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DENTAL SCIENCE
Review Article

A Practical Guide to Use and Methods of Disinfection of Alginate Impression Materials

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Received: November 23, 2015; **Published:** December 18, 2015

Abstract

Alginates are classified as elastic impression materials. Within this elastic category it is further subdivided into irreversible hydrocolloids. The reason they are referred to as irreversible is due to the fact that once set in gel form they cannot convert back into sol form. They are widely used in contemporary dentistry for impression making especially in partially edentulous subjects. One of the reasons for its wide usage is that it is comparatively cheaper in price as compared to other impression materials. In addition to it, minimum armamentarium is needed for its manipulation. Disinfection of alginate impression materials is necessary for prevention of cross-contamination. Alginate undergoes changes in its dimension if it is kept in a disinfectant for an extended period of time. In this contribution the method of using alginate alongside the different techniques used for its disinfection and their effect have been reviewed.

Keywords: *Alginate; Impression Materials; Disinfection; Contamination*

Impression Materials

Impression materials are primarily used to reproduce different parts of the oral tissues. All impression materials should initially be plastic while the replica is being made. Impression materials are transferred to the patient's mouth by means of an impression tray. The tray can be a stock tray or a customised tray. The tray provides support to the impression material. Once the tray is seated into the mouth the impression undergoes setting either chemically or physically [2].

Classification of Impression Materials

Many criteria can be used for the classification of impression materials. The most commonly used method of classification is by chemical means [3]. They classified impression materials according to their elastic properties and chemical type into:

a. Elastic materials and
b. Non-elastic materials

Elastic Materials

For dentate patients, the impression material should be flexible enough to be removed from the undercut areas without damage. It should have adequate elasticity to recover from undercut areas and produce accurate information. Elastic materials have the property of being able to stretch and compress and are also able to give a reasonable degree of elastic recovery following deformation [3]. Elastic impression materials are further classified into Synthetic elastomers and Hydrocolloids [3]. *Synthetic Elastomeric Materials*

The synthetic elastomeric materials are

a. Polysulphides
b. Silicones which are further sub divided into:

Addition silicones and condensation silicones

a. Polyether

Hydrocolloid Materials

The hydrocolloid materials are

a. Agar, which is a reversible hydrocolloid and
b. Alginate which is an irreversible hydrocolloid

The hydrocolloid materials are

These are only used in edentulous cases; the materials are hard set. The non- elastic group of materials include:

a. Impression Plaster
b. Impression Compound
c. Zinc oxide eugenol pastes
d. Impression waxes

Alginate

Alginates are used for making impressions of partially edentulous arches. They are also used as preliminary impression materials during the formation of complete dentures. They also have a role in orthodontics where they are used to make study models for orthodontic treatment [4].

Typical formulation of an alginate impression material

Below, a formulation of a typical alginate powder is given, as described by (and taken from) ISP Alginates'4 (1997):

1. Sodium/potassium alginate, ~14% by weight that undergoes cross-linking with calcium to form a gel.
2. Trisodium phosphate or tetrasodium pyrophosphate, ~0.42% by weight. It acts as a retarder to prolong the working and setting time.
3. Calcium sulphate hemihydrate, ~9% by weight. It serves as cross-linking agent during the setting of the alginate impression material.
4. Potassium fluorotitanate, ~3% by weight that is used for controlling the pH of the set material.
5. Magnesium oxide, ~10%by weight that is also used for the modification of the pH of the alginate material.
6. Diatomaceous earth, ~63.58% by weight. This is the filler that is responsible for the modification of the gel elasticity. Fillers are also responsible for improving the dimensional stability of the gel.

Minute traces of ethylene glycol are also found in the formulation of alginates. It minimises the amount of dust that comes out when the alginate container is shaken, for even dispersion of particles.

