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RESEARCH ARTICLE

COMPARISON OF EFFICACY OF OZONATED OIL AND CHLORHEXIDINE GEL IN THE MANAGEMENT OF GINGIVITIS

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ABSTRACT

Context: Gingivitis is the most common inflammatory diseases of supporting tissues of teeth. Role of microbial aetiology and host response in progression of gingival diseases has been well established. The most common variant; 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. The objective of this article is find alternative treatment methods.

Aim: With this aim we investigate the application of ozonated oil and compare its efficacy with that of chorhexidine in treatment of plaque induced gingivitis.

Materials and Methods: A total of 50 subjects, aged from 18 to 70 years, with plaque-induced gingivitis were selected from the outpatient Department of Periodontology, Hazaribag College of Dental Sciences, Hazaribag, 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 25 subjects in each group. Subjects were instructed to gently massage their gingiva thrice a day for 3 weeks with the drug. Plaque index and gingival index scores were recorded for all the 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. But the added benefit of ozonated oil over chlorhexidine is freedom from side effects like unpleasant taste and staining of teeth.

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INTRODUCTION

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 he 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. (Mariotti, 1999) 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. (Moshrefi, 2002) 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,

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several alternatives to chlorhexidine have been investigated. Currently, ozone therapy is gaining popularity as a modern non-invasive method of treatment (Sechi *et al*., 2001); it is a powerful oxidizing agent with a high antimicrobial power against oral pathogens, without resistance development has been reported not only for gaseous ozone (Huth *et al*., 2009) and (Baysan and Lynch, 2004), but also for ozone in aqueous (Restaino *et al*., 1995; Nagayoshi *et al*., 2004; Arita *et al*., 2005; Ebensberger *et al*., 2002). It is used in various treatment modalities in field of medicine, dentistry, veterinary, food industry, and water treatment. Ozone is being discussed in dentistry as a possible alternative oral antiseptic agent. Its A high level of biocompatibility to fibroblasts, cementoblasts, and epithelial cells (Arita *et al*., 2005; Ebensberger *et al*., 2002; Huth *et al*., 2006; Ramzy *et al*., 2005) suggests its use against oral infectious diseases. (Sechi *et al*., 2001; Nagayoshi *et al*., 2004; Castañeira *et al*., 1995; Cruz *et al*., 1997) Ozonated olive oil undergoesozonization using a steady flow of ozone–oxygen mixture in the ratio of 5:95% until olive oil transforms from the greenish-colored liquid status to the whitish gel status (Cruz *et al*., 1997). Due to the germicidal action of ozone, as well as its oxygenating power, that favours tissue regeneration, it was applied in the treatment of alveolitis following surgical extraction of the lower third molar (Agapov *et al*., 2002). In the present study, the effect of ozonated oil (test) and chlorhexidine gel (control) has been evaluated and compared on plaque induced gingivitis.

MATERIALS AND METHODS

The present study was conducted in the Department of Periodontology, Hazaribag College of Dental Sciences, Hazaribag. A total of 50 subjects were selected for this study on the basis of following criteria:

Inclusion criteria

1. Subjects with plaque-induced gingivitis
2. No evidence of clinical attachment loss
3. Willing to participate in the study.

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

Diagnosis of plaque induce gingivitis was performed by the clinical assessment which was based on plaque index (Turesky-Gilmore-Glickman modification of Quigely Hein Index, 1970) (Kallar *et al*., 2011) and gingival index (Loe and Silness, 1963). The plaque index and gingival index scores were recorded in each individual at baseline (pre) and after 3 weeks (post).

Sampling

A total of 50 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 25 subjects each. Group I had fourteen males and eleven females. Group II had six males and nineteen females.

Drug

The Study group (Group I) was advised to massage their gingiva with 1 ml of ozonated oil. The oil base used in ozonatedoil, was consist of 60% sesame oil, 30% sunflower oil, 5% castor oil and tuvarak oil each. The control group was advised to massage their gingiva with 1 ml of 1% chlorhexidinedigluconate gel. 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.

Statistical tests employed

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 SPSS (version 16) software.

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 1. The comparison of pre and post values of plaque index and gingival index in study group and control group

Group	Pre		Post	
Plaque index	Mean±SD	p value	Mean±SD	p value
Study group	2.873± 0.45	0.104	1.753±0.34	0.306
Control group	2.765± 0.36		1.982±0.62	
Gingival index				
Study group	1.872±0.42	0.062	1.024±0.45	0.225
Control group	2.014±0.32		1.562±0.36	

