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# Infection Control in Orthodontics

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## Introduction

For protection of both the doctor and patient, infection control is of utmost importance in preventing the spread of infectious disease. This is of special significance in dentistry because more microorganisms are found in the oral cavity than in any other part of the body. According to a study Orthodontists have the second highest incidence of hepatitis B among dental professionals [1].

Individuals undergoing treatment in dental office may be undetected hepatitis-B carriers and patients secreting herpes simplex viruses in saliva may be asymptomatic. Such patients have the potential for transmitting diseases. Diseases such as hepatitis-B, HIV and tuberculosis have long incubation period and hence, it is difficult to identify the source of such infections to the dental practioners and other patients.

The greatest danger for orthodontist and his staff is from puncturing of the skin with contaminated instruments, sharp edges of orthodontic appliance, as any cuts or abrasions will allow micro-organisms to enter into the body. The microorganisms can also spread by direct contact with a lesion, by indirect contact through contaminated instruments or office equipments, by inhalation of aerosols induced by hand pieces and ultrasonic cleaners, and while scrubbing of instruments.

As responsible clinicians, our goals should be to reduce the number of pathogenic organisms to a level at which our own body resistance may prevent infection and to break the circle of infection by eliminating cross-contamination. Although many authors have previously published articles and reviews raising concern about sterilization maintenance in dental offices [2,3,4] here in this article, we have attempted to provide certain practical guidelines to be followed in our practice for optimal infection control.

## Primary goals of infection control

- To lower the risk of cross contamination by reducing the levels of pathogens.
- To correct any break in aseptic technique.
- To use universal precautions with every patient (treat every patient and instrument as potentially infectious).
- To protect patients and personnel from occupational infections

## Areas of infection control

### Orthodontist and staff

♦Basically, good personnel hygiene is the keystone of protection. The most important aspect of this is careful hand washing. They should be washed at least for a minute in cold water with germicidal soap. Cold water is suggested because hot water may cause pores to open.[1 ]Then the use of a hand disinfectant is administered. Of course, after all preparations, proper gloves should be used. As far as the Orthodontist is concerned a reasonably complete medical history of his patient is important in determining who are more likely to carry pathogenic organisms.

### Instruments

♦The Orthodontist must decide for himself, which instruments need to be sterilized. Instruments can be of three categories according to Spaulding system5:

♦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.

### Operator site

We should have in mind that our chair, table, light handles, spittoon, three way syringes etc., all become contaminated. It should be wiped frequently with 70% isopropyl alcohol. It is advisable to have straight tubing for the hand piece, three-way syringe and hand pieces should be fitted with non retraction valve. Minimize the number of tubing and wires which can accumulate dust.

## Steps in infection Control

### PATIENT SCREENING:

A regular informative medical history of the patient can help to identify factors that assist in the diagnosis of oral and systemic disorders. Many patients often fail to give the information. Every patient should be treated as potentially infectious.

This important fundamental application of infection control is termed as UNIVERSAL PRECAUTIONS. The blood and body fluid precautions substantially reduce the clinical guess work of a patient's infection status.

### PERSONAL PROTECTION:

Repeated exposure to saliva and blood during the dental treatment procedures may challenge the dentist's immune defense with a wide range of microbial agents. In this context, immunological protection and barrier protection are required

**Immunological Protection:** For immunological protection the operator should be vaccined with available vaccines of proven efficacy to prevent the onset of clinical or sub-clinical infection. The occupational risk of contacting hepatitis B, measles, rubella, influenza and certain other microbial infections can be minimized by stimulating artificial active immunity.

**Barrier Control:** Barrier protection is against the range of potential pathogens encountered during patient treatment. The physical barriers like disposable gloves, face masks, protective eyewear, headcap and surgical gowns during treatment procedure will minimize the infectious exposure.

Certain points which should be kept in mind are

1. Gowns must be cleaned daily.
2. Short nails will avoid tears in gloves and decrease the chance of patient discomfort. Hand jewelry and watches also should be avoided.
3. Hands should be cleaned before wearing gloves patient and should be washed after removing gloves also. Washing is recommended if the procedure involved more than 15-20 minutes. For routine OPD patients, use of hand scrub in between patients is recommended.
4. Gloves should be changed after every patient and should be changed if get torn or visibly soiled while working on one patient.
5. Use disposable protective coverings, cover for dental light, handle, tray, covers and tubing for hand pieces, aspirator and air water syringe. For example, the inner cover of sterile gloves can be wrapped around light handles for light adjustments during the procedure.
6. Let the patient rinse with antimicrobial mouth wash before treatment.
7. Avoid handling the chart, telephone, pen, pencil etc. while attending patients.
8. Use sensor lights instead of switches wherever possible.
9. Use sensor controlled water filter / foot or elbow operated water tap.
10. Disposable items should be burned immediately.
11. Impression should be disinfected immediately.
12. Protective eye-wear should be used in the lab.
13. Avoid the splash from the lathe or other waste materials to be on the floor or table.

## Washing and care of hands

♦Before gloving

to remove transient micro-organisms to suppress residual micro-flora while wearing the gloves.

♦After glove removal

to remove micro-organisms, which may have penetrated the gloves through microscopic defects or tears

to reduce any residual micro-flora build up that may have occurred

♦Hand washing for routine dental procedures is described in (Figure 1). Hand washing should be performed for about 40-45 seconds for performing routine orthodontic procedures Hands should be dried with hot air or disposable paper towels, and should be followed by the use of disposable gloves.

