# Comparison of effect of ozone oil and non-eugenol periodontal dressing on tissue response, wound healing, and pain following periodontal crown lengthening surgery – A clinical study

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Running title: Analysis of CoePak & ozone oil after CLP

## Abstract

Aim: To compare effect of ozone oil and non-eugenol periodontal dressing in terms of tissue response, wound healing and pain after surgical crown lengthening procedure (CLP).

Introduction: Using periodontal dressing following periodontal procedures for protection of surgical site from mechanical trauma has become questionable as complete healing can take place even without a dressing, provided surgical area is kept clean. Ozone has excellent antimicrobial property. It increases $pO_2$ level of blood leading to increased synthesis of factors enhancing wound healing.

Settings and Design: Patients referred from Institutional Prosthodontics department to Department of Periodontology were selected according to inclusion and exclusion criteria. convenience sampling technique was used.

Methodology: CLP was performed on six patients requiring prosthetic rehabilitation with insufficient crown height. Patients were randomly assigned to Ozone oil or COE-PAK group after surgery. Early Healing Score (EHS) and VAS scoring was done after seven days. Obtained data was statistically analysed.

Statistics: Unpaired t test was used to compare between the two groups.

Results: EHS scores were better for Ozone oil than COE-PAK but not statistically significant. VAS scores were significantly better for Ozone oil than COE-PAK
Conclusion: Ozone oil and COE-PAK are effective in enhancing wound healing, whereas Ozone oil is better at reducing pain perception and can be used as an alternative to COE-PAK.
Keywords: Ozone oil, Periodontal dressing, Crown lengthening, Wound healing, Pain
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## Introduction

Wound healing is a complex multifactorial event that is influenced by a number of underlying mechanisms.[1] Adequate soft and hard tissue wound healing following dental/periodontal procedures is crucial for achieving suitable treatment outcomes.[1] After injury (whether traumatic or surgically induced), wound healing includes a series of highly regulated, sequential steps: inflammation, granulation tissue formation, re-epithelialization, and remodeling.[2] Optimal wound healing requires angiogenesis and revascularization followed by creation of granulation tissue, as well as sufficient supply of oxygen, nutrients and growth factors.[1,3] Impaired or insufficient capillary ingrowth can result in poor wound healing, including excessive inflammation, pain, bleeding, dehiscence etc.[4,5] Improved wound healing and decreased postoperative pain are crucial in enhancing patient satisfaction, compliance and attaining clinical success[1] and thus dressing technology has an important role to play.[6]

Since the introduction of first intraoral wound dressing i.e., Wonder Pack by Ward[7] in 1923 which was zinc oxide eugenol based, with the purpose of immobilizing the tissue and eradication of pain, various dressings have been suggested in the past.[8] After surgical removal of gingival tissue, it is a common practice to cover the exposed wound with a periodontal dressing to provide patient comfort and protection for the wound during the initial healing phase.[9] Having discussed the therapeutic benefits of a periodontal dressing, the fact that complete healing can take place even without a dressing, provided the surgical area is kept clean, and that there is no difference in healing between dressed and non-dressed wounds, lends support to the theory that not all surgical areas need to be "packed".[8]

Periodontal crown lengthening surgery (CLP) is a procedure in which the wound heals by secondary intention if simple gingivectomy is performed and osteotomy is not required. However, the application of a periodontal dressing following the gingivectomy[9] and reverse bevel flap[10] procedures has been shown to offer no real advantage upon the final clinical result, and in fact may increase the occurrence of postoperative pain.[9] If plaque accumulation were inhibited on the wound surface and teeth following gingivectomy, healing comparable with that following the use of a periodontal dressing might be achieved.[9] Various clinical trials have suggested that the use of a dressing accumulates plaque-causing inflammation,[11] irritates the healing tissues[10] and causes more pain and swelling.[12]

