REVIEW ARTICLE

IMPRESSION DISINFECTION: CURRENT STATUS AND FUTURE TRENDS

Dr. Dibyatanu Majumdar*, Dr. Khushbu Gupta*
Dr. T. K. Giri**, Dr. S. Mukherjee***

ABSTRACT

An undisputed truth in the dental profession is the paradigm shift we are about to experience after this COVID pandemic breakout. The phenomenon of impression disinfection will see the change of status from an academic luxury to a daily indispensable necessity. This change necessitates the knowledge of impression disinfection for every dental professional. Hence, this article summarizes the necessary disinfection materials and protocols as pertaining to the impressions in our day-to-day practise.

KEY WORDS

Disinfection, Disinfectants, Impression, Levels of Disinfection, Sterilization, Alginate

ABOUT THE AUTHORS

* Third year M.D.S. Student
** Professor and Principal
*** Professor and H.O.D
Department of Prosthodontics and Crown and Bridge
Dr. R. Ahmed Dental College and Hospital, Kolkata

CORRESPONDING AUTHOR

Dr. Khushbu Gupta
Third year M.D.S. Student
Department of Prosthodontics and Crown and Bridge
Dr. R. Ahmed Dental College and Hospital, Kolkata

INTRODUCTION

All dental office personnel must be considered at risk with respect to infectious diseases.[1] The oral cavity has abundant nutrients, moisture, hospitable temperature and availability of surfaces on which microbial populations like pigmented and non-pigmented cocci, aerobic, anaerobic, gram-positive, gram-negative and even spore-bearing bacilli, coliforms, proteus and lactobacilli can grow and thrive. This warm moist environment is the reason for the heavily laden microsomal life forms of bacteria, virus and fungi. These may travel through the blood or saliva and has the potential to infect the dentists, the dental assistants as well as the laboratory technicians who handle these. The transmission of Hep B, HIV I and II, Herpes, Tuberculosis and Staphylococcal infections are of primary concern.[2]

In the current scenario of awareness of SARS-CoV RNA has long been shown to be present in large amounts in throat wash and saliva of SARS patients.[3] The same study indicated the use of saliva as an early aid to the detection of SARS-CoV disease back in the year 2004.

Dentistry, as a field of surgery exposes us to our fair share of blood and saliva, there by aligning us alongside the infectious disease specialists. Though a lot of microorganisms in the oral cavity are comparatively harmless, a few may cause infections.[4]

The importance of impression disinfection can be highlighted as a major step to prevent cross-contamination between the patient, dentist, dental assistant, lab personnel, dispatch people and to another patients being treated or served by either of the above which may cause serious medico-legal issues if detected and tried in a court of law. Various international studies have shown that many of the prosthesis transferred to clinics from laboratories are contaminated with pathogenic micro organisms emerging in the oral cavity of other patients. A study by Almortadi and Chadwick had shown that upto 25% of impressions received by various labs had visible blood and saliva on them and inappropriately disinfected in 43 % of the cases.[5] An Indian study by Marya et al.(2011), had shown that 75.9% of the respondents were only washing the impressions

under running water compared to only 24.1% respondents who used chemical disinfectants; and thus concluded that the level of infection control in India appears to be many years behind than that of the advanced countries and observed a lack of commitment to the standard of infection control practices in Dental Colleges in India.[4] This is a cause of concern in the long run as the students are not being instinctively trained to disinfect the impressions routinely; thereby percolating this habit onwards to clinical practise.

The survival of microorganisms from impressions and stone casts had prompted the CDC and the ADA to establish guidelines for the disinfection of the impression materials. Even the British Dental Association, in its current guidance-Advice Sheet A12 clearly states "The responsibility for ensuring impressions have been cleaned and disinfected before the dispatch to the laboratory lies solely with the dentist. It is good practise to agree the cleaning and disinfection process with the laboratory and label the device to indicate the disinfected status.[6]"

Disinfection entails the destruction of all pathogenic bacteria or organisms capable of giving rise to infection whereas sterilisation involves the process by which an article, surface or medium is freed of all living micro oraganisms either in the vegetative or spore state.[7] For disinfection of impressions, an ideal disinfectant should not alter the properties of the set impression material and should be non- corrosive to the impression tray carrying the impression; and at the same time achieve adequate destruction of microorganisms.

Since times earlier, there have been several attempts to sterilize dental impressions. Olin et al.[1] had shown significant distortions in elastomeric impressions made on custom made acrylic trays when they were steam sterilised. Similar results were shown by Holtan et al.[8] while using rim lock metal stock trays. However, in the modern times some companies have claimed their addition silicone impression materials to be fully autoclavable. Surendra et al.[9], in their study, found no significant difference in autoclaved impression though such claims are still to be verified by the tests of time.

Though sterilisation can guarantee complete destruction of microbial life forms, it has the possibility of undesirably changing the accuracy of the dimensions of the impression thereby producing an inaccurate reproduction of the surfaces. On the other hand, though disinfection doesn't cause complete destruction of all microbial forms, it can effectively spare the surface accuracy of the impression; thereby allowing an accurate cast production. Such a cast can then be disinfected thoroughly to get rid of the potential pathogenic microorganisms. Therefore, in the current scenario disinfection of the impressions is the only viable option up our sleeve.

PRE-REQUISITES of IMPRESSION DISINFECTION-

The Federation Dentaire Internationale (FDI) requires as a standard precaution that all patients impressions should be rinsed under running water to remove saliva and visible blood.[10]

It has been a common practice to wash the impression under running water and this itself used to be the recommended practice up until 1991 according to the British Dental Association.[6] Studies have proven that this one procedure alone can reduce the microbial count 40%- 90%.[11] This makes sense because this procedure can effectively reduce the biological load, as well as expose the impression material so that the disinfecting solutions can act directly upon them. Selecting a disinfectant and disinfecting method may be important for the stability of irreversible hydrocolloid.[12]

LEVELS OF DISINFECTION- (Table 1) [13]

According to the efficacy of the various available disinfectants, they are usually classified into three levels viz high level, intermediate level and low level.

High level disinfection involves bacterial spore inactivity along with other microbial forms. Intermediate level disinfection involves destruction of microorganisms like Tubercle bacilli but not able to kill spores. Low level disinfection possesses narrow anti-microbial activity.

Dental impressions are categorised under semi-critical objects and require high level disinfection or sterilisation.

TYPES OF DISINFECTANTS - (Table 2)

- **GLUTARALDEHYDE-**

- High level disinfectant (Chemisterilisation)
- Colourless liquid with pungent odour
- Exists in acidic, neutral and alkaline forms
- A broad spectrum chemical agent with fast killing capability
- On proper use, its capable of destroying all life forms including spores and viruses[14]
- Though it is the best disinfectant for cold sterilisation, its is considered a health hazard
- Can cause irritation to skin, eyes and respiratory tract-Acts as a sensitizer
- Precautions -Wearing butyl or nitrile gloves, closed system for solution handling, good exhaust ventilation

- **SODIUM HYPOCHLORITE-**

- Broad spectrum antimicrobial activity

TABLE 1: LEVELS OF DISINFECTION

Type of Disinfection	Disinfectants	Type of Impression Materials	Type of Exposure
High level disinfection	Glutaraldehyde	Irreversible hydrocolloids	10 minutes
		Zinc -oxide Eugenol	10 minutes
		Polysulphide Polyether	10 minutes
		Addition Silicone	10 minutes
Intermediate level disinfection	Sodium hypochlorite Complex Iodophors Phenols Chlorhexidine Alcohols	Irreversible hydrocolloid	10 minutes
		Zinc- oxide Eugenols	10 minutes
		Polysulphide Polyether	10 minutes
		Addition Silicone	10 minutes
		Impression Compound	10 minutes
Low level disinfection	Quaternary ammonium compounds Simple phenols detergents	Not recommended for impression disinfection	

- Advantages-Soluble water, relatively stable, non-toxic at usable concentrations, non- staining, non inflammable, Colourless, it has fast bactericidal activity
- Disadvantages-Mucous membrane irritation[15], less efficient in organic environment, corrosive on metals

➢ **IODOPHORS -**

An iodophor is a preparation containing Iodine complexed with a solubilising agent viz. Surfactant or Povidone. The result is a water-soluble material that releases free Iodine when in solution.