## Healthcare personnel hand washes

♦These hand washes are non-irritating, anti-microbial preparations designed for frequent use.♦Healthcare personnel hand washes have bacteriostatic or germicidal ingredients which have been shown to be active against residual skin micro flora, or transient micro-organisms.

## Other types of hand cleansers

♦General soaps may cause excessive dryness or defatting of the hands and may be extremely irritating for extensive use.

♦Hand cleaners labeled 'mild', 'gentle', lotion', and 'non-irritating' are formulated to be nonirritating, to minimize fat removal from the hands or, to re-lubricate the skin and preserve the skin pH

♦Do not necessarily contain active antibacterial agents.

 

## Antiseptics used in hand washing

### Chlorhexidine

- This is 2-4% chlorhexidine gluconate with 4% isopropyl alcohol in a detergent solution with a pH of 5.0 to 6.5.
- More effective than povidone iodine or parachlorometexylenol (PCMX).

### Povidone Iodine

- These products contain 7.5% to 10% povidone iodine providing 0.75% to 1.00% available iodine.
- Products containing emollients are available, for repeated use as healthcare personnel hand washes.

### Phenolic compounds

- Hexachlorophene
- Can be absorbed into the blood stream through intact skin, although it is more readily absorbed through abraded skin. It may be toxic if the blood concentration rises with repeated exposure.
- Parachlorometexylenol (PCMX) is bactericidal and fungicidal at 2% concentration. It is not toxic.

### Alcohols

- Ethyl alcohol and isopropyl alcohol are widely used as topical skin antiseptics, and have a potent bactericidal effect, especially at 70% concentration.

## Gloves

- Cuts and abrasions often found in fingers will serve as roots of microbial entry into the system when ungloved hands are placed in patient's oral cavity – WET FINGERED DENTISTRY. Hand washing is not a substitute for use of gloves.
- Four types of gloves can be identified for use in dentistry:[6]

A] **Sterile surgical gloves**: best fitting and expensive disposable glove. Used when maximum protection is required. Ensure practitioner proper fit of high quality latex glove.

B] **Latex examination gloves**: most commonly used gloves. Occasional hypersensitivity to latex has been reported. Inadequate drying before gloving can cause dermatitis. In case of hypersensitivity opt for a glove without corn starch or use vinyl or neoprene gloves or cotton glove liners with latex gloves.

C] **Vinyl examination gloves**: over gloves. Used when intra operative procedure is interrupted for a brief time e.g. to attend telephone etc

D] **Non disposable gloves/Heavy utility gloves**: Used when handling contaminated instruments or supplies. They can be washed sterilized, disinfected and reused. Pin holes are present in all gloves. It can lead to penetration and multiplication of microorganism.

The reasons for wearing operating gloves during dental Procedures are:

- To protect patients from becoming infected with micro organisms on the operator's hands.
- To protect the operator and staff from microorganisms present in the patient's blood and saliva
- Double gloving reduces the risk of puncture but not recommended now

## Orthodontist's gloves

The risk of glove puncture is high for orthodontists, who repeatedly handle wire bands and ligatures, although puncturing and tearing can be reduced by the use of elastomeric ligatures. Orthodontist can use puncture resistant gloves which are thicker at the palm, a high stress area for ligature placement and thinner material at the finger tips. Improper fitting gloves and reuse of gloves are not recommended. Washing of gloves with antiseptics increases the size and number of pinholes.

## Protective eye wear

Eyes are more susceptible to physical and microbial injury because of their limited vascularity and diminished immune capacities. Droplets containing microbial contaminants can lead to conjunctivitis. Operator should have a protective eye wear during working. If protection eye wear is available for patients, it is advisable because hand pieces, sharp instruments, arch wires etc. are routinely passed over the patients face. Removing a patient's glasses during dental treatment for the sake of comfort can no longer be recommended.

## Masks

Face masks can protect the operator from microbe-laden aerosolized droplets. The best mask can filter 95% of droplets of 3.0 to 3.2 microns in diameter. Mask should fit around the entire periphery of the face. It is better to change the mask between each patient.

**Points to consider before using a mask**

- Mask should be necessarily worn
- While examining any patient
- By the assistant also while using hand pieces, air / water syringes or scalers
- Washing contaminated instruments
- When the patient or the operator have any kind of respiratory disorder
- New mask should be used for each patient
- Body of the mask should not be touched during treatment or with unprotected hands while removing
- Mask should be removed immediately after finishing by tearing it from the back and not left hanging around the neck

- A wet mask should be removed immediately as it increases the permeability of the mask to microorganism

## Shoe covers and Head covers

- A pair of smooth, slip-on shoes should be kept exclusively for use in the clinics. These should be cleaned at the end of each clinical session.
- Head covers provide an effective barrier.

## Proper clinical attire

Appropriate dental clinic attire is a misunderstood area. Many practitioners place too much emphasis on choice of attire and not enough emphasis on correct protocol.

Current recommendations state that clinical attire should be changed at least once a day or when it becomes visibly soiled. Studies have shown that clinical attire easily becomes contaminated whenever a rotary instrument is used in the mouth. For this reason, a disposable cover must be worn over the gown when using rotary instruments.

Either a cotton weave or preferably a polyester-cotton blend is acceptable.

Although OSHA statement indicates that all exposed skin surfaces should be covered, short sleeved uniform may be acceptable. Intact skin is an adequate barrier against blood borne pathogens. Gowns should be with less buckles and buttons.

OSHA emphasizes that Street clothes and shoes must not be worn during patient treatment. Personnel must not wear clinic attire to and from the work place. Aprons / lab coats are to be used wisely. It is mandatory to use the aprons while examining patients or while working in the laboratory. These procedures will inevitably sow microorganisms into the fabric of the apron [7].

## Other barriers such as use of mouth wash

The use of an appropriate mouth wash prior to treatment procedure will reduce the total number of microbes in the oral cavity. Such a mouth rinse can reduce the number of oral microbes over a period while dental procedures are being performed.

## Disinfection

Disinfection procedures are advised only for those operatory surfaces and materials that cannot be routinely sterilized, such as, the table, dental chair and working surfaces, and for certain orthodontic instruments.

## Surface protection procedures [8]

Surfaces that are likely to be contaminated by the dental surgeon handling it or by the spill or spatter of oral contaminants should be disinfected .Surfaces touched by the dental surgeon are called **touch surfaces.** E.g. unit handles, various controls, light cure unit, micromotor,ultrasonic handpiece, 3 way syringe etc. these instruments need to be treated with disinfectants or covered with a protective barrier. The surfaces which are contaminated by contact with soiled instruments are called **transfer surfaces**. E.g. instrument trays, tube and hand piece holders.

**Splitter surface** is any surface which is not a touch or transfer or instrument surface and is within few feet of the oral cavity e.g. the dental chair surface. These surfaces are not cross contamination surfaces. Prevention of contact by touching and elimination of spill and spatter is ideal for preventing infection from surfaces. Since it is not possible, two main methods of protection of surfaces are used which are disinfection and barriers

**Disinfection** involves cleaning of surfaces after every patient and application of disinfectant chemical material. These chemicals include—alcohol, iodophore, synthetic phenols, gluteraldehyde, chlorine etc.

**Barriers** are impermeable materials used to cover surfaces of any inanimate object that would otherwise become contaminated. They are available in a variety of materials like plastic films, laminated paper plastics, aluminum foil etc. They are available in different sizes and shapes. Small barriers can be used to cover areas like light switches and a single large barrier can be used to cover head rest, back rest and chair control.

**Advantages of barriers**: Ease and speed of insertion; protection of equipment from damage of chemicals and body fluids and availability in standard sizes .

**Disadvantages:** Added cost and difficulty in storage and disposal.

Dental patient chair: All chair functions should be controlled from a foot switch to avoid possible contamination by use of hand operate switches. Greatest potential for cross contamination is from chair mounted controls. Covering switches with clear plastics, which is replaced between patient sessions, will allow visualization and use without contamination of switches.

Task seat or chair: Dentist should not touch seat covering with contaminated hands. Cleaning and disinfecting of porous seat covering may be accomplished with soap and water.

Spittoons: Spittoons should be flushed with water, scrubbed and disinfected. Assembly around spittoons can be protected by barriers and removed when contaminated.

Cabinetry: The amount of cabinetry should be minimized and they should be made from material that will with stand repeat cleaning and disinfection.

Tubing and hoses: These provide an ideal environment for the formation of biofilm. Layers of slime like substance are formed which protects the bacteria from disinfection and can trap other potentially infective microorganisms.

All water lines should be flushed for 3-5 minutes if the system has been idle for several hours. After each patient running high speed hand pieces for a minimum of 20-30 seconds to discharge water and air should be done to flush out patient material that have entered during use. Routine disinfection of water lines is possible by using a disinfection solution in water lines while unit is idle. Anti retraction valves to prevent backflow of patient material

 

into water line should be regularly tested for proper functioning.

## Procedure for cleaning of dental unit waterline

- Suck about 1 litre of 1% sodium hypochlorite through the suction line at the end of the day, leave it for overnight. Next day before starting the work rinse with water and use.

## Surface disinfection

- Materials like sodium hypochlorite 5.25% (1:10 dilution), iodophors like **Biocide** & combination synthetics (Phenolics, Multicide & Omni II Vitaphine) have the disadvantage of leaving surfaces wet for 10 minutes, which is inconvenient in a busy dental practice.
- Glutaraldehyde products that are intended to be used as surface disinfectants contain only 0.25% (w/v) glutaraldehyde. However, they should be used with care, as repeated contact may damage the skin.
- Surfasept S.A is a commercially available disinfection solution which is aldehyde free, contains Isopropyl alcohol, chlorhexidine digluconate and flavoured excipient. It must be sprayed onto the area which must be completely and uniformly moistened then wiped.[9]

Surface disinfection can be done by scrubbing the surface with the iodophor-soaked gauze pads and allowed to dry. Then 70% isopropyl alcohol should be used to remove the residue.

## Instrument disinfection

Least critical instruments such as Ligature tier and distal-end cutter, tying pliers, arch forming pliers, torquing keys, boons gauge, elastomeric rings etc. should be disinfected

Quaternary ammonium compounds are cationic surface acting agents. Commonly used ones are Cetrimide and Benzylkonium chloride. Disadvantages with these compounds are that they get inactivated by soap, reduced activity in presence of metal ions common in natural water, reduced effectiveness in presence of organic matter, lack of activity against tuberculous bacteria and are not sporicidal

8% solution of formaldehyde in alcohol and 2% solution of activated glutaraldehyde were considered to be two disinfectant of choice. But apart from toxicity issues, aldehyde based solution cause corrosion and rusting of stainless steel instruments which comprise majority of dental and orthodontic instruments.

Hence, an alternative solution is 5% Bibforte solution (ALPRO MEDICAL GMBH, Germany) which is aldehyde free, non-toxic and non-corrosive disinfectant. 100g BIB forte contains 2.2 g dodecyldipropylenetriamine, 1.7 g trialkylethoxy ammoniumpropionate, tensides and auxillaries. It is bactericidal (incl. TBC, MRSA), yeasticidal and virus inactivating. 5% solution is made by adding 50 ml of Bibforte solution to 950 ml of water and instruments are immersed in 5% solution for 30 minutes for effective disinfection. In emergency situation, 10% Bibforte solution with 5 minutes immersion of instruments can used for early and effective disinfection (as recommended by manufacurer) [10].

## Disinfection of Removable Appliances

Removable retainers and orthopedic appliances are coated with saliva and millions of microorganisms, which may include pathogens and opportunist microbes that may cause disease if host resistance is low. Handling of these appliances in the orthodontic office risks transmission of attached microbes to the orthodontist, laboratory personnel, and other patients— unless specific measures are taken to limit the spread. Also, in making adjustments on these appliances, the rotating bur drives acrylic particles covered with microbes toward the eyes, nose, and mouth of the operator, and onto environmental surfaces. Appliances of subsequent patients placed on tray or bench surfaces may be contaminated.

Glasses protect the eyes, and a full-face mask prevents infection of the face due to fast -moving, microbe-laden, acrylic particles that can break the skin. Cross-infection between patients can be prevented by operatory disinfection, but the rapid succession of patients makes this difficult. An alternative approach is to reduce the number of microorganisms at the source by disinfecting removable appliances in individual germicide containers throughout the appointment.

**Oral Safe** is a germicide-deodorant that is harmless if ingested. In a previous study it was found to destroy 99% of microbes on removable appliances during 10 minutes of submersion. Now a three-minute procedure has been developed that combines the use of a germicide-deodorant with ultrasonic energy to kill 10 times more microorganisms than passive submersion, and to clean and thoroughly deodorize removable appliances.[11]

## Dental laboratory Practices

Impressions bite records and devices placed in patients mouth should be properly rinsed to remove saliva, blood and debris and then disinfected by immersion in any compatible disinfecting product prior to handling over to the laboratory. Laboratories should institute proper infection control.

**Impressions / casts**

The following four methods are acceptable for the disinfection of impressions:

- Immersion in a chemical disinfectant such as 0.5 % - 1% sodium hypochlorite containing 1% chlorine, 2% gluteraldehyde for 60minutes, 4% formaldehyde for 10 minutes. Even though gluteraldehyde is not effective against HIV and HBV, it is generally accepted.
- Spraying of a disinfectant on the impression – 0.5% chlorhexidine in 70% alchohol
- Usage of an ultraviolet disinfection unit.
- Usage of an antiseptic containing alginate impression material.

## Recommended Procedure for disinfecting the alginate impression

- Rinse the impression thoroughly under running tap water, shake the impression to remove excess water.
- Dip the impression in a 1:10 solution of sodium hypochlorite for several seconds to ensure maximum contact of undercut with the disinfectant.
- Wrap the impression in gauze soaked in 1:10 sodium hypochlorite, place in a plastic bag and seal for 10 minutes.
- Remove the impression and rinse thoroughly under running tap water.

**Dental casts** from impressions may harbor infectious microorganisms or the wax bite records from the patients may cause dental casts to become infected. Dental casts may be disinfected by adding disinfectant like iodophor or neutral gluteraldehyde to dry gypsum during the mixing process. Spraying the dental casts with iodophor or chlorine products may be recommended.

## Sterilization

Sterilization can be accomplished in one of several ways. Some of the most common ways that are followed in orthodontic practice include steam autoclave sterilization, dry heat sterilization, chemical vapour sterilization and ethylene oxide sterilization [12]. (Table 1).

## Instrument Processing

The overall process consists of

- Holding ( presoaking )
- Precleaning
- Corrosion control, drying, lubrication
- Packaging
- Sterilization
- Sterilization monitoring
- Handling processed instruments

**Presoaking:** Placing instruments in presoak solution until time is available for full cleaning prevents drying, begins to dissolve organic debris and in some instances begin microbial kill. Presoak solution consists of detergents, enzymes, or detergents containing disinfectants. Used solution should be discarded atleast once a day.

**Cleaning:** Blood, saliva and materials on instrument can insulate underlying microorganisms from sterilizing agents. Cleaning reduces this bioburden. Cleaning solutions with antimicrobial activity can eliminate build up of contaminants as the cleaning solution is being repeatedly used.

**Hand cleaning**: is an effective method if performed properly. Heavy utility gloves and protective eyewear should be worn during hand cleansing of instruments. Instruments should be immersed in the detergent solution and then scrubbed with soft brush.

Disadvantages of hand cleaning: time consuming; can splatter contaminants; increase chance of accidental puncture by sharp instruments.

