


## Original Research Article

# A comparative study for assessment of post-operative sequelae following mandibular transalveolar molar extractions using ozone and dexamethasone

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(Received: 15 November 2022, accepted: 13 February 2023)

**Keywords:**  
Dexamethasone /  
Ozone /  
Transalveolar  
extractions

**Abstract – Objectives:** Trans-alveolar extractions involve surgical removal of tooth that has its own postoperative sequelae, most commonly manifested as pain and swelling. This study aims to compare the efficacy of topical ozone and dexamethasone in management of post-operative sequelae after mandibular trans-alveolar molar extractions. **Materials and Methods:** Sixty patients requiring surgical removal of mandibular molars under local anesthesia were randomly allocated into two groups, each group consisting of 30 patients. Group 1 received Topical Ozonated Oil in the extraction socket post-operatively, while Group 2 was administered 8 mg dexamethasone injection post-operatively. The patients were checked for postoperative wound healing, pain and swelling on 1st, 3rd and 7th day. **Results:** The results showed comparatively similar results for the pain severity and swelling score at the 1st and 7th postoperative day in both the groups. A greater reduction of pain was noticed in Group 1 on 3rd postoperative day. Wound Healing was noted to be better in Group 1 at 3rd and 7th post-operative day. **Conclusion:** In conclusion, topical ozone therapy can be used as an effective alternative treatment modality, when compared to dexamethasone for better management of post-operative sequelae following mandibular trans-alveolar molar extractions.

## Introduction

Oral surgical procedures including trans-alveolar extraction of mandibular molars induces inflammatory oedema and pain. Excess inflammatory components lead to oedema and pain, causing significant discomfort to the patient, hence, its control has become a subject of scientific interest to oral surgeons [1].

Many physical methods and pharmacological agents such as drains and anti-inflammatory steroids are being used to reduce post-operative pain and oedema. In 1957, Arth *et al.* synthesized a new family of steroid compounds, amongst one was dexamethasone. Dexamethasone is a potent, highly selective, long acting, synthetic corticosteroid, with potent anti-inflammatory action, which inhibits the initial step in inflammatory process after trans-alveolar extractions [2]. Considering the immunosuppressive effects of cortisol and its synthetic analogues, use of dexamethasone in third molar surgery needs further research to evaluate protocols and proper assessment prior to its use [3].

Medical grade ozone is used as a newer treatment modality owing to its anti-inflammatory and analgesic actions to provide therapeutic outcomes. Chronic and/or acute infections such as long-standing non-healing ulcers, circulatory disorders, infections, burns, and skin lesions have shown to have a better healing effect after ozone application. Topical ozone therapy has a microbicidal action which also increases vascularity and stimulates immune system by increasing interferon production. E.A Fisch pioneered the use of ozone therapy in dentistry in the 1930's, to aid in disinfection and wound healing during dental surgeries [4,5].

Ozone is a natural colorless gas molecule, chemically composed of three oxygen atoms. It has a striking pungent odor at room temperature which can be detected at concentrations as low as 0.02–0.05 ppm. At 20 °C, it has a half-life of 40 min and at 0 °C about 140 min [6]. Literature studies have reported that ozone therapy has the potential to eliminate 99% of microflora, when used for a duration of 10–20 s. The antimicrobial effect of ozone increases in the liquid environment, especially in acidic pH [7,8].

Although, many studies have been done to evaluate the efficacy and ability of dexamethasone and ozone therapy for management of post operative sequelae following transalveolar

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extractions, there are only a few of them studying their comparative actions. Therefore, this comparative study was conducted to evaluate the ability of topical ozone therapy versus dexamethasone following mandibular trans-alveolar molars extractions for management of post-operative sequelae.

## Materials and methodology

### Sample selection and study design

Patients requiring trans-alveolar extractions of mandibular molars were included in this study for a period of 7 months (July 2021 to January 2022). This comparative study included patients reporting to the Department of Oral and Maxillofacial Surgery of our institution for direct consultation and those who were referred from ITBP dental camps.

Healthy ASA class – I patients in the age group of 18–40 years, requiring surgical removal of mandibular single molar tooth, which requisite elevation of mucoperiosteal flap, buccal bone guttering with or without sectioning of the tooth were included in this study. Syndromic patients or with ASA class III were excluded.

A total of 60 participants adhering to the above criteria were allocated equally by computerized slip generation procedure (ratio of 1:1) in Microsoft Excel, 2021 using INDEX, SORTBY, and SEQUENCE Functions for Mac Version 16.16.10. irrespective of age and sex. The patients were categorized into two study groups as:

- **Group 1**–Topical Ozonated Oil (MedCare Ozonated Olive Oil, Dermozone Herbal Pvt. Ltd.).
- **Group 2**–Intramuscular Dexamethasone 8 mg (Dexona 8 mg, Zydus Cadila).

Meticulous patient care was done by clinical examination for vital signs – blood pressure, respiratory rate, pulse rate and  $SpO_2$ , and radiographical examination with intraoral periapical (IOPA) and orthopantomogram (OPG) to assess the complaint and its relevant history of presenting illness. All patients in the study were submitted to standard surgical protocols of trans-alveolar extraction. All extractions were performed by the same surgeon to minimize variability. Post-extraction, the socket was filled with Ozonated oil in Group 1 patients and the socket was irrigated with normal saline in Group 2 patients. Mucoperiosteal flap repositioning with socket closure using 3-0 silk suture was done, and all patients were given usual post-operative instructions. Post-operatively, Group 1 patients were advised to apply Ozonated oil at the extracted site thrice daily for a period of 5 days, while Group 2 patients were administered a single dosage injection of Dexamethasone 8mg via IM route. Postoperative antibiotics were not prescribed and analgesics were given on SOS basis to the patients.

Preoperative facial measurement of all the patients in both the group included marking of four points on the face with indelible ink: mandibular angle, tragus, lateral canthus of eye, alar base. Using measuring tape, the linear distances of mandibular angle to lateral canthus of eye and tragus to alar base were noted. The sum total of all measurements was taken as the facial size. The average measurements were taken (in cm) and recorded. The measurements were carried out just before the surgery, which would be used to check swelling post-operatively.

**Table I.** Demographic details.

	Group 1	Group 2
1. No. of subjects	30	30
2. Age		
Mean age $\pm$ SD	26.8 $\pm$ 5.9	25.3 $\pm$ 3.9
Range	18–40	18–38
3. Sex:		
Female	14	16
Male	16	14

### Postoperative parameters

**(i) Pain** – Scores were recorded after asking patient about their pain experience following post-operative 1st, 3rd and 7th days, using Visual Analog Scale.

**(ii) Swelling** – Facial measurements were recorded at postoperative days (POD) 1st, 3rd, and 7th in a similar manner to preoperative measurements. Postoperative swelling was expressed as a percentage increase in facial width.

Grade: 0–None

1–Mild (1–33%).

2–Moderate (34–67%).

3–Severe (68–100%).

**(iii) Wound Healing** – The patients were followed up on the 3rd and 7th day postoperatively for evaluation of wound healing. They were evaluated base on the post-extraction healing using the Healing index of Landry, Turnbull and Howley [9,10].

**(iv) Adverse effects** – The adverse effects/complications (if any) were recorded when the patients were recalled for the follow-up at 1st, 3rd and 7th day.

The total surgical duration and the number of analgesic doses (if taken any) were also recorded for both the groups.

### Statistical analysis

Data was analysed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at  $p < 0.05$ . Post-surgical changes are statistically analysed by Student's Paired t test and two group comparisons were made.

## Results

The study included total 60 patients (29 females and 31 males) with the demographic details for both the groups is enlisted in Table I. The difference in both groups for demographic comparison was not statistically significant.

The mean duration of the surgery was  $49.4 \pm 13.7$  min for Group 1, and  $54.4 \pm 11.9$  min for Group 2. The difference in both groups was not statistically significant ( $p > 0.05$ ).

**Table II.** Comparison of pain severity.

Time of assessment	Group 1	Group 2	Group 1 vs Group 2
	Mean $\pm$ SD	Mean $\pm$ SD	<i>P</i> value
Post-operative Day 1	4.0 $\pm$ 0.7	4.3 $\pm$ 1.3	0.35
Post-operative Day 3	3.3 $\pm$ 0.99	4.07 $\pm$ 0.59	0.002*
Post-operative Day 7	2.14 $\pm$ 0.54	2.9 $\pm$ 0.58	0.10

\* *P* < 0.05 statistically significant.

**Table III.** Comparison of post-operative swelling (facial measurements).

Time of assessment	Group 1	Group 2	Group 1 vs Group 2
	Mean $\pm$ SD	Mean $\pm$ SD	<i>P</i> value
Post-operative Day 1	2.52 $\pm$ 1.6	2.98 $\pm$ 1.69	0.43
Post-operative Day 3	1.97 $\pm$ 1.6	2.77 $\pm$ 1.85	0.004*
Post-operative Day 7	0.56 $\pm$ 0.25	0.69 $\pm$ 0.39	0.13

\* *P* < 0.05 statistically significant.

On comparing pain severity, there was no statistically significant difference in between these two groups on the 1st and 7th POD. Reduction in pain was better in group 1 compared to group 2 at 3rd POD, and was statistically significant (Tab. II).

Swelling score revealed no significant difference between both the groups on 1st and 7th POD. Group 1 reported better reduction of swelling than group 2 at 3rd POD, with statistically significant result (Tab. III).

On comparing the wound healing index, Group 1 showed better wound healing than group 2 on POD3 and POD7, with statistically significant result (Tab. IV).

On comparing the total number of analgesics taken by the subjects at POD7, Group 2 subjects consumed more analgesics than Group 1, which showed a statistically significant result (Tab. V).

Group 1 presented 1 patient with adverse effect (Alveolar Osteitis), while Group 2 showed none in Day 1 and Day 3, showing no statistical difference between two groups.

## Discussion

Trans-alveolar extraction procedures range from being relatively easy to extremely difficult [11], depending on the depth, location, tooth angulation and the underlying bone density. Trans-alveolar extractions most commonly result in considerable amount of pain, swelling and trismus, along with localised alveolar osteitis and delayed socket healing in rare cases [12].

Post-operative pain and oedema are related to the inflammatory process, characterized by increase in vascular permeability, leukocytes migration into the inflamed area with the release of inflammatory chemical mediators, and their interaction with other mediators such as kinin and complement [13]. Generally, the

maximum pain intensity is seen at 3–5 h post-surgery, which continues for 2–3 days, and gradually diminishes by the 7<sup>th</sup> day [14,15]. Swelling reaches peak intensity within 12–48 h, resolving between the 5th and 7th POD [10].

In the present study, pre-assessment was done prior enrolment of the patient for group distribution to avoid disparity in terms of procedural difficulty, which in turn could have affected the post-operative outcome. Radiological criteria were assessed in terms of tooth position using IOPA and Panoramic Imaging – OPG. Clinical criteria were standardized for all enrolled patients to check for any acute and/or chronic inflammatory/infections in the surgical site. The assessments were done according to WHARFE classification along with WAR lines for matching complexity of the gesture and evaluation of case difficulty.

In an attempt to rule out these sequelae complications, pharmacological agents such as steroids, non-steroidal anti-inflammatory drugs (NSAIDs), anti-histamines, long-acting local anaesthetics and antibiotics have been used since ages with varying degree of success [16]. Glucocorticoids (hydrocortisone) secreted by the zona fasciculata of adrenal cortex [17], aids in the prevention of inflammation by interfering with capillary dilatation, oedema formation, fibrin deposition, leucocyte migration, and phagocytosis [18], inhibiting the arachidonic acid cascade [16]. Corticosteroids are a well-known adjuvant to surgical procedures, including the removal of impacted teeth for suppressing the inflammatory mediators, thereby reducing fluid transudation and decreasing oedema post-operatively [13,19].

The most commonly used forms of corticosteroids in dentistry includes dexamethasone (oral), dexamethasone sodium phosphate (IV/IM) and dexamethasone acetate (IM) [19]. Dexamethasone is a white, odourless compound, slightly

**Table IV.** Comparison of wound healing.

Time of assessment	Group 1	Group 2	Group 1 vs Group 2
	Mean $\pm$ SD	Mean $\pm$ SD	P value
Post-operative Day 3	2.72 $\pm$ 1.22	1.91 $\pm$ 1.16	0.004*
Post-operative Day 7	4.38 $\pm$ 0.3	2.69 $\pm$ 0.86	0.013*

\*  $P < 0.05$  statistically significant.

**Table V.** Comparison of total analgesic consumption.

Time of assessment	Group 1	Group 2	Group 1 vs Group 2
	Mean $\pm$ SD	Mean $\pm$ SD	P Value
Post-operative Day 7	2.55 $\pm$ 0.94	8.53 $\pm$ 1.13	0.006*

\*  $P < 0.05$  statistically significant.

water soluble, and is a synthetic analogue of prednisolone in which a methyl group has been added at the carbon 16th position and a fluorine atom at the carbon 9th position. It is well known that the addition of fluorine atom at the carbon 9th position greatly enhances the anti-inflammatory activity of the resulting compound [3].

With the recent advancements, Ozone Therapy is a new addition to the existing treatment modality used for reducing inflammation with potent analgesic action. Clinically, ozone can be applied in three basic forms, such as gaseous, water, and oil, depending on the medical condition. Prozone (W & H, UK Ltd) produces ozone in a gaseous state for use in various dental applications [20]. Ozonytron produces an electromagnetic field to transform oxygen into ozone, which is transmitted to the tissue via plasma probes, for usage in extraction sockets, gingival pockets, or root canals [21]. Topical Ozone Therapy is effective in accelerating post-extraction healing as it forms a pseudo-membrane over the socket, preventing any further physical or mechanical insults by covering the exposed nerve endings, ultimately reducing the pain [22], and post-extraction healing time [23]. Topical ozone has an anti-inflammatory action which aids in reducing the release of algogenic chemical mediators and thereby, acting as a potent analgesic, thus promoting wound healing alongside. Ozone application in the extraction socket causes oxidation (inactivation) of metabolic pain mediators, acting as a potent analgesic [23].

Ahmedi *et al.* reported in his study that ozone was more effective than normal saline in reduction of pain after surgical extraction of lower third molars significantly [20]. Our study showed significantly lower VAS pain scores in the ozone group when compared to the dexamethasone group at 3rd post-operative day. The patients in the ozone group also took fewer analgesics compared to the dexamethasone group, when

assessed at 7th day post-operatively. This was in accordance with study by Sivalingam *et al.* who administered topical ozone therapy after third molar dis-impactions as it provides excellent patient comfort, effectively reducing the postoperative pain, swelling and trismus [22].

Ozone improves the transportation of oxygen in the blood by raising the PO<sub>2</sub> in tissues [24]. In our study, statistically significant decreased swelling scores in the ozone group when compared to dexamethasone group at 3rd POD was observed. A study by Xiao *et al.* [25] showed that the ozone application decreases the wound area and thereby, accelerates wound healing by increasing fibroblasts migration [25]. Kazancioglu *et al.*, reported the successful use of ozone gas as an extraoral agent to induce wound healing following transalveolar molar extractions [21]. Our study results are similar to these results as we had better wound healing in the ozone group compared to the dexamethasone group at 3rd and 7th POD respectively.

The present study showed a significant improvement in the postoperative parameters of pain, swelling and wound healing in Group 1 patients. The present study shows that Topical Ozone Therapy aids in better management of postoperative sequelae than Dexamethasone after transalveolar mandibular molar extractions.

## Conclusion

Topical ozone therapy has a superior analgesic effect, with better wound healing and possess better anti-inflammatory properties when compared to Dexamethasone, in the management of post-operative sequelae after mandibular transalveolar molar extractions. Topical ozone therapy is atraumatic, non-invasive, and it greatly increases the patient's acceptability and compliance with the dental treatment.

## Conflict of interest

The authors declare that they have no conflict of interest.

## Funding

This research did not receive any specific funding.

## Ethical approval

All procedures performed in this study were in accordance with the ethical standards of the institutional research committee (SDDHDC/IEC/2021/25) and with the 1964 Declaration of Helsinki and its later amendments of 2013.

## Informed consent

All the surgical and experimental procedures were explained verbally and in writing, and informed written informed consent was obtained from all patients and/or families before enrolment.

## Author contributions

Vishal Kumar Poddar: *Conceptualization, Methodology.*

Mehak Juneja: *Writing original draft.*

Srimathy S. Arora: *Visualization.*

Samrat Ganguly: *Investigation.*

Swapnil Mahavir Jain: *Supervision.*

Ankita Pati Upadhyay: *Writing- Reviewing and Editing.*

**Acknowledgements.** The authors extend their gratitude towards Dr Abdul Saheer, HOD, Department of Public Health Dentistry, Al Azhar Dental College, Kerala for constant help on statistics and experimental design with proper interpretations.

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