The therapeutic administration of Ozone gas in air, water or oily medium for the treatment of various pathologies is known as Ozone therapy. The topical route of ozone therapy has been used to treat extensive wounds, fungal, bacterial and viral infectious conditions, ischemic lesions and other pathologies showing efficiency mainly in disinfection and wound healing.[13] For diseases such as ulcers or aphthous stomatitis, gingivitis, and dermatitis, ozonated oil aids on the pain relief and healing process.[14] It also assists in wound healing and resolution of inflammation by arresting plaque accumulation after oral surgical procedures.[13,14,15]

To the best of our knowledge, no study has compared the effectiveness of topical application of ozone oil with COE-PAK in terms of tissue response, wound healing and pain after Crown Lengthening Procedure. Thus, current study is formulated with the aim of comparing the effect of ozone oil and non-eugenol periodontal dressing in terms of tissue response, wound healing and pain after periodontal flap surgery.

Methodology

A randomized single blind clinical trial was conducted in the Department of Periodontology, SMBT Dental College, Sangamner, Maharashtra from July 2022-October 2022. The study sample consisted of six patients aged 20 to 60 years requiring surgical crown lengthening for prosthetic rehabilitation reporting to the department. Patients were explained about the nature, need, and outcome of the study, followed by which a verbal and written informed consent was obtained. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional) and with the Helsinki Declaration of 1975 that was revised in 2013.

INCLUSION CRITERIA –

1) Systemically healthy patients.
2) Patients requiring crown lengthening periodontal surgery.
3) Patient should be able to understand and give a written informed consent.
4) Both males and females between the age group of 18-60 years would be included.
5) Availability of the patient for the entire duration of the study.

EXCLUSION CRITERIA –

1) Patients with systemic diseases (i.e., diabetes mellitus, cancer, HIV, bone metabolic diseases).
2) Patients on systemic corticosteroids, immunosuppressive agents, radiation therapy, and/or chemotherapy prescribed or received within two months prior to study entry.
3) Patients contraindicated for crown lengthening periodontal surgery
4) Pregnant and/or lactating females.
5) Smokers and alcoholics.
6) Patients using tobacco products.

Patients meeting with the inclusion criteria were enrolled in the study. All the surgical treatment procedure was performed by a single operator. Randomization and allocation of test (Group 1) and control (Group 2) group was done by “toss of a coin method” as Group 1: Topical application of Ozone Oil and Group 2: Non-eugenol

Crown lengthening surgery was performed in the required area under local anesthesia (2% lignocaine hydrochloride). After the surgical procedure, for control group, COE-PAK (produced by GC America Inc.) was mixed and applied, according to manufacturer instructions (Figure 1) and for test group, Ozone oil (70mg/ml) ozone insufflated in olive oil produced by ADC Inc. Dentozoneindia (Figure 2) was applied immediately by the clinician and was also given to the patient to apply as directed on the operated site twice daily for the next seven days. All the surgical treatment procedure were performed by one operator for each patient (Figure 3 and 4). Standard post operative instructions and medications were given to all the patients. Patients were recalled after seven days. After one week the pack, if given, was removed by the same operator (figure 3 and 4). Tissue response and wound healing

(according to the Early Wound Healing Score by Lorenzo Marini et al. 2018[17]) of all patients was evaluated by another designated blinded assessor. The patient was shown the MVAS[18] for evaluation of pain by the same blinded assessor and asked to rate their pain level on a scale of 0-10. The collected data was then put to statistical analysis.

Statistical Analysis

Collected data was entered in Microsoft Office Excel 2010 and results were analysed using Statistical Product and Service Solution (SPSS) Version 21 Software. Frequency analysis of the ordinal data was performed and cross tabulated for frequency and proportion. Descriptive statistics such as mean and standard deviation were calculated was both the groups. All statistical analysis was done at 95% Confidence interval and p value less than 0.05 was considered to be statistically significant. Unpaired t test was applied to compare between the two groups.

Results

A total of six patients were enrolled in the study with 3 patients in each group. The overall mean score of EHS was higher in test group than in the control group (Table 1). However, no statistically significant difference (p=0.251) was observed between the test and control groups with respect to all the three parameters of EHS (Figure 5). A statistically significant difference (p=0.026) was observed in test group as compared to control group for MVAS score rated by the patients (Table 2).

