COMPARATIVE EVALUATION OF OZONE GEL AND PLATELET RICH FIBRIN IN ALVEOLAR OSTEITIS MANAGEMENT

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ABSTRACT

Introduction: Alveolar osteitis (AO), or dry socket, is a painful postoperative complication commonly occurring after mandibular third molar extractions. It results from the loss or disintegration of the blood clot, leaving exposed alveolar bone. Platelet-Rich Fibrin (PRF), an autologous biomaterial, and ozone gel have been explored for their regenerative and anti-inflammatory potential in AO management. This study aims to compare the clinical efficacy of PRF and ozone gel in treating AO. Materials and methods: A randomized clinical trial was conducted on 28 patients aged 20–70 years with clinically diagnosed AO. Participants were randomly assigned to two groups: Group 1 (PRF) and Group 2 (ozone gel). PRF was prepared using Choukroun's protocol and placed into the socket with sutures. In the ozone group, commercially available ozone gel (450 mcg/ml) was applied into the socket. Both groups received standard analgesics as needed. Pain (VAS), perisocket inflammation, wound healing, and analgesic intake were evaluated on days 1, 3, and 7 post-treatments. Statistical analyses were performed using Friedman and Mann-Whitney U tests, with a significance level set at $p < 0.05$. Results: PRF showed a statistically significant reduction in pain, inflammation, and analgesic intake from days 1 to 7 ($p < 0.05$). Wound healing scores were also significantly higher in the PRF group on the 7th day. In comparison, the ozone group showed clinical improvement, but with higher pain and inflammation scores and increased analgesic use, particularly in the first five days post-intervention. Intergroup comparisons revealed significantly better outcomes for PRF in all assessed parameters by day 7. Conclusion: PRF was more effective than ozone gel in reducing pain, inflammation, and enhancing wound healing in AO. PRF should be considered a preferred treatment, with ozone gel as a supportive adjunct when PRF is unavailable.

Keywords: Alveolar osteitis, dry socket, platelet-rich fibrin, ozone gel, wound healing.

Introduction

Tooth extraction is among the most frequent oral surgical procedures, yet it is not without complications. One of the most painful postoperative sequelae is alveolar osteitis (AO)—commonly known as *dry socket*—a condition characterized by the premature disintegration or loss of the blood clot, leaving the alveolar bone exposed. This results in severe radiating pain, halitosis, and delayed socket healing. AO typically manifests within three days post-extraction, especially after surgical removal of mandibular third molars, and may last up to two weeks if untreated. It has been reported to occur in 1–5% of all extractions and in up to 15% of transalveolar procedures, with a higher prevalence among smokers and women over 30 years of age.[1],[3]

The exact etiology of AO remains multifactorial, with bacterial contamination, increased local fibrinolysis, and traumatic extractions implicated as the primary triggers.[4],[5] Risk factors include smoking, oral contraceptive use, poor oral hygiene, surgical difficulty, and operator inexperience.[6] Blum's definition of dry socket emphasizes the absence of a blood clot in the socket, accompanied by intense throbbing pain that may radiate to the ear, temple, or neck.[1] Birn's fibrinolytic theory further explains that trauma or infection activates plasminogen, leading to clot dissolution and exposure of bone.[7] Conventional management of AO remains largely palliative, involving socket irrigation, analgesics, and obtundent dressings such as iodoform gauze with zinc oxide–eugenol.[4] Other interventions like chlorhexidine, oxytetracycline–hydrocortisone mixtures, and low-level laser therapy (LLLT) have also shown varying success rates.[4],[8] Despite numerous preventive and therapeutic approaches, a universally accepted standard of care is lacking, prompting exploration of biological and regenerative materials. Platelet-Rich Fibrin (PRF) and ozone gel have recently emerged as promising agents in managing alveolar osteitis. PRF, a second-generation autologous platelet concentrate, contains a dense fibrin matrix rich in platelets, leukocytes, and growth factors such as PDGF, TGF-β, and VEGF, which promote angiogenesis, fibroblast proliferation, and tissue regeneration.[9] Its sustained release of cytokines accelerates wound healing while minimizing infection risk. Similarly, ozone (O_3), a triatomic oxygen molecule, possesses potent antimicrobial, analgesic, and immune modulatory properties. In gel form, it enhances local oxygenation, reduces bacterial load, and stimulates tissue repair.[10] Given their biological activity and ease of application, both modalities are attractive options for AO treatment. This study was designed to compare the clinical efficacy of PRF and ozone gel in the management of alveolar osteitis by evaluating pain, inflammation, wound healing, and analgesic consumption over one week.

Materials and Methods

A randomized clinical investigation was carried out in the Department of Oral and Maxillofacial Surgery at SIBAR Institute of Dental Sciences, Guntur, India. The study population consisted of 28 individuals between 20 and 70 years of age who were clinically diagnosed with established alveolar osteitis. Diagnosis was based on the presence of at least two characteristic symptoms—such as continuous throbbing pain radiating to nearby regions, unpleasant taste or odor, or persistent discomfort not relieved by medication—along with at least one clinical finding, including the absence of a blood clot, localized swelling, or lymph node enlargement. Patients who were pregnant, undergoing immunosuppressive therapy, or who declined to participate were excluded from the trial. Eligible participants were randomly allocated into two equal groups, each containing 14 subjects. Group I received treatment with platelet-rich fibrin (PRF), whereas Group II was treated using ozone gel with a concentration of 450 mcg/ml. For the PRF preparation, approximately 10 millilitres of venous blood were collected from each participant and centrifuged at 3000 revolutions per minute for ten minutes according to Choukroun's standard protocol. The fibrin clot obtained from the middle layer was gently separated from the red cell fraction and inserted into the debrided extraction socket under local anesthesia (2% lignocaine containing adrenaline at a dilution of 1:80,000). The socket was secured using a 3-0 black silk suture in a figure-of-eight pattern and compressed with sterile gauze to ensure stability. In patients assigned to the ozone group, the sockets were irrigated with sterile saline and filled with commercially available ozone gel, following identical anesthesia and suturing procedures. All participants were provided with standard postoperative instructions and were prescribed diclofenac sodium (50 mg) for pain management, with paracetamol as an alternative for those intolerant to NSAIDs. Clinical evaluations were conducted on the first, third, and seventh postoperative days. The parameters assessed included pain intensity using a visual analog scale (VAS) ranging from 0 to 10, the degree of perisocket inflammation (graded from 0 to 3), wound healing based on standardized granulation scores (0 to 3), and the quantity of analgesic tablets consumed daily for the first five days.

Data collected were analyzed using SPSS statistical software. Nonparametric tests—including the Friedman, Mann–Whitney U, and Wilcoxon signed-rank tests—were applied for intragroup and intergroup comparisons. A p-value of less than 0.05 was considered to denote statistical significance. Ethical approval for the study protocol was obtained from the institutional review committee prior to commencement.

Results

All twenty-eight participants successfully completed the clinical trial without any complications or adverse effects. Both treatment modalities—platelet-rich fibrin (PRF) and ozone gel—were well tolerated, and no patient exhibited any allergic reactions or systemic side effects throughout the study period. Within-group analyses demonstrated notable improvements in both treatment arms, though the magnitude and pace of recovery varied. In the PRF group, there was a marked and statistically significant reduction in pain intensity from the first to the seventh postoperative day ($p < 0.05$) (Table.1). By the end of the observation period, most individuals experienced complete or near-complete relief from discomfort. A progressive decline in perisocket inflammation was also evident, showing significant changes across all follow-up intervals. Wound healing exhibited substantial progress, with the majority of sockets displaying healthy granulation tissue and epithelial coverage by day seven (Table.3) . The requirement for pain medication dropped sharply after the third postoperative day, and none of the patients required additional analgesics beyond the fourth day. In contrast, the ozone gel group also showed gradual symptomatic improvement; however, the early reduction in pain and inflammation between the first and third postoperative days was less pronounced compared with PRF. Healing scores indicated moderate granulation tissue formation by the third day and partial epithelialization by the seventh day. Analgesic consumption remained higher in this group during the initial five days, suggesting slower relief and delayed tissue recovery. When comparing outcomes between the two interventions, PRF demonstrated clear superiority across most measured parameters. On the third and seventh postoperative days, mean pain and inflammation scores were significantly lower among patients treated with PRF ($p < 0.05$). Similarly, wound healing on the seventh day showed more advanced granulation and faster epithelial regeneration in the PRF-treated sockets (Table.2) Analgesic intake was consistently reduced in this group from day one through day five, with statistically significant differences at every interval ($p < 0.05$). Overall, the findings indicate that platelet-rich fibrin facilitated more rapid pain relief, accelerated tissue healing, and reduced dependency on analgesic medication compared with ozone gel during the crucial first postoperative week. These outcomes highlight the enhanced regenerative potential of PRF in managing alveolar osteitis

Pain	Group	Mean Rank	Test statistic	P - value
Day 1	PRF	12	63	0.089
	Ozone	17		
Day 3	PRF	8.64	16	0.000*
	Ozone	20.36		
Day 7	PRF	7.57	1	0.000*
	Ozone	21.43		

.**Table 1**. Comparison of pain between subjects treated with PRF and Ozone on 1st, 3rd and 7th day

Perisocket Inflammation	Group	Mean Rank	Test statistic	P - value
Day 1	PRF	14.50	98	1.000
	Ozone	14.50		
Day 3	PRF	9.57	29	0.001*
	Ozone	19.43		
Day 7	PRF	9.93	34	0.001*
	Ozone	19.07		

Table 2. Comparison of inflammation between subjects treated with PRF and Ozone on 1st, 3rd and 7th day

