
Cross Infection in Dentistry

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Abstract

Patients are becoming more sophisticated in their scrutinizing of the dental and medical professions' approach to asepsis. The current climate in society regarding infectious diseases in general, and herpes, hepatitis and HIV infections, in particular, dictates that today's dental practices must use effective infection control techniques. Dental appliances such as dentures could infect technicians and auxiliary staff, or impressions used to make models of the mouth. Disinfection of impressions is a part of the universal package of precautions required for protecting both patients and dental personnel from harmful microorganisms present in the mouth.

Keywords: microorganisms, universal precautions, disinfection, impressions, sodium hypochlorite

Introduction

The mouth is a permanent source of microorganisms that could be transferred and cause infection in other persons. Media coverage of exposure incidents is becoming more intense. The life-time cost of effective infection control is far less than one malpractice settlement (1). The dental profession has possessed traditional standards of cross-infection control, but recent expression of real concerns by both the public and the profession over the transmissibility of infectious diseases in the dental office has demanded a formalized and extended to teaching cross-infection control in the dental curriculum.

Failure to adequately clean, disinfect and/or sterilize dental instruments contaminated with pathogenic organisms from a previous patient will endanger subsequent patient (2). This route of pathogenic microorganisms transfer is known as cross-contamination and the resulting infection is referred to as cross-infection. The highest potential for cross-infection is between dentists, surgery assistants and patients because blood, saliva and contaminated instruments are present. These precautions helped reducing both the spread of infectious diseases and the fear among dental health care workers (DHCW) and patients of being infected (3).

Discussions

Pathogens and Routes of Cross-Infection

Transmission of infection from one person to another requires a source of infection, a vehicle such as blood, saliva or tissue debris and a route of transmission. Transmission takes place through direct contact, indirect contact, droplet inhalation and inoculation. **Table 1** presents pathogens for which there are documented cases of occupational infections in dentistry (4).

Table 1. Habitats and routes transmission of infections caused by exogenous pathogens in dentistry.

Microorganisms	Habitats	Routes of transmission in dentistry	Infections
Herpes Simplex Virus type 1	Nasopharynx	Direct contact	Oral herpes lesions, Conjunctivitis, Herpetic whitlow
Hepatitis B Virus Hepatitis C Virus Hepatitis D Virus Hepatitis G Virus	Hepatocytes	Inoculation (sharps injuries)	Hepatitis B Hepatitis C Hepatitis D Hepatitis G
Human Immunodeficiency Virus (HIV)	T4 lymphocytes, some other cells	Not yet proven	HIV infection, Acquired Immune Deficiency Syndrome (AIDS)
<i>Mycobacterium tuberculosis</i>	Pharynx	Inhalation of aerosols/droplets from oropharyngeal secretions	Tuberculosis
<i>Pseudomonas aeruginosa</i>	Dental unit water	Inhalation of aerosols or ingestion of contaminated water	Pneumonia, Wound infections, Dental abscess
Methicilin resistant <i>Staphylococcus aureus</i>	Mouth, skin, nasopharynx	Direct contact by hands	Dental abscess
<i>Candida albicans</i>	Moth, skin	Direct contact with saliva and nasopharyngeal secretions	Candidiasis, Cutaneous infections

We may summarized the possible pathways of cross-infection, occasionally found in dentistry, as follows:

From patient to DHCW

The patient's oral microorganisms can be spread either by direct or indirect contact, droplet inhalation, or by inoculation. The risk of transmission of hepatitis C is not fully evaluated, but dental personnel have a high frequency of antibodies to this virus, suggesting that exposure has occurred. Health care workers face occupational hazards for HCV infection primarily through needle stick and other contaminated sharps accidents. Current universal blood-borne precautions for infection control appear to be effective against occupational cross-infection in patient care settings (5).

Non-A, non-B hepatitis are viral infections transmitted mainly by blood and blood products. Although probably less than 1% of the U.K. population (and hence dental patients) are infected, groups at high risk for other blood-borne infections are also at risk for non-A, non-B hepatitis. Immunization against hepatitis B cannot protect against non-A, non-B hepatitis; recommended cross-infection procedures must suffice to protect patients and staff. The two new hepatitis viruses F and G are yet to be fully evaluated and remain as potential sources of cross-infection (6).

