ORIGINAL ARTICALE

Effectiveness of Pre Procedural Rinse with Chlorhexidine and Povidone-Iodine in Preventing Bio Aerosol Contamination during Ultrasonic Scaling – A Clinical and Microbilogical Study

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Abstract

Aerosol is defined as small droplet usually 5µm or less in diameter, which can remain suspended in air for some time. The aim of the study is to compare the virtue of Chlorhexidine and Povidone-iodine solution as a pre-procedural mouth rinse in reducing bio-aerosol contamination during ultrasonic scaling. The study included 30 systemically healthy patients in different age groups. Patients were divided into two groups. Group I received pre procedural rinse with Chlorhexidine and group II with Povidone-iodine solution. The aerosols produced during the ultrasonic scaling were collected on blood agar plates and were sent for culture. Results showed that colony forming units in group I were significantly reduced compared to group II. The study concluded that pre procedural rinse with chlohxidine significantly reduces the bio-aerosol contamination and prevent cross infections.

***Keywords**: Aerosols, Chlorhexidine, Povidone-iodine, Ultrasonic scaling*

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Received on: 03/07/2017 Revised: 05/07/2017 Accepted : 09/08/2017

Introduction

Dental professionals are at high-risk for developing infectious diseases. The major source of potential aerosol contamination in a dental set up is the ultrasonic scaler. [1] Veksler et al. have demonstrated that preoperative rinsing with 0.2% chlorhexidine (CHX) gluconate diminished the quantity of aerobic and facultative flora of the oral cavity. [2] Povidone iodine (PI) as a pre-procedural rinse effectively reduces gingival surface flora prior to oral prophylaxis with ultrasonic scalers and maintains this reduction throughout the duration of the prophylactic procedure. [3] Hence, an attempt was made to measure the effect of CHX gluconate and PI on the reduction of viable bacteria in the dental aerosols.

Materials and Methods

This study was a randomized, double-blind clinical trial in which 30 patients of both sexes within the age range of 20-50 years were selected. Sample size determination was done on the expense of data collection and the need to have sufficient statistical power and randomization was done on an alternate basis. Participants who met the minimal criteria for entry were informed about the purpose of the study. Criteria for participation included having

a minimum of 20 permanent teeth and excluded any patient who was diagnosed as periodontitis, had medical conditions or taking medications that would contraindicate treatment. The plaque index [4] and Gingival bleeding index [5] were recorded for every patient in the first sitting. All subjects were assigned to one of two groups (CHX and PI) by using a randomization table. Patients were asked to perform the pre procedural rinse with either of the assigned material. Two standardized locations in the same operatory were considered throughout the procedure were chosen to be evaluated for the aerosol collection that is one at 6" (fig: 1) (chest level of patient) [1, 7, 8] the second one at the mask of the operator, that is at 18" (fig: 2) [1, 6, 7, 8]. For each patient, two set of agar plates were exposed during the study. The set of agar plates were exposed during post rinse scaling for 30 min. Supragingival scaling was performed in all subjects. To ensure the room was free from aerosols, only one patient was treated per day. During each scaling procedure, saliva ejector was used. The same procedure was carried out on all subjects by a single operator who was blinded of both, the mouth rinses. During the treatment, and for 30-min after the treatment, two coded blood agar plates were left uncovered at the pre designated sites to collect samples of aerosolized bacteria. After collecting the samples, blood agar plates were incubated aerobically at 37°C for 48 h and anaerobically in an increased CO_2 chamber for 48 hours. Colonies were counted using the colony counter device by the examiner, who was blinded of the rinse provided. Statistical analysis was performed using independent sample t-test to compare bacterial load between Chlorhexdine and Povidone- Iodine.

Fig: 1 – Blood agar plate at 6" distance that is at chest level of patient.

Fig: 2 - Blood agar plates at 18" on dental chair tray

Fig: 3 - Colony formation with Povidone Iodine rinse

Fig: 4 - Colony formation with CHX rinse.

