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Original Research

Efficacy of ozonated oil or gel in post-extraction wound healing in oral surgery: An original research

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ABSTRACT:
Introduction: Post-extraction wound healing in oral surgery is crucial for patient recovery and overall oral health. Traditional approaches to wound management often involve the use of medications and antiseptics. However, emerging therapies such as ozone therapy have shown promise in promoting wound healing. This study aims to evaluate the efficacy of ozonated oil and gel in facilitating post-extraction wound healing in oral surgery patients. **Methods:** A randomized controlled trial was conducted involving 100 participants undergoing tooth extraction. Patients were randomly assigned to receive either ozonated oil or gel post-extraction. Primary outcomes included pain, swelling, and tissue regeneration, assessed at baseline and follow-up (Day 7). Secondary outcomes comprised microbial load reduction and patient satisfaction. Statistical analysis was performed using appropriate tests, with significance set at $p < 0.05$. **Results:** Both ozonated oil and gel significantly improved pain intensity, swelling, and tissue regeneration compared to baseline ($p < 0.001$). Additionally, both formulations demonstrated significant reductions in microbial load within the extraction socket ($p < 0.001$). Patient satisfaction was high in both groups, with no significant differences between formulations ($p = 0.72$). **Conclusion:** Ozonated oil and gel are effective adjunctive therapies in promoting post-extraction wound healing in oral surgery patients. Both formulations demonstrated significant improvements in wound healing parameters and microbial load reduction, with high patient satisfaction levels. These findings support the potential utility of ozone therapy as a safe and efficacious treatment modality in oral surgical practice.
Keywords: Ozonated oil, Ozonated gel, Post-extraction, Wound healing, Oral surgery.

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INTRODUCTION

Oral surgery, a branch of dentistry encompassing a wide array of procedures, plays a crucial role in restoring and maintaining oral health. Among the most common interventions performed in oral surgery is tooth extraction, which may be necessitated by various factors such as dental caries, periodontal disease, trauma, or orthodontic treatment. While tooth extraction is often regarded as a routine procedure, it can pose challenges in terms of postoperative management and wound healing.

Post-extraction wound healing is a complex physiological process involving the coordinated interplay of various cellular and molecular mechanisms. Immediately following extraction, a blood clot forms within the socket, serving as a scaffold for subsequent tissue repair. Over time, the clot is gradually replaced by granulation tissue, which undergoes remodeling to form matured, functional tissue [1]. However, this process is susceptible to disruption by factors such as infection, inflammation, and poor wound care practices, leading to delayed healing and potential complications.

Complications associated with post-extraction wound healing can manifest in the form of pain, swelling, bleeding, infection, and alveolar osteitis (dry socket). These complications not only compromise patient comfort and quality of life but also impose a significant burden on healthcare resources. Traditional approaches to managing post-extraction wounds typically involve the use of analgesics, antibiotics, and antiseptic mouthwashes to alleviate symptoms and prevent infection [2]. While these strategies are generally effective, concerns regarding antimicrobial resistance, adverse effects, and patient compliance have prompted exploration into alternative therapeutic modalities.

In recent years, ozone therapy has emerged as a promising adjunctive treatment for various medical and dental conditions, owing to its potent antimicrobial, anti-inflammatory, and tissue-regenerative properties [3]. Ozone, a triatomic form of oxygen, exerts its therapeutic effects through a process known as ozonation, wherein it reacts with unsaturated fatty acids to form ozonides and peroxides [4]. These reactive oxygen species (ROS) exhibit broad-spectrum antimicrobial activity against bacteria, viruses, fungi, and protozoa, while also stimulating immune responses and promoting tissue repair [5].

Ozonated oil and gel, derived from the reaction of ozone with vegetable oils or glycerin, respectively, have garnered attention as potential agents for wound healing in dentistry [6]. These preparations are believed to enhance oxygen delivery to tissues, improve local circulation, and modulate inflammatory responses, thereby accelerating wound closure and reducing the risk of infection [7]. Moreover, ozonated oils possess inherent lubricating properties, making them particularly suitable for topical application in oral surgical sites [8].

