

Research Article

Dental Aerosol Hazard Prevention with Pre-procedural Antiseptic Mouthwashes (Comparative Study)

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Abstract Background: One of the recommended methods for reducing aerosol contamination during the daily regular usage of high-speed turbine and ultrasonic scaling is the use of preprocedural mouth rinse. Several agents have been investigated as a preprocedural mouth rinse. Chlorhexidine significantly reduce the viable microbial content of aerosol when used as a preprocedural rinse. Studies have shown that cetylpyridinium chloride (CPC) mouthwash is equally effective as chlorhexidine in reducing plaque and gingivitis. This study compared the effect of 0.07% CPC to 0.2% chlorhexidine gluconate (CHX) as preprocedural mouth rinses in reducing the aerosol contamination by high-speed turbine. Materials and Methods: 36 patients were divided into three groups based on the preprocedural rinse used (0.2% CHX, 0.07% CPC and distilled water). Conservative treatment was done for 20 min. (10 min before rinsing and 10 min after rinsing) in the same closed operatory for all the patients after keeping blood agar plates opened at three standardized locations (patient chest, dentist chest and at 12-inch from patient mouth). Colony forming units (CFUs) on blood agar plates were counted, after incubation at 37°C for 48 hr. Statistical analysis was done with (SPSS version 21). Results: This study showed that the two antiseptic mouthwashes significantly reduced the bacterial colony forming units (CFUs) in aerosol samples at three plates locations. Chlorhexidine rinses were found to be superior to cetylpyridinium chloride when used pre-procedurally in reducing aerolized bacteria. The number of CFUs were higher at the patient's chest location as compared to other locations. Conclusion: 0.07% CPC and 0.2% CHX were effective as a pre-procedural rinse in reducing CFU count during dental treatment using high-speed turbine.

Keywords: Dental Aerosol; Pre-Procedural Mouthrinse; Chlorhexidine Mouthwash; cetylpyridinium chloride; Colony Forming Units.

Introduction

The spread of oral microbes in the dental office during various oral treatments has been a source of concern. The use of specific equipment, such as ultrasonic devices (1), high-speed dental hand-pieces (2), or three-way syringes (3), may disseminate microorganism-containing aerosols and splatters into the surroundings. Aerosol is a volatile dispersion of solid or liquid particles carrying different microorganisms such as bacteria, viruses, or fungus (4). These particles and organisms may induce cross-infections at the dental office, putting patients' and dental workers' health at risk (5). Ultrasonic scalers and highspeed handpieces generate more airborne contaminants than any other dental equipment (6).

Chlorhexidine (CHX) is regarded as the gold standard chemical for reducing oral biofilm development and more potent than other compounds in reducing the levels of salivary streptococci and Mutans

Streptococci bacteria (7), or microbiological transmission via oral aerosols (8), also have many oral uses such as; control of gingivitis and periodontal diseases, (9)

because of its wide antibacterial range and sustained period around the oral mucosa (10). Other antiseptics, such as cetylpyridinium chloride, have been utilized as pre-procedural mouth rinses (11). CPC has significant antibacterial activity (12), and is a product that may be marketed safely (13).

Plaque and gingivitis effectiveness tests have been conducted on commercial mouth rinse products containing the antibacterial component cetylpyridinium chloride (CPC) (14). Because of its excellent antibacterial activity, fewer side effects, and cheaper cost, CPC was offered as a suitable alternative to CHX (1).

As far as, no Iraqi study was found to evaluate the efficacy of a preprocedural mouthrinse containing 0.07% CPC compare to 0.2% CHX and distilled water in reducing the levels of viable bacteria in oral spatter during use of high-speed turbine within dental treatment. Therefore, a clinical study was conducted.

Material and Methods

This study was carried out after the confirmation by the Research Ethics Committee at College of Dentistry/ University of Baghdad. Patients who satisfied the inclusion and exclusion criteria were included in the research, who received dental care at a private specialist dental clinic, completed an informed consent form, and their participation were entirely voluntary. Total 36 patient were selected for the study, and there randomly divided into 3 groups i.e. 12 patients in each group, and without gender criteria.

1. Patient's inclusion criteria:

- 1- Patients who were over the age of 15, and had DMFT \geq 4.

2. Exclusion criteria

- 1- Any patient who wore orthodontic bands or had partial removable dentures.
- 2- A patient had soft or hard tissue tumors of the oral cavity.
- 3- Patient had a history of systemic illness or disorders.
- 4- Patient was taking antibiotics or anti-inflammatory medication prior to the trial.
- 5- Women who were pregnant or nursing.

In the present study, the sample size was based on statistical analysis, 36 patients were randomly divided into four groups according to pre-rinse with mouthwash as followed:

- Group I: Control group was rinsed with distilled water (D.W)
- Group II: Rinsed with 0.2% chlorhexidine gluconate (CHX)
- Group III: Rinsed with 0.07% cetylpyridinium chloride (CPC)

Methods

The study was carried out at a private dental clinic in Baghdad city/ Iraq after gaining permission from the clinic's dentist. Half an hour before the start of work, the clinic's ventilation was checked, and then the dental chair and its accessories were cleaned, and all surfaces inside the clinic were disinfected with 70% alcohol, all instruments which used during treatment were sterilized in an autoclave at 121oC and a pressure of 15 pounds per square inch (PSI) for 15 minutes. Then dentist, researcher and patient were used the personal protective equipments (PPE) that included; face mask, face shield, medical gloves, gown and patient towel. Before dental treatment all the participants were received PI according to plaque index system (15), and dental caries following the criteria recommended by world health organization (WHO) (16).

Patients who participated within study had a conservative treatment for selected half that contained two adjacent carious teeth, the researcher putted three labeled blood agar plate (17) at three standardized locations: (18) (Figure 1)

- Plate at patient chest
- Plate at dentist chest
- Plate at 12-inch from the patient mouth

Prior to the dental treatment, the high-speed turbine, handpiece, and air-water syringe were turned on and flushed for one minute to remove contaminated water caused by overnight stagnation in the water lines (19). After conservative treatment for 10 minutes, the researcher asked the patient to rinse with 10ml of mouthwash randomly for one minute and wait for 10 minutes for better retention of solution within the mouth (20), after those the new agar plates were putted in the same predestined locations and dental treatment continued for 10 minutes. The same dental clinic and the same dentist was work for all participants and only one patient was treated per day to ensure that the clinic free from aerosol contamination. After the end of time for aerosol collection the plates were closed, sealed, labelled, and immediately transferred for incubation.

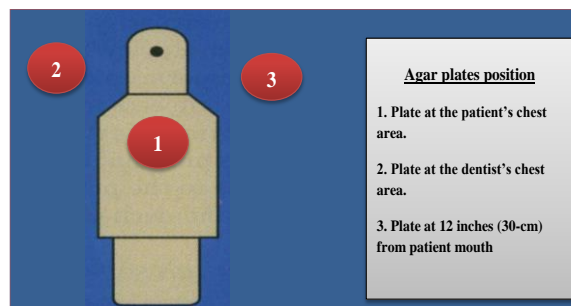


Figure 1: Position of agar plates

Microbiological Examination

After the samples were collected, the blood agar plates were incubated aerobically at 37 degrees Celsius for 48 hours before being examined for the number of bacterial colony forming units (CFUs/agar plate). A manual bacterial count was carried out under the guidance of a microbiologist.

Statistical analysis

The statistical analysis was performed by Statistical Package for the Social Science (Spss version 22). Descriptive statistics was used as mean and standard deviation with cluster chart bars. Inferential statistics were performed as One Way Analysis of Variance ANOVA, levene test of homogeneity of variance, Shapiro Wilk test of normality, Dunnett T3 post hoc test for multiple pairwise comparison and paired T test.

Results

Total 36 patients were selected for the study, and there randomly divided into three equal groups i.e. 12 patients in each group.

All patient were examined for PL, DMFS and DMFT, and the most correlation between the dental caries (DMFS, DMFT) and the colony count of bacteria was strong positive significant except for CHX group was strong positive significant between DMFT and CFU before rinsing and non-significant correlation after rinsing at patient chest, and weak positive non-significant for DMFS and CFU before rinsing and significant after, at dentist chest, while at 30-cm location there was weak negative non-significant before

rinsing and significant relation after rinsing (Table-1). While the most correlation between the plaque and the microbial colony count was weak not significant (Table-2).

Table 1: The statistical correlation between caries experience (DMFS, DMFT) and the colony count of aerosol bacteria in all mouthwashes groups, locations and periods.

Groups		DMFS		DMFT	
		r	p	r	p
CHX	PCHB	0.541	0.069	0.674	0.016
	PCHA	0.564	0.056	0.564	0.056
	DCHB	0.158	0.624	0.457	0.136
	DCHA	0.363	0.247	0.375	0.229
	30 cm B	-0.186	0.563	0.073	0.822
CPC	30 cm A	-0.474	0.120	-0.275-	0.387
	PCHB	0.777	0.003	0.793	0.002
	PCHA	0.721	0.008	0.782	0.003
	DCHB	0.798	0.002	0.819	0.001
	DCHA	0.785	0.002	0.850	0.000
DW	30cm B	0.873	0.000	0.833	0.001
	30 cm A	0.753	0.005	0.789	0.002
	PCHB	0.617	0.033	0.788	0.002
	PCHA	0.593	0.042	0.764	0.004
	DCHB	0.664	0.018	0.839	0.001
	DCHA	0.652	0.021	0.844	0.001
	30 cm B	0.665	0.018	0.798	0.002
	30 cm A	0.785	0.002	0.809	0.001

Table 2: The statistical correlation between plaque index and the colony count of aerosol bacteria in all mouthwashes groups, locations and periods.

Plate positions	CHX		CPC		DW	
	r	p	r	p	r	p
PCHB	0.021	0.949	-0.318	0.314	0.103	0.749
PCHA	-0.085	0.792	-0.343	0.275	0.083	0.797
DCHB	0.182	0.572	-0.336	0.285	-0.038	0.907
DCHA	0.564	0.056	-0.364	0.245	-0.152	0.636
30 CM B	0.399	0.199	-0.044	0.891	-0.107	0.740
30 CM A	0.365	0.243	-0.171	0.596	-0.094	0.772

1. Location I: Patient chest

The mean of bacterial colony before and after treatment among groups at three positions showed within (Figure 2).

The mean of CFUs was significantly post-rinse as compared to pre-rinse within all groups. The lowest bacterial mean was in the group that used 0.2% CHX mouthwash as pre-procedural rinsing (39.333 CFUs/agar plate), followed by group whose rinsed with 0.07 % CPC (55.167 CFUs/agar plate) and highest mean within control group (184.917 CFUs/agar plate) in patient chest location. The analysis results showed that post-rinse bacterial reduction with 0.2% CHX was 86.7% followed by 0.07% CPC in the percentage of colony reduction at patient chest area with 79.2 % and least within DW group 9.7% (Table 3) (Figure 3) with significant difference among three groups at this location.

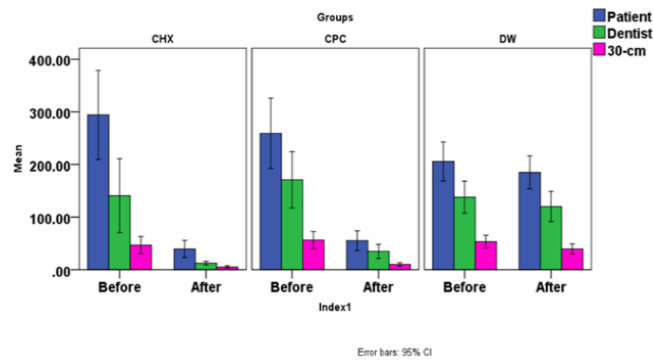


Figure 2: The mean of bacterial colony before and after treatment among groups at three positions.

Table 3: Bacterial colony mean and percentage of reduction among groups before and after rinsing at patient chest position.

Groups	Before		After		% red.	P *value
	Mean	±SD	Mean	±SD		
CHX	294.250	133.196	39.333	25.649	86.767	0.000
CPC	259.167	105.277	55.167	29.557	79.265	0.000
DW	205.833	58.454	184.917	49.381	9.727	0.000
F	2.213		57.855			
P value	0.125		0.000*			

*=significant at p<0.05.

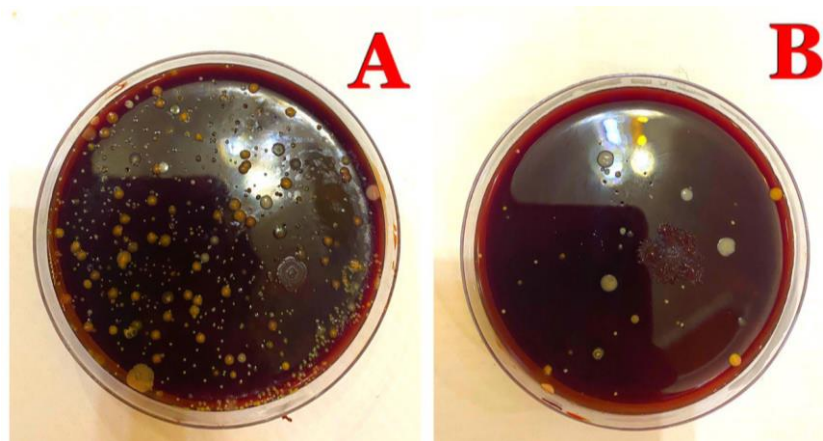


Figure 3: A: Microbial colony growth on agar plate before rinsing at patient chest B: Microbial growth after rinsing with CPC mouthwash at patient chest position.

2.Location II: Dentist chest

In the dentist chest area the mean number of colony after rinsing was significantly lowest within CHX mouthwash group (12.250 CFUs/agar plate) followed by (34.750 CFUs/agar plate) for group with CPC pre-rinsing and highest mean was (120.000 CFUs/agar plate) within control group. The colony reduction after treatment was 89.9% for CHX and 80.2% with CPC mouthwash and least bacterial reduction after distilled water rinsing 13.3%, and there was significant difference found among groups in this position (Table 4).

Table 4: Bacterial count mean and reduction among groups before and after rinsing in dentist chest.

Groups	Before		After		% red.	P *value
	Mean	±SD	Mean	±SD		
CHX	140.667	110.783	12.250	5.691	89.992	0.002
CPC	170.917	84.459	34.750	21.111	80.257	0.000
DW	137.750	47.998	120.000	45.451	13.335	0.000
F	.559		45.719			
P value	0.577		0.000*			

*=significant at p<0.05.

3. Location III: 12-inches from patient mouth

The mean of bacterial colony for all groups before and after rinsing has been show within (Table 5). According to statistical result there was no significant difference among groups before rinsing, while the relation was significantly difference after rinsing among three groups at this location. The lowest mean of microbial colony was showed with CHX group (5.333CFU/agar plate) and group (10.167CFU/agar plate) after mouthwash rinsing with highest mean within group rinsed with distilled water (39.500CFU/agar plate).

The microbial reduction was highest within groups that used CHX followed by CPC mouthwash as pre-rinse with (88.5% and 82.1%) respectively, and the lowest reduction had been shown within DW rinsing (26.02%) with significant difference among group at this location at (p<0.05).

Table 5: Bacterial count mean and reduction among groups before and after rinsing in 12-inches location

Groups	Before		After		% red.	P*value
	Mean	±SD	Mean	±SD		
CHX	46.833	25.626	5.333	3.143	88.554	0.000
CPC	56.417	25.678	10.167	4.970	82.177	0.000
DW	53.417	18.817	39.500	15.085	26.023	0.000
F	.518		46.952			
P value	0.600		0.000*			

Discussion

Pre-procedural mouthwash appears to be among the most efficient techniques of limiting the spread of microorganisms in the dental office, and some research has been conducted on this subject ⁽²¹⁾. The current study demonstrated a strong great relation between dental caries and colony count, which is comparable with an Iraqi study (Al-Khayoun et al., 2015) that discovered the intensity of caries lesion to be extremely important and significantly associated with salivary Mutans streptococci ⁽²²⁾. Other research has discovered a significant positive link between the quantity of functional Mutans streptococci and the number of decayed, missed, and filled permanent teeth (DMFT) ^(23, 24).

The present study results are in contrast with Iraqi studies that found no significant relationship between the mean number of decayed, missing, and filled primary teeth (dmft) and the number of (S. mutans), attempting to demonstrate and encourage the principle that tooth decay is a multifactorial disease influenced by a number of factors ^(25,26).

Because blood agar plates are a suitable nonselective culture medium for culturing airborne bacteria, they were used in this work to catch airborne microorganisms. When an airborne bacterium fell and grew on culture medium, it created colonies, which are measured in colony forming units (CFUs) ⁽²⁰⁾.

The present study found that the patient's chest had the highest bacterial accumulation compared to other locations. These findings are consistent with previous studies which show that larger salivary droplets generated during dental procedures settle quickly from the air with massive contamination on the patient's chest ^(8, 27), because the operator was subjected to a reflecting spray instead of a direct aerosol released straight from the patient's mouth as seen in other previous studies that viewed through their results that the dentist chest area was the next higher position for bacterial concentration after the patient chest ^(21, 28).

The control and test groups' observations demonstrate that as distance extended, the number of CFUs created by aerosol reduced significantly. This finding is consistent with the findings of a 1995 research by Logothesis and Martinez-Welles ⁽²⁰⁾, who used agar plates positioned at eight standardized sites to collect aerosols and found that the number of CFUs reduced as the distance from the reference point increased.

CPC 0.07% had efficiency in reducing the number of CFUs on the blood agar plate when used as a pre-procedural mouthrinse 10 minutes prior to conservative treatment. These results are in agreement with those of a previous study that evaluated a mouthwash containing CPC as pre-rinse ⁽¹¹⁾.

According to the present study findings, the dentist profited the most from pre-procedural rinse. Blood agar plates placed on the dentist's chest in groups that rinsed with CHX or CPC had 89 percent and 80 percent less CFUs, respectively, than plates from patients who rinsed with water. This protects dentists from the pathogens that are created during dental procedures. To lower the risk of cross-infection in the dental environment, it is necessary to reduce the number of germs in the oral cavity prior to the formation of the aerosol/splatter. The pre-rinse also have benefit to patient, the plate positioned on patient chest showed bacterial reduction 86% and 79% with CHX and CPC pre-rinse mouthwashes respectively.

These interventions may help patients in a variety of ways throughout dental procedures, including minimizing the likelihood of bacterial transmission to other regions of the body, such as the eyes via airborne particles ⁽²⁹⁾, or even into the lungs by breathing ⁽³⁰⁾.

The improved efficiency of 0.2 percent CHX in reducing CFUs might be attributed to the fact that CHX begins its antibacterial action at the time of aerosol creation as well as the start of aerosol formation. CHX's antiplaque activity appears to be linked to the drug's retention in oral tissues and subsequent delayed active release ⁽¹⁰⁾.

Conclusion

Within the limitations of this research, the results reveal that 0.07% CPC and 0.2 % chlorhexidine as a preprocedural rinse were effective in reducing the viable microbiological load of aerosols that produced during the use of a high-speed turbine in conservative treatment. Furthermore, the patient's chest area was more exposed to bacterial aerosols than other sites, requiring the use of preventative measures to limit cross contamination in a dental office.

Conflicts of interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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الوقاية من مخاطر الرذاذ الجوي للأسنان بغسولات الفم المطهرة قبل العمل (دراسة مقارنة)

الباحثون: وسناء ماجد حميد , ندى جعفر الشيخ راضي

الخلاصة

المقدمة: إحدى الطرق الموصى بها لتقليل التلوث بالرذاذ المتطاير أثناء الاستخدام اليومي المنتظم لآلة حفر الأسنان عالية السرعة وتنظيف الأسنان بالموجات فوق الصوتية هي استخدام غسول الفم قبل علاج الأسنان. تم التحقيق في العديد من العوامل مثل مضمضة الفم قبل علاج الأسنان. يقلل الكلور هيكسدين بشكل كبير من المحتوى الميكروبي الحيوي للرذاذ المتطاير عند استخدامه كغسول للجراحة. أظهرت الدراسات أن غسول الفم كلوريد السيتيليريدين له نفس الفعالية مثل الكلور هيكسدين في تقليل ترسبات الأسنان والتهاب اللثة. قارنت هذه الدراسة تأثير 0,07% من كلوريد السيتيليريدين مع 0,2% كلور هيكسدين جلوكونات كغسولات للفم قبل العلاج لتقليل الرذاذ المتطاير لآلة حفر الأسنان عالية السرعة. المواد والعمل: تم تقسيم 36 مريض حسب نوع غسول الفم المستعمل (0,2% كلور هيكسدين جلوكونات، 0,07% من كلوريد السيتيليريدين أو الماء المقطر). تم حفر الأسنان لمدة 20 دقيقة (10 دقائق قبل استعمال غسول الفم و 10 دقائق بعد الغسول) وتم العمل في نفس عيادة الأسنان المغلقة لكل المرضى المشاركين بعد وضع صفائح الوسائط البكتيرية مفتوحة خلال العلاج في ثلاث مواقع ثابتة (صدر المريض، صدر طبيب الأسنان وعلى مسافة 12- انش من فم المريض). تم حساب وحدة تكوين المستعمرات البكتيرية على صفائح الأوساط البكتيرية بعد الحضانة في درجة حرارة 37 درجة سيليزية لمدة 48 ساعة. التحليل الإحصائي تم بواسطة SPSS 21).

النتائج: أظهرت هذه الدراسة أن استخدام غسول الفم المطهر يقلل بشكل كبير من وحدات تكوين المستعمرات البكتيرية في عينات الرذاذ الجوي في ثلاثة مواقع. تم إيجاد أن غسول الفم الكلور هيكسدين أعلى تأثيراً في تقليل الرذاذ المتطاير من كلوريد السيتيليريدين عند استخدامه قبل علاج الأسنان. وكانت عدد وحدات المستعمرات البكتيرية أعلى في موقع صدر المريض مقارنة بالمواقع الأخرى.

الاستنتاج: 0,2% كلور هيكسدين جلوكونات و 0,07% من كلوريد السيتيليريدين لديهم فعالية لتقليل وحدة المستعمرات البكتيرية للرذاذ الجوي عند استخدامهم كغسولات للفم قبل علاج الأسنان باستعمال آلة حفر الأسنان عالية السرعة. كلمات مفتاحية: رذاذ الأسنان، غسول الفم ما قبل العلاج، غسول الفم الكلور هيكسدين، كلوريد السيتيليريدين، وحدة تكوين المستعمرات البكتيرية.