"Effect of different mouth washes as a pre-procedural rinse to combat aerosol contamination– A cross-sectional study."

ABSTRACT:
Background: Ultrasonic scaling is a potent source of aerosol generation in dental offices, thus causing increase risk of bacterial infections. Pre-procedural mouth rinsing has been found effective in reducing the bacterial load of the aerosol produced during the procedure.
Aim and objectives: the aim of the present study was to evaluate and compare the efficacy of two different mouthwashes containing Chlorhexidine and Octenidine with distilled water, by using them as preprocedural rinsing agents in reducing the bacterial load of the aerosol produced by ultrasonic scaler.
Materials and Methods: 60 subjects aged 18-35years were randomly divided into three groups on the basis of mouth rinses used for preprocedural mouthrinsing - **Group 1:** Distilled Water (Control), Group 2: 0.2% Chlorhexidine (CHX), Group 3: 0.1% Octenidine. The aerosols were collected on agar plates placed and stabilized on patient's as well as on operator's chest. all the agar plates were sent for microbiological analysis to the microbiological laboratory for Colony Forming Unit (CFU) count on the same day of ultrasonic scaling procedure. The data obtained was subjected to the statistical analysis using SPSS software version 20.0.
Result: At all locations, the mean CFU was significantly highest in Group I, followed by Group II and Group III. It was observed that aerosol generation on patients was significantly more than operator.
Conclusion: In our study 0.1% octenidine was found to be most effective preprocedural mouthwash in reducing the bacterial load in the aerosol produced during ultrasonic scaling followed by 0.2% chlorhexidine and distilled water.

Keywords: Aerosol; Chlorhexidine; Octenidine; Distilled water; preprocedural mouth rinsing

Introduction:

Dental surgeons and oral health care workers are daily exposed to a variety of micro- organisms including bacteria, viruses, protozoan and fungi through the patients and the working environment. Dental procedures such as ultrasonic scaling, use of an air water syringe produce aerosol and splatter, which possess a potential risk to the clinician, the dental personnel and the immune compromised patient.[1-2] Studies also indicated that the cavitation effect produced during piezo surgical procedures, produces a significant amount of aerosol by the coolant fluid in the process of washing away blood and providing optimal visibility to the operating field.[1]

The terms "aerosol" and "splatter" in the dental environment were used by Micik and colleagues in their pioneering work on aerobiology.3-4 Aerosol can be defined as, "A suspension of solid or liquid particles in a gas". The particle size of an aerosol is less than 50 micrometer, whereas splatter is defined as air borne particles larger than 50 micrometer. The solid and liquid phases of aerosol are comprised of bacteria, blood elements, viruses, and organic particles of tissue, tooth, saliva and debris. The amount of aerosol contamination depends on the quality of saliva, nasal and throat secretions, blood, dental plaque, and the presence or absence of any dental infection.[5] Due to small particle size, aerosol settles at longer distances

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and even in very narrow diametric respiratory passages. The microorganisms in aerosols may cause cross-infections in the dental office, jeopardizing the health of patients and dental professionals. They can even lead to potential respiratory tract infections such as severe acute respiratory syndrome (SARS) and tuberculosis[.6]

Various methods are being used to arbitrate aerosol contamination including use of personal protective equipment like gloves, masks etc., high?efficiency particulate air room filters, ultraviolet treatment of ventilation system, use of high?volume evacuator and pre-procedural rinsing with an antiseptic mouthwash. It was observed in various studies that pre-procedural rinsing with various anti-bacterial agents is highly effective in reducing microbial load in aeroso[l.7-8]

Chlorhexidine gluconate is a commonly used mouth rinse in dental practice. It is considered to be the most effective anti-plaque agent but it also has some side effects like tooth staining, taste alteration, enhanced supra gingival calculus formation and desquamation of oral mucosa. Octenidine hydrochloride is a new bipyridine antibacterial compound that has been developed as a potential antimicrobial/ antiplaque agent for use in mouth wash formulations. The present study was conducted to determine the efficacy of pre-procedural rinsing with chlorhexidine 0.2% and Octenidine 0.1%, and compare both with distilled water, in reducing the microbial load of the aerosols produced during ultrasonic scaling.

Materials and method:

A total of 60 subjects aged 18-35years were randomly selected from the Outpatient department of Department of Periodontics. Patients with moderate to severe gingivitis with minimum 20 permanent teeth were selected in the study. Patients suffering from any known systemic diseases like blood dyscrasias, renal or hepatic disease, immune suppression; patients with cardiac pacemaker or any respiratory infections were excluded from the study. Patients who were smokers, tobacco chewers, pregnant or lactating, and those who had received any antibiotic therapy, chemotherapeutic mouth rinses and oral irrigation; any surgical or non-surgical therapy in the last 6 months were also excluded. All included study subjects were clearly explained about the need and design of the study and a written informed consent was obtained. Institutional ethical committee clearance was obtained (IEC no. PMNM/79/2020)

The study subjects were categorized into following three groups (n=20): Group 1 (Control): Patients undergoing scaling after rinsing with 20 ml of distilled water; Group 2: Rinsing with 20 ml of 0.2% Chlorhexidine for 30sec.; Group 3: Rinsing with 20 ml of Octenidine 0.1% for 30sec. Patients were treated in a closed room after fumigating the room with SILVICIDTM(Bioshield) for 10 mins, one hour before the scheduled appointment of patient. Fumigation was done following the standard protocol to decrease the microbial load in air, thus avoiding the aerosol contamination. Before ultrasonic scaling, agar plates are placed and stabilized with adhesive tape on patient's chest as well as on operator's chest for aerosol collection, as these two areas are considered to be the most prone for contamination with aerosol. The plates are placed for10 minutes, removed and labelled. The treatment of all study subjects was performed by a single operator.

Then, all the agar plates were sent for microbiological analysis to the microbiological laboratory for Colony Forming Unit (CFU) count on the same day of ultrasonic scaling procedure. The data obtained was subjected to the statistical analysis using SPSS software version 20.0.

Results:

The data was obtained for aerosol contamination scores in three study groups (Group 1: Water, Group 2: Chlorhexidine, Group 3: Octinidine) and two sub groups (operators, patients). It was observed that colony forming unit count in regard to aerosol generation on patients was maximum in control group i.e water (183.2±9.25), followed by Chlorhexidine (134.55±16.98); and Octinidine (122.20±18.49). Similar pattern of CFU in aerosol was observed in operators with CFU count being maximum in control group i.e water (118.15±10.78), followed by Chlorhexidine (51.90±2.94); and Octinidine (43.90±8.61), (Table no. 1). Intergroup comparison was done between all the three study groups and two sub groups for mean aerosol contamination scores using two way ANOVA statistical analysis. It was found that level of significance was statistically significant (p-value<0.05) for main groups as well as subgroups (Table no. 2). Newman-Keuls multiple posthoc test was done for intergroup comparisons between each pair of groups and it was observed that statistically a significant relation was observed between Water vs CHX; water vs Octinidine and CHX vs Octinidine (Table no. 3). Newman-Keuls multiple posthoc test was done for intergroup comparisons between all the three groups+sub groups. It was observed that statistically all the intergroup comparisons were significant (p-value<0.05), except Octinidine and patients with Water and operators (p=0.3019), (Table no. 4).

Discussion:

Airborne contamination during dental procedures may come from a variety of sources. Foremost among these are: dental instrumentation, salivary, and respiratory sources. Dental handpieces, ultrasonic scalers, and the air-water syringes used in common dental practice are capable of producing aerosols, which are usually a mix of air and water derived from these devices and the patient's saliva.[9] Dental instruments, surfaces within the dental operatory, and dental equipment, when improperly cleaned, sterilized, and stored, or disinfected can also serve as fomites and contribute to cross-infection.

Harrel SK et al.[7] reviewed aerosols and splatter in dentistry and various implications of infection control. They observed that many dental procedures produce aerosols and droplets that are contaminated with bacteria and blood. These aerosols represent a potential route for disease transmission. The literature also documents that airborne contamination can be minimized easily and inexpensively by layering several infection control steps into the routine precautions used during all dental procedures. In addition to the routine use of standard barriers such as masks and gloves, the universal use of preprocedural rinses and high-volume evacuation is recommended.[10]

In our study, we compared two different mouth rinses with control group, in terms of their efficacy against bacterial counts in aerosol generated during ultrasonic scaling procedure. We compared the efficacy of these mouthrinses in terms of aerosol generation on patients and operator too.

The results of present study revealed that both chlorhexidine and Octinidine were significantly effective pre-procedural mouth rinses as compared to use of water. Similar results were obtained in a study conducted by Ammu A. et al.[11] and Nayak SU et al.[12] who observed that there was a highly significant reduction of bacterial CFU with mouthwashes as compared to water. In our study, we also observed that bacterial count was found more on patients than operators. Similar findings were observed by Nayak SU et al.[12] and Rani et al.[2]

Results of our study showed that Octinidine was more effective than chlorhexidine mouth rinses in controlling the bacterial counts in aerosol. Octenidine hydrochloride (OCT) Octenidine is a bispyridine derivative, i.e., N,N-[1,10-decanediyldi-1(4H)-pyridinyl - 4 pylidene] bis (1-octanamine) dihydrochloride, a new bipyridine antimicrobial compound.13 Study conducted by Decker EM et al.14 suggested that a mouthrinse containing 0.1% OCT is capable of exerting beneficial clinical effects upon plaque accumulation and gingivitis. Similar to our study, Decker EM et al.14 also found that OCT was more effective than chlorhexidine, because of its prolonged bacterial anti-adhesive activity. OCT has a broad antimicrobial activity against Gram-positive and Gram-negative bacteria, chlamydiae and fungi. Its microbiostatic and microbicidal efficacy is 10 times higher than chlorhexidine.15-18 Beiswanger et al.19 conducted a three-month clinical trial of 0.1 % Octenidine mouthrinse and observed that Octenidine reduced plaque by one-third and gingivitis by one-half as compared with the placebo. They found that group with 0.1% octenidine rinsing had significantly less plaque (39%), gingivitis (50%), and bleeding sites (60%) than the group using the control product. Similar to our study, Dogan et al. 20 compared the short-term relative antibacterial effects of OCT and CHX. They observed that OCT was favourably more effective than CHX in its antibacterial activity both in vitro and in vivo conditions.

Thus, our study revealed that preprocedural oral rinsing with an antiseptic mouthwash significantly reduces the bacteria in aerosol which is generated during dental procedures. The risk of crosscontamination with infectious agents in the dental operatory can be reduced to a greater extent by following preprocedural rinse. Octenidine can be a better alternate mouth rinse than chlorhexidine as pre-procedural mouth rinse for aerosol generating procedures.

Limitations of study:

1. The CFU estimation in the present study includes only aerobic bacteria capable of growth on blood agar plates; anaerobic bacteria and viruses that require specialized media were not isolated, which needs to be addressed in further investigations.
2. The present study compared only two mouth rinses with water. Further studies should be conducted with different formulations of mouth rinses, so that best alternative can be derived.
1. Our study determined the efficacy of pre procedural mouth rinses only for ultrasonic prophylaxis. Various other dental procedures can also generate a large amount of aerosol with infectious components launched into the

dental environment, such as the air turbine handpiece, air-water from a three-way syringe and sodium bicarbonate jet. Therefore, future studies should be conducted to determine the bacterial counts and efficacy of mouth rinses in various common dental procedures.

table no. 1: Aerosol contamination scores in three groups (Water, Chlorhexidine, Octinidin) and two sub groups (operators, patients)

Groups x sub groups	n	Mean	SD	SE
Water and operators	20	118.15	10.78	2.41
Water and patients	20	183.20	9.25	2.07
Chlorhexidine and operators	20	51.90	2.94	0.66
Chlorhexidine and patients	20	134.55	16.98	3.80
Octinidin and operators	20	43.90	8.61	1.92
Octinidin and patients	20	122.20	18.49	4.13

Table no. 2: Comparison of three groups (Water, Chlorhexidine, Octinidin) and two sub groups (operators, patients) with mean aerosol contamination scores by two way ANOVA

Sources of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F-value	p-value
Main effects					
Main groups	2	106362.32	53181.16	348.8794	0.0001*
Sub groups	1	170253.33	170253.33	1116.8971	0.0001*
2-way interaction effects					
Main groups x sub groups	2	1680.82	840.41	5.5133	0.0052*
Error	114	17377.50	152.43		
Total	119	295673.96			

*p<0.05 is significant

Table no. 3: Pair wise comparison of three groups (Water, Chlorhexidine, Octinidin) with mean aerosol contamination scores by Newman-Keuls multiple posthoc test

Groups	Water	Chlorhexidine	Octinidin
Mean	150.68	93.22	83.05
SD	34.40	43.55	42.13
Water	-		
Chlorhexidine	p=0.0001	-	
Octinidin	p=0.0001	p=0.2603	-

*p<0.05 is significant

Table no. 4: Pair wise comparison of interactions of three groups (Water, Chlorhexidine, Octinidin) and two sub groups (operators, patients) with mean aerosol contamination scores by Newman-Keuls multiple posthoc procedures

Groups x sub groups	Water and operators	Water and patients	Chlorhexidine and operators	Chlorhexidine and patients	Octinidin and operators	Octinidin and patients
Mean	118.15	183.20	51.90	134.55	43.90	122.20
SD	10.78	9.25	2.94	16.98	8.61	18.49
Water and operators	-					
Water and patients	p=0.0001*	-				
Chlorhexidine and operators	p=0.0001*	p=0.0001*	-			
Chlorhexidine and patients	p=0.0003*	p=0.0001*	p=0.0001*	-		
Octinidin and operators	p=0.0001*	p=0.0001*	p=0.0428*	p=0.0001*	-	
Octinidin and patients	p=0.3019	p=0.0001*	p=0.0001*	p=0.0021*	p=0.0001*	-

*p<0.05 is significant

Conclusion:

Oral cavity is the reservoir for variety of microorganisms like bacteria and viruses. Thus routine dental procedures increase the risk of exposure to microorganisms. The present study clearly indicated that the patients and operator are exposed to a large amount of microbial population during simple procedures like ultrasonic scaling, and we can decrease this microbial load by pre-procedural mouth rinsing. Our study highlights the importance of pre-procedural mouth rinsing for the patient and using personal protective equipments by operator while caring out dental procedures to prevent cross-infection. Therefore, along with other barrier techniques, pre-procedural rinsing should be incorporated as a mandatory practice in all dental setups.

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