

# Effectiveness of Topical Ozone Gel Application in the Management of Postextraction Wound Healing: An *In Vivo* Study

Lin Jacob Varghese<sup>1</sup>, Banibrata Lahiri<sup>2</sup>, Narendra Varma Penumatsa<sup>3</sup>, Crystal Runa Soans<sup>4</sup>, Aswini Sekar<sup>5</sup>, Fazil Arshad Nasyam<sup>6</sup>

## ABSTRACT

**Aim:** The purpose of the current study was to determine the effectiveness of topical ozone gel application in the management of postextraction wound healing.

**Materials and methods:** The current study involved a total of 40 participants. The patients were randomly placed into two groups with sample size estimated as  $n = 20$  in each group. Group A: Control: patients received only saline irrigation and group B: patients receiving topical ozone gel. The surgical procedure was standardized for all groups, and local anesthesia was used during the procedure. After the removal of the mandibular third molar, the control group irrigated the socket with saline, whereas in the study group, the socket was filled with ozone gel. On the first, third, fifth, and seventh postoperative days, a single examiner evaluated each participant for postoperative mouth opening, discomfort, and patient satisfaction. The *t*-test was used to analyze quantitative data, whereas the Fisher exact test was employed to analyze qualitative data. Statistical significance was defined as a *p* value less than 0.05.

**Results:** On comparison of patient satisfaction, in the ozone gel group, 13 patients were very satisfied but in the control group, 8 patients were very satisfied. On comparison of pain intensity, on the 5th day, the complete absence of pain patients was more in the ozone gel group (12 patients) compared with the control group (4 patients). There was a statistically significant difference found between these two groups ( $p < 0.001$ ). On comparison of mouth opening, on the 3rd and 5th day, mouth opening was better in the ozone gel group ( $29.22 \pm 1.28$  and  $34.06 \pm 0.09$ ) compared with the control group ( $27.38 \pm 1.03$  and  $31.14 \pm 0.82$ ), respectively. And there was a statistically significant difference found between these two groups ( $p < 0.001$ ) on both the days.

**Conclusion:** The current study came to the conclusion that using ozone gel significantly improves postoperative pain, mouth opening range, and promotes faster wound healing.

**Clinical significance:** The primary goals of postoperative care for exodontia patients have always been pain management and infection control. The most frequent postoperative consequences are pain and edema. Hence, ozone therapy can be used as an effective topical agent to manage postextraction pain and swelling in healthy patients without the need for excess medications.

**Keywords:** Complications, Extraction, Ozone gel, Wound healing.

*The Journal of Contemporary Dental Practice* (2023): 10.5005/jp-journals-10024-3557

## INTRODUCTION

One of the most often performed procedures in the field of oral and maxillofacial surgery is third molar surgery. However, this operation needs precise planning and surgical expertise. Complications with surgical operations, in general, are always possible. Between 2.6 and 30.9% of third molar extraction procedures result in problems. Complications might range in severity from minor expected side effects like postoperative discomfort and swelling to permanent nerve damage, mandibular fractures, and potentially fatal infections.<sup>1</sup>

A number of theories have been advanced to lessen postoperative complications, including the administration of corticosteroids locally or systemically, the use of nonsteroidal anti-inflammatory drugs, the insertion of a tube drain to lessen inflammation, and the use of various incision types to lessen patient trauma. Ozone has lately been studied in conjunction with all of these techniques to determine its efficacy in reducing inflammation, discomfort, and fostering healing.<sup>2</sup>

Three oxygen atoms make up the inherently unstable gas known as ozone. It has been established that ozone

<sup>1</sup>Department of Oral and Maxillofacial Surgery, Sree Anjaneya Institute of Dental Sciences, Calicut, Kerala, India

<sup>2</sup>Department of Oral and Maxillofacial Surgery, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India

<sup>3</sup>Department of Preventive Dental Sciences, College of Dentistry, Prince Sattam Bin Abdulaziz University, Al-Kharj, Saudi Arabia

<sup>4</sup>Department of Orthodontics and Dentofacial Orthopaedics, AB Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangaluru, Karnataka, India

<sup>5</sup>Department of Public Health Dentistry, Chettinad Dental College and Research Institute, Chengalpet, Tamil Nadu, India

<sup>6</sup>Department of Oral and Maxillofacial Surgery and Diagnostic Sciences, College of Dentistry, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia

**Corresponding Author:** Crystal Runa Soans, Department of Orthodontics and Dentofacial Orthopaedics, AB Shetty Memorial Institute of Dental Sciences, NITTE (Deemed to be University), Mangaluru, Karnataka, India, Phone: +91 9611200050, e-mail: drcrystalsoans@gmail.com

possesses special features such as immune-stimulating, analgesic, antihypnotic, detoxicating, antibacterial, bioenergetic, and biosynthetic effects. Ozone can be applied through several ways like oil, gas, and water.<sup>3</sup> Ozone has been used in dentistry for a variety of conditions, such as wound healing, dental caries, oral lichen planus, gingivitis and periodontitis, halitosis, osteonecrosis of the jaw, post-surgical pain, plaque and biofilms, root canals, dentin hypersensitivity, temporomandibular joint disorders, and teeth whitening.<sup>4</sup>

Ozone is now frequently utilized in oral and maxillofacial surgery. Studies have demonstrated that using ozone in the form of ozonized water as an irrigant during third molar extractions, as well as the efficiency of ozone gas and ozonized olive oil/gel in healing the extraction wound after the procedure, can better control infection, inflammation, and pain while accelerating and improving wound healing.<sup>5</sup> Very limited studies are available on the application of ozone gel after third molar surgery. Therefore, this study was conducted to evaluate the effectiveness of topical ozone gel application in the management of postextraction (mandibular third molar) wound healing.

## MATERIALS AND METHODS

### Selection of Participants

This study was conducted in the Department of Oral and Maxillofacial Surgery, Sree Anjaneya Institute of Dental Sciences, India, during the year of 2023. A total of 40 patients were involved in this study. The patients were given a thorough explanation of the process and the material used, and written consent was obtained. An orthopantomogram (OPG) was taken for all the patients. Patients having a class I impacted the third molar of the same difficulty level who were willing to participate in the trial were considered in the study. For impacted third molars, the Pell and Gregory classification<sup>6</sup> was used to determine the difficulty index. The exclusion criteria were patients who were not willing to participate in the trial, patients with bleeding and clotting disorders, and any systemic diseases. The patients were randomly placed in groups and were kept blinded regarding the material placed in the tooth socket to avoid bias.

The trial was conducted in two groups with a sample size estimated as  $n = 20$  in each group, and the patients were randomly placed in the groups.

### Group A: Control

Patients received only saline irrigation.

### Group B: Patients Receiving Topical Ozone Gel

The study employed ozone gel that is available commercially (Ozone Olive Healing Gel, ADC Inc. Dentozoneindia), a natural product made of a suspension of unoxidized olive oil with medical-grade ozone.

### Operative Procedure

A standardized surgical technique was used across all groups, and the surgery was carried out while the inferior alveolar, lingual, and buccal nerves were blocked under local anesthesia (2% lidocaine and 1:80,000 adrenaline) to remove the mandibular third molar. Periosteal elevator was used to lift the mucoperiosteal flap. A low-speed handpiece with a rose head bur and copious irrigation was used to conduct the osteotomy. A high-speed handpiece with a

**How to cite this article:** Varghese LJ, Lahiri B, Penumatsa NV, *et al.* Effectiveness of Topical Ozone Gel Application in the Management of Postextraction Wound Healing: An *In Vivo* Study. *J Contemp Dent Pract* 2023;24(11):887–890.

**Source of support:** Nil

**Conflict of interest:** None

**Table 1:** Comparison of mean age among two groups

Study groups	n	Mean $\pm$ SD	t-value	p-value
Group A: Control	20	22.30 $\pm$ 0.15	4.178	0.671
Group B: Ozone gel	20	23.46 $\pm$ 1.21		

fissure bur was used for tooth sectioning. The socket was examined and thoroughly irrigated after the tooth had been fully removed.

All of the patients that were included underwent open extraction surgery. After extraction, the socket was irrigated with saline in the control group, and antibiotics and analgesics were prescribed for 5 days to the patients. In the study group, socket was filled with ozone gel. Patients were instructed to apply ozone gel three times per day for 5 days to the extraction site. In the study group, no antibiotics were prescribed. The patients received only analgesics on an SOS basis. Postextraction instructions were given to all patients.

### Clinical Evaluation

On the first, third, fifth, and seventh postoperative days, a single examiner measured the participants' postoperative mouth opening (interincisal distance) using Vernier calipers and recorded in millimeters. Subjective patient satisfaction was measured using a scale that ranged from very satisfied to very unsatisfied.

A four-point visual analog scale (VAS) was used to measure postoperative pain:

0 = No pain is present.

1 = Mild pain is present (pain reported only in response to questioning and without any behavioral signs).

