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Influence of chlorhexidine mouthwashes on air contamination of dental offices

Abstract

Objective: It was evaluated the influence of pre-procedural rinse with mouthwash with chlorhexidine (0.12%) on the degree of air contamination in a dental clinic.

Methods: The sample consisted of 21 patients with periodontal disease were randomly divided into three groups: pre-procedural mouthwash Absence (Control); pre-procedural rinse mouthwash with distilled water (Water) and pre-procedural rinse with mouthwash with chlorhexidine base 0.12% (Chlorhexidine). It was conducted basic periodontal treatment using ultrassonic device. The microbial load generated during the service was captured by sedimentation plates with half Agar Blood culture (AS), exposed for a time of 10 minutes. The boards remained in an oven at 37°C for 48h. It held the count of colony forming units (cfu/cm²).

Results: By applying Kruskal-Wallis test, there was a statistically significant difference between groups. Dunn's test for multiple comparisons revealed that the Control group average showed a statistically significant difference compared to the others.

Conclusion: Prior mouthwash dental care (chlorhexidine-based 0.12% and distilled water) influenced air contamination, being effective in reducing the amount of microorganisms present in the aerosol generated by dental procedures with ultrasonic device. Clinical relevance: Proven spread of contaminants in the air through aerosols and their reduction with the prior mouthwash dental care, it is suggested that this measure is routinely adopted to reduce the risk of cross-infection.

Keywords: biosafety, dentistry, aerosols, chlorhexidine

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Fábio Barbosa de Souza,[1] Ângelo Evandro Leão Raposo Marques,[2] Karoline Maria Santos de Oliveira,[2] Gabriel Marques Bezerra,[2] Igor Rafael Cavalcanti Marques,[2] Carlos Roberto Weber Sobrinho[3]

[1]Department of Prosthodontics and Oral Facial Surgery, Federal University of Pernambuco, Brazil
[2]Dental School, Federal University of Pernambuco, Brazil
[3]Department of Tropical Medicine, Federal University of Pernambuco, Brazil

Correspondence: Fábio Barbosa de Souza, Federal University of Pernambuco, Department of Prosthodontics and Oral Facial Surgery, Federal University of Pernambuco, Av. Prof. Moraes Rego s/n, University City, Recife-PE, CEP: 50670-901, Tel +55-81-2126-8830, +55-81-9974-8237, Fax +55-81-2126-8344, Email fabiobdsouza@gmail.com

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Introduction

Dental care environments are considered to be suitable sites for the contamination caused by biological components or bioaerosols due to the invasive procedures. The air and hence the working environment of a dental surgeon are contaminated, and this problem is accentuated during clinical activity.[1] This contamination through the air can lead to serious health problems for people living in these environments. According to Medeiros et al., [2] the absence of special measures to avoid this problem can turn these sites into real sources of infection spread, provoking a chain reaction called cross infection

During dental procedures, the risk of transmission of infectious-contagious diseases is increased. One of the transmission routes is aerolization, that is, a transfer of microorganisms occurs through aerosols when dental instruments, such as ultrasound and jet of sodium bicarbonate are used.[3] To combat any type of contamination and infection by "invisible" agents present in the air in hospital and outpatient settings, several measures of asepsis and biosafety must be followed. Currently, the dental prefessionals are much more informed and aware of the need to use sterilization, disinfection and biosafety methods in the dentistry.[4]

The use of oral antiseptics before dental care (pre-procedural mouthrinses) points as a possible way for the decrease of the contaminants generated in these procedures, given their antimicrobial properties. Several studies have demonstrated the actions of oral antiseptics on the oral microbiota, such as Simões et al.,[5] which confirmed in vitro the antimicrobial activity of some commercially available products. This study states that different antimicrobial potentials were found in the different antiseptics tested. Fine et al.[6] demonstrated that pre-procedural oral antiseptic mouthrinses significantly reduced the viable microbial content of dental aerosol generated by ultrasound, potentially reducing the risk of cross-contamination in the dental office. A reduction that reaches 94.1% in the colony forming units (CFU) count in relation to the absence of mouthrinse. Chlorhexidine is an antiseptic chemical that has an antimicrobial action recognized in the literature. It is a cationic bisguanide, available mainly in the form of digluconate salts. It presents broad spectrum on Gram-positive, Gram-negative bacteria, fungi and yeasts. Its action will occur through the rupture of the bacterium or through the coagulation and precipitation of its cytoplasmic constituents.[7,8] However, the continuous use of this substance causes some side effects, such as tooth coloration, alteration of taste and, less commonly, desquamation of the oral mucosa.[9]

The use of oral antiseptics based on chlorhexidine (0.12%) is an important tool in the reduction of air contamination in dental offices, and is considered by some authors to be the gold standard for this purpose.[10,11] Moura et al.[12] stated that the mouthrinse with the aforementioned product reduced about 85% of the amount of microorganisms present in the saliva, thus preventing them from being dispersed in the environment during dental procedures. Some clinical studies have evaluated the effect of mouthrinses with chlorhexidine-based oral antiseptics 0.12% on aerosols, compared to 0.2% concentration products. Positive results have been reported for these less concentrated chlorhexidine mouthrinse compared to the more concentrated looking at total microbial counts, showing similar efficacy with reduced side effects.[13,14]

In the literature, there are in vitro studies on the action of oral antiseptics based on chlorhexidine against microorganisms, however,

it is necessary to evaluate the action of the pre-processual mouthwash with these products as a way to combat the presence of microorganisms in the air of dental offices, and such practice may present itself as another means to prophylaxis of possible infections, aiming at increasingly protecting the health professional and other individuals who attend these environments. The aim of this study was to evaluate the influence of pre-procedural mouthwash with oral antiseptic based on chlorhexidine (0.12%) on the degree of air contamination in a dental outpatient clinic.

Methods

This investigation consisted of a quantitative, experimental and field research, with clinical and laboratory stages, carried out at the Nucleus and Reception and Ready Care Unit of the Dental School and at the Laboratory of Microbiology and Immunology of the Department of Tropical Medicine of the Federal University of Pernambuco (UFPE) / Recife, Brazil.

A total of 21 volunteers were enrolled in dental clinics at the Federal University of Pernambuco - Brazil, aged between 21 and 59 years old, with a need for basic periodontal procedures, with at least 20 permanent teeth presence of calculus and dental plaque in at least 1/3 of the dental elements of each individual, gingival bleeding in at least 30% of teeth faces through the bleeding index, presenting gingivitis or moderate periodontitis, at least 3 months without use of any oral antiseptic and antibiotic use, for at least one year without cleaning (scraping and prophylaxis) in a dental office. All individuals who did not apply inclusion criteria or those who had severe allergic diseases / allergies were not included in the study.

The volunteers were randomly assigned according to the use of pre-procedural mouthwash (Table 1).

Table 1 Distribution of research groups (n = volunteers)

Group	Description	N
Control	Absence of Pre-Procedure Mouthrinse	7
Water	Pre-Processual Mouthrinse with Distilled Water 7	7
Chlorhexidine	Pre-procedural Mouthrinse with chlorhexidine-based antiseptic (Periogard®-Colgate)	7

Prior to sample collection, the clinic remained with the air conditioners switched off and the windows open for 15 minutes. After that time, the appliances were turned on and the windows closed. The equipment (chair, equipment, and bench) was cleaned using a neutral detergent and then 70% alcohol under friction. Then the disinfection of the reservoir and water lines (triple syringe and high-speed hose) was carried out, in which 500 ml of distilled water+0.3 ml of 1% sodium hypochlorite, and operated for one minute, to cause a continuous flow of water. This practice allowed to discard residual aqueous content of the pipes and or pipes, as well as to minimize the collection of possible impurities. After this, the reservoir was emptied and filled with distilled water. Throughout the procedure, the operator used the necessary PPE, which comprised: lab coat, gloves, mask, goggles and cap.

