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Infection Control in Orthodontics and Prosthodontics: Review and Update

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Abstract

Dental professionals are exposed to a wide variety of microorganisms in the blood and saliva of the patients. These microorganisms may cause infectious diseases. The use of effective infection control procedures and universal precautions in the dental office and the dental laboratory will prevent cross contamination that could extend to dentists, dental office staff, dental technicians and patients. Sterilization is a process by which an article, surface or medium is freed of all micro-organisms either in vegetative or spore state. Control of infection that spreads through various instruments and armamentarium used in the field of orthodontics, prosthodontics and dentistry in general is of utmost importance as a preventive measure for cross infection. Considering the fact that the rate at which newer strains evolve with time and older strains develop resistance it has become a constant challenge through time and in the years to come. The article reviews the various methods of sterilization by focusing on the guidelines for an effective and efficient orthodontic and prosthodontics clinical practice

Keywords: Sterilization, Disinfection, Saliva, orthodontics, Prosthodontics

Introduction

On a daily basis, the practicing dentist and his personnel are at risk of being exposed to a wide range of patients with blood borne diseases such as HIV/AIDS, hepatitis B, hepatitis C, and airborne diseases such as Influenza and Tuberculosis To accomplish infection control accurately and to reduce the risk of cross contamination, all patients have to be treated while practicing universal precautions, the latter including the imperative steps of disinfection and sterilization. In contrast to the dental treatment room and surgical operatories, the dental laboratory is often overlooked when planning effective infection control and exposure control measures. Technicians are particularly vulnerable to microbial cross-contamination from the impressions they receive from dental offices. Casts poured from impressions can also harbour infectious microorganisms that can be distributed throughout the laboratory when the casts or dies are trimmed. [1] Dental laboratories including those in private offices and small clinics, should be isolated from the possible transmission of pathogens or be properly prepared to prevent cross-contamination between patients and dental technicians. It is essential that all dental laboratory technicians must have a basic understanding of infection transmission and be properly evaluated for the exposure risk they face from blood-borne pathogens

Transmission of infection

Microorganisms capable of causing disease are present in human blood. Contact with blood or saliva mixed with blood may transmit pathogenic microorganisms. Impressions, casts, impression trays, record bases, occlusal rims, articulators and dental prostheses can all transmit pathogenic microorganisms from the dental office

to the dental laboratory. Studies have reported that organisms are transmitted from impressions to casts [2] and from dentures to pumice, where they continue to live. [3] The presence and identification of organisms transmitted to dental laboratories [4],[5],[6] Streptococcus and Staphylococcus species, Bacillus species, Enterobacter species, Hepatitis virus, Herpes simplex and human immunodeficiency virus (HIV) are among the microorganisms found frequently in blood and saliva. A study [4] has found that 67% of materials sent from dental offices to laboratories were contaminated with bacteria of varying degrees of pathogenicity.

Table 1 summarises the general routes of transmission of microbes. (Table 1).

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1.	Direct contact with infectious lesions or infected saliva or blood.
2.	Indirect transmission via transfer of microorganisms from a contaminated intermediate object.
3.	Splatter of blood, saliva / nasopharyngeal secretions directly into broken or intact skin or mucosa.
4.	Aerosolization, the airborne transfer of microorganisms.

Methods of infection control

Infection control is as old as disease control in health care modalities. The dental profession has developed an increased appreciation of the potential for disease transmission in the dental clinic and laboratory. The most efficient method of implementing conscientious infection control for our collective protection is to practice universal precautions in the form of personal barrier techniques. Recently, dental materials have been disinfected using effective techniques. Hence, this literature review is undertaken to upgrade our knowledge on the pros and cons of all the available procedures and techniques in the field of infection control in dental office and laboratory.