All the patients in the test group experienced less postoperative pain than control group according to MVAS (Figure 6).

Discussion

Application of Ozone oil via topical route has already been proved as a treatment for tissue repair as it not only promotes wound healing but also has antimicrobial, immunological, antioxidant and pain reducing properties.[13]

Although no statistically significant difference was found, the early healing score (EHS) for ozone oil group in this study was higher than COE-PAK group indicating better healing whereas statistically significant difference was observed for MVAS scores which were higher in COE-PAK group indicating more pain perception.

Comparative evaluation of non-eugenol dressings with other agents like cyanoacrylates, methacrylate gel containing chlorhexidine, curcumin extract etc. promoting wound healing has shown conflicting results.[8,9,10,19] Jones and Cassingham[12] conducted a study to compare healing with and without periodontal dressing post periodontal surgery and it was concluded that for the sites with dressings, the inflammatory indices were slightly higher, although no statistically significant difference was observed. Similarly, in the present study inflammation was higher in the dressing group but was not statistically significant (p=0.519). The possible explanation for higher inflammatory indices can be accumulation of plaque around the dressing.[20-25]

The modification of a methacrylic gel for use as a periodontal dressing was attempted by Addy et al.,[26] and the results suggested that the modified methacrylic gel containing chlorhexidine fulfilled the requirements of a substitute to periodontal dressing in the aspects of wound healing in a similar fashion as ozone oil in the present study as both chlorhexidine and ozone oil have anti-inflammatory and anti-microbial properties. Cyanoacrylate adhesives synthesized by Coover et al.[27] were used by Bhaskar et al.[28] in periodontal and oral surgical procedures and found that the material was easily applied, produced quick haemostasis, was more tissue

tolerant, had minimal bulk, reduced postoperative pain, allowed faster wound healing and stimulated less proliferation of granulation tissue underneath them than conventional periodontal dressings.[29] These results were similar to results of our study where ozone oil had no bulk, allowed accelerated healing of wound, reduced postoperative pain.

Ozone oil showed less inflammation and faster healing after seven days as compared to COE-PAK in our study. In last few decades, Bocci et al.[30-33] carried a series of trials and showed that contact of human blood with ozone led to an elevated level of release of transforming growth factor- β1, interferons (α, β and γ), interleukins (IL-1, IL-2, IL-6, IL-8) and tumour necrosis factor- α, which are pivotal for human wound healing. Moreover, it has also been suggested that wounds receive more oxygen when ozonated oil is applied, and the modification of wound healing under application of oxygen is well documented in some of the previous literature.[14] The reduction in primary wound healing time, the enhancement of phagocytotic activity, faster migration of epithelial cells and fibroblast activation have been documented after application of oxygen.[34]

Antoniazzi et al.[19] evaluated healing after surgical crown lengthening on post-operative pain and swelling with and without a periodontal dressing concluding that the use of periodontal dressing seems to be preferable following surgical crown lengthening. In our study, patients who applied ozone oil experienced less pain and discomfort in comparison to control group. Although evaluation of pain was of a subjective nature, it is significant that all of the patients had more pain or discomfort when a dressing was used. The placebo effect of test group at the surgical site could be the reason for this. Bahl et al.[35] justified lower VAS score after transalveolar extraction in the ozone group suggesting that application of ozone oil causes oxidation of pain mediators acting as a potential analgesic. On applying topically, ozone oil forms a protective layer over the surgical site in the early post operative phase leading to wound contamination prevention.[35] It also covers the exposed nerve endings, ultimately reducing pain.[35]

From the previously published literature about use of periodontal dressings, it is still a controversy whether to use it compulsorily after every periodontal surgery or not.[12] Materials like Ozone oil, methacrylate gels containing chlorhexidine or curcumin, cyanoacrylate adhesives etc. prove to be good alternatives to periodontal dressings.[8,9]

To the best of our knowledge, the present study was a first of its kind study to compare postoperative results following application of periodontal dressing versus ozone oil as a topical application after periodontal crown lengthening surgery. Ozone oil is effective in enhancing wound healing and produced marginally better results than COE-PAK, whereas Ozone oil is significantly efficacious than COE-PAK at reducing pain perception.