**Mechanical/Ultrasonic cleaning**:

Coupling of powerful ultrasonic vibrations with cold disinfection increases the effectiveness of the process. In a densely packed pile of instruments, there is only a thin layer of disinfectant around each instrument; vibration assures penetration of a properly concentrated solution into every area of every instrument [13]. Cleaning solution specifically recommended for use in ultrasonic cleanser should be used in proper dilution. The instruments are kept in the ultrasonic cleanser basket and submerged in the cleaning solution.

**Ultrasonic Cleaner:** The cleaner should be covered and operated for 6-10 minutes or until no visible debris remains. If instrument cassettes are used cleaning time is increased to 15 minutes. After cleaning instruments are thoroughly rinsed. Cleaned instruments must be considered contaminated and handled with gloved hands.

## Corrosion control and lubrication

### Corrosion

It is an electrolytic process in which the contact of two dissimilar metals or dissimilar areas within a single metal sets up a potential difference resulting in an electron flow. The electron flow leaves behind reactive ions that readily combine with atmospheric oxygen to form oxides (rust). Conditions such as extreme temperatures, physical abrasion, galvanism, or reactive extraneous ions that disrupt the chromium oxide layer will render the steel vulnerable to corrosion. Instruments made of carbon or 400 series steel are more susceptible than those of 300 series steel. Recent studies showed no significant difference in mean wear whether sterilized with steam autoclave or dry heat.

### To reduce corrosion [14]

- Clean and remove debris from the instruments and rinse with distilled water.
- Avoid tap water which contains dissolved alkali and metallic ions.
- Water must be deionized and of good quality.
- Keep the pH of steam above 6.4; otherwise pitting will occur.
- Chrome plated instruments and stainless steel instruments should be sterilized separately because the electrolyte action can carry carbon particles from the exposed metal of a chromium plated instrument and get deposited on stainless steel.
- It is better to keep the instruments in wrapping. Detergents with chloride bases should be avoided because chloride residue unites with steam to form HCl.

 

**Table 1** Sterilization methods.

| Method of steriliation | Advantage | Disadvantage |
|---|---|---|
| **HOT AIR OVEN** | 1] no corrosion 2] Large capacity per cost 3] Items are dry after cycle | 1] longer sterilization time 2] Cannot sterilize liquids 3] May damage plastic and rubber items |
| **RAPID HEAT STERILIZER** | 1] no corrosion 2] Short cycle 3] Items are dry after cycle | 1] cannot sterilize liquids 2] May damage plastic and rubber items 3] Small capacity per cost. |
| **AUTOCLAVE** | 1] good penetration 2] Time efficient 3] Sterilize water based liquids | 1] non stainless items may corrode 2] Closed containers cannot be used 3] May damage plastic or rubber items |
| **UNSATURATED CHEMICAL VAPOUR STERILIZATION** | Suitable method for orthodontic instruments | Drawback of this is the odor, even though not toxic requires adequate ventilation. |
| **ETHYLENE OXIDE STERILIZATION** | Suited for large institutions. | 1] Slow procedure-- 4 hours at 54°C and 12 hours at room temperature 2] Costly 3] If moisture is present it reacts with ethyleneoxide to form ethylene glycol coating. 4] After sterilization articles should be aerated for 24 hours for dissipation of gas. |

- Detergents with pH of more than 8.5 may disrupt chromium oxide layer.

**Packaging:** Cleaned instruments should be packed prior to sterilization to protect them from recontamination after sterilization. The instruments should be packed in an appropriate wrapping material before sterilization. A wrapping material designed for a particular type of sterilizer should be used with the sterilizer. E.g. A single layer cloth wrap for steam sterilization, self sealing polyfilm paper pouches for chemical vapour sterilization, paper wrap for dry heat sterilization. Wrapping material should be self sealing or heat sealed or double folded and sealed with appropriate tape.

## Types of Sterilization

**HOT AIR OVEN**: Dry heat denatures protein of microorganisms rendering it nonviable. It operates at a temperature of 160°C for 1-2 hours. Smaller dental units are convection ones without forced air circulation. Larger units have large capacities and are either convection or forced air circulation unit. Sterilization time begins only after the proper temperature of 160°C is reached and then this temperature must be maintained.

Common misuse is opening the door to keep forgotten things without starting the cycle again.

**RAPID HEAT STERILIZER**: Uses controlled internal air flow system at 375°F. Sterilization claims of 6 minutes are made with unwrapped instruments and 12 minutes for wrapped instruments.

**AUTOCLAVE:** Moist heat denatures and coagulates protein of microorganisms. The sterilization is due to latent heat of vaporization present in moist heat. When steam condenses on contact with cooler surfaces, it becomes water and gives latent heat to that surface. This principle is used in autoclave. Temperature required is **121°C for 20 minutes at 15 pounds pressure**. For practical considerations high pressure vacuum models are operated at a temperature of136°C for 5 minutes at 30 pounds pressure.

Jones.M etal investigated the effects of routine steam autoclaving on orthodontic pliers. In this five commonly used orthodontic pliers of three different types of manufacture were evaluated. [1]SS pliers; [2]Chrome plated pliers; [3]cheaper chrome plated pliers.

Generally all pliers stood well to combination of routine clinical use and steam autoclaving. However, the SS pliers appeared to perform the best [15].