2 = Moderate pain is present (pain reported in response to questioning and also accompanied by signs, or pain is reported spontaneously without any questioning).

3 = Severe pain is present (eliciting a strong vocal response or a response that was accompanied by grimaces, withholding of the arm, or tears).

### Statistical Analysis

SPSS software version 20.0 was used to analyze the data that had been gathered. The *t*-test was used to analyze quantitative data, whereas the Fisher exact test was employed to analyze qualitative data. Statistical significance was defined as a *p*-value less than 0.05.

## RESULTS

Table 1 shows the mean age comparison of two study groups. The mean age control group was  $22.30 \pm 0.15$  and  $23.46 \pm 1.21$  for the ozone gel group. There was no statistically significant difference found between these two groups.

Patient's satisfaction level in both the groups was depicted in Table 2. At the end of the 7th day, in the ozone gel group, 13 patients were very satisfied, 4 patients were fairly satisfied, 2 patients were fairly unsatisfied, and 1 patient was very unsatisfied. But in the

**Table 2:** Evaluation of patient’s satisfaction level among study groups

	Patient satisfaction			
	Very satisfied	Fairly satisfied	Fairly unsatisfied	Very unsatisfied
Group A: Control	8	5	4	3
Group B: Ozone gel	13	4	2	1
$\chi^2 = 2.102, p = 0.001$				

**Table 3:** Evaluation of pain score (VAS) among study groups

Duration and study groups	No pain	Mild pain	Moderate pain	Severe pain	Fischer exact test
1st day					
Control	0	10	6	4	$\chi^2 = 5.326$
Ozone gel	0	9	8	3	$p = 0.894$
3rd day					
Control	0	11	6	3	$\chi^2 = 9.712$
Ozone gel	0	12	8	0	$p = 0.368$
5th day					
Control	4	14	2	0	$\chi^2 = 12.388$
Ozone gel	12	7	1	0	$p = 0.001^*$
7th day					
Control	13	6	1	0	$\chi^2 = 8.109$
Ozone gel	16	4	0	0	$p = 0.627$

\*Statistically significant

**Table 4:** Evaluation of mouth opening among study groups

Duration and study groups	Mean ± SD	t-value	p-value
1st day			
Control	24.28 ± 0.32	3.929	0.871
Ozone gel	24.92 ± 0.17		
3rd day			
Control	27.38 ± 1.03	4.138	0.001*
Ozone gel	29.22 ± 1.28		
5th day			
Control	31.14 ± 0.82	5.149	0.001*
Ozone gel	34.06 ± 0.09		
7th day			
Control	34.01 ± 1.72	3.281	0.629
Ozone gel	34.78 ± 0.27		

\*Statistically significant

control group, 8 patients were very satisfied, 5 patients were fairly satisfied, 4 patients were fairly unsatisfied, and 3 patients were very unsatisfied. There was a statistically significant difference found between these two groups ( $p < 0.001$ ).

Table 3 reveals the pain score (VAS) among study groups. On 1st day, the mild pain patients were more in both groups (control–10 and ozone gel–9). On 3rd day, mild pain patients were slightly more in the ozone gel group (12 patients). On 5th day, complete absence of pain patients were more in the ozone gel group (12 patients) compared with control group (4 patients). There was a statistically significant difference found between these two groups ( $p < 0.001$ ).

On 7th day, the complete absence of pain patients were more in the ozone gel group (16 patients) and 13 patients in the control group.

On 1st day, the mouth opening in the control group was  $24.28 \pm 0.32$  and in ozone gel group was  $24.92 \pm 0.17$ . On 3rd and 5th day, mouth opening was better in the ozone gel group ( $29.22 \pm 1.28$  and  $34.06 \pm 0.09$ ) compared with the control group ( $27.38 \pm 1.03$  and  $31.14 \pm 0.82$ ), respectively. And there was a statistically significant difference found between these two groups ( $p < 0.001$ ) on both days. On the 7th day, mouth opening in the ozone gel group was  $34.78 \pm 0.27$ , and the control group was  $34.01 \pm 1.72$ , and there was no statistically significant difference found between these two groups (Table 4).

The inference of the study includes that an incorporation of ozone gel plays an important role in the improvement of postoperative pain, and range of mouth opening and gives better wound healing.

