LMJ LINK MEDICAL JOURNAL OF HEALTH AND COMMUNITY RESEARCH

Crossref DOI: https://doi.org/10.61919/8hg2ve74

Original Article

Effect of Platelet-Rich Fibrin on Alveolar Osteitis and Early Recovery After Mandibular Third Molar Surgery: A Randomized Controlled Trial

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ABSTRACT

Background: Alveolar osteitis is a painful complication after impacted mandibular third molar surgery and is associated with clot disintegration, delayed healing, repeated clinical visits, and increased analgesic use. Platelet-rich fibrin is an autologous fibrin matrix that may enhance clot stability and early tissue repair. Objective: To evaluate the effectiveness of platelet-rich fibrin in reducing alveolar osteitis and improving early recovery after impacted mandibular third molar extraction. Methods: This randomized controlled clinical trial included 60 adults requiring surgical removal of a single impacted mandibular third molar. Participants were allocated to a platelet-rich fibrin group or a conventional socket management group. The primary outcome was alveolar osteitis. Secondary outcomes included pain measured by Visual Analog Scale, facial swelling, Landry Wound Healing Index score, and analgesic consumption during the first post-operative week. Results: Alveolar osteitis occurred in 2 patients in the platelet-rich fibrin group and 8 patients in the control group (6.7% vs 26.7%; p = 0.038). Platelet-rich fibrin was associated with lower pain scores on days 1, 3, and 7, reduced facial swelling on days 3 and 7, better day-7 healing scores, and lower analgesic consumption. Conclusion: Platelet-rich fibrin reduced dry socket incidence and improved early post-operative recovery after mandibular third molar surgery. Keywords: Alveolar Osteitis; Platelet-Rich Fibrin; Third Molar; Tooth Extraction; Postoperative Pain; Wound Healing.

"Cite this Article" | **Received**: 11 August 2025; **Accepted**: 08 December 2025; **Published**: 31 December 2025.

Author Contributions: Concept: MHS; Design: ZH and CK; Data Collection: AS and FWP; Analysis: CK and SS; Drafting: MHS and ZH.. **Ethical Approval**: Khyber Medical University, Peshawar, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest; **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

INTRODUCTION

Surgical removal of impacted mandibular third molars is among the most frequently performed procedures in oral and maxillofacial surgery and remains clinically relevant because post-operative morbidity can substantially affect patient comfort, function, and treatment satisfaction (1). Although the procedure is routinely performed under local anesthesia, early recovery may be complicated by pain, facial swelling, delayed soft tissue healing, trismus, infection, and alveolar osteitis, commonly referred to as dry socket (2,3). Alveolar osteitis is particularly distressing because it is associated with severe post-operative pain, partial or complete loss of the initial intra-alveolar blood clot, exposed socket bone, delayed healing, repeated clinical visits, and increased requirement for local management and analgesic medication (4). The clinical burden is especially relevant after mandibular third molar surgery because this region is frequently associated with dense cortical bone, limited vascularity, greater surgical manipulation, and higher procedural difficulty compared with simple extractions (5).

The biological basis of alveolar osteitis is multifactorial and involves premature clot breakdown, local fibrinolytic activity, bacterial contamination, surgical trauma, and impaired early wound stabilization (6,7). Several patient- and procedure-related factors have been associated with increased risk, including smoking, oral contraceptive use, traumatic extraction, local infection, poor oral hygiene, and inadequate socket vascularity (8,9). Conventional preventive approaches, including atraumatic technique, antiseptic rinses, local medicaments, antibiotics, and socket dressings, may reduce post-operative complications in selected settings, but their effectiveness is variable and some approaches carry concerns related to cost, antimicrobial stewardship, local irritation, or inconsistent healing benefits (10,11). Therefore, a clinically useful adjunct should ideally be autologous, biologically active, easy to prepare, safe, inexpensive, and capable of supporting clot stability and early tissue repair without introducing unnecessary pharmacological exposure.

Platelet-rich fibrin is a second-generation autologous platelet concentrate prepared from the patient's venous blood without anticoagulants or biochemical additives. Its fibrin matrix contains platelets, leukocytes, cytokines, and growth factors that may support angiogenesis, fibroblast migration, epithelialization, extracellular matrix organization, and modulation of local inflammation (12,13). In extraction sockets, this fibrin scaffold may also provide mechanical stabilization of the clot and a biologically favorable matrix for early wound healing, thereby targeting one of the central events in the pathogenesis of alveolar osteitis (14). Previous clinical and systematic evidence has suggested that platelet concentrates, including PRF, may reduce pain, swelling, trismus, and delayed healing after mandibular third molar surgery; however, reported findings remain inconsistent because of differences in trial design, sample size, PRF preparation protocol, follow-up duration, surgical difficulty, and outcome definitions (15–17).

This inconsistency creates a practical knowledge gap for oral surgeons: whether PRF placement in mandibular third molar extraction sockets provides a measurable reduction in alveolar osteitis and improves early post-operative recovery when compared with conventional socket management. The present randomized controlled clinical trial was therefore designed according to a PICO framework in which adults requiring surgical extraction of a single impacted mandibular third molar represented the target population, PRF placement was the intervention, conventional socket management was the comparator, and the primary outcome was incidence of alveolar osteitis, with post-operative pain, facial swelling, soft tissue healing, and analgesic consumption evaluated as secondary recovery outcomes. The study objective was to determine whether placement of autologous PRF in the extraction socket reduces the incidence of alveolar osteitis and improves early clinical recovery after impacted mandibular third molar surgery compared with conventional management.

MATERIALS AND METHODS

This randomized controlled clinical trial used a parallel-group design to evaluate the effect of platelet-rich fibrin on alveolar osteitis and early post-operative recovery after surgical extraction of impacted mandibular third molars. The study was conducted over four months in dental clinical settings in the urban region of Sindh, Pakistan, where a consistent flow of patients requiring mandibular third molar surgery allowed recruitment of eligible participants. The trial compared two management strategies after extraction: placement of autologous PRF within the extraction socket and conventional socket management without adjunctive biologic material. The primary outcome was the incidence of alveolar osteitis, while secondary outcomes included post-operative pain intensity, facial swelling, soft tissue healing, and analgesic consumption during the first post-operative week.

Adults aged 18 to 35 years requiring surgical removal of a single impacted mandibular third molar under local anesthesia were screened for eligibility. Participants were included if they were classified as American Society of Anesthesiologists physical status I or II and had comparable surgical difficulty based on pre-operative clinical and radiographic assessment. Patients were excluded if they had systemic

conditions known to affect wound healing, active oral infection at the surgical site, smoking history, pregnancy or lactation, oral contraceptive use, or recent intake of antibiotics or anti-inflammatory medications. These criteria were applied to reduce confounding from known risk factors for alveolar osteitis and delayed socket healing. Eligible participants were recruited after clinical and radiographic evaluation, and written informed consent was obtained before enrollment.

A total of 60 participants were enrolled and allocated equally into two groups, with 30 participants receiving PRF and 30 receiving conventional socket management. The sample size was selected in line with comparable controlled clinical trials evaluating biologic adjuncts in mandibular third molar surgery and was considered adequate for detecting clinically meaningful differences in early post-operative outcomes. Participants were randomly assigned to the PRF or control group before surgery. Baseline variables recorded before intervention included age, sex, and type of impaction, and these characteristics were compared between groups to assess baseline comparability.

All surgical procedures were performed using a standardized protocol by the same experienced oral surgeon to reduce operator-related variability. Local anesthesia was administered, followed by flap reflection, bone removal and tooth sectioning where required, extraction of the impacted mandibular third molar, socket debridement, and irrigation. In the PRF group, venous blood was collected immediately before surgery and centrifuged to obtain an autologous fibrin clot, which was placed directly into the extraction socket before closure. In the control group, the socket was irrigated and sutured without placement of any additional material. Post-operative instructions and medications were standardized for both groups to minimize performance bias and ensure that differences in recovery were attributable as far as possible to the socket intervention.

