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RESEARCH ARTICLE

STERILIZATION AND INFECTION CONTROL IN ORTHODONTICS

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ABSTRACT

Infection control has been one of the major concerns in the field of dentistry since decades. The dentist and his office personnel are at a great risk of contracting wide range of infections like HIV, hepatitis B, herpes, tuberculosis, respiratory diseases such as pharyngitis etc., as they are exposed to bacteria in the blood and saliva in patients routinely. There are various methods of sterilization which are commonly used like, hot air oven, autoclave, cold sterilization, etc. Orthodontists are more prone to cuts, abrasions, and puncture wounds from sharp edges of orthodontic wires, pliers and orthodontic appliances. These cuts serve as portal of entry for the bacteria which can enter the body and cause infections. In this article we have attempted to provide a brief overlook on methods of sterilization and infection control in orthodontics which can be practiced to prevent the spread of infections.

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INTRODUCTION

Microorganisms are found everywhere. They cause contamination and infection hence, it becomes necessary to remove or destroy them from materials or from areas. This is the object of sterilization. The process of sterilization finds application in microbiology for prevention of contamination by extraneous organisms, in surgery for maintenance of asepsis, in food and drug manufacture for ensuring safety from contaminating organisms and in many other situations. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Brief overlook on history of sterilization

- In ancient times, demons and evil spirits were thought to be the cause of pestilence and infection. Methods involving witchcraft and magic were used to drive them away (Brian Skellie, 2010)
- Hippocrates of Cos (460-377 BC), disproved the idea that disease was punishment for sin and was the first to separate medicine from philosophy. He also advocated irrigation of wounds with wine or boiled water, foreshadowing asepsis. (Brian Skellie, 2010)
- In 1862, French chemist and microbiologist, Louis Pasteur publishes his findings on how germs cause disease, and introduced technique of sterilization and steam sterilizer. (Ananthanarayan and Paniker's text book of microbiology 9th edition; Brian Skellie, 2010)
- Charles chamberland, a pupil and collaborator of Louis Pasteur introduced the first pressure steam sterilizer (autoclave). (Brian Skellie, 2010)
- Robert Koch and his associates devised the first nonpressure flowing steam sterilizer. Disinfecting properties of steam and hot air, mark the beginning of science of disinfection and sterilization.
- Joseph Lister, an English physician, reduced the mortality rate of his patients in 1867 by using a carbolic solution spray as he operated. (Brian Skellie, 2010) He also introduced antiseptic technique in surgery. (Ananthanarayan and Paniker's text book of microbiology 9th edition)
- In 1956, Principles and Methods of Sterilization in Health Care Sciences by J.J. Perkins was published. This textbook set the standard and methodology for processing and sterilization of reusable medical devices. (Brian Skellie, 2010)

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- In 1963, Glutaraldehyde was introduced, the first chemical solution approved by the Environmental Protection Agency (EPA) as a sterilant for heat-sensitive instruments. (Brian Skellie, 2010)

Definitions

Sterilization: is defined as the process by which an article, surface or medium is freed of all micro- organisms either in the vegetative or spore state. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

***Disinfection*:** means the destruction of all pathogenic organisms, or organisms capable of giving rise to infection. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Antisepsis: is the term used to indicate the prevention of infection, usually by inhibiting the growth of bacteria in wound or tissue. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Antiseptics: are chemical disinfectants which can be safely applied to skin or mucous membrane and are used to prevent infection by inhibiting the growth of bacteria. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Bactericidal agents: are those which are able to kill bacteria. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Bacteriostatic: agents only prevent the multiplication of bacteria and they may remain alive. The same chemical, which is bactericidal at a particular concentration, may be only bacteriostatic at a higher dilution. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Sterilization in orthodontics

Today sterilization of instruments has become one of the major concerns in dental practice. With the ongoing research in this aspect, newer methods of sterilization which are efficient, effective, and time saving are being developed.

Instruments can be of three categories according to Spaulding System (Spaulding, 1968)

a) Critical Items: these are the items which penetrate the mucosa. Critical items confer a high risk for infection if they are contaminated with any microorganism as they enter the tissue and hence they must be sterile (Spaulding, 1968) E.g. forceps, scalpels, surgical burs, BP blade, bone chisel, scaling instruments.

b) Semi Critical: Semi critical things contact mucous membranes or non-intact skin. (Spaulding, 1968) Instruments that touches the mucosa should be sterilized whenever possible or treated with high level disinfectants. E.g. most of the orthodontic pliers, mouth mirrors, retractors, burs, dental hand pieces, airway syringe, switch, lamp handles, etc.

c) Noncritical: Noncritical things which contact with intact skin, however, not the mucous membranes. These things are divided into noncritical patient care things and noncritical environmental surfaces. (Spaulding, 1968) e.g. Dental chair, benches, floor, glass slab, cement spatulas, etc. should be disinfected.

The OSHA guidelines for infection control and blood borne pathogens must be strictly followed.

Personal protection

a) *Immunological Protection*: It is through immunization. The operator must be vaccinated against the hepatitis B, measles, rubella, tetanus, influenza and certain other microbial infections to which they may be exposed in clinical practice. Immunization is the most effective method to reduce the chances of disease acquisition. (Chris *et al*.,)

b) *Barrier protection:* This includes

Gloves

Gloves act as protective barrier against microorganisms when directly handling infectious materials and also against cross contamination from dental team to the patients. Gloves must be changed in between patients. Hands must be clean before wearing gloves and washed after removing gloves.

The reasons for wearing operating gloves during dental procedures are: (Chris *et al*.,)

- Gloves protect operator from direct contact with microorganisms in patients mouth
- To protect the patient from microorganisms on the hands of the dental team.
- Special purpose gloves are available for various uses.eg heat resistant gloves, utility gloves

Types of gloves

a) Sterile surgical gloves
b) Non sterile examination gloves:
   - Nitrile examination gloves.
   - Vinyl examination gloves.
c) Utility gloves:
   - Heavy latex gloves.
   - Thin copolymer gloves.
d) Heat resistant gloves.

Powdered gloves*:* for easy donning of gloves, powders have been used as lubricants. Earlier powders derived from pines or club moss were found to be toxic. Talcum powder was used for decades but it may cause postoperative granuloma and scar formation. Hence health care industries shifted to corn starch. Cornstarch can transport latex protein which is capable of triggering respiratory allergic reaction, air way inflammation, and wound inflammation according to FDA. Hence they have proposed a ban on most powdered gloves (Robert Lowes, 2016)

***Shoe and Head Covers*:** Shoe and head covers provide a barrier against splatter of saliva and other body fluids

Mouth Masks: Mask protects the mucous membrane of nose and mouth from aerosols in the patients mouth (Chris *et al*.).

- Face shields are appropriate for heavy splatter, but mask is still required to protect against aerosols that drift behind the shield.(Robert Lowes, 2016)

- Mask must be changed after each patient or if it becomes moist due to perspiration within the same procedure (after every one hour).(Robert Lowes, 2016)
- Face mask are composed of synthetic materials that filter out 95% -99.9% of 2 to 3 Micrometer size particle that contact the mask. (Chris *et al*.,)
- Doom shaped masks are adequate barriers against splatter and they prevent hepatitis B, HIV infection, measles, influenza, air borne respiratory viruses or tuberculosis.
- Avoid touching the mask during the treatment and discard it immediately after dismissing the patient. Wearing it around the neck, causes contaminated edges of the mask to rub against the skin and cause cross contamination.(Robert Lowes, 2016)

Protective eyewear*:* Is indicated. (Robert Lowes, 2016)

- To protect operators eyes from infectious aerosols, splatter, ultraviolet radiation, and chemicals used at the chair side.
- To prevent physical damage to eyes from small pieces of propelled object during polishing, grinding of appliances, and sand blasting procedures etc.
- Protective eyewear should also be offered to the patients during the treatment to avoid accidental injury to eyes.
- Put on the eyewear with clean hands before gloving and remove it with clean hands after gloves are removed.
- Disinfection of eyewear*:* eyewear is removed by grasping the temple piece with clean fingers. Place it on paper towel and spray disinfectant and allow it to stand for 5 minutes or soak it in 5% hypochlorite bleach. Then rinse well and dry the eye wear.(Robert Lowes, 2016)

