

Comparing the Effect of Storage Time on Dimensional Changes of Two Alginate Impression Materials (Golchay & Bayer)

Sarira MehrabanJahromi¹, Tohid Yeganeh², Parsa Atashrazm³, Mahmood Reza Mobayeni¹,
Mohsen Tamizi⁴, Fatemeh Nematollahi¹

¹Assistant Professor, Removable Dental Prosthesis Dept, School of Dentistry, Tehran Azad University

² Dentist

³ Prosthodontist

⁴ Faculty member, Removable Dental Prosthesis Dept, School of Dentistry, Tehran Azad University

Received: March 2014

Accepted: Aug 2014

ABSTRACT

Background and Aim: Considering the extensive usage of alginate impression materials in dentistry and availability of various brands in the market, quality control of these alginates and assessment of their properties are necessitated. The aim of the present study was to determine the dimensional stability of the impressions made by Golchay Iranian alginate and Bayer German alginate (as the standard) after being stored in moist environment for 0, 12 and 60 minutes.

Materials and Methods: In this in-vitro experimental study, 60 impressions were taken from a mandibular acrylic model using Bayer and Golchay alginate materials (30 samples of each material). Impressions were stored 0, 12 and 60 minutes in moist condition (10 specimens in each group) and were poured using stone gypsum. A digital caliper with the accuracy of 0.01 mm was used to measure the mesiodistal dimension, occlusogingival height and inter-arch distance of the gypsum casts. Values of these three dimension variables for two alginates within each time span were analyzed using one-way ANOVA and student t tests (significance level was set at 0.05). 2-way ANOVA test was used to evaluate the effect of time, alginate type and the interaction between these two variables.

Results: There was no significant statistical difference between samples of Golchay and Bayer alginates regarding mesiodistal dimension, occlusogingival height and inter-arch Distance ($P > 0.06$); moreover, the dimensional stability of the impressions made with each alginate were the same after being stored in moist environment for 0, 12, and 60 minutes ($P > 0.05$).

Conclusion: It seems that impressions made with Golchay and Bayer alginates have similar dimensional changes over time and in moist environment.

Key words: Alginate; Dental impression material; Dimensional accuracy; Storage time

INTRODUCTION

Impression taking and pouring the cast is among the important stages of obtaining an accurate and proper prosthesis. The impression material must have adequate accuracy for recording the details of hard and soft tissues to prepare an ideal restoration.¹ Alginate is an elastic and irreversible impression material which is widely used in dentistry because of properties such as

hydrophilicity, good taste and smell, ease of application, and economic considerations. The casts made of this material are used for a broad range of applications including making diagnostic casts, temporary restorations, dental protectors, night guards, custom trays, and removable partial prostheses.^{1,2}

One of the problems of using alginate is its dimensional stability over time and impossibility of repouring it.² Since this material is manufactured within Iran and is welcomed by dentists,

Corresponding Author: Nematollahi F., Neyestan 10, Pasdaran, Tehran, Iran. TEL:0912-418-79-57
Email:Farzaneh.nematollahi@yahoo.com

as well as the economical reasons, the Iranian alginates are highly essential to be evaluated with ADA and ISO standards and to be compared with foreign types. The most important characteristic of alginate which leads to enhanced accuracy of impression taking is acceptable dimensional stability within the first 1 hour after the impression taking, if stored in moist environment.³ In this study, Bayer alginate which is commonly used for final impression taking of partial prosthesis is compared with its Iranian counterpart (Golchay) in terms of dimensional stability.

Based on researchers' advice according to primary studies, in order to maintain the dimensional accuracy, the hydrocolloid impression must be poured immediately or in 12 minutes at most.⁴⁻⁶ However, some sources have permitted storing the impression in moist environment for 2-4 minutes, nearly an hour, and even for 2 hours for diagnostic purposes.⁷⁻¹⁰ Thus, the considered time spans in this study were 0, 12 minutes and 1 hour after impression taking. Due to the lack of similar findings regarding alginate dimensional changes, this study was performed to compare the dimensional stability of a common Iranian alginate with an ADA approved alginate within the most usual storage time (12 and 60 minutes).

Materials and Methods:

In this experimental in-vitro study, dimensional stability of Golchay alginate (Iralgin, Golchay, Iran) and Bayer (Bayer, Netherlands) was evaluated through measuring the variables of mesiodistal dimension, occlusogingival height and inter-arch distance of the casts made of these two alginates.

