

Effect of ozonated oil and chlorhexidine gel on plaque induced gingivitis: A randomized control clinical trial

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Abstract

Background:

Several chemotherapeutic agents have been developed to prevent gingivitis and its progression into periodontitis. In this present study, the efficacy of ozonated oil and chlorhexidine gel was assessed and compared on plaque induced gingivitis.

Aim:

To evaluate the effect of ozonated oil on plaque induced gingivitis and to compare its efficacy with chlorhexidine gel.

Materials and Methods:

A total of 20 subjects, aged from 18 to 65 years, with plaque-induced gingivitis were selected from the outpatient Department of Periodontology, Government Dental College and Hospital, Aurangabad, for this study. They were divided randomly into the test or ozonated oil group (Group I) and the control or chlorhexidine gel group (Group II) with 10 subjects in each group. Subjects were randomly assigned to massage their gingiva thrice a day for 3 weeks with ozonated oil (test), and chlorhexidine gel (control). Plaque index and gingival index scores were recorded for the 20 subjects at baseline and after 3 weeks.

Results:

Ozonated oil (Group I) and chlorhexidine gel (Group II) groups showed statistically significant differences with respect to plaque index and gingival index, from the baseline to 3 weeks ($P < 0.001$ in both). But the difference between Group I and Group II, at the end of the study period, was not statistically significant with respect to the plaque index and gingival index.

Conclusions:

The ozonated oil and chlorhexidine gel, both can be used as an effective agent in maintaining and improving gingival health.

Keywords: Chlorhexidine gel, gingival massage, ozonated oil, plaque induced gingivitis

INTRODUCTION

Plaque-induced gingivitis is an inflammatory process, limited to the gingiva, resulting from bacteria located at the gingival margin. To prevent gingivitis and its progression to periodontitis, daily and effective supra-gingival plaque control methods are considered the most effective methods to regain and maintain dental and periodontal health.

Chlorhexidine is considered to be the “gold standard” agent for chemical plaque control methods, as it is a broad spectrum antiseptic. However, chlorhexidine is discouraged because of its unpleasant taste and undesirable side effects such as tooth staining.[1]

Ozone (O_3), is found in nature, in the form of a gas in the stratosphere in a concentration of 1–10 ppm, being continually created from and destroyed into molecular O_2 . It is one of the most important gases in the stratosphere due to its ability to filter ultraviolet rays, which is critical for the maintenance of biological balance in the biosphere. The German Chemist Christian Friedrich Schonbein is considered to be the father of ozone therapy (1840). When he passed an electric discharge through water, a strange smell was produced, which he called ozone, from the Greek word ozein (odor). In dentistry, Dr. E.A. Fisch (1889–1966) was the first dentist to use ozonated water in his practice. Joachim Hansler, a German physicist, joined Hans Wolff, another German physician, to develop the first ozone generator for medical use. The main use of ozone in dentistry is relies on its antimicrobial properties. It is proved to be effective against both Gram-positive and Gram-negative bacteria, viruses and fungi.[2] In periodontology, it has been used for gingivitis, periodontitis, peri-implantitis, surgical cuts, prophylaxis. Ozone can be used in various forms for treatment of periodontal disease: Ozonated water, ozonized oil, and gaseous ozone.[3]



In the present study, the effect of ozonated oil (test) and chlorhexidine gel (control) has been evaluated and compared on plaque induced gingivitis to improve the oral health through gingival massage based on the clinical parameters including plaque and gingival scores. In addition to the antimicrobial properties of the oil and gel, gingival massage can mechanically disrupt the biofilm on the teeth, disperses the agents throughout the gingiva, stimulates blood circulation to the gingival tissues, and strengthen its immune response. Furthermore, it is easy to perform, more acceptable and can have a better patient compliance.[4]

MATERIALS AND METHODS

The present study was conducted in the Department of Periodontology, Government Dental College and Hospital, Aurangabad.

A randomized controlled clinical trial was performed. A total of 20 subjects were enrolled for this study based on the following inclusion and exclusion criteria:

Inclusion criteria

1. Subjects with plaque-induced gingivitis
2. Age range of 18–65 years old
3. Subjects exhibited no evidence of clinical attachment loss
4. Ready to give consent.

Exclusion criteria

1. Use of antibiotics in the past 3–4 weeks
2. History of dental treatment/use of mouthwash
3. Patient with acute necrotizing ulcerative gingivitis, acute herpetic gingivostomatitis, allergic gingivitis, gingivitis associated with skin diseases, gingivitis associated with endocrine-metabolic disturbances, gingivitis associated with hematologic-immunologic disturbances, gingival enlargement associated with medications, gingival tumors were excluded
4. Individuals with known systemic disease
5. Pregnant or lactating women.

Diagnosis of plaque induced gingivitis was performed by the clinical assessment which was based on plaque index (Turesky-Gilmore-Glickman modification of Quigley Hein Index, 1970)[5] and gingival index (Loe and Silness, 1963).[6]

The plaque index and gingival index scores were recorded in each individual at baseline (pre) and after 3 weeks (post). A total of 20 subjects with almost equal baseline mean scores were chosen for the study. A simple random sampling was carried out using a lottery method. Group I (study group-ozonated oil) and Group II (control group-chlorhexidine gel) included 10 subjects each. Group I had four males and six females. Group II had six males and four females.

The Study group (Group I) was advised to massage their gingiva with 1 ml of ozonated oil [Figure 1]. The oil base used in ozonated oil, was consist of 60% sesame oil, 30% sunflower oil, 5% castor oil and tuvarak oil each. The control group (Group II) was advised to massage their gingiva with 1 ml of 1% chlorhexidine digluconate gel [Figure 2]. All the subjects were advised to massage their gingiva by using the index finger thoroughly around all teeth in circular motions for 10 min, thrice a day, for 3 weeks. Patients were instructed not to eat or drink for at least 1/2 h after the gingival massage. No specific instructions on other oral hygiene practices (tooth brushing, flossing) were given in order to eliminate the bias which could have arrived because of modifying their oral hygiene practices.



Figure 1
Ozonated oil



Figure 2
Chlorhexidine gel

The pre- and post-values of the plaque and gingival index scores within the same group were compared using a paired *t*-test. The comparison of the pre- and post-values between the two groups was performed using an unpaired *t*-test. The statistical analysis was performed using GraphPad software, (Inc.7825 Fay Avenue, Suite 230La Jolla, CA 92037 USA).

RESULTS

The pre and post values of plaque index score and gingival index score showed a statistically significant difference in Group I and Group II ($P < 0.001$).

Table 1 shows a comparison of pre and post values of the plaque index scores and gingival index scores, between the study (Group I) and the control group (Group II). There was no statistically significant difference in both the scores indicating that the pre and post mean values of both the groups were almost the same. Table 2 shows that the effect of ozonated oil and chlorhexidine gel was same in males and females belonging to same groups.

Group	Sample	Pre		Post	
		Mean±SD	P	Mean±SD	P
Plaque index	Group I	2.00±0.45	0.0001	1.50±0.30	0.0001
	Group II	2.01±0.47	0.0001	1.50±0.30	0.0001
Gingival index	Group I	1.75±0.20	0.0001	1.20±0.10	0.0001
	Group II	1.75±0.20	0.0001	1.20±0.10	0.0001

SD: Standard deviation.

Table 1

A comparison of the pre- and post- values of plaque index and gingival index scores between Group I and Group II

Group	Sample	Plaque index		Gingival index	
		Pre	Post	Pre	Post
Group I	Males	2.00±0.45	1.50±0.30	1.75±0.20	1.20±0.10
	Females	2.01±0.47	1.50±0.30	1.75±0.20	1.20±0.10
Group II	Males	1.98±0.42	1.48±0.28	1.72±0.18	1.18±0.08
	Females	2.02±0.48	1.52±0.32	1.78±0.22	1.22±0.12

SD: Standard deviation.

Table 2

A comparison of plaque index and gingival index scores in males and females

DISCUSSION

Plaque-induced gingivitis is the common form of periodontal disease, results from interactions of the immune system and existing biofilm. The classification of gingival diseases relies on the presence of dental plaque and factors that modify the inflammatory status of gingiva. The modification of plaque-induced gingivitis can occur by local or systemic factors. Local factors include tooth anatomic factors, dental restorations and appliances, root fractures and cervical root resorption, whereas, systemic factors involve the endocrine system, hematologic diseases, drugs, or malnutrition.[7]

Chlorhexidine has emerged as an important oral antiseptic agent and is used as an adjunct to periodontal therapy. It is a broad spectrum antiseptic with antimicrobial effects on Gram-positive as well as Gram-negative bacteria, some viruses, and fungi.[8] However, due to the undesirable effects such as brownish discoloration of teeth, some restorative materials, the dorsum of tongue and taste disturbance, after prolonged use, several alternatives to chlorhexidine have been investigated.[9]

Ozone gas is considered to be an oral antiseptic agent because it is a stronger antimicrobial agent. It kills bacteria, fungi, and viruses and does not induce microbial resistance. Application of ozone in dentistry is based on physical and chemical properties such as antimicrobial action, immunostimulatory action, antihypoxic, biosynthetic, and detoxicating effect.[10] Ozone gas is not recommended for intra-oral use, for safety concern.[11] Ozone gas dissolved in water and oils were and are still commonly used in different fields of dentistry.[12,13,14] Ozonated oils are obtained from the chemical reaction between ozone and unsaturated fatty acids of vegetable oils.[15,16,17,18] They are gaining importance due to its excellent curative results, simple application, long-term effects, and nontoxic nature. Ozone therapy should be contraindicated in pregnancy, glucose-6-phosphate-dehydrogenase deficiency, hyperthyroidism, severe anemia, severe myasthenia, and active hemorrhage.[19]

In the present study, route of administration of ozonated oil and chlorhexidine gel is through gingival massage by which the antiseptic agent disperses throughout the gingiva and gingival margin and it stimulates circulation within gingival tissues, which allows the immune system to fight against the infection.