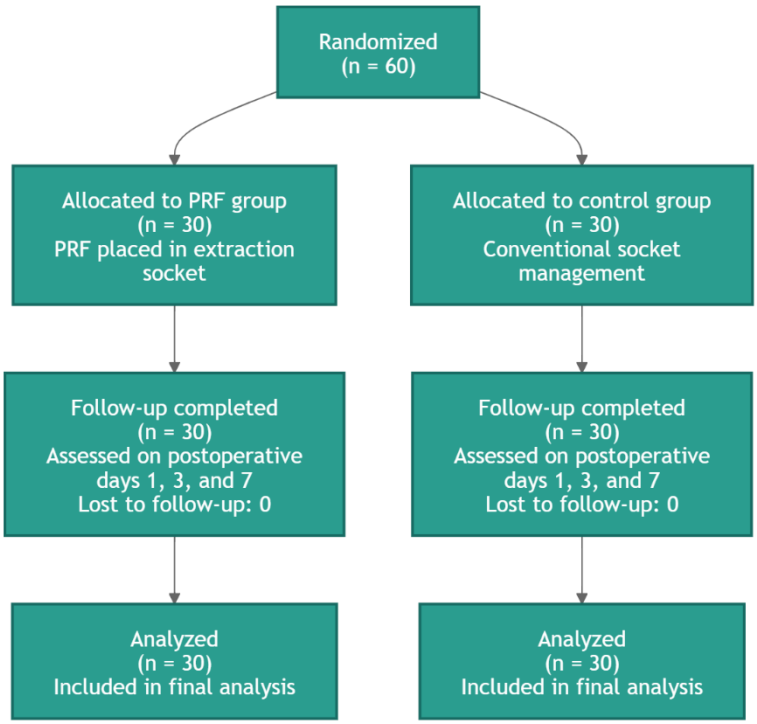

Figure 1 CONSORT Flowchart

Alveolar osteitis was operationally defined as persistent throbbing post-operative pain associated with partial or complete loss of the intra-alveolar blood clot and clinical evidence of delayed socket healing. It was assessed on the third and seventh post-operative days. Pain intensity was measured using a 10-cm Visual Analog Scale on post-operative days 1, 3, and 7, with higher scores indicating greater pain intensity. Facial swelling was assessed using standardized linear facial measurements between fixed anatomical landmarks with a flexible measuring tape, and measurements were recorded at follow-up visits. Soft tissue healing was evaluated on day 7 using the Landry Wound Healing Index, where higher

scores indicated better healing quality. Analgesic consumption was recorded as the total number of tablets used during the first post-operative week.

Data collection was performed using standardized clinical assessment forms, and all scheduled assessments were conducted on post-operative days 1, 3, and 7. To address measurement bias, the same outcome definitions and measurement procedures were applied across both study groups. Selection bias was reduced through random allocation, procedural bias was limited by using a single surgeon and standardized operative technique, and confounding was addressed through restrictive eligibility criteria excluding major known risk factors such as smoking, oral contraceptive use, active infection, pregnancy, and systemic conditions affecting healing. Data integrity was supported through complete follow-up, direct clinical recording at predefined time points, and verification of entered values before analysis.

Statistical analysis was performed using statistical software. Continuous variables were summarized as mean and standard deviation, while categorical variables were summarized as frequency and percentage. Normality of continuous variables was assessed using the Shapiro–Wilk test. Between-group comparisons for normally distributed continuous outcomes, including pain scores, facial swelling, healing index scores, and analgesic consumption, were performed using independent-sample t-tests. Changes in repeated pain and swelling measurements over time were evaluated using repeated-measures analysis of variance to assess time effects and group-by-time interaction. The incidence of alveolar osteitis was compared between groups using the chi-square test. Statistical significance was set at $p < 0.05$. Results were reported with p-values, and clinically important comparative outcomes were planned for tabular presentation with effect estimates where appropriate.

The study was conducted after approval from the institutional ethical review committee, and all participants provided written informed consent before participation. Patient confidentiality was maintained during data collection, entry, and analysis. Participation was voluntary, and clinical care was provided according to standard oral surgical practice. The use of autologous PRF minimized the risk of immunological reaction or disease transmission because the biologic material was prepared from each participant's own blood.

RESULTS

All 60 participants completed follow-up and were included in the final analysis. The PRF and control groups were comparable at baseline for age, sex, and impaction pattern, with not statistically significant between-group differences. The overall mean age was 24.8 ± 4.1 years; 34 participants were female and 26 were male. Mesioangular impaction was the most frequent type, observed in 27 participants.

Table 1. Baseline Demographic and Clinical Characteristics of Participants

Variable	Total Sample	PRF Group (n=30)	Control Group (n=30)	p-value
Age, years	24.8 ± 4.1	25.1 ± 4.3	24.5 ± 3.9	0.566
Male	26 (43.3%)	12 (40.0%)	14 (46.7%)	0.602
Female	34 (56.7%)	18 (60.0%)	16 (53.3%)	0.602
Mesioangular impaction	27 (45.0%)	14 (46.7%)	13 (43.3%)	0.963
Vertical impaction	19 (31.7%)	9 (30.0%)	10 (33.3%)	0.963
Distoangular impaction	14 (23.3%)	7 (23.3%)	7 (23.3%)	0.963

The incidence of alveolar osteitis was significantly lower in the PRF group than in the control group. Dry socket developed in 2 participants in the PRF group compared with 8 participants in the control group, corresponding to rates of 6.7% and 26.7%, respectively. This represented an absolute risk reduction of 20.0%, with an estimated number needed to treat of 5 patients to prevent one case of alveolar osteitis. The relative risk was 0.25, indicating an approximately 75% lower risk in the PRF group.

Table 2. Incidence of Alveolar Osteitis

Outcome	PRF Group (n=30)	Control Group (n=30)	Effect Estimate	p-value
Dry socket present	2 (6.7%)	8 (26.7%)	RR 0.25; 95% CI 0.06 to 1.08	0.038

Outcome	PRF Group (n=30)	Control Group (n=30)	Effect Estimate	p-value
Dry socket absent	28 (93.3%)	22 (73.3%)	ARR 20.0%; NNT = 5	—

Post-operative pain scores were consistently lower in the PRF group across all follow-up points. On day 1, the PRF group had a mean VAS score of 5.1 ± 1.2 compared with 6.4 ± 1.3 in controls, producing a mean difference of −1.30 points. By day 3, the difference increased slightly to −1.40 points, and by day 7, pain remained lower in the PRF group by −0.70 points. The largest standardized effect was observed on day 3, suggesting faster early pain resolution with PRF.

Table 3. Post-Operative Pain Scores

Time Point	PRF Group Mean ± SD	Control Group Mean ± SD	Mean Difference (95% CI)	Cohen's d	p-value
Day 1	5.1 ± 1.2	6.4 ± 1.3	−1.30 (−1.95 to −0.65)	−1.04	0.001
Day 3	3.2 ± 1.0	4.6 ± 1.1	−1.40 (−1.94 to −0.86)	−1.33	<0.001
Day 7	1.1 ± 0.6	1.8 ± 0.7	−0.70 (−1.04 to −0.36)	−1.07	0.002

Facial swelling was also significantly reduced in the PRF group. On day 3, mean swelling was 11.4 ± 2.1 mm in the PRF group and 14.2 ± 2.5 mm in the control group, with a mean difference of −2.80 mm. By day 7, swelling decreased in both groups but remained lower with PRF, with a mean difference of −1.80 mm. Healing quality was superior in the PRF group, with a Landry Wound Healing Index score of 4.3 ± 0.6 compared with 3.5 ± 0.7 in controls. Analgesic consumption was also lower in the PRF group, with participants taking a mean of 5.2 ± 1.8 tablets compared with 8.1 ± 2.3 tablets in controls.

Table 4. Post-Operative Clinical Recovery Outcomes

Outcome Variable	PRF Group Mean ± SD	Control Group Mean ± SD	Mean Difference (95% CI)	Cohen's d	p-value
Facial swelling day 3, mm	11.4 ± 2.1	14.2 ± 2.5	−2.80 (−3.99 to −1.61)	−1.21	<0.001
Facial swelling day 7, mm	5.3 ± 1.4	7.1 ± 1.6	−1.80 (−2.58 to −1.02)	−1.20	0.003
Healing index day 7	4.3 ± 0.6	3.5 ± 0.7	0.80 (0.46 to 1.14)	1.23	<0.001
Analgesics consumed, tablets	5.2 ± 1.8	8.1 ± 2.3	−2.90 (−3.97 to −1.83)	−1.40	<0.001

The recovery profile demonstrated a consistent clinical advantage in favor of PRF. Compared with controls, PRF was associated with a 74.9% relative reduction in dry socket incidence, a 20.3% reduction in day-1 pain, a 30.4% reduction in day-3 pain, a 38.9% reduction in day-7 pain, a 19.7% reduction in day-3 swelling, a 25.4% reduction in day-7 swelling, and a 35.8% reduction in analgesic consumption. These findings indicate that PRF improved both complication prevention and symptom recovery during the first post-operative week.

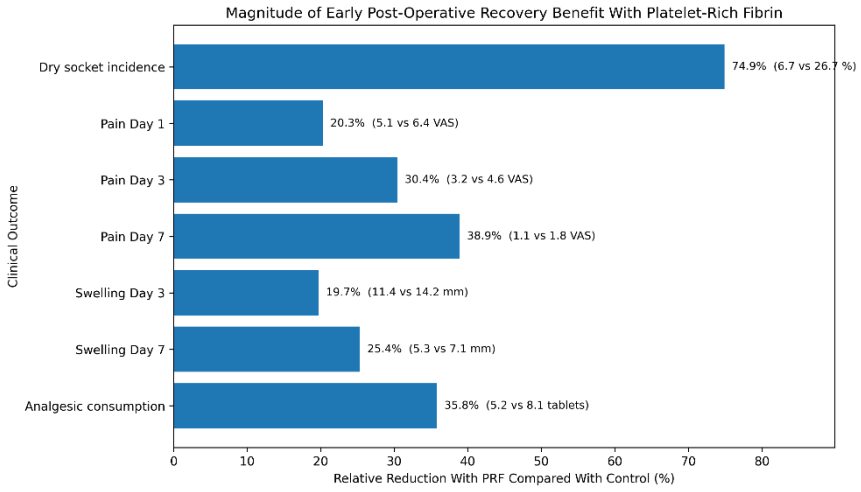

Figure 2 Magnitude of Early Post-Operative Recovery Benefit With Platelet-Rich Fibrin

The figure shows that the strongest relative benefit of PRF was observed for prevention of alveolar osteitis, with dry socket incidence reduced from 26.7% in controls to 6.7% in the PRF group. Clinically meaningful recovery advantages were also observed across symptomatic outcomes, including 30.4% lower pain by day 3, 38.9% lower pain by day 7, 25.4% lower swelling by day 7, and 35.8% lower analgesic consumption, supporting a consistent early recovery gradient favoring PRF placement.

DISCUSSION

The present randomized controlled trial demonstrated that platelet-rich fibrin placement after impacted mandibular third molar extraction was associated with a lower incidence of alveolar osteitis and a more favorable early post-operative recovery profile compared with conventional socket management. Dry socket occurred in 6.7% of participants in the PRF group compared with 26.7% in the control group, representing a 20.0% absolute risk reduction and an estimated number needed to treat of 5. This magnitude of benefit is clinically meaningful because alveolar osteitis is not only painful but also increases follow-up visits, local socket care, analgesic use, and patient dissatisfaction after third molar surgery. The observed reduction is consistent with previous evidence suggesting that platelet concentrates may support clot stabilization and reduce post-extraction inflammatory complications, although prior studies have varied in design, PRF preparation protocol, and outcome definitions (18).

The biological plausibility of these findings lies in the structure and cellular composition of PRF. As an autologous fibrin matrix containing platelets, leukocytes, cytokines, and growth factors, PRF may protect the developing clot from early breakdown while supporting angiogenesis, fibroblast migration, epithelialization, and extracellular matrix maturation. These mechanisms are relevant to alveolar osteitis, where premature clot disintegration and exposed alveolar bone are central clinical features. The lower dry socket rate in the PRF group therefore supports the interpretation that PRF may function both as a physical scaffold and as a biologically active healing matrix. Similar mechanisms have been described in studies evaluating PRF for soft tissue repair, dry socket management, and post-extraction healing, although the consistency of clinical benefit remains influenced by methodological heterogeneity across trials (19,20).

