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ROLE OF DISINFECTANTS ON ALGINATE IMPRESSION MATERIALS

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ABSTRACT

Alginate is classified as elastic aqueous irreversible impression materials. Alginate is referred to as irreversible due to the fact that once set in a semi-solid form, it cannot get converted back. They are widely used in contemporary dentistry for impression making particularly in partially edentulous subjects. Primary reasons for its wide usage is that it is economical compared to other impression materials. In addition to it, a minimum armamentarium is needed for its manipulation. Disinfection of alginate impression materials is necessary for prevention of cross-contamination. In alginate impressions, microbial load is transferred from three to five times than other impression materials. Pre wash of the impression under running water is advocated primarily to cast off all particles including blood and saliva prior to active disinfection procedure.It should be mandatory to disinfect alginate impressions. Alginate also undergoes dimension changes if it is kept in a disinfectant for an extended period of time.But still there is no routine method of disinfection of dental impressions that is accepted by dental professionals. It is the responsibility of the dentist to make appropriate choices of disinfection

methods for different impression materials.This review primarily focuses on the effects on disinfection on alginate impression material.

INTRODUCTION

A dental impression is a negative imprint of hard and soft tissues in the mouth from which a positive reproduction(cast or model) can be formed.It is made by placing an appropriate material in a stock or custom dental impression tray which is designed to roughly fit over the dental arches.Impression materials is of liquid or semi-solid nature when first mixed and placed in the mouth,it then sets to become an elastic solid after few minutes.However,the impression after taking from the patient's mouth invariably contaminated with patient saliva or blood,such fluids can contain viral and bacterial pathogens.This would become a common source of transmission of infection to those handling , to the dental clinics or labs and which then cross-infect the dental casts poured from the impressions[1].The importance of cross-infection control cannot be exaggerated. Disinfection and sterilization methods are used to attain disinfection and sterility of materials and instruments in order to avoid the spread of pathogens from patients to patient, patient to health care personnel and health care personnel to patient, it is the duty of the health care policies makers to allocate the appropriate methods of cleaning, disinfection.Cleaning is the removal of all foreign material while decontamination is the removal of pathogenic microorganisms from objects. Disinfection is the process of elimination of many pathogenic microorganisms on inanimate objects except bacterial spores[2,3].Disinfection is divided into three groups according to their potency. High level disinfection involves bacterial spore destruction along with other microbial forms. Intermediate level disinfection involves killing microorganisms but not able to kill spores. Low level disinfection has narrow antimicrobial activity.

Dental impressions are classified under semi-critical objects and require high level disinfection or sterilization[4].However,Sterilization in an autoclave will bargain the dimensional accuracy of the impression hence it is not accomplishable.Until 1991, the only advocated procedure for disinfection of impressions was rinsing under running water where only 40% of microorganisms were removed and potential for transmission of microorganisms remains[5].Now a days, a pre wash of the impression under running water is advocated primarily to cast off all particles including blood and saliva prior to active disinfection procedure[6,7].Alginate is the one of the most widely used dental impression material but it has reported that the microorganisms present in alginate are three to five times more than any other impression materials. Disinfection of Alginate Should be done as a routine procedure. By knowing all the methods and techniques, dental professionals in private clinics, hospitals, dental schools and prosthetic laboratories are advised to follow the required procedures of disinfection regularly. However ,most of them are not following the required protocols for impression disinfection[8]. It is of most importance to raise the level of awareness in dental professionals and dental students involved in any process of handling, transportation, processing and storage of dental impressions. Different techniques of

disinfecting impressions and control of cross-infection must be a part of the undergraduate modules of dental universities and dental technician schools[9]. The aim of this review is to make an update on the various techniques and types of Alginate disinfection along with their criteria and protocols to be remembered for disinfection.

MATERIALS AND METHODS

A review of scientific literature was done in preparation of the manuscript. The relevant articles were collected from databases such as pubmed, google scholar, MESH etc .The time frame of the articles was between the year 2000 to 2020. Around 25 articles were collected on the basis of containing keywords, further analysed and reviewed.

METHODS OF DISINFECTION

Impressions should be rinsed fully under tap running water before disinfection as to remove as much as bioburden as possible. Both immersion method and spraying method has been recommended for disinfection of alginate.