DISCUSSION

Ozone is a natural gaseous molecule made up of three oxygen atoms. Ozone therapy can be defined as a versatile bio-oxidative therapy in which oxygen/ozone is administered via

gas or dissolved in water or oil base to obtain therapeutic benefits (Baysan and Whiley, 2000). The word ozone originates from the Greek word ozein, which means odor and was first used by German chemist Christian Friedrich Schonbein, father of ozone therapy (1799-1868) in 1840. The first application of ozone in medical field seems to have been for treating gaseous, post-traumatic gangrene in German soldiers during the 1st world war (Bocci, 2004). However a big step forward was the invention of a reliable ozoniser for medical use by the physicist Joachim Hansler (1908- 1981). The idea to use ozone in medicine developed slowly during the last century and it was stimulated by the lack of antibiotics and the disinfectant properties of ozone. Ozone, which is used for medical purposes, is a gas mixture comprised of 95 to 99.95% oxygen and 0.05 to 5% pure ozone. Due to proven therapeutic advantages of ozone, many fields in dentistry could benefit from ozone therapy. The first dentist who used ozone was Edward Fisch in 1950 for treating Austrian surgeon Ernst Payr for a gangrenous pulpite and thereby inspired him to begin a line of investigations dedicated to ozone use in health care. The first ozone generator for medical use was developed by German physicians named Joachim Hansler and Hans Wolff. Their design continues to be the basis for modern equipment. Medical grade ozone is a mixture of pure oxygen and pure ozone in the ratio of 0.05% to 5% of O_3 and 95% to 99.95% of O_2. Due to the instability of the O_3 molecule, medical grade ozone must be prepared immediately before use. After preparation with in less than an hour, only half of the mixture is still ozone while the other half is transformed into oxygen. As a result, it is impossible to store ozone over long periods of time. In order to control the decomposition of O_3 into oxygen it can be associated with a vehicle with aqueous properties to promote the conversion more quickly or with a vehicle with more viscous properties to retard the conversion.

There are three different systems for generating ozone gas:

a) Ultraviolet System produces low concentrations of ozone, used in esthetics, saunas, and for air purification.
b) Cold Plasma System: used in air and water purification.
c) Corona Discharge System: produces high concentrations of ozone. It is the most common system used in the medical/ dental field. It is easy to handle and it has a controlled ozone production rate.

Ozone has been shown to possess unique properties and has potential applications to the clinical practice of dentistry and medicine. There are several known actions of ozone, such as antimicrobial (bactericidal, viricidal, and fungicidal), immunostimulating, immune modulatory, antiinflammatory, biosynthetic (activation of the metabolism of carbohydrates, proteins, lipids), bioenergetic, antihypoxic, analgesic, haemostatic, etc. The use of ozone has been proposed in dentistry because of its antimicrobial, disinfectant, biocompatibility and healing properties. Ozone has been applied for treatment of early carious lesions, sterilization of cavities, root canals, periodontal pockets, enhancing epithelial wound healing such as ulcerations and herpetic lesions, Bleaching of discolored root canal treated teeth, Desensitization of extremely sensitive teeth, treatment of periimplantitis, and as a rinse for the avulsed teeth or as a denture cleaner and decontamination of used tooth brush (Baysan and Whiley, 2000; Hickel and Huth, 2004; Celiberti and Pazera, 2006; Baysan and Beighton, 2007; Abu-Nab'a and Shorman, 2003). In following conditions, ozone therapy is contraindicated; pregnancy, Glucose-6-phoshate dehydrogenase deficiency (favism), hyper thyroidism, severe anemia and severe myasthenia Active Prolonged inhalation of ozone can be deleterious to the lungs and other organs but well calibrated doses can be therapeutically used in various conditions without any toxicity or side effect. The European Cooperation of Medical Ozone Societies, warns that direct intravenous injections of ozone/oxygen gas should not be practiced due to the possible risk of air embolism. (Bocci and Borrelli, 2009) Singla *et al*. 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 (Singla *et al*., 2014).

Nagayoshi *et al*. 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, Porphyromonasgingivalis and endodontalis, Actinomycesactinomycetemcomitans, 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. (Nagayoshic *et al*., 2004) Huth *et al*., conducted a clinical study in 2007 and 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. (Huth *et al*., 2007) A study conducted by Kshitish and Laxman, found higher percentage of reduction in plaque index (12%), gingival index (29%) and bleeding index (26%) using ozone irrigation as compared to chlorhexidine. (Kshitish and Laxman, 2010) Patel *et al*. (25) found that the adjunctive use of the ozonatedolive 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. (Patel *et al*., 2012) Montevecchi *et al* found that ozonated oil is a more effective antiseptic than chlorhexidinedigluconate and povidone-iodine against S. aureus and the periodontal pathogen P. gingivalis (Montevecchi *et al*., 2013). Thus based upon the review of existing literature and results of the present study we can comment that ozonated oil is efficacious in the management of gingivitis.

Conclusion

Gentle massaging of gingival tissues with ozonated oils can be an effective alternative therapy against plaque induced gingivitis.

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