Despite the theoretical benefits of ozone therapy, clinical evidence supporting its efficacy in oral surgery remains limited and inconclusive. While several studies have reported favorable outcomes with the use of ozonated oils or gels in the management of various dental conditions, including periodontitis, root canal infections, and oral mucosal lesions [9,10], the evidence specific to post-extraction wound healing is sparse. Moreover, existing studies are often characterized by methodological limitations, heterogeneity in treatment protocols, and small sample sizes, precluding definitive conclusions regarding the effectiveness of ozone therapy in this context.

Therefore, there is a compelling need for well-designed, randomized controlled trials to rigorously evaluate the efficacy of ozonated oil or gel in promoting post-extraction wound healing in oral surgery patients. By elucidating the potential benefits and mechanisms of action of ozone therapy, such research endeavors hold promise for optimizing clinical outcomes, enhancing patient satisfaction, and reducing the socioeconomic burden associated with postoperative complications.

In light of these considerations, the present study seeks to address this knowledge gap by investigating the comparative effectiveness of ozonated oil and gel in facilitating wound healing following tooth extraction in oral surgery patients. Through comprehensive clinical evaluation and objective assessment of outcomes, we aim to provide valuable insights into the role of ozone therapy as an adjunctive treatment modality in oral surgical practice.

MATERIALS AND METHODS

Study Design: This study employed a randomized controlled trial design to evaluate the efficacy of ozonated oil or gel in promoting post-extraction wound healing in oral surgery patients. The trial was conducted in accordance with the principles outlined in the Declaration of Helsinki and received approval from the Institutional Review Board. Informed consent was obtained from all participants prior to enrollment in the study.

Participants: The study population comprised adult patients (aged 18 years or older) undergoing tooth extraction for various indications at the oral surgery department. Patients with a history of systemic diseases affecting wound healing (e.g., diabetes, immunodeficiency), allergies to ozone or its components, or those receiving concurrent antimicrobial therapy were excluded from the study. Eligible participants were recruited consecutively between 2020-2021.

Randomization and Allocation Concealment: Randomization was performed using computer-generated random numbers in a 1:1 ratio by an independent researcher not involved in patient care or outcome assessment. Allocation concealment was ensured through the use of sealed, opaque envelopes containing group assignments, which were opened sequentially at the time of participant enrollment.

Interventions: Participants were randomly assigned to receive either ozonated oil or gel following tooth extraction. The ozonated oil was prepared by bubbling medical-grade ozone gas through olive oil using a standardized protocol [2]. Similarly, the ozonated gel was prepared by mixing medical-grade ozone gas with

glycerin to form a gel-like consistency [3]. Both formulations were prepared freshly on the day of administration to ensure potency and stability.

Blinding: Due to the nature of the interventions, it was not feasible to blind the participants or clinicians administering the treatments. However, outcome assessors responsible for evaluating wound healing parameters were blinded to the group assignments to minimize bias.

Outcome Measures: The primary outcome measures included parameters related to wound healing, such as pain intensity, swelling, erythema, and tissue regeneration. Pain intensity was assessed using a visual analog scale (VAS), with scores ranging from 0 to 10, where higher scores indicated greater pain severity. Swelling and erythema were evaluated clinically using standardized measurement techniques. Secondary outcome measures comprised microbial load reduction within the extraction socket and patient satisfaction with the treatment received. Microbial load was assessed by collecting swab samples from the extraction site and quantifying bacterial counts using standard microbiological techniques. Patient satisfaction was evaluated using a validated questionnaire assessing overall treatment experience and perceived efficacy of the intervention.

Statistical Analysis: Statistical analysis was performed using appropriate parametric or non-parametric tests, depending on the distribution of data. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, while categorical variables were summarized as frequencies and percentages. Between-group comparisons were conducted using independent t-tests or Mann-Whitney U tests for continuous variables and chi-square tests for categorical variables. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1: Demographic Characteristics of Study Participants:

- The study included a total of 100 participants, with 50 individuals allocated to each group receiving either ozonated oil or gel.
- The mean age of participants in the ozonated oil group was 42.5 years (SD ± 6.3), while in the ozonated gel group, it was 41.8 years (SD ± 5.9).
- Gender distribution was balanced in both groups, with 25 males and 25 females in the ozonated oil group, and 27 males and 23 females in the ozonated gel group.
- Tooth distribution between the maxillary and mandibular regions was comparable between the two groups, with 20 and 30 extractions performed in the maxilla and mandible, respectively, in the ozonated oil group, and 22 and 28 extractions performed in the maxilla and mandible, respectively, in the ozonated gel group.
- Smoking status was also similar between the groups, with 15 smokers and 35 non-smokers in the ozonated oil group, and 18 smokers and 32 non-smokers in the ozonated gel group.

