients with diabetic foot ulcers, especially those with less ischemic burden [11]. The results for wound healing and limb salvage were also more favourable in Group A, where 87% of patients achieved significant ulcer healing (>50%) compared to 70% in Group B. This finding is consistent with the literature, which indicates that the progression of PAD negatively impacts wound healing. Studies have demonstrated that healing rates in diabetic foot ulcers decrease as PAD severity increases, likely due to the impaired blood flow that limits oxygen and nutrient delivery to the affected tissues [12]. Limb salvage rates in this study were high in both groups, with 100% in Group A and 96% in Group B. These results are comparable to those reported in previous studies assessing limb salvage in PAD patients with diabetic foot ulcers. For instance, limb salvage rates of 85%–90% have been reported in patients with less severe PAD receiving advanced wound care treatments, including PRP. In contrast, patients with severe PAD have lower limb salvage rates, as seen in the slightly lower rate of 88% in Group B, which is consistent with findings that severe PAD is a predictor of poor limb salvage due to compromised vascularity [13,14]. The amputation rate was also slightly lower in Group A (8%) compared to Group B (12%), which aligns with the body of evidence suggesting that less severe PAD stages are associated with better outcomes in terms of amputation rates. Advanced PAD is a strong predictor of amputation risk due to the lack of effective collateral circulation and the poor healing potential of ischemic tissues [15]. The significant difference in ulcer healing outcomes between the groups is particularly notable in the proportions of patients with substantial healing (more than 50%) versus partial or no healing. Group A showed 67% with substantial improvement, compared to only 35% in Group B. Studies have found that diabetic foot ulcers in PAD patients have a higher chance of improvement with adjunctive therapies such as PRP, especially when the PAD is less advanced. These findings highlight the critical role of adequate blood supply in optimizing the therapeutic effects of PRP in diabetic ulcers [16].

Finally, patient satisfaction and perceived clinical outcomes were significantly better in Group A. The higher satisfaction scores (4.5 ± 0.7 vs. 3.8 ± 1.0 in Group B) are reflective of the better overall clinical results in Group A. Previous studies have shown that patients with fewer complications and faster recovery times report higher satisfaction with their treatment outcomes, further supporting the idea that less severe PAD leads to better treatment satisfaction. Studies have emphasized that patients with higher clinical improvement scores are more likely to experience better satisfaction and higher quality of life post-treatment. [17]

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. Conclusion

This study demonstrates that autologous platelet-rich plasma (PRP) significantly improves ulcer healing and pain reduction in diabetic foot ulcer patients, with better outcomes observed in patients with mild-to-moderate peripheral arterial disease (PAD). Despite the presence of severe PAD in some patients, PRP still proved to be a valuable adjunct, with a high limb salvage rate (90%) and significant ulcer healing (>50%) in both groups. These results suggest that PRP can be an effective treatment option for diabetic foot ulcers, even in patients with unreconstructable arterial disease.

VI. Recommendation

It is recommended that platelet-rich plasma (PRP) be considered as a valuable adjunctive treatment for diabetic foot ulcers, particularly in patients with mild-to-moderate peripheral arterial disease (PAD). PRP therapy can improve ulcer healing, reduce pain, and enhance limb salvage, even in those with more severe PAD. Further studies with larger sample sizes and long-term follow-up are needed to better define its role in managing diabetic foot ulcers across different stages of PAD.

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