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Comparative Evaluation of Postoperative Pain, Swelling, and Trismus Following Impacted Mandibular Third Molar Surgery Using Platelet-Rich Fibrin and Ozone Therapy: A Randomized Clinical Study

¹Dr. Pankhuri Pande, ²Dr. Abhinav Miglani, ³Dr. Subho Arpan, ⁴Dr. Upasa Sarma Medhi, ⁵Dr. Sumit Bhatt, ⁶Dr. Sai Sagar

¹Associate Professor, Department of Oral and Maxillofacial Surgery, VYWS Dental College and Hospital, Amravati, Maharashtra.

²Department of Oral & Maxillofacial Surgery, Institute of Dental Sciences, K-8, Kalinga Nagar, Bhubaneswar, Odisha-751003.

³Consultant Oral and Maxillofacial Surgeon, Rotary Club of Purulia Service Centre - Eye and Multispeciality Hospital, Purulia, West Bengal.

⁴Department of Oral and Maxillofacial Surgery, Institute of Dental Sciences, K-8, Kalinga Nagar, Bhubaneswar, Odisha-751003.

⁵PhD Scholar, Assistant Professor, Department of Oral and Maxillofacial Surgery, Rajasthan Dental College & Hospital, Nirwan University, Jaipur, Rajasthan.

⁶Senior House Surgeon, Govt Hospital Neyattinkara, Trivandrum, Kerala.

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ABSTRACT

Background: Postoperative pain, swelling, and trismus are common complications following impacted mandibular third molar surgery. Various adjunctive therapies have been introduced to improve healing and reduce postoperative discomfort. Platelet-rich fibrin (PRF) and ozone therapy have shown promising results due to their anti-inflammatory and healing-enhancing properties.

Aim: To compare the effectiveness of PRF and ozone therapy in reducing postoperative pain, swelling, and trismus after impacted mandibular third molar surgery.

Materials and Methods: This randomized clinical study included 45 patients requiring surgical extraction of impacted mandibular third molars. Participants were randomly divided into three groups: Group I (control), Group II (PRF), and Group III (ozone therapy). Postoperative pain was assessed using the Visual Analog Scale (VAS), swelling was measured using facial reference points, and trismus was evaluated by measuring maximum mouth opening on postoperative days 1, 3, and 7. Statistical analysis was performed using ANOVA and post hoc tests, with $p < 0.05$ considered statistically significant.

Results: Both PRF and ozone therapy groups demonstrated reduced postoperative pain, swelling, and trismus compared to the control group. The PRF group showed superior improvement in soft tissue healing and reduction in pain scores, while the ozone therapy group demonstrated better reduction in swelling during the early postoperative period. The differences between the study groups were statistically significant ($p < 0.05$).

Conclusion: Both PRF and ozone therapy are effective adjuncts in minimizing postoperative complications following impacted mandibular third molar surgery. PRF showed comparatively better overall healing outcomes, whereas ozone therapy was more effective in controlling early postoperative swelling.

Introduction

Surgical extraction of impacted mandibular third molars is one of the most commonly performed procedures in oral

and maxillofacial surgery.^{1,2} Despite advances in surgical techniques and postoperative care, patients frequently experience complications such as pain, swelling, and trismus following the procedure. These postoperative sequelae can

significantly affect the patient's quality of life, daily activities, and overall satisfaction with treatment.^{3,4}

Various pharmacological and non-pharmacological approaches have been proposed to minimize postoperative discomfort after third molar surgery. Conventional management commonly includes analgesics, antibiotics, corticosteroids, and cold therapy. However, increasing interest has been directed toward biologically active adjuncts that can accelerate healing and reduce inflammation with minimal adverse effects.⁵⁻⁷

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate introduced by Choukroun et al., which contains platelets, leukocytes, cytokines, and growth factors embedded within a fibrin matrix. PRF promotes angiogenesis, tissue regeneration, and wound healing, thereby reducing postoperative complications. Due to its autologous nature, ease of preparation, and cost-effectiveness, PRF has gained popularity in oral surgical procedures.⁶