Impressions were taken of a mandibular dentic made of Typodont acrylic resin as the original model. It consisted of a cone shaped pin in the crown, with outer-crown height of 2mm which was applied on the distal occlusal fossa of the second premolar and the lower right first molar, and another one on the distal fossa of the left second premolar with use of composite; this

point was used as the reference point for measurements. In the original model, the mesiodistal distance was 10, the occlusogingival height was 7.5 and the inter-arch distance was 37mm. The tip of the cone provided a proper reference point for measurement which made a line parallel with horizon, with the adjacent and contralateral cones and would decrease the measurement error. First an impression was taken from the original model using a premade tray, and after pouring the cast over it a custom acrylic tray was made. Similar to the trays that are used to take impressions for the removable intraoral prosthesis, this tray was made with the distance of two layers of wax, and had three stops, two on the posterior and one on the anterior part.⁶ This tray was used for impression taking to produce 6 casts. (3 cast for Iranian and 3 for the foreign alginate). A custom tray was made and used for taking other impressions. The teeth were slightly greased with paraffin prior to impression taking, so that placement of samples would be facilitated. The impression taking was performed 30 times with Golchay alginate and 30 times with Bayer alginate. According to the manufacturer's instruction, the proper amount of each alginate was mixed (Iralgin: 23g powder and 50ml pure water; Bayer: 21g powder and 50ml pure water). Working time of Iranian alginate was 75 seconds and setting time was 2 minutes and 30 seconds. These numbers for the foreign alginate were 1 minute and 2 minutes, respectively. To clone the conditions, all the casts were rinsed under the flow of cold water for 10 seconds after the impression taking.

Stone cast was used to pour the casts (Mold stone, Dental Pars, Iran); it was mixed based on the manufacturer's instruction (the ratio of powder to water) at the room temperature (25°C) and on vibrator. In each group of 30, 10 casts were poured with the same stone immediately, 10 casts after 12 minutes of being stored in wet gas inside of a plastic sealed environment, and the last 10 after 1 hour of storage in a sealed plastic environment.¹⁰

In all cases, the stone models were removed off the casts 1 hour after being poured^{6, 11} and

the codes of time and type of impression taking were written on them. In this way, 60 casts were obtained, each of which were measured for the horizontal mesiodistal distance from the reference point of the occlusal surface of the second premolar and the first right molar, the vertical occlusogingival distance on the labial surface from the buccal cusp tip to the cervix of the left second premolar. Measurements were performed 24 hours after casts were poured.

The considered dimensions were measured using an electronic digital caliper (Minova co., Japan) with an accuracy of 0.01 mm.

Each dimension was measured by 3 operators, 2 of whom were blind to the used alginate and only the 3rd person knew the type of alginate. The Mean of these three measurements was calculated for result analysis.

The obtained measurements of the three variables of mesiodistal dimension, occlusogingival height and the inter-arch distance in each of the three studied times was analyzed using

one-way ANOVA and Student T-test (the significance level was set at 0.05). Two-way ANOVA was used to analyze the effect of storage time, alginate type, and interaction of these two variables.

Results:

The test results revealed that there was no significant statistical difference regarding time, type of alginate and interaction of the two, on the studied variables. After the storage time of 0, 12 and 60 minutes, the values of mesiodistal dimensions, occlusogingival height and the inter-arch distance of the casts made of two alginates were measured with the aid of a digital caliper, and the difference between them and the original model was recorded in millimeters and changes were calculated in percent (Table 1 and 2).

Table 1- Mean changes of mesiodistal dimensions, occlusogingival height, and the inter-arch distance of impressions made of two alginates after 0, 12 and 60 minutes

Alginate	Dimensions (mm)	Mean changes in 0 min of storage time	Mean changes in 12min of storage time	Mean changes in 60min of storage time
Bayer	Mesiodistal	0.11±0.142 P=0.229	0.23±0.227 P=0.661	0.19±0.189 P=1
Bayer	Occlusogingival	0.08±0.233 P=0.064	0.11±0.221 P=0.227	0.09±0.223 P=0.704
Bayer	Inter-arch distance	0.33±0.203 P=0.487	0.23±0.227 P=0.853	0.27±0.173 P=0.973
Golchay	Mesiodistal	0.21±0.222 P=0.229	0.20±0.115 P=0.661	0.19±0.122 P=1
Golchay	occlusogingival	0.24±0.111 P=0.064	0.23±0.167 P=0.227	0.13±0.137 P=0.704
Golchay	Inter-arch distance	0.40±0.248 P=0.487	0.25±0.248 P=0.853	0.27±0.211 P=0.973

