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Original Research Article

An In-Vitro Study Analysis Using Die Stones for the Dimensional Accuracy of Elastomeric Impression Material

Dr. K.Premnath[1*], Dr. Nagaranjani Prakash[2], Dr. Kamala R[3], Dr. Sadananda M P[4], Dr. Syed Ahmed Rheel[5], Dr. B.P.G. Tilak[6]

[1]Professor, Department of Prosthodontics, KGF College of Dental Sciences, KGF Karnataka, India
[2]Assistant Professor, Department of Prosthodontics, Government Dental College and Research Institute, Bangalore, Karnataka, India
[3]Associate Professor, Department of Dentistry, ESIC Medical College, Bangalore, Karnataka, India
[4]Professor, Department of Oral & Maxillofacial Surgery, KGF College of Dental Sciences, KGF, Karnataka, India
[5]Reader, Department of oral Medicine, KGF College of Dental Sciences, KGF, Karnataka, India
[6]Reader, Department of Oral Surgery, Dr Hegedawar Sanghan Smirthi Dental College, Hingoli, Maharastra, India

***Corresponding author:** Dr. K. Premnath
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Abstract

The impression materials are essential for the fabrication of stone casts and dies. The successful impression is based on the accuracy of impression material with respect to detailed reproduction and dimensional accuracy Differences in dimensional stability, wettability, and surface hardness are seen among various elastomeric impression materials. The purpose of repouring elastomeric impression material is to evaluate the accuracy of the material between different time intervals. At two different time interval with different types of die, stones poured for vinyl siloxanther elastomeric impression and additional silicone for the study to evaluate the dimensional accuracy material. The poor reproducibility, lack of surface details, and bubbles in the cast, which may lead to an inaccurate die and a poorly fitting prosthesis due to poor incompatible materials. ***Method:*** The study involves as per American dental association specification, using a stainless steel die nearly 90 impressions were taken, out of which 45 impressions were taken by each impression material, by pouring into 3 different die stones and equally subdivided into groups of 15 each. The statistical analysis was used for ANOVA test and TUKEY' POST – HOC TEST. A Computerized coordinated measuring system was used to assess various dimensions on stone cast poured from the impression of the stainless steel model. **Group A, B, C:** Indentium Medium poured with Ultrarock, Elite rock, Alpenrock. **Group D, E, F:** Monopren Transfer poured with Ultrarock, Elite rock, Alpenrock. ***Results:*** The result shows that Addition silicone yielded less accurate cast than formulated identium (vinyl siloxane ether)**.** ***Conclusion:*** The study concluded that presence of a certain amount of variation at a time interval (15 min and 75 min) on impression repouring, henceforth indicates that when poured immediately better accuracy is seen, and newly formulated vinyl siloxane impression material yields more accurate impressions.

Keywords: Impression material Vinyl siloxane ether, Addition Silicone, Dimensional Accuracy, Stainless steel dies.

INTRODUCTION

In dentistry, accurate and dimensionally stable impressions are the prerequisite step towards the fabrication of a successful prosthesis in dentistry for fabrication dimensionally stable and accurate impressions are the steps of prerequisites. An utmost importance for better acceptable restoration to obtain mechanically, functionally, biologically and aesthetically is much important and the impression material replication of the soft and hard tissue of the patients is obtained at unstrained and or various position of displacement [1,2].

The dentist makes choices for the selection of material based on experience and personal preference. The impression material such as agar is more economical but high technique sensitive with poor surface detail reproduction [3-6].

Elastomeric impression materials for dimensional stability is the choice of material have emerged as the material of choice due to various reasons Polysulfides has the disadvantage of long setting time, the poor dimensional stability of the impression, water as a by-product. It has an advantage of good surface reproduction including condensation silicone impression materials [7-9].

Condensation type silicone impression materials due to poor dimensional instability result in prosthesis poor retention and during polymerization; a production of alcohol by-product is attributed. The investigators recommended that the polyvinyl siloxanes

and polyether have been used as new elastomeric impression material [10-13].

In the profession of dentistry, good results are obtained with convenience and takes less time by the experienced professional includes four basic types of elastomeric impression material.

- Polysulfides
- Condensation silicones
- Additional silicones
- Polyethers.

The combination of polyvinyl siloxane and polyether introduced and considered to be more accurate than older ones [14-16].

Methodology

Fabrication of a master die and its procedure

A stainless steel model with two tapered abutment preparations was fabricated done with the support of lathe. The stainless steel model dimension: Height - 8.0910 mm in 3.1352 mm top radius and 4.2250 mm –base radius, 28.5022 mm - a distance between centres of the abutments. Diagram of stainless steel model displaying 2 abutments intraabutment: diameter and height, 6.2704 and 8.0910 mm, respectively, interabutment dimensions -28.5022 mm. The abutments tapered of 12 degrees to simulate a tooth preparation. Fig 1

Sample Grouping

Group A: Indentium Medium poured with Ultrarock,
Group B: Indentium Medium poured with Elite rock,
Group C: Indentium Medium poured with Alpenrock,
Group D: Monopren Transfer poured with Ultrarock,
Group E: Monopren Transfer poured with Elite rock,
Group F: Monopren Transfer poured with Alpenrock

The set of impression poured at 15 minutes and 75 minutes were grouped as

GroupA1 and A2: Indentium Medium poured with Ultrarock (15 mins and 75 min)
Group B1and B2: Indentium Medium poured withEliterock (15mins&75m mins)
Group C1 and C2: Indentium Medium poured with Alpenrock (15 minand 75 mins)
Group D1and D2: Monopren Transfer poured with Ultrarock (15 min and 75 mins)
Group E1 and E2: Monopren Transfer poured with Elite rock (15 min and 75 mins)
Group F1 and F2: Monopren Transfer poured with Alpenrock (15mins and 75 mins)

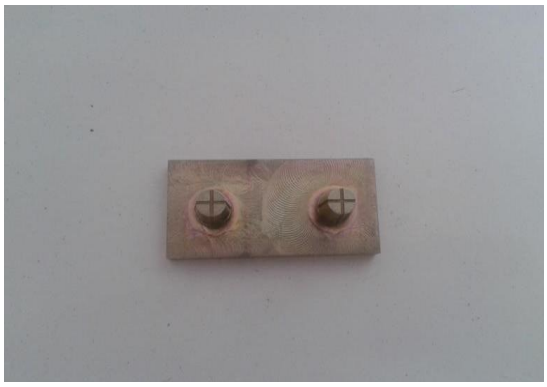


Fig-1: Stainless steel dies

The impression is made on dentulous perforated metal stock trays. It was cut and modified in order to repeat the same position (fig 2).

Fig-2: Impression trays

Fig-3: Modification of impression trays

The borders of the tray were extended using tray acrylic resin material to control the flow of materials in order to control in the border of the tray a tray acrylic resin material is used as the extension (fig 3).

Impression making as per ADA specification

The impressions made at a temperature of 23 degree Celsius. As per American Dental Association specification, a total number of 90 impressions were made using a stainless steel die.Nearly 45 impressions were made from each impression and equally divided into groups of 15 each and two different time intervals poured by three different die stones.

Impressions using Identium

In the impression trays, a tray adhesive was applied and Pentamix was used for one step medium body technique performance by mixing the medium body impression material. The tray of impression was gently removed away from a master die (fig 4). Impressions were stored and made at 23^0C. The stone was first mixed by hand for 10 seconds and then for 20 seconds mixed mechanically under vacuum. The mixes were vibrated and impressions were poured at 15 min and again repoured at 75 min.

Fig-4: Final Impression made

Impression for Transfer of monoprint

In the impression trays, a tray adhesive was applied and mixing gun was used for one step medium body technique performance by mixing the medium body impression material and simultaneously on die surface and tray applying the material. The tray of impression was gently removed away from a master die. Impressions were stored and made at 23^0C. The stone was first mixed by hand for 10 seconds and then for 20 seconds mixed mechanically under vacuum. The mixes were vibrated and impressions were poured at 15 min and again repoured at 75 min.

The first pour was measured and analyzed with each other; between the group samples dimensional changes were observed and in the second set of the above samples to obtain and the impression was repoured. The measurements are made from Digital Stereo Microscope. The data obtained were analysed for the group samples of the first pour and second pour and also dimensional changes comparison was done.

RESULTS

The study shows by the investigation that using addition silicone, Vinyl siloxane ether impression material poured at two different time intervals changes

in the dimensional accuