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Enhancement Of Postoperative Healing After Impacted Third Molar Surgery: A Quasi-Experimental Comparison Of Platelet-Rich Fibrin And Collagen Membrane

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ABSTRACT

Objective:
To compare platelet-rich fibrin with resorbable collagen membranes in terms of post-operative pain, facial swelling, maximum mouth opening, soft-tissue healing, radiographic bone fill, and dry socket following impacted mandibular third molar extraction.

Design:
Quasi-experimental comparative study.

Place & duration of study:
Tertiary care hospital, Karachi (January–June 2025).

Methodology:
Seventy patients undergoing surgical removal of an impacted mandibular third molar were allocated by a fixed alternating sequence into two equal groups. Group A received platelet rich fibrin placed in socket and Group B received resorbable collagen membrane. Pain, facial swelling and maximum interincisal mouth opening were recorded at 24 and 72 hours, soft-tissue healing at seven days, radiographic bone-fill at two weeks and dry socket throughout follow-up. P-value of <0.05 was considered as significant.

Results:
Platelet-rich fibrin significantly reduced pain at 24 hours (3.2 ± 0.8 vs. 4.7 ± 1.1) and 72 hours (1.5 ± 0.6 vs. 2.8 ± 0.9; $p < 0.001$). The PRF group also demonstrated less facial swelling, greater maximum mouth opening ($p < 0.001$), superior 7-day soft-tissue healing (4.5 ± 0.5 verses 3.8 ± 0.6; $p < 0.01$), and greater 2-week radiographic bone fill (68.3% ± 6.4 vs. 54.7% ± 7.2; $p < 0.01$). Dry socket incidence did not differ significantly between groups (2.9% vs. 11.4%; $p = 0.08$).

Conclusion:
Platelet-rich fibrin produced superior healing outcomes compared with a resorbable collagen membranes following third molar extractions.

KEYWORDS: Platelet-Rich Fibrin; Third Molar; Tooth Extraction; Postoperative Pain; Wound Healing; Bone Regeneration; Edema; Trismus

INTRODUCTION:

Surgical removal of impacted mandibular third molars is one of the most frequently performed procedures in oral and maxillofacial surgery. Although the procedure is generally predictable, the inflammatory response associated with surgical trauma commonly produces postoperative sequelae. Pain, facial swelling, and limitation of mouth opening are among the most commonly reported problems and are particularly evident during the first few days after surgery. These symptoms interfere with eating, speaking, oral hygiene, sleep, and routine daily activities, thereby influencing the patient's overall postoperative experience and quality of recovery (1). The degree of morbidity varies with the depth of impaction, surgical difficulty, operating time, the extent of bone removal and individual patient characteristics.

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Healing of the extraction socket is an important consideration following mandibular third molar surgery. The healing process involves coordinated inflammatory, proliferative, and remodeling phases, with progressive formation of granulation tissue, soft-tissue closure, and new bone deposition within the socket. Disturbance of this process can contribute to complications such as alveolar osteitis, which is characterized by increased postoperative pain and delayed socket healing (2,3). Interventions that reduce early inflammatory morbidity while supporting soft-tissue and osseous repair are therefore of continuing interest in oral surgical practice.

Platelet-rich fibrin is an autologous fibrin matrix prepared from the patient's own blood and contains platelets, leukocytes, and a range of biologically active mediators Its three-dimensional fibrin architecture serves as a temporary scaffold within the extraction socket, while its cellular and molecular components contribute to angiogenesis, tissue organization and repair. Unlike platelet concentrates that require anticoagulants or more complex processing, PRF can be prepared using a relatively straightforward chairside protocol. These characteristics have led to its increasing use in oral surgical procedures where enhancement of local tissue healing is desired (4).

Clinical studies evaluating platelet-rich fibrin following mandibular third molar removal have reported potentially beneficial effects on several postoperative outcomes. Reductions in pain and facial swelling, improved postoperative mouth opening, and more favorable soft-tissue healing have been described in patients treated with platelet-rich fibrin compared with conventional socket management or control interventions (5-7). In addition to clinical recovery, its potential role in promoting bone formation has generated interest in its use for extraction-socket healing. Systematic reviews have also suggested that platelet-rich fibrin may provide benefits in postoperative recovery and tissue regeneration, although differences in study design, preparation protocols, assessment methods, and follow-up periods have resulted in variability among reported findings (8).