Besides the valuable properties of ozone gas dissolved in oil, the possible mechanism of action of oil therapy alone could be that the viscosity of the oil probably inhibits bacterial adhesion and plaque co-aggregation. Other possible mechanisms might be that the saponification or the “soap making” process that occurs as a result of alkali hydrolysis of fat, that is, when oils are acted upon by salivary alkalis such as bicarbonates, the soap making process is initiated. Soaps are known to be good cleansing agents because they are effective emulsifiers. Emulsification greatly enhances the surface area of the oil, thereby increasing its cleansing action.[20]

One of the main quantitative methods developed for determining the quality of ozonated oil is peroxide value (Ip). The Ip is the number that expresses in milliequivalents of active oxygen the quantity of peroxide contained in 1000 g of the substance (British Pharmacopoeia, 2012). Ip is an indicator of

how much active oxygen could be released: The higher I_p , the stronger antimicrobial effectiveness of ozonated oil. With the I_p of 1500 mmol-equiv/kg in ozonated oil was used in this trial.

Singla *et al.*[21] conducted a study, where chlorhexidine gel, olive oil, sesame oil, and coconut oil was used for gingival massage and concluded that these oils and chlorhexidine gel can be used as valuable preventive agents in maintaining and improving oral health status. Nagayoshi *et al.*[22] tested the efficacy of three different concentrations of ozone water (0.5, 2, and 4 mg/ml in distilled water) on the time-dependent inactivation of cariogenic, periodontopathogenic and endodontopathogenic microbes (*Streptococcus*, *Porphyromonas gingivalis* and *endodontalis*, *Actinomyces actinomycetemcomitans*, *Candida albicans*) in culture and in biofilms and confirm that ozonated water was highly effective in killing of both Gram-positive and Gram-negative micro-organisms. Depending on the dosage, the oral microbes were inactivated after 10 s. Huth *et al.*, in 2007,[23] established a condition under which aqueous ozone exerts inhibitory effects on the nuclear factor-kappa B system, suggesting that it has an anti-inflammatory capacity. A study conducted by Kshitish and Laxman,[24] found higher percentage of reduction in plaque index (12%), gingival index (29%) and bleeding index (26%) using ozone irrigation as compared to chlorhexidine. Patel *et al.*,[25] found that the adjunctive use of the ozonated olive oil with scaling and root planning resulted in a significant improvement of clinical parameters as well as microbiological parameters over the time and in comparison to the control groups. The ozonated olive oil as monotherapy also showed a significant improvement in clinical parameters as well as microbiological parameters over the time without any documented side effects. However, there was a significant increase in dentinal hypersensitivity following ozonated olive oil as an adjunct to scaling and root planning therapy. Montevecchi *et al.*[26] found that ozonated oil is a more effective antiseptic than chlorhexidine digluconate and povidone-iodine against *S. aureus* and the periodontal pathogen *P. gingivalis*.

Based on all the studies mentioned above and considering the properties of ozone and chlorhexidine, we evaluated and compared the role of ozonated oil and chlorhexidine gel on plaque induced gingivitis in the present study.

Limitation

The groups were unsupervised in the application of therapy; compliance with the requirement to invest 10 min, 3 times a day for 3 weeks was difficult in few patients. Since this study has shown positive results, it can be used as an exploratory study and further research can be carried out on a larger sample. In addition, the lack of significance between the groups could be due to the smaller sample size. The reassessment was performed after 3 weeks based upon the previously conducted similar studies:[27,28,29] longer periods of follow-up can be considered in further research. Due to the possible mechanism of action of oil therapy as mentioned above, in addition to the antimicrobial properties of the oils, they would have a beneficial role in decreasing the plaque and gingivitis. The role of mechanical disruption of the biofilm due to gingival massage may be as relevant as ozonated oils or chlorhexidine gel. Hence, to verify such hypothesis, a group of gingival massaging without any product could be included in the further research.

CONCLUSIONS

Gingival massage with ozonated oils can be used as an effective alternative to gingival massage with chlorhexidine gel against plaque induced gingivitis.

Financial support and sponsorship

Ozone Forum of India and ICPA Health Product Ltd.

Conflicts of interest

There are no conflicts of interest.

Article information

J Indian Soc Periodontol. 2016 Jan-Feb; 20(1): 32–35.

doi: 10.4103/0972-124X.170806

PMCID: PMC4795130

PMID: 27041835

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Received 2015 Apr 2; Accepted 2015 Sep 24.

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