EFFECT OF POURING TIME ON THE DIMENSIONAL STABILITY OF ALGINATE IMPRESSION MATERIAL

1USAMA SHAFAQ, 2SHOAIB RAHIM, 3AMNA SALEEM, 4MEHRUNNISA ANWARI

ABSTRACT

The purpose of this study was to determine whether the alginate impression material produces a dimensionally accurate casts when pouring gypsum product into the impression is delayed for 1 hour or 2 hours by using specified storage conditions compared to immediate pouring.

A Randomized Control Trial (in vitro experiment) was conducted in the Department of Prosthodontics, Armed Forces Institute of Dentistry over a duration of 03 months. Ninety impressions were made of a stainless steel die and were randomly divided into three groups. The 30 control group impressions were poured only after rinsing with tap water, whereas the 30 experimental group-A impressions were poured after 01 hours and 30 experimental Group-B impressions were poured after 02 hours. The dimensional change in the diameter and height of the raised column and the distance between two lines were measured in the casts of all groups.

Using “Independent Samples Kruskal Wallis Test” there was significant differences (p<0.05) in the mean dimensional change (that is, Height and diameter of the raised column as well as distance between the two lines on the raised column) between 3 pouring times, that is, immediate pouring, delayed pouring after 1 hour and 2 hours. A Post-Hoc test showed that the mean dimensional changes were statistically significantly lower for delayed pouring after 1 hour and 2 hours from original die compared to immediate pouring (p<0.05).

The dimensional accuracy of casts produced from alginate impression materials is time dependent. Even under specified storage conditions there was statistically significant difference in the dimensional change after 1 hour and 2 hours delay in pouring. Research is needed to compare the dimensional stability among different brands.

Key Words: Alginate Impressions, Dimensional stability.

INTRODUCTION

An impression is a record, a negative replica of the mouth tissues taken at an unrestrained rest position or in various positions of displacement. In dentistry, the use of dimensionally stable impression materials and the development of accurate impression materials are the first and foremost step towards the fabrication of a successful and well fitted prosthesis. The choice of an impression material for a particular situation depends on the treatment being provided, operator preference, and so on. Even with the introduction of more refined and more sophisticated rubber base impression materials, irreversible hydrocolloid impression materials have stood the test of time. Alginate impression material is one of the most frequently used dental materials; easily manipulable, cost-effective, and indispensable and essential part of dental practice.

However, there seems to be general agreement that the casts should be poured immediately after the impressions are removed from the mouth to obtain maximum accuracy. Irreversible hydrocolloid impression material has dimensional changes as a result of syneresis or evaporation of water when exposed to air. Therefore, whether or not irreversible hydrocolloid impression materials are accurate enough for restorative and prosthetic dental use is in question. Past studies have shown that these impressions between 0 and 12 minutes are necessary to maintain clinically acceptable accuracy. Two principle characteristics of impression materials are accuracy and dimensional stability. Accuracy can be evaluated in terms of horizontal and vertical changes from a master die. Cohen et al studied the dimensional stability of three different irreversible hydrocolloid impression materials under five different storage conditions. Storing of the impressions was carried out at different times as 10 minute, 30 minute, one hour and 24 hours before pouring. They concluded that immediate pouring made the most accurate cast.
The purpose of this study was to determine whether the alginate impression material produces a dimensionally accurate casts when pouring gypsum product into the impression is delayed for 1 hour or 2 hours by using recommended storage conditions (that is, storage in humid/moist environment) compared to immediate pouring.

**METHODOLOGY**

A Randomized Control Trial (in vitro experiment) was conducted in the Department of Prosthodontics, Armed Forces Institute of Dentistry over a duration of 03 months. A total of 90 impressions were made of a stainless steel die using Alginite impression material (CAVEX CA-37 Normal Set / Dust Free). The water: powder ratio and the mixing time was used according to the instructions by the manufacturer, that is, 1 scoop of powder (9g) + 1/3 beaker of water (20ml). The impressions were randomly divided into three groups. The 30 control group impressions were poured only after rinsing with tap water. The impressions were recorded of a stainless steel die, made according to ADA specification No. 19. The dimensions of the die were 38mm diameter of the body, 29.97mm diameter of the raised column and 31mm height of the body and 3mm height of the raised column. The distance b/w lines on the raised column was 25mm (Fig 1). Only a single die was used so as to omit any variables in dimensions. The material was packed in the specially designed impression tray and the die pressed into the tray. The whole apparatus was kept in water at 37°C during the setting time, to simulate the humid oral environment. After the setting time, the die was separated and rinsed in the running water for 15 seconds. The impression was randomly designated into 1 of the 3 groups. The impressions were poured in Dental plaster (ISI KO-PO-HARD CKH-52) and then next impression was recorded. The 30 Control group impressions were those that have been poured immediately, 30 Experimental Group-A impressions were poured after 01 hours and 30 Experimental Group-B impressions were poured after 02 hours. The impressions of Experimental Group-A and Group-B were stored under specified storage conditions (wrapped in wet towel and sealed in plastic bag). The dimensional change in the diameter and height of the raised column and the distance between two lines were measured in the casts of all groups using an analog vernier caliper (Mitutoyo No. 505-633).

Probability simple random sampling technique. Inclusion criteria consisted of impression of the die that were not distorted and included all the areas required for measurement. Exclusion criteria consisted of stone die containing bubbles and dies in which the areas to be measured were not clear. The data obtained was entered and analyzed in Statistical Package for Social Sciences (SPSS) 20.0 database.

**RESULTS**

This controlled trial was designed to assess time dependent dimensional stability of the alginate impression material. The mean dimensional changes in the diameter and height of the raised column and the distance between C-D line in the experimental and control groups have been illustrated in Table 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Dimensional Change (mm)</th>
<th>Diameter of the Raised Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>29.9890 ± 0.01094</td>
<td></td>
</tr>
<tr>
<td>Experimental A</td>
<td>30.0133 ± 0.03100</td>
<td></td>
</tr>
<tr>
<td>Experimental B</td>
<td>30.0537 ± 0.04507</td>
<td></td>
</tr>
</tbody>
</table>

**Height of the Raised Column**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Dimensional Change (mm)</th>
<th>Height of the Raised Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>25.0103 ± 0.03034</td>
<td></td>
</tr>
<tr>
<td>Experimental A</td>
<td>25.0453 ± 0.03748</td>
<td></td>
</tr>
<tr>
<td>Experimental B</td>
<td>25.0967 ± 0.04908</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

Alginate is an irreversible hydrocolloid because of its chemical setting reaction. It provides sufficient detail reproduction to make it suitable for routine use in dentistry. In this study, all samples of experimental group shrank in size even under controlled moisture conditions. In the past, attempts were made to improve dimensional stability by alteration of the composition of the alginate powder. Williams and Watkins examined the properties of alginates that had been siliconized; however, the addition of silicone was found to have no advantage. Impression tray design was also studied.
with regard to dimensional stability. Two studies found that the use of perforated trays led to significantly less distortion of the impression material.\textsuperscript{11,12} In our study, perforated tray was used without tray adhesive and stainless steel die of the impression was recorded had no undercuts. Although the alginate impressions in experimental groups of the present study were sealed in the plastic bags the results still show that dimensional changes still continue to occur over a period of 1-2 hours although in small amount. Other studies have found that traditional alginate impressions are most dimensionally stable if they are poured immediately after set which is in accordance with our study.\textsuperscript{14} These traditional alginate studies measured dimensional changes up to only 24 hours and found changes from 0.6\% to 3.4\% at 24 hours.\textsuperscript{5} In our study the dimensional changes measured over a period of 1 and 2 hours were found to be in range of 1.5\% to 2\% with respect to control group. Alcan et al stored the impressions of different alginites for up to 96 hours at room temperature before pouring them to produce plaster casts. Each plaster cast was then compared with the master model to determine the amount of change. They found that 2 of the 3 alginites studied had statistically significant dimensional changes over the study period. The percentages of dimensional changes at 96 hours ranged from 0.48\% to 0.9\%. The authors concluded that because the mean distortion found was “very small in terms of millimetres, [the difference] can be accepted in clinical tolerance and in orthodontic analyses.” Alcan et al contended that changes in this range translate into differences of up to 0.07mm in relation to an 8-mm-wide tooth.\textsuperscript{11} In our study the dimensional changes were in terms of 100\textsuperscript{th} of millimeters, which is very small. The dimensional changes that occur in an alginate impression could cause full-arch measurement errors of nearly 4 mm. This is a significant distortion that could lead to misdiagnosis and possible treatment planning errors, since a mandibular central incisor of 5mm in width is nearly equal to the measuring error.\textsuperscript{14} The goal should be to minimize inaccuracies as much as possible. Thus more accurate records can have obtained with digital models or with elastomeric impression materials if certain delay is to be expected or more precision is required.\textsuperscript{15-17}

**CONCLUSION**

The dimensional accuracy of casts produced from alginate impression materials is time dependent although in terms of 100\textsuperscript{th} of millimeters. Even under specified storage conditions there was statistically significant difference in the dimensional change after 1 hour and 2 hours delay in pouring. Therefore, keeping in view the aforementioned results it advised not to delay the pouring of stone cast of an impression made with alginate if a prosthesis is to be fabricated.

**REFERENCES**


**CONTRIBUTIONS BY AUTHORS**

1. **Usama Shafiq:** Research title, Research proposal (including study design, methodology, availability of materials specifically for research, ethical approval), article writing
2. **Shoaib Rahim:** Research proposal, Results, stats and Discussion writing
3. **Amna Saleem:** Data collection
4. **Mehrunnisa Anwari:** Data collection