Resorbable collagen membranes represent another approach to managing the extraction sockets and supporting tissue healing. Collagen is a biocompatible material that can function as a temporary scaffold and may assist stabilization of the wound environment. A collagen membrane placed over or within the extraction site can provide protection to the underlying healing tissue and may support early soft-tissue repair and subsequent bone regeneration (9). Their resorbable nature also eliminates the need for a second procedure for membrane removal. Consequently, collagen-based materials have been incorporated into various oral surgical and regenerative procedures.

Despite the reported benefits of both platelet-rich fibrin and collagen membranes, the relative effectiveness of these two approaches remains less clearly established. Much of the available literature has evaluated platelet-rich fibrin against conventional treatment, placebo, or no additional biomaterial, while studies involving collagen membranes have frequently focused on their regenerative properties rather than direct comparison with platelet-rich fibrin. Furthermore, postoperative pain, swelling, trismus, soft-tissue healing, radiographic bone formation, and alveolar osteitis are not consistently evaluated together within the same investigation. Differences in surgical technique, patient selection, outcome assessment, and postoperative protocols further limit direct comparison across studies.

Evidence from Pakistan has also contributed to the growing literature concerning platelet-rich fibrin and collagen-based materials in oral surgical procedures; however, direct comparative evidence between these two materials following impacted mandibular third molar surgery remains limited (10). Local evidence is particularly relevant because variations in patient demographics, clinical practice, surgical techniques, and postoperative care may influence treatment outcomes. Evaluating both interventions under comparable clinical conditions can therefore provide a clearer assessment of their relative effects on postoperative morbidity and socket healing.

The need for an intervention that can simultaneously minimize early postoperative morbidity and support satisfactory tissue regeneration provides the rationale for directly comparing platelet-rich fibrin with a resorbable collagen membrane. A comparative assessment using objective clinical and radiographic outcomes may help determine whether one approach provides greater benefit during the early healing period following impacted mandibular third molar surgery.

Therefore, this study was conducted to compare the effects of platelet-rich fibrin and resorbable collagen membranes on postoperative pain, facial swelling, maximum mouth opening, soft-tissue

healing, radiographic bone fill, and incidence of dry socket following surgical removal of impacted mandibular third molars.

MATERIAL AND METHOD:

Seventy eligible patients were enrolled. Patients aged 18–40 years requiring surgical extraction of a partially or completely impacted mandibular third molar were eligible. Only patients classified as American Society of Anesthesiologists (ASA) physical status I or II, who provided written informed consent and were able to attend all postoperative assessments, were included. Patients were excluded if they had uncontrolled systemic disease including diabetes mellitus, hypertension or a bleeding disorder; were immunocompromised; had received previous steroid therapy; had active infection at the operative site; were pregnant or lactating; were smokers; or were considered unlikely to complete follow-up.

Participants were divided equally into two groups of 35 using a fixed alternating sequence, with consecutive patients assigned alternately to Group A or Group B. Group A received platelet-rich fibrin and Group B received a resorbable collagen membrane.

All procedures were performed under local anesthesia using a standardized operative technique. The procedure involved flap elevation, bone removal and tooth sectioning when clinically indicated, followed by socket management and wound closure. In Group A, freshly prepared autologous platelet-rich fibrin (PRF) was placed into the extraction socket following tooth removal. In Group B, a resorbable collagen membrane was positioned over the socket before suturing. Identical postoperative instructions and follow-up procedures were provided to participants in both groups.

Data were recorded using a structured clinical proforma. Baseline demographic variables were documented preoperatively, and postoperative evaluations were conducted at 24 hours, 72 hours, 7 days and 2 weeks. Pain intensity was assessed using a 10-point visual analog scale (VAS). Facial swelling was measured using standardized anatomical reference points. Trismus was evaluated by recording the maximum interincisal mouth opening. Soft-tissue healing was assessed at 7 days using a modified healing index. Radiographic bone fill was evaluated at 2 weeks. The incidence of dry socket and any other complications was documented throughout the follow-up period.

Institutional ethical approval was obtained before the study commenced. Written informed consent was obtained from every participant. Confidentiality was preserved by using coded participant information, and participants were informed that they could discontinue participation at any time without affecting their clinical care.

Data were analyzed using SPSS version 26.0. Descriptive statistics were used to summarize the participants' demographic and baseline data; continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Between-group differences in postoperative pain, facial swelling and maximum mouth opening were assessed using the Mann–Whitney U test, according to the distribution of the data. Within-group comparisons across the follow-up intervals were made using the paired t-test. Categorical outcomes, including the incidence of dry socket, were compared using Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

A total of seventy patients undergoing surgical extraction of impacted mandibular third molars were included in the study. Participants were evenly distributed between the PRF group (n = 35) and the collagen membrane group (n = 35). The mean age was 27.4 ± 5.2 years among patients receiving PRF and 28.1 ± 5.5 years among those treated with a collagen membrane. The sex distribution was also similar between the two groups. Statistical analysis showed no significant differences in baseline demographic variables ($p > 0.05$), confirming comparable demographic characteristics at the beginning of the study (Table 1).

Table 1. Baseline Demographics of Participants

Variable	PRF Group (n=35)	Collagen Membrane Group (n=35)	p-value
Age (years), mean ± SD	27.4 ± 5.2	28.1 ± 5.5	0.54
Male	18(51.4%)	17(48.6%)	0.80
Female	17(48.6%)	18(51.4%)	

Postoperative pain was evaluated using a 10-point Visual Analogue Scale at 24 and 72 hours. A significantly lower pain intensity was recorded in the PRF group at 24 hours compared with the

collagen membrane group (3.2 ± 0.8 vs. 4.7 ± 1.1; p < 0.001). Pain severity declined further by 72 hours in both groups, although the PRF group continued to have significantly lower scores (1.5 ± 0.6 vs. 2.8 ± 0.9; p < 0.001). The reduction in pain from 24 to 72 hours was statistically significant within both treatment groups (p < 0.001).

Postoperative facial swelling was also significantly less pronounced among patients treated with PRF at both assessment points (p < 0.001). Maximum mouth opening was greater in the PRF group at 24 and 72 hours, reflecting reduced postoperative restriction of mandibular movement (p < 0.001). Both groups showed significant improvement in swelling and mouth opening over the follow-up period (p < 0.01) (Table 2).

Table 2. Postoperative Pain, Facial Swelling, and Maximum Mouth Opening

Outcome	Time Point	PRF Group (mean ± SD)	Collagen Membrane Group (mean ± SD)	p-value
Pain (VAS)	24 hours	3.2 ± 0.8	4.7 ± 1.1	<0.001
	72 hours	1.5 ± 0.6	2.8 ± 0.9	<0.001
Facial swelling (cm)	24 hours	1.8 ± 0.4	2.5 ± 0.6	<0.001
	72 hours	1.2 ± 0.3	1.9 ± 0.5	<0.001
Maximum mouth opening (mm)	24 hours	32.5 ± 3.4	28.7 ± 3.9	<0.001
	72 hours	38.6 ± 2.9	33.2 ± 3.2	<0.001

