

Short Communication

Quantitative analysis of changes in bacterial aerosols during endodontic, periodontic and prosthodontic treatments

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Aerosols are solid or liquid particles which are ejected during dental treatments into air and develop air-borne infection. The aim of this study was to investigate the amount of bacterial aerosols during endodontic, periodontic and prosthodontic treatments. In this study, air samples were collected during three different dental treatments. This sampling was performed at four different distances from the patients' mouth within 7 days. The bacterial growth was assessed using blood agar plates. Data was analyzed using Kruskal-wallis test. The results obtained show that the greatest amount of aerosol was observed in prosthodontic treatment and the least value was shown during endodontic procedure ($P < 0.0001$). Regarding the increased number of aerosols during prosthodontic treatments, preventive interaction for infection control is inevitable.

Key words: Bacterial aerosols, dental treatments, infection transmission, blood agar, air sampling.

INTRODUCTION

Infection control is one of the main concerns of the dental community (Grenier, 1995). Contact with infectious particles from the patients that have become airborne is a route for the spread of infection in a dental office (Harrel and Molinari, 2004).

"Aerosols" are solid or liquid particles with a diameter 50 micron or less; and the particles with diameter more than 50 μ are called "Splatter" (Szymanska, 2007; Harell and Molinari, 2004; Bentley et al., 1994). During dental treatments, splatters are thrown out into the air and on different surfaces as well. The much smaller particle size is aerosols, the lesser precipitation and more penetration to the lower respiratory system (Szymanska, 2007; Harrel, 2004; Bentley et al., 1994; Kedjarune et al., 2000; Harrel and Molinari, 2004). The aerosols with 10-15 μ diameter sediment in the upper respiratory ducts and this

happen in lower respiratory ducts and alveolus of the lungs for the aerosols with 0.5-5 μ diameters (Szymanska, 2007; Harrel, 2004; Kedjarune et al., 2000; Shivakumar et al., 2007). Droplets suspending within aerosols, will remain even after finishing the dental treatment, and if they would not be evacuated and expelled from dental clinic or office, during treatment and after, they will infect patients, upcoming sufferers and other staffs (Meurman et al., 2006).

The bacterial content of aerosols differs based on patient's situation and the site of dental treatment. These aerosols are composed of saliva, nasopharyngeal secretion, Plaque, blood, dental structures and dental materials that are used during treatment (D'Achille et al., 1994). In some studies presence of microbiological aerosols during dental treatment has been surveyed (Larato et al., 1967; Barnes et al., 1998). It has been also shown that the bacterial aerosols are dispersed inside those areas which have not been involved in dental treatments (Grenier, 1995) and bacterial aerosols increase before, during and after dental treatments

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Table 1. Mean (\pm Standard Deviation) number of colony forming per unit (CFU/Plate) in air sampling during three different treatments and distances.

Time intervals	Distances	Endodontic	Periodontic	Prosthodontic
During treatment	Dentist 's chair	21.43(7.5)	124.71(7.74)	43(68./93).144
	Trolley	31.71(18.33)	42.86(21.12)	109.0(70.17)
	Dentist's table	33.71(15.97)	50.43(24.57)	103.57(60.54)
	Sterilizing room	21.29(14.28)	722.7(13.31)	21.29(14.28)

(Al-Maghlouth et al., 2007; 2004).

Analyzing of microbial infection of the air surrounding mobile dental units, before, during and after treatment, has shown that the surrounding air microbial contamination (manifested by CFU/Plate) was 4 times higher during treatment than before it's beginning (Shivakumar et al., 2007). There are some studies which evaluated the role of aerosols in transmission of pathogenic agents, but those with multi-center follow ups in dental clinics are so rare (Grenier, 1995; Lu and Zambito, 1981).

The objective of this study was to assess quantitative analysis of dispersion of bacterial aerosols during three dental treatments including endodontic, periodontic and prosthodontic treatments.

MATERIALS AND METHODS

This experimental *in vitro* study was performed in endodontic, periodontic and prosthodontic clinics of Dental School, Shahed University. The data was collected by counting colonies forming unit (CFU) per each blood agar plate in definite distances. Diameter of each plate was 8 cm and its area was 50.24 cm². The quantity of the plates in each turn was 4 and air sampling was done 7 days in 3 clinics; so total number of plates was 84 blood agar plates (Difco laboratories, Detroit, MI) supplemented with 5% defibrinated sheep blood were applied in this study. Blood agar was chosen because it is a general-purpose, nonselective and enriched medium that promotes the growth of aerobic microorganisms. Air condition, ventilation system and number of dental units (n=1) and treated patients (n=4) per clinic were the same. Other factors which have been adjusted in each clinic were as follows: size of each clinic (4×4×4 m³), air condition system at the similar positions in each of three clinics from active unit, arrangement of dental devices like trolley, adjacent dental unit, size of windows and doors in each of endodontic, periodontic and prosthodontic clinics, The area of each plate (50.24 cm²).

The periodontal treatment was performed by ultrasonic scaling using Cavitron (Dentsply, USA); in endodontic treatment, access cavity preparation was performed with high-speed dental handpiece and in prosthodontic treatment, tooth preparation for fixed partial denture were considered for air sample collection. These treatments were implemented by dental specialists and the time for the treatment was three hours. The patients were healthy adults with acceptable dental hygiene (Barnes et al., 1998). The sites of air sampling were as follows: dentist's chair (50 cm distance from active dental unit), on trolley (150 cm distance from active dental unit), on dentist's table (200 cm distance from active dental unit) and sterilization room (300 cm distance from active dental unit).

Before use, the plates were preserved in 4°C, but after the sampling, they were kept in the room temperature (20-22°C). The plates were immediately transferred to the microbiology laboratory

of Medical School, Shahed University and were incubated in aerobic condition at 37°C for 48 h. Total bacterial colonies count was reported as colony forming unit per plate (CFU/plate). The results were analyzed by kruskall-Wallis test.

RESULTS

Sample size was 196 plates. The results showed the greatest amount of aerosol was seen in prosthodontic treatment and the least value was shown during endodontic procedure ($P < 0.0001$).

The results of colonies counting during endodontic, periodontic and prosthodontic treatments are presented in Table 1.

Kruskall-Wallis test showed that there is no significant difference in number of colonies at different distances sampling in endodontic treatment ($p = 0.37$).

Using kruskall-Wallis test it was determined that there is no significant difference in number of colonies at different sampling distances in periodontal treatment. ($p = 0.31$).

Kruskall-Wallis test revealed that there is no significant difference in number of colonies at different sampling distances in prosthodontic treatment ($p = 0.19$).

DISCUSSION

Researchers who study the microbiological air condition in dental office affirm that it is one the most dangerous contamination carriers in the working environment of a dentist. Infectious particle remain in air (Grenier, 1995; King, 1997; Iegnani et al., 1994) so simultaneous monitoring of the microbiological condition of air and the removal of contaminated air from the room dental office is necessary.

The aim of this study was to measure amount of bacterial aerosols during three dental treatments. In this study for the first time the numbers of grown colonies were measured in different distances in different clinics. Results of our study showed that maximum number of aerosols in prosthodontics and periodontics was on dentist's chair and this results may be due to dentist's position in these two treatment. In periodontal and prosthodontic therapies, because of the necessity of higher precision and dexterity in carrying these treatments out, the dentist's position and the chair altered

continuously so the dentist's body was a barrier against the scattering of bacterial aerosols over the surface of the trolley; subsequently the number of aerosols showed a significant increase over dentist's body or the chair.

In quantitative analysis of bacterial aerosols, Grenier (1995) and Larato (1966) in 2 separate studies showed that dental treatments significantly increase the levels of bacterial air contamination even in a closed dental operator or a multichair dental clinic. Al-maghlouth et al. (2004) in qualitative and quantitative analysis of bacterial aerosols demonstrated that aerosols increase during and after work sessions and, therefore, increase the chance for infectious agents' transmission. In another study, this researcher showed that the concentration of total bacterial aerosols was 5 times higher in the multichair clinics, 3.6 times higher in the prosthetic laboratories, and twice higher in the sterilization center and isolation clinic during the treatments compared to before pre-treatment time (Grenier, 1995).

Results of our study showed that number of grown colonies during prosthodontic treatment was more than periodontal and endodontic treatments ($p < 0.0001$). It is consistent to Al-Maghlouth's (2007) study. However in Almaghlouth's study number of grown colonies was measured in prothesis laboratory and type of treatment in multi chair clinic has not been determined.

The number of disseminated aerosols in clinical environments, during dental treatments was manifested by colony forming units per plate. This number just only demonstrated the quantity of aerobic bacteria on the blood agar plates. It is so clear that the real number of existing bacteria on the collected samples was more than the counted values on the plates. Furthermore, conditions of the plates for microorganisms' growth were not appropriate for all kinds of organisms (e.g. different types of viruses and anaerobic bacteria).

According to ADA agenda, applying personal protective devices (e.g. face masks, gloves, eye shields), mouth rinsing before treatment with disinfective agents like chlorhexidine, using rubber dam, ultra violet ventilation system and suitable air conditioning are recommended for the purpose of decreasing the bacterial aerosol quantity during dental treatments and protecting the patients, dentists and dental staffs as well (ADA Council, 1996; Logothetis and Martinez-Welles, 1995).

According to the present study, it seems that the risk of infection transmission not only involves the people who are in direct contact with patients, but also other people in dental clinics environment.

Thus, following all the regulations of infection control is necessary regarding the high probability of cross contamination in these environments, more orientation on effective methods for better controlling and evacuating of dental aerosols is needed.

In this study amount of bacterial aerosols during three dental treatments including endodontic, periodontic and prosthodontic treatments were measured.

Conclusion

The number of bacterial aerosols in each dental clinic, during treatment increased significantly and consequently the risk of its transmission enhanced. The maximum number of bacterial aerosols was belonged to prosthodontic treatments and the minimum in endodontic therapies.

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