IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 9 Ver. VI (Sep. 2015), PP 89-93
www.iosrjournals.org

Comparative Evaluation of Dimensional Stability of Three Different Elastomeric Impression Materials – An Invitro Study

Dr Neethu.L[1], DrGilsa K Vasunni[2]
[1](Senior resident), [2] (Prof and HOD) Department of Prosthodontics, Govt. Dental College, Kozhikode

Abstract: *Aim- To compare the dimensional stability of 3 different types of impression materials – addition silicone impression material, condensation silicone impression material and polyether impression material at 1 hour, after 24 hours and after 7 days of storage in open air by comparing the measurements of the gypsum casts with master model.*
Methodology- A metal model of maxillary dentulous arch was fabricated and five reference holes were drilled on its tooth surfaces. Using perforated metal stock tray for addition silicone and condensation silicones, thirty putty wash impressions of the master model were made with each impression material. Using custom tray and medium viscosity polyether impression material, 30 single mixes, single consistency impressions were made. The impressions were divided into 3 groups and each group poured with type IV dental stone at three time intervals (within 1 hour, 24 hours and 1 week after impression making). Using a universal measuring microscope, 8 distances between the five reference points were calculated and compared to the master model.
Result- ANOVA model was used to statistically analyze the data. All the three types of elastomeric impression materials, remained dimensionally stable up to 24 hours after taking impression .The addition silicone impression material and polyether impression material tested remained dimensionally stable up to 7 days after taking the impressions. Both brands of condensation silicone impression materials tested showed significant dimensional change after 7 days of taking the impression.
Conclusion- According to this study, impressions taken with polyether and addition silicone impression materials remain dimensionally stable for a period of 7 days. The impressions taken with condensation silicones should ideally be poured within 24 hours. Thus if impressions can be poured within 24 hours after making of the impressions, condensation silicones are an economic alternative to addition silicone and polyether
Keyword: *Addition silicone impression material, condensation silicone impression material, polyether impression material, dimensional stability*

I. Introduction

Impression materials that are currently popular in dentistry include hydrocolloids, addition silicones, polyether and condensation silicon. The dimensional stability of an impression material reflects its ability to maintain the accuracy of the impression over time. As many dentists send their impressions to a laboratory or technician for making casts or dies, dimensional stability should be considered while selecting an impression material. Materials with high dimensional stability are polyether and polyvinyl siloxanes. Modified condensation silicones are being marketed which claim to have good dimensional stability for a period of seven days.

An accurate impression is very much essential for fabrication of a well-fitting prosthesis whether it be a single crown or that which spans over a wide area of the arch. So in this study a replica of the maxillary arch was used, measurements were made over the whole span of the arch and a comparative evaluation was performed.

II. Methodology

A metal model of maxillary dentulous arch containing teeth from 3nd molar to 3nd molar was fabricated. Five reference holes were drilled this metal model and these were designated as reference point 1,2,3,4 and 5 respectively. (Figure 1)

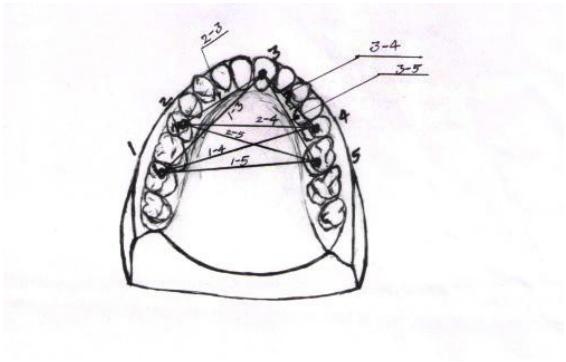

Fig :1

Fig: 2

2.1 Materials Used In The Research

Materials	Brand
Addition silicon impression material	Express, 3M ESPE,Germany
Condensation silicon impression material – putty , light body and activator	1)Speedex, ColteneWhaledent, Switzerland 2) Alphasil, Muller-Omicron, Germany
Polyether impression material- medium body	ImpregumPenta, 3M ESPE, Germany
Tray adhesive for a) Addition silicon	VPS tray adhesive, 3M ESPE Germany
b) Condensation Silicon c) Polyether	Adhesive for polysiloxane, ColteneWhaledent, Switzerland Polyether Adhesive, 3M ESPE , Germany
d) Self cure acrylic resin	(DPI-RR,India)

A perforated box type metal stock tray was selected for addition silicone and both brands of condensation silicones Three metal strips were welded to the outer surface of the tray resulting in a tripodal arrangement of the metal strips around the tray. An acrylic jig was fabricated around the master model with slots corresponding to the metal strips so that the tray could be repeatedly and consistently seated in a self-limiting way each time an impression was made. (Figure 2) Using this stock tray, putty wash impressions of the master model were made with putty and light body consistencies of both addition and condensation silicones. Thirty impressions each of these three impression materials were made. Thus a total of 90 impressions were made using stock tray.