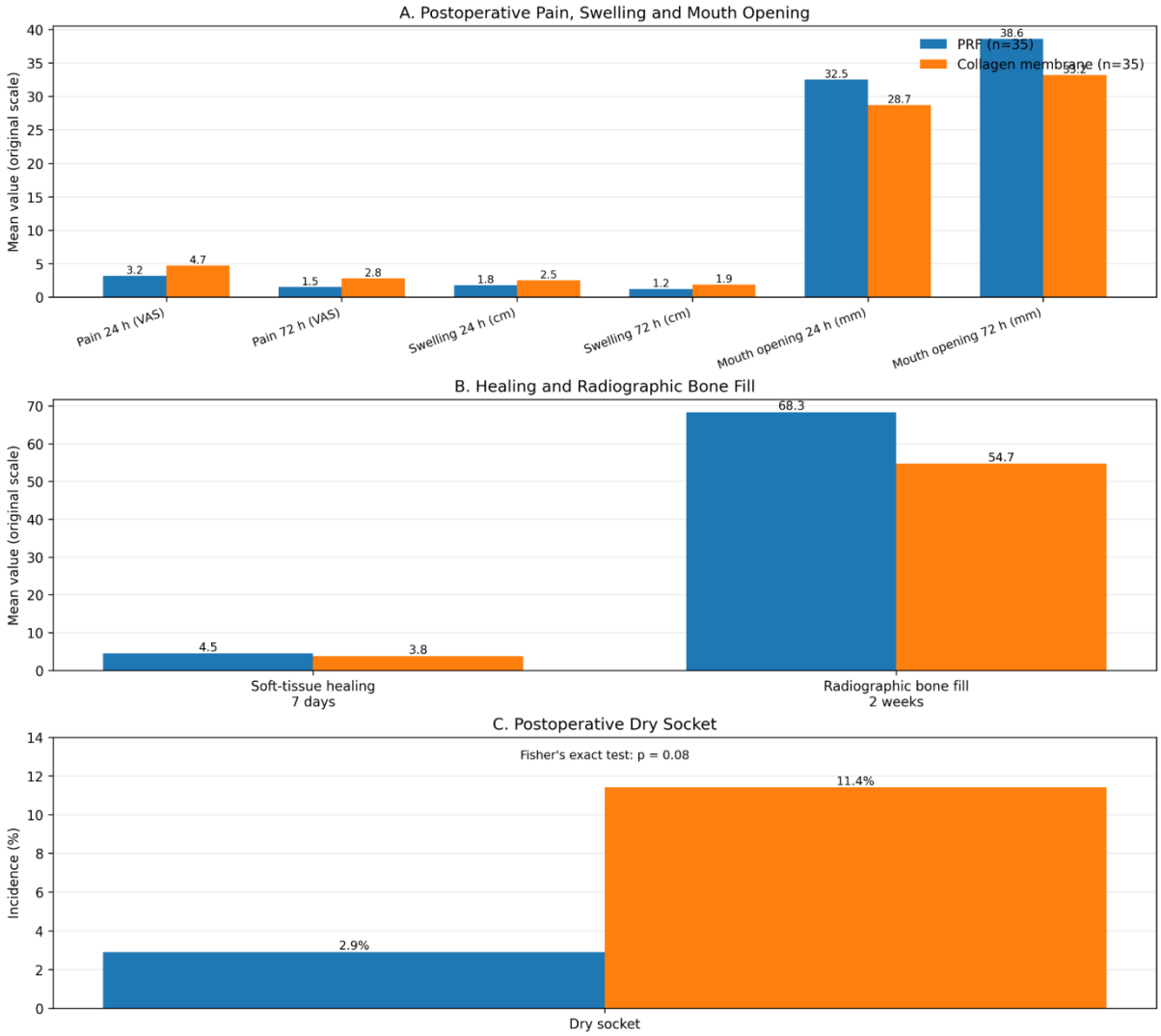
Assessment at day 7 showed a significantly higher mean soft tissue healing score in the PRF group than in the collagen membrane group (4.5 ± 0.5 vs. 3.8 ± 0.6; p < 0.01). Radiographic evaluation at two weeks likewise showed greater mean bone fill among patients who received PRF (68.3% ± 6.4) compared with those treated with a collagen membrane (54.7% ± 7.2; p < 0.01).

Dry socket was observed in one patient (2.9%) in the PRF group and four patients (11.4%) in the collagen membrane group. Although the frequency was numerically lower following PRF treatment, the difference did not reach statistical significance (Fisher's exact test, p = 0.08). No other postoperative adverse events were recorded during the follow-up period (Table 3).

Table 3. Soft Tissue Healing, Radiographic Bone Fill, and Postoperative Complications

Outcome	PRF Group (n=35)	Collagen Membrane Group (n=35)	p-value
Soft tissue healing score at 7 days, mean ± SD	4.5 ± 0.5	3.8 ± 0.6	<0.01
Radiographic bone fill at 2 weeks (%), mean ± SD	68.3 ± 6.4	54.7 ± 7.2	<0.01
Dry socket, n (%)	1 (2.9%)	4 (11.4%)	0.08

Figure 1. Comparison of Postoperative Outcomes Between PRF and Collagen Membrane Groups



Taken together, the postoperative findings showed more favourable recovery measures in the PRF-treated participants, including lower pain and swelling, better preservation of mouth opening, higher soft tissue healing scores, and greater radiographic bone fill. The occurrence of dry socket was numerically lower following PRF application, although the observed difference between the two groups was not statistically significant. No other postoperative complications or adverse events were reported during the study follow-up.

DISCUSSION:

The present study examined whether the biological properties of platelet-rich fibrin (PRF) translate into measurable clinical advantages when compared with a resorbable collagen membrane following surgical removal of impacted mandibular third molars. Across multiple postoperative parameters—pain intensity, facial swelling, mouth opening, soft tissue repair, and early bone formation—PRF demonstrated consistently superior outcomes. Although a lower frequency of dry socket was observed in the PRF group, the difference did not reach statistical significance.

Pain following third molar surgery primarily results from surgical trauma, inflammatory mediator release, and tissue edema. In this study, participants treated with PRF experienced notably lower pain scores during the early postoperative phase. This observation corresponds with findings from randomized trials that reported reduced analgesic requirements and improved comfort when PRF was applied to extraction sockets (1,4,11,15). The mechanism underlying this effect is likely multifactorial. PRF forms a dense fibrin scaffold enriched with platelets and leukocytes that gradually release bioactive molecules. These mediators regulate inflammation and promote faster tissue organization, potentially limiting peripheral sensitization. Systematic evaluations of PRF in oral surgery have similarly concluded that its application is associated with reduced postoperative pain

compared with conventional management (8–10). The current results further strengthen this growing body of evidence.

Postoperative edema and restricted mandibular movement are common consequences of surgical extraction of impacted molars. In the present study, both facial swelling and limitation in mouth opening were less pronounced in the PRF group. Comparable outcomes have been described in clinical studies in which PRF contributed to attenuation of inflammatory responses (15,18,19,27).The biological composition of PRF may account for this effect. Growth factors such as PDGF and TGF-β support vascular stabilization and tissue repair, while leukocytes within the fibrin matrix may modulate inflammatory cascades. Reduced tissue edema likely contributed to improved interincisal distance and faster functional recovery. Three-dimensional imaging studies have also demonstrated diminished postoperative swelling in sites treated with PRF (19), reinforcing the anti-inflammatory potential observed in the present work.

Assessment of mucosal healing at one week revealed more favorable healing scores in the PRF-treated sockets. This supports prior clinical research demonstrating enhanced epithelial closure and improved soft tissue maturation with PRF application (4,13,16,21,22). Unlike passive barrier materials, PRF acts as a biologically active matrix. It provides structural support while simultaneously releasing cytokines and growth factors that stimulate fibroblast proliferation, angiogenesis, and collagen synthesis. Comparative investigations between PRF and collagen membranes have similarly indicated that autologous fibrin matrices may accelerate early wound healing more effectively than inert regenerative barriers (2,26).

Radiographic analysis conducted two weeks postoperatively showed greater bone fill in the PRF group. This finding is consistent with randomized clinical trials and prospective studies reporting enhanced early bone formation in extraction sites treated with PRF (5–7,17,23,24). The regenerative advantage of PRF may stem from its capacity to stabilize the initial clot while serving as a scaffold for osteogenic cell migration. In addition, sustained growth factor release may stimulate differentiation of mesenchymal cells into osteoblasts, thereby supporting new bone deposition. Reviews examining ridge preservation strategies have also recognized PRF as a promising adjunct for promoting socket regeneration (10,20). The increased radiographic density observed in this study may therefore reflect accelerated early-phase bone remodeling.

Although fewer cases of alveolar osteitis were noted in the PRF group, statistical significance was not achieved. Previous investigations have suggested that PRF may reduce the likelihood of dry socket by enhancing clot stability and improving vascularization (3,14).The limited number of events in the present study may have restricted statistical power to detect a meaningful difference whereas Larger trials have demonstrated clearer protective trends in favor of PRF (3,14). Even so, the reduced incidence observed here is consistent with the hypothesis that biological clot stabilization contributes to improved postoperative outcomes.

Collagen membranes are widely employed in regenerative dentistry for their barrier function and structural support. Clinical studies have shown that collagen-based materials can improve healing compared with untreated sockets (12). However, collagen membranes function primarily as passive scaffolds and do not inherently deliver growth factors whereas PRF combines mechanical support with biological activity. The superior performance observed in this study suggests that regenerative materials capable of actively modulating the healing cascade may provide additional clinical benefits over materials that serve only as physical barriers (2,26).

From a practical standpoint, PRF is autologous, relatively inexpensive, easy to prepare chairside and associated with minimal risk of immunologic reaction. The observed improvements in postoperative comfort and early tissue repair indicate that PRF may enhance patient recovery and satisfaction after impacted third molar surgery, and its incorporation into routine oral surgical protocols could therefore be justified, particularly in cases where accelerated healing is desirable.

There are certain limitations within the current study. The follow-up period was restricted to early healing phases, preventing assessment of long-term bone maturation. Future multicenter studies with extended observation periods and larger cohorts would provide more definitive evidence regarding the long-term regenerative benefits of PRF.

CONCLUSION:

Both platelet-rich fibrin and resorbable collagen membranes supported effective postoperative recovery following surgical removal of impacted

mandibular third molars. Platelet-rich fibrin, however, demonstrated superior early reduction in pain, facial swelling and functional limitation, together with better soft-tissue healing and greater radiographic bone fill, most probably because of its autologous biological activity. Selection of material should therefore take account of both biological advantages and clinical objectives.

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Author's Contribution:
Momil Nadeem Shaikh: conceptualization and study design
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Dania Hamid: approval of the final manuscript. Review and analysis

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