- Low to intermediate level of disinfection
- Proven bactericidal, mycobactericidal and virucidal–Not sporicidal
- Non-inflammable
- Causes staining, irritating effect on mucosa
- Organic material on surface-neutralisation of the disinfectant capability(Importance of pre-wash)

➢ **CHLORHEXIDINE -**

- Activity declines in the presence of organic matter
- Broad spectrum
- 2% concentration is used as a disinfectant
- Bactericidal, virucidal
- Effective for impression disinfection
- Newer use to produce self–disinfecting alginate impression material[16]

➢ **ALCOHOLS -**

- Alcohols are usually contra indicated for impression disinfection–causes surface changes
- Potent bactericidal, tubeculocidal, fungicidal and viricidal[17]
- Usually includes isopropyl alcohol and ethyl alcohol
- Medical surfaces disinfected with isopropyl alcohol
- Also used as an antiseptic

➢ **PHENOLS-**[18]

- Intermediate to low level disinfection-Protoplasmic poison
- Bactericidal at low concentrations, also antifungal and antiviral
- Used in mouthwashes, scrub soaps and surface disinfectants
- Generally not used for disinfection of impressions (Low level disinfection)

TABLE 2: TYPES OF DISINFECTANTS

CLASS OF DISINFECTANT	TYPES OF DISINFECTANTS	RECOMMENDED CONCENTRATIONS	PRIMARY MECHANISM OF ACTION	COMMERCIAL PREPARATIONS AVAILABLE
GLUTARALDEHYDE	NON-OXIDIZING	2%	Alkylating agent for proteins. Mainly affecting the amines, amides and sulfhydryl groups	CIDEX
SODIUM HYPOCHLORITE	OXIDIZING	0.5% or 200-5000 PPM	Disrupts the cell membrane transport chain through inhibition of enzymes and damages the DNA	CLOROX CHLORAMINE T PUREX
IODOPHORS	OXIDIZING	1-2%	Proteins, enzymes are inactivated	BETADINE HY-SINE IOPREP
ALCOHOLS	NON-OXIDIZING	60-90%	Cell membrane lipid content is solubilized and proteins are coagulated	ISO-PROPYL ALCOHOL
CHLORHEXIDINE	NON-OXIDIZING	2-4%	Intracellular contents are coagulated and cell membrane damaged	SAVLON
PHENOLIC COMPOUNDS	NON-OXIDIZING	1-3%	Protoplasmic poison causes damage to cell membrane	DETTOL LYSOL HI-PHENE

TECHNIQUES of IMPRESSION DISINFECTION -

Across the various dental associations of the world, two most effective methods are:

A) Spraying with disinfectant solution -

The impression materials which may be predisposed to distortion if immersed in fluids; Spraying with disinfectants provides an acceptable alternative option. The impressions can be sprayed thoroughly and thereafter placed in airtight plastic bags for the appropriate contact time. After such time has elapsed, the impression can be removed, rinsed under tap water thoroughly, the adherent water can be removed by shaking and the impression can be poured.

The downside of Spray disinfection is that all surfaces may not receive equivalent amount of the disinfectant.[19]

B) Immersion in disinfectant solution –

For materials which can tolerate immersion in fluids, the impressions may be immersed in the container containing the disinfectant solution for the specified amount of time.[20]

TIME NEEDED FOR DISINFECTION- THE RATIONALE -

For adequate impression disinfection, the time needed for the inactivation of microbial contaminants is determined by the manufacturer's information. As a general rule, the minimum time must be at least equal to the time needed for tuberculocidal activity.[21] This time is specified by the manufacturer of the germicide.

DISINFECTING AGENTS FOR VARIOUS IMPRESSION MATERIALS

➢ DISINFECTION OF ALGINATE IMPRESSIONS

- 0.5% Sodium hypochlorite / Iodophors
- Immersion with caution; only for a short-term exposure time (< 10miutes)[22]

- Immersion disinfection for prolonged period will cause impression distortion (imbibition)

➢ **DISINFECTION OF AGAR IMPRESSIONS**

- Stable when immersed in 1:10 Sodium hypochlorite/1:213 Iodophor
- Immersion time 10 minutes
- Do not immerse in alkaline glutaraldehyde[22]

➢ **DISINFECTION OF ZINC-OXIDE EUGENOL IMPRESSIONS**

- Immersion is preferred; spraying can be used for bite registrations
- Immersion in 2% Glutaraldehyde / Iodophors
- Not compatible with chlorine compounds; Phenolic spray can be used[22]
- Adverse effect on long immersion of 16 hours in diluted hypochlorite

➢ **DISINFECTION OF IMPRESSION COMPOUND IMPRESSIONS**

- 1:10 dilution of Sodium hypochlorite or iodophor
- Immersion for specific time period

➢ **DISINFECTION OF POLYSULPHIDES AND SILICONE IMPRESSIONS**

- Glutaraldehyde/Iodophors/0.5% Sodium hypochlorite
- Immersion for specific time period
- Disinfectants requiring more than 30minutes exposure time is not recommended[22]