Setting chemistry of alginate

The setting process of alginates involves the cross-linking of the alginate with a divalent ion, usually calcium in the form of calcium sulphate, whereby a transition from a sol to a gel phase gel takes place [1]. (Figure 2.1)

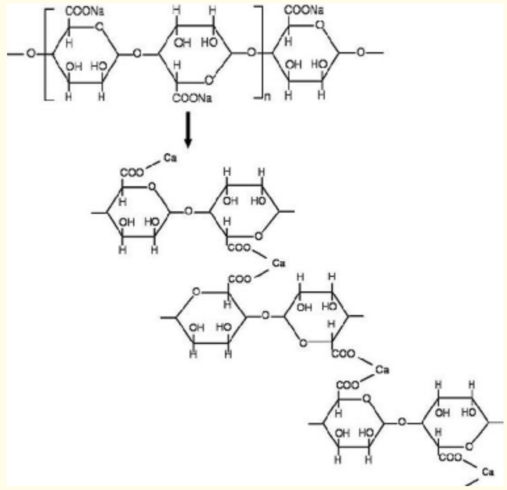

Figure 2.1: *Illustrating the mechanism by which cross-linking takes place between sodium alginate and calcium [1].*

Structural Chemistry of Alginates

When water is added to an alginate powder several reactions occur, which are described subsequently. Overall typically, with for example sodium alginate, the monovalent sodium ions are replaced by divalent calcium ions. The latter cross-link the alginate (Figure 2.1). This cross-linking is responsible for the transition of material from a sol form to an irreversible gel form. There is a concomitant increase in the cross-linking of the material as the reaction progresses. This cross-linking eventually results in the formation of the elastic properties of the gel [3].

Trisodium phosphate, for example, is included in the formulation of the alginate as a retarding agent. It is added to provide adequate working time of impression materials while it is being manipulated; in the absence of trisodium phosphate the resultant calcium sulphate cross-linking reaction is very rapid. This rapid setting would not allow adequate working time to dentist or technician [5].

Trisodium phosphate removes calcium ions, which are sparingly soluble, as explained below by [1]. When water is added to an alginate powder, the trisodium phosphate, which is very soluble in water, quickly ionises into sodium ions and phosphate ions:

$Na_3PO_4 \rightarrow 3Na^+ + PO_4$-

Simultaneously, the sparingly soluble calcium sulphate forms calcium ions and sulphate ions, at a much slower rate:

$CaSO_4 \rightarrow Ca^{2+} + SO_4^{-2}$

Then the calcium ions react with phosphate ions to form calcium phosphate

$2Na_3P0_4 + 3CaSO_4\text{-} \rightarrow Ca_3\ (PO_4)_2 + 3Na_2SO_4$

Hence: $3Ca^{2+} + 2PO_4^{2-} \rightarrow Ca_3\ (PO_4)_2$

So, until all the sodium phosphate is exhausted, no calcium ions are available for the cross linking of the alginate [1]. Once this reaction is over the calcium ions cross-link the alginate as shown in figure 2.1.

Properties of alginate Impression Materials

Dental alginates must satisfy the requirements of the regulating authorities, such as the American Dental Association (ADA) and the International Standardisation Organisation (ISO), before they are launched in the market for public use. The American Dental Association regulation No.18, commonly referred to as ADA Specification No.18, has laid down requirements for established alginates. These requirements deal with the odour of alginate impression materials, in addition to the mixing and setting time, permanent deformation, flexibility, strength, dimensional changes, reproduction of surface detail of alginate impression materials and disinfection guidelines [3].

Working/Mixing Time

The working time is defined as the time that is available for mixing and manipulating an impression material. It is the time, during which the viscosity of the material is still low, which allows the material to be seated in the mouth in order for the impression to be recorded [3].

Two types of alginates are available in the market, rapid setting and normal setting alginates. The normal setting alginates should have a working time of around 2-3 minutes whereas a fast setting alginate should have a working time of just over a minute or two. When the alginate is properly mixed the resultant mixture has a smooth and creamy consistency 7 [6]. Temperature and moisture can alter the working time of alginate impression materials, as can the powder/water ratio; a low water to powder ratio results in a shorter working time [6].