## Conclusion

In conclusion, the results of this study suggest that Ozone oil has a potential therapeutic effect on facilitation of postoperative wound healing and pain reduction through faster re-epithelization by its anti-inflammatory and anti-oxidant properties and can be a good alternative to periodontal dressings. Plaque accumulation was not considered as a factor for presence of inflammation under the dressing in this study. Further clinical trials with a larger sample size in a split mouth design including a plaque index along with microbial and histopathological analysis are needed to determine the clinical efficacy of Ozone oil post periodontal surgery to get a definitive conclusion on wound healing enhancement

and pain management after ozone oil application in comparison to COE-PAK.

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| **Table 1: Comparison of Early healing score (EHS) between both study groups in respect to its three parameters** | | | | |
|---|---|---|---|---|
| **EHS** | **Group 1 (Ozone Oil) Mean (SD)** | **Group 2 (COE-PAK) Mean (SD)** | **Unpaired t test** | **p value (Significance)** |

| | | | | |
|---|---|---|---|---|
| CSR (Re-Epithelialization) | 6.0 (0.0) | 4.0 (1.73) | t = 2.0 | p=0.116 (NS) |
| CSH (Haemostatsis) | 2.0 (0.0) | 2.0 (0.0) | t = 0.0 | p=1.000 (NS) |
| CSI (Inflammation) | 1.66 (0.57) | 1.33 (0.57) | t = 0.707 | p=0.519 (NS) |
| Overall (EHS) | 9.33 (1.15) | 7.33 (2.3) | t = 1.342 | p=0.251 (NS) |

**p> 0.05 – no statistically significant difference (NS)**

**Table 2: Comparison of pain VAS score between both study groups 1 week after surgery**

| | **Group 1 (Ozone Oil) Mean (SD)** | **Group 2 (COE-PAK) Mean (SD)** | **Unpaired t test** | **p value, (Significance)** |
|---|---|---|---|---|
| Pain VAS Score | 0.0 (0.0) | 2.0 (1.0) | t = -3.464 | p =0.026* |

***p<0.05 – statistically significant difference**



Fig. 1


Fig.2


OZONE

Fig 3


Ozone Oil Group
Immediate post-op.
Ozone Oil application
7 days Follow up.



Fig 4


COE-PAK Group
Immediate post-op.
COE-PAK application
7 days Follow up.

