Infection Control In Prosthodontics

Dr.Naveen.B.H¹, Dr.Kashinath.K.R², Dr.Jagdeesh.K.N³, Dr. Rashmi.B.Mandokar³
¹Reader, ²Prof. & Head, ³Senior lecturer, Dept of Prosthodontics, Sri Siddhartha Dental College, Tumkur, Karnataka.

Abstract:
Dental professionals are exposed to a wide variety of microorganisms in the blood and saliva of the patients. These microorganisms may cause infectious diseases. The use of effective infection control procedures and universal precautions in the dental office and the dental laboratory will prevent cross contamination that could extend to dentists, dental office staff, dental technicians and patients.

This review of literature has attempted to appraise the different protocols designed to protect the dentist and laboratory technician from potential infection as well as to protect the patients from cross contamination.

Key words: Dental infection, Dental Clinical, Dental Laboratory, Disinfectant, Sterilization.

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Introduction:
Infection control is as old as disease control in health care modalities. The dental profession has developed an increased appreciation of the potential for disease transmission in the dental clinic and laboratory. The most efficient method of implementing conscientious infection control for our collective protection is to practice universal precautions in the form of personal barrier techniques.

Recently, dental materials have been disinfected using effective techniques.

Hence, this literature review is undertaken to upgrade our knowledge on the pros and cons of all the available procedures and techniques in the field of
infection control in dental office and laboratory. For convenience, the literature was reviewed under following groups,

- Infection control in dental office.
- Infection control in dental laboratories.

**Infection control in dental office:**

Prosthodontic patients are a high-risk group relative to their potential to transmit infectious diseases as well as their susceptibility to acquire them. The dental profession must assume that every patient treated is a risk of cross infection and to adopt appropriate control measure.\(^{(5)}\)

The cycle of cross contamination

**Patient evaluation**

Any treatment is performed only after a comprehensive patient evaluation. This is achieved by a medical history specially designed to identify patients who are either particularly susceptible to infection or who are at risk of transmitting infection, known as carriers of disease or by being in a high-risk category.\(^{(5)}\)

**Personal protection**

Dentist can best manage patients infected with Hepatitis—B viruses (HBV) and protect themselves, and in turn other patients, by being vaccinated with HBV vaccine. **Clare Connor's**\(^{(5)}\) report has shown that the vaccine is safe and highly efficacious, affording protection with a success rate of more than 95%. In June 1982, the council on dental therapeutics adopted a resolution recommending that all dental personnel having patient contact including dentists, dental students and dental auxiliary personnel, and all dental
laboratory personnel receive the Hepatitis B vaccine. (6).

The vaccination programme must certainly be considered the most effective cross infection control measure to protect dental personnel and in turn their patients, from a potentially fatal disease. (5,12)

A long-sleeved, high-necked clinical coat, eye shields, facemasks and rubber gloves must be considered essential to reduce cross contamination with in prosthodontic practice. Dental personnel should wear eye shields and a facemask covering the nose and mouth when there is exposure to aerosols and splatter (5,6,23).

For maximum protection, cuts and abrasions on the skin should be covered with adhesive dressings beneath the gloves. Pregloving disinfection confers strong antimicrobial properties on the internal surfaces of the gloves. Hands should be washed using a disinfectant hand wash agents such as povidone-iodine or chlorhexidine. (6)

**Instrument and equipment decontamination**

It is generally recognized that disposable equipment should be used whenever possible. All other instruments that have been used in the oral cavity should be cleaned thoroughly in an ultrasonic bath before being sterilized in an autoclave. (2)

Disinfectants must be used to decontaminate non-sterilable apparatus (e.g. Shade & mould guides, mixing spatula, wax knives, occlusal plane indicators, articulators, face bows, and other maxillo mandibular registration apparatus).

**R.R. Runnels** (22) in 1988, six basic infections control procedures as mandatory for the control of infectious disease in dental practice. These commonly recommended procedures are as follows (6,22).

* All dental treatment personnel should wear latex examination gloves during patient treatment.

* All dental treatment personnel should wear masks covering the
nose and mouth during patient treatment.

* All dental treatment personnel should wear protective eyewear during patient treatment.

* All items used in the oral cavity should be sterilized in a heat or heat pressure sterilizer whenever possible.

* All “touch & splash” surface should be disinfected with an EPA registered.

ADA accepted disinfectant whenever sterilization is not possible. Presently available chemicals meeting these criteria include glutaraldehyde, sodium hypochlorite, iodophor and synthetic phenolic compounds.

* Contaminated material should be disposed off carefully by placing it in a sealed, appropriately marked containers.

Roger E. Johansen et al (21) in 1987 conducted a study (a) to measure and compare the linear dimensional changes of five representative rubber elastomers including polyether, condensation silicone, polysulfide and two polyvinyl siloxane, after immersing in a 2% glutaraldehyde solution and (b) the effect on acrylic resin after sterilizing by immersion when acrylic resin trays with impression were used in clinical practice. Their results indicated that the polyether was affected dimensionally by immersing in the disinfectant (as they shrunk when dry and swelled when in solutions.) The dimensions of two silicon - tray resin assemblies were not greatly changed and the adhesive used was not degraded by disinfectant.

S. A. Belt et al (2) studied the biocidal effectiveness of chlorine dioxide and 5.25% sodium hypochlorite to kill pathogenic organisms on denture base acrylic resin strips in the presence of 10% horse serum organic material in 1989. They concluded that, the chlorine dioxide achieved complete disinfection of all three organisms within 2 minutes. Sodium hypochlorite achieved complete
disinfection of all the three organisms within 4 minutes. Disinfectants applied by spray atomization was examined by D. G. Drennon et al (7) in 1989 for possible dimensional distortion of elastomeric impression materials namely polyether, polysulfide and addition silicone. Chlorophenol, a 0.25% acid glutaraldehyde, an iodophor, a phenyl phenol and a phenol sodium phenate spray disinfectants were used. It was also shown that the disinfectants applied by spray atomization were effective on the surface of an elastomeric impression material contaminated with selected test organisms. In 1990, J. O. Look et al (13) studied the biocidal action of germicides against an enveloped virus on an irreversible hydrocolloid impression surface. The authors concluded that dipping or immersion is strongly preferred to spraying, to avoid inhalation of an aldehyde. The 0.5% sodium hypochlorite spray was effective in 3 to 10 minutes range and iodophor required 3 to 10 minutes immersion for inactivation of the virus.

Rhonda F.K.J et al (19) in 1991 determined that the steam autoclaving causes linear dimensional change or decreased strength in heat processed poly (methylmethacrylate) implant material. Two types of methylmethacrylate cranial implants were tested, chemically activated and heat polymerized. The heat-polymerized resin was tested and processed, following autoclaving. It was compared to an autopolymerising methylmethacrylate for impact strength. They concluded that, there was no significant change in strength between non-sterilize heat-processed methyl methacrylate and autoclaved heat-processed methyl methacrylate. The heat-processed specimens were significantly stronger than autopolymerising methylmethacrylate cranioplasty. A significant linear distortion of 1.211% was measured between
the autoclaved and non-sterile heat processed methylmethacrylate was found but was not considered clinically significant.

In 1992, H. S. Harold et al \(^{10}\) determined the efficacy of eight disinfectant solutions viz sodium hypochloride (undiluted), sodium hypochloride (diluted), Alcide L.D., OMC II, Biocide, Sporicidin, Lysol, Impresepct and sterile water (control) when used as for immersion and a spray against three microorganisms (S. aureus, M. Phlei and Bacillus subtilis) and normal mixed oral flora on the surface of irreversible hydrocolloid impressions. This study concluded that, Alcide L.D., Lysol spray, OMC II and Biocide were relatively ineffective against the three microorganisms tested and on mixed oral flora. Full strength sodium hypochlorite and Impresepct were essentially equal in effectiveness against S. Aureus, M. phlei and mixed oral flora. Sporicidin and diluted sodium hypochlorite were effective only against S. aureus. Full strength sodium hypochlorite was the most effective disinfectant over all and required the shortest contact time (1 minute).

Brace & Plummer \(^{18}\) in 1993 demonstrated that dental prostheses could be easily and effectively disinfected with a chlorine dioxide procedure.

In 1994, R. S. Schwartz et al \(^{20}\) evaluated the effectiveness of four disinfectants i.e., 0.525% sodium hypochlorite, OMC 11, Alcide L.D and Iodofive, against five different microorganisms (S.aureus, S.choleraesuis, P.aeruginos, M.bovis or B.subtilis) and mixed oral flora on irreversible hydrocolloid impressions. The impressions were cultured after immersion in one of the disinfectants. This study concluded that Alcide L.D achieved greater reduction of all test organisms, sodium hypochlorite 0.525% was effective against S. aureus, S. choleraesuis, P. aeruginosa and mixed oral flora. Iodofive and OMC 11 were ineffective against
all organisms tested including mixed oral flora.

In 1996, M. Dellinges and D. Curtis \(^{(16)}\) evaluated the accuracy of the new mechanical torque wrench system for implant restorations and tested the effects of steam autoclaving or chemiclave sterilization procedures on the accuracy of the wrenches. The results of this study concluded that torque wrench system before sterilization will result in recordings close to target values. Autoclave and chemiclave sterilization increased the range of torque values as compared with values recorded before sterilization. Autoclaving produced statistically higher torque values for the 10 Ncm Dyna Torque wrench.

The effectiveness of microwave energy in the disinfection of Molloplast-B long-term soft lining material contaminated with Candida albicans or S.aureas was studied by A. Baysan et al\(^{(1)}\) (1998). The results of this study concluded that, sodium hypochloride solution proved a more effective method than exposure to microwave energy, which in turn was more effective than leaving the lining material dry overnight. Because sodium hypochloride solution presents some disadvantages in clinical use, including a long soaking period, bleaching and corrosive effects on metals, microwave energy disinfections can be considered an effective and simpler alternative.

Furukawa K. H. et al \(^{(15)}\) (1998) evaluated the effectiveness of both spray and immersion disinfection of Coe Soft and Coe Comfort denture liners by using chlorine dioxide. Specimens made of soft denture liners attached to acrylic resin bases were contaminated with E.coli, S.aureus and Candida albicans. They concluded that, chlorine dioxide was effective against nonporous stainless steel specimens but was inadequate for denture liners at the
recommended 3 minutes time of disinfection. The immersion technique was more effective than the spray technique, but the difference was not significant. They recommended that coe soft and coe comfort denture liners be removed before entering the laboratory. These materials, even adhering to proper disinfection procedures still contain sufficient microorganisms to cause contamination of the clean laboratory.

In the year 2000, T. Larsen et al (26) examined the effect of UV. radiation for the disinfection of dental impressions and occlusal records.

The results in this study concluded that the UV radiation delivered by the device did not produce a sufficient bacterial reduction for the disinfection of dental impressions and occlusal records.

Infection control in dental laboratories.

Henry N. Williams et al (11) in 1986 determined the number and genera of fungi present in used dental laboratory pumice.

In 1988 M. J. McGowan et al (17) studied the effects of 0.5%, 1%, 2%, 3%, 4%, and 5.25% concentrations of sodium hypochlorite on Ticonium and Vitallium alloys.

The result of this study indicated that the short term exposure of both Ticonium and Vitallium alloys to either a 2% sodium hypochlorite solution for a period of 5 minutes or a 5.25% sodium hypochlorite solution for a period of 3 minutes will produce no harmful effects on these metals.

C. Shen et al (3) in 1989, studied the effect of two alkaline glutaraldehyde base disinfectants, (one alkaline and the other an alkaline with a phenolic buffer,) on a heat cured denture base resin.

From this study they concluded that, phenolic-buffered disinfectants should not be used as a disinfecting agent. A disinfectant to be used on a denture base resin should not contain chemicals that may cause
dissolution, swelling, pitting or crazing of the resin. 

The effects of a 2% concentration of ID 210 solution on impression compound, impression plaster and zinc oxide eugenol impression material was investigated by Wafter S.D. & P. G.Fong (8) (1990).

This laboratory study evaluated the dimensional stability, surface detail reproduction and assessed the penetration of the disinfectant into the impression materials and the transfer of the disinfectant from impressions to stone casts. 1% aqueous toluidine blue dye was chosen for assessment of the penetration of disinfectant. The results of this study concluded that, a 20-minute immersion in 2% ID 210 solution had no adverse effects on the dimensional stability or surface detail reproduction of the rigid impression materials. The dyed disinfectant penetrated into impression plaster and also diffused into stone casts poured against such impressions.

J. M. Stanley et al (25) in 1991 studied the effects of chemical disinfecting agents like Sodium hypochlorite, Exspor, Cidex and Wescodyne-D, on color stability of denture acrylic resins. The tested resins were CH Lucitone, Triad VLC and Trulinear. This study concluded that, both 1% sodium hypochlorite and 2% Cidex disinfectant produced the least color change in the samples tested.

Polyzois G.L, Zissis and Yannikakis (9) (1995), evaluated the effect of the glutaraldehyde and microwave disinfection method on the dimensional stability, hardness and flexural properties of a heat polymerized denture base acrylic resin. The results showed that all specimens exhibited linear changes and small microhardness differences during disinfection procedures. These changes were clinically not significant. The Flexural properties remained unaffected during all disinfectant procedures. They concluded that microwave method is a useful
alternative to immersion and water. The addition of an antiseptic product that contained Octenidine as active agent to conventional pumice reduced the number of microorganisms by 99.999%. The mix of sterilim with water reduced the number of bacteria by 99%.

**In the light of the current knowledge disinfection protocol can be summerised as:-**

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<th>Item</th>
<th>Disinfection Protocol</th>
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| **Burs - carbon, steel, diamond points.** | • Dry heat oven- ie 60°C for 1 hour,  
• Chemical vapour-20 minutes at 270°F,  
• Ethylene oxide-450-800 mg/l. |
| **Dapen dishes**         | • Steam autoclave-121°C for 15 to 20 minutes at 15 lb pressure/square inch,  
• Ethylene oxide-450-800 mg/l. |
| **Glass slabs**          | • Steam autoclave- 121°C for 15 to 20 minutes at 15 lb pressure/square inch,  
• Dry heat oven-160°C for 1 hour,  
• Chemical vapour-20 minutes at 270°F.  
• Ethylene oxide-450-800 mg/l. |
| **Hand instruments Carbon steel** | • Dry heat oven-160°C for 1 hour,  
• Chemical vapour-20 minutes at 270°F.  
• Ethylene oxide450-800 mg/l. |
| **Stainless steel**      | • Steam autoclave- 121°C for 15 to 20 minutes at 15 lb pressure/square inch,  
• Dry heat oven-1 60°C for 1 hour,  
• Chemical vapour-20 minutes at 2700°F.  
• Ethylene oxide-450-800 mg/l. |
| **Hand pieces**          | • According to manufactures recommendation.  
• Ethylene oxide-450-800 mg/l.  
• Steam autoclave- 121°C for 15 to 20 minutes at 15 lb pressure/square inch. |
| **Impression trays, Aluminum metal tray, Chrome — plated tray, Custom acrylic** | • Steam autoclave- 121°C for 15 to 20 minutes at 15 lb pressure/square inch,  
• Chemical vapour-20 minutes at 270°F.  
• Ethylene oxide-450-800 mg/l. |
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<tr>
<th>Instrument</th>
<th>Sterilization Method</th>
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| resin tray, Plastic tray,        | • Ethylene oxide-450-800 mg  
|                                  | • Dry heat oven  
|                                  | • Chemical vapour-20 minutes at 270° F.  
|                                  | • Ethylene oxide-450-800 mg/l.                   |
| Mirrors (mouth & face)           | • Discard; do not reuse                                  |
| Needle                           | • Ethylene oxide-450-800 mg/l.                        |
| Orthodontic pliers               | • Dry heat oven-160°C for 1 hour,  
|                                  | • Chemical vapour-20 minutes at 2700 F.            
|                                  | • Ethylene oxide-450-800 mg/l.                     |
| Tissue retraction Pluggers       | • Steam autoclave- 121°C for 15 to 20 minutes           
|                                  | at 15 lb pressure/square inch,                     
|                                  | • Dry heat over-160°C for 1 hour,                   
|                                  | • Chemical vapour-20 minutes at 270° F.            
|                                  | • Ethylene oxide-450-800 mg/l.                     |
| Polishing wheels and disks       | • Ethylene oxide-450-800 mg/l.                        |
| Saliva evacuators, Ejectors      | • Ethylene oxide-450-800 mg/l.                        |
| Stones                           | • Chemical vapour-20 minutes at 270° F.               |
| Water- air syringe tips          | • Steam autoclave- 121°C for 15 to 20 minutes           
|                                  | at 15 lb pressure/square inch,                     
|                                  | • Dry heat oven-160°C for 1 hour,                   
|                                  | • Chemical vapour-20 minutes at 270° F.            
|                                  | • Ethylene oxide-450-800 mg/l.                     |
| X-ray equipment                  | • Ethylene oxide-450-800 mg/l,  
|                                  | • According to manufacture recommendation.          |
| Impressions compound, Zinc       | • Immersed in 2% ID 210 solution for 20 minutes        
| oxide eugenol                    | • Immersed for 10 minutes in 2% glutaraldehyde.      |
| Irreversible hydrocolloid        | • Spray with sodium hypochlorite, rinse, spray again   
|                                  | and stand under damp gauze or in sealed bag for 10  
|                                  | minutes.                                            
|                                  | • Immersed in 2% glutaraldehyde for 10 minutes       |
| Reversible hydrocolloid          | • Spray with sodium hypochlorite, rinse, spray again   
|                                  | and stand under damp gauze for 10 minutes.           |
| Polysulfide                      | • Rinsed for 45 seconds with water and immerse for 30 
|                                  | minutes in 2% glutaraldehyde.                        
|                                  | • Immersed for 15 minutes in 5.25% sodium hypochlorite 
|                                  | solution and rinsed in water.                       |
Addition reaction silicone materials
- Immersed in 2% glutaraldehyde for 1 hour, rinse in sterile water

Condensation reaction silicone materials
- Immersed in 2% glutaraldehyde for 10 minutes and washed with sterile water

Polyether
- Immersed in 2% glutaraldehyde for 1 hour at room temperature, rinsed with sterile water for 45 seconds and dried for 10 minutes

Dentures
- Rinsed under running water, cleaned for debris in an ultrasonic cleaner and immersed for 12 hours in alkaline glutaraldehyde disinfection solution.
- Rinsed under running water, 4% chlorhexdine scrub for 15 seconds followed by a 3 minutes contact time with chlorine dioxide.
- Sterilized by ethylene oxide gas-450-800 mg/I.

Pumice
- Addition of antiseptic product containing Octenidine to conventional pumice,
- Addition of benzoic acid to conventional pumice,
- Working pumice should be discarded after each use.

Metal framework (Ticonium & Vitallium)
- Immersed 3 minutes in 5.25% sodium Hypochlorite solution and rinsed in water.

References:


