IMPRESSION MATERIAL DISINFECTANTS

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ABSTRACT:

Impression making is an important and frequently done procedure in dental clinics. Once the impression is taken models are made and indirect restorations, prosthesis or appliances are fabricated. Irrespective of the purpose a suitable disinfection procedure and protocol should be followed before, during and after impression making. This is done in order to avoid cross contamination and to reduce the risk of disease transmission from patient to operator and also to technicians. The purpose of this article is to focus on disinfection procedures of various commonly used impression materials.

KEY WORDS:

Disinfection, impression material, glutaraldehyde, sodium hypochlorite.

INTRODUCTION

The oral cavity has a complex flora of microorganisms which can easily cause infections in some undesirable condition or transferred to people handling impressions. The spread of infection through dentistry, because of direct contact with saliva, blood and infection of mouth could be transferred easily from non-observance of immunity factors ***(1) (2)***person via oral contact.All impression materials are capable of spreading infection to the laboratory, and indirectly to the personnel and other patients in the other offices, so they should be disinfected with effective disinfecting materials before use ***(3).***In 1963, Ray and Fuller***(4)*** showed a contamination with *Mycobacterium tuberculosis* of 12% of the dental

impressions of patients with known tuberculosis. In hepatitis B there are over 100 million viral particles per ml. of blood, whereas in AIDS there are only up to 100 viruses per mL of blood ***(5)***.The risk to dental personnel is still far higher from hepatitis B than it is from the human immunodeficiency virus, and the hepatitis virus is more transmissible, especially because it occurs in saliva. The principal potential route of transmission to dental laboratory personnel is via infected impressions***(6).***Alginate impressions because of their structure, texture and hydrophilic setting mechanisms are more susceptible to infection than some other impression materials ***(7).***At present it is not possible to detect all patients in high risk groups for both HBV and HIV. All available information indicates that if adequate routine precautions are taken when treating all patients, and if all blood and saliva are considered infectious, the transmission of HBV and HIV is unlikely**.**The principal potential route of transmission of infection from a patient to a dental technician is via contaminated impressions and other prosthetic materials***(8)*** and it is known that microorganisms can be recovered from casts poured from impressions taken of dental molds that have been experimentally inoculated with bacteria***(9).*** Apart from disinfection personal protection by using eye ware, gloves, mask and head cap should be followed to reduce risk of cross contamination.

GENERAL STEPS IN DISINFECTION *(12)*

The general steps in the disinfection procedure are as follows:
• Blood and bioburden must first be cleaned off the impression prior to disinfection
• Cleaning should be performed immediately after taking the impression, before blood and bioburden has a chance to dry onto the impression material. While instruments can be pre-soaked to loosen debris, impression materials have limited tolerance of immersion in liquids and this should therefore be minimized and controlled
• The impression material is next disinfected using an EPA-registered disinfectant
• After disinfecting the impression, it must be rinsed under running water before being further processed or sent to the laboratory. Failure to properly rinse the disinfectant off the impression can result in a substandard model due to incorporation of residual disinfectant into the mixed stone or plaster.

DISINFECTION, STERLIZATION AND SUITABLE AGENTS

In order to avoid cross-contamination of dental staff and dental technicians the impression should be immediately disinfected as soon as they are taken from the mouth of the patient. Disinfection implies the destruction of pathogenic organisms and is relative, depending on, among other factors, the duration of exposure to the disinfecting agent**.**
Chemical sterilants/disinfectants can be broadly classified into three categories ***(10)***

- High-level disinfectants are able to inactivate spores and all other microbial forms. Examples are ethylene oxide gas and immersion glutaraldehyde solutions
- Intermediate-level disinfectants may not inactivate spores but will destroy microbes, in particular tubercle bacilli. Examples are formaldehyde, chlorine compounds, iodophors, alcohols, and phenolic compounds.

- Low-level disinfectants include the quaternary ammonium compounds, simple phenols, and detergents. These are unacceptable for disinfection of contaminated impressions; intermediate and high level disinfectants are recommended to protect against HBV***(11)***

Glutaraldehyde formulations, for example, should not be used as surface disinfectants or as aerosols because their vapours are known to be toxic when released into the air ***(6)*** Glutaraldehydes can damage nickel-coated impression trays when immersed for long periods of time ***(9)*** Hypochlorite solutions also affect trays. The reaction with aluminum trays acts in two ways— aluminum inactivates hypochlorite, and hypochlorite corrodes aluminium ***(12).*** These disinfectant solutions however may affect crucial qualities of impression material such and therefore altering surface roughness, surface detail reproduction and also the dimensional stability. One report ***(13)*** has investigated the value and efficacy of reducing immersion times by warming the disinfectants to 37degree Celsius. Therefore this method is very significant as adequate disinfection can be obtained without any compromise on the impression taken but further research needs to be done in this .The acid-potentiated glutaraldehydes contribute to an improvement in the quality of the surface of the stone dies compared to controls***(14).*** This disinfectant contains nonionic ethoxylate molecules with both hydrophobic and hydrophilic chains that are reported to stabilize the solution and enhance the biocidal activity.