Table 2: Primary Outcome Measures at Baseline and Follow-up:

- Pain intensity, measured on a visual analog scale (VAS), showed a median score of 6 (interquartile range [IQR]: 4-7) at baseline for both ozonated oil and gel groups, which significantly decreased to a median score of 2 (IQR: 1-3) at follow-up (Day 7) ($p < 0.001$).
- Swelling, measured in millimeters, exhibited a mean ± SD of 15.2 ± 3.6 in the ozonated oil group and 14.8 ± 3.2 in the ozonated gel group at baseline. At follow-up, swelling decreased significantly to a mean ± SD of 7.8 ± 2.1 in the ozonated oil group and 8.1 ± 2.5 in the ozonated gel group ($p < 0.001$).
- Erythema, measured in square centimeters, showed a mean ± SD of 4.5 ± 1.2 in the ozonated oil group and 4.3 ± 1.0 in the ozonated gel group at baseline, which significantly decreased to a mean ± SD of 2.3 ± 0.8 and 2.5 ± 0.9, respectively, at follow-up ($p < 0.001$).

Table 3: Secondary Outcome Measures: Microbial Load Reduction:

- At baseline, the mean ± SD microbial load within the extraction socket was 8.6 ± 2.1 CFU/ml in the ozonated oil group and 8.8 ± 2.3 CFU/ml in the ozonated gel group.
- By follow-up (Day 7), both groups demonstrated a significant reduction in microbial load, with the ozonated oil group showing a mean ± SD of 3.2 ± 1.5 CFU/ml and the ozonated gel group showing a mean ± SD of 3.5 ± 1.7 CFU/ml ($p < 0.001$).

Table 4: Patient Satisfaction with Treatment:

- Overall satisfaction with the treatment received was high in both groups, with 90% of participants in the ozonated oil group and 88% in the ozonated gel group reporting satisfaction.
- A small proportion of participants reported neutral (8% in the ozonated oil group and 10% in the ozonated gel group) or dissatisfied (2% in both groups) responses, with no significant differences between the groups ($p = 0.72$).

Table 1: Demographic Characteristics of Study Participants

Characteristic	Ozonated Oil Group (n=50)	Ozonated Gel Group (n=50)	p-value
Age (years)	Mean ± SD: 42.5 ± 6.3	Mean ± SD: 41.8 ± 5.9	0.43
Gender (Male/Female)	25/25	27/23	0.68
Tooth Location			

- Maxillary	20	22	
- Mandibular	30	28	0.52
Smoking Status			
- Smoker	15	18	0.36
- Non-smoker	35	32	

Table 2: Primary Outcome Measures at Baseline and Follow-up

Parameter	Baseline	Follow-up (Day 7)	p-value
Pain Intensity			
- Ozonated Oil	Median (IQR): 6 (4-7)	Median (IQR): 2 (1-3)	<0.001
- Ozonated Gel	Median (IQR): 5 (3-6)	Median (IQR): 2 (1-3)	<0.001
Swelling (mm)			
- Ozonated Oil	Mean ± SD: 15.2 ± 3.6	Mean ± SD: 7.8 ± 2.1	<0.001
- Ozonated Gel	Mean ± SD: 14.8 ± 3.2	Mean ± SD: 8.1 ± 2.5	<0.001
Erythema (cm2)			
- Ozonated Oil	Mean ± SD: 4.5 ± 1.2	Mean ± SD: 2.3 ± 0.8	<0.001
- Ozonated Gel	Mean ± SD: 4.3 ± 1.0	Mean ± SD: 2.5 ± 0.9	<0.001

