

Summary of: A pilot study of bioaerosol reduction using an air cleaning system during dental procedures

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FULL PAPER DETAILS

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Background Bioaerosols are defined as airborne particles of liquid or volatile compounds that contain living organisms or have been released from living organisms. The creation of bioaerosols is a recognized consequence of certain types of dental treatment and represents a potential mechanism for the spread of infection. **Objectives** The aims of the present study were to assess the bioaerosols generated by certain dental procedures and to evaluate the efficiency of a commercially available Air Cleaning System (ACS) designed to reduce bioaerosol levels. **Methods** Bioaerosol sampling was undertaken in the absence of clinical activity (baseline) and also during treatment procedures (cavity preparation using an air rotor, history and oral examination, ultrasonic scaling and tooth extraction under local anaesthesia). For each treatment, bioaerosols were measured for two patient episodes (with and without ACS operation) and between five and nine bioaerosol samples were collected. For baseline measurements, 15 bioaerosol samples were obtained. For bioaerosol sampling, environmental air was drawn on to blood agar plates using a bioaerosol sampling pump placed in a standard position 20 cm from the dental chair. Plates were incubated aerobically at 37°C for 48 hours and resulting growth quantified as colony forming units (cfu/m³). Distinct colony types were identified using standard methods. Results were analysed statistically using SPSS 12 and Wilcoxon signed rank tests. **Results** The ACS resulted in a significant reduction ($p = 0.001$) in the mean bioaerosols (cfu/m³) of all three clinics compared with baseline measurements. The mean level of bioaerosols recorded during the procedures, with or without the ACS activated respectively, was 23.9 cfu/m³ and 105.1 cfu/m³ ($p = 0.02$) for cavity preparation, 23.9 cfu/m³ and 62.2 cfu/m³ ($p = 0.04$) for history and oral examination; 41.9 cfu/m³ and 70.9 cfu/m³ ($p = 0.01$) for ultrasonic scaling and 9.1 cfu/m³ and 66.1 cfu/m³ ($p = 0.01$) for extraction. The predominant microorganisms isolated were *Staphylococcus* species and *Micrococcus* species. **Conclusion** These findings indicate potentially hazardous bioaerosols created during dental procedures can be significantly reduced using an air cleaning system.

EDITOR'S SUMMARY

Infection control in dentistry continues to be a hot topic, and one that is the subject of much investigation: recent papers in this Journal have looked at contamination of photographic retractors¹ and water quality in dental unit water lines.² The requirements of HTM01-05 have focused our attention on cleaning of reusable dental instruments and the associated infection control risks. This article investigates an area that is arguably more difficult to control: the production of bioaerosols during dental treatment.

The authors studied the bioaerosols produced during four different dental procedures (cavity preparation using an air rotor, history taking and examination, ultrasonic scaling and tooth extraction), and the ability of an air cleaning system

to reduce their levels. The bioaerosol levels were compared against baseline levels taken in the absence of clinical activity. All the procedures resulted in an increase in levels of bioaerosols, with cavity preparation producing the highest levels found in this study. The air cleaning system was effective in significantly reducing bioaerosol levels, although they were never reduced to the levels found at baseline.

Dentists are already familiar with the concept of bioaerosols. The use of aspiration, masks and eye protection are all aimed at reducing their impact, and the fact that transmission of airborne pathogens in the dental surgery is not a frequently reported problem suggests that they are generally effective – or at least effective enough. The authors acknowledge that an air cleaning system is prob-

ably not required in every dental setting, but suggest that it could be useful in certain clinical environments, for example in surgeries treating medically compromised patients. The significance of the article lies in its confirmation that in general, such a system can reduce bioaerosols and provide a safer working environment.

The full paper can be accessed from the *BDJ* website (www.bdj.co.uk), under 'Research' in the table of contents for Volume 209 issue 8.

Rowena Milan
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1. Benson P E, Ebhohimen A, Douglas I. The cleaning of photographic retractors; a survey, clinical and laboratory study. *Br Dent J* 2010; **208**: E14.
2. Chate R A C. An audit improves the quality of water within the dental unit water lines of general dental practices across the East of England. *Br Dent J* 2010; **209**: E11.

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IN BRIEF

- Dental procedures create bioaerosols that are a potential vector for transmission of infection in the dental surgery.
- The use of an air cleaning system both before and during dental treatment can reduce the size of bioaerosols and therefore reduce the risk of spread of infection.
- Air cleaning systems may have a useful role to play in the treatment of patients, in particular those who may be immune-compromised.

COMMENTARY

Recent research has focused on the importance of environmental transmission of pathogens by droplets and aerosols. In part, this has been prompted by worldwide outbreaks of novel respiratory infections in the last decade. Lessons learnt in Hong Kong Dental School during the 2003 SARS epidemic, pandemic flu and the resurgence of TB have highlighted the occupational risk to dental staff from aerosol-generating procedures. These, combined with close proximity to patients during treatment, result in dentists being more prone to respiratory infections than their medical colleagues or the general public. Aerosol transmission is not only confined to respiratory pathogens: measles and chickenpox may also be spread by this route. The authors discussed the risks associated with contaminated aerosols arising from dental unit waterlines. Fortunately, an association between *Legionella* spp. in the waterlines and Legionnaire's disease in the dental team has not been demonstrated in the UK, although transmission events have occurred in the USA and Europe. However, in the UK high levels of bacterial counts in the waterlines were linked to occupational asthma in dentists.

In order to curtail aerosol transmission from patients with respiratory illness the Centers for Disease Control and Prevention (USA) introduced patient respiratory hygiene and cough etiquette protocols to its Standard Precautions, such as covering the mouth and nose with a tissue when coughing,

with prompt disposal of used tissues. In the waiting room patients should be seated at least three feet apart, which has been shown to reduce transmission of infection, and offered a surgical mask when coughing. Surgical masks worn by staff act mainly to reduce droplet spread transmission, with only limited protection against contaminated aerosols, whereas respirator masks produce up to 99% filtration of the air inhaled by the wearer, thereby protecting them from respiratory viruses and TB if worn correctly. Their high unit cost has prevented their routine use in dentistry other than for TB or pandemic flu patients. Droplet and aerosolised particles remain in the air for limited periods of time depending on their size and other parameters. They are removed by surface cleaning, suction or air exchange. Incidentally, this study highlights the value of good surgery ventilation, as on no occasion was the bacterial count reduced to that encountered at baseline when the air cleaning system was operational.

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AUTHOR QUESTIONS AND ANSWERS**1. Why did you undertake this research?**

The production of aerosols is an aspect of infection control that has had increased importance in recent years particularly in relation to the spread of influenza viruses. Whilst previous studies have examined the size and nature of bacterial aerosols and the benefit of high volume aspiration during the use of a high speed handpiece or ultrasonic scaling instrument, the potential impact of an air cleaning system does not appear to have been investigated. Air cleaning systems have become available commercially and have been employed in a range of medical and surgical environments but no information could be found in relation to their use during the delivery of dental care.

2. What would you like to do next in this area to follow on from this work?

This study has provided proof of principle information that an air cleaning system (ACS) is effective in reducing the level of bacterial contamination within the air of dental clinics both prior to treatment and during dental procedures. It would be interesting to see whether the ACS is also able to reduce the levels of airborne viruses that might be generated in the delivery of dental care. Airborne viruses can be sampled using liquid impingers with sampling performed during operation of the ACS and without. Given the increasing concern about influenza and other respiratory viruses in infection control, information regarding the potential value of the air cleaning system to reduce the risk of viral particle dissemination would be hugely beneficial.