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Effects of Platelet-Rich Plasma on Wound Healing Following Tooth Extraction: A Randomized Controlled Clinical Study

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Abstract

Background: Platelet-Rich Plasma PRP refers to a biological preparation that is highly enriched with growth factors. It has been suggested that PRP administration can help to enhance the healing process after tooth extraction. However, its clinical effectiveness remains controversial. **Objectives:** To determine the effects of PRP on soft tissue healing and bone regeneration after tooth extraction**. Methods:** This was a randomized controlled study carried out at the Faculty of Dentistry, AL-Kafeel University, Najaf, Iraq, between November 2022 and January 2023. Forty patients requiring tooth extraction were randomly divided into two equal groups (n=20). In group I, PRP was applied right after the tooth extraction procedure, while group II was subjected to conventional healing via blood clot formation. PRP was prepared through a single-spin centrifugation (3000 rpm, 10 minutes) using ACD anticoagulant tubes. Assessments were done after one, four, and eight weeks to check soft tissue healing and bone regeneration. **Results:** PRP accelerated soft tissue healing; complete mucosa repair was achieved in four weeks as opposed to five weeks in the control group. Bone height and width increased by 1.01 mm and 1.16 mm, respectively, and postoperative complications were decreased with the use of PRP. **Conclusions:** PRP enhances soft tissue healing and facilitates bone regeneration after tooth extraction. Further research needs to be carried out.

Keywords: Platelet-rich plasma; Tooth extraction; Wound healing; Bone regeneration; Alveolar socket; Growth factors.

1. Introduction

One of the most common surgical procedures performed by dentists is tooth extraction. In the aftermath of tooth extraction, the alveolus undergoes several phases of healing processes involving hemostasis, inflammation, proliferation, and remodeling to form new bone and tissue [1,2]. The process is influenced directly by the activity of various growth factors and the general health of the individual.

Platelet-rich plasma (PRP) is an autologous blood product containing platelets in a concentration three to five times higher than normal physiological levels. On activation, platelets release several growth factors such as PDGF, TGF-β, VEGF, and EGF; all these growth factors play a vital role in wound healing and angiogenesis [3, 4]. As PRP is a biological product, it has been used as an adjunctive therapy in various branches of surgery such as oral and maxillofacial surgery, orthopedic surgery, and plastic surgery [5].

Platelet- rich plasmahas shown promise for various applications in dentistry, such as periodontal regeneration [6,7], implants, endodontic revascularization [8], and socket management after tooth extraction [9,10]. Some research has shown

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that PRP can help heal soft tissues faster [11], minimize cases of alveolar osteitis or dry sockets, and induce trabecular bone formation in the socket following an extraction procedure [12]. However, literature on the subject is quite variable since inconsistent results have been reported due to differences in PRP formulation and patient ,criteria among other reasons [13].

This study was conducted to determine the impact of platelet-rich plasma (PRP) on healing of wounds and formation of bones after tooth extraction in patients suffering from chronic pulpitis, severe periodontitis, and periapical lesions, when compared with other healing techniques not using PRP [14].

2. Materials and Methods

2.1 Study Design and Setting

The prospective randomized controlled clinical trial took place in the Oral Surgery Unit at the Dental College of Al-Kafeel University in Najaf, Iraq, between November 2022 and January 2023. The experiment followed the ethical guidelines stated in the Helsinki Declaration. All participants gave written informed consent before the start of the trial.

2.2 Sample Size and Randomization

A total of 40 patients requiring tooth extraction were enrolled. Participants were randomly allocated using a simple randomization scheme into two equal groups (n=20 per group): Group I (PRP group), in which extraction sockets received autologous PRP, and Group II (Control group), in which sockets were left to heal by conventional blood clot formation.

2.3 Inclusion and Exclusion Criteria

The inclusion criteria were adults who were 23 years or older of both sexes, who underwent one or more extraction procedures of non-restorable teeth under local anesthesia. The exclusion criteria involved pregnant or lactating women, severe thrombocytopenia, platelet dysfunction disorders, those on anticoagulation or immunosuppressive therapy, cardiovascular disorders requiring prophylactic antibiotics, those with malignancy, or subjects enrolled in another ongoing study. Subjects with diabetes mellitus or smokers were included as covariates for future analysis.