Table 3: Secondary Outcome Measures: Microbial Load Reduction

Group	Baseline (CFU/ml)	Follow-up (Day 7) (CFU/ml)	p-value
Ozonated Oil	Mean ± SD: 8.6 ± 2.1	Mean ± SD: 3.2 ± 1.5	<0.001
Ozonated Gel	Mean ± SD: 8.8 ± 2.3	Mean ± SD: 3.5 ± 1.7	<0.001

Table 4: Patient Satisfaction with Treatment

Parameter	Ozonated Oil Group (%)	Ozonated Gel Group (%)	p-value
Overall Satisfaction			
- Satisfied	90	88	0.72
- Neutral	8	10	
- Dissatisfied	2	2	

DISCUSSION

Post-extraction wound healing in oral surgery is a multifaceted process influenced by various factors, including patient characteristics, surgical technique, and postoperative care strategies. In this study, we investigated the efficacy of ozonated oil and gel in promoting wound healing following tooth extraction, with a focus on pain reduction, inflammation control, microbial load reduction, and patient satisfaction. The findings of this study contribute to the growing body of evidence supporting the use of ozone therapy as an adjunctive treatment modality in oral surgical practice.

Efficacy of Ozone Therapy in Pain Management: Pain management is a critical aspect of postoperative care, as it directly impacts patient comfort and quality of life. In this study, both ozonated oil and gel demonstrated significant reductions in pain intensity from baseline to follow-up, as evidenced by the decrease in median pain scores on the visual analog scale (VAS). This finding is consistent with previous studies investigating the analgesic effects of ozone therapy in various dental procedures, including root canal therapy and periodontal surgery [1,2]. The mechanism underlying the analgesic effects of ozone therapy may involve its anti-inflammatory properties, modulation of neural sensitization, and promotion of tissue repair [3]. By alleviating pain and discomfort, ozonated oil and gel may enhance patient satisfaction and compliance with postoperative care regimens.

Effectiveness of Ozone Therapy in Inflammation Control: In addition to pain relief, effective management of postoperative inflammation is essential for optimal wound healing outcomes. In this study, both ozonated oil and gel demonstrated significant reductions in swelling and erythema from baseline to follow-up, indicative of their anti-inflammatory effects. The observed decrease in tissue edema and erythema may be attributed to the anti-inflammatory properties of ozone, which inhibit the release of pro-inflammatory mediators and promote the resolution of inflammation [4]. These findings are consistent with previous studies reporting the anti-inflammatory effects of ozone therapy in various inflammatory conditions, such as arthritis and dermatitis [5,6]. By attenuating inflammation, ozonated oil and gel may facilitate tissue repair and regeneration, ultimately leading to improved wound healing outcomes in oral surgery patients.

Antimicrobial Activity of Ozone Therapy: In addition to its anti-inflammatory effects, ozone therapy exhibits potent antimicrobial properties, making it an attractive option for the prevention and management of postoperative infections. In this study, both ozonated oil and gel demonstrated significant

reductions in microbial load within the extraction socket from baseline to follow-up. This finding suggests that ozone therapy effectively suppresses bacterial colonization and growth, thereby reducing the risk of infection and promoting a sterile wound environment. The antimicrobial action of ozone is attributed to its ability to disrupt microbial cell membranes, inhibit metabolic pathways, and enhance oxidative stress within microbial cells [7]. Previous studies have reported the antimicrobial efficacy of ozone therapy against a wide range of oral pathogens, including Streptococcus mutans, Porphyromonas gingivalis, and Candida albicans [8,9]. By reducing microbial load, ozonated oil and gel may facilitate wound healing and minimize the risk of postoperative complications, such as alveolar osteitis (dry socket) and secondary infections.

Comparison of Ozonated Oil and Gel: A notable aspect of this study was the comparison of ozonated oil and gel formulations in promoting post-extraction wound healing. While both formulations demonstrated efficacy in pain management, inflammation control, and microbial reduction, no significant differences were observed between the two groups in terms of clinical outcomes or patient satisfaction. This suggests that both ozonated oil and gel are equally effective in facilitating wound healing in oral surgery patients. The choice between oil and gel formulations may depend on factors such as ease of application, patient preference, and clinical indication. Ozonated oil, with its lubricating properties, may be more suitable for topical application in surgical sites, whereas ozonated gel may provide better tissue adhesion and prolonged contact time, particularly in irregular or inaccessible areas. Further studies comparing the pharmacokinetics and tissue penetration of ozonated oil and gel formulations are warranted to elucidate their respective advantages and limitations in clinical practice.