A custom tray was fabricated using cold cure acrylic for polyether. Custom acrylic trays were fabricated at least 24 hrs prior to impression making. Wax spacer of 3 mm with tissue stops was adapted onto the cast to ensure uniform space for impression material. This tray was then duplicated and multiple trays were fabricated using the mould . Using this tray, a single mix, single consistency impression was made with medium viscosity polyether impression material. A total of 30 impressions were made with polyether using the acrylic custom tray.

2.2 Making Of The Impression

Impression were made with two techniques – a two-step putty wash technique for addition and condensation silicones and a single mix single consistency technique for polyether.

For making impressions with polyvinylsiloxane and condensation silicones, the corresponding tray adhesives were applied onto the inner surface and borders of the perforated metal stock tray and allowed to dry for 15 minutes. The materials were mixed according to manufacturer recommendations and impression was made using two stage putty wash technique. A spacer of 0.5 mm thickness was given for light body to provide sufficient thickness of light body for adequate tear strength while maintaining the dimensional stability of the impressions

For polyether, tray adhesive was applied onto the acrylic custom tray and dried for 15 minutes. The material was mixed in automatic mixing machine. One part of the material was loaded onto the tooth surface using a dispensing cartridge and other part was dispensed onto the tray. The tray was seated onto the master model and held under pressure till the impression had set

2.3 Pouring Of The Impressions

Thirty impressions were made with each of these four impression materials (1 addition silicone, 1 polyether and 2 condensation silicones) thus giving a total 120 impressions. These thirty impressions of each material were divided into 3 groups based on the time of pour.

The 40 impressions (10 impressions of each material) of the first group were poured within 1 hour since making of their respective impressions. The 40 impressions in the second group were poured after 24 hours and the 40 impressions in the third group were poured exactly 1 week after taking the respective impressions.

All impressions were stored at room temperature for the time period under study before being poured in stone. Repouring of the impressions was not done to avoid any effect of the stone water mix on the stability of the impression material.

The impressions were poured with type IV dental stone mixed according to manufacturer's recommended water -powder ratio over a vibrator. The casts were examined for clinical acceptability. The casts were labeled and kept for drying.

2.4 Measuring Of The Casts

The casts were allowed to dry for at least 48 hours before measurements were obtained. The measurements were made between the mid-points of the reference holes, using Universal Measuring Microscope which has a least count of 0.2 micrometer for the X and Y carriage, least count of 1 minute for the angular scale and a magnification of 30x. Each measurement was repeated three times and a mean was recorded for a particular dimension. The measurements of each cast, for eight distances between five reference points were recorded using universal measuring microscope and tabulated for three time periods of pouring of the impressions with type IV gypsum; within 1 hour, at 24 hours and at the end of 7 days after making of the impressions, for the four elastomeric impression materials – Addition silicone impression material, two condensation silicone impression materials (Alphasil and Speedex) and polyether impression material.

III. results

The difference of each of these measurements from master cast was calculated and these values were used for statistical analysis using Analysis Of Variance (ANOVA). The statistical analysis showed that with regard to almost every measurement, there was significant difference between various casts with respect to both material and time. Since p value and F ratio with regard to material and time are small, comparison of the means for each measurement for the three time periods and of four materials for each time period was done. Two way table for means and absolute deviation from master cast for one of the measurements is as given below

	1hr	1 day	1 week	Mean
Material 1	-0.15213	-0.15575	-0.14278	-0.15022
Material 2	-0.08268	-0.08246	-0.28907	-0.1514
Material 3	0.01762	0.02781	0.05932	0.034917
Material 4	-0.14921	-0.15146	-0.24744	-0.1827
Mean	-0.0916	-0.09047	-0.15499	

Table 1: Two way table for means (2-3)