According to each group, patient was instructed to perform the mouthwash with 5 ml of the indicated solution (except for the Control group), for a period of one minute. The periodontal treatment was then performed with ultrasound, which was performed by a pre-trained operator (dentistry student), under the supervision of a dentist, in the morning. Supragingival rasping, surface smoothing, prophylaxis with pumice paste and water, and topical application of neutral fluorine were done.

The analysis of the air quality itself started with the collection of microbiological samples in the outpatient clinic, which occurred during the clinical care of the selected patients, by sedimentation method. For this, a plate with blood agar (BA) culture medium, positioned open on the patient's chest for 10 minutes of procedure, was used. After the exposure period, the plates were closed and removed, placed in an isothermal container and sent to the UFPE Microbiology Laboratory. Samples of the BA medium were grown in an oven for 48h at 37°C. After incubation, the colonies were counted through a magnifying glass for this purpose and the results expressed in colony forming units per cm² (CFU/cm²).

Data from the microbiological analyzes were entered in an Excel spreadsheet and analyzed in the ASSISTAT version 7.7 BETA program. Descriptive and inferential statistical methods were used, considering a level of significance of 5%. The project was approved by the Ethics Committee of the aforementioned educational institution (CAAE: 29051114.6.0000.5208) and each volunteer/patient had to complete and sign the Free and Informed Consent Term as a prerequisite for participation in the study.

Results

In the quantitative analysis, the values of CFU/cm², as well as the results of the descriptive statistics (means and standard deviations) are described in Figure 1, according to the groups studied. The Kolmogorov-Smirnov test revealed that the data did not present normality (p=0.2022). When applying Kruskal-Wallis test, there was a statistically significant difference between the groups (H=610.1380; H-crit=5.9915; p<0.05). The Dunn test for multiple comparisons, at a 5% probability level, revealed that the mean of the Control group presented a statistically significant difference in relation to the others and the groups that performed pre-procedural mouthwash with water and chlorhexidine (0.12%), did not present a statistically significant difference (Figure 1).

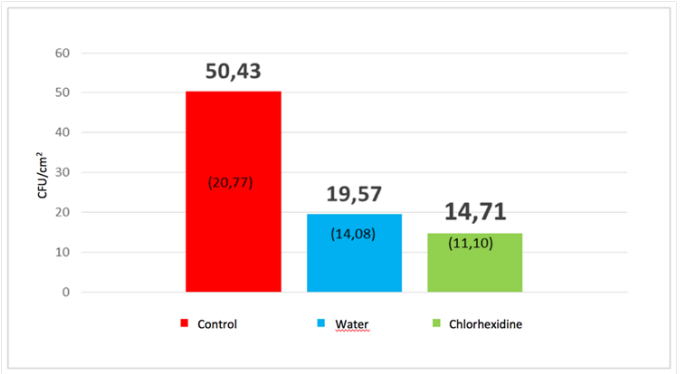

Figure 1 Average quantitative analysis of air contamination by counting CFU/cm² according to the group, in blood agar medium. The standard deviation values are represented in brackets. Equal letters represent statistical similarity in the comparison of means between groups.

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Discussion

It was verified that the chlorhexidine mouthwash actually reduced the amount of CFU/cm^2 that were deposited on the plate with culture medium, a reduction that can be tied to the mechanism of action of the substance, which Lin et al.[15] is related to its molecular structure of cationic bisbiguanide. The cationic molecule is absorbed into the cell membrane (negatively charged), causing intracellular components to leak. In low concentrations, it has bacteriostatic function. In higher concentrations will cause coagulation and precipitation of the cytoplasm, thus presenting bactericidal function. When in contact with the oral cavity, chlorhexidine undergoes adsorption on the teeth, tongue and oral mucosa. The binding to salivary mucopolysaccharides and hydroxyapatite is reversible, so that when the concentration of the substance in oral medium is lowered, chlorhexidine is released. This property is called residual effect or substantivity.[16,17]

These aspects about the action of chlorhexidine explain its influence on the reduction of the population of viable microorganisms in the aerosol from the ultrasound device, thus generating a significant reduction in the contamination of the environment of the dental office, reducing the risk of infection through it. The results obtained in the present research are according to the study of Santos et al.,[18] which showed that previous use of the oral antiseptic containing 0.12% chlorhexidine decreased the air contamination generated by the sodium bicarbonate jet during dental prophylaxis in a dental clinic. In their study, Moura et al.[9] did not use contaminated aerosols but rather irreversible hydrocolloid molds and found that 0.12% chlorhexidine mouthwash prior to molding significantly reduced the microbial load on them, facilitating their disinfection.

Narayana et al.[19] observed that the group in which subjects performed pre-procedural mouthwash with chlorhexidine-based oral antiseptic (0.12%) showed a reduction of about 60% in aerosol contamination generated during the use of the ultrasound device in comparison with the group that had no mouthwash, a result that corroborates this research. On the other hand, the mouthwash with distilled water also significantly reduced the number of CFU/cm², resembling the chlorhexidine group, which is according to the study by Logothetis; Martinez-Welles et al.,[20] who demonstrated that 0.1% chlorhexidine prior mouthwash significantly reduced the number of CFUs, which had no significant statistical difference with distilled water. Despite this, Lascala[21] states that within a clinical concept, bacterial plaque is a physically stable substance on the tooth and is impossible to be removed by mouthwashing with water due to mechanical action. Possibly, this reduction in the amount of CFU/cm^2 is attributed to the mechanical effect produced by the mouthwash, which, independently of the antimicrobial action of the liquid, would be able to remove the more superficial microorganisms adhered to the mineralized and non-mineralized structures. Thus, such infectious agents would not be released into the air during the operative action of the ultrasound apparatus.

The research was carried out with a strict control so that external influencers modified minimally the results, such as: cleaning air filters, decontaminating water lines with distilled water and sodium hypochlorite, using distilled water during the procedure and washing the benches with neutral detergent and later with 70% alcohol. These measures caused any increase or decrease in plaque contamination levels to occur by micro-organisms thrown into the air during the ultrasonic scraping procedure.

It was observed that the microorganisms were not totally extinguished from the aerosol generated by the ultrasound. This finding is in agreement with Nolte's statement,[22] which reports that there are critical points present in inaccessible areas, which protect microorganisms from mechanical cleaning, as well as the antibacterial effect of the solutions employed. This fact was also explained by Mao, Thomas and Muralidharan[23] who, in their study, justified the presence of microorganisms even after the mouthwash with chlorhexidine 0.2%. According to the authors, the action of the mouthwash will occur only on the surface of the calculus, and soon after it is broken by ultrasound, it releases viable microorganisms in the aerosol.

In order to improve infection control and reduce air contamination in the dental office, it was verified that the pre-procedural mouthwash with both chlorhexidine 0.12% and with distilled water was effective in reducing the counts of CFU /cm^2 from the aerosol generated by the ultrasound device during the supragingival scraping procedure. Whether due to the chemical effect or the mechanical effect of the mouthwash, this contributes to an increasingly biosecure dental practice that is free from the "invisible" threats that are pathogenic microorganisms.

Conclusion

The mouthwash prior to dental care, both with oral antiseptic based on chlorhexidine 0.12% and with distilled water, exerted influence on the air contamination, being effective in reducing the amount of microorganisms present in the aerosol generated by dental procedures with ultrasound. Thus, it is suggested that the performance of pre-procedural mouthwashes be an attitude to be followed as another step of Biosafety in dental outpatient clinics, helping to reduce the risks of possible cross-infection and improve the quality of air breathed by all who attend the outpatient environment in dentistry.

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None.

Conflicts of interest

The authors declare that there is no conflicts of interest.

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