Setting Time

The setting time is referred to as the time period at which the impression material starts to attain some elasticity as a result of cross-linking of the alginate impression material [3]. As in the case of working time, alginate impression materials also have two different setting times, namely normal setting alginates and fast setting alginates. The setting time of a fast setting alginate is around 1.5-3 minutes whereas the setting time of a normal setting alginate is in the range of 3-4.5 minutes. The manufacturer can alter the setting time by altering the ratio of sodium phosphate in the composition. The clinician can also alter the setting time of the material by altering the water to powder ratio (but this is not recommended). The setting reaction is also temperature dependent (i.e. the warmer the water/or room temperature, the faster the setting time) [3].

Permanent Deformation

The first step in the fabrication of prosthesis for multiple purposes is impression taking. Therefore a dimensionally accurate impression is very important for accurate fabrication of prosthesis. The ADA specification permits a maximum of 5% permanent deformation when the alginate material undergoes 20% compression for 5 seconds. This specification is supposed to represent the alginate impression material's removal from the oral cavity where undercut areas are present and recovery from the latter. Permanent deformation can be affected by a number of factors, such as the degree of cross-linking of the set alginate [6].

Flexibility

The alginate materials show some degree of flexibility following setting. However, the flexibility is not greater than agar impression materials [3]. The flexibility is affected by water to powder ratio; thinner mixes result in lower flexibility (Craig., *et al*. 2004). Flexibility is advantageous to alginate impression materials because it allows the impression material to be removed easily from the oral cavity without distortion of material. The ADA specification allows flexibility within 5%-20% when the value of stress is around 0.1 MPa [6].

Strength

Crown and bridgework requires accurately fitting impressions because of the fixed nature of the prosthesis. In crown and bridgework the use of alginate impression material is very limited. Dentists, due to their poor tear strength, do not often use these materials. These materials tend to tear when they are removed from undercut areas and inter-proximal areas. There are two types of strengths; compressive strength and tensile strength. The chances of an alginate impression material fracturing in tension are much higher than in compression. Therefore the tensile strength is considered to be more important than compressive strength, as far as the alginate impression materials are concerned [3].

The minimum compressive strength as required by ADA specifications should not be less than 0.35 Mpa, and or tensile strength between 0.37–0.69 N/mm. Tearing is also thickness dependent, but unlike flexibility, tearing occurs in areas where the sections of the impression material are thin. Hence tear strength is directly proportional to the thickness of the impression material [6]. Tear strength is often measured using the so-called 'Trousers' test piece [7].

It should be noted that the manufacturer's instructions should be followed while mixing of alginate takes place. Failure to comply with the given instructions could result in the final alginate gel being weak and with reduced elasticity [5].

Reproduction of surface details

The impression material should be able to record fine details of the oral mucosa. Besides this the material should be able to transfer the fine details obtained from impression to cast. The ADA specifies that the alginate impression material product should be able to reproduce a line that is at least 0.075 mm wide to the cast [6].

Dimensional Stability

The dimensional stability of an impression material is important to produce a prosthesis that does not cause any trauma to the patient. A dimensionally unstable impression material leads to poor fit of the prosthesis that does not serve the purpose of restoration of functionality and aesthetics [8].

Alginate impression materials undergo some degree of shrinkage when they are exposed to air [9]. The accuracy of alginate materials is greatly reduced when they are stored for a prolonged period of time. Being a hydrocolloid, the set alginate material loses water when it is placed in air; the loss of water in air causes the set alginate material to shrink [6]. Furthermore, when the material is placed in an aqueous medium, it is claimed to swell over a period of time, due to water being imbibed by the material [5]. Then the material begins to shrink as water-soluble components are leached from the material. However, work by [6] and the results of the research carried out in this project do not show this swelling behaviour. Both of these conditions affect the dimensional stability of set alginate impression materials [6].

The dimensional stability of alginate impression materials is also affected by the use of disinfectants. Most dentists tend to disinfect the impression by aerosols rather than immersion in disinfectant medium, because of the fear of loss of dimensional stability [10]. The immersion of alginate impression materials in disinfectants, for a period of time (an hour or above), had an adverse effect on the dimensional stability of the materials. However, the dimensional stability of alginates remained stable, for an hour when they were disinfected by means of aerosols [11].