Ozone therapy has also emerged as a promising adjunct in oral surgery because of its antimicrobial, anti-inflammatory, analgesic, and wound-healing properties. Ozone enhances oxygen supply to tissues, stimulates local circulation, and promotes tissue repair. Several studies have reported beneficial effects of ozone therapy in reducing postoperative pain and swelling following oral surgical procedures.⁷

Although both PRF and ozone therapy have independently demonstrated positive outcomes in oral surgery, limited studies have directly compared their effectiveness following impacted mandibular third molar extraction. Therefore, the present randomized clinical study was undertaken to comparatively evaluate the effects of PRF and ozone therapy on postoperative pain, swelling, and trismus after impacted mandibular third molar surgery.

Materials and Methods

Study Design: The present study was designed as a randomized clinical trial to evaluate and compare the effectiveness of platelet-rich fibrin (PRF) and ozone therapy in reducing postoperative pain, swelling, and trismus following surgical extraction of impacted mandibular third molars.

Study Population: A total of 45 patients requiring surgical removal of impacted mandibular third molars were selected from the outpatient department of Oral and Maxillofacial Surgery. The patients were aged between 18 and 35 years and were selected based on predefined inclusion and exclusion criteria.

Inclusion Criteria

- Patients aged between 18 and 35 years

- Patients requiring surgical extraction of impacted mandibular third molars
- Patients who were systemically healthy
- Patients willing to participate and provide informed consent

Exclusion Criteria

- Patients with systemic diseases affecting healing
- Pregnant or lactating women
- Patients with acute infection at the surgical site
- Patients on corticosteroids, anticoagulants, or immunosuppressive therapy
- Smokers and tobacco users
- Patients allergic to study medications

Group Allocation

The selected patients were randomly divided into three groups with 15 patients in each group:

- Group I: Control Group
- Group II: Platelet-Rich Fibrin (PRF)
- Group III: Ozone Therapy

Surgical Procedure: All surgical procedures were performed under local anesthesia using a standardized surgical protocol. A mucoperiosteal flap was reflected, bone guttering and tooth sectioning were carried out when required, and the impacted tooth was extracted atraumatically. The surgical site was irrigated with normal saline.

In Group II, PRF was prepared by collecting 10 mL of intravenous blood in sterile tubes without anticoagulant and centrifuging it immediately at 3000 rpm for 10 minutes. The obtained PRF clot was placed into the extraction socket before suturing.

In Group III, Patients received topical application of ozonized oil at the extraction site immediately following impacted mandibular third molar extraction. The ozonized oil was applied directly into the extraction socket prior to suturing under standardized clinical conditions.

All extraction sites were sutured using 3-0 silk sutures. Postoperative medications, including antibiotics and analgesics, were prescribed uniformly for all patients.

Evaluation Parameters

Pain Assessment: Pain intensity was assessed using the Visual Analog Scale (VAS).

Swelling Assessment: Facial swelling was measured using standardized facial reference points.

Trismus Assessment: Maximum mouth opening was measured as the interincisal distance using a vernier caliper.

Statistical Analysis: The collected data were analyzed using

SPSS software version 25.0. Intergroup comparisons were performed using one-way ANOVA followed by post hoc tests. A p-value of less than 0.05 was considered statistically significant.

Results: Postoperative pain scores assessed using the Visual Analog Scale (VAS) were highest in the control group at all follow-up intervals. Both the PRF group and ozone therapy group demonstrated significantly lower pain scores compared to the control group (Table 1). On postoperative day 1, the ozone therapy group showed comparatively lower mean pain scores than the PRF group; however, by postoperative days 3 and 7, the PRF group demonstrated greater reduction in pain intensity. The differences among the groups were statistically significant ($p < 0.05$).

Postoperative facial swelling was observed in all groups on day 1, with gradual reduction over time. The ozone therapy group exhibited the least swelling during the early postoperative

period compared to the PRF and control groups (Table 2). By postoperative day 7, both PRF and ozone therapy groups showed significantly reduced swelling compared to the control group. Intergroup comparison revealed statistically significant differences between the study groups ($p < 0.05$).