Fig. 5

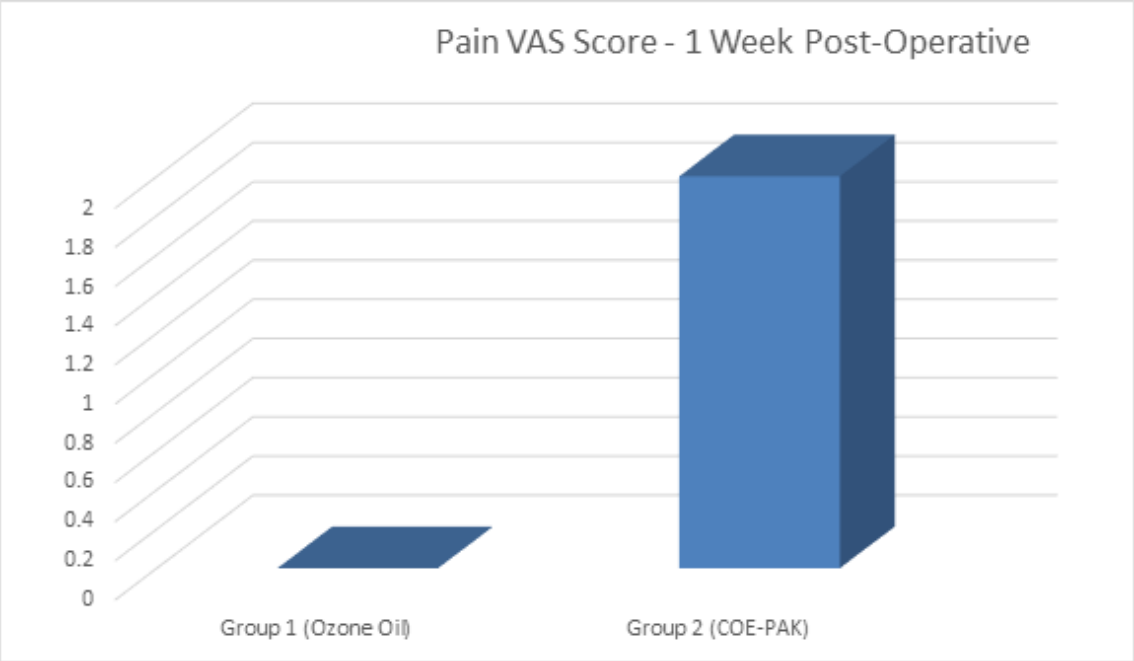
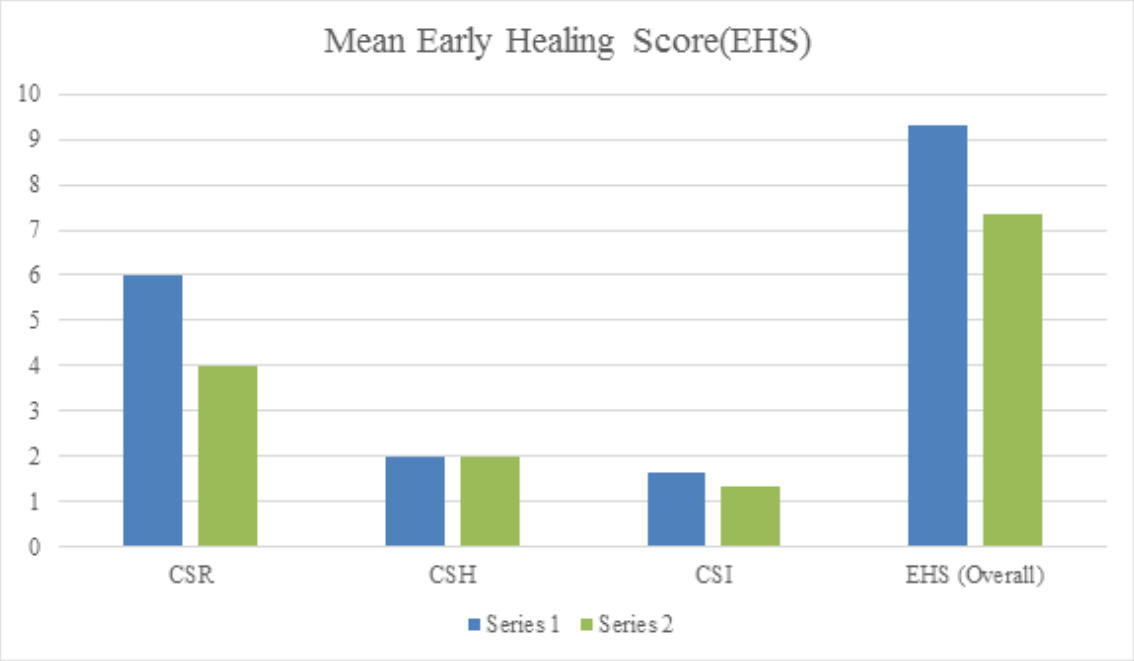

Pain VAS Score - 1 Week Post-Operative
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Group 1 (Ozone Oil)
Group 2 (COE-PAK)



Fig. 6


Mean Early Healing Score(EHS)
10
9
8
7
6
5
4
3
2
1
0
CSR
CSH
CSI
EHS (Overall)
Series 1
Series 2