Cross-infection from herpes type 1 has been described from saliva contamination and contact and from contaminated dental record cards. The herpetic whitlow on the fingers of a dentist was quite a common lesion amongst dental personnel prior to the routine use of gloves. Oral herpes 2 infections are now frequently reported, but the primary mode of transmission is thought to be by sexual activity.

From DHCW to patient

Transmissible pathogens are rarely spread from DHCW to patients, but this can happen if proper preventive procedures are not followed. The steps recommended for prevention of cross-infection in dentistry came from the AIDS epidemic. Ironically thought, in a multitude of cohort studies salivary transmission of HIV was unproven. Moreover, blood transmission of HIV is unlikely unless a large amount of blood is transferred. There is compelling evidence, however, that six patients of an HIV-infected dentist from Florida were infected with HIV at the dental practice. The dentist's HIV strain and that of the patients was virtually identical and the patients possessed no other risk factors for HIV (for references, see Robinson and Challacombe 1993) (7). So far, there are no more documented cases of occupationally HIV-infected HCW, including DHCW (for references, see Sterilization Monitoring Service Indiana University School of Dentistry 2001) (8).

From patient to patient

Microorganisms from the oral cavity can be transferred between patients by cross-contamination. There is a report on the spread of HIV from one patient to another in a private general surgery practice in New South Wales, Australia. Five of nine patients seen at that practice on the same day, became HIV-positive whilst the surgeon remained HIV-negative. Four out of the five HIV-positive patients did not have any apparent risk factors for acquiring the disease. The fifth patient admitted having sex male partners of unknown HIV status being the likely source of HIV that led to his death a year later. This strongly suggests that he was already infected and the source of HIV of the other patients (for reference see Miller and Palenik 1998) (9).

Methicillin resistant *Staphylococcus aureus* (MRSA) has been isolated from the mouth of patients discharged from surgical wards. The strains causing the infections had identical

antibiotic sensitivities to those from the dentist's hands. *MRSA* can cause life-threatening disease in older populations. Implications for dental practitioners include the fact that they may be passive vectors for the disease and that dental treatment of patients with active *MRSA* infections must follow effective infection control practices (10).

From patient to dental technician

Cross-infection control is the responsibility of the entire dental team and its overall effectiveness can be limited by the standard of any of its members as well as the degree to which they can co-operate. The general recommendation is that dental work, such as impressions, gypsum casts, dentures, and wax registration records, should be disinfected at the clinic prior to sending them to the laboratory. It is also appropriate for the dental technician to perform the disinfection provided that safe packaging has been used. Contamination of the laboratory could occur if cross-infection control is neglected. Indeed, occupational infection of dental laboratory technicians with HBV has been reported (9). Clinics need to collaborate with their referring dental laboratories on an effective and practical infection procedure. This applies to impressions and dental work sent between the clinic and laboratory.

From DHCW to family

Family members of DHCW suffering from an occupationally acquired infection are at increased risk of acquiring the same infection.

From community to dental patients

Water used during dental treatment could be a factor in transmission of waterborne diseases. Colonization of the dental unit water lines occurs by the formation of biofilms, which release high numbers of planktonic microorganisms into the streaming water. These planktonic microorganisms are transported into the patient's mouth through water from the turbine or the three-way syringe. In healthy individuals, this probably poses little health threat. However, in immunocompromized or debilitated patients, there is potential of systemic infection from these organisms so sterile water is therefore required.

The types of microorganisms found contaminating dental unit water supplies include species of *Pseudomonas* (*P. aeruginosa*, *P. cepacia*, *P. posimobilis*), *Klebsiella* and *Moraxella*, but other bacteria and yeast may be present. *Legionella* species, including *L. Pneumophila* have also been isolated from dental unit water. *P. aeruginosa* is usually opportunistic in urinary tract infections, wound infections, pneumonia and septicemia in burn patients. It is adherent to the epithelial cells of the upper and lower respiratory tract, therefore it is employed in cystic fibrosis development. It is very resistant to chemical disinfectants, particularly phenoloic-based ones and antibiotics. There are documented cases of cross-infection in immunocompromized patients due to *P. aeruginosa* (11). Furthermore, pathogens such as *S. aureus* and *P. aeruginosa* were isolated from biofilms or backflow fluids from the saliva ejector tubing, a notable source of cross-contamination between dental patients (12). In a study made in Germany in 1995 was showed that high numbers of non-tuberculous mycobacteria (*Mycobacterium gordonae*, *flavescens*, *chelonae*, *simiae*) may be swallowed, inhaled or inoculated into oral wounds during dental treatment. Mycobacterial proliferation in biofilms forming within dental units may explain the extent of mycobacteria contamination of dental spray and cooling water (13).

Cross-infection control

Ideally, it would be helpful to know what pathogens a person was carrying prior to any form of medical or dental treatment. In practice this is impossible, as the patient may be an asymptomatic carrier due to the subclinical nature, the prodromal period and the carrier state associated with a number of diseases, or just saying less about the truth. In some countries (e. g. Holland), each dental procedure is assessed for its cross-infection risk, and suitable precautions adopted. Such an approach can be successful but, it is often difficult to accurately assess risk, and two or more dental procedures are often done at one visit. American Dental Association (ADA) requires the adoption of the concept of universal precautions (a set of cross-infection measures for all the patients, considering every patient as possibly infectious). All personnel involved in the practice of dentistry must understand the risk involved, and should fully conversant with the procedures employed in cross-infection control. One exception to the concept of universal precautions is the treatment of potential carries of transmissible spongiform encephalopathy (TSE)> The transmissible agents thought to be responsible for this disease are proteins called prions. In order to destroy prions, steam serilization for 18 minutes is recommended. The alternative is to destroy all instruments used on a patient suspected of carrying TSE. In practice there are very few patients in this category, and so apart from the sterilization procedures called universal precautions fro cross-infection. At present there is no evidence that TSE could be transmitted by simple dental procedures.

The universal infection control rules should encompass six aspects: routine patient evaluation, personal protection with barrier techniques, instrument sterilization - including sterilization control, surface and equipment disinfecting, asepsis in the laboratory and appropriate disposal of contaminated waste including sharps.

Disinfection is defined as the removal or killing of all pathogens, but not spores. Ideally, all vegetative microbes should be killed, but a reduction in the number of pathogens to a level that is unlikely to cause infection is acceptable. The methods of disinfection are heating (by Pasteurisation or by boiled in water), using ultrasonic, or using chemical solutions. The disinfectants used in dentistry are presented in **Table 2**.

Table 2. Disinfectants used in dentistry.

Type of disinfectants	Use
Iodophors	Surfaces Hands
Aldehydes	Surfaces (only mild aldehydes that do not affect skin)
Alcohol	Surfaces (have poor cleaning properties)
Alcohol plus additives	Surfaces
Quaternary ammonium compounds	Surfaces (have limited efficacy)
Peroxygenated compounds	Surfaces Immersion of impressions

In practice, the choice of disinfectant is probably not as important as how it is used. The disinfected should have rapid bactericidal properties in order to kill microorganisms in the presence of blood and other detritus that may be present. The disinfectant is applied after a thoroughly water cleaning technique to remove blood and organic contaminants.

reduction of oral microbes can be achieved by a single rinse with 0,12% chlohexidine gluconate oral antiseptic, that means before dental procedures will start, as a mean of minimizing the potential spread of contagion between patients and doctors.

Impressions are a potential vehicle in transmission of infectious agents. Moreover, casts produced from contaminated impressions may themselves be contaminated because microorganisms are able to migrate from the impressions into the casts, while setting occurs (14). The disinfection of impressions, and other laboratory fabricated material, is more difficult and requires immersion. The agent chosen must have a deleterious effect on the dimensional stability of hydrocolloids, and must act in a reasonable time (in practice this is about 15-30 minutes). Irreversible hydrocolloid is capable of resisting contamination by viruses and saliva when the disinfectant iodine or chlorhexidine is added to the water being used to mix the material. Accurate casts can be obtained when either of the two disinfectants is incorporated into the alginate impression material (15).

Hypochlorites are the most widely used chlorine disinfectants. They have a broad spectrum of anti-microbial activity and are both inexpensive and fast acting (16). Chlorine solutions are inherently unstable deteriorate when exposed to heat or light and if used for disinfection should be freshly made daily. Chlorine solutions should be kept in a plastic airtight container in a well-ventilated room, and changed after every session or more frequently if usage has been heavy. Unfortunately, they are corrosive and inactivated by organic matter (17).

In a previous study, the alginate impressions, when poured immediately, were not significantly affected regarding detail reproduction (Mann-Whitney test) and linear dimensional change (*t*-test) when immersed for 3-10 minutes in 1:4 - 1:512 dilutions of 4, 2% active chlorine (18).



References

1. Terezhalmay, G., T., Gitto, C., A., (1998). Today's minimal requirements for a practical dental office infection control and exposure control program. *Dent Clin North Am* 42(4): 629-642.
2. Samaranayake, L., P., (1996). Principles of infection control. In: *Essential Microbiology for Dentistry*. ed. Samaranayake, L., P., Edinburgh: Churchill Livingstone p 317-320.
3. Marsh, P., Martin, M., V., (1999). Cross-infection control. In: Oral microbiology. Eds. Marsh P., Martin, M., V., Oxford: reed educational and Professional publishing Ltd. p 178-184.
4. Martin, M., V., Burke, F., J., T., Field, E., A., Wilson, N., H., F. (1997). Transmissible microorganisms and dentistry. *Dent Update* 24: Infection Control Supplement no. 2.
5. Samaranayake, L., (1993). Rules of infection control. *Int Dent J* 43(6): 578-584.
6. Gillcrist, J., A., (1999). Hepatitis viruses A, B, C, D, E and G: Implications for dental personnel *J Am Dent Assoc* 130: 509-520.
7. Robinson, P., Challacombe, S., (1993). Transmission of HIV in a dental practice - the facts. *Br. Dent J* 10:383-384.
8. Sterilization Monitoring Service Indiana University school of Dentistry (2001). Practitioner-to-Patient Transmission of Bloodborne Pathogens. *Dental Asepsis Review* 22(2):1-4.
9. Miller, C., H., Palenik, C., J., (1998). *Infection Control and Management of Hazardous Materials for the Dental Team*. 2nd ed. St. Louis: Mosby-Year Book.
10. Kozai, H., K., Nagasaka, N., (1997). In vitro susceptibility of Staphylococcus aureus including MRSA to four disinfectants. *ASDC J Dent Child* 64(4): 260-263.
11. Marsh, P., Martin, M., V., (1999). Cross-infection control. In: Oral Microbiology Eds. Marsh, P., Martin, M., V., Oxford: Reed educational and Professional publishing Ltd. p 178-184.

12. Barbeau, J., Nadeau, C., (1997). Dental unit waterline microbiology: a cautionary tale. *J Can Dent Assoc* 63(10): 775-779.
13. Schulze-Robbecke, R., Feldmann, C., Fischer, R., Janning, B., Exner, M., Wahl, G., (1995). dental units: an environmental study of sources of potentially pathogenic mycobacteria. *Tuber Lung Dis* 76(4): 318-323.
14. Flanagan, d., A., Palenik, C., J., Setcos, J., C., Sheldrake, M., A., Miler, C., H., (1998). Antimicrobial activities of dental impression materials. *Dent Mater J* 14:399-404.
15. Huizing, K., L., Palenik, C., J., Setcos, J., C., Sheldrake, M., A., Miler, C., H., (1994). A method to evaluate the anti-microbial abilities of disinfectant-containing gypsum products. *QDT Yearbook* 17:172-176.
16. Dychdala, G., R., (1991). Chlorine and chlorine compounds. In: *Disinfecting, Sterilization, and Preservation*. Ed. Block SS. 5th ed. Philadelphia: Lea and febiger p 131-151.
17. Gerhardt, D., E., Williams, H., N., (1991). Factors affecting the stability of sodium hypochlorite solutions used to disinfect impressions. *Quintessence Int* 22: 587=591.
18. Georgescu, C., E., Skaug, N., (2001). Validated chemical immersion disinfection of dental alginate impressions using aqueous sodium hypochlorite. *Master of Philosophy in Dentistry, University of Bergen, Norway* p 1-82.