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Research Article

Effectiveness of Platelet-Rich Fibrin (PRF) in Post-Extraction Socket Healing Among Diabetic and Non-Diabetic Patients

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Abstract

Introduction: Tooth extraction can lengthen healing time and raise risk for diabetic patients, due to reduced cell repair and weakened immune systems. Using PRF as a biomaterial can improve the outcome of healing. This work focused on measuring how PRF works to promote healing of the socket following tooth extraction in both diabetic and non-diabetic patients. **Methodology:** A total of 93 patients were included and they were placed into two groups: Group A included 46 controlled diabetic patients, while Group B included 47 non-diabetic patients. Patients were treated with PRF following tooth extraction and followed up for 12 months. Pain was assessed using the Visual Analogue Scale (VAS), soft tissue healing was graded using the Landry, Turnbull, and Howley index, and bone regeneration was evaluated through radiographic scoring. Postoperative infections and complications were also recorded. **Results:** Non-diabetic patients exhibited significantly lower pain scores ($p < 0.001$) and better soft tissue healing at 3 weeks ($p = 0.002$) compared to diabetic patients. Diabetic patients showed a higher incidence of infections (13.0% vs. 2.1%, $p = 0.045$) and poorer bone regeneration at 3, 6, and 12 months ($p < 0.001$). At 12 months, 93.6% of non-diabetic patients achieved complete healing, compared to 65.2% in diabetic patients ($p < 0.001$). **Conclusion:** PRF significantly improved healing outcomes following tooth extraction in both diabetic and non-diabetic patients, with non-diabetics experiencing superior results in terms of pain reduction, soft tissue healing, bone regeneration, and overall healing. However, diabetic patients experienced delayed healing, highlighting the impact of diabetes on tissue repair processes.

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Introduction

Tooth extraction is among the most common oral surgical procedures performed in dental practice [1]. Blood coagulation, inflammation, cell proliferation, and tissue remodeling are all components of the intricate physiological process that constitutes post-extraction wound healing [2]. While the healing of the extraction socket is typically uneventful in healthy individuals, systemic illnesses like diabetes mellitus can cause delayed collagen production, decreased immunological response, and microvascular problems, all of which can seriously hinder the healing process [3].

A lack of good control over Type 2 diabetes in those with diabetes mellitus may result in delayed healing wounds, an increased danger of complications right after surgery such as alveolar osteitis, infection and longer lasting pain [4]. The sluggish recovery of soft and hard tissues in diabetes is largely owing to changes in white cell function, endothelial cells and a decline in new blood vessel formation [5]. For dental surgeons dealing with diabetic patients, extractions can be difficult as these patients usually demand more careful attention and extended recovery.

Because they aid faster recovery after surgery, regenerative techniques have recently become more popular. For example, doctors are now using a patient's own platelets in concentrates, primarily known as Platelet-Rich Fibrin (PRF) [6] rather than other options. The natural healing properties of this second-generation PRF come from the fact that it is produced without anticoagulants [7]. Among the growth factors in the blood is PDGF, TGF-β and VEGF which are important for angiogenesis, growth of tissue and collagen production [8]. PRF promotes faster and more certain healing by providing a proper setting for cells to move and grow [9].

Numerous research has shown that PRF has positive effects in various oral surgical applications, including socket preservation, sinus lift procedures, and periodontal regeneration [10]. However, limited literature exists specifically evaluating its effectiveness in diabetic patients who inherently suffer from compromised healing [11]. Given the growing prevalence of diabetes worldwide and the increasing reliance on regenerative therapies, it is crucial to understand whether PRF can mitigate the negative effects of diabetes on post-extraction healing and if its application can bring diabetic healing outcomes closer to those of non-diabetic individuals [12].

Despite the clinical relevance, few comparative studies have explored the differential effectiveness of PRF in socket healing among diabetic versus non-diabetic patients, highlighting a significant research gap. The research aims to assess if the use of Platelet-Rich Fibrin (PRF) leads to better healing of extraction sites in diabetic compared to non-diabetic patients.

Materials and Methods

Study Design and setting

This prospective comparative study was conducted at the Department of Oral and Maxillofacial Surgery, Fatima Jinnah Dental College (DUHS), Karachi, over duration of 12 months, from January 2023 to December 2023. The purpose of the study was to assess and contrast how well PRF promotes post-extraction socket repair in patients with managed diabetes and those without the disease. A total of 93 patients were included and divided into two groups: Group A (controlled diabetics, n = 46) and Group B (non-diabetics, n = 47). All tooth extractions were carried out under standardized aseptic conditions by qualified oral surgeons. PRF was prepared and applied uniformly in all cases, and follow-ups were conducted at designated intervals up to 12 months postoperatively.

Sample Size Calculation

Software called OpenEpi was used to determine the sample size. With a 95% degree of confidence, 80% power, and an expected difference of 25% in socket healing outcomes between those with and without diabetes treated with PRF, the minimum required sample size was 90. To take into consideration the possibility of losing follow-up, the final sample size was increased to 93 patients.

Inclusion and Exclusion Criteria

People between 30 and 65 years old who only needed a single simple tooth to be removed were included in the study. The first group had members with type 2 diabetes and controlled blood glucose (with HbA1c below 8%) and the second had members free from any medical conditions. No one with diabetes out of

control, those who use tobacco or alcohol or those with bleeding issues were included in the study. Patients using anticoagulants, corticosteroids or immunosuppressants, as well those who had acute oral infections or malignancies, were not included in the study.

Grouping and Clinical Procedure

Patients were allocated to two different groups. 46 diabetic patients in Group A were treated with PRF after extracting their teeth, while Group B consisted of 47 non-diabetic people given PRF treatment after extraction. All procedures were done while using local anesthesia and aseptic methods, as well as techniques that do not harm the surrounding tissues. For PRF, we took 10 mL of blood from each patient through an IV line and collected it in sterile empty tubes, without using any anticoagulant. After the fibrin clot was formed into a membrane, it was put into the extraction socket before stitching it closed. Postoperative care was standardized for all participants, including the administration of analgesics and antibiotics, along with uniform instructions on oral hygiene, dietary guidelines, and scheduled follow-up visits.

Follow-up and Healing Assessment

Patients were monitored over a 12-month period to assess both short- and long-term socket healing. Clinical evaluations were performed on postoperative days 3, 7, and 21, and then monthly at 1, 3, 6, 9, and 12 months. Parameters included pain (Visual Analogue Scale), inflammation, soft tissue closure, granulation tissue, infection, and radiographic bone regeneration. Soft tissue healing was assessed using the Landry, Turnbull, and Howley Index, while bone regeneration was measured using a visual numeric scale (1–10) based on trabecular density, adapted from established socket healing indices. Digital periapical radiographs were taken at baseline, and at 3, 6, and 12 months. A composite healing index was calculated by equally weighting soft tissue healing, pain resolution, and bone fill. Postoperative infection was diagnosed clinically by the attending oral surgeon based on swelling, redness, purulent discharge, or localized fever after day 7.

Data Collection and Statistical Analysis

All observations were documented using a structured proforma. Data were entered and analyzed using SPSS version 26. A summary of the therapeutic and demographic features was obtained using descriptive statistics. The Chi-square test was applied to compare categorical healing outcomes between groups, while independent sample t-tests were used for continuous variables such as pain scores and bone density measurements. P-values below 0.05 were regarded as statistically noteworthy.

Ethical Considerations

Institutional Research and Ethics Committee of College examined and accepted the study approach. Informed written consent was obtained from all participants after explaining the nature, purpose, and potential risks of the study. Patients were assured of confidentiality, and participation was entirely voluntary, with the right to withdraw at any stage without any impact on their standard medical or dental care. The research was carried out in compliance with the Declaration of Helsinki's ethical guidelines.

Results

The study included 93 individuals in total, 46 of whom were in Group A (controlled diabetics) and 47 of whom were in Group B (non-diabetics). All participants completed the full 12-month follow-up period. The mean age was slightly higher in Group A (52.4 ± 8.1 years) compared to Group B (49.7 ± 7.6 years), but this variation was not prominent statistically ($p = 0.07$). Gender distribution was comparable, with males comprising 52.2% of Group A and 55.3% of Group B ($p = 0.76$). The average BMI was 27.3 ± 3.2 kg/m² in Group A and 26.1 ± 3.5 kg/m² in Group B ($p = 0.11$). As expected, the mean HbA1c level in the diabetic group was 6.9 ± 0.7%, confirming good glycemic control, while Group B had no applicable HbA1c data. Tooth extractions were predominantly molars in both groups 69.6% in Group A and 72.3% in Group B with no significant difference ($p = 0.76$). In summary, neither the baseline demographics nor the therapeutic features differed statistically significantly, ensuring that both groups were appropriately comparable for outcome assessment (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Group A (Diabetic, n=46)	Group B (Non-Diabetic, n=47)	*p*-value
Age (years)	52.4 ± 8.1	49.7 ± 7.6	0.07
Gender (Male/Female)	24 (52.2%) / 22 (47.8%)	26 (55.3%) / 21 (44.7%)	0.76
Body Mass Index (kg/m²)	27.3 ± 3.2	26.1 ± 3.5	0.11
HbA1c (%)	6.9 ± 0.7	Not applicable	N/A
Site of Extraction (Molar)	32 (69.6%)	34 (72.3%)	0.76
Site of Extraction (Other)	14 (30.4%)	13 (27.7%)	

Postoperative pain was evaluated using the Visual Analogue Scale (VAS) on days 3, 7, and 21 following tooth extraction. As shown in Table 2, diabetic patients in Group A consistently reported higher pain levels compared to non-diabetic patients in Group B. On day 3, the mean pain score was 4.9 ± 1.2 in Group A versus 3.8 ± 1.1 in Group B. By day 7, pain levels had decreased but remained higher in diabetics (3.1 ± 0.9) compared to non-diabetics (2.0 ± 0.8). On day 21, minimal pain was reported in both groups, but Group A still had higher scores (1.3 ± 0.6) compared to Group B (0.7 ± 0.5). These variations were consistently statistically significant ($p < 0.001$), indicating a slower pain resolution in diabetic patients.

Table 2: Mean Pain Scores (VAS) at Different Time Points

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	*p*-value
Day 3	4.9 ± 1.2	3.8 ± 1.1	< 0.001
Day 7	3.1 ± 0.9	2.0 ± 0.8	< 0.001
Day 21	1.3 ± 0.6	0.7 ± 0.5	< 0.001

Soft tissue healing was evaluated for three weeks post-extraction using the Landry, Turnbull, and Howley index. As detailed in figure 1, a far higher percentage of patients in the non-diabetic group (Group B) exhibited "Excellent" healing (59.6%) compared to those in the diabetic group (Group A), where only 23.9% achieved this grade. Conversely, "Fair" and "Poor" healing outcomes were more frequent among diabetics, with 28.2% and 6.5% respectively, compared to just 8.5% and 0% in non-diabetics. The overall distribution of healing grades between the two groups was statistically noteworthy ($p = 0.002$), showing that diabetes negatively affected soft tissue healing outcomes despite PRF application.

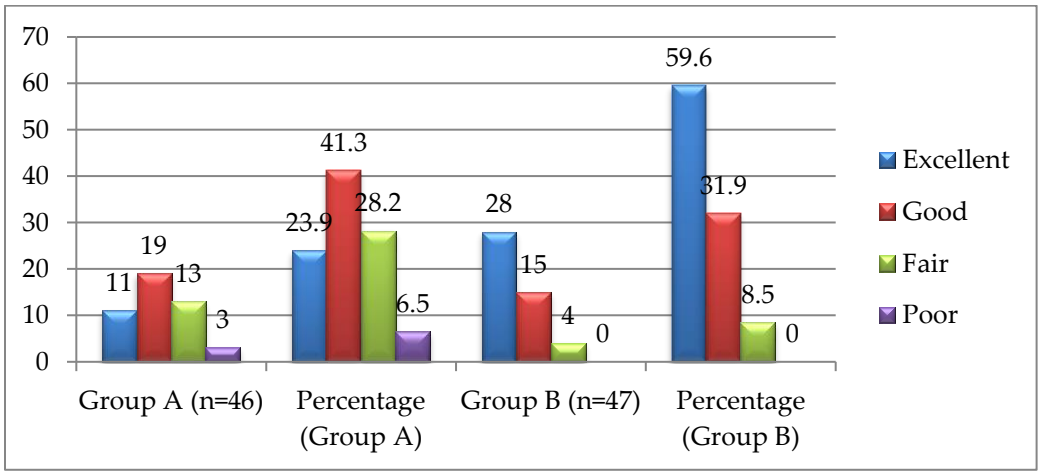

Figure 1: Healing Index at 3 Weeks Post-Extraction

Postoperative complications, particularly infection and inflammation, were notably more frequent in the diabetic group. As shown in figure 2, 13.0% of patients in Group A (controlled diabetics) developed

localized infections or exhibited signs of delayed healing, compared to only 2.1% in Group B (non-diabetics). This variation was statistically noticeable ($p = 0.045$), pointing to a higher susceptibility to complications among diabetic patients, even with the use of PRF. These findings suggest that Diabetes-related compromised immune response and impaired healing of wounds may still influence outcomes despite adjunctive regenerative therapy. Therefore, close postoperative monitoring and additional preventive strategies may be necessary for diabetic individuals undergoing dental extractions.

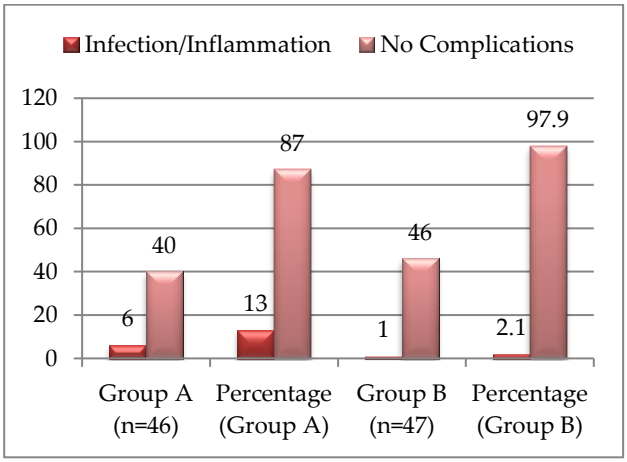

Figure 2: Postoperative Infections and Complications

Bone regeneration was evaluated through radiographic scoring at 3, 6, and 12 months postoperatively. As presented in Table 3, patients in Group B (non-diabetics) consistently exhibited higher bone density scores at each time point compared to patients in Group A (controlled diabetics). At 3 months, Group A had a mean score of 4.1 ± 0.8, while Group B had a significantly higher mean score of 5.6 ± 1.0 ($p < 0.001$). The difference continued at 6 months, with Group A scoring 6.3 ± 0.7 and Group B scoring 7.8 ± 0.6 ($p < 0.001$), and at 12 months, where Group A had a mean score of 7.9 ± 0.9 and Group B reached 9.1 ± 0.5 ($p < 0.001$). These outcomes advocate that non-diabetic patient exhibited more favorable bone regeneration, possibly due to the impact of diabetes on bone healing, despite the application of PRF therapy.