***SprayMethod*:**

Spraying uses less solution, and often the same disinfectant can be used .Spraying does increase the chances for staff exposure to hazardous chemicals. Using stream spray can minimize aerosolization[10].

When using impression materials that cause distortion by immersion method, spraying may provide an acceptable alternative to immersion. Impressions can be sprayed thoroughly and placed in airtight plastic bags[11]**.** After the appropriate contact time the impression can be removed, rinsed thoroughly with tap water, shaken gently to remove adherent water, and poured[12].

***Sterilization*:**

For sterilization of Alginate,e.g. exposure to UV light, steam autoclave, and radiofrequency flow discharge etc.[13]

***Microwaveirradiation*:**

Microwaves are easy to use, low cost and provide good disinfection for alginate thus effective tool for Alginate disinfection[14].It could also lead disinfection with no changes in physical properties of Alginate.

***Immersionmethod*:**

It is the most reliable method because all the surfaces of impressions and trays come in contact with disinfection solution.But this method is not suitable or the best method for alginate because hydrocolloids materials are extremely hydrophilic[15].

UV *rays*:

It is also a disinfecting method for impressions.In one study when comparing UV rays disinfection with Glutaraldehyde,NaOcl,UV rays exhibited maximum efficacy[16].This method also depends on various factors.

***Othermethods*:**
Sealing in a bag and spraying with a Hydrojet system is effective to remove the microbes . All the disinfection systems would be effective with ultraviolet[[17].

CRITERIA AND PROTOCOLS FOR ALGINATE DISINFECTION

Optimally, impressions should be decontaminated through chairside disinfection immediately after removal from the patient's mouth. Personal protective equipment must be utilized with adequate ventilation when disinfecting[18].For adequate inactivation of microbial contaminants, appropriate application (time of contact) is needed,after the appropriate contact time the impression can be removed, rinsed thoroughly with tap water, shaken gently to remove adherent water, and poured.Rinsing after impression disinfection also is essential to remove residual stone, soap, or disinfectant from the impression surface[19].

The most suitable method for Alginate disinfection to be selected.eg-spray method. There should be a Periodic check for efficacy[20]**.**Factors such as effectiveness,chemical stability **,**compatibility of the disinfection solution should be considered as the disinfection procedure should not change the dimensions and significant details of the alginate impression. Disinfectant with appropriate life, P.H,and temperature should be considered[21].It should be noted that no single disinfectant is compatible with all impression materials.Therefore,the compatibility of disinfectant solution with impression material should be assessed prior to disinfection procedure,Any compatible disinfectant solution should not cause any alteration on the surface detail reproduction[22]**.**

DIFFERENT TYPES OF DISINFECTANTS AND DISINFECTION TECHNIQUES

Glutaraldehyde:
Glutaraldehyde is a high level disinfectant solution.It is a broad spectrum chemical agent which has fast killing capability. Glutaraldehyde is also called chemo sterilizer. If it is used correctly with proper concentration and specialized equipment, it can destroy all types of microorganisms including bacterial and fungal spores, tubercle bacilli and viruses[23]. Usually it is a colorless liquid and has pungent odour. Even though it is classified as the best disinfectant,it would cause any drawbacks if not used properly.Hence precautions should be proceeded while using it e.g. wearing nitrile gloves,handling in a closed system, exhaust ventilation and with a low temperature of the solution as it will reduce the soaring concentration of the solution[24].

Sodium hypochlorite:
This provides intermediate level disinfection and has a broad spectrum antimicrobial activity. The advantages of sodium hypochlorite includes fast bactericidal activity, easily soluble in water, stable, nontoxic at use

concentrations, low in cost, non-staining, non inflammable and colorless. Disadvantages is less. It has been reported that the alginate impression disinfected with spray method using 1% sodium hypochlorite has not shown any severe dimensional changes or surface roughness of stone cast when fabricated from that impression [25]However, in another study Alginate disinfection by immersion method with 0.5% NaOCl for 15 min exhibited small dimensional change [26].

Iodophors:

Iodophors are categorised as low to intermediate levels of disinfection. Iodophors are bactericidal, mycobactericidal and virucidal[27].It needs more frequent application for complete disinfection in case of Alginate.It could also cause little dimensional stability or changes[28].

Alcohols:

These provide intermediate level disinfection. Alcohols like isopropyl alcohol and ethyl alcohol are commonly used disinfectants. Ethyl alcohol is more effective in bactericidal than bacteriostatic activity. It also has tuberculocidal, fungicidal and virucidal[29].These Alcohol are contraindicated for alginate impressions because they can cause surface changes of impressions utmost[30].

Phenols:

Phenols are categorised as intermediate level disinfectants. Phenols are also known as protoplasmic poisons. When used at very low concentration, they cause lysis of antifungal and antiviral properties as well. These are commonly used as surface disinfectants. Ideally not recommended for alginate disinfection as some phenols are low level disinfectants .They are incompatible and cause acute toxicity as well[31][32].

Chlorhexidine:

Chlorhexidine is an intermediate level disinfectant. It has a broad spectrum of activity.It is commonly used in oral products. It is bactericidal, virucidal and myco bacteriostatic and its activity depends on specific pH. The 2% chlorhexidine disinfectant solution has shown activity against s.aureus,e.coli. It can also be effective when used as a water substitute in alginate mixing. Impression can also be immersed in chlorhexidine solution and it causes successful disinfection[33].According to one study, 1.0 g/L of the solution has efficacy in self-disinfecting alginate impression material as it has shown antimicrobial activity and did not cause any alter in dimensional accuracy, flow ability and setting time of alginate impression materials[34].

Ozonated water:

Ozone is an inorganic gaseous molecule.It has antimicrobial, antihypoxic activities[35].Ozonated water can also be used as a disinfectant for impressions. According to one study, aqueous ozone is more biocompatible compared to other disinfectant solutions such as chlorhexidine, NaOCl, H2O2. This disinfectant reduces the number of microorganisms on the surface of alginate and by increasing the time of immersion much more effective disinfection can be achieved[36,37].

POSSIBLE DRAWBACKS OF ALGINATE DISINFECTION

A number of studies have evaluated and reported the effects of disinfection of different disinfectants on irreversible hydrocolloid (alginate) impressions. Results have varied greatly depending on the techniques and materials evaluated. Generally, however, distortion has been found to be minimal and not clinically significant[38].Based on these findings, disinfection via immersion in dilute hypochlorite or iodophor is recommended as its ability to maintain the accuracy of impressions. However, studies have reported significant adverse effects on specific materials with disinfectants that do not react with alginates[39]. Improper amount, concentration, time of contact , compatibility would result in faulty disinfection along with changes in dimensional stability, accuracy, surface details and inferior properties[40]. Surface details may also be changed. These are the possible drawbacks of disinfecting alginate.

Dimensional stability of alginate:

The accuracy of an impression material is the key for the production of a well-fitting restoration and longevity[41]. But, alginate is affected by the reactions namely syneresis and imbibition after removal from the patients mouth, therefore stone casts must be soon fabricated as possible to avoid dimensional changes[42].The dimensional stability of an impression material reflects its ability to maintain the accuracy of the impression but maintaining the stability is critical if the impression was not casted soon after removal from the mouth.
Therefore, the dimensional changes of the alginate impression must be limited only upto an allowable range of 0.15%. Although the hydrophilic nature of irreversible hydrocolloid material is valuable for making impressions in a moist environment,the microorganisms present in blood and saliva tend to get embedded in alginate impression material which would become a serious risk in clinical use. This necessitates the disinfection of impression materials to avoid cross infection with maintaining the accuracy of the impression.[43][44].

