Research Article

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Comparative Evaluation of the Efficacy of Two Pre-Procedural Mouth Rinses in Decreasing the Viable Aerosol Produced During Ultrasonic Scaling

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ABSTRACT

Background: The oral cavity provides a unique environment which is an ideal medium for the growth of bacteria. Repeated exposure of the dental professional to these microorganisms present in blood and saliva places them at a higher risk for developing various infectious diseases.

Aims & Objectives: The aim of the study was to evaluate the number of colony forming units without and with pre-procedural mouth rinses of Chlorhexidine 0.2% and Listerine and to compare the efficacy of these two mouth rinses in reducing the number of colony forming units in aerosols produced by ultrasonic scalers at various distances.

Results: The results of this study clearly indicate that the antibacterial mouthrinses (Chlorhexidine 0.2% and Listerine) used as a preprocedural mouthrinses can significantly reduce the viable microbial content in aerosols generated during ultrasonic scaling. When the two mouthrinses were compared, Chlorhexidine 0.2% was found to have a more significant effect than Listerine in reducing the number of colony forming units.

Conclusion: the results indicate that pre-procedural rinsing with an antibacterial mouthrinse may potentially have a role in reducing the risk of cross contamination with infectious agents in the dental operatory.

Keywords: Aerosol. Chlorhexidine, Listerine, Splatter, Scalers, Ultrasonic.

INTRODUCTION

An aerosol is a suspension of liquid and / or solid particles in the air. They can be expelled into the atmosphere during coughing, sneezing, laughing, talking etc. Most of the routine dental procedures will produce aerosol and splatter which consists of combinations of water, organic particles like tissue and tooth dust, and organic fluids like blood and saliva. OSHA in 1991 had passed a mandate on the need for all dental procedures that produces aerosols to be strictly accompanied by remedial measures to eliminate the same. CDCP (Center for Disease Control & Prevention) has recommended the usage of rubber dams and high velocity air evacuation devices and proper positioning of the patient so as to eliminate the formation of splatter or droplets during dental treatment. Unfortunately, none of these methods are successful in the case of ultrasonic scaling. Several studies have demonstrated clearly that hand pieces, three way syringes, air polishing slurry

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Fig 1: Location of agar plates.

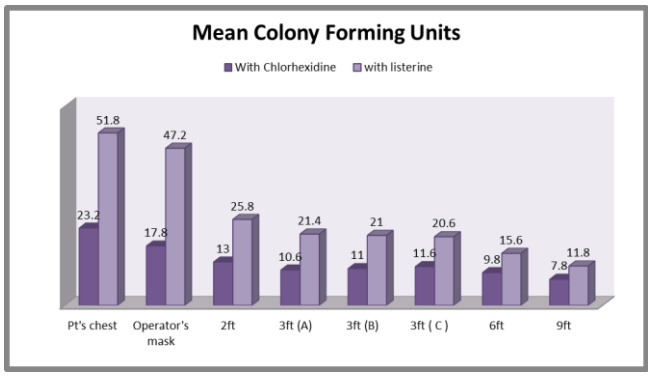

Fig 2: Comparison of mean colony forming units with pre-procedural mouth rinses (Chlorhexidine-0.2% and Listerine) in group-I and group-II.

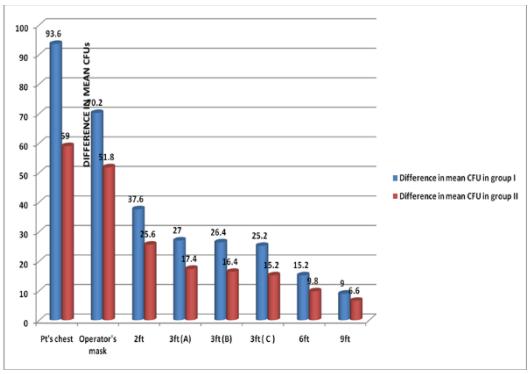

Fig 3: Comparison of difference in mean colony forming units in group-I and group-II at different locations.

and ultrasonic scalers creates more CFUs around the operating unit and operatory.[1-2] Checchi et al [3] in their study has found ultrasonic scalers to be the highest producer of contaminated aerosol and splatter.

Several attempts were made to reduce the bacterial splatter during ultrasonic scaling by using topical agents. During early 70s mouthrinses were used as part of infection control and they found very encouraging results. [4] Recent studies have shown that pre procedural rinsing can reduce the aerosol contamination to a great extent [5]. The purpose of this study is to compare and evaluate the efficacy of pre-procedural mouthrinses Chlorhexidine 0.2% and Listerine in reducing viable bacteria in aerosols generated during ultrasonic scaling and also to evaluate the number of colony forming units at various distances in the dental operatory.

MATERIALS AND METHOD

Criteria and selection:

A total number of 50 patients, 25 males and 25 females in the age group of 18-45 years were selected from the out-patient department.

Study design:

Subjects fulfilling the criteria of the study were selected. They were informed of the nature and purpose of the study and written consent was obtained.

Following that a thorough medical and dental history was taken and Plaque and Gingival Index scores were recorded. Then the subjects were randomly assigned into two groups.

1. Group I (Chlorhexidine 0.2%)

2. Group II (Listerine)

A split-mouth design was used in the study. Ultrasonic scaling of one side (maxillary and mandibular) of the subject's mouth was done without pre-procedural mouth rinse and the opposite side was scaled after giving the pre-procedural mouth rinse. The advantage of this design is that the subject themselves serves as his/her control group. Group I had 25 subjects who rinsed with Chlorhexidine 0.2% while Group II had 25 subjects who rinsed with Listerine. To ensure that the operatory was aerosols free only one patient was treated per day and the treatment was completed in the same sitting. The dental operatory was disinfected with ethyl alcohol prior to each appointment and was fumigated with 40% formaldehyde after each case.

Table 1: Mean colony forming units for subjects in group-I &II without and with pre-procedural mouthrinse (Chlorhexidine 0.2% and Listerine).

	Patient's Chest	Operator's Mask	2-feet	3feet (A)	3feet (B)	3feet (C)	6-feet	9-feet
Chlorhexidine								
Without	116.8	88.0	50.6	37.6	37.4	36.8	25.0	16.8
With	23.2	17.8	13.0	10.6	11.0	11.6	9.8	7.8
Listerine								
Without	110.8	99.0	51.4	38.8	37.4	35.8	25.4	18.4
With	51.8	47.2	25.8	21.4	21.0	20.6	15.6	11.8

Table 2: Percentage reduction in colony forming units in group-I after using preprocedural mouth rinse (Chlorhexidine 0.2%).

Without Pre-procedural mouthrinse			With Pre-procedural mouthrinse		Percentage reduction
Location of agar plates	Mean	Standard Deviation	Mean	Standard Deviation	
Patient's Chest	116.8	±26.60	23.2	±8.64	80.14%
Operator's Mask	88.0	±12.88	17.8	±5.45	79.77%
2-feet	50.6	±6.00	13.0	±2.41	74.30%
3-feet (A)	37.6	±3.20	10.6	±2.02	71.80%
3-feet (B)	37.4	±3.07	11.0	±2.06	70.50%
3-feet (C)	36.8	±4.98	11.6	±3.04	68.48%
6-feet	25.0	±3.08	9.8	±2.62	60.80%
9-feet	16.8	±2.19	7.8	±1.83	53.57%

Table 3: Percentage reduction in colony forming units in group-II after using pre-procedural mouthrinse (Listerine).

Without Pre-procedural mouthrinse			With Pre-procedural mouthrinse		Percentage reduction
Location of agar plates	Mean	Standard deviation	Mean	Standard deviation	
Patient's Chest	110.8	±21.25	51.8	±8.89	53.25%
Operator's Mask	99	±12.02	47.2	±4.46	52.30%
2-feet	51.4	±5.12	25.8	±3.01	49.80%
3-feet (A)	38.8	±3.72	21.4	±2.75	44.85%
3-feet (B)	37.4	±3.34	21.0	±2.98	43.85%
3-feet (C)	35.8	±2.43	20.6	±2.02	42.46%
6-feet	25.4	±2.14	15.6	±2.08	38.58%
9-feet	18.4	±2.27	11.8	±2.02	35.87%

Table 4: Mean colony forming units with pre-procedural mouthrinses (chlorhexidine 0.2% and Listerine) in group-I and group-II.

Pre-procedural mouthrinse	Patient's Chest	Operator's Mask	2feet	3feet(A)	3feet(B)	3feet(C)	6feet	9-feet
Chlorhexidine 0.2%	23.2	17.8	13.0	10.6	11.0	11.6	9.8	7.8
Listerine	51.8	47.2	25.8	21.4	21.0	20.6	15.6	11.8

Table 5: Evaluation of paired t-value in group-I and group-II at different distances and estimation of statistical significance between group-I and group-II.

GROUP-I				GROUP-II			
Location of agar plates	Differences In mean	Standard deviation	Paired t-value	Differences In Mean	Standard deviation	Paired t-value	Student t-test
Patient's Chest	93.60	±20.76	22.54 P<0.001	59.00	±18.75	15.73 P<0.001	6.18 P<0.001
Operator's Mask	70.20	±12.34	28.44 P<0.001	51.80	±16.42	15.77 P<0.001	4.48 P<0.001
2-feet	37.60	±8.48	22.17 P<0.001	25.60	±6.74	18.99 P<0.001	5.54 P<0.001
3-feet (A)	27.00	±4.33	31.18 P<0.001	17.40	±5.43	16.02 P<0.001	6.87 P<0.001
3-feet (B)	26.40	±4.07	32.43 P<0.001	16.40	±4.93	16.63 P<0.001	7.78 P<0.001
3-feet (C)	25.20	±6.11	20.62 P<0.001	15.20	±5.01	15.17 P<0.001	6.34 P<0.001
6-feet	15.20	±5.03	15.11 P<0.001	9.80	±3.58	13.69 P<0.001	4.38 P<0.001
9-feet	9.00	±2.54	17.72 P<0.001	6.60	±2.03	16.26 P<0.001	3.67 P<0.01

The ultrasonic unit was switched on and flushed for a period of 2 minutes between treatments. Identical power and water settings were used for all subjects. Sterile distilled water was used in the booster. Slow-speed saliva ejector was used to remove excess water. Eight standardized locations representative of all areas of the operatory, were chosen to evaluate for each treatment group. The same closed operatory measuring I1ft.x I1ft. x 10ft. was used for all treatment procedures.

Standardized distance: Location of agar plates

- = Mouth of the patient was taken as a reference point.

Position of plates (fig.1)

1= Patient's chest
2= Operator's mask
3= 2 feet from reference point
4= 3 feet (A) from reference point
5= 3 feet (B) from reference point
6= 3 feet (C) from reference point
7= 6 feet from reference point
8= 9 feet from reference point

Trypticase Soy Agar plates were selected to be used as a medium to collect the aerosol and for assessing the total colony forming units. In order to determine the baseline value of air contamination of the operatory a culture plate was opened and kept near the side of the dental chair 30 minutes prior to the procedure. The subject was then seated and under strict barrier control scaling was done. Care was taken to restrain from all activities like talking, sneezing etc that can cause aerosol contamination during the procedure. During the course of the treatment and for 30 minutes post treatment, eight coded agar plates were left uncovered at predestinated sites to collect samples of aerosolized bacteria.

During the next phase, the patient rinsed with 15c.c of 0.2% Chlorhexidine for 2 consecutive 30-second periods under supervision. Scaling was then done for 10 minutes in the remaining half of the mouth. Another set of eight coded uncovered agar plates were placed during the treatment and 30 minutes after the treatment. The subjects were then moved to another area for completion of the treatment.

Similarly, for Group II patients, initial scaling was done in a randomly selected half mouth for 10 minutes. During this period and 30 minutes after the treatment, eight coded plates were placed at designated places. Patients were then asked to rinse with 15c.c of Listerine mouthrinse for two consecutive 30-second periods. Again, scaling was done in the remaining half of the mouth for 10 minutes. Another set of coded uncovered agar plates were placed during this period and 30 minutes after the treatment. After each sampling, the plates were immediately transported to microbiology laboratory.

Microbiological Examination:

Trypticase Soy Agar plates were then incubated at 37° C for 48 hours. After the incubation period, the plates were observed for microbial growth and with a colony counter the colony forming units in each plate was calculated. The results obtained were then analyzed statistically using a Student Unpaired't' test to evaluate and estimate the statistical significance between Group I and Group II.

RESULTS

The mean colony forming units for subjects in group- I and II, without and with pre-procedural mouth rinse (Chlorhexidine 0.2% and Listerine) was evaluated. In both the groups there was significant reduction in the aerosol contamination when preprocedural rinse was used. (Table.1)

The percentage reduction in colony forming units in group-I after using pre-procedural mouth rinse of Chlorhexidine 0.2% was compared. There was a percentage reduction of 80.14% in the patient's chest. Operator's mask showed a percentage reduction of 79.77%, 74.3%, at 2 feet, 71.80% at 3 feet (A), 70.50% at 3 feet (B), 68.48% at 3 feet (C), 60.80 % at 6 feet and 53.57 % at 9 feet respectively.(Table.2) The percentage reduction in colony forming units in group-II after using pre-procedural mouth rinse of Listerine was compared. There was a percentage reduction of 53.25% in the patient's chest. Operator's mask showed a percentage reduction of 52.30%, 49.80%, at 2 feet, 44.85% at 3 feet (A), 43.85% at 3 feet (B), 42.46% at 3 feet (C), 38.58 % at 6 feet and 35.87 % at 9 feet respectively.(Table.3)

The mean colony forming units with pre-procedural mouthrinses (Chlorhexidine 0.2% and Listerine) in group-I and group-II were compared .At the Patient's chest in Group-I, mean colony forming units was 23.2 and in Group-II, it was 51.8. It was 17.8 in the Operator's mask in Group-I and 47.2 in Group-II, 13.0 and 25.8 at 2 feet,10.6 and 21.4 at 3 feet (A),11.0 and 21.0 at 3 feet (B). 11.6 and 20.6 at 3 feet (C),9.8and 15.6 at 6 feet and 7.8 and 11.8 at 9 feet respectively.(Table.4; fig.2) Evaluation of paired t-value at different distances and estimation of statistical significance was carried out between the two groups. At all points Group I showed to be statistically highly significant when compared to Group II. (Table.5, fig.3)

DISCUSSION

Infection control procedures in the dental offices especially aerosol contamination have become a matter of concern for us during the course of past several years. Microorganisms in the saliva and plaque combines with the splatter and aerosol which are produced as a result of their interaction with the vibrating tip of the ultrasonic scaler. This

aerosol mist containing microorganisms may spread to several feet from the area of operation. Lorato et al [6] in their studies have shown an increase of 2200% of bacteria that is expelled to the atmosphere after an ultrasonic scaling. Barnes et al [2] had shown that during Sub gingival scaling of periodontally involved teeth with ultrasonic scalers aerosol containing blood will be produced thereby increasing the risk of infection and cross contamination.

Trypticase Soy Agar plates were selected as a medium based on the studies by Fine et al.[7]. Eight standardized locations representative of all areas of the operatory were selected based on the standardization procedure described by Zainab et al.[8] The results of this study demonstrated that with pre-procedural antibacterial mouthrinse, there was considerable decrease in number of colony forming units when compared to those without pre-procedural mouthrinse. The maximum percentage reduction was seen at patient's chest level and least at 9 feet distance In the present study it was found that in Group I, 80.14% reduction at patient's chest level and 53.57% reduction at 9 feet distance. In Group II, there was 53.25% reduction at patient's chest level and 35.87% reduction at 9 feet distance. The result of our study was in accordance to the findings of Muir KF et al.[9] and De Paola et al.[10]

In our study, the analysis revealed that the number of colony forming units decreased as the distance increased. Maximum numbers of colony forming units were recovered from the plate positioned at patient's chest. Next highest count was on the operator's mask. Then plates positioned at 2 feet, 3 feet (A), 3 feet (8), 3 feet (C), 6 feet and 9 feet from the reference point in a descending order. This finding is in agreement with the study done by Logothetis et al [11] and Bentley et al.[1] This was observed to be due to the fact that the larger salivary droplets generated during dental procedures settle rapidly from the air with heavy contamination in patient's chest.

In our study, although in both groups, mouth rinses significantly reduced the number of colony forming units at all eight standardized locations, the results showed that Chlorhexidine 0.2% pre-procedural rinse is superior in comparison to Listerine mouthrinse. This finding is in accordance with the study done by Logothetis et al .[11] The difference in the results appears to be due to the retention of Chlorhexidine on oral tissues and its subsequent slow release in an active form. Since Chlorhexidine exhibits substantivity, the 10-minutes waiting period before air polishing was thought to be an important factor. But in the present study, even though scaling was done immediately after 2 consecutive 30-second pre-rinses, Chlorhexidine was found to be more effective in reducing the number of colony forming units in comparison to Listerine mouthrinse which could only mean that Chlorhexidine 0.2% has a more significant antibacterial effect on oral microorganisms when compared to Listerine.

When we interpret the results the limitations of this study should be taken into consideration. The colony forming units counted here are values that represent only aerobic bacteria capable of growth on Trypticase Soy Agar plates. Viruses, anaerobic bacteria and other organisms requiring specialized media were not cultured in this study. However, this study demonstrates that contamination from splatter and aerosol dissemination remains a significant hazard to dental personnel when ultrasonic scaler is used and it clearly suggests that a routine pre rinse with antibacterial mouthrinse could eliminate the majority of bacterial aerosols generated, providing some protection as far as 9 feet from the center of operation, thereby decreasing the risk of disease transmission.

CONCLUSION

The results of this study clearly indicate that the antibacterial mouthrinses (Chlorhexidine 0.2% and Listerine) used as a preprocedural mouthrinse can significantly reduce the viable microbial content in aerosols generated during ultrasonic scaling and when the two mouthrinses were compared, Chlorhexidine 0.2% was found to have a more significant effect than Listerine in reducing the number of colony forming units.

While this study design doesn't in itself permit an assessment of the decreased risk of cross contamination, the results indicate that pre-procedural rinsing with an antibacterial mouthrinse may potentially have a role in reducing the risk of cross contamination with infectious agents in the

dental operatory. Further studies are needed to evaluate the anaerobic microorganisms in the aerosols generated during ultrasonic scaling and the efficacy of different mouth rinses in reducing them.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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