➢ **DISINFECTION OF POLYETHER IMPRESSIONS**

- Iodophor/0.5% Sodium hypochlorite
- Preferred method is spraying
- Prolong immersion–Distortion (even with 2% glutaraldehyde)

Immersion with caution. Using disinfectant only for a short exposure time(<10 minutes)

FUTURE TRENDS –

OZONATED WATER-

- Inorganic gaseous molecule, less stable than O2 in lower atmosphere
- Anti-microbial, anti-hypoxic, analgesic and immunostimulatory activities
- Used for disinfection of waterlines, oral cavity and dentures–can also be used for impressions
- Claimed to be more biocompatible than other disinfectant solutions
- Ozonated water can reduce the number of microorganisms on the surface of irreversible hydrocolloid impression materials and by increasing the time of immersion, more effective disinfection can be achieved.[23]

MICROWAVE IRRADIATION-

- Simple to use, low in cost, good disinfection

TABLE 3. DISINFECTING AGENTS FOR VARIOUS IMPRESSION MATERIALS[18]

IMPRESSION MATERIALS	DISINFECTING AGENTS
ALGINATE IMPRESSIONS	0.5% Sodium hypochlorite or iodophor
AGAR	1:10 dilution (0.5%)Sodium hypochlorite or 1:213 Iodophor
ZINC OXIDE EUGENOL	2% Glutaraldehyde, Iodophors or Chlorine compounds
IMPRESSION COMPOUND	1:10 dilution (0.5%)Sodium hypochlorite or Iodophor
POLYSULPHIDE AND ADDITION SILICONE	Glutaraldehyde, iodophor, 0.5% Sodium hypochlorite
POLYETHER	Iodophor, 0.5% Sodium hypochlorite

- Dentures disinfected with microwaves–found better than NaOCl

- Polyvinylsiloxane impression materials were disinfected with microwaves with no changes in physical properties[24]

ULTRAVIOLET LIGHT [25]

- The effectiveness of UV rays in disinfection depends on intensity, time, humidity and access to the microorganism

- Higher watt UV light decreases the colony count in lesser time

- Samra et al.(2018) recommended the use of UV light as more suitable for disinfecting impressions without compromising the dimensional stability

SUMMARY

- Hydrocolloids have a stipulated time for disinfection. Immersion is preferred over spraying and self-disinfecting materials are more effective, but immersion is to be accompanied for better results

- The method of choice for disinfection of Polyether impression material is by spraying of disinfectant, though modern polyethers seem to withstand even long term immersion.

- Hydrophobic elastomers (Polysulphides and silicones) can be safely immersed in disinfectants.[26]

CONCLUSION

Dental impressions are an inevitable part in our day-to-day practice. All professional bodies like the ADA, CDC, British Dental Association generally agrees to treat all impressions as contaminated materials and emphasizes the need for their disinfection. Numerous studies are available in the dental literature for disinfection of impressions; however many of them differ in terms of specimens taken, base-line measurements, and other such parameters.

It has been generally agreed that chemical disinfection does not produce dimensional changes that adversely affect the clinical performance and thus are considered to be virtually harmless; however this harmlessness is to be taken with a pinch of salt. Restrictions exist concerning the duration and method compatible with a particular impression material-which relate to their chemical nature so that disinfection is achieved without hampering the dimensions.

In this article, an attempt has been made to review the disinfection protocols as suggested in the literature in accordance with different impression materials.

REFERENCES

1. The Effects Of Sterilisation On Addition Silicone Impressions In Custom And Stock Metal Trays. OLIN, P,S, et al. 6, 1994, Journal Of Prosthetic Dentistry, Vol. 71, pp. 625-630.

2. Evaluation Of Practice Of Cross Infection Control For Dental Impressions Among Laboratory Technicians And Prosthodontists In Ksa. Sedky, Nabila. 3, Buraidah : Internation Journal Of Infection Control, 2014, Vol. 10.

3. Detection Of Sars Associated Corona Virus In Throat Wash And Saliva In Early Diagnosis. WanG, W,K, et al. 7, Taipei : Emerging Infectious Diseases, 2004, Vol. 10.

4. Current Status Of Disinfection Of Dental Impressions In Indian Dental Colleges : A Cause Of Concern. Marya, C,M, et al. 11, Faridabad : Journal Of Infection In Developing Countries, 2011, Vol. 5.

5. Disinfection Of Dental Impressions- Compliance To Accepted Standards. Almortadi, N And Chadwick, R,g. 12, Dundee : British Dental Journal, 2010, Vol. 209.