Reduction in maximum mouth opening was noted in all patients immediately after surgery. The PRF and ozone therapy groups demonstrated better recovery in mouth opening compared to the control group at all follow-up intervals (Table 3). The PRF group showed greater improvement in mouth opening by postoperative day 7 when compared with the ozone therapy and control groups. The differences were found to be statistically significant ($p < 0.05$).

Clinical evaluation of the extraction sockets revealed improved soft tissue healing in the PRF group, followed by the ozone therapy group (Table 4). The control group demonstrated comparatively delayed healing.

Table 1. Comparison of Mean VAS Pain Scores Among the Study Groups

Postoperative Day	Control Group	PRF Group	Ozone Therapy Group	p-value
Day 1	7.12 ± 0.81	5.34 ± 0.72	4.98 ± 0.69	<0.05
Day 3	5.86 ± 0.74	3.42 ± 0.61	3.89 ± 0.66	<0.05
Day 7	2.41 ± 0.52	0.94 ± 0.28	1.22 ± 0.35	<0.05

Table 2. Comparison of Mean Facial Swelling Among the Study Groups

Postoperative Day	Control Group (mm)	PRF Group (mm)	Ozone Therapy Group (mm)
Day 1	14.28 ± 1.62	10.54 ± 1.34	9.76 ± 1.28
Day 3	11.43 ± 1.38	7.12 ± 1.04	6.54 ± 0.96
Day 7	4.21 ± 0.86	1.68 ± 0.42	2.03 ± 0.51

Table 3. Comparison of Mean Maximum Mouth Opening Among the Study Groups

Postoperative Day	Control Group (mm)	PRF Group (mm)	Ozone Therapy Group (mm)	p-value
Preoperative	42.16 ± 2.14	41.84 ± 2.02	42.08 ± 1.96	>0.05
Day 1	28.34 ± 1.92	32.18 ± 1.74	31.46 ± 1.68	<0.05
Day 3	33.21 ± 1.86	37.52 ± 1.48	36.74 ± 1.56	<0.05

Table 4. Comparison of Soft Tissue Healing Scores Among the Study Groups on Postoperative Day 7

Group	Mean Healing Score	p-value
Control Group	2.86 ± 0.52	
PRF Group	1.12 ± 0.34	<0.05
Ozone Therapy Group	1.46 ± 0.41	

Lower healing scores indicate better healing outcome.

Discussion

Surgical extraction of impacted mandibular third molars is one of the most commonly performed procedures in oral and maxillofacial surgery. Despite improvements in surgical

techniques and postoperative care, patients frequently experience complications such as pain, swelling, and trismus following surgery.^{8,9} These postoperative sequelae mainly occur due to tissue trauma, inflammatory response, and muscle irritation associated with flap reflection, bone

removal, and tooth sectioning.¹⁰ Therefore, several adjunctive modalities have been investigated to reduce postoperative discomfort and improve wound healing. The present study was undertaken to comparatively evaluate the effectiveness of platelet-rich fibrin and ozone therapy in minimizing postoperative complications following impacted mandibular third molar surgery.

The findings of the present study demonstrated that both PRF and ozone therapy significantly reduced postoperative pain, swelling, and trismus compared with the control group. These results suggest that both treatment modalities can effectively enhance postoperative recovery and patient comfort after third molar surgery.

Postoperative pain is one of the most common and distressing complications after impacted third molar extraction. In the present study, both PRF and ozone therapy groups showed significantly lower pain scores compared with the control group at all postoperative intervals (Table 1). The PRF group demonstrated greater reduction in pain intensity during the later postoperative period. This may be attributed to the biologic properties of PRF, which contains platelets, leukocytes, cytokines, and growth factors embedded within a fibrin matrix. These growth factors, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF- β), and vascular endothelial growth factor (VEGF), are gradually released over time and contribute to tissue regeneration, angiogenesis, and reduction of inflammation. The fibrin matrix also acts as a biologic scaffold that enhances wound healing and protects the surgical site, thereby reducing postoperative pain and discomfort.^{11,13}