ALTERNATIVE DISINFECTANTS FOR ALGINATE

Alternative modes of disinfection includes traditional sources like aloe Vera, Neem, Turmeric, Lemon can also be used to treat alginate impressions due to its low cost, non toxic nature, biocompatible and effective which will overall work effectively in impression.
A study by (Sumanti and Maulida et al 2018) reported the efficacy of Aloe vera as a disinfectant by immersion and spray method on alginate impression material and its effect on the dimensional stability of the resultant gypsum cast. The efficacy of the disinfection procedures against Staphylococcus aureus, Pseudomonas aeruginosa, and Candida albicans was evaluated by determining the number of colony-forming units (CFU) recovered after disinfection of alginate discs inoculated with 1x106 CFU for defined intervals with aloe vera solution (99.96%). Dimensional stability was determined. It was identified that there is a mean percentage reduction in colony count of S. aureus, P. aeruginosa, and C. albicans after 3 minutes of immersion in aloe vera and after 3 minutes spray disinfection. Complete elimination of all the microorganism cells after 7 min immersion and spray disinfection. There was

a statistically significant difference in the increase of the mean anteroposterior (AP) and cross arch (CA) dimension after 3 and 7 minutes immersion in aloe vera. Spraying with aloe vera for 7 minutes was proved to be the most effective disinfection procedure without altering dimensional stability[45]**.**

Table:0-LEVELS **OF DISINFECTANTS** [46,47]

TYPES OF DISINFECTION	**DISINFECTANTS**	**TYPES OF IMPRESSION MATERIALS**	**TIME OF EXPOSURE**
HIGH LEVEL OF DISINFECTION	Glutaraldehyde	Irreversible hydrocolloid Zinc-oxide eugenol Polysulfide Polyether Addition Silicon	10mins 10mins 10mins 10mins
INTERMEDIATE LEVEL OF DISINFECTION	Sodium Hypochlorite Complex Iodophors Phenols Chlorhexidine Alcohols	Irreversible hydrocolloid Zinc Oxide zugenol Polysulfide Polyether Addition Silicon Impression compound	10mins 10mins 10mins 10mins 10mins
LOW LEVEL OF DISINFECTION	Quaternary ammonium compounds. Simple phenols detergents.	Not recommended for impression disinfection	Not recommended for impression disinfection

TABLE:1-TYPES OF DISINFECTANTS [48]

Class of disinfectant	**Type of Disinfectant**	**Recommended Concentration**	**MOA (Primary)**	**Commercial preparations available**
Glutaraldehyde	Non oxidizing	2%	Alkaline agent for proteins. Mainly amines, amides and sulfhydryl groups	Cidex
Sodium Hydrochloride	Oxidizing	0.5% or 200-50000PPM	Disrupts cell membrane transport chain by causing inhibition.	Clorox Purex Chloramine
Iodophors	Oxidizing	1-2%	Proteins and enzymes are inactivated	Betadine a3333 Isoprep Hy-Sine
Alcohols	Non oxidizing	60-90%	Cell membrane lipid content is solutilized and proteins are inactivated or precipitated.	Isopropyl/ Ethyl alcohol
Chlorhexidine	Non oxidizing	2-4%	Intracellular contents are coagulated and cell membrane is damaged.	Savlon
Phenolic	Non oxidizing	1-3%	Protoplasmic poison causes damage to cell membranes.	Lysol Dettol H-Pheno

CONCLUSION

Cross infection control is a very important aspect of patients safety. In alginate impression microbial load is transferred from three to five times than other impression materials. Hence it is customary to rinse alginate impressions as a routine work in dental offices and laboratories . It is the responsibility of the dentist to make appropriate choices of disinfection methods for different impression materials in order to avoid changes in accuracy and details and to

get best results for impression disinfection. It is also important to create awareness regarding impression disinfection. The disinfectant should be effectively clean, thereby removing dirt, effective against a broad spectrum of microorganisms and should have ultimately realistic contact time and the product's chemistry profile should be sustainable. Disinfectants should be used in impressions prior to cast pouring and also it should be used before taking impressions in some cases. It has been reported that the most effective method of reducing the burden of microorganisms from alginate without any changes in accuracy is chlorhexidine, when it is used as liquid for alginate preparation and post-setting disinfection solution.Hence, it is mandatory to do disinfection of alginate and any other impressionable materials.

AUTHOR CONTRIBUTION

Divya Dharshini.A has contributed for execution of the work, data collection and drafting of manuscript. Dr.Jayalakshmi Somasundaram has contributed for concept and design of the study, validation of the data collection, revision and proof-reading of the review. Dr.Muralidharan has contributed for validation of the data collection, revision and proof-reading of the review

CONFLICT OF INTEREST

NIL.

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