Table 3: Radiographic Bone Density Scores over Time

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	*p*-value
3 Months	4.1 ± 0.8	5.6 ± 1.0	< 0.001
6 Months	6.3 ± 0.7	7.8 ± 0.6	< 0.001
12 Months	7.9 ± 0.9	9.1 ± 0.5	< 0.001

At the 12-month follow-up, a composite healing index was used to assess overall socket healing, combining factors such as soft tissue healing, pain reduction, infection absence, and radiographic bone fill. As shown in figure 3, a significantly higher percentage of non-diabetic patients (Group B) achieved complete healing compared to diabetic patients (Group A). Specifically, 93.6% of Group B patients (44 out of 47) achieved complete healing, while only 65.2% of Group A patients (30 out of 46) reached this status ($p < 0.001$). Conversely, a higher proportion of diabetic patients (34.8%) experienced partial healing compared to non-diabetic patients (6.4%). It appears from these findings that non-diabetic patients may heal better than diabetic patients, even after both are treated with PRF.

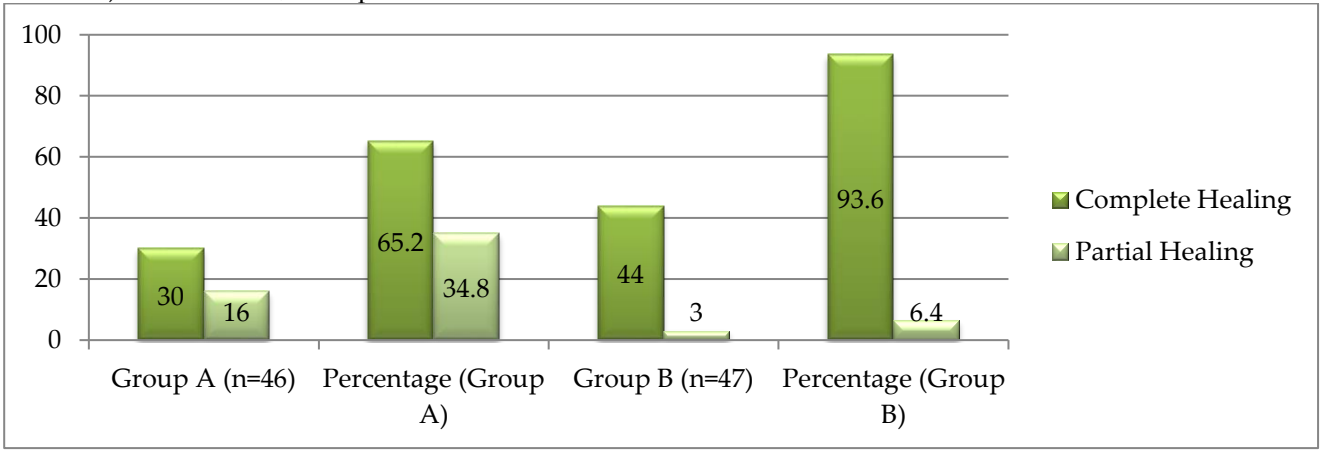

Figure 3: Composite Healing Score at 12 Months

Discussion

This study evaluated the sequel of PRF on the post-extraction recovery for both non-diabetic and diabetic people. Overall, the results demonstrate that non-diabetic patients experienced significantly better healing outcomes compared to diabetic patients across multiple parameters, including pain levels, soft tissue healing, bone regeneration, and infection rates. Diabetic patients reported higher pain levels at all-time points, had poorer soft tissue healing at 3 weeks, and exhibited slower bone regeneration. The incidence of infections and postoperative complications was also higher in diabetic patients. At 12 months, non-diabetic patients showed superior healing, with 93.6% achieving complete healing compared to 65.2% in the diabetic group.

The findings of this research align with a substantial body of literature highlighting the challenges associated with healing in diabetic patients [13]. Diabetic patients are known to have impaired wound healing due to a combination of factors, including poor blood circulation, reduced angiogenesis, and a compromised immune response [14]. These factors likely contributed to the higher pain scores, delayed soft tissue healing, and increased infection rates observed in this study.