Wound Healing	Group	Mean Rank	Test statistic	P - value
Day 1	PRF	14.43	97	0.961
	Ozone	14.57		
Day 3	PRF	17	63	0.079
	Ozone	12		
Day 7	PRF	18.79	38	0.003*
	Ozone	10.21		

Table 3. Comparison of wound healing between subjects treated with PRF and Ozone on 1st, 3rd and 7th day

Discussion

Alveolar osteitis remains a clinically challenging complication despite decades of research. First described by Crawford in 1896, its pathogenesis is still debated, though Birn's fibrinolytic theory remains the most widely accepted explanation, attributing clot disintegration to increased fibrinolytic activity.[12–14] The condition is influenced by multiple factors—traumatic extractions, microbial invasion, hormonal fluctuations, and systemic conditions—which contribute to delayed healing and intense postoperative pain. The present study sought to evaluate two biotherapeutic modalities—ozone gel and platelet-rich fibrin—in the management of established alveolar osteitis. Both are minimally invasive, economical, and biologically safe interventions designed to accelerate healing and reduce patient discomfort.

Efficacy of Ozone Gel

Ozone therapy has gained recognition for its strong antimicrobial and oxygenating properties, disrupting bacterial cell walls and enhancing local circulation.[18–20] Guerra et al. reported that ozonated oil effectively reduced microbial colonization and improved epithelial healing, though early discomfort persisted.[21] Similarly, Filippi and Nagayoshi demonstrated ozone's potential in enhancing oral wound healing and inhibiting bacteria in dentinal tubules, respectively.[22,23]

In the present study, ozone gel provided gradual improvement in pain and inflammation but was less effective than PRF in the early postoperative phase. The delayed pain relief may result from limited gel retention within the socket and dilution by saliva, which could diminish its therapeutic concentration.

Efficacy of Platelet-Rich Fibrin

Conversely, PRF produced significantly superior outcomes across all evaluated parameters. The fibrin matrix of PRF serves as a biological scaffold, supporting sustained release of growth factors including PDGF, TGF-β, VEGF, and IGF, which are crucial for angiogenesis, fibroblast migration, and collagen synthesis.[24–26] Studies by Kumar et al. and Sharma et al. corroborate PRF's ability to reduce pain and inflammation while promoting epithelial closure within one week of application.[24,25] The presence of leukocytes within PRF further contributes to its antibacterial and immunoregulatory effects, enhancing socket sterilization and accelerating tissue repair.[27] Our findings parallel those of Eshghpour et al., who demonstrated that PRF application after third molar extraction significantly reduced AO incidence and shortened healing time.[28] Dohan et al. emphasized PRF's advantage over

platelet-rich plasma due to its ease of preparation, absence of additives, and three-dimensional fibrin network that supports sustained growth factor release.[26] These properties make PRF a cost-effective and biologically superior alternative for managing alveolar osteitis, especially in resource-limited clinical settings.

Comparative Analysis

While ozone gel displayed favourable antimicrobial activity, its effects were primarily palliative rather than regenerative. PRF, being autologous, directly engages in the regenerative cascade, stimulating angiogenesis and fibroblast proliferation, resulting in faster epithelialization and durable pain relief. By day 7, PRF-treated sockets showed near-complete closure, whereas ozone-treated sockets exhibited partial healing and residual tenderness. Moreover, patients treated with PRF required fewer analgesics, underscoring its analgesic potential derived from reduced inflammatory cytokine release.

Limitations and Clinical Implications

The small sample size (n = 28) limits the generalizability of the findings, and larger multicentric trials are needed to validate the results. Furthermore, the viscosity and dilution of ozone gel within the oral cavity may have reduced its effectiveness, suggesting that controlled-release formulations could enhance its clinical performance. Nonetheless, both agents were safe, economical, and easy to use in outpatient settings. PRF's single-application protocol offers practical benefits—reduced chair time, enhanced patient compliance, and minimized postoperative follow-ups. Its autologous nature eliminates the risk of hypersensitivity reactions and reduces dependence on systemic medications, thereby lowering the risk of adverse drug effects. Ozone gel, while less effective, remains a viable alternative when autologous blood preparation is contraindicated or unavailable.

Conclusion

Alveolar osteitis remains one of the most painful postoperative complications in oral surgery. This comparative clinical study demonstrated that Platelet-Rich Fibrin (PRF) significantly outperforms ozone gel in relieving pain, reducing inflammation, and promoting faster wound healing.

The superior outcomes associated with PRF are attributed to its sustained release of growth factors that facilitate angiogenesis and epithelial regeneration. Ozone gel, though beneficial as an antimicrobial and anti-inflammatory agent, exhibited slower and less predictable healing responses.

Given its autologous nature, simplicity, and strong regenerative capacity, PRF should be considered the first-line therapy for managing alveolar osteitis, while ozone gel may serve as a supportive adjunct in mild cases or when PRF is not feasible. Future research with larger sample sizes and extended follow-up periods is warranted to further substantiate these findings and explore potential synergistic use of both modalities.

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