2.4 Clinical Procedure

Both groups underwent administration of an inferior alveolar nerve block or local infiltration anesthesia with lidocaine 2% with epinephrine 1:80,000 (NORMON S.A., Spain). The tooth extractions were performed according to the method of minimal trauma with the use of periotome, elevators, and anatomical forceps, avoiding gingival flaps when possible. Irrigation of the alveolus with sterile saline solution was carried out.

For Group I patients, PRP was immediately placed in the alveolus, and the alveolus was subjected to compression with sterile cotton pellets impregnated with PRP. For Group II patients, classical hemostatic treatment involved compressive pressure applied to the alveolus using dry sterile cotton pellets.

The postoperative recommendations for both groups of patients were also identical: patients were recommended to keep the cotton pellets within their mouth for 30–60 min, not rinse their mouths for two days, not smoke, and protect the alveolus from thermal and mechanical irritation.

Fig. 1: PRP-TUBE (separated platelets in centrifuge)

2.5 Outcome Measures and Follow-Up

The clinical follow-up assessments were conducted after 1 week, 4 weeks, and 8 weeks from the surgical procedure. The main outcomes included soft tissue healing with the presence of mucosal closure, quality of the granulation tissue formed, and absence of infections, along with radiographic bone regeneration measurements such as bone height and bone width.

2.6 Statistical Analysis

The data collection and analysis process involved the use of SPSS version 25.0 (IBM Corporation, USA). The means and standard deviations were obtained. For the comparison among groups, t-tests for independent samples and chi-square tests were used. Significance was considered at $p < 0.05$.

3. Results

3.1 Demographic Characteristics

Both groups were similar concerning age, gender, medical condition, and smoking habit. The indications for tooth extraction included chronic pulpitis, periodontitis, and periapical pathology. No significant difference was found between the two groups at baseline ($p > 0.05$).

3.2 Soft Tissue Healing

Patients undergoing PRP treatment showed much better soft tissue healing than those in the control group during the entire duration of the study. At four weeks after extraction, mucosa covering the whole socket was noted in 85 percent of PRP treatment subjects, while only 60% had this feature in the control group. After eight weeks, total epithelialization of all PRP sites occurred with normal tissue structure formation, while 20 percent of the control sockets still showed delayed or poor tissue healing.

3.3 Bone Regeneration Parameters

The radiological assessment revealed significantly higher bone fill volume in the PRP group. The average bone height increase was 1.01 ± 0.34 mm for the PRP group and 0.52 ± 0.28 mm for the control group ($p=0.012$). Also, the average bone width

increase was 1.16 ± 0.41 mm for the PRP group and 0.67 ± 0.33 mm for the control group (p=0.021). Such discrepancies were statistically significant during both the 4-week and 8-week intervals (Table 2).

3.4 Postoperative Complications

The incidence of dry socket (alveolar osteitis) was zero in the PRP group, compared to two patients (10% occurrence) in the control group. The postoperative pain levels were significantly reduced in the PRP group for the first 72 hours (p=0.038). There were no cases of infection at the surgical site, allergic reactions, or systemic complications reported in any of the groups.

Fig. 2: Wound directly post-extraction (with PRP)

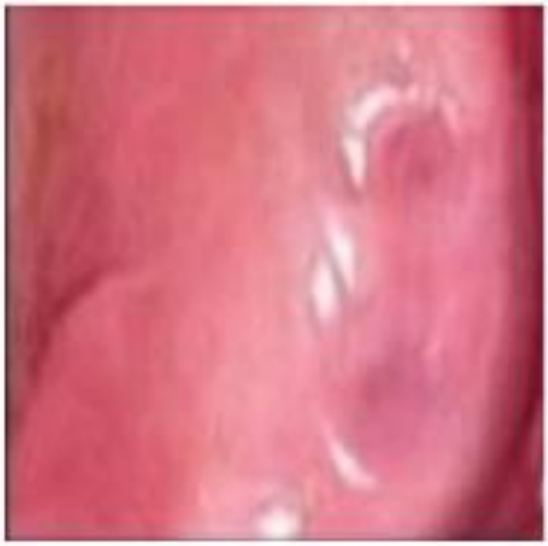

Fig. 3: Wound soft tissue healing 4 weeks post-extraction (with PRP)

