

## Comparing the Efficacy of Two Mouth Rinses in Reducing Bacterial Aerosol Contamination

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### Abstract

**Background:** The aim of this study was to compare bacterial aerosol contamination generated by ultrasonic scalers between two groups following two consecutive 30-second rinses with chlorhexidine gluconate (0.12% w/v)(Hex) for one group and a mouthrinse containing essential oils (EO) for the other group.

**Methods:** 54 subjects free from any systemic disease (27 males, 27 females; aged 18 to 45 years) with moderate to severe forms of gingivitis were included in the study. They were randomized into 2 groups of 27 each; one group rinsed with Hex while the other rinsed with EO. Blood agar plates were placed uncovered in eight standardized locations to determine aerosols during the experimental procedure. The subjects of each group were instructed to rinse for two consecutive 30-second periods before ultrasonic scaling. The blood agar plates were collected at different time intervals [without rinsing before scaling (aerosols generated during normal mouth opening of the patient during pre-operative examination), after rinsing before scaling and 30 minutes after scaling] to assess the aerosol contamination. After each sampling, the plates were incubated in an increased CO2 chamber for 48 hours in order to assess colony-forming units at each interval.

**Results:** Results showed that both groups had demonstrated reduced colony-forming units at all eight locations after rinsing as compared prior to rinsing. The group that had rinsed with essential oils mouthrinse had significantly reduced colony-forming units when compared with the group that had rinsed with chlorhexidine mouthrinse [P < 0.001].

**Conclusion:** The results of the above study suggest that pre-procedural rinsing with essential oils had significantly reduced bacterial aerosol contamination when compared to rinsing with chlorhexidine.

**Keywords:** Mouthrinse, Aerosol, Contamination, Essential Oils, Chlorhexidine

### Introduction

Cross-Contamination and the potential for disease transmission to clinicians and patients from the aerosols produced in the dental office have been of great concern worldwide. Dental instruments like air, water or air turbine had pieces when used generate aerosols that could be harmful. An aerosol mist is formed when microorganisms in saliva and plaque combine with air and water spray. This aerosol mist when is suspended in the surrounding atmosphere and tend to extend several feet from the immediate area of operation that amounted to about 100,000 bacteria per cubic foot of air [1,2].

Literature reveals that significant amounts of bacterial aerosol contamination are produced by the use of ultrasonic scalers and high-speed handpieces [3-6]. The ultrasonic scaler tip produces both small and large particles. Aerosols can remain airborne for extended period of time and may be inhaled and was also found that the microorganisms could survive in the aerosol produced for as long as 6 days [7]. The smaller particles of an aerosol (0.5 to 10 µm in diameter) have the potential to penetrate and lodge in the smaller passages of the lungs and carry the greatest potential for transmitting infections [8].

Harrel and Molinari [9] recommend three levels of defense in the reduction of aerosols. The first recommended layer of defense is a personal protective barrier such as mask, gloves, and safety glasses. The second layer is routine use of an antiseptic preprocedural rinse. The final layer is the use of high evacuation device. Personal

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protective barriers and high evacuation devices are routinely used in the dental office to prevent aerosol contamination and preprocedural rinses are not commonly used.

The purpose of this study was to compare bacterial aerosol contamination generated by ultrasonic scalers following two consecutive 30-second rinses with chlorhexidine gluconate (0.12% w/v) (HEX) and a mouthrinse containing essential oils (EO).

## Materials and Methods

54 Subjects (27 males, 27 females; aged 18 to 45 years) with moderate to severe forms of gingivitis were included in the study. Ethical clearances were obtained from the Institution's Ethics Committee and written informed consent was obtained from all the patients.

Other patient selection criteria included:

Patients free from systemic disease.

Patients who have not received any medication in the last 3 months.

Patients suffering from moderate to severe forms of gingivitis who had a plaque index (Silness & Loe) & Gingival Index within the range 2-3.

Thorough asepsis was ensured during the entire procedure & care was taken to ensure to avoid acts that generated aerosols from the patient as well as the operator & his assistant. Only one subject was treated in a day & the treatment ended the same day. The operatory was fumigated after each case so as to ensure it free of aerosols.

Before each appointment, the entire operatory was cleaned & disinfected using ethyl alcohol (70 %). Similarly between each treatment, the ultrasonic scaler was flushed with distilled water for 2 minutes according to the manufacturer's instructions.

The amount of water dispensed, the water pressure & power settings on the ultrasonic unit were identical for each subject. Each subject was treated by the same operator & ultrasonic unit with sterile ultrasonic inserts. Blood agar plates were placed uncovered in eight standardized locations to determine aerosols during the experimental procedure (Figure 1). The blood agar

plates that were positioned at the patients chest area the dental operator chest area was stabilized with the help of double sided adhesive tape at a distance of twelve inches from the patients mouth & operators mouth to the chest.

Patients were divided randomly into two groups of 27 each of which one group rinsed with HEX while the other rinsed with EO. Convenience sampling technique was used for the selection of the groups with the help of sequential numbered opaque sealed envelopes (SNOSE) method of randomization. The subjects of each group were instructed to rinse for two consecutive 30-second periods before ultrasonic scaling.

The blood agar plates were collected at different time intervals (without rinsing before scaling, after rinsing before scaling and 30 minutes after scaling to assess the aerosol contamination at each interval.

After each sampling, the plates were transported in an air tight sterile container which was then incubated in an increased CO<sub>2</sub> chamber for 48 hours at 37° celsius in order to assess colony forming units at each interval (Lab Line Colony Counter- Lab Line Bio Medical Products Inc).

Using a colony counter, the colony forming units were counted in reflected light.

## Statistical Evaluation

To assess the significance of the differences in the number of colony forming units found at different sampling times & simultaneously to compare the number of colonies formed at eight locations for two groups, data processing was done with analysis of variance (ANOVA). A paired t test was conducted to test for the significant differences between the group variance by within the group variance.

## Results

Results of the study showed that both the groups had demonstrated reduced colony forming unit's at all eight locations after rinsing as compared prior to rinsing.

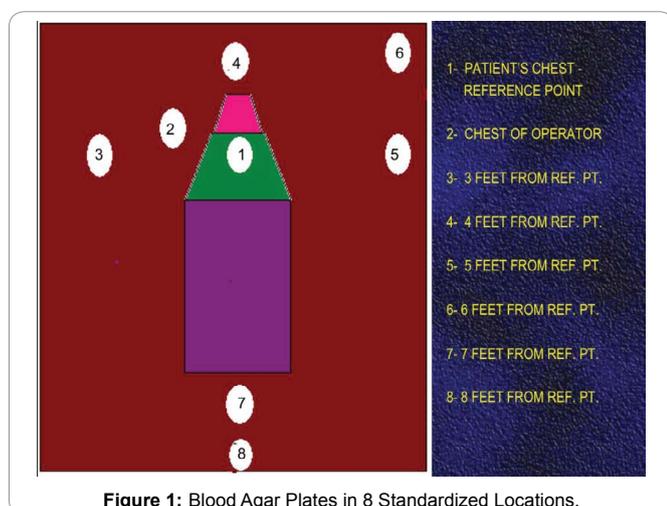
The group that had rinsed with essential oils had significantly reduced colony-forming units when compared with the group that had rinsed with a mouthrinse containing chlorhexidine gluconate [P < 0.001].

The results of the comparison of colony forming units according to treatment locations between Chlorhexidine group & Essential Oils are shown in the Table (Table 1).

The following species of microorganisms namely  $\beta$  Hemolytic Streptococci, Streptococcus pyogens and Staphylococcus Aureus were found when cultured before rinsing before scaling from the culture plates (Figure 2).

## Discussion

It is of primary importance to control and minimize the bacteria-laden aerosols produced by the air-polishing device and there is enough evidence to support this and hence an attempt was made to evaluate the ability of pre-rinsing to lower microbial counts before the use of aerosol-producing instruments by conducting this study [10-18].



Area Distance from Treatment	Essential Oils (EO)		Chlorhexidine (Hex)		Difference in Means	Significance
	Range	Mean ± SD	Range	Mean ± SD		
Patient's Chest	23-81	49.1 ± 14.4	82 -116	103 ± 9.5	53.9	p<.001
Operator's Mask	34-63	45.0 ± 8	73-108	93.0 ± 10.8	48	p<.001
3 Feet	23-52	36.0 ± 8.1	73-106	83.0 ± 11.7	47	p<.001
4 Feet	23-54	32.5 ± 7.8	44-89	73.7 ± 10.8	41.2	p<.001
5 Feet	23-59	33.0 ± 8.8	41-82	72.1 ± 11.2	39.1	p<.001
6 Feet	25-51	32.9 ± 6.5	43-86	71.0 ± 9.3	38.1	p<.001
7 Feet	14-34	20.7 ± 7.2	28-72	46.1 ± 10.8	25.4	p<.001
8 Feet	3-12	9.1 ± 2.7	18-37	24.1 ± 6.0	15	p<.001

Table 1: Comparison of Colony Forming Units According to Treatment Locations between Hexidine Group & Essential Oils Group.

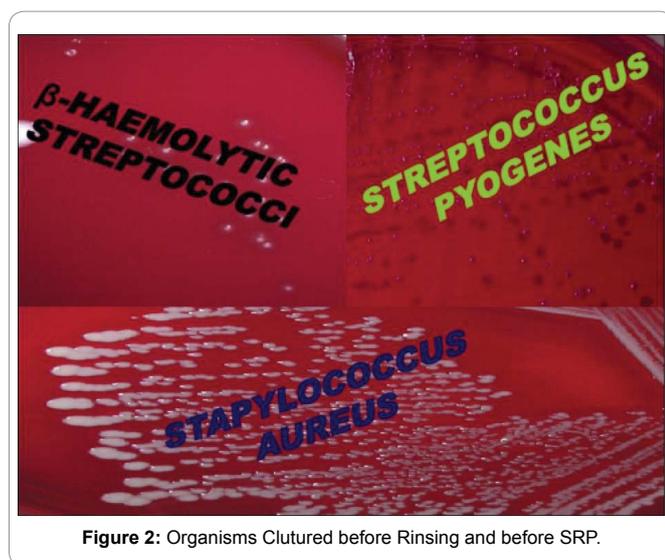


Figure 2: Organisms Clutred before Rinsing and before SRP.

So far only one study by Snophia Suresh et al has been reported in literature the efficacy of pre-procedural rinsing with Chlorhexidine & essential Oils in reducing bacterial aerosol contamination. Results of the study suggested that pre-procedural rinsing with chlorhexidine mouth rinse was much better in reducing bacterial aerosols when compared with an essential oil mouth rinse [19]. The results from the above study differ from our study wherein the results suggest that that pre-procedural rinsing with essential oil mouth rinse was much better in reducing bacterial aerosols when compared with an essential oil mouth rinse.

The reasons attributing to the findings of this study possibly justify the findings of an In-vitro study by Pauline C. Pan to compare the antimicrobial activity of commercially available antiseptic mouthrinses against saliva-derived plaque biofilms in static and flow-through biofilm systems in vitro using batch chamber slide biofilm with confocal visualization model namely an essential oil(0.064% thymol, 0.092% eucalyptol, 0.060% methyl salicylate and 0.042% menthol) rinse(EO, CoolMint Listerine, Johnson and Johnson); a 0.12% chlorhexidine rinse (CHX, Peridex,3M Pharmaceuticals), seven 0.05% cetylpyridinium chloride rinses (CPC1, PLAX global mouthrinses, countries of origin shown in Figure 1, Colgate Palmolive); a 0.05% cetylpyridinium chloride/0.05% chlorhexidine rinse (CPC/CHX, PerioAid, Dentaaid); an amine fluoride/stannous fluoride rinse (AFSF, Meridol, GABA); a 0.07% cetylpyridinium chloride rinse (CPC2, Crest Pro Health, Clean Mint, Proctor & Gamble); Sterile water or phosphate buffered

saline (PBS) and 70% ethanol (Etoh) served as the negative control and positive controls respectively. The results of the above study suggested that the essential oil mouthrinse demonstrated superior antiplaque biofilm activitywhen compared with the other mouth rinses used in the study [20].

Gram positive cocci and bacilli in the aerosol samples were revealed in our investigations. The normal habitat for streptococcus is in the human respiratory tract and skin and it is the main cause of bacterial endocarditis. Staphylococcus which is an opportunistic organism is the normal commensal on the skin surface and anterior nares. The water emerging from scaler unit contacts the patient's lip and cheeks and disperses from the surface and that could be the probable reason why these bacteria are common in this study.

## Summary and Conclusion

From the above study, we infer that pre-procedural rinsing with essential oils had significantly reduced bacterial aerosol contamination when compared to rinsing with chlorhexidine. It also demonstrates that bacterial aerosol contamination remains a significant hazard to dental personnel.

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