6. Association, British Dental. advice Sheet A12, Infection Control In Dentistry. London : BDA, 2009.

7. Paniker, C K J.ananthanarayan And Paniker's Textbook Of Microbiology (seventh Edition). Hyderabad : Orient Longman Private Limited, 2006.

8. Dimensional Stability Of A Polyvinylsiloxane Impression Materila Following Ethylene Oxide And Steam Autoclave Sterilisation. Holtan, J,R, OLIN, P,S and Rudney, J. 4, Minneapolis, Minn : Journal Of Prosthetic Dentistry, 1991, Vol. 65.

9. Evaluation Of Dimensional Stability Of Autoclavable Elastomeric Impression Material. Surendra, G,P, et al. 1, Bangalore : Journal Of Indian Prosthodontic Society, 2011, Vol. 11.

10. Internationale, Federation Dentaire. Recommendations For Hygiene In Dental Practice, Including Treatment For Infectious Patient. Technical Report Number 10. S.l. : International Dental Journal, 1987.

11. Anti-microbial Effect Of Four Disinfectants On Alginate, Polyether And Polyvinylsiloxane Impression Materials. Al-jabrah, O, Al-Shumailan, Y And Al-Rahdan, M. 3, S.L. : International Journal Of Prosthodontics, 2007, Vol. 20.

12. Dimensional Stability Of Irreversible Hydrocolloid Impression Material As A Function Of Pouring Time : A Systematic Review. Nassar, U, Aziz, T and Flores-mir, C. 2, Edmonton : Journal Of Prosthetic Dentistry, 2011, Vol. 106.

13. An Overview Of Dental Impression Disinfection Techniques-a Literature Review. Mushtaq, M, A and Khan, M,W,U. 4, s.l. : Journal Of The Pakistan Dental Association, 2018, Vol. 27.

14. Anti-microbial Activity, Uses And Mechanism Of Action Of Glutaraldehyde. Gorman, S,p, Scott, E,m And Russell, A.D. 2, s.l. : Journal Of Applied Microbiology, 1980, Vol. 48.

15. Mechanisms Of Actions Of Sodium Hypochlorite In Cleaning And Disinfection Processes. Fukuzaki, S. 4, s.l. : Biocontrol Science, 2006, Vol. 11.

16. Self Disinfecting Irreversible Hydrocolloid Impression Material Mixed With Chlorhexidine Solution. Wang, J, et al. 5, s.l. : Angles Orthodontics, 2007, Vol. 77.

17. The Relationship Of Concentration And Germicidal Efficiency Of Ethyl Alcohol. Morton, H,E. 1, New York : Annals Of New York Academy Of Science, 1950, Vol. 53.

18. Disinfection Of Dental Impression - A Current Overview. Hemalatha, R And Ganapathy, D. 8, Chennai : Internation Journal Of Pharmaceutical Sciences, 2016, Vol. 7.

19. Resource, online. Impression disinfection. S.L. : Dental Economics, 1999.

20. Sakaguchi, R,L and Powers, J, M.Craig's Restorative Dental Materials. 13. New Delhi : Elsevier Inc, 2014.

21. Disinfection Of Impression Materials- A Comprehensive Review Of Disinfection. Mantena, S,R, et al. 1, s.l. : International Journal Of Dental Materials, 2019, Vol. 1.

22. Anusavice, K. Phillips science of dental materials. . 12. Delhi : Elsevier Inc., 2014.

23. Prevention Of Cross-contamination Risk By Disinfection Of Irreversible Hydrocolloid Impression Materials With Ozonated Water. Savabi, O, et al. 9, s.l. : International Journal Of Preventive Medicine, 2018, Vol. 37.

24. The Disinfection Of Impression Materials By Using Microwave Irradiation And Hydrogen Peroxide. Choi, Y,R, KIM, K,N and KIM, K,M. 4, s.l. : Journal Of Prosthetic Dentistry, 2014, Vol. 112.

25. Comparative Evaluation Of Dimensional Stability Of Impression Materials From Developing Countries And Developed Countries After Disinfection With Different Immersion Disinfectant Systems And Ultraviolet Chamber. Samra, R,K and Bhide, S,V. 2, s.l. : Saudi Dental Journal, 2018, Vol. 30.

26. Accuracy And Stability Of Impression Materials Subjected To Chemical Disinfection - A Literature Review. Kotsiomiti, E, Tzialla, A And Hatjivasiliou, K. 1, Thessaloniki : Journal Of Oral Rehabilitation, 2008, Vol. 35