The effects of storage time on Golchay samples The results of one-way ANOVA showed no statistically significant difference in the values of these variables in the three storage times. ($P>0/06$) In other words, the standard casts of Bayer alginate had the same dimensional changes with respect to the time they were poured, and that they fell within the acceptable range in terms of value of the changes considering the standard deviation. The percent of mean of changes also was in the standard range (1.8%).

the surface details, dimensional stability, tear resistance, proper setting time, economics of material, ease of application, need or no need for custom tray, ease of pouring, and the smell.⁸ From all the above mentioned, the feature focused on in the current study is dimensional stability of Golchay Iranian alginate and Bayer standard alginate through measurement of the ternate variables of mesiodistal dimensions, occlusogingival height and the inter-arch distance of the impressions within the three storage times of 0, 12 and 60 minutes in moist environment. Bayer alginate was considered as the standard in this study because it is conventionally used in final impression taking of the partial prosthesis¹²

Table 2- Percent of changes in mesiodistal dimensions, occlusogingival height, and the inter-arch distance of casts made of two alginates after storage time of 0, 12 and 60 minutes

Alginate	Dimensions (mm)	Percent of changes in storage time of 0min	Percent of changes in 12min	Percent of changes in 60min
Bayer	Mesiodistal	1.1%	2.3%	1.9%
Bayer	Occlusogingival	1.1%	1.57%	1.3%
Bayer	Inter-arch distance	0.89%	0.63%	0.72%
Golchay	Mesiodistal	2.1%	2.01%	1.9%
Golchay	Occlusogingival	3.3%	3.04%	1.70%
Golchay	Inter-arch distance	1.08%	0.69%	0.73%

The effects of storage time on Bayer samples The results of one-way ANOVA revealed no statistically significant difference between the values of the variables within the three storage times. ($P>0/06$) But the percent of mean of changes of mesiodistal and occlusogingival dimensions was more than 1.8 in 0 and 12 minutes storage time, and in 60 minutes all dimensions fell within the standard range.

Discussion:

Diversity of impression materials and the importance of obtaining an accurate impression for indirect restorations have made it essential to choose a material that has this superior feature. Among the considerable features of impression material are capability of recording

and the maximum storage time in moist environment is defined to be 1 hour.¹⁰ Hence, if no difference of dimensional changes be found between Bayer and Golchay, the Iranian one which is more economic, can be used instead.

Assessing the effect of storage time and alginate type on the variables that determine the dimensional stability of the casts with use of one-way ANOVA and Student T-test indicated no significant statistical difference in any of the variables. The dimensional stability of two alginates based on pouring time was not different either.

In a study by Moshref et al. on the effect of storage time on the dimensional stability of Golchay and Alginoplast alginates, 5 storage times in moist environment was considered (0, 15, 30, 60, and 180 minutes) along with a metal model. They found no considerable dimensional changes in up to 3 hours of storage in moist environment. This indicates longer

dimensional stability of this material, and is in line with the results of the current study.¹³

Atash Razm et al. studied the dimensional changes of Hydrogum 5 impression material in storage times of 0.5, 24 and 120 hours. They reported that if stored in moist environment and in zip keep, none of the studied storage times would significantly affect the dimensional changes of the obtained cast. Again, this result is in line with the present study.¹⁴

In a different study by Atash Razm et al. (1390), the dimensional accuracy was compared between Bayer and Ariadent alginates. They focused on measurement of the biggest and the smallest diameter of the model, the distance of the axis between the two dies and their height. No significant difference was detected between two alginates, confirming the suitable application of Iranian alginate; which is in accordance with the results of the present study.¹⁵

In the present study, the percent of dimensional changes of obtained casts compared to the original model proved the Bayer alginate to be standard in all pouring times. The higher percent of changes was observed in 0 and 12 minutes, but the changes reached the minimum in 60 minutes, being considered as standard and acceptable.

Regarding the property and the coefficient of elasticity, the dimensional changes of the alginate impression material is acceptable up to 1.8%. In other words, after hardening and being removed off the mouth, it undergoes more dimensional changes but returns to the initial form over a short time due to elasticity. About 1.8% of the dimensional changes are irreversible or plastic changes.¹⁵

Dimensional changes in impression materials might occur because of several reasons such as contraction due to syneresis, water absorption due to exposure to water or high humidity environment and consequent expansion, or longer time needed to return to the initial dimension.¹⁶

Based on the present study, it seems that returning to the initial state needs longer time and 60 minutes is a proper waiting time for pouring this type of alginate. Therefore, in case of using Golchay alginate, the storage time is better to be

considered 60 minutes so that the dimensional stability could be similar to Bayer alginate.

Conclusion:

With respect to the limitations of this study, the claim can be made that the dimensional stability of the impressions made of Iranian Golchay alginate and Bayer standard one have no considerable difference. Also storing the impressions made of two materials in moist environment up to 1 hour does not have considerable clinical effect on their dimensional stability, and that they can be stored in such environments up to 1 hour. It can also be concluded that in case of using Golchay alginate the proper time needed for it to return to the initial state is best to be considered 60 minutes. Since no significant difference was observed in the dimensional stability between two alginates, if the other terms and features are approved, Golchay can be used as an acceptable alginate for taking the initial and final impressions of the partial prostheses and study casts.

References:

- 1-WalkerMP,BurckhardJ,MittsDA,WilliamsK B,Dimensional change over time of extended-storage alginate impression materials.AngleOrthod 2010;80(6):1110-5
- 2-NassarU,AzizT,Flores-Mir C.Dimensionality stability of irreversible hydrocolloid impression materials as function of pouring time:A systematic review ,J Prosthet Dent 2011;106(2);126-33
- 3- Nassar U, Hussein B, Oko A, Carey JP, Flores-Mir C. Dimensional accuracy of 2 irreversible hydrocolloid alternative impression materials with immediate and delayed pouring.J Can Dent Assoc. 2012;78:c2
- 4-Shillingburg HT, Hobo S, Whitsett LD, Jacobi R, Brackett SE.Fundamentals of fixed prosthodontics.4nd ed. Philadelphia: Quintessence Publishing Co.2012
- 5-Zarb GA, Hobkirk JA, Eckert SE, Jacob RF

- . Prosthodontic Treatment for Edentulous Patients . 13th ed .St Louis: Mosby;2012.P:126
- 6-Phoenix RD, Cagna DR, DeFreestCF.Stewart's Clinical Removable Partial Prosthodontics . 4nd ed. Chicago: Quintessence;2012.P:133-149
- 7-Johnson GH, Chellis KD, Gordon GE, Lepe X: Dimensional stability and detail reproduction of irreversible hydrocolloid and elastomeric impressions disinfected by immersion. J Prosthet Dent 1998; 79(4):446-453.
- 8-Craig RG, Powers JM, Wataha JC. Dental materials : Properties and manipulation.8nd ed. St Louis: Mosby;2004.P: 145-156
- 9-Van Noort R. Introduction to dental materials.2nd ed. Edinburg:Mosby;2002.P:120
- 10- Wadhwa SS, Mehta R, Duggal N, Vasudeva K. The effect of pouring time on the dimensional accuracy of casts made from different irreversible hydrocolloid impression materials. Contemp Clin Dent 2013; 4(3):313-8.
- 11- Frey G, Lu H, Powers J: Effect of mixing methods on mechanical properties of alginate impression materials. J Prosthodont 2005; 14(4):221-225
- 12- Patil D, Perrye DG, Walmsley AD. Are we abusing our alginate impression? Dent Update 2007; 34(10):650-5
- 13- Moshref R, Mokhtari M. Storage time effect on dimensional accuracy of Iranian and foreign hydrocolloid impression material. JIDA 2007;58
- 14-Atashrazm P, Tamizi M, Mehrabanjahromi S, Nematollahi F,Jalalian S. The effect of time storage on the dimensional changes of Hydrogam 5 alginate. J Res Dent Sci 2013; 10 (1) :17-21
- 15- Atashrazm P, Valaee N, Mobini M, ZamaniAlavijeh L. Comparison of the Dimensional Changes of Ariadent and Bayer Alginate Impression Materials (Invitro). J Res Dent Sci 2012; 8 (4) :168-174
- 16- Rodrigues SB1, Augusto CR, Leitune VC, Samuel SM, Collares FM.Influence of delayed pouring on irreversible hydrocolloid properties. Braz Oral Res 2012;26(5):404-9.