Major Aspects of Infection Control in Dental Environment

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Abstract

The purpose of this work was to provide policies and procedures to minimize the potential for infection and cross infection from patient to dental staff and vice versa. Based on a thorough review of dental literature, the guidelines include evaluation of patient medical and dental histories, personal protection, equipment asepsis, instrument sterilization, surface disinfection, and using aseptic technique. This review indicated that strict adherence to the contamination control guidelines could reduce transmission of infectious diseases in dental environment.

INTRODUCTION

Infection, in general, may originate in the oral cavity. It may become localized or extend diffusely to different parts of the body. If the infection spreads, an infinitely more dangerous situation exists. The spread of infection depends upon a variety of factors and circumstances, which may alter its course at any point. These factors include:

- The type and virulence of participating microorganisms.
- The quantity of these microorganisms.
- The duration of exposure of living tissue to these microorganisms.
- The physical state of the patient (host resistance).

Certain anatomic features, which determine the infection direction e.g., muscles attachment channeling the infection into certain tissue spaces [1,2].

Numerous investigations have been performed regarding the exposure of dental personnel to infectious diseases. These investigations resulted in formulating guidelines for contamination control with respect to sterilization and disinfection in dental practice. Further recommendations have also been made to prevent transmission of infectious diseases [3,7]. However, the list of identified risks to health care professionals has increased tremendously [1,2].

Health care workers worry about acquiring infectious diseases such as hepatitis, AIDS, tuberculosis, pneumonia, herpes, syphilis, gonorrhea, or rubella from patients. On the other hand, patients worry about being exposed to diseases in dental offices. Before illustrating the major aspects of infection control in the dental environment, we would like to discuss the transmission routes of different infectious diseases, which can occur by the following:

1. Through the exchange of blood; this route is primarily two-way street especially for HIV/HBV. Percutaneous injury to dentists (by burs, syringe needles, sharp instruments, or scalpel blades) is the most direct patient-to-dentist transmission method. Infected dentist, in turn, can then unknowingly infect other patients (dentist-to-patient transmission method) [7,8].

2. Through close contact as in herpes simplex virus type II, infectious mononucleosis, gonorrhoea, and syphilis [7].

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3. Through saliva droplets as in chicken pox, German measles, Hepatitis B, herpes simplex type I, influenza, measles, and tuberculosis [7].
4. Through aerosols, sprays, or droplets which may result in legionellosis caused by legionella and this may lead to respiratory problems and possibly death [7].

The goal of this work was to evaluate and review the dental literature to provide policies and procedures to minimize the potential for infection and cross infection from patient to dental team and vice versa.

Infection Control

Figure I demonstrates the major aspects of infection and contamination control in the dental environment. Each of these aspects is reviewed in this work, which include the following:

Patient Evaluation

The identification of patients with transmissible diseases and of those belonging to high-risk groups (e.g. health care personnel, patients and staff in hemodialysis units, patients requiring frequent blood transfusion as hemophiliac patients, household and sexual contacts of persons with persistent hepatitis B antigen, newborns of HBsAg carrier mother, morticians and embalmers, blood bank workers, persons at increase risk of disease of sexual practices, prisoners, users of illicit injectable drugs and international travellers)[5] is essential before treatment begins [3,4,6].

According to the Centers for Disease Control (CDC), the medical and dental histories must be carefully checked. However, these histories sometimes are not reliable and cannot be considered a totally inclusive source of information. Therefore, we have to identify all patients with blood borne pathogens. This can be performed by blood and body fluid examination. One must consider all such patients infectious until proved otherwise [9].
One must frequently re-evaluate the patient medical and dental histories, at least on a yearly basis. Consultation with physicians is most important in the proper care especially with medically compromised patients [10].

Personal Protection

Protection of patients and dental personnel from threat of infection is recommended. Therefore, the following measures should be taken:

All dental personnel and health care workers involved in patient care should have appropriate immunizations (vaccination) such as for hepatitis B virus. A booster dose of vaccine is also recommended at three yearly intervals, even if the level of anti HbsAg is adequate. However, many blood-borne pathogens exist for which there is presently no vaccine, including HIV and non-A/non B hepatitis [7,10].
For dental personnel, three more vaccinations are important and these are against tetanus, poliomyelitis, and tuberculosis [7].
Using good quality and well fitting gloves provides the patient with protection from contamination with microorganisms on the practitioner's hands and also protects dental health care workers from contamination by the patient's blood and saliva. One should note that fingernails should be cut short and hands should be washed with antimicrobial solution before gloves are placed and after gloves are removed. Gloves should be changed between patients. If during the course of treatment, a glove is torn, the glove should be removed, and the hands washed and then regloved. Moreover, keep gloved hands away from nose, face, hair, chairs, charts, telephones, and contaminated pens during treatment. When it is necessary to contact these objects, use overgloving by a second pair of gloves[6,10].
Using the dry glass or synthetic fiber face mask with a minimum filtration of 95% is an important barrier. It provides protection from inhalation of aerosols generated by high speed handpieces and air-water syringes, prevents transmission of microorganism through moisture penetration, and is efficient in filtering bacteria. Masks must be worn by all individuals while in operatory. It should be changed between patients, when sneezing, when damp, or when used for 1 hour [11].
Using eyeglasses or chin-length shields can prevent splashed blood, saliva, bacterial or viral contact (herpes virus or HBV) with eye by aerosol spray or droplet infection from inhalation of aerosols. Protective eyewear or shields should be routinely cleaned and disinfected between patients [10].
Using sterilized reusable or disposable uniforms, gowns, or laboratory coats with long sleeves and high collar are also recommended. Moreover, laundering can be effectively accomplished with a high temperature (60-70°C) wash cycle with normal bleach, followed by machine drying (100°C or more). This method along with dry cleaning and steam pressing is effective in killing the AIDS virus [10,12].
Use clinical shoes, which should be maintained, only at the treatment site. Personnel must not wear jewelry such as rings, watches and bracelets.
Clinical attire should be removed prior to leaving operatory and placed in laundry or disposable bags and should be washed at the hospital or away from the family laundry [10].
Using procedural barrier, such as rubber dam, has been shown to be an effective barrier to reduce the number of microorganisms contained in aerosols and bacterial leakage. Although high-speed evacuation is not a true form of barrier control, it should be used whenever possible. Evacuation decreases the amount of particles that become airborne [7,10].
Disposable impervious-backed paper, plastic, or aluminum wrap can be used to cover surfaces and operatory equipment such as light, handles, brackets, and instrument tables. This aids in the prevention of surface contamination from blood or saliva [7].
Open intraorally contaminated x-ray film packets in the dark room with disposable gloves without touching the film. Drop the contaminated packets in a paper cup. Discard the packets and the gloves before processing the film [7,10].
Avoid hand or percutaneous injury with needles, endodontic files, scalpels, and other sharp instruments. After needles or scalpel blades have been used, they should be removed with a hemostat and placed into puncture-resistant receptacles [7,10,13].

Use antimicrobial mouthrinse that have residual activity before and after treatment (Chlorhexidine Gluconate is the most effective).
Do not allow patient to handle instruments. Open sterile trays, place suction tips and saliva ejectors in the patient's presence.
Use the same infection control procedures for all patients (universal precaution) [7, 8, 10, 14, 15].

Equipment Asepsis

All instruments and devices should be rinsed in cold water as soon as possible after use, if they had not been placed in holding solution. Gross debris should be removed manually, using a stiff bristle autoclavable brush, or ultrasonically if possible. Thorough rinsing of instruments after sonication in preparation for sterilization markedly reduces carry-over of detectable organic debris.
One must follow the manufacturer's direction for proper cleaning, sterilization, and disinfection of all instruments, devices, handpieces, air/water syringes and ultrasonic unit. Handpieces should be sterilized or disinfected between patients. Handpieces can be sterilized using autoclave, chemical vapor, or dry heat [7, 10].
Routine sterilization between patients is desirable. When this is not possible disinfect between patients and sterilize at the end of the working day, or use disposable air/water syringes [7].
To disinfect between patients flush with water for 30 seconds, spray into a vacuum line, clean and scrub with a brush and an ADA approved cleaner/disinfectant to remove debris, rinse well and dry, lubricate when indicated by manufacturer and spray out excess lubricant, spray or saturate with an ADA approved disinfectant, cover with clear plastic wrap for at least 10 minutes, and rinse with water and dry. Clean fibreoptic light transmitting surface with cotton swab wet with isopropyl alcohol [6, 7].
Items that are not associated with treatment such as sinks, floors, walls, and furnishings should be cleaned routinely with water and detergent, unless they have become contaminated with blood or other body fluids, then it should be cleaned and disinfected [6,7].