## DISCUSSION

In dentistry practice, surgical extraction of the third molars is frequently performed. Damage to the tissue during surgery results in the release of potassium, serotonin, and histamine from the damaged cells, as well as bradykinin from the injured blood vessels. As a result, the tissue reacts by activating its nociceptors, changing its color, and swelling up. Prostaglandin is released by bradykinin, and nociceptors are activated. The final result is the emergence of symptoms like discomfort, edema, and a limited range of motion in the mouth.<sup>7</sup>

Ozone therapy has been suggested for use in oral and maxillofacial surgery because of its antibacterial, disinfecting, and therapeutic characteristics. Numerous research studies have indicated that ozone is beneficial for oxygen metabolism, cellular energy, immunological modulation, antioxidant defense, and microcirculation. Based on these findings, many authors suggest the use of ozone therapy to enhance the bone healing.<sup>8</sup>

In the current study, the ozone gel group performs better than the control group in terms of managing postextraction wound healing. According to this finding, which is in line with studies by Brozoski MA et al.<sup>9</sup> and Agrillo A et al.,<sup>10</sup> ozone improves blood circulation by raising the concentration of red blood cells and hemoglobin. This localized stimulation of the circulatory system leads to increased oxygenation of tissues, and this effect is more evident in the vessels of smaller diameter that fill quickly red blood cells by increasing local microcirculation. Finally, the activity of stimulating angiogenesis results in a more clearly defined vascular network. Granulation tissue develops as a result of the underlying necrotic bone region becoming more vascular. Revascularization of the underlying bone causes spontaneous dislocation of the necrotic fragment over time, exposing living tissue that does not require surgical treatment and leading to partial healing or complete closure of the wound.

According to Domb W<sup>11</sup> and Shokry M and Alshaimaa S,<sup>12</sup> ozone can interact with blood components such as erythrocytes, leukocytes, platelets, endothelial cells, and the vascular system to positively impact oxygen metabolism, cell energy, the immunomodulatory effect, the antioxidant defense system, and microcirculation in the tissues. Similarly, Reedy SA et al.<sup>13</sup> and Patel PV and Gujjari SK<sup>14</sup> stated as, it has antimicrobial, disinfectant, and wound healing properties. Therefore, improving epithelial wound healing in conditions like ulcerations and herpetic lesions is one

of the advised uses for ozone treatment. Ozone may be helpful in dentoalveolar surgery to promote hemostasis, improve the area's oxygen supply, speed up epithelial wound healing, and limit bacterial growth.

The study's findings unequivocally demonstrate the superiority of ozonized gel over conventional treatments. The results of this study on the function of ozone in routine interalveolar extractions are in agreement with findings from earlier studies on a related subject. The effectiveness of using ozonized water during surgery to remove an impacted third tooth was examined and confirmed by Glória JC et al.<sup>15</sup> Another study by Kumar et al.<sup>16</sup> was conducted to assess how ozonized olive oil affected the treatment of oral diseases and lesions, they discovered that there was no toxicity or unfavorable side effects and that the lesions regressed more quickly and the symptoms improved. Bahl et al.<sup>17</sup> demonstrated in their prospective study that patients who applied ozonized olive oil postoperatively at the extraction site without receiving antibacterial or analgesic medication on an SOS basis experienced less postoperative pain and edema, improved wound healing, and less dependence on opioid analgesics.

No side effects were reported in this study. The use of ozone is contraindicated in myocardial infarction, hyperthyroidism, myasthenia, autoimmune disorders, ozone allergy, and alcohol intoxication.<sup>17</sup>

The limitation of this study includes the less sample size, the lack of analysis of the microbiological activity of the administration of ozone gel, and the histology of healing. This study only involved one center. A multicentric investigation should be done to confirm the involvement of ozone in efficient wound healing for a larger population.

## CONCLUSION

Within the limitations of this study, it can be concluded that ozone gel significantly improves postoperative pain, mouth opening range, and promotes faster wound healing. This study convincingly revealed that applying topical ozone to wounds in cases of exodontia improves and accelerates healing, confirming its superiority over traditional therapy. The development of better dispensing methods suitable for patient self-administration and the prolonged progressive action of ozone at the targeted site.

## REFERENCES

- Green R, Pynn B, Brauer H. Complications during and after surgical removal of third molars. *Oral Heal Gr* 2013;1:1–11. Available from: <https://www.google.com/search?q=Green+R%2C+Pynn+B%2C+Brauer+H.+Complications+during+and+after+surgical+removal+of+third+molars.+Oral+Heal+Gr+2013%3B1%3A1%E2%80%9311.&oq=Green+R%2C+Pynn+B%2C+Brauer+H.+Complications+during+and+after+surgical+removal+of+third+molars.+Oral+Heal+Gr+2013%3B1%3A1%E2%80%9311.&aqs=chrome.69i59j965j0j7&sourceid=chrome&ie=UTF-8&bshn=rimg/1>
- Baysan A, Lynch E. The use of ozone in dentistry and medicine. *Prim Dent Care* 2005;12(2):47–52. DOI: 10.1308/1355761053695158
- Suh Y, Patel S, Kaitlyn R, et al. Clinical utility of ozone therapy in dental and oral medicine. *Med Gas Res* 2019;9(3):163–167. DOI: 10.4103/2045-9912.266997.
- Sivalingam VP, Panneerselvam E, Raja KV, et al. Does topical ozone therapy improve patient comfort after surgical removal of impacted mandibular third molar? A randomized controlled trial. *J Oral Maxillofac Surg* 2017;75(1):e1–e9. DOI: 10.1016/j.joms.2016.09.014.
- Sandhu RK. Ozone in dentistry – A review. *J Adv Med Dent Sci Res* 2021;9(7):115–119. Available from: <https://jamdsr.com/uploadfiles/25vol9issue7pp115-119.20210713104747.pdf>.
- Pell G and Gregory B. Impacted mandibular third molars: Classification and modified techniques for removal. *Dent Digest* 1933;39:330–338. Available from: <https://www.bristolctoralsurgery.com/files/2015/03/Pell-and-Gregory-Classification-1933.pdf>.
- Sierra SO, Deana AM, Ferrari RAM, et al. Effect of low-level laser therapy on the post-surgical inflammatory process after third molar removal: Study protocol for a double-blind randomized controlled trial. *Trials* 2013;14(1):373–379. DOI: 10.1186/1745-6215-14-373.
- Kazancioglu HO, Ezirganli S, Aydin MS. Effects of laser and ozone therapies on bone healing in the calvarial defects. *J Craniofac Surg* 2013;24(6):2141–2146. DOI: 10.1097/SCS.0b013e3182a244ae.
- Brozowski MA, Lemos CA, Da Graca Naclerio-Homem M, et al. Adjuvant aqueous ozone in the treatment of bisphosphonate induced necrosis of the jaws: Report of two cases and long term follow up. *Minerva Stomatol* 2014;63(1–2):35–41. PMID: 24487948.
- Agrillo A, Petrucci MT, Tedaldi M, et al. New therapeutic protocol in the treatment of avascular necrosis of the jaws. *J Craniofac Surg* 2006;17(6):1080–1083. DOI: 10.1097/01.scs.0000249350.59096.d0.
- Domb W. Ozone therapy in dentistry: A brief review for physicians. *Interv Neuroradiol* 2014;20(5):632–636. DOI: 10.15274/INR-2014-10083.
- Shokry M, Alshaimaa S. Effect of xenograft-ozonated gel mixture on alveolar bone healing following removal of impacted third molar: A randomized controlled clinical trial. *Egypt Dent J* 2016;62(4):4749–4757. Available from: <https://www.bau.edu.lb/BAUUpload/Library/Files/Uploaded%20Files/Dentistry/Effect-of-xenograft-Ozonated-gel-mixture.pdf>.
- Reedy SA, Reddy N, Dinapadu S, et al. Role of ozone therapy in minimal intervention dentistry and endodontics – A review. *J Int Oral Health* 2013;5(3):102–108. PMID: PMC3769872.
- Patel PV, Gujjari SK. The morphometrical and histopathological changes which were observed after topical ozone therapy on an exophytic fibrous gingival lesion: A case report. *J Clin Diagn Res* 2013;7(6):1239–1243. DOI: 10.7860/JCDR/2013/4963.3039.
- Glória JC, Douglas-de-Oliveira DW, E Silva LDA, et al. Influence of ozonized water on pain, oedema, and trismus during impacted third molar surgery: A randomized, triple blind clinical trial. *BMC Oral Health* 2020;20(1):41. DOI: 10.1186/s12903-020-1029-5.
- Kumar T, Arora N, Puri G, et al. Efficacy of ozonized olive oil in the management of oral lesions and conditions: A clinical trial. *Contemp Clin Dent* 2016;7(1):51–54. DOI: 10.4103/0976-237X.177097.
- Bahl D, Samuel S, Charyulu RN, et al. Use of topical ozone therapy for wound healing after transalveolar extractions: A miracle alternative therapy. *World J Dent* 2021;13(1):57–61. DOI: 10.5005/jp-journals-10015-1888.