TYPES OF IMPRESSION MATERIAL

Impression materials include non-elastic or rigid impression material (eg: impression compound) and elastic impression materials (eg: Hydrocolloids,elastomers). The vast majority of procedures use elastic impression materials i.e aqueous hydrocolloids (alginate) and non-aqueous elastomeric materials including addition reaction silicones, condensation reaction silicones, polysulfides and polyethers . The characteristics of these materials with respect to their hydrophilicity, the presence or absence of surfactant and their tolerance of immersion in water or other fluids are key elements in understanding disinfection protocols for impression materials**.** For example polyether is hydrophilic and may leach alginates are sensitive to wet and dry environments etc.

RIGID IMPRESSION MATERIAL

IRREVERSIBLE-ZINC OXIDE EUGENOL

Olsson et al. ***(15)*** reported the effect of disinfection solutions on the dimensional stability and surface detail of Luralite, Momax, and Opotow zinc oxide-eugenol impressions. The disinfectants were aqueous solutions of Cidex (2% glutaraldehyde), Tecno-sept (0.7% ampholytic soap + 4% propanol-2), Hibitane (0.5% chlorhexidine), K-644 (2.4% mixture of chlorinated sodium phosphate and potassium bromide), Chloramine (5% sodium salt of p-toluenesulfanchloroamide), Benzalkon (1% benzalkonium chloride), and Surface phenol derivate (0.5% mixture of 2-phenyl phenol and chlorocresol). No significant influence on accuracy or surface detail was observed after one hr of exposure to the disinfectant, and

small but clinically insignificant changes in dimensions occurred after impressions were stored in air for 24 hr after disinfection. The only unacceptable combination with ZOE was with sodium hypochlorite, where a dimensional change was observed ***(6).*** However ZOE and impression plaster is not widely used these days.

REVERSIBLE-IMPRESSION COMPOUND

Storer and McCabe ***(16)*** the only authors to test this material, report that surface quality is unaffected by alkaline glutaraldehydeand formaldehyde but was affected by sodium hypochlorite. However, dimensional changes occurred with all disinfectants tested ***(16).***

ELASTIC IMPRESSION MATERIAL

HYDROCOLLOIDS

REVERSIBLE- AGAR AGAR

As with the irreversible hydrocolloid materials, it is probable that the water used for the dilution of then disinfectants is the factor causing the instability, rather than the disinfectant per se ***(17).*** Hence to avoid dimensional changes spraying method of disinfectant is the most viable method. There may be interactions between disinfectants and hardening substances like potassium sulphate. A further possible source of contamination of these materials is the water bath used for liquefying and conditioning. The recommended temperature ranges used support bacterial growth ***(18)*** and the addition of a disinfectant solution to the water may solve this problem.

IRREVERSIBLE-ALGINATE

In 1982, Meiners et al ***(12)***found no way to disinfect alginate impressions without causing significant dimensional changes. In the early 1990s, simple and reliable hygienic procedures were introduced for these materials ***(13) (14)*** Today, methods of disinfection vary widely in concentration, type, and working time. Common procedures are based on glutaraldehyde or sodium hypochloride ***(19)***.But both ingredients are questioned because of potential health risks for the dental staff. As a solution, disinfectants on the basis of free oxygen (*peroxomono*- or disulfate) were developed ***(19)***The most common technique for disinfection is spraying the disinfecting agents on alginate impressions, but some studies have shown that these impressions can be disinfected by immersion method as well ***(20).*** However, spraying that is performed with reduced contact time may restrict the effectiveness of disinfection, particularly for theporous hydrophilic hydrocolloids, where microorganisms can penetrate through the body and survive in the impression ***(21)*** Disinfection of hydrocolloid impressions with the glyoxal and phenol glutaraldehyde produced a surface smoother than controls ***(22).***

ELASTOMERIC IMPRESSION MATERIAL

Bergman et al ***(23)*** and Storer and McCabe ***(24)*** investigated the disinfection of elastomeric impression materials. An evaluation of polysulfides, polyethers, and condensation and addition silicones with a variety of disinfectants was conducted. They found in some cases that some disinfectants adversely affected impression materials, and therefore care should be used in selection of a satisfactory combination.In the study by Storer and McCabe ***(24)*** on

silicone, polysulfide, and polyether rubber, they found after 16 hr of disinfection that 2% glutaraldehyde was the most suitable with silicone and polysulfide with respect to surface detail and accuracy.

ADDITION REACTION SILICONE

The smallest dimensional changes were observed for addition silicones with Cidex, Techno-sept, Hibitane, K-644, and Benzalkon***(24)***.Thus greater accuracy and stability of addition reaction silicone materials makes it the material of choice prolonged disinfection is done.

CONDENSATION SILICONE

The evaporation of volatile by-products from condensation-reaction silicone materials may contribute not only to dimensional changes observed over time ***(25) (26)*** but also to adverse and inconsistent reactions with many of the disinfecting solutions.

POLYETHER

Polyether materials have been shown to be unstable under conditions of high humidity and in aqueous solutions ***(6)***Therefore they should not be immersed in disinfectant solution for prolonged period of time. Expansion of polyethers is observed when elastomers are immersed in both acid and alkaline electroplating solutions for 5 hours ***(26).***

POLYSULFIDE

Continuing polymerisation of some polysulphide impressions ***(14)*** may lead to dimensional changes and it also interferes with setting. According to Storer and McCabe ***(24)*** 16 hr of disinfection with 2% glutaraldehyde was more suitable with polysulfide with regards to surface detail and accuracy.

RECOMMENDED PROTOCOL FOR DISINFECTION (6)

ZINC OXIDE EUGENOL-

Soak for 10 minutes in glutaraldehyde,chlorohexidine, chloramine may also be used; sodium hypochlorite not used

IMPRESSION COMPOUND-

Immersed in alkaline glutaraldehyde, sodium hypochlorite causes dimensional changes

ALGINATE-

-diagnostic casts:Soak for 10 minutes in giutaraidehyde.

-final impressions:Dip in giutaraidehyde, rinse in sterile water, dip again, and stand under damp gauze for 10 minutes, or spray with sodium hypochiorite, rinse, spray again, and stand under damp gauze for 10 minutes.

AGAR AGAR-

Dip in giutaraidehyde, rinse in sterile water, dip again, and stand under damp gauze for 10 minutes, or spray with sodium hypochiorite, rinse, spray again, and stand under damp gauze for 10 minutes.

CONDENSATION REACTION SILICONES

Soak for 10 minutes in glutaraldehyde

ADDITION REACTION SILICONES

Place in glutaraldehyde for 1 hour, rinse in sterile water, and soak in a fresh solution of glutaraldehyde for at least 10 hours.

POLYETHER

Dip in giutaraidehyde, rinse in sterile water, dip again, and stand under damp gauze for 10 minutes,

POLYSULFIDE

Dip in glutaraldehyde for few hours

CONCLUSION

There are a number of impression material disinfectants available such as glutaraldehyde, sodium hypochlorite, chlorohexidine, chloroamine. Glutaraldehydes, iodophores and phenols are used for disinfection the impressions more commonly.HIV is inactivated by exposure to glutaraldehyde and sodium hypochiorite. HBV is also degraded by these agents, but it is resistant to antiseptic agents, and unlike the AIDS virus, it is not destroyed by chlorhexidine. Sodium hypochlorites are used only as disinfectants and not as sterilants. Concentrations of solutions should be regularly monitored as dilutions bound to occur with time. Sterilisation of impressions is imperative when treating patients known to be carriers of HBV and/ or HIV, and all patients should be assumed to be carriers **.** Health effects that may occur as a result of exposure to glutaraldehyde include throat and lung irritation, asthma and difficulty breathing, contact and/or allergic dermatitis, nasal irritation, sneezing, wheezing, burning eyes and conjunctivitis**.** Iodophores are rapidly inactivated in the presence of organic matter. Iodine is corrosive and staining. Phenol is toxic, corrosive and skin irritant. Chlorhexidine is inactivated by anionic soaps. Chloroxylenol is inactivated by hard water.Sodium hypochlorite is less toxic than glutaraldehyde and 0.5% solution of sodium hypochlorite is used in endodontic procedure while 1-2% solution is used as a disinfectant therefore sodium hypochlorite can be diluted and used to make it cost effective. In a study conducted by Sukhija et al Peracetic Acid was found most effective followed by Glutaraldehyde and Sodium Hypochlorite; the latter disinfectants were comparable in their antimicrobial effect. Povidine-Iodine and Isopropyl Alcohol were found to be less effective than Peracetic Acid, Glutaraldehyde and Sodium Hypochlorite, but were effective than the control group. Disinfection of impression materials should be mandatory to prevent cross-infection.

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