Table 1. Comparison of bone regeneration parameters between PRP and control groups

Parameter	PRP Group (n=20)	Control Group (n=20)	Mean Difference	p-value
Bone Height Gain (mm) at 4 weeks	0.68 ± 0.22	0.31 ± 0.18	0.37	0.018
Bone Height Gain (mm) at 8 weeks	1.01 ± 0.34	0.52 ± 0.28	0.49	0.012
Bone Width Gain (mm) at 4 weeks	0.74 ± 0.29	0.38 ± 0.24	0.36	0.031
Bone Width Gain (mm) at 8 weeks	1.16 ± 0.41	0.67 ± 0.33	0.49	0.021

4. Discussion

Our current study provides clinical data suggesting that PRP positively influences the process of soft tissue repair and the initiation of bone formation after the extraction of teeth. These results are in line with other published studies showing faster healing and lower frequency of complications in extraction sockets filled with PRP [15,16].

The positive effect of PRP on the healing process after tooth extraction is well known. Once the platelets are activated via thrombin or calcium chloride, the platelets release their contents such as PDGF, TGF-β, VEGF, and EGF. All the growth factors play an important role in fibroblast proliferation, blood vessel formation, collagen deposition, and osteogenesis [3,17]. The better result achieved in our study regarding soft tissue closure (85% compared to 60% of sites closed at 4 weeks) may be explained by the mitogenic and chemotactic action of the platelet growth factors on epithelium and fibroblasts.

In relation to bone formation, the observed significant changes in terms of bone height (1.01 mm) and width (1.16 mm) after eight weeks in the PRP group correlate with earlier studies and experiments [12] found a marginally significant increase in the bone volume fraction of the trabecular bone in PRP-sockets at three months post-operation. Similarly, the findings of Gawai and Sobhana [13] showed increased osteogenic activity at one month, but not after four months, suggesting a time-dependent effect. The results could therefore represent the period of optimal activity of PRP on bone tissue [18,19].

The lack of incidence of alveolar osteitis in the PRP group can indicate the possible protective effect of PRP antimicrobial peptides and immunomodulating functions [20]. Platelets release antimicrobial peptides and activate macrophages via secretion of chemokines, thus triggering the innate immune response in the wound region [21]. Such an observation is important in view of the fact that the teeth with the sockets in question were affected by a pre-existing periodontal infection or other pathological conditions.

There are certain shortcomings worth noting. Firstly, the small sample size in terms of number of participants (n=40) limits the generalizability of the study [22]. Furthermore, the absence of a standardized technique for quantifying bone volume through radiography (such as cone beam computed tomography) prevents accurate evaluation of bone density [23,24]. Additionally, the single centrifugation process may result in lower amounts of platelets as compared to dual spinning. It has not been possible to establish a standardized PRP protocol [14, 25].

Potential confounders such as tobacco smoking and systemic diseases like diabetes mellitus have been accounted for, but they cannot be eliminated through

stratification randomization techniques. Future research may benefit from employing validated platelet counting measures, blinded analysis of the radiograph, and longer periods of follow-up lasting six to twelve months [26].

5. Conclusion

Autologous platelet-rich plasma (PRP) therapy in extraction sockets has been shown to enhance soft tissue healing and early bone formation compared with traditional blood clot-based healing. In this study, we show that PRP therapy is a safe method and might play a biological role in the treatment of extraction sockets. Further studies are encouraged.

Declarations

Ethical Approval and Consent to Participate

This study was approved by the Ethics Committee of the College of Dentistry at Al-Kafeel University. Informed written consent was acquired from each subject before including them in the study.

Availability of Data and Materials

Any datasets used or produced as part of this research are available from the corresponding author on reasonable request.

Competing Interests

There are no competing interests for any of the authors involved in this work.

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