Instrument Sterilization

Sterilization is the process, which kills or destroys all types and forms of microorganisms, including viruses, bacteria, fungi, and spores. Four methods of sterilization are generally accepted in dentistry. These include:
1. Steam under pressure/autoclaving: This technique requires a temperature of 121°C (249°F) at 15 p.s.i. for 15-40 minutes.
2. Chemical vapor sterilization/chemclave: This method is based on the factors of heat, water and chemical synergism. The temperature requirements are 132°C (270°F) for 20 minutes.
3. Dry heat sterilization: This technique requires a temperature of 160°C 320°F) for 2 hours.
4. Glutaraldehyde solutions: This technique requires immersion of instruments in fresh 2% glutaraldehyde for I hour, reimmerse in fresh 2% glutaraldehyde for 3 hours, wash with sterile water, dry aseptically, and then store in a sterile dry container [10, 18].
Ethylene oxide gas, ultraviolet light, microwave, and other forms of radiation are effective but have limited use in dentistry at present.
Surgical and other instruments that normally penetrate soft tissue or bone should be sterilized after each use.
Instruments that come in contact with mucous membranes should also be sterilized. However, if sterilization is not feasible, a high level disinfectant/sterilant may be used [10, 18].
Disinfectant/sterilant chemicals should not be used on items that can be sterilized. The sterilizer manufacturer's operating instruction should be followed.
Sterilization monitors should be used routinely to verify the adequacy of sterilization cycle. Several sterilization monitors are available, including process indicators, control indicators, and biological monitors (the most dependable method).
Instruments or devices should be wrapped or bagged, using heat-stable wraps or bags capable of maintaining sterility for I month.
Have a color change sterilization indicator in each package. The package must be sealed effectively using heat or indicator tape to ensure that sterility is maintained [6, 7, 10, 16, 17].
Sealed sterilized kits should be stored on clean shelves or drawers so they can be maintained in a sterile condition for future use. The seal of sterilized package should be inspected before use.
A maximum storage time might be considered as one month [7, 9, 10, 18].

Disinfection

Disinfection is a process that is less lethal than sterilization and eliminates virtually all recognizable microorganisms, but not necessarily all microbial forms.
All items that can be sterilized should be sterilized.
Disinfection is added to the methods for preventing cross-contamination for instances in which sterilization is not possible.
Disinfection is a compromise over sterilization; however, it does contribute substantially to the reduction of microorganisms.
A disinfectant is deemed acceptable for dentistry if the solution is registered with the Environmental Protection Agency (EPA) or approved/accepted by the American Dental Association (ADA).
Disinfection techniques include immersion disinfection and surface disinfection.
Three levels of disinfection are differentiated, depending on the type and form of microorganism destroyed:
1. High-level disinfection: A process that can kill some, but not necessarily all, bacterial spores. It is tuberculocidal and if the disinfectant is capable of destroying bacterial spores, it is labelled sporicidal.
2. Intermediate-level disinfection: A process that is capable of killing Mycobacterium tuberculosis, hepatitis B virus, and HIV. It may not be capable of killing bacterial spores.
3. Low level disinfection: A process that kills most bacterial, some fungi, and some viruses. It does not kill M. tuberculosis or bacterial spores [7, 10].
Chemical disinfectant must be used according to the instruction on the label with regard to personal protection, mix-

ing, dilution, method and duration of application, temperature requirements, shelf life, activated use life, and reuse of the chemical disinfectant.

Chemical disinfectants include glutaraldehyde, iodofors, chlorine dioxide, sodium hypochlorite (household bleach) and phenolics.

Items and equipments that do not normally penetrate or contact mucous membranes require intermediate-level disinfection.

The patient must rinse with antiseptic mouthrinse before having impressions made or trying in dental prosthetic devices. Also the impression materials, articulators, custom trays, and fixed and removable appliances.

Some glutaraldehyde solutions can be used, as disinfectants and sterilizers on operatory surfaces and act in 3 to 30 minutes, depending on the amount of debris and types of viruses present. Glutaraldehydes have disadvantages when used as surface disinfectants, such as vapor toxicity, hand and eye irritation, and cost. They are therefore not recommended [7].

Sodium hypochlorite is more suitable for surface disinfection than for instrument sterilization because of its highly corrosive action on metal. On surfaces, sodium hypochlorite is virucidal, bactericidal, and tuberculocidal. Disinfection can occur in 3 to 30 minutes, depending on the amount of debris present.

One should note that cleaning and disinfecting of environmental surfaces and equipment should be performed between patients and at the beginning and end of the work day. Barriers to shield surfaces must be used when surface decontamination is approximately 80% effective in bacterial control [3,7,10,14,19].

The final and important part of the sterilization/disinfection process is aseptic storage. The ideal way to store instruments is dry in protective container. There are two systems that are useful for aseptic storage; instrument trays with a loose but airtight lid and dry sterilization bags [7,20,21].

Aseptic Technique

Poor technique by either dental assistant or the operator can result in infection. Most of the postoperative infections are caused at the time of dental procedure.

Dentistry in general and endodontics in particular has long emphasized the importance of aseptic techniques using sterilized instruments, disinfecting solutions, such as sodium hypochlorite, and barriers [7,10].

Sterilization indicators can be used to determine whether sterilization has occurred.

Using aseptic technique in dental procedures will minimize or prevent transmission of infectious diseases. This, according to ADA Council on Dental Therapeutics will:

1. Decrease the number of pathogenic microbes to the level where normal body resistance mechanism can prevent infection.
2. Break the cycle of infection from dentist, assistant, and patient and eliminate cross-contamination.
3. Consider all patients and instruments as though they could transmit an infectious disease.
4. Protect patients and personnel from infection, and protect all dental personnel from the threat of malpractice[4,7,10,20,21].

Discussion

The subject of infection control has had a high impact on dentistry in the last decade. Dentistry is unusual in that it is undertaken in an environment in which there is saliva and blood. In addition, there are aerosol, splatter and the possibility of flying debris. Also, the resheathing of local anaesthetic needles can be a serious infection risk. Furthermore, all infection control procedures recommended by ADA, Ad Hoc Committee on Infectious Disease, and the Centers for Disease Control (CDC) should be documented and followed. Practitioners should attempt to stop cross contamination. These recommendations change frequently; therefore, one must remain constantly up-dated on current information [22,23].

Infection control measures described in this work are designed to be safe for any dentist and his team as well as any patient, including those infected with HIV or the hepatitis viruses. However, there are more measures that have to be taken into consideration to prevent or minimize cross contamination. These are:

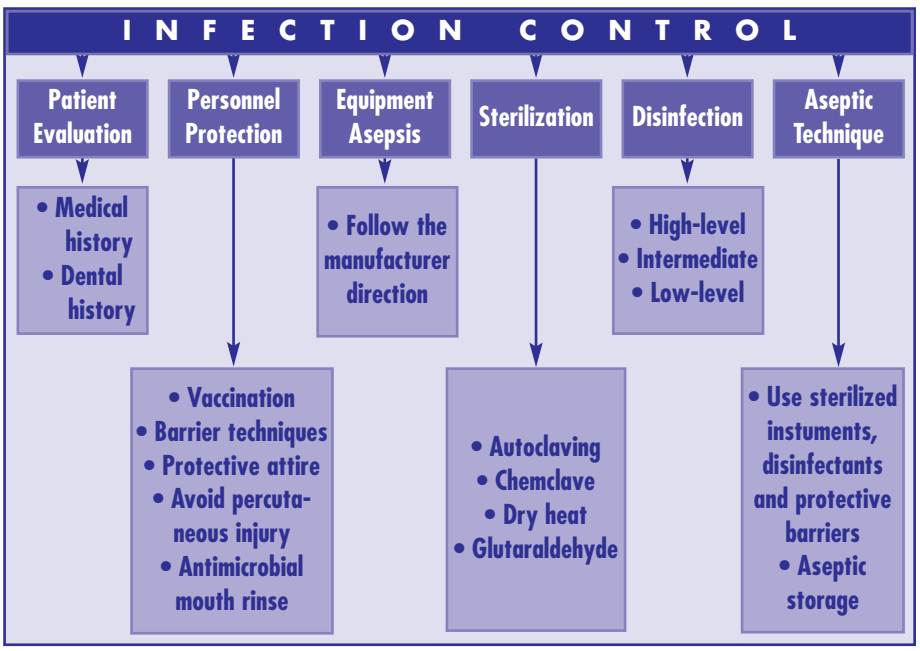

Fig. 1: Major aspects of contamination control in dental environment.

Utilizing disposable items whenever possible.
Using individualized bur blocks for each procedure.
Using pre-arranged tray set-ups if possible.
Avoid placing sterile wrapped/bagged items in drawers with non-sterile items.
Keep handpieces, air/water syringes, and ultrasonic scalers covered when not in use.
Water lines must be flushed for 3 minutes at the beginning and end of each working day, and for 30 seconds between patients.
Evacuate a large amount of cleansing solution through the evacuator line.
Place Kleenex and other patient care items behind or beside the patient (never in front of the patient).
The receiving area should be located in an area separated from the production area.
The auxiliary personnel in dentistry are also important members of the cross infection control team. They must be fully trained in the techniques of cross infection control and understand why the procedures are being done [3,10,14,24].
Never place non-sterile items such as hand mirrors, timers, pencils, patient records, audiovisual aids, etc. on the bracket table.
Personnel with exudative lesions or dermatitis shall refrain from all direct patient care and from handling dental patient care equipment until the condition is resolved.
There is a mistaken belief among some practitioners that disposable items such as needles can be sterilized. This is dangerous, as the fine-gauge needles used in dentistry cannot be satisfactorily sterilized. Other items such as local anaesthetic cartridge should not be reused as undetected blood products are often aspirated onto them during injection. In general, disposable items are as their name suggests-disposable [7, 10, 25].

Conclusion

The review presented in the current work provides the theoretical background and guidelines for the practitioners and the whole dental team as well as patients to implement sensible, practical, and safe procedures free from infection. The guideline include evaluation of patient medical and dental histories, personal protection, equipment asepsis, instrument sterilization, surface disinfection, and using aseptic technique. It is therefore, important that all dentists and auxiliary staff follow the infection control guidelines and apply them to daily practice. This guideline could reduce transmission of infectious diseases in dental environment.

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