Pain reduction was another important finding. Participants treated with PRF reported lower VAS scores on day 1, day 3, and day 7, with mean differences of −1.30, −1.40, and −0.70 points, respectively. The day-3 difference was particularly relevant because inflammatory pain after surgical third molar extraction commonly peaks during the early post-operative period. The corresponding large standardized effects suggest that the reduction was not only statistically significant but also clinically perceptible. Reduced analgesic consumption further supported this interpretation, as the PRF group used a mean of 5.2 tablets compared with 8.1 tablets in the control group, indicating a 35.8% relative reduction in analgesic requirement. This finding is important from a patient-centered perspective because reduced medication use may improve comfort, reduce adverse drug exposure, and support earlier return to normal activity.

Facial swelling followed the same direction of effect. PRF-treated participants had lower swelling measurements on day 3 and day 7, with mean differences of −2.80 mm and −1.80 mm, respectively. Although swelling after third molar surgery is expected because of tissue trauma and inflammatory edema, the lower values in the PRF group suggest a moderated inflammatory response and improved early tissue organization. Better Landry Wound Healing Index scores in the PRF group further reinforce this interpretation, with a mean score of 4.3 compared with 3.5 in controls. Together, these findings indicate that PRF did not merely reduce the occurrence of dry socket but improved multiple interconnected dimensions of recovery, including pain, swelling, healing quality, and analgesic requirement.

The study has several strengths. The randomized controlled design, equal group allocation, complete follow-up, standardized surgical procedure, and use of the same experienced oral surgeon helped reduce selection and procedural variability. The exclusion of major dry socket risk factors such as smoking, oral contraceptive use, active infection, pregnancy, systemic healing disorders, and recent anti-inflammatory or antibiotic use improved internal validity by limiting important confounders. The use of clinically meaningful outcomes, including dry socket incidence, VAS pain score, swelling measurement, wound healing index, and analgesic consumption, allowed a broad assessment of early recovery rather than reliance on a single endpoint.

Despite these strengths, some limitations should be considered when interpreting the findings. The sample size was relatively modest, and the study was conducted in a single urban region, which may limit generalizability to wider surgical settings and more diverse patient populations. Follow-up was limited to the first post-operative week, so the study could not evaluate longer-term bone healing, periodontal outcomes distal to the second molar, or delayed complications. Operator blinding was not feasible because PRF placement is clinically visible, and although standardized criteria were used, outcome assessment may still be vulnerable to observer bias. In addition, the manuscript would be strengthened by more detailed reporting of random sequence generation, allocation concealment, assessor blinding, trial registration, and the exact PRF centrifugation protocol, as these details are essential for reproducibility and external validation.

Overall, the findings support PRF as a simple, autologous, and biologically plausible adjunct for improving early recovery after impacted mandibular third molar surgery. The combined reduction in dry socket incidence, pain intensity, swelling, and analgesic use suggests that PRF may provide clinically useful benefits when applied in appropriately selected patients. However, routine adoption should be supported by larger multicenter trials with standardized PRF preparation methods, longer follow-up, blinded outcome assessment where feasible, and reporting of patient-reported quality-of-life outcomes. Future comparative trials should also evaluate PRF against other preventive strategies to clarify its relative effectiveness, cost-effectiveness, and practical role in routine oral surgical care (21).

CONCLUSION

Placement of autologous platelet-rich fibrin in extraction sockets after impacted mandibular third molar surgery significantly reduced the incidence of alveolar osteitis and improved early post-operative recovery compared with conventional socket management. Patients receiving PRF experienced lower pain scores, reduced facial swelling, better soft tissue healing, and lower analgesic consumption during the first post-operative week. These findings suggest that PRF is a clinically useful adjunct that may enhance clot stability and early tissue repair after mandibular third molar extraction, although larger multicenter trials with standardized preparation protocols and longer follow-up are needed before broad routine implementation can be recommended.

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