**UNSATURATED CHEMICAL VAPOUR STERILIZATION**: Uses special solution containing 0.23%formaldehyde (active ingredient) and 72.38% ethanol plus acetone, ketone, water and other alcohols. It's a suitable method for orthodontic instruments.

Operates at 270°F(132°C) with 25 pounds pressure for 20 minutes.

**ETHYLENE OXIDE STERILIZATION**: Ethylene oxide at normal temperature is a gas with very high penetrating ability. It acts by alkylating the amino, carboxyl, sulphhydril groups in protein molecules. It reacts with RNA and DNA. Used to sterilize heat sensitive instruments.

## Special Considerations for Orthodontic armamentarium [8,16]

**Orthodontic pliers**: High quality stainless steel pliers can be sterilized by steam, dry heat, chemical vapour and ethylene oxide gas .For low quality pliers steam autoclave is not preferred for it may damage the material. For pliers with plastic parts ethylene oxide sterilization is the only effective method. Effects of Three Types of Sterilization on Orthodontic Pliers were studied

by Mazzochi et al. [15]. The study showed that clinical and metallurgic modifications of common orthodontic pliers after 500 cycles of sterilization in autoclave, chemiclave, or dry-heat units are negligible. Vendrell and Hayden [17] compared the wear of orthodontic ligature-cutting pliers after multiple cycles of cutting stainless steel ligature wire and sterilizing with dry heat or steam autoclave. Fifty ligature-cutting pliers with stainless steel inserts were randomly divided into 2 equal groups to be sterilized in either dry heat or steam autoclave. Each plier was subjected to a series of ligature wire cuts followed by the assigned sterilization method. The amount of wear at the tip of each plier in both groups was measured with a stereomicroscope system and digital photomicrography. Orthodontic ligature-cutting pliers with stainless steel inserts showed no significant difference in mean wear whether sterilized with steam autoclave or dry heat. Steam autoclave sterilization can be used with no significant deleterious effects on pliers with stainless steel inserts.

**Orthodontic wires:** Smith et al[18] 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. Mayhew and Kusy [19] studied the effects of sterilization on the mechanical properties and the surface topography of 0.017 ×0.025-inch Nitinol and Titanal arch wires. Three approved heat sterilization methods were used namely, dry heat applied at 180° C (355° F) for 60 minutes, formaldehyde alcohol vapor pressure of 20 to 25 psi for 30 minutes at 132° C (270° F) and steam autoclave at 121° C (250° F) and 15 to 20 psi pressure for 20 minutes. They concluded that neither the heat sterilization nor multiple cycling procedures had a deleterious effect on the elastic moduli, surface topography, or tensile properties of Nitinol or Titanal arch wires.The bending moduli and the tensile strengths were approximately 10% greater for Nitinol than for Titanal. Kapila, Haugen and Watanabe [20] determined the effects of in vivo recycling interposed by dry heat sterilization (together referred to as clinical recycling, CR) on the load-deflection characteristics of nickel-titanium alloy wires (Nitinol and NiTi). The results indicated that both dry heat sterilization (DHS) alone, as well as clinical recycling (CR), produced significant changes in the loading and unloading characteristics of Nitinol and NiTi wires.

**Ligatures**

Metal and elastomeric ligatures are potential agents in the transmission of infectious diseases. Cross-contamination in handling elastomeric ligatures is a serious concern in the orthodontic office, since cold sterilization can damage the elastomeric material. Mulick [21] recommended single-use dispensing of elastomeric materials to eliminate contact of canes or sticks with contaminated hands. Schneeweiss [22] described a method of cutting elastomeric modules into smaller sections and covering them with clear tubing, which could then be cold sterilized. During arch wire placement, the operator contacts only the outside tubing while removing ligatures. The used section of ligatures is cut off and discarded after ligation

**Orthodontic bands**

Preformed bands are first checked on the patient cast, if in case they don't fit intraorally then these tried bands are cleaned in ultrasonic cleaner and disinfected with disinfectant solution for recommended time as per manufacturer before placing it back in the box .

**Elastics and elastometric chains:** 5% Bibforte. Elastomeric Rings, Chains etc are sterilized by immersing in 5% Bibforte Solution for 30 Minutes. Vapoclave(ethylene oxide) is preferred for E-chain and ligature wires.

**Retrieved Arch wires, ligatures other sharps** are treated with 5% Bibforte solution and dispatched to the central processing unit in plastic boxes

**Orthodontic brackets and buttons:** Reuse is not advised as it may impair the performance and increase the risk of patient injury. Effects of recycling on metallic direct-bond orthodontic brackets was studied by Buchman. The methods of three recycling companies (Esmadent, Ortho-Cycle, and Ortho-Bonding) as well as the author's flame method were examined for their effects on bracket base torque, slot width, and mechanical properties. While it appeared that the amount of dimensional changes in the brackets after recycling is of little clinical signifficance, the changes in the metallurgic microstructure suggest susceptibility to metallic intergranular corrosion [23].

**Rubber items and saliva ejectors**: Best method is to discard them after each use. Ethylene oxide sterilization is ineffective for rubber material and they may be damaged by dry or moist heat sterilization.

**Hand pieces**: Steam, dry heat, chemical vapour and ethylene oxide sterilization are acceptable for hand pieces.

- Run the handpiece over a sink for 20 seconds allowing water to flush through the hand piece thoroughly. Remove the bur.
- Scrub the hand piece thoroughly with detergent and water, to remove any debris. Rinse and dry the hand piece.
- Lubricate the hand piece with a good quality oil recommended by the hand piece manufacture
- Expel excess oil by running the hand piece for 2 seconds, after replacing the bur or hanging the hand piece in a hand piece rack.
- Remove the bur, if replaced. Clean the fiber-optic, bundle ends with alcohol Place the hand piece in a clear view sterilisation pouch, together with a chemical indicator strip
- Sterilise in an autoclave or chemiclave, according to the

 

manufacturer's instructions. Do not leave the handpiece in the steriliser after sterilisation cycle is complete.

♦Remove the hand piece from the bag, insert the bur, and use.

**Rotary instruments** Burs become very contaminated and are classed as critical items; they must be sterilised after use. Diamond and carbide burs may be safely autoclaved with minimal damage but carbon-steel burs are damaged by autoclaving. Carbon-steel burs may be sterilised by using a chemical vapour steriliser. A glass bead steriliser at 218ºC for 10 seconds may be used to sterilise grossly contaminated carbon-steel burs during the same dental procedure.

## Visible-light curing units

It has been shown that light curing devices are a potential source of transmission of infectious diseases, due to contamination of the light curing tip, which directly contacts oral structures, and the handle, which becomes contaminated with blood and saliva from the operator's or assistant's gloved hands. Some new designs of unit feature removable, autoclavable light curing tips. However, the handles still present a problem, since they cannot be sterilised. Units should be cleaned and disinfected with a phenolic disinfectant after use. Plastic units should be disinfected using an iodophor. Glutaraldehyde disinfectants have been found to damage the glass rods in a fiber-optic light tip, with a subsequent reduction in light output; the use of this disinfectant should be avoided.

## Procedure

♦Thoroughly wipe and clean the whole unit.

♦If the fiber optic light tip can be sterilised, detach it and sterilise as recommended by the manufacturer.

♦Wrap the handle and light curing tip (if not autoclavable) in a wrap, soaked with an iodophor disinfectant. The wrap should remain in place for at least 10 minutes or until the unit is next used.

♦Remove the wrap and wipe the unit with distilled water to remove residual disinfectant. ♦Some practitioners cover the top light curing tip with Clingfilm, which is removed after use

♦Disposable protective coverings could be used on the handles, providing they do not interfere with the unit's cooling mechanism.

**Stones**: For diamond stones dry heat , chemical vapour and ethylene oxide gas sterilization are preferred. For polishing stones chemical vapour and ethylene oxide sterilization are preferred. Polishing buff is disinfected by immersing it in CIDEX (2% glutaraldehyde) solution or alternatively in 5% Bibforte for 30 minutes.

**Impression trays.** For aluminum trays dry heat is not preferred. For chrome plated trays all methods of sterilization can be employed. For plastic or acrylic trays, ethylene oxide or gluteraldehyde sterilization is preferred.

**Stainless steel hand instruments** can be sterilized by autoclave, dry heat, chemical vapour and ethylene oxide sterilization. **Ultrasonic tip** can be autoclaved but for ultrasonic cord preferred methods are vapoclave and gluteraldehyde. **Tongue blade**, **lip and cheek retractors** can be sterilized by steam or dry heat. **Welder points** sterilized preferably by vapoclav(ethylene oxide).

**Orthodontic Marking Pencils.** Conventional orthodontic marking pencils cannot be autoclaved. Gas sterilization, as used in this study, is effective in killing bacteria, but is also costly and difficult, making it impractical for orthodontic offices. One article has suggested alcohol-containing permanent markers as a safe and effective alternative to pencils, but this report also noted that the pens become increasingly ineffective in eliminating bacteria the longer they are used. Because alcohols are intermediate disinfectants that do not kill spores or certain viruses, the permanent markers may be unreliable infection-control devices. Soaking or spraying the tips of marking pencils with disinfectants could be more effective than wiping, but this method is unlikely to gain acceptance from practitioners. The only sure way to avoid potential cross-contamination is to use the inexpensive disposable markers available from orthodontic supply companies [24].

**Orthodontic adhesives.** Composites used as orthodontic direct bonding adhesives have a polymeric matrix that can host and nurture a variety of aerobic and anaerobic microorganisms acting alone or in combination. Their accumulation can lead to the weakening of the bond and possibly the attacking of the tooth. A number of microorganisms have been identified as present on the removed direct bonding brackets. Results of rendering the adhesive microbe-resistant by adding a bactericide have shown to be encouraging [25].

## Sterilization requirements for the placement of temporary anchorage devices [26]

According to the CDC, the placement of miniscrews in an orthodontic office is a surgical procedure. The following are the requirements for any oral surgical procedure: (1) perform surgical hand antisepsis with an antimicrobial product, (2) wear sterile surgeon's gloves, (3) use sterile saline solution or sterile water as a coolant or irrigator, (4) use devices specifically designed to deliver sterile irrigating fluids, and (5) use packaged sterile instruments. In addition, to reduce the risk of postsurgical infection after implant placement, every load containing implantable devices should be monitored with a biologicial indicator (spore test) and avoid placing the device until after the results of the spore test are known. Because of the potential risk of infection from cutting or otherwise penetrating tissues that are not normally exposed, many precautions must be implemented to ensure patient protection.