A hydrocolloids dimensional stability is also influenced by variations in temperature. Although it is best to pour the impression as soon as possible, after it is taken, in busy dental practices this is seldom possible. In such a situation the impression may be stored for a short period of time covered in a moistened tissue [3].

Selection of Impression Tray

Selection of impression tray is based on the size of dental arch. For alginate impressions perforated stock trays are recommended. To further enhance the retention of Alginate adhesives can be used. Customization of stock trays is needed for individual patients. Wax, tracing stick impression compound can be used for customization. Border molding of modified impression tray must be done to adapt the margins of the tray in the oral cavity.

A careful intra oral examination is done before registration of impression. In case of any existing fixed prosthesis, wax block out of pontic must be done to prevent tear of impression.

Mixing and Loading of Alginate

Alginates are supplied in containers with a measuring scoop for measuring the powder. Alginate mixing takes place by mixing powder into the liquid. Temperature variation can increase or decrease the setting of Alginate. Colder water can be used if longer working time is desired. Mixing is carried out with a steel based spatula. The spatula is brushed against the walls of the mixing bowl in a rapid circular motion. It is done to obtain a homogenous mix.

Mechanical mixing of alginate is done to ensure that the e mix is the homogenous each time they are mixed. Mixing time is 45-60 seconds for hand spatulation and 15 seconds for mechanical.

The required amount of material is loaded onto the tray. The tray must be filled with the impression material up to the tray borders and any excess unsupported material (over-filled tray) at the periphery must be removed with the mixing spatula. The surface of the alginate is smoothed with a wet gloved finger.

Preparing the mouth before Impressions

A gentle stream of air is applied onto the surfaces of the teeth prior to impression making. The teeth should not be left to dry completely since alginate material have a tendency to sticks to dried teeth thereby leading to distortion of impression on removal.

Having the patient rinse with water and mouthwash mixture will eliminate mucin and lower the surface tension, thereby eliminating air bubbles. If repetitive impressions are made with alginate, the film over the teeth is lost and getting a satisfactory impression is prevented. While repeating impressions, the patient must be asked to rinse the mouth to re-hydrate and produce a new film over the teeth for accurate impressions. Pre-packing of the sulci, especially lower lingual, upper labial, hamular notch/distobuccal areas, should be considered when registration of impression is being done for removable prosthesis.

Impression Making

The mixed alginate should be rubbed onto the occlusal surfaces with a gloved finger to fill the occlusal grooves, allowing accurate reproduction of the occlusal tooth anatomy. Some alginate must be placed in the palatal vault. Impression tray is positioned in the mouth by retracting the patient's lips on one side with a mouth mirror/gloved finger; and on the other side, by rotating the tray into the mouth. The tray has to be centered in position in the mouth; and with light pressure, impression is held in place. The soft tissues, especially labial flange, should be relieved and manipulated for the alginate to flow into the sulci and record the details.

When tray is seated, pressure should be released immediately and the tray should be held lightly in place to prevent unseating. It is imperative to release pressure as soon as the tray is seated. Alginate materials start setting from the tooth surface to the impression tray. Pressure will cause impression to set under strain. On removing the impression from mouth, these strains will be released, causing distortion and an inaccurate cast. Moving the impression tray during gelation will incorporate similar strains.

Removal and Inspection of Impression

Once set, the impression has to be removed with a firm, quick snap. The impression should not be rocked or twisted before or during removal of the impression. This is to minimize the time for which the set material is distorted as it moves over the teeth. The seal between tissues and the impression may have to be removed before removal of maxillary impressions, by gently pushing with the gloved finger or by using air-syringe into the buccal sulcus. During removal of the maxillary impression, the operator's index fingers (of both the hands) should be in the buccal sulci to break the seal while thumb holds the tray handle and the other fingers support the impression tray.

Upon removal of the impression from the mouth, impression is inspected for defects under good lighting before it is rinsed. The impression should be rinsed with cold water to remove any saliva or blood. Most patients have thin, serous saliva. This type of saliva can be removed by holding the impression under gently running cool tap water. But thick, ropy saliva is difficult to remove. A thin layer of dental stone powder can be sprinkled onto the surface of the impression. The stone adheres to saliva and acts as a disclosing agent. When impression is placed under running tap water, the saliva will be seen and can be removed by light brushing with wet camel's hair brush [10]. The impression should then be covered in a damp gauze/napkin to prevent syneresis (generally, not recommended to place in water, which would cause imbibition-expansion).

