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Comparison of Aerosol Contamination during Ultrasonic Scaling With or Without Pre-Rinse- A Microbiological Study

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ABSTRACT

Background: Many dental instruments are known to produce aerosol. In that ultrasonic scaler produces largest amount. Aerosols are solid or liquid suspentions in the air. It has the potential to cause various infections to dentists as well as patients. The aim of this study is to evaluate the aerosol contamination produced during ultrasonic scaling by the help of microbiological analysis.

Materials and methods: This study consisted of 10 patients who were randomly assigned to two groups. Group I advised with pre procedural rinsing with 0.2 % of Chlorhexidine mouthwash while Group II was without pre procedural rinse. 3 agar plates were used for each patient; one kept on the chest of patient, another agar plate was kept 3 feet away and third was at 6 feet away during scaling. All agar plates were sent for microbiological analysis.

Results: The numbers of colony forming units formed on blood agar plates were less in patients with preprocedural rinse while highest number of colonies was found on blood agar plate positioned at the patient's chest area followed by that at 3 feet and at 6 feet than without rinse.

Conclusions: 0.2 % of chlorhexidine had a significant effect as pre-procedural mouth rinse in reducing the number of microorganisms in the aerosol produced by the ultrasonic scaling units.

Keywords: aerosol, microorganisms, oral cavity, preprocedural rinse, ultrasonic scaler.

INTRODUCTION

The oral cavity is a unique environment which contains numerous habitats that can provide an ideal medium for bacterial growth. Most of the procedures performed by the dentist have the potential for creating contaminated aerosols and splatter which contains bacteria, fungi, protozoa and even blood borne viruses produced during dental operative procedures and thus, promoting an increased risk of cross infection.[1]

The use of various devices like ultrasonic scalers, prophy angles, and air-water syringes produce some splatter in the form of relatively large droplets. [2] In dentistry, the ultrasonic scaler and the air polisher are considered to be the greatest producers of small particle aerosol contamination. Ultrasonic scaler produces more airborne contamination than any other instruments in dentistry. In the dental clinics, ultrasonic scalers are very commonly used. So, the dentists and patients are more prone to get exposed to a great variety of infectious agents and toxic substances transported by aerosols and droplets. Micik et al[2] proposed the terminology, "aerosol and splatter" in dental environment and are considered to be the pioneers in the work on aerobiology, where patient is the source, and the

aerosols originates from the saliva as well as from the dental plaque. Aerosols are suspensions of liquid and/or solid particles in the air consists of particles less than 10 microns in diameter which are not visible to the naked eye.[3] The smallest particle size (ranging between 0.5 µm and 10 µm) has the greatest potential to penetrate the respiratory passages and the lungs, possessing the ability to transmit the disease.[2]

These aerosols are responsible to cause various respiratory infections, opthalamic and skin infections, tuberculosis and hepatitis B that have been reported in various studies.[4] Ultrasonic tip after coming in contact with fluids like saliva, blood or water, it leads to both small and large aerosol particles formation. Various instruments like hand pieces, ultrasonic scalers and air water syringes can produce visible spray which are called as splatter and can travel only a short distance and settles out quickly either on the floor, nearby equipment and operatory surfaces, the dentist and / or on the patient.[5] According to the study conducted by Millers,[6] aerosols generated from the patients mouth contains upto 1,00,000 bacteria per cubic foot of air. King et al.[7] reported that bacteria could be recovered 6 inches from the mouth of patient and the colony forming units (CFUs) formed were significantly reduced when aerosol reduction device was used. Various methods like using high vacuum suction, patient positioning, use of rubber dams, and pre-procedural antibacterial mouth rinses have potential to reduce aerosol contamination in the dental office.[6] Current literature suggests that having patients use an antimicrobial rinse before treatment may decrease microbial aerosols.

Broad – spectrum antibacterial activity and substantivity of chlorhexidine is 8 – 12 hrs so it is considered as the "Gold standard" of antimicrobial rinse.[3, 4] Chlorhexidine contains cations which decreases the absorption through mucosa hence decreases the chances of toxicity.

So, the aim of this study was to evaluate the efficacy of preprocedural rinsing with 0.2 % chlorhexidine and the aerosol contamination produced during ultrasonic scaling at various distance with the help of microbiological analysis.