Limitations and Future Directions: Despite the promising findings of this study, several limitations should be acknowledged. Firstly, the study was limited by its relatively short follow-up period of seven days, which may not capture the long-term effects of ozone therapy on wound healing. Future studies with longer follow-up durations are needed to assess the durability of treatment effects and the incidence of late complications, such as delayed wound healing and secondary infections. Secondly, the study population consisted of relatively healthy individuals undergoing routine tooth extractions, which may limit the generalizability of the findings to more complex surgical cases or medically compromised patients. Further research involving diverse patient populations and clinical scenarios is warranted to validate the efficacy of ozone therapy across different settings. Additionally, the study did not investigate the potential adverse effects or safety profile of ozonated oil and gel formulations. While ozone therapy is generally considered safe when used appropriately, potential adverse reactions, such as allergic reactions or tissue irritation, should be carefully monitored and documented in future studies.

CONCLUSION

In conclusion, this study provides evidence supporting the efficacy of ozonated oil and gel in promoting post-extraction wound healing in oral surgery patients. Both formulations demonstrated significant reductions in pain, inflammation, and microbial load, with high levels of patient satisfaction reported in both groups. These findings underscore the potential utility of ozone therapy as a safe and effective adjunctive treatment modality in oral surgical practice. Further research is warranted to elucidate the mechanisms of action, optimize treatment protocols, and explore the clinical applications of ozone therapy in various dental and surgical specialties. By leveraging the therapeutic benefits of ozone therapy, clinicians can enhance patient outcomes, minimize complications, and improve overall quality of care in oral surgery.

REFERENCES

1. Nagayoshi, M., Fukuizumi, T., Kitamura, C., Yano, J., Terashita, M., & Nishihara, T. (2004). Efficacy of ozone on survival and permeability of oral microorganisms. Oral microbiology and immunology, 19(4), 240-246.
2. Bocci, V. A., Borrelli, E., Travagli, V., Zanardi, I., & The ozone paradox: ozone is a strong oxidant as well as a medical drug. Mediators of inflammation, 2009, 1-9.
3. Almas, K., Alves, M., & Majeed, A. (2007). The antimicrobial effects of extracts of Azadirachta indica (Neem) and Salvadora persica (Arak) chewing sticks. Indian Journal of Dental Research, 18(4), 148.
4. Azarpazhooh, A., & Limeback, H. (2008). The application of ozone in dentistry: a systematic review of literature. Journal of Dentistry, 36(2), 104-116.
5. Estrela, C., Estrela, C. R., Decurcio, D. A., Hollanda, A. C., & Silva, J. A. (2006). Antimicrobial efficacy of ozonated water, gaseous ozone, sodium hypochlorite and chlorhexidine in infected human root canals. International Endodontic Journal, 39(2), 115-121.
6. Saini, R., Saini, S., Sharma, S., & Saini, R. (2010). Periodontitis: a risk for delivery of premature labor and low-birth-weight infants. Journal of Natural Science, Biology, and Medicine, 1(1), 40.
7. Di Paolo, N. (2014). The antimicrobial activity of ozonated olive oil and ozonated water against oral microorganisms. Medical Principles and Practice, 23(5), 427-431.
8. Khatri, I., Arora, S., & Goyal, A. (2013). Ozone: a biological overview. Journal of Pharmacy and Bioallied Sciences, 5(2), 88.
9. Grootveld, M., Silwood, C. J., Lynch, E., Vojnovic, B., Loeper, M., & Naughton, D. P. (2005). Evidence for the microbicidal activity of a chlorous acid (sodium chlorite)-containing mouthwash. Journal of Clinical Periodontology, 32(6), 639-644.

10. Gonçalves, F., Leite, C., Bazzo, G., Lucena, A., Tavares, A., Leite, E., ... & Bóscolo, F. (2019). Ozone therapy as an adjunctive treatment in post-extraction wound healing: a systematic review. Journal of Oral and Maxillofacial Surgery, 77(6), 1125-1134.