Excess unsupported alginate should be removed with a sharp knife. If the tray is left on a firm surface with unsupported material, the impression would distort as the weight of the impression acts directly on the unsupported material. This occurs in the posterior areas of the upper and lower impressions, and it will lead to anteroposterior distortion of the cast.

Decontamination of Impression Materials

The need to disinfect the impression material arises due to the fact that over a period of time much attention has been paid to prevent the cross infection of infectious diseases, such as Human Immune Deficiency Virus (HIV), Tuberculosis, Herpes Simplex virus and Hepatitis B [12]. The dentists in general, and the dental laboratory technicians in particular, are prone to be infected with such contagious viruses if proper measures regarding decontamination of impression materials are overlooked. Inspite of the fact that the dental regulating authorities have laid down certain rules regarding disinfection methods of impression materials, there is still considerable ambiguity over the issue. This lack of certainty is because of the fact that none of the available disinfectants are flawless. It is for this reason that no single disinfectant solution is recommended as a benchmark for use globally [13]. When an impression that is contaminated with blood and saliva is poured to form a cast, it results in the transfer of the blood-borne microorganisms to the cast. This implies that the stone cast also needs to be disinfected, as it could also be a possible source of cross-contamination of infectious organisms [14].

Researchers have mostly relied on theoretical considerations to prevent the growth of micro-organisms in impression materials. This is because a limited amount of work has been done to investigate the presence of micro-organisms in impression materials. For this reason, there is very little information in the literature characterising the presence of micro-organisms in impression materials. A few of the studies have found different bacterial species in impression materials, but the level of bacterial contamination was not high [15]. A study to investigate the presence of viruses also did not give positive results indicating the lack of viral contamination of impression materials [16]. These studies signify reduced chances of microbial contamination from impression materials to dental professionals, particularly professionals associated with dental laboratory [17].

Methods of disinfection of alginate impression material and its effect on its dimensional stability Although at present, in dentistry, many different types of disinfectants are available, none of them are universally acceptable as mentioned earlier. It is due to the fact that all the disinfectants have some disadvantages. This situation is further aggravated because of the fact that the present market offers a wide range of different impression materials as well. Although the ingredients of alginate impression materials are similar, their detailed composition differs and is not disclosed by manufactures. Therefore disinfections on different types of impression materials have been carried out with different types of disinfectants. The degree of success with each disinfectant has shown marked deviations [18]. Apart from disinfection by chemical means, efforts have also been made to disinfect the impression materials by means of ultrasonic and microwave radiation [19].

Effect of hypochlorite, Perform ID and Sterilox

Researchers have investigated the change in dimensional stability, with respect to time, of alginate impression materials immersed in different disinfecting solutions [19]. The disinfectants used in the study were Sodium Hypochlorite 5.25%, Perform ID and Sterilox-both as a 10% dilution and in the form of concentrated solution. The investigators tested 400 samples. In order to keep the operator dependency minimal, the specimens were fabricated in a mould, which was in the form of a precisely machined cylinder. Dimensionally, the mould was 3mm in diameter with a 4mm height. On placement of the impression material into the cylinder, the material was compressed and covered with a glossy plastic release film. A glass slab was then placed over the film and excess material came out through the extrusion orifice that was present at chamber's base. The material was allowed to set, for the time recommended by the manufacturer. The control samples (5 samples) in the study were stored at 99% humidity, at room temperature. The changes in dimensions were measured with a customised Automatic Laser Radial Micrometer. The resolution of this device was 0.0001 mm. The measurements were taken at three different time periods. The first measurement of the samples took place soon after they had been prepared, to obtain a baseline reading. This was followed by a measurement at the time claimed by the manufacturers to be suitable enough for impression materials to be disinfected, without any negative effect on dimensional stability. The last measurement was taken after 24 hours of immersion [19]. These time points seem to be in a very limited range for taking measurements. In the work carried out in this thesis, measurements were taken every five minutes, over an hour time period. The samples were stored in humid environment, to simulate conditions in which the impression materials are generally kept before transfer to the laboratory. The results of this study indicated differences between the materials that were immersed in bleach and the other groups. However none of the differences between the control and Sterilox groups were statistically significant. The net shrinkage was no more than 2.8%. The results of this study showed that an alginate material, when treated with Sterilox in both its' dilute and concentrated form, underwent expansion. On the contrary a totally opposite phenomenon was observed with other treatments. Shrinkage pattern was observed after 24 hours. The greatest shrinkage was observed in the alginate that was immersed in bleach. The mechanism by which these changes occurred was not investigated by the researchers [19].

Studies about the dimensional stability of a cast made from an alginate impression material that had been immersed in undiluted sodium hypochlorite are also present [20]. Alginate impressions were made on a typodont. The impressions were treated with 4.65% undiluted sodium hypochlorite aqueous solution (Sainsbury's Bleach) for 30 minutes. The impressions that were used as control were not treated with hypochlorite disinfectant. The casts of the resultant impressions were poured after 30minutes and stored for 24 hours before being measured. A Reflex microscope was used to measure the changes in dimension. The results of this study indicated no significant differences in the dimensional stability of the casts that were treated with the disinfectant from the ones that did not go through any disinfection procedure. Therefore the researchers of this study claim that the use of 4.65% undiluted sodium hypochlorite is safe for the disinfection of alginate impression materials, for a period of 5 minutes, without any detrimental effects on the casts made from such impression materials [20].

Bergman., *et al*. (1985) [11] investigated the effect of six different types of disinfectants on four different alginate materials. The researchers used stainless steel test blocks to measure the dimensional stability and the surface detail of alginate materials. The reason for using stainless steel test block was the sensitivity of hydrocolloids to humidity. The stainless steel test blocks were indented with three lines. The lines were to be reproduced by the impression material, in order to study the sharpness of surface details. The lines were 0.057, 0.036 and 0.079 mm in dimensions with a width of 0.077 mm. A specimen holder specifically with the purpose of keeping the humidity inside the equipment around 100% was used. The individual materials were mixed according to the guidelines given by the manufacturer. They were then immersed in the disinfectant solutions for evaluation of dimensional change and reproduction of surface detail sharpness. The disinfectant solutions used were 2% gluteraldehyde, 2-4% Propanolol, 0.5% chlorhexidine, 5% sodium salt of sulfonchloramide, 1% benzalkonium chloride and a mixture of phenyl- phenol and 0.5% chlorcresol. The control used in the study was distilled water. The measurements were taken at three different intervals; as soon as the sample was prepared; then after the material remained immersed in disinfectant or distilled water for an hour; then the measurements were taken after the samples was stored in air for 24 hours. The measurements were taken by means of a measuring microscope. The results of this study showed significant dimensional changes; whereas the surface detail reproduction of sharpness did not show any significant change [11].

Effect of Gluteraldehyde

Alginate impression materials have been in immersed in Iodophor (Biocide), Phenol gluteraldehyde (Sporicidin) and Glyoxal gluteraldehyde (Impresept D) for disinfection purposes [21]. The effect of immersion following removal from the disinfectants, on the dimensional stability and surface smoothness, was evaluated. In this study neutral Glyoxal gluteraldehyde (Impresept D) was specifically prepared for the disinfection of alginate, addition silicone and polyether impression materials. The mandibular arch cast was used as a master cast. The samples, which were used as controls, were not immersed in disinfecting solutions. The alginates that were used in this experiment were Jeltrate and Pelgaflex, both of regular viscosity. The materials were mixed according to the manufacturer's instructions, and placed in a mandibular cast during the working time. The setting time was allowed as stipulated by the manufacturer. After impressions were set, they were rinsed for 10 seconds, to simulate the situation in the dental practice where impressions are rinsed for the same time period, for removal of saliva and other oral fluids. The samples were immersed for 10 minutes, in the disinfectants, as recommended in the disinfectants' literature. The impressions were then poured to fabricate casts. A measuring microscope was used for evaluation of dimensional changes whereas the surface quality was assessed by means of a Surfanalyzer instrument. The results from this study concluded that these hydrocolloid impression materials could be immersed for disinfection purposes without any significant clinical changes in accuracy to effect the treatment. The surface quality of the alginate impression materials that were treated with disinfectants also showed a much greater degree of smoothness in comparison to their control counterparts [21].