Infection control in prosthodontics clinics/ office

Prosthodontic patients are a high-risk group relative to their potential to transmit infectious diseases as well as their susceptibility to acquire them. The dental profession must assume that every patient treated is a risk of cross infection and to adopt appropriate control measure.[7]

Pretreatment Considerations

When the dental operatory is being prepared for treatment at the beginning of the day, the waterlines should be flushed for several minutes to remove bacterial growth that may have accumulated overnight. The equipments should be disinfected. A hospital level tuberculocidal disinfectant that is registered with the environmental protection agency should be used on hard surfaces in the dental office.

Patient evaluation

Any treatment is performed only after a comprehensive patient evaluation. This is achieved by a medical history specially designed to identify patients who are either particularly susceptible to infection or who are at risk of transmitting infection, known as carriers of disease or by being in a high-risk category. [7]

Personal protection

Dentist can best manage patients infected with Hepatitis—B viruses (HBV) and protect themselves, and in turn other patients, by being vaccinated with HBV vaccine. Clare Connor's [7] report has shown that the vaccine is safe and highly efficacious, affording protection with a success rate of more than 95%. In June 1982, the council on dental therapeutics adopted a resolution recommending that all dental personnel having patient contact including dentists, dental students and dental auxiliary personnel, and all dental laboratory personnel receive the Hepatitis B

vaccine [8]. The vaccination programme must certainly be considered the most effective cross infection control measure to protect dental personnel and in turn their patients, from a potentially fatal disease.[7,9] A long-sleeved, highnecked clinical coat, eye shields, facemasks and rubber gloves must be considered essential to reduce cross contamination with in prosthodontic practice . Dental personnel should wear eye shields and a facemask covering the nose and mouth when there is exposure to aerosols and splatter[7,8].For maximum protection, cuts and abrasions on the skin should be covered with adhesive dressings beneath the gloves. Pregloving disinfection confers strong antimicrobial properties on the internal surfaces of the gloves. Hands should be washed using a disinfectant hand wash agents such as povidone-iodine or chlorhexdine. [7]

Disinfection of impression

- Personal protective equipment: Protective eye wear, masks and gloves when handling a contaminated impression until it has been disinfected.
- Rinse the Impression: Immediately after an impression is taken in the dental operatory, rinse it under running water in order to remove any saliva or blood. This step in essential for allowing optimum disinfection of the impression.
- Disinfection techniques: Once the impression is rinsed and shaken to remove excess water, it must be disinfected. This may be accomplished by immersing the impression in, or spraying it with, an acceptable disinfectant.

a) **Disinfection of an impression by immersion**: It is preferred over spraying. Spraying may not be effective because constant contact of the disinfectant with all surfaces of the impression cannot be assured. [10]

i. Place rinsed impression into a zippered plastic bag containing appropriate disinfectant.
ii. Leave it immersed in disinfectant for 15 minutes. Polyether components and hydrocolloids may be adversely affected by disinfectants; therefore their immersion time is limited to 10 minutes.
iii. Remove impression from disinfectant.
iv. Rinse with running water and shake off excess water.

b) **Disinfection of an impression by spraying:**

i. Spray the cleaned impression and impression tray with an acceptable disinfectant.
ii. Seal the sprayed impression in a zippered plastic bag for 15 minutes.
iii. Remove the impression from the sealed bag.
iv. Rinse the impression with running water and shake off excess water

Hydrocolloid impressions: A number of investigators have evaluated disinfection of irreversible hydrocolloid (alginate) sometimes with contradictory results. Based on these findings, the ADA recommended disinfecting alginates by immersion in diluted hypochlorite, iodophor or glutaraldehyde with phenolic buffer. Investigators reported significant adverse effects of specific materials with disinfectants that are non-reactive with other alginates suggesting that caution should be exercised. Given the hydrophilic nature of the material, a minimal disinfection time should be used.[10,11] Limited data are available on disinfection of reversible hydrocolloid, however research data suggest that there is no effect on dimensional accuracy of impressions immersed in an iodophor diluted 1:213, 5.25% sodium hypochlorite with a dilution 1:10, 2% acid glutaraldehyde with dilution of 1:4, and glutaraldehyde with phenolic buffer diluted 1:16 immersion in 2% alkaline glutaraldehyde has significant adverse effects on the impressions and resultant dies.

Rubber base impression materials: They can be disinfected by immersion in iodophor, diluted chlorine solution, glutaraldehyde or complex phenols for the time required for tuberculocidal activity. It is important to review the method of disinfection with the manufacturers to prevent distortion of the impression or loosening of the adhesive bond between the impression tray and impression material.[11, 12] These impressions also should be rinsed with water before pouring. It is important to inform the dental laboratory that the impression has been disinfected to prevent the laboratory personal from performing more disinfection procedures that might distort the impression. Studies by a number of investigators have shown that polysulphides and silicones are relatively stable and can be disinfected without adverse effects by immersion in most disinfectants approved for use in dentistry. [11]

Dental Prosthesis and Appliances:

The ADA recommends disinfection by immersion in iodophors or chlorine compounds. Although both of these disinfectants are somewhat corrosive, studies have shown little effect on chrome cobalt alloy with short-term exposure (10 minutes) to iodophors or 1:10 hypochlorite. Damage of heat cured denture base resin has been shown to occur after only 10 minutes of immersion in a glutaraldehyde with phenol buffer, although immersion in 2% alkaline glutaraldehyde did not damage the acrylic surfaces. Given the tissue toxicity of glutaraldehydes and phenolics, however iodophors or chlorine compounds are preferred for disinfection of acrylic appliances. Prostheses never should be stored in a disinfectant before insertion. After disinfection and thorough rinsing, acrylic items can be stored in diluted mouthwash until inserted. Fixed metal/porcelain prosthesis may be disinfected by immersion in glutaraldehydes for the time recommended for tuberculocidal inactivation by the disinfectant manufacturer. In addition several clinical services have confirmed that fixed prosthesis can be disinfected by short immersion in diluted hypochlorite without apparent harm to the device.[12, 13] The higher the content of noble metal, the less the likelihood of adverse effects on the metal core should be taken to minimize the exposure times of metals to potentially corrosive chemicals. Iodophors probably could be used as well, but no data are available to substantiate this. Unglazed porcelain should not be exposed to any disinfectant and (porcelain firing/ glazing will suffice), fixed metal prostheses can be sterilized with ethylene oxide or even by autoclaving if desired. Any device that has been immersed in a disinfectant should be rinsed thoroughly before delivery to the patient. [13]Prostheses or appliances that have been worn by patients should be cleaned thoroughly before disinfection by scrubbing with a brush and an antiseptic handwash or by cleaning in an ultrasonic unit.[12,13, 14]

Disinfection of Wax Bites, Wax Rims, Casts, Custom Impression Trays & Bite Registrations

Wax rims and wax bites should be disinfected by the spray wipe spray method using an iodophor as recommended by the ADA. Rinse spray may be more appropriate for wax bites. For adequate disinfection these should remain for the time recommended for tuberculocidal disinfection. After the second spray, they can be enclosed in a sealed plaster bag for the recommended time. These items probably should be rinsed again after disinfection to remove any residual disinfectant.

Other Prosthodontic Items:

- Heat stable items such as facebow forks, orthodontic pliers and metal impression trays that come in contact with oral tissues should be heat sterilized rather than disinfected.

- Articulators and facebows should be cleaned and disinfected. After manipulation chairside (wooden handled spatulas should be cleaned and disinfected).
- Other times such as Hanau torches should be disinfected after use, or the area to be touched should be covered with a barrier such as plastic wrap to prevent contamination. [12]
- Rubber bowls should be cleaned and disinfected after chairside use.
- Items such as shadeguides should be cleaned and disinfected to avoid cross contamination. If iodophors are used on shadeguides, they should be wiped with water or alcohol after the exposure time to remove any residual disinfectant. Ultraviolet light is a part of electromagnentic spectrum. It ranges from 400nm downwards to approximately 150nm. It is well established that greater germicidal effect is in the range of 240- 280nm with the optimum being 253-7nm. This is widely accepted as a near maximum for bactericidal and germicidal effect. Most investigators show that the rays are absorbed by the cellular DNA chain which is the initial event in the chain of events leading to cellular death.[12,14]

Infection Control In Orthodontics Clinics/Office

Instruments can be of three categories according to Spaulding system [15]:

a) **Critical**: - Instruments that penetrate the mucosa must be sterilized. E.g. Bands, band removers, ligature directors, band forming pliers, orthodontic mini-implant placement kit etc.

b). **Semi Critical**: - Instruments that touches the mucosa should be sterilized whenever possible or treated with high level disinfectants. E.g. most of the orthodontic instruments, mirrors, retractors, dental hand pieces, etc.

c). **Least Critical**: - Instruments that don't touch mucous membrane such as Distal-end cutter, ligature cutter, arch forming pliers, torquing keys, bracket positioning gauges, V-bend forming plier etc. should be disinfected.

Special Considerations for Orthodontic armamentarium

- Orthodontic pliers: High quality stainless steel pliers can be sterilized by steam, dry heat, chemical vapour and ethylene oxide gas .For pliers with plastic parts ethylene oxide sterilization is the only effective method.
- Orthodontic wires: Smith et al [16] evaluated the effect of clinical use and various sterilization/disinfection protocols on three types of nickel-titanium, and one type each of β-titanium and stainless steel arch wire. The sterilization/disinfection procedures included disinfection alone or in concert with steam autoclave, dry heat, or cold solution sterilization. Load/deflection and tensile tests showed no clinically significant difference between as-received and used-then-disinfected/sterilized wires. Although sterilization of stain less steel wire is not of much use as most of them have bends and do not fit in another patients mouth but this is very useful in case of NITI wires as they do not have bends and can be reused. These results suggest that nickel-titanium arch wires can be recycled at least once.
- Elastomeric ligatures: Cross-contamination in handling elastomeric ligatures is a serious concern in the orthodontic office, since cold sterilization can damage the elastomeric material.. Schneeweiss [17] described a method of cutting elastomeric modules into smaller sections and covering them with clear tubing, which could then be cold sterilized.
- Elastics and elastometric chains: are sterilized by immersing in 5% Bibforte Solution for 30 Minutes.
- Rubber items and saliva ejectors: Best method is to discard them after each use..

- Hand pieces: Steam, dry heat, chemical vapour and ethylene oxide sterilization are acceptable for hand pieces.
- Rotary instruments: Diamond and carbide burs may be safely autoclaved with minimal damage but carbon-steel may be sterilised by using a chemical vapour steriliser. Plastic units should be disinfected using an iodophor.
- Orthodontic Marking Pencils: Sterilised by wiping with a sterile gauze or by soaking pencil tips in disinfectant.

Summary

The increased awareness of the dangers of cross-contamination with hepatitis B virus (HBV) and HIV during dental procedures is having a growing impact on attitudes toward infection control in the dental clinic and laboratory. The principal potential route of transmission from the patient to the dental technician is through contaminated impressions and prostheses. It has been demonstrated that microorganisms can be recovered from casts recovered from impressions made of dental moulds experimentally inoculated with bacteria. The responsibility to have a thorough knowledge of the patient's history and to ensure that support staff members are not put at risk of cross-contamination begins with the clinician. It would seem essential therefore, that impressions be disinfected by the clinician or a suitably protected technician prior to the initiation of any laboratory procedures. The only safe approach to routine treatment is to assume that every patient may be a carrier of an infectious agent and hence, technicians must wear gloves and carry out necessary infection control measures.

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