List of the items needed to comply with sterilization guidelines:

(1) sterile implant; (2) biological indicators; (3) sterile instruments; (4) pouches or central supply room wrap if using cassettes; (5)

Sharpie permanent marker 3601 or 13801 (Sanford LP, Oak Brook, Ill) (ink from this marker does not emit toxic fumes during sterilizing); (6) antimicrobial soap or alcohol-based surgical hand rub; (7) sterile, powder-free gloves for doctor and clinicians; (8) clinic gown (disposable or a separate one for procedure); (9) mask; and (10) protective eyewear for doctor, clinician, and patient. Compliance with CDC guidelines and patient assurance of sterile instruments are necessary for using TADs in a practice.

## Monitoring sterilization

Monitoring the effectiveness of the sterilization process in a particular time interval is very important. Spores of Bacillus stearothermophilus are used to monitor steam and unsaturated chemical vapor sterilizers, and spores of Bacillus subtilis are used to monitor dry heat sterilizers. In spore testing the biological indicators (spore strips or vials) are kept inside a regular instrument package. Spore testing can measure the use and functioning efficiency of sterilizers.

The other way is chemical monitoring which uses a special ink that changes color or form when exposed to sterilizing temperatures. These are in the form of autoclave tape, strips or tabs or special marking on the outside of the pouches.

## Storage of sterilized instruments

Unpackaged instruments removed from the sterilizer have a zero –sterile shelf life. Do not allow packages to become compressed. Store the packages in a low dust area. The sterile shelf life is dependent upon the integrity of the packaging material. This is determined by assuring that the package never becomes wet, by observing the packaging for tears upon removed from storage, and when delivered to chair side for use on the next patient.

## Waste and Sharps disposal system

Management of Regulated Medical Waste in Dental Health-Care Facilities is done by use of color-coded or labeled container that prevents leakage (e.g., biohazard bag) to contain nonsharp regulated medical waste (Table 2). Handling, segration, mutilation, disinfection, storage, transportation and final disposal are vital steps for safe and scientific management of biomedical waste management in any establishment. The commonly used items in an orthodontic office and their disposal protocol are shown in (Table 2). The aim of waste disposal protocol for any establishment should be to increase the general waste which can be discarded and disposed off in secured landfill and as much as possible to reduce the load of waste which requires incineration and may cause environmental concerns. Attempt should be thus made to make protocols which increase the amount of waste disposed in Black container while reducing that in yellow container but at the same time doesn't impair the quality of the system. A sharps container is a mandatory part of the overall waste disposal system within the dental office. Sharps container must be rigid, puncture proof, leak resistant and should be sterilizable.

## Post exposure plan

In case of an accidental exposure the exposed part is washed thoroughly. Blood and contaminants can enter unprotected eyes, nose or mouth which should be immediately rinsed. In case if the blood has splattered on to a skin surface which is cracked or there is fresh wound then they are washed with soap and antiseptic solution. Medical history of the patient is rechecked. It is important to report to accident to the emergencies department because it's not only Hepatitis-B ,but there is a risk of contracting HIV in an accidental exposure and post exposure prophylaxis for HIV is preferably initiated within 1-2 hours of exposure. All the employees are instructed to inform the person in charge of accidental exposures who will immediately arrange for the necessary medical attention and compile the necessary reports.

**Table 2** Color coding and Final Waste Disposal System.

| Colour Coding | Treatment Options |
|---|---|
| Yellow - Plastic Bags | Incineration & deep burial |
| Red Plastic Bags | Chemical Disinfection, Autoclave |
| Blue /White/Trans-Plastic Bags puncture proof | Chemical Disinfection, Shredding, Autoclave |
| Black-Plastic Bag | Secured Landfill |

**Table 3** Waste Disposal Protocol in an Orthodontic office.

| S.no | Material | Disposal |
|---|---|---|
| 1 | Impression material (Discarded/Used) | Immerse 1% Sodium hypochlorite solution bucket for 24 hours and then Dispose in Black container |
| 2 | Dental Casts (Discarded/Used) | Immerse 1% Sodium hypochlorite solution bucket for 24 hours and then Dispose in Black container |
| 3 | Removable Appliances with wire component (Used/Broken not to be worn by patient anymore) | Sharps Container containing 1% Sodium hypochlorite |
| 4 | Wires, steel ligatures, orthodontic mini-implants, Needles after being burnt, | Sharps Container containing 1% Sodium hypochlorite |
| 5 | Wax bite registrations | Red container |
| 6 | Debonded brackets, buttons and other attachments | Red container |
| 7 | E-chain, elastic ligatures, elastics | Red container |
| 8 | Mouthmask, Gloves | Red container |
| 9 | Headcap, Shoe covers | Black container |
| 10 | Infected cotton | Yellow container |
| 11 | Syringe (after breaking at Hub in Needle destroyer) | Red container |
| 12 | LA bottles | Black container<br>If broken, Sharps container. |

## Conclusion

Effective infection control must be a routine component of professional activity. The use of universal precautions in the management of all patients greatly minimizes occupational exposure to microbial pathogens. It is incumbent upon each orthodontist to conduct his practice in a manner that will not cause harm to anyone. By following the procedures outlined here, the orthodontist can minimize and even prevent the possibility of cross infection. Practical reality, of course dictates that to prevent possible spread of infectious diseases, dental professionals must be provided with up-to-date information that can be utilized to develop an optimal programme of asepsis.

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