Peutzfeldt and Asmuseen (1989) [22]. investigated the effect of different types of disinfectants on three commercially available alginates namely: Alginoplast fast setting, Blue Print regular and Jeltrate. 2% Chloramines, 70% ethanol, trisodium phosphate that is chlorinated and having a pH of 5, 2%gluteraldehyde and 0.13% gluteraldehyde, were used as disinfectants. Deionized water was used as a control. The immersion time of the materials in all these disinfectants was 60 minutes. After immersion they were stored in a humid environment for 24 hours. The resultant casts were made after 24 hours. The measurements were made by means of a dial gauge. The results of this study did not recommend the use of 70% ethanol as a disinfectant due to a significant shrinkage of the alginate materials. This large shrinkage was attributed to the dehydrating effect of the ethanol on the alginate impression materials. However the impression materials showed no significantly different dimensional changes in all the other disinfectant solutions. One phenomenon that was observed by the researchers in this study was the negative shrinkage of the casts that were made from Blue Print. The absorption of water in the Blue Print caused it to swell and therefore caused a negative shrinkage (expansion) of the material [22].

In another study, by Jones., *et al*. (1988) [23], alginate impression materials also showed clinically unacceptable dimensional changes when they were immersed in a 2% gluteraldehyde disinfectant solution, for more than a period of 10 minutes. The casts that were made from these disinfected impressions also showed a greater degree of discolouration [23].

Effect of Ethylene oxide gas

Another method, by which an irreversible hydrocolloid had been sterilised, was by the use of gaseous ethylene oxide [24]. The advantage this study offered was that the process of sterilization could be performed at a significantly lower temperature in comparison to sterilization performed in an autoclave. Autoclave sterilization has resulted in adverse effect on the materials because of the high temperature. After exposure of the irreversible hydrocolloid powder to ethylene oxide, 30 samples were prepared and studied for microbial growth. The results showed effective control of the growth of micro-organism. Gaseous ethylene oxide exposure to alginate impressions also did not show any significant adverse effects on the dimensional stability and setting time of the materials, which were measured by means of a micro-measuring device. The test controls used in this study were not made from the sterilised powder. This was the first work ever reported by the group of researchers, with respect to the use of gaseous ethylene oxide as a sterilising agent for hydrocolloid materials, in spite of the fact that there is a widespread role of the gas in sterilisation of other surgical equipments [24].

Effect of aerosol disinfection method

Another experiment was performed by Bergman., *et al*. [11] similar to the one described above, with the only exception being that instead of the samples being immersed in disinfectants, they were sprayed with aerosols. The comparative results of the study showed greater dimensional changes when the impression materials were immersed in disinfectants instead of being sprayed. No significant changes in surface detail of the impression materials were seen as a result of either immersion or spraying in a disinfectant. Thus the reproduction of surface sharpness remained satisfactory after exposure of an hour whereas the pattern was more variable after 24hours. The dimensional stability of alginate impression materials was totally unacceptable after an immersion period of an hour; on the contrary the dimensional stability of the sprayed material was satisfactory. It was concluded that if the situation demands immersion of impressions for disinfection purposes, for an hour or more, then an alginate is a contra-indicated material for the purpose [11].

Although spraying is documented as one of the methods of disinfecting an alginate impression material, by [11] one of the studies by Al-Omari., *et al*. [25] considered the method of disinfection by spraying and then storing of the impression for 30 minutes, as inappropriate. They studied the effect of four different types of disinfectants on an alginate impression material. The disinfectants consisted of potassium monopersulphate, sodium dichloroisocyanurate, chlorhexidine 0.05% by weight to volume diluted in 70% methylated spirit and cresol respectively. Sterile water was used as a control. A ruled test block fabricated in accordance to ADA specification No. 18 was used in this study. The mixing of alginate was done according to the manufacturer's instructions. The total number of samples prepared in this study was 25. Samples were immersed in sterile water for only 5 minutes. The samples were then evaluated for dimensional changes in the disinfectant solutions. The alginate samples exhibited expansion with the only exception being that of samples immersed in chlorhexidine disinfectant. The latter caused shrinkage of the samples. It was assumed that the shrinkage was due to the drying effect of the methylated spirit, in which the chlorhexidine was diluted. The samples that were sprayed were not measured for dimensional changes because they deteriorated very rapidly, as observed visually. Hence, the researchers claimed considerable shrinkage, which was visually observed of alginate impression materials that were sprayed with an alcoholic solution of a phenol derivative, and considered it inappropriate for disinfection purposes and subsequent storage for a period of 30 minutes [25].

In a study conducted by [26] the use of spray disinfection was advocated. In this study the shape of the maxillary arch was simulated by means of stainless steel die. The die consisted of three studs that resembled the anterior teeth and the two molar teeth on each side respectively. Hypochlorite, iodophor and phenol were used as the disinfectants. Water served as a control in this study. An automated machine mixed the alginate impression material. The impression of the maxillary arch was made. The impression was disinfected by means of the spray technique. The impressions after undergoing treatment were stored in a plastic container. Measurements were made after 10, 30 and 60 minutes. A total of five samples were used per individual disinfectant solutions and water. Residual disinfectant was rinsed by means of tap water for 10 seconds before pouring the cast. The measurements were made by means of a computerised contact-measuring device (Micro Val Measuring Systems). The results of this study also showed no significant alteration in the dimensional accuracy of alginate impression materials and the resultant cast when they were disinfected by means of a spray disinfection method [26].

The same group of researchers before studying the effect of disinfectants on the dimensional changes of impression material carried out a study on the effect of disinfectants on the surface reproduction details of gypsum cast. They used both the immersion and spraying methods of disinfection. The results in this study indicated that surface reproduction details can be obtained without any deleterious effect on the resultant cast if the impression materials are treated for 10 to 30 minutes with either spray or immersion disinfection procedure [27].

Dellinger., *et al*. [27] conducted a study in which the alginate impression materials were disinfected both by means of spraying and immersion. The alginate impression material was disinfected with 0.5%sodium hypochlorite, Sporicidin spray and Banicide. The controls used in this study were not disinfected by any means and were kept in a moist paper. The disinfection procedure was performed for 10 minutes. The results of this study concluded that the casts produced after the disinfection of either immersion or spray type was not significantly different from the casts that were produced from controls. Therefore the researchers advocated the use of both the types of disinfectant methods [27].

Cast Fabrication

Alginate impressions should be poured using vacuum-mixed stone and vibrator. A thick mix can trap air bubbles. The stone should be allowed to set in trays with the teeth down. If tray is turned upside down onto base of stone, there would be a tendency for water to rise to the highest point (cusp tips). This can result in faulty, very soft cusps on the model. Inverting the tray may also "bend" alginate away from tray if excess material has not been trimmed away prior to pouring. Cast has to be removed immediately after adequate set; otherwise, the model would have "moth-eaten" appearance.

Conclusion

Registration of accurate impression is a very important step of indirect restoration that is often neglected by dentists. Hence, minutest of details needs to be taken into consideration at the time of impression making. Disinfection of impression is a very important step towards prevention of cross-contamination. The recommended protocols for disinfection must be adhered to prevent cross contamination and to prevent a significant change in dimensional stability of alginate. Immersion for a prolonged period of time tends to result in absorption of liquid leading to swelling or expansion of impression. It inadvertently leads to fabrication of prosthesis that does not confirm to true size of the dental arch. It leads to ill-fitting prosthesis leading to discomfort and pain for the patient.

Digitalized impression is being contemplated upon by modern day dental care providers. Till such time, reliable alginate impressions can be made by following an appropriate technique. Factors compromising reliability can be avoided with a clear knowledge and understanding of the clinical situation alongside the use of skillful technique.

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