THE EFFECT OF MECHANICAL MIXING AND ADDITION OF INTERNAL DISINFECTANT SOLUTIONS ON DIMENSIONAL ACCURACY OF IRREVERSIBLE HYDROCOLLOID IMPRESSION MATERIAL – AN IN-VITRO STUDY

Shikha Anand Giri, Surekha R. Godbole, Ram U. Thombre

ABSTRACT

Background: Impressions to be disinfected immediately after the removal from the mouth as its exposed to infected saliva and blood and it act as a significant source for cross contamination among dental office staff and technicians. Aims and Objectives: To study the effect of mechanical mixing and addition of internal disinfectant solutions on dimensional accuracy of irreversible hydrocolloid impression material. Materials and Method: The master model of maxillary jaw was made with four conical shape abutments with pointed apex in the canine and first molar regions, to be used as reference points. Under controlled environment of 200 - 230°C room temperatures this study was carried out. A total of 30 study casts were poured from three groups of alginate impressions mixed using, Group A (control) - distilled water, Group B (Solution B) i.e., 0.01% Iodine, and Group C (solution C) i.e. 0.2% Chlorhexidine. Dimensional accuracy of irreversible hydrocolloid impression material was tested by the measurements of the reference points of subsequent study casts made from solution A, B and C with a travelling microscope. Results: The results of this study shows that when both disinfectant solutions used to mix alginate impression material, the accuracy of the resultant stone casts was equal to that of those casts made when the alginate was mixed with distilled water. Conclusion: The use of internal disinfectants thus can provide the accuracy needed in dentistry while reducing the possibility of cross-contamination via dental impressions.

Keywords: Disinfectant; Alginate impression; Dimensional accuracy; Cast; Mechanical mixing

Introduction

The risk of infection through cross-contamination in dental practice is significant for certain infectious diseases including staphylococcal infections, tuberculosis, recurrent herpes virus, hepatitis A, B, C and human immunodeficiency virus (HIV).1 Contamination of dental impressions with varying amounts of blood, saliva and debris is a routine occurrence in the dental operatory. Therefore these impressions must be considered the potential to transmit the serious disease to all dental personnel who routinely handle them. A major concern is the problem of disinfecting dental impressions, particularly irreversible hydrocolloid impressions; these materials are susceptible to dimensional distortion during disinfection because of their hydrophilic nature.2,3 The antibacterial effect of the disinfectant on impression materials was already known.1 This in-vitro study was conducted to assess the effect of mechanical mixing and addition of internal disinfectant solutions on dimensional accuracy of irreversible hydrocolloid impression material.

Materials and Method

A master model of maxillary jaw was made (Figure 1,2,3). It had four conical shape abutments with pointed apex in the canine and first molar regions, to be used as reference points (Figure 3). The height of the model was 2.4cm and all abutment points were in one plane, to facilitate its measurements under travelling microscope for linear measurement. The master model was milled from aluminum because of its property of low water absorption. A wooden stand was made with a base and an upper compartment with a hinge like action and the master model was screwed on to the base of the stand, to avoid any movements at the time of making impressions (Figure 4). To standardize tray positioning and the thickness of the impression material, the stock metal perforated tray was attached to the upper compartment of the master model stand to provide identical positioning and removal of the tray. The mounted tray and an anterior vertical stop allowed for 3mm thickness of the irreversible hydrocolloid impression material between the tray and the conical abutments. The method by which this study was carried out can be divided into three steps:

Making of impression: Under controlled environment of 20°C - 23°C room temperatures this study was carried out. 10 impressions were made for each of the three groups. For group A- alginate was mixed with (group A solution-control group) i.e. Distilled water. For group B- alginate was mixed with (group B solution) i.e. 0.01% iodine made from a 2% Betadine solution by mixing 5ml of 2% Betadine solution to 95ml distilled water. For group C- alginate was mixed with (group C solution) i.e. 0.2% chlorhexidine made from a 20% aqueous solution of chlorhexidine gluconate. For consistency all measuring and mixing was done according to the manufacturer’s recommendations of automatic mechanical alginate mixing device which was two leveled scoops of alginate and the corresponding mixing time of 10 seconds was adopted and was constantly maintained for all the three groups. The alginate was loaded in the impression tray. Then the impression tray was placed over the aluminum die and hand pressure was slowly applied for about 30 seconds and a 2.5lb weight was then placed on the top of upper member of the impression tray. Impressions were allowed to set for 3 minutes before being removed with a snap technique and the resulting impression was checked for any defect.3

Pouring of model: All impressions are poured in gypsum type IV (die stone) which was mixed as per the manufacturer’s directions. A total of 30 impressions and 30 study casts were made. The stone casts were allowed to set for 45 minutes...
The effect of mechanical mixing and addition of internal disinfectant solutions

before removal from the impression tray and were left to dry for 24 hours on the bench before measurements were made. Dimensional accuracy of irreversible hydrocolloid impression material was tested by the measurements of the reference points of subsequent study casts made from solution A, B and C with a travelling microscope. The anteroposterior measurement was made between points B to A. The mesiodistal measurement was made between points B to C. The diagonal measurement was made between points C to A. The comparative evaluation in dimension among two disinfectants were made by measurements made from the control group study casts and the study casts made from group B and C solutions. All the readings were recorded and were then subjected for statistical analysis using specific tests and formulas.

Results
The accuracy of alginate impressions made with three different solutions was expressed in mm (mean values and standard deviations) as difference between measurements of impressions and of master model. The results obtained by mixing irreversible hydrocolloid impression material with distilled water (Solution A, Control group) and Disinfectant Solutions, such as 0.01% iodine (Solution B) and 0.2% Chlorhexidine (Solution C) are tabulated in Table 1 and 2.

Discussion
It is well known that irreversible hydrocolloid, because of its gel structure, undergoes dimensional changes almost as soon as it is set. Therefore, the longer an impression is allowed to sit between removal from the mouth and the time it is poured in stone, the greater the resulting distortion. From this perspective, all post impression disinfection procedures will add to error in the resulting cast. Studies reporting on immersion and spray disinfection of alginate impression material are usually effective against microorganisms on the surface of impressions and uncertainty exists on organisms present in the body of such impressions and the extent to which disinfectant solutions can penetrate impressions. Substituting a solution of a disinfectant for water in the alginate mix can be found to be more effective cross-infection measure than immersion of water-alginate impressions in disinfectant solutions. When surface disinfection is eliminated by placing an integral disinfecting agent within the impression material, the problems of dehydration and water uptake and the resultant distortion caused by surface treatment of the impression are no longer concerns. Dimensional accuracy of irreversible hydrocolloid impression material was tested by the measurements of the reference points of subsequent study casts made from solution A, B and C with a travelling microscope. Detail compara-

<table>
<thead>
<tr>
<th>Distance</th>
<th>Solution A</th>
<th>Solution B</th>
<th>Solution C</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-A</td>
<td>23.16</td>
<td>23.16</td>
<td>23.15</td>
</tr>
<tr>
<td>B-C</td>
<td>30.65</td>
<td>30.65</td>
<td>30.66</td>
</tr>
<tr>
<td>C-A</td>
<td>42.36</td>
<td>42.36</td>
<td>42.36</td>
</tr>
</tbody>
</table>

Table 2. Comparison of distance B-A, B-C and C-A with solution A, B and C, shows comparison of distance between B-A, B-C and C-A with solution A, B and C respectively, the readings of solution C shows significant results than as compared to solution B and A.

Figure 1. Armamentarium used in the study, Figure 2. Equipments used in the study, Figure 3. Master model, Figure 4. Master model with stand, Figure 5. Making of measurements

Table 1: Mean of Measurements of reference points *Distilled Water (Control group), **0.01% Iodine, ***0.2% Chlorhexidine
tive evaluation of linear dimensional change amongst the two internal disinfectants namely solution B and C was made by the statistical analysis of the results obtained from the models made from solution B and C. It was found that even though statistical significant results were obtained from solution C i.e. 0.2% chlorhexidine disinfectant solution than as compared to Solution B i.e. 0.01% iodine disinfectant solution, it was clinically insignificant. The results of this study shows that when either of two disinfectant solutions was used to mix alginate impression material, the accuracy of the resultant stone casts was equal to that of those casts made when the alginate was mixed with distilled water. The use of internal disinfectants thus can provide the accuracy needed in dentistry while reducing the possibility of cross-contamination via dental impressions.

Conclusion
Within the scope and limitations of the study following conclusions were made. The use of either Chlorhexidine or iodine disinfectant solution is a suitable substitute for water when using alginate impression materials. No difference was noted in the handling properties of the alginate when mixed with different disinfectants. It was found that solution B was better than solution C after the statistical analysis of the results obtained from the models. Currently the internal disinfectants used in this study have not been tested against all pathogens of concern to dentists. Additional research must be accomplished before broad statements can be made concerning the effectiveness and suitability of internal disinfectants. Disinfectants within the alginate can only be expected to affect organisms in contact with the material itself. Therefore it can be concluded that the internal disinfection of alginate could enable dentists to pour an impression immediately, thereby ensuring that its accuracy is not compromised by either time or the process of disinfecting and curtails an added step for disinfection, thereby, saving valuable clinical time of the dentist.

Authors Affiliations
1. Shikha Anand Giri MDS, Assistant Professor, Department of Prosthodontics, V.Y.W.S. Dental College and Hospital, MUHS University, 2. Surekha R. Godbole MDS, Professor, Department of Prosthodontics, Sharad Pawar Dental College, Deemed University, 3. Ram U. Thombare MDS, Vice Dean, Professor and Head, Department of Prosthodontics, Sharad Pawar Dental College, Deemed University, India.

References

How to cite this article

Address for Correspondence
Dr. Shikha Anand Giri MDS, Assistant Professor, Department of Prosthodontics, V.Y.W.S. Dental College and Hospital, MUHS University, India. Email: drshikhagiri@yahoo.com

Source of Support: Nil
Conflict of Interest: None Declared