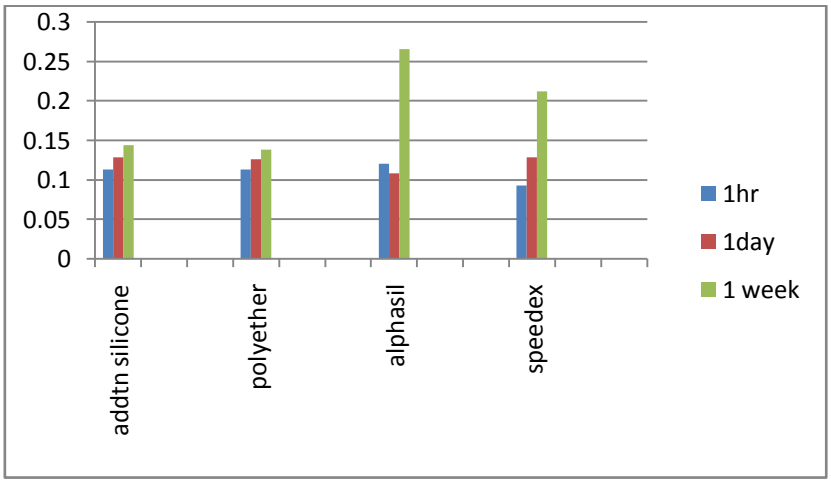

Fig 3 - Absolute deviations of measurements from master cast (2-3)

IV. Discussion

An accurate die is the most important requirement for a precisely fitting prosthesis. The first step in the production of an accurate die is a precise impression. Numerous impression material are available now for use in dentistry. Since the introduction of polysulphides in 1950s, the elastomers have become the material of choice for taking fixed partial denture impressions.

There are four classes of elastomeric impression materials available today – Addition silicone, Condensation silicone, Polyether and Polysulphide . Of these, the addition silicone has become the most favoured material for taking fixed partial denture impressions due to its superior properties like excellent surface reproducibility, good dimensional accuracy, dimensional stability and the ability to produce multiple accurate casts by repeated pouring of the same impression.[2,3,4].

The dimensional stability of an impression material reflects its ability to maintain the accuracy of the impression over time. These materials should remain stable without further changes for a long period of time.

Numerous researches have been carried out for comparing the dimensional stability of the various elastomeric impression materials and all of these studies have given contradictory results. This study aimed at comparing the dimensional stability of the newer varieties of condensation silicones available in the market with polyether and addition silicone by pouring the impressions with type IV gypsum at three different time intervals; within 1 hour, after 24 hours of storage in open air and after 7 days of storage in open air. This was accomplished by measuring 8 distances between 5 reference points on each of these gypsum casts and comparing them with the corresponding measurements on the master model.

The relevance of this study lies in the fact that if proven to be as dimensionally stable as addition silicones, condensation silicones will definitely be a cheaper alternative which will bring down the cost of dental treatment to a great extent. If polyether is found to be equally stable, it will offer the choice of an impression material with excellent surface reproducibility and good tear strength.

For this study a completely dentulous metal master model was selected. A complete coverage impression is recommended in most instances following tooth preparation and hence the dimensional stability over the whole arch is relevant even for a an impression for a three unit FPD.[5]

The results showed that since p value is small, there is statistically significant differences between gypsum casts obtained from all the four materials poured at all three time intervals. The gypsum casts obtained by pouring any of the four impression material within the first hour after taking the impression were comparatively similar. This is in direct accordance with the result of many previous studies.[5,6,7] The gypsum casts obtained by pouring any of the four impression materials after 24 hour storage time in open air after taking the impression were also comparatively similar. This contradicts the observation of some authors who stated that storage of condensation silicones for 4 hours or more resulted in large shrinkage[5,8]It however agrees with others who observed only very slight changes in condensation silicone and polyether[7,9,10].

The gypsum casts obtained by pouring impressions taken with addition silicone and polyether after 7 days of storage in open air were similar to those obtained by pouring impression within 1 hour and 1 day while those obtained by pouring impressions, taken with both brands of condensation silicone, after 7 days varied significantly from those obtained by pouring impressions of these materials within 1 hour and after 24 hour. The improved stability of polyether may be due to the influence of time of the year, relative humidity, use of custom acrylic tray with tray adhesive and lack of contact with water. The main reason behind the low dimensional stability of the condensation silicones may be the formation of ethyl alcohol as a byproduct during the polymerization reaction, which may continue even after the setting of the material, making polymerisation shrinkage a continuous process[1,11]

The majority of gypsum casts obtained by pouring impressions taken with polyether were smaller than the master model whereas casts obtained by pouring impressions taken with other impression materials were larger than master model. The decreased size of the casts obtained by pouring polyether was observed and documented by many authors[5,10,12]. This is apparently due to the expansion of material during setting. This can lead to undersized dies. The casts obtained by pouring polyether after prolonged periods of storage were larger than those obtained by pouring the material immediately. This may be due to release of volatile substances from the material resulting in its shrinkage[13].

All measurements of casts except those obtained by pouring both brands of condensation silicones poured after seven days of storage after taking the impression are well within the clinically acceptable range as specified by ADA specification number 19(maximum dimensional change at the end of 24 hours for Type I and III-0.5% and Type II- 1%).[14]

In this study only horizontal measurements were taken, so the changes in the vertical direction cannot be appreciated with this study. The changes seen on the cast may be due to a combination of the dimensional changes in the impression itself, expansion of gypsum and interaction between the material and gypsum. The measurements on the gypsum casts poured from the impressions were used for this study and not the impressions directly because prosthesis are almost always fabricated on gypsum casts or dies and not directly on

the impression. The dimensional stability of polyether may have been influenced by the relative humidity of storage conditions. Many studies have reported a loss of dimensional stability of polyether after storage for 24 hours at >50% relative humidity[13,15].So the effect of storage under varying relative humidities have to be further investigated. The dimensional stability of each type of elastomeric impression material has found to vary with the brand of the material used. So while deciding the storage period of an impression the scientific research data pertaining to the particular brand of material should be considered and not just the manufacturer's claim of stability.

V. Conclusion

1) All the three types of elastomeric impression materials, addition silicone impression material, condensation silicone impression material (both the brands tested) and polyether impression material tested , remained dimensionally stable if poured within the first hour after taking impression .
2) All the three types of elastomeric impression materials, addition silicone impression material, condensation silicone impression material (both the brands tested) and polyether impression material tested , remained dimensionally stable upto 24 hours after taking impression
3) The addition silicone impression material and polyether impression material tested remained dimensionally stable upto 7 days after taking the impressions.
4) Both brands of condensation silicone impression materials tested showed significant dimensional change after 7 days of taking the impression.
5) Impressions taken with condensation silicone impression material should be poured within 24 hours after taking the impressions
6) All measurements of casts except those obtained by pouring both brands of condensation silicones after seven days of storage after taking the impression are well within the clinically acceptable range as specified by ADA specification number 19(maximum dimensional change for Type I and III-0.5% and Type II- 1%)

References

[1]. A.M. Lacy, T. Bellman, H.Fukui, Jendresen: Time dependent accuracy of elastomer impression materials. Part II: Polyether, polysulfides and polyvinylsiloxane.JPD,March 1981;45(3): 329-33
[2]. Prothero J. H. Prosthetic dentistry. Chicago, Prothero, 1904.
[3]. Starcke E. N. J. A historical review of complete denture impression materials. J Amer Dent Assoc 1975; 91 (5): 1037-41.
[4]. Asgar K. Elastic impression materials. Dent Clin N Amer 1971; 15 (1): 81-98.
[5]. Peter T Williams ,Garth Jackson , W. Bergman.An evaluation of the time dependent dimensional stability of eleven elastomeric impression materials.JPD July 1984,52(1):122-125
[6]. V. Fano, P.U.Gennari, I Ortalli. Dimensional stability of silicon-based impression materials.Dent Materials March 1992,8:105-09
[7]. W.B. Eames, S. W. Wallace, N. B. Suway, L. B. Rogers: Accuracy and dimensional stability of elastomeric impression materials; JPD ,1979;42(1):159-62
[8]. Clancy JM, Scandrett FR, Ettinger RL. Long-term dimensional stability of three current elastomers. J Oral Rehabil 1983;10:325-333
[9]. Leonardo de Cesero, Lígia Maria Nogarett,Lisiane Martins FracassoArtigoTécnico-Científico: Influence of Elastic Recovery Time on Dimensional Stability of Polydimethylsiloxane (PDS) ; Polimeros 2013
[10]. Glen et Johnson, R.G. Craig. The accuracy of four types of rubber impression materials with time of pour and repeat pour of models JPD April 1985,53 (4):484-90
[11]. Garrofé AB, Ferrari BA, Picca M, Kaplan AE: Linear dimensional stability of elastomeric impression materials over time ActaOdontolLatinoam. 2011;24(3):289-94
[12]. Marcinak CF, Young FA, Draughn RA, Flemming WR: Linear dimensional changes in elastic impression materials, J Dent Res. 1980 Jul;59(7):1152-5
[13]. Kanehira M, Finger WJ, Endo T: Volatilization of components from and water absorption of polyether impressions
[14]. American Dental Association: ANSI/ADA standard No:19 – Dental elastomeric impression materials (2004)
[15]. Eduardo Batista Franco, Leonardo Fernandes Da Cunha, Ana Raquel Benetti; Effect of storage period on the accuracy of Elastomeric impressions. J Appl Oral Sci. 2007;15(3):195-8