Results

In this study, 30 patients were selected and were randomly divided into CHX and PI; each group consisted of 15 patients. The clinical parameters recorded that is, plaque index and Gingival bleeding index showed no statistical difference between the groups. For this study, 30 patients were selected with gingivitis and the mean of their plaque index [7] indicated that all the subjects participating in the study fell in the range of 1.0-1.9. In table 1 the descriptive

statistic of bacterial load was shown. The mean CFU at 6" and 18" in CHX treated grouped showed 154.8 and 30.7 CFU respectively. Minimum of 112 and maximum of 192 CFU were found on agar plate placed at 6" in CHX treated group. The minimum of 217 and maximum of 286 CFU were found on agar plate placed at 6" in PI treated group. At 18" distance the minimum CFU count was 28 with CHX and 30 with PI and maximum was 35 with CHX and 42 with PI. Table 2 showed the statistically difference between the CFU with a p value of 0.00 at both 6" and 18" in the intra group comparison. In inter group comparison of CFU, using independent sample t- test, also revealed the statistically significant p value of 0.00 at both 6" and 18" [Table 3]. The table 4 showed the mean CFU using CHX and PI, the p vale was 0.056.

Table 1: Descriptive statistics of Bacterial load (Colony forming units)

Mouth wash	Site	N	Mean	Median	S.D	Min	Max
Chlorhexidine	6"	15	154.8	152	27.8	112	192
	18"	15	30.7	30	2.01	28	35
Povidone Iodine	6"	15	236.7	231	20.1	217	286
	18"	15	35.4	36	4.1	30	42

Table 2: Independent t-test to compare bacterial count from both the sites

Mouth wash	Site	N	Mean	SD	*p* value
Chlorhexidine	6"	15	154.8	27.8	0.000
	18"	15	30.7	2.01	
Povidone Iodine	6"	15	236.7	20.1	0.000
	18"	15	35.4	4.1	

Table 3: Independent sample t-test to compare bacterial load between Chlorhexdine and Povidone- Iodine

Distance	Mouth rinse	N	Mean	S.D	*p* - value
6"	Chlorhexidine	15	154.8	27.8	0.000
	Povidone Iodine	15	236.7	20.1	
18"	Chlorhexdine	15	30.7	2.01	0.000
	Povidone Iodine	15	35.4	4.1	

Table: 4 Inter group comparison of CFU

Mouth rinse	N	Mean % reduction in CFU	*p* value
Chlorhexidine	15	80 %	0.056
Povidone Iodine	15	73 %	

Discussion

The American Dental Association has recommended that potential contaminated aerosols or splatter be controlled during dental procedures. [9] While there have been no definitive epidemiologic studies that have linked dental aerosols to disease transmission, the presence of a cloud of contaminated aerosol and splatter, such as that produced by an ultrasonic scaler, should be of concern to the dental practitioner. [1] This study demonstrates that a sufficient amount of aerosol and splatter from the patient will be ejected far enough to come into contact with dental personnel. In conducting this study, an attempt was made to evaluate and compare the ability of different pre-procedural rinsing agents to lower the microbial counts during the use of aerosol producing ultrasonic scalers. The results of this study showed that there was a significant reduction of the bacterial CFU in both the groups. The pre-rinse level of CFU was maximum at patient's chest followed by the operator's mask and at 18". The highest CFU at the patient's chest position is similar to the findings of Bentley et al. who observed the larger salivary droplets generated during dental procedures settle rapidly from the air with heavy contamination on the patient's chest. [10] In this study, the pre-rinse CFU at the 6" followed the 18" CFU values. Worrall et al. also found that the highest counts were found near the headrest.

[10] However, King et al. have reported that CFU count on the face-shield of the operator were found to be less, as the operator was exposed to a deflected spray and not the direct spray that is emitted straight from the subject's mouth. [11] At 9 ft in front of the patient, CFU being decreased have been reported, revealing that the number of CFU decrease as the distance from the reference point increased. [7,8]

The post rinse CFU's using CHX and PI are as follows. At both position, the reduction in aerobic colonies post rinse was maximum for CHX group than PI group showed. Chlorhexidine showed significant reductions in CFU at 6" position followed by the 18" position. Logothetis and Martinez-Welles also showed that CHX gluconate pretreatment rinse was effective in reducing bacterial aerosol contamination with the use of air polisher. [9] Muir and others found that a 2 min prerinse with CHX significantly reduced aerosols produced by ultrasonic scalers. [12] Torollu et al. have reported that the level of viable microbial bacteria cannot be reduced significantly by preprocedural rinse of 15 ml of 0.2% CHX for 1 min. [13] In PI group, significant reduction was seen at both the positions, showing maximum reduction 18" position. This finding may result from the antiseptic mouthwash's ability to inhibit microbial growth. PI is good for quick microbicidal activity unlike CHX which has substantivity effect. [14] It can also be supported by early study by Vanderwyk who noted microbicidal activity of PI showing 72% reduction for 30 min after rinsing and the decrease was still 38% below the prerinse count after 90 min. [15] Cawson and Curson studied the topical effect of 2% tincture iodine and 2% CHX in alcohol and both were found to provide the best antimicrobial activity on the oral mucosa. [16] PI is good for Mycobacterium tuberculosis control while CHX has no adequate antimicrobial effect on M. tuberculosis. [17, 18] The results of this study demonstrated maximum reduction of aerobic colonies using CHX. The highest anaerobic CFU reduction was found at 6" position and at 18" for CHX group followed by PI group. Both the groups (CHX and PI) reduced the growth of CFUs, suggesting that a CHX and PI pre-procedural rinse are definitely similar in reducing aerosolized bacteria. The broad antimicrobial effects of CHX includes significant reductions in the numbers of total aerobes (65 85%), anaerobes (42-80%), streptococci (44-78%) and actinomyces (85-97%). [19] CHX also has binding property (substantively) which enables CHX to bind to the bacterial surfaces and affect the adherence as well as to initiate bacterial destruction. [20] Though the results present a strong case for mouth rinsing before the dental procedure, few dentists use mouth rinsing as a means to either minimize endogenous spread of infection from patient to the dentist or the dental auxiliaries on a routine basis, why this procedure has not gained more acceptance, is an enigma. Barriers to its implementation may be the taste and the cost of the mouth rinse. Nevertheless, the explanation of the benefits should convince the most reluctant patients to participate. The extent of this potential hazard due to aerosols is difficult to estimate since there is no evidence in literature that specific disease has been caused in dental personnel by contaminated aerosol or dust. Nevertheless, such contamination must be regarded as undesirable and aerosol control measures such as pre-procedural rinse should be strictly implemented in periodontal clinic. The present study results have prompted a consideration of the routine use of CHX and PI mouthwash as prior to all dental procedures as it results in the reduction in number of oral bacteria available for possible induction of bacteremia or dissemination to the attending dentist and other personnel. The limitations of this study should be considered in the interpretations of the results. The CFUs counted here are values that represent the bacteria capable of growth on blood agar plates. No attempt has been made to identify the type of bacteria, either pathogenic or nonpathogenic. Moreover, viruses, fungi and specific bacteria require specialized media, which were not cultured in this study. Future studies are needed to investigate the viable pathogenic microorganisms generated during the use of ultrasonic scaling device. The plate count (CFU) only provides an approximation of the number of bacterial colonies formed on blood agar, these approximations do not take into account the viral content within the aerosols. Clinical transfer of this study result is that the preprocedural rinse should be compulsory to prevent disease transmission through aerosols. It

becomes mandatory especially in those patients with infectious diseases. To prevent aerosol transmission in such cases, hand scaling is a better choice.

Conclusion

This study indicates that a pre-procedural rinse can significantly reduce the viable microbial content of aerosols generated during scaling. Hence, pre-procedural rinsing may be of value in protecting patients and dental professionals during dental procedures. Chlorhexidine was found to be superior to Providine Iodine in reducing the number of viable bacteria proved by decreased number of colony forming units.

Conflict of Interest: *None declared*
Source of Support: *Nil*
Ethical Permission: *Obtained*

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