Material and Methods:

After obtaining institutional ethical committee approval, 20 subjects were selected from the Out Patient Department of Periodontics of Pandit Deendayal Upadhyay Dental College, Solapur. Before starting the study written informed consent was taken from all the participants. Then all the participants were randomly divided into two groups i.e. group I and group II. Group I included 10 subjects with moderate chronic periodontitis undergoing ultrasonic scaling with pre procedural rinsing with an undiluted 0.2 % of Chlorhexidine antimicrobial mouthwash (HEXIDINE® [ICPA]) (Figure 1). Group II included 10 subjects with moderate chronic periodontitis undergoing ultrasonic scaling without pre procedural rinsing.

Figure 1: 0.2 % of Chlorhexidine antimicrobial mouthwash (HEXIDINE® [ICPA]) Mouthwash

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Full mouth periodontal examination including gingival index according to criteria given by Loe and Silness and clinical attachment level using William's graduated periodontal probe were recorded.

Inclusion criteria*:*

- Subjects aged between 25 to 50 years.
- Subjects with a minimum number of 20 teeth present in the mouth.
- Subjects with moderate chronic periodontitis showing more than 30 % of sites with clinical attachment loss > 4 mm measured with a William's periodontal probe.[9]

Exclusion criteria*:*

- Subjects with any known systemic history.
- Patients who underwent any periodontal treatment in the last 6 months.
- History of any antibiotic / anti-inflammatory therapy for 3 months prior to study.
- Pregnant and lactating women.
- Patients allergic to chlorhexidine mouthwash.

Method of collection of sample

A clean sterilized environment was maintained with fumigation in the working area; before treatment. Full mouth ultrasonic scaling was carried out with piezoelectric ultrasonic scaler during treatment and a motorized suction was used for every patient. 10 out of 20 patients rinsed with 10 ml of undiluted 0.2 % Chlorhexidine mouth wash ten minutes before the treatment. Blood agar plate was the media of choice to collect the airborne microorganisms as it is an ideal medium for culturing air borne bacteria. Out of the three blood agar plates, one plate was positioned at the patient's chest area approximately 15 inches away (position A), second blood agar plate at 3 feet (position B) and third at 6 feet distance (position C) from patient's mouth. Blood agar plate was left uncovered at predesigned sites to collect the samples of aerosolized bacteria. Same blood agar plates were placed for the remaining 10 patients who were undergone ultrasonic scaling without pre procedural rinse. After collecting the sample, the blood agar plates were transferred in air tight container for incubation . Samples were incubated at 37º C for 48 hrs. The evaluation of the number of CFUs that grew on the each plate was done in Microbiology department of Dayanand College, Solapur (Figure 2 & 3).

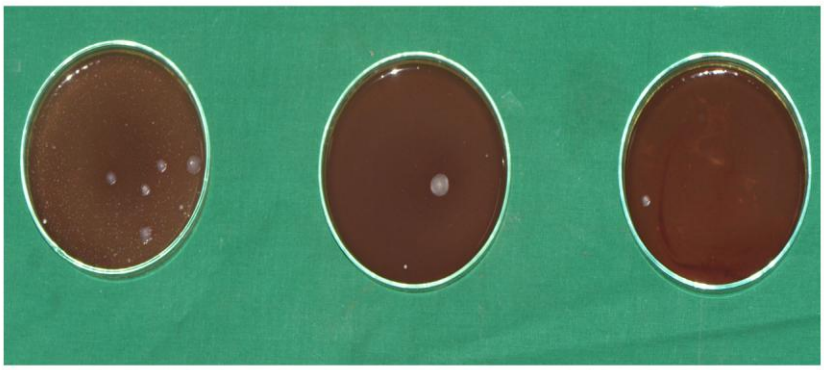

Figure 2: Culture plates of Group I after 48 hours at various position.

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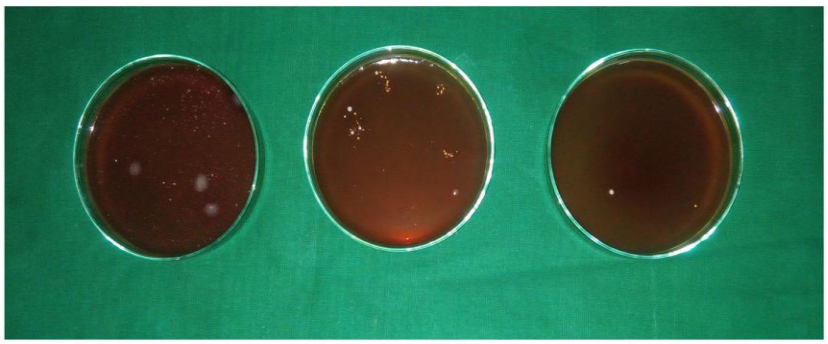

Figure 3: Culture plates of Group II after 48 hours at various position.