In terms of pain, it is well-established that diabetic patients often experience prolonged and heightened discomfort following surgical procedures due to their reduced ability to manage inflammation and tissue regeneration [15]. The findings of this study, where diabetic patients consistently reported higher pain scores at 3, 7, and 21 days post-extraction, are consistent with this established trend. This delayed pain resolution in diabetics may be attributed to both metabolic and physiological impairments related to diabetes, including altered inflammatory response. Regarding soft tissue healing, the outcome of this research is in accordance with previous studies that have documented slower tissue repair in diabetics [16].

Non-diabetic patients in this study demonstrated significantly superior soft tissue healing, with a greater proportion achieving "Excellent" healing scores compared to diabetics. Diabetes is known to impair collagen synthesis, which is critical for wound healing, and this likely contributed to the inferior soft tissue healing observed in the diabetic group. The incidence of postoperative infections was noticeably greater in the diabetic batch, reflecting a common issue in diabetic patients who are prone to infections due to a weakened immune system and impaired neutrophil function. This finding is corroborated by existing research, which consistently reports higher infection rates in diabetics following various surgical procedures, including dental extractions [17].

Bone regeneration was another area where non-diabetic patients demonstrated superior outcomes. Non-diabetics consistently had higher radiographic bone density scores at 3, 6, and 12 months compared to diabetics. This finding supports the literature on impaired bone healing in diabetics, as diabetes negatively affects osteogenesis and angiogenesis, which are essential for bone regeneration after surgery [18]. Studies have shown that hyperglycemia reduces the ability of osteoblasts to proliferate and differentiate, leading to slower and less effective bone healing in diabetic individuals [19]. The composite healing index at 12 months further highlighted the differences between diabetic and non-diabetic patients. A larger proportion of non-diabetic patients achieved complete healing (93.6% vs. 65.2%), which reflects the cumulative effect of better soft tissue healing, less pain, fewer infections, and superior bone regeneration.

PRF may help counteract impaired angiogenesis and immune responses in diabetic patients by releasing bioactive molecules like PDGF, VEGF, and TGF-β, which are known to enhance tissue vascularization, stimulate fibroblast proliferation, and modulate local inflammation. These molecular effects may explain the improved healing observed even in diabetic individuals, although less pronounced than in non-diabetics.

Limitations and Future Suggestions

This study has several limitations. The sample size, while adequate for this study's scope, may not fully reflect healing variability in a larger population. A multicenter study with a larger sample size could yield more robust results. Additionally, the study focused on patients with controlled diabetes, and the findings may not apply to those with poorly

controlled diabetes, who could experience worse healing outcomes. Without a control group not receiving PRF treatment, the specific contribution of PRF to healing could not be isolated. The study also focused solely on results up to 12 months, so did not consider the effects that happen later on such as bone loss or additional problems. Research in the future should involve a larger group of patients, including those with poorly controlled diabetes, to see how PRF affects a wider range of people. Adding a control group and performing follow-up over a longer period would allow researchers to study PRF and see the long-term effectiveness of its results. More investigations should be carried out to understand the chemical changes that allow PRF to boost healing in those with diabetes.

Conclusion

All in all, this study reveals that patients without diabetes experience better post-extraction recovery following PRF than diabetic patients. The healing of soft tissues was better; infections were less common and non-diabetic patients experienced less pain and had a stronger bone regeneration. On the other hand, people with diabetes hampered healing and experienced a higher rate of problems. Based on the findings, PRF may provide significant benefits for healing after tooth removal, mainly in those without diabetes and studies need to further explore how it works in diabetics.

Authors' contributions

Conceptualization and supervision: TN; Methodology: TAK; Investigation, writing original draft and review: TU, RI; Data collection: ASC; Data analysis: ASC.

Conflict of interest

The authors declared no conflict of interest.

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