***Protective clothing*:** The over clothes become highly splattered with saliva and blood throughout the day, hence they should be washed regularly. Protective clothing should require minimal handling and be easily laundered. (Robert Lowes, 2016)

- Clinic coats with large sleeves drag across patient drape and mouth and become contaminated hence knit cuffs that tuck under the gloves are preferred.(Robert Lowes, 2016)
- Sterile drape to prevent contamination of patient's clothing from saliva, blood and aerosol, should be used.
- Used over coats should be placed directly into a laundry bag with minimum of handling.(Robert Lowes, 2016)
- Persons handling the soiled over garments must wear protective gloves. Hot water at 70^{o} C should be used for washing the soiled clothes.(Robert Lowes, 2016)

Five basic steps in the sterilization process

- Cleaning
- Packaging
- Sterilization
- Storage
- Distribution.

1. Cleaning and Disinfecting: This is the first step in processing of the instruments. Cleaning and disinfection is critical because it reduces the number of microbes present on the instruments and removes blood, saliva, and other debris which may insulate microbes from sterilizing agents and reduces disinfection or sterilization effectiveness. *Ultrasonic cleaning* (Miller, 1993; Bentley, 1994; Bentely and Sarll, 1995). Is preferred to manual scrubbing as it reduces the direct handling of the contaminated instruments and the chances for cuts and punctures in the gloves. The time required ranges from about 5-15 minutes. Cleaning solution used should have antimicrobial activity to reduce the buildup of microbes. The solution should be changed at least daily. Few instruments cannot be ultrasonically cleaned, like some high-speed hand pieces.

2. Packaging: Instruments are packed before sterilization to prevent them from becoming contaminated after the sterilization process, during storage or during distribution. Before packing, instruments should be dry and clean with no debris on it (Chris *et al*.,). Orthodontic instruments can be placed in pouches, bags, or trays during the packaging procedure.

- Orthodontic pliers are wrapped in Pouches prior to sterilization. These pouches sterilize the hinged instruments in an open position. They have external and internal chemical indicators which change color after sterilization, allowing easy recognition of processed instruments from non-sterilized items. (George Kyritsis, 2013)
- Multipart instruments should be disassembled for sterilization. Unpackaged instruments can be contaminated by dust or aerosols in the air. If at all they are sterilized they should be handled with sterilized tongs.

3. Sterilize: In step 3, instruments are sterilized by various methods like (autoclave, chemiclave, cold sterilization, etc.)
4. Storage: In the fourth step, instruments are removed from the sterilizer/processor and allowed to cool. Then the instrument should be stored in cool, dry and dust free area until use.
5. Distribution and Use: when needed sterilized instruments are retrieved from storage and checked to ensure the external chemical indicator and placed on sterile, disposable, or at least disinfected tray at chair side for use.

Methods of sterilization

Hot air oven: The standard sterilization protocol for the hot air oven is a holding period of least two hours at a temperature of 160 °C. In a rapid cycle air is heated to 190 °C for holding time of 6 minutes for unwrapped objects and holding period of 12 minutes for wrapped objects. (Mayhew and Kusy, 1988) Mechanism of action of dry heat is that it kills the microbes by denaturation of proteins. The oven is usually electrically heated and fitted with a fan for even distribution of heat. It is used to sterilize glassware, forceps, scissors, scalpels, all-class syringes, swabs, some pharmaceutical products such as liquid paraffin, sulfonamides, dusting powder, fats, greases, etc. (Ananthanarayan and Paniker's text book of microbiology 9^{th} edition) Most of orthodontic instruments with cutting edges or sharp beaks are sterilized in hot air oven to prevent their rusting. Oven should not be over loaded, there should be space of at least 1cm for circulation of air between the objects. After sterilization the oven is allowed to cool before opening the door. (Ananthanarayan and Paniker's text book of

microbiology 9th edition) There are two types of ovens. (Chris *et al*.,)

i. *Static air type:* here heating coil is at the bottom of oven which causes the air to rise inside the chamber through convection. (Chris *et al*.,)
ii. *Forced air type:* here the air is circulated in the chamber at high velocity. (Chris *et al*.,)

Recommended temperature for sterilization By (British Pharmacopeia 1988, European Pharmacopeia 1990)

Temperature in °C	Holding temperature in minutes.
160	120
170	60
180	30
190	12(wrapped instrument) 6(unwrapped instrument)

Flaming: Items like inoculating loops or wires, spatulas and tips of forceps are held in a Bunsen flame. Hold the instrument in the flame untill it becomes red hot. Infected items may be dipped in disinfectant before flaming to prevent spattering. (Ananthanarayan and Paniker's text book of microbiology 9th edition) An alternative method is to dip the instrument in 70% or higher concentration of ethanol, then touch the object to a Bunsen burner flame. The ethanol ignites and burn off rapidly, leaving fewer residues when compared to gas flame.

***Glass bead sterilizers*:** Glass bead sterilizers work by heating glass beads of 1.5 - 2mm size to a temperature of 218-246 °C. Instruments are then quickly doused in these glass beads, which heat the object while physically scraping contaminants off their surface. Orthodontic bands, expansion appliance keys can be effectively sterilize by this method. 2or3 pliers can be sterilized within 20to 30 sec. (Miller *et al*., 1992) but repeated exposure to high temp. Can spoil the beaks of the pliers. Glass bead sterilizers are ineffective against prions, and the effectiveness of the glass bead sterilizer for viral infection control has not been demonstrated. (Glass bead sterilizer)

Boiling: vegetative bacteria are killed almost immediately at 90-100 degree C, but some bacteria require prolonged period of boiling. Boiling is not recommended for sterilization of surgical instrument, and should be regarded only as a means of disinfection. Material should be immersed in water and boiled for 30min. Sterilization can be promoted by addition of 2% sodium bicarbonate in water. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Autoclave: The basic principle behind the autoclave is that water boils when its vapour pressure equals that of the surrounding atmosphere pressure. Hence when pressure inside a closed chamber rises, the temperature at which water boils also increases. Saturated steam has a much greater, penetrative power. When steam Contacts a cooler surface it condenses to water and gives up its latent heat to the surface, and it is this heat which kills the microorganisms and not the pressure (Chris *et al*.,). The large reduction in volume sucks in more steam to the area and the process continues till the temperature of that surface is raised to that of the steam. The condensed water ensures moist conditions for killing the microbes. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Sterilization by steam under pressure is carried out at temperatures between108° and 147° C by using the appropriate temperature and tie, a variety of materials such as dressings, instruments, Laboratory ware, culture media and pharmaceutical products can be sterilized. Aqueous solutions are sterilized between 108°C and 126°C. Heat is conducted through the walls of the scaled containers until the temperature of the fluid inside is in equilibrium with the steam outside (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Recommended temperature and duration for autoclave

Temperature in degree centigrade	Holding time (in minutes)
121	15
126	10
134	3

Radiation: Two types of radiation are used for sterilization.

- Nonionizing radiation.
- Ionizing radiation.

Infrared and ultraviolet rays are of the nonionizing low energy type while gamma rays and high energy electrons are of the high energy ionizing type. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

- *Nonionizing radiation:* In nonionizing radiation electromagnetic rays with wavelengths longer than those of visible light are used and these are to a large extent absorbed as heat. Hence infrared radiation can be considered as a form of hot air sterilization. Infrared radiation is used for rapid mass sterilization of syringes. Ultraviolet radiation is used for disinfecting enclosed areas such as entryways, hospital wards, operation rooms and small virus inoculation rooms and virus laboratories. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