Statistical analysis

All the samples were subjected to statistical analysis. Comparison of the two groups was done using Independent T test and comparison within a group was done using ANOVA test for both the groups.

Results

The clinical parameters like gingival index and clinical attachment loss were recorded to confirm moderate chronic periodontitis. The comparison between group I and group II shows higher mean value for non pre procedural rinse (group II) as showed in table 1/ graph 1. On applying ANOVA test the p value was < 0.001 which was statistically significant for both group I and II. The 'F' ratio obtained was 14.757 for group I (table 2) and 53.440 for group II (table 3). The mean CFUs in group I at position A (28.2000), position B (13.7000) and position C (4.4000) as shown in graph 2. The mean CFUs in group II at position A (161.0000), position B (65.5000) and position C (13.1000) as shown in graph 3. This concluded that the CFUs count at patient's chest (position A) was highest and gradually reducing further (position B & C) in both the groups.

Discussion

Dental plaque contains various microorganisms. Dental plaque is considered as one of the etiological agent in the development of periodontal disease comprising complexes of micro organisms, both bacterial and viral origin in the gelatinous matrix.[2] So the elimination of dental plaque is important. It is difficult to eradicate whole plaque and calculus from the tooth surface. Conventional non – surgical therapy is considered to be the cornerstone of periodontal treatment.[8,9] This can be achieved either by hand scaling or ultra sonic scalers.

The ultrasonic scalers produces aerosols that are heavily contaminated by the microorganisms and can cause a serious health threat to the patients, clinician and the surrounding, in the form of systemic conditions like common cold, influenza, tuberculosis and severe acute respiratory syndrome (SARS).[1] As the oral pathogens show a high probability of bypassing the host defense, to reduce the bacterial load in the aerosol, adjunct therapy in the form of chemical plaque control is required. Studies have also shown that ultrasonic scaling in conjunction with various plaque control agents used as a pre - procedural rinse have been found to be more effective in reducing bacterial loads when compared with distilled water or saline [6,10] Various other studies support the results of this study demonstrating the excellent antimicrobial effects of 0.2 % chlorhexidine as a pre – procedural mouth rinse in aerosol reduction.[11,12]

Various mouthrinses are used to reduce the bacterial load in aerosols. Chlorhexidine is a bisbiguanide molecule that binds strongly to hydroxyapatite, the organic pellicle of the tooth, oral mucosa, salivary proteins, and bacteria. Because of this binding, chlorhexidine containing mouthrinses exhibit high substantivity with 30 % of drug released after rinsing and slow release for long time. 0.2 % of Chlorhexidine was the first clinically effective and demonstrated

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mouthwash, that inhibited supragingival plaque formation and due to broad spectrum antimicrobial activity of chlorhexidine, it is highly effective against gram positive and negative organisms, yeasts, dermatophytes and some lipophilic viruses.[6,13,14]

Pre – procedural rinsing is suggested to be capable enough to reduce the planktonic microorganisms load. But, it will be less effective against biofilm microbes such as plaque, subgingival microorganisms, blood from the surgical site or nasopharyngeal organisms.[15] It is well proven and accepted fact that pre-procedural rinse with chlorhexidine will reduce the bacterial count but the depth of pocket penetration is less than 2 mm.[16,17] Keeping these advantages of chlorhexidine in mind, it is used as pre procedural rinse in current study.

In this current study blood agar plates are used to collect the airborne micro-organisms as it is a valid medium. These aerobic micro-organisms settle down on agar plate and grow on it to form colonies. It is counted as 'colony forming units (CFUs).'

This study shows that the spread of aerosols can be detected till 6 feet. The CFUs are observed to be reduced from 15 inches to 6 feet. (graph 2, 3) When 10 ml of undiluted 0.2 % of chlorhexidine was used as a pre procedural mouth rinse prior to ultrasonic scaling, CFUs were decreased than the ultrasonic scaling done without the use of mouthwash. These results were in accordance with other studies in which blood agar plate positioned at patient's chest area received a greater number of microorganisms and demonstrated the efficacy of pre – procedural rinsing with chlorhexidine in reducing the aerosol contamination produced by ultrasonic scaling. Use of 0.2 % chlorhexidine mouthwashes as a pre – procedural mouth rinsing for the duration of 60 seconds can cause substantial reduction in bacterial counts.[1,3,6]

So the result of present study showed that the use of 0.12 % pre – procedural rinse prior to ultrasonic scaling reduced the bacterial load in aerosol and effective in decreasing the aerosol contamination. Aerosols are found to be highest in the area near the patient and operator. So it is necessary the precautionary measures should be followed.

Conclusion-

0.2 % of chlorhexidine had a significant effect as pre – procedural mouth rinse in reducing the number of microorganisms in the aerosol produced by the ultrasonic scaling units. Thus, it is beneficial to use the pre - procedural rinse to prevent the harmful effect of aerosol.

Acknowledgement

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Figure Legends-

Figure 1: 0.2 % of Chlorhexidine antimicrobial mouthwash (HEXIDINE® [ICPA]) Mouthwash

Figure 2: Culture plates of Group I after 48 hours at various position.

Figure 3: Culture plates of Group II after 48 hours at various position

Table Legends-

Table 1: Difference between Group I and group II using Independent T - test.

Table 2: Difference between position A, B and C within group I using ANOVA T- Test.

Table 3: Difference between position A, B and C within group II using ANOVA T - Test.

Groups	Mean	Standard Deviation	Mean Difference	95% Confidence Interval for difference		T	P
				Lower	Upper		
Group 1	15.4333	13.78326					
Group 2	79.8667	69.69873	-64.4333	-90.3988	-38.4678	-4.967	**.000**

Table No 1: Difference between Group I and group II using Independent T - test.

*T- *t* score

†P- *p* value

Groups	Mean	Standard Deviation	95 % Confidence Interval for difference		F	P
			Lower	Upper		
Group A	28.2000	5.47317	24.2847	32.1153		
Group B	13.7000	15.92378	2.3088	25.0912	14.757	**.000**
Group C	4.4000	2.98887	2.2619	6.5381		

Table No 2: Difference between position A, B and C within group I using ANOVA T - test.

*T- *t* score

†P- *p* value

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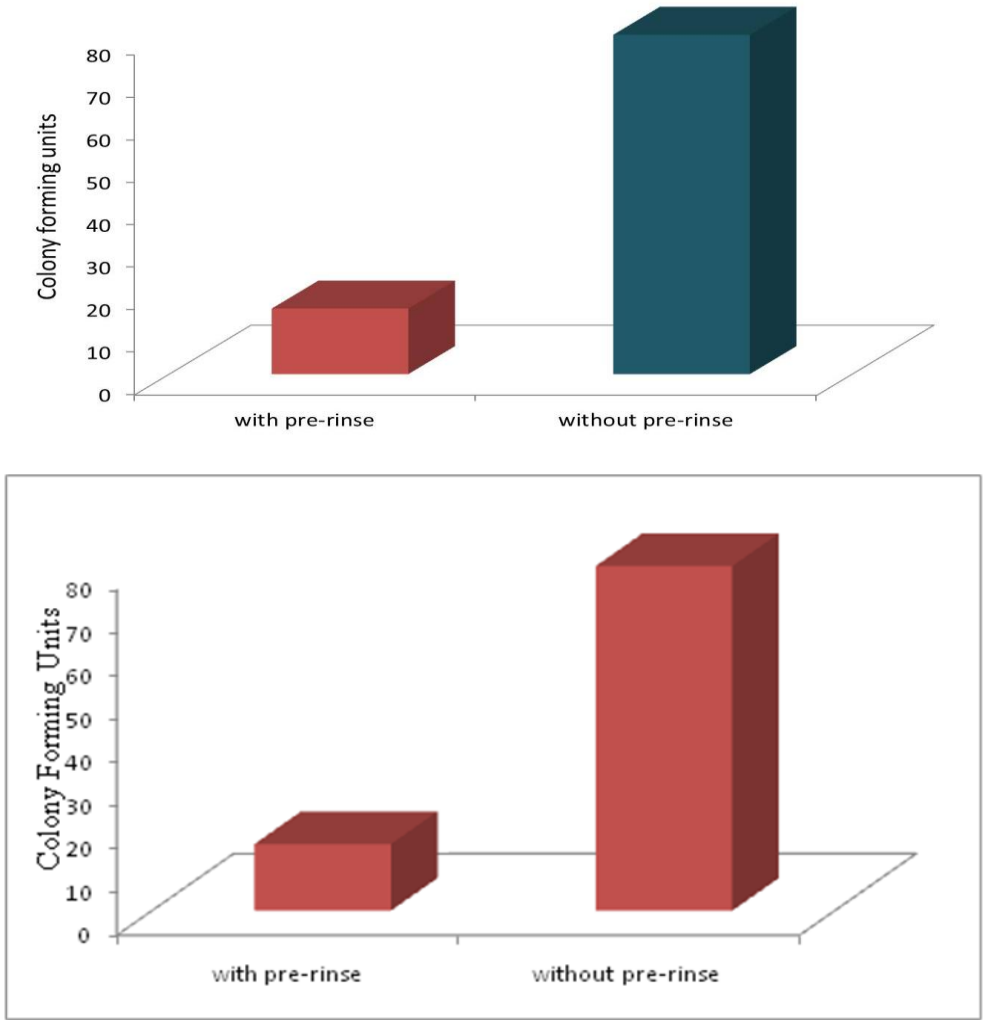
Groups	Mean	Standard Deviation	95% Confidence Interval for difference		F	P
			Lower	Upper		
Group A	161.0000	49.40535	125.6575	196.3425		
Group B	65.5000	25.85537	47.0042	83.9958	53.440	**.000**
Group C	13.1000	6.88719	8.1732	18.0268		

Table No 3: Difference between position A, B and C within group II using ANOVA

T - test.

*T- *t* score

†P- *p* value



Graph 1: Comparison between CFU of group I and group II

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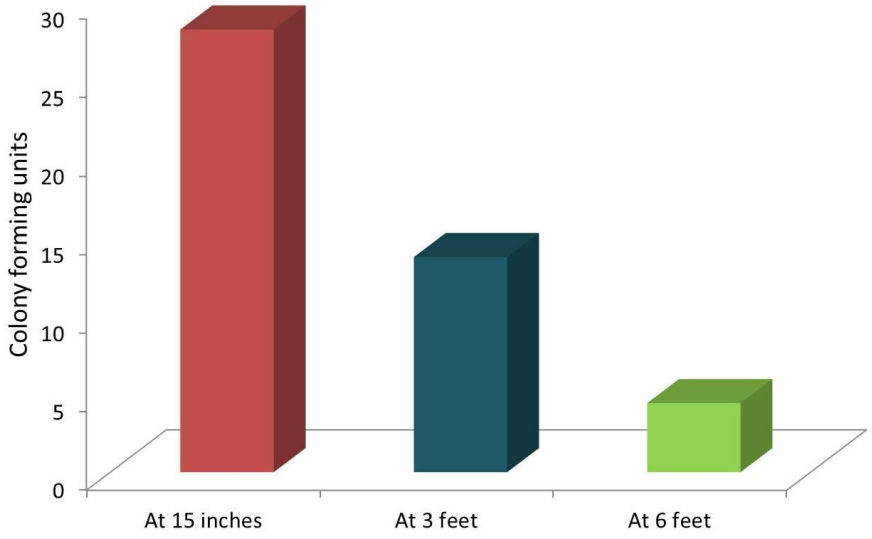
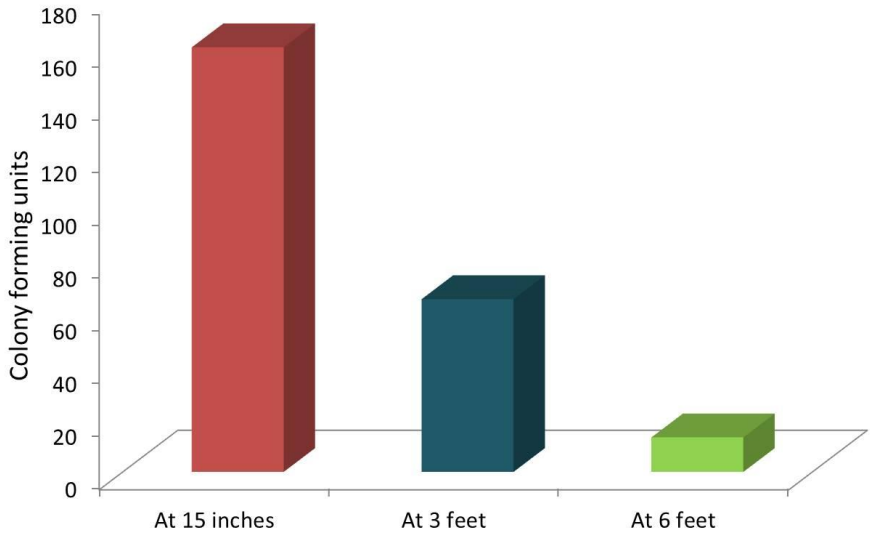


Graph 2: Comparison among CFU at position A, B and C of group I



Graph 3: Comparison among CFU at position A, B and C of group II

ABBREVATIONS:

1. CFUs – colony forming units.
2. SARS – severe acute respiratory syndrome

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