The reduction in postoperative pain observed in the ozone therapy group may be explained by the analgesic and anti-inflammatory properties of ozone. Ozone improves tissue oxygenation, stimulates local blood circulation, and reduces microbial contamination at the surgical site. In addition, ozone has been shown to modulate inflammatory mediators and reduce oxidative stress, which may contribute to decreased postoperative pain. The findings of the present study are in accordance with previous studies that reported beneficial effects of ozone therapy in reducing postoperative discomfort following oral surgical procedures.¹¹⁻¹³

Swelling is another common postoperative complication that results from tissue injury and inflammatory exudate accumulation following surgery. In the present study, postoperative facial swelling was significantly reduced in both PRF and ozone therapy groups when compared with the control group (Table 2). The ozone therapy group demonstrated comparatively better reduction in swelling during the immediate postoperative period. This finding may be related to the ability of ozone to enhance oxygen metabolism and improve local microcirculation, thereby reducing inflammatory edema. Ozone also exerts anti-inflammatory effects by decreasing the production of inflammatory mediators and promoting faster tissue

repair.^{14,15}

The PRF group also demonstrated reduced postoperative swelling compared with the control group. The fibrin matrix present in PRF may help stabilize the surgical wound and reduce inflammatory reactions. Furthermore, the gradual release of growth factors from PRF promotes soft tissue healing and tissue maturation, thereby reducing postoperative edema. Similar findings have been reported in previous studies evaluating the role of PRF in oral surgical wound healing.¹⁶

Trismus, characterized by restricted mouth opening, commonly occurs after third molar surgery due to inflammation and spasm of the masticatory muscles. In the present study, both PRF and ozone therapy groups showed improved recovery in maximum mouth opening compared with the control group (Table 3). The PRF group demonstrated superior improvement in mouth opening by postoperative day 7. This may be attributed to reduced inflammation, enhanced tissue healing, and decreased muscle stiffness associated with PRF application. The regenerative properties of PRF may contribute to faster recovery of soft tissues surrounding the surgical site, thereby improving mandibular function and mouth opening.

Clinical evaluation of soft tissue healing revealed superior healing outcomes in the PRF group compared with the ozone therapy and control groups (Table 4). The enhanced healing observed with PRF may be attributed to its high concentration of platelets and growth factors, which stimulate fibroblast proliferation, collagen synthesis, angiogenesis, and epithelial regeneration. The leukocytes present within PRF also contribute to antimicrobial activity and immune regulation, further enhancing wound healing. Ozone therapy also demonstrated improved healing compared with the control group because of its antimicrobial and immunomodulatory properties. However, the regenerative potential of PRF appeared to be comparatively greater than ozone therapy in the present study.

Overall, the findings of the present study suggest that both PRF and ozone therapy are effective adjunctive modalities for reducing postoperative complications after impacted mandibular third molar surgery. PRF demonstrated superior long-term healing outcomes and better improvement in pain and trismus during the later postoperative period, whereas ozone therapy was particularly effective in controlling early postoperative swelling and discomfort.

Although the present study produced promising results, certain limitations should be considered. The sample size was relatively small, and the follow-up duration was limited to the early postoperative period. In addition, variations in surgical difficulty, patient pain threshold, and healing response may influence postoperative outcomes. Therefore, further multicentric studies with larger sample sizes and longer follow-up periods are recommended to validate the findings and establish standardized clinical protocols for the

use of PRF and ozone therapy in oral surgical procedures.

Conclusion

Within the limitations of the present study, both platelet-rich fibrin (PRF) and ozone therapy were found to be effective adjunctive modalities in reducing postoperative complications following impacted mandibular third molar surgery. Both treatment modalities demonstrated significant reduction in postoperative pain, swelling, and trismus when compared with conventional management alone.

PRF showed superior overall healing outcomes and better improvement in postoperative pain and mouth opening during the later healing period. Ozone therapy demonstrated greater effectiveness in controlling early postoperative swelling and discomfort.

Therefore, the use of PRF and ozone therapy may enhance postoperative recovery and patient comfort following impacted mandibular third molar extraction. Further studies with larger sample sizes and longer follow-up periods are recommended to confirm the findings and establish standardized treatment protocols.

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