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Assessment of Occupational Hazards of Dental Bioaerosols in a Dental Office

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KEYWORDS

Amalgam, Bioaerosol, Occupational hazards, Pulpitis, Restorative materials

ABSTRACT:

Background: Dental personnel are more prone to cross-infections, because of the limited dimensions and poor ventilation.

Aims and Objectives: To assess the levels of microbial contamination at pre-determined areas before and after dental treatment procedures in the department of conservative dentistry and endodontics at a dental college.

Materials and Methods: The study subjects included those who were diagnosed with chronic irreversible pulpitis on whom access opening of the tooth was planned and those who required permanent restorations like silver amalgam restorations. At the start of the treatment procedure, a set of petri dishes were exposed on the patient's chest, on the dental tool rack and on the operator's mouth mask (on which the petri dishes were stuck). After treatment procedures, the petri dishes were sent to the laboratory for microbial analysis after incubating at 37°C for 2 days aerobically and for 3 days anaerobically. After this period, colonies were counted to assess the number of colony forming units.

Results: The petri dish placed over patient's chest had more microbes after first day and the mean comparison among aerobic and facultative anaerobic counts before and after treatment was statistically significant.

Conclusion: There is atmospheric microbial contamination during dental treatment procedures. Hence, utmost care needs to be taken to prevent cross-contamination

1. Introduction

Introduction:

Infection control has been one of the major concerns of the dental community. Bioaerosols are important considerations in infection control as well as in occupational hazards. They may carry potentially hazardous microbes, viruses, fungi, allergens, and other toxic substances that may harm the dentists, patients and or dental assistants by causing nosocomial infections.[1]

Most of the aerosols produced during treatment procedures have a diameter of about 5 µm or less, and these can cause respiratory or other health problems

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because they can penetrate into and remain within the lung.[2]

The driving force of a high-speed dental drill and the cavitation effect of an ultrasonic scaler, both being used in combination with a water spray, can generate numerous airborne particles derived from blood, saliva, tooth debris, dental plaque, calculus, and restorative materials.[3]

Thus, diseases like pneumonia, influenza, hepatitis, and skin and eye infections can be transmitted during dental treatment procedures from these infectious bioaerosols. At present, the most threatening diseases dentists and their staff are prone to are Hepatitis B and Acquired Immunodeficiency Syndrome (AIDS). Dental personnel are at a serious risk of contracting these diseases during dental operative procedures.[2, 3]

Most of the aerosols generated during dental treatment procedures have been found to radiate toward the patient's chest, dentist as well the dental assistant's face. It is known that poorly maintained ventilation and air-conditioning systems can be a potential source of fungal and other microbial organisms. The air-conditioning system could therefore act as a vehicle for the transmission of bacteria and other microorganisms in the dental clinic.[4, 5]

Since no studies have been done to assess the level of atmospheric microbial contamination in a dental office, the present study was undertaken. An evaluation needed to be done to find out whether the conditions of dental office is doing more harm through cross-contamination than good.

Material and Methods:

Subjects who were diagnosed with chronic irreversible pulpitis were selected for procedure like access opening of the tooth. Also included in this study were those who required any permanent restorations like silver amalgam restorations. Five patients were treated in each treatment session. The study subjects were asked to report to hospital on the day of study. Informed consent were obtained from all the study subjects. Ethical clearance was obtained from institutional ethical committee.

Before the start of the study, the operating chamber was fumigated. All aseptic precautions were carried out. The operating chamber was left unused and locked for 15 hours. The operating chamber was provided with good ventilation and had an area of 20 x 30 sq.ft.

To find out the baseline atmospheric microbial contamination, a set of two petri dishes (90 mm diameter) containing brain heart infusion (BHI) agar with 5% sheep blood was exposed in the middle of the operating chamber for 60 minutes prior to the start of the work . The microbial aerosols were allowed to settle down by gravitometric settlings. These petri dishes were sent for aerobic and anaerobic culture to the department of Microbiology. Then a patient, a dentist, an dental assistant entered the operating chamber. They kept their movements down to the minimum. At the start of the actual treatment procedures, a set of petri dishes were exposed on;

1) The patient's chest.

2) On the dental tool rack, and

3) On the operator's mouth mask (on which the petri dishes were stuck).

These were the areas which were considered more prone to be contaminated.

These petri dishes were exposed throughout the dental procedure. Dental treatment was done for 2 hours. The same procedure was repeated over five sessions for five days. The dental operating chamber was disinfected before the start of next sessions in the following week. On sixth day the operating chamber was fumigated (Fig 3) before the start of final session.

The petri dishes were sent to the laboratory for microbial analysis after incubating at 37°C for 2 days aerobically and for 3 days anaerobically . After this period, colonies were counted to assess the number of colony forming units

Results:

Friedman's Test was used to compare the differences in the CFUs and to assess their significance. The values were expressed as mean ± SD. The level of atmospheric microbial contamination was assessed by using Air Microbial Index (AMI) by the 'plate' method.

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We found that petri dish placed over patient's chest had more microbes after first day (Table 1). The mean comparison among aerobic and facultative anaerobic counts before and after treatment was statistically significant (Table 2).

Discussion

A safe environment is most important consideration for all dental personnel and patients. Dental procedures give rise to bioaerosols with higher concentration of microbes. To protect the patient as well as the dental operator is of prime importance. This motivated the authors to take up the study. Patients with dental problems were screened and treated.[6]

The numbers presented as culture / plate are relative values, representing aerobic and anaerobic bacteria capable of growing on BHI agar with 5% sheep blood. This medium was used because it was valid for collecting of airborne microorganisms and for cultivation of fastidious pathogenic micro-organisms. It is a non selective, enriched medium and is used for general purposes; it promotes the growth of microbes such as those sampled from air. It is likely that the actual microbial content in the specified areas was much higher than that reported, because the growth conditions used did not allow the identification of all types of organisms, e.g., viruses, anaerobic bacteria, and other organisms requiring specialized media. Anaerobic culture conditions were used because most of the bacteria that originate from the oral cavity are facultative anaerobes.[3, 7]

Aerosols containing microbes from the oral cavity are created when modern high-speed rotating instruments are used. How far these aerosols spread and what level of contamination they cause in the dental surgery has become a matter of growing concern. As stated by Bentley et al, there are several factors which influence aerosol distribution and include[8-10]

1. Type of procedure and whether high volume evacuation was used.
2. The position of the tooth in the mouth, which affects the position of the operator relative to the subject in the dental chair.
3. Levels of microorganisms in the subject's mouth and other factors.

Larato et al[11] observed similar patterns of microbial air contamination before, during and after dental treatment in a closed operatory. A subsequent decrease of atmospheric microbial contamination was noticed 2 hours after the end of the working period. The Air Microbial Index (AMI) values in our study showed significant results, which was in contrast with the findings of the study conducted by Timmerman et al.[12]

Larato et al and Williams et al reported that when heavy droplets that fall on to the floor and they become part of the floor dust. Aerosols particles, which are light in weight, remain suspended in the air, leaving a residue known as droplet nuclei that can reach the respiratory passages of those who get exposed. Dental operators and dental assistants should always wear mouth masks, eyeglasses, gloves, head caps and lateral protective shields.[11, 13]

Mills et al have shown that there is a microbial growth when the sample from turbine handpiece was sent for culture after treatment procedures. Unscreened HIV patients must have been treated in the operating chamber. This may lead to the formation of bioaerosols containing HIV virus, which can be transmitted to the operator through the muco-cutaneous route of conjunctiva.[12-14]

Fine et al showed that pre-procedural oral rinsing with an antiseptic mouthwash significantly reduces the viable microbial content of bioaerosols generated during dental operative procedures. They concluded that pre-procedural rinsing may have a potential role in reducing the risk of cross-contamination with infectious agents in the dental operatory procedures. The Occupational Safety and Health Administration (OSHA) has mandated that all known aerosols and blood splatter must be controlled. Respiratory diseases and elevated levels of antibody to Legionella pneumophila has both been observed most commonly in dental health workers.[15-18]

As suggested by infection control guidelines it is important that all dental personnel wear a mouth mask, head cap, gloves, lateral protective shield, and eye glasses and follow all aseptic precautions. Before the start of any dental operative procedure, a pre-procedural mouth rinsing with an antiseptic mouthwash is advisable which may significantly reduces the airborne microorganisms. It is suggested to fumigate the operating

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chamber at least twice a week. Further such studies are recommended.

Conclusion

The present study demonstrates that there is atmospheric microbial contamination during dental treatment procedures. Dental personnel are found to be more prone to cross-infections, because of the limited dimensions and poor ventilation in dental clinics. Hence, utmost care needs to be taken to prevent cross-contamination

Trial	Before treatment	After treatment		
		Dental tool rack	Patient's chest	Mouth mask
Aerobic 1st day	10	59	151	110
Facultative anaerobic 1st day	5	38	107	105
Aerobic 2nd day	20	76	170	207
FACULTATIVE ANAEROBIC 2nd day	12	40	96	120
AEROBIC 3rd day	22	72	182	263
FACULTATIVE ANAEROBIC 3rd day	16	38	108	132
AEROBIC 4th day	21	69	190	250
FACULTATIVE ANAEROBIC 4thday	14	30	122	110
AEROBIC 5thday	24	64	183	200
FACULTATIVE ANAEROBIC 5thday	17	37	162	198
AEROBIC 6thday	5	54	59	63
FACULTATIVE ANAEROBIC 6thday	2	35	39	42
MIN	2	30	39	42
MAX	24	76	190	263
MEAN	14	51	130.75	150
SD	7.31	16.47	50.21	71.67

Table 1: Minimum, Maximum, Mean And SD Values of Aerobic And Facultative Anaerobic Counts

Trial	MIN	MAX	MEAN	SD	P value
Before treatment	2	24	14	7.31	<0.001 Significant
After treatment Dental tool rack	30	76	51	16.47	
After treatment Patient's chest	39	190	130.75	50.21	
After treatment Mouth mask	42	263	150	71.67	

Table 2: Mean Comparison Among Aerobic And Facultative Anaerobic Counts

Statistical Analysis: Friedman's test. Statistically significant if $P<0.05$

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