- *Ionizing radiation:* X-rays, gamma rays and cosmic rays are highly lethal to DNA and other vital cell constituents. They have very high penetrative power. Since there is no appreciable increase in temperature, this method is also referred to as cold sterilization. Large commercial plants use gamma radiation for sterilizing most of the plastics syringes, swabs, catheters, fabric, metal foil, animal feed. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Ultrasonic and sonic waves: are credited with bactericidal powers but the results are variable. Microorganisms vary in their sensitivity to them and survivors are found after such treatment. Hence this method is of no practical value in sterilization and disinfection. (Ananthanarayan and Paniker's text book of microbiology 9th edition) Hinged instruments like some brands of orthodontic pliers should not be submerged in ultrasonic or disinfecting solution if hinges corrode or rust. It can also remove residual cement from the bands, and mixing spatulas. (Sturtevant's 5th edition)

Cold sterilization: Immerse heat-sensitive instruments into antimicrobicidal fluids (such as gluteraldehyde, orthophthalaldehyde, or concentrated hydrogen peroxide) to kill bacteria, fungi, mycobacteria, or viruses. There is no rise in temperature during the process hence the name cold sterilization.

- *Aldehydes: Formaldehyde* is active against the amino group in protein molecule.
  Uses: 10% formalin containing 0.5% sodium tetraborate is used to sterilize metal instruments, heat sensitive instruments like catheters. For fumigation of wards, sick rooms and laboratory. In aqueous solution it is bactericidal, sporicidal and also lethal to viruses. (Ananthanarayan and Paniker's text book of microbiology 9th edition)
  Disadvantages: gas is irritating, toxic and irritating vapour from disinfected surface. (Ananthanarayan and Paniker's text book of microbiology 9th edition)
- 2% *Gluteraldehyde* is more commonly used as it is less toxic and less irritating to eyes and skin than formaldehyde (10% formalin). Steps involved in sterilization of instruments are: air and towel dry the instruments and then immerse the instruments in glutaraldehyde solution. After about 10 minutes of immersion. Remove instruments from solution and rinse it in sterile water and dry them. Prolonged immersion damages the cutting surface. (Ananthanarayan and Paniker's text book of microbiology 9th edition)
- *Alcohol:* Ethyl and Iso-propyl alcohol are commonly used mainly as skin antiseptic and act by denaturation bacterial proteins. (Ananthanarayan and Paniker's text book of microbiology 9th edition) To be effective they have to be used in concentration of 60-90%in water. Alcohol is used for sterilization of orthodontic arch wire materials before recycling, this kills most of pathogenic bacteria. Many studies concluded that neither the heat sterilization nor multiple sterilizing cycling have any deleterious effect on the elastic property, surface topography, or tensile properties of nitinol or titanium arch wire. (Mayhew and Kus 1988)

Ethylene oxide sterilization: Ethylene oxide is a colorless liquid with boiling point of 10.7°C and at room temperature and pressure it is a highly penetrating gas with sweet ether smell. Its action id due to alkylating amino, carboxyl, and hydroxyl and sulphydryl group in protein molecule (Ananthanarayan and Paniker's text book of microbiology 9th edition). It has excellent penetration capacity and is sporicidal as well as viricidal. It is both toxic, inflammable and highly explosive. Hence mixed with inert gases like CO_2, nitrogen to a concentration of 10% to eliminate its tendency to explode. Used to sterilize delicate and heat sensitive instruments like heart lung machine, respirators, handpieces, orthodontic marking pencils which cannot be autoclaved, books, clothing and for fumigation of rooms. The holding time for sterilization is 4hrs. Then a resting period of 8-12 hours is allowed to ensure that all traces of ethylene oxide are removed. Otherwise, the chemical can cause "cold burns" on contact. Ethylene oxide is also used to sterilize heat sensitive items like paper, leather, wood, rubber as well as plastic. The conventional Gas sterilization is effective for killing bacteria, but its cost and holding time of 12 hours makes it impractical for orthodontic offices. (Ananthanarayan and Paniker's text book of microbiology 9th edition)

Laser* (*Light Amplification by stimulated Emission of Radiation): with the data obtained from research in the field of lasers has shown us that laser beams can be used to sterilize instruments, operatory area and the air in operating rooms, as well as wound surfaces. The study compared the various types of lasers like CO_2, Argon, and NdYAG lasers etc. Argon was found to be more effective for sterilization. The cost factor has been the primary reason for its uncommon use. (Powell and Whisenant, 1991)

Special consideration for orthodontic instruments

***Surface Disinfection*:** There are three levels of disinfection: (Michele 6th edition)

- High level,
- Intermediate level,
- Low level.

High-level disinfectants	Intermediate-level disinfectants	Low-level disinfectants
• Formaldehyde • Glutaraldehyde • Hydrogen Peroxide • Peracetic acid	• Sodium hypochlorite • Iodophors (e.g. povidone-iodine and poloxamer-iodine)	• Phenols • Quaternary ammonium compounds

The disinfectant must kill mycobacterium species, HBV, HIV, respiratory viruses and other hospital pathogen. While disinfecting the surfaces nitrile latex utility gloves should be worn. High-level disinfectants, such as glutaraldehyde, are used as chemical sterilants and should never be used on environmental surfaces. Intermediate-level disinfectants are registered with the Environmental Protection Agency (EPA) and have a tuberculocidal claim, and low-level disinfectant are EPA-registered without a tuberculocidal claim (i.e., hepatitis B virus and HIV label claims).

- *Hydrogen peroxide* is used in hospitals to disinfect surfaces and it is used in solution, alone or in combination with other chemicals as a high level disinfectant. Hydrogen peroxide is sometimes mixed with colloidal silver. It is often preferred because it causes far fewer allergic reactions than alternative disinfectants. Also used in the food packaging industry to disinfect foil containers. A 3% solution is also used as an antiseptic.7.5% solution of hydrogen peroxide is approved by FAD for sterilization. (BODE science center)
- *Chloroxylenol* is the principal ingredient in Dettol, a household disinfectant and antiseptic
- Sodium hypochlorite: One of the most popular Chlorine-releasing agents (CRAs), is sodium hypochlorite solution, which are widely used for the disinfection of hard surfaces and blood spillages containing the human immunodeficiency virus or hepatitis B virus. (BODE science center)

***Ready-to-use Solutions for surface disinfection* (BODE science center)**

- Bacillol® AF: Alcohol-based rapid disinfectant with extensive spectrum of activity. Dries without leaving residues
- Bacillol® 30 Foam: Ready-to-use rapid disinfectant for sensitive surfaces
- Bacillol® plus :Alcohol-based, rapid disinfectant

***Operatory asepsis (protection of operatory surfaces)* (Sturtevant's 5th edition)**

- Operatory surfaces which are repeatedly touched or soiled should be protected with disposable covers which are changed after each patient. (Sturtevant's 5th edition)

- For *dental unit trays*: paper, plastic film, surgical pack wraps, or aluminum foil can be used to cover them.
- For *semi critical items* like air water syringe, suction tips, hand pieces, lamp handles, switches: that get contaminated by blood or saliva should be removed for cleaning and disinfection after every patient unless they are disposable. They should be protected from contamination by covering them with plastic sheets, aluminium foil or surgical wraps. (Sturtevant's 5th edition)
- *Noncritical items:* like chair, bench, walls, floor which are not contacted during treatment, but if contaminated they should be cleaned and disinfested. (Sturtevant's 5th edition)
- For *chair back and control units*: they must be covered to prevent contamination from operator's fingers. Covering them reduces the need for frequent disinfection, thus prevents the damaging effects of disinfectants and also saves time.
- *Protection of complex devises*: Items like cameras, curing light units, intraoral cameras, air abrasion unit, are examples of complex devises. They are used in operatory and cannot be sterilized or readily disinfected. Hence plastic bags of suitable sizes should be used to cover them. (Sturtevant's 5th edition)
- *Surface disinfection*: dental unit trays, chair side tables and other surfaces of the operatory must be disinfected. Steps involved in the disinfection are: (Michele L. Darby 6th edition)
- *Step1-Clean (spray the disinfectant on the surface).*
- *Step 2-Wipe (vigorously wipe the surface with paper towel to remove adherent debris).*
- *Step 3-Reapply Disinfectant and leave it for specified contact time, then wipe of any remaining wet areas with paper towel and finally rinse it off with water if the surface comes in contact with mouth.*

Sterilization of brackets and band material: The orthodontic brackets and band materials can be sterilized by standard autoclave, glass bead sterilizer, chemical vapour or dry heat sterilizing cycles. The contaminated brackets and bands must be cleaned, rinsed, dried and then subjected to sterilization cycles. (Dr. DevinderPreet Singh and Dr. Shefali Arora, 2015) Chlorhexidine is an appropriate disinfectant to be used on metal or ceramic brackets. In a study that evaluated the effect of 0.01 % Chlorhexidine solution on metal and ceramic brackets, it was found that Chlorhexidine does not have a significant effect on the metal bracket's adhesion ability (Speera *et al*., 2005).

Sterilization of Molar bands

1. Keep the bands in Ultrasonic cleaner for 5-12 minutes to remove any residual cement or debris.
2. Then the bands should be rinsed in distal water and dried.
3. Sterilize using dry heat or Autoclave.
4. Glass bead sterilizer can also be used for faster sterilization. Bands can be sterilized in about 45 seconds by using a glass bead sterilizer.

Sterilization of pliers and cutters

- Pre-clean the pliers by manual scrubbing or in a ultrasonic bath**.**
- Lubricate the hinges for proper functioning and remove the excess lubricant before the heating process. (Chris H. Miller, Charles J Palenik)
- Packaging: Priers must be wrapped before sterilization to allow the sterilant to contact all the surfaces. (George Kyritsis, 2013)
- To avoid the rusting of cutting edges of the pliers and cutters, they can be sprayed with 2 % sodium nitrite (rust inhibitor). Best approach is not to process the pliers through steam. (Chris *et al*.,)
- Instead dry the pliers and sterilize them in hot air oven, chemiclave, or sometimes one or two pliers can be sterilizes in glass bead sterilizer.

Sterilization of orthodontic wires: various studies are being carried out on the effect of sterilization on the orthodontic wires. The results are contradictory. Some of the studies report mechanical alterations whereas the others defend the opposite. A study was done on six different arch wires by autoclaving and, no significant change was observed on the alloy's surface characteristics that would affect their utilization. (Sterilization and Disinfection in Orthodontics AlevAksoy)

Disinfection of elastomeric ligatures: Polyurethane elastomers are frequently used in orthodontics as ligature and chain. The unused parts of elastomeric ligatures are generally sterilized via cold sterilization since they are not heat-resistant. Disinfection of these materials in a 5% gluteraldehyde solution for period of 10 minutes is recommended. Various studies showed that repeated disinfection of the same elastic can accelerate the destruction of the cross links in the long chain molecules of Polyurethane polyesters. Sterilization of elastomeric ligatures inside the autoclave at 121 degreeC does not lead to permanent deformations or to increased shrinkage whereas in the case of dry-heat, their manipulation becomes more difficult (Mayberry *et al*., 1996). (Sterilization and Disinfection in Orthodontics AlevAksoy)

***Disinfection of removable orthodontic appliance*:** removable retainers and orthodontic appliances are coated with biofilm which contains millions of pathogens which pose a threat of infection to orthodontist and laboratory technician hence they have to be disinfected by

- 0.12% chlorhexidine spray for 5 -10 minutes.
- Dipping in 2% gluteraldehyde solution, to reduce the no. of pathogens in appliance.

Disinfection of alginate impressions:

- Rinse the impression thoroughly under the running tap water, and remove the excess water from the impression.
- Dip the impression in a 1:10 solution of sodium hypochlorite for several seconds, then Wrap the impression in a gauze soaked in 1:10 sodium hypochlorite and place in an air tight plastic bag for 10 minutes.
- Or place in 2% glutaraldehyde solution for 10 minutes.
- Or spray the impression with disinfectant of choice, then place in air tight bag for 10 min.
- Then rinse the impression thoroughly under the running tap water to remove the remaining disinfectant. After this the impression can be sent to the lab.

Disinfection of Occlusal rims and Wax bites: Wax rims and wax bites are disinfected using an iodophor, chlorine dioxide, or sodium hypochlorite spray, since immersion in a disinfectant can cause distortion of the wax. After a second spray, the wax bites is placed in a sealed plastic bag for the sufficient contact time. The bites should remain wet with disinfectant for time recommended for tuberculocidal activity. (Dental economics: impression disinfection)

Sterilization of Impression trays: steps involved

- Impression trays should be rinsed thoroughly under running water to remove residual blood and saliva.
- Place the trays in ultrasonic bath to removes the additional adherent impression materials.
- Then clean, dry and pack the trays in autoclave for sterilization.
- Chrome-plated and aluminum impression trays can be cleaned, packaged, and heat-sterilized. Disposable, single-use, plastic impression trays are available which avoids the need for heat sterilization. (Dental economics: impression disinfection)

Sterilization of handpiece: Surface of handpiece comes in contact with the saliva and blood in oral cavity. Hence the surface can be cleaned with high level disinfectant and sterilized by autoclaving or in ethylene dioxide sterilization. Before each patient run the handpiece for few seconds (at least for 30-60 seconds) to flush out the bacteria which is drawn into the turbine or water line due to negative pressure. (Sturtevant's 5th edition)

Sterilization of burs: Burs are first cleaned in the ultrasonic bath to remove any debris. Then to avoid corrosion or rusting the burs are sterilizes in the hot air oven or ethylene oxide gas. For autoclaving the burs are protected by submerging in 2% sodium nitrite solution. After sterilization dry and store the burs in a clean place. Before use any remaining sodium nitrite is rinsed off in sterile water. (Sturtevant's 5th edition)

Sterilization of orthodontic marking pencils: they can be disinfected using various chemicals or cellophane tape can be wrapped around the pencil which can be changed in case of contamination or at the end of each day.

Protection of orthodontic instrument: Orthodontic Instrument such as pliers, and cutters are difficult to sterilize due to their complex design and tendency of the sharp edges to rust during sterilization process. Hence some special precaution must be followed. Pliers are considered semi critical items as they come in contact with the mucous membrane. In clinical practice it is not possible to sterilize the pliers after every patient, hence the orthodontist should atleast make an attempt to sterilize them using sterilants like glutaraldehyde, hydrogen peroxide, Peracetic acid.

Conclusion

Dentists work in an environment which is filled with many kinds of micro-organisms. These microorganisms may be normal commencers of oral cavity or they may be pathogenic causing many diseases such as influenza, hepatitis, AIDS, herpes, tuberculosis, pharyngitis and many more. Although orthodontists usually do not perform surgeries or treat infectious diseases, they can still get infected from patients who are carriers of pathogens but clinically asymptomatic. Thus today, proper sterilization and infection control techniques has become a crucial aspect of every clinical set up. Though complete sterilization in orthodontic clinics is practically impossible to achieve, atleast the number of pathogenic organisms should be reduced to level where they cannot cause diseases. We have to keep in mind that every patient is potentially infectious, and proper measures must be taken to prevent the transmission of diseases. The number of cases of transmissible diseases like HIV, Hepatitis B & C, herpes, is increasing worldwide mainly among health care professionals which makes it an absolute necessity to protect clinic staff and patients from getting infected. Hence protection of dentist and patient becomes a key step in infection control for this we can follow CDC (Centers for Disease Control and Prevention) guidelines for infection control in dental health care settings-2003. Sterilization of orthodontics instrument poses special problems during cleaning and disinfection because of their complex design, hinge regions, cutting edges, and their sensitivity to high temperatures. As these instruments are expensive and difficult to repair, there is always risk of damage to the instruments during cleaning. The research in the field of sterilization and disinfection is still in progress and we are yet to find an ideal and cost effective method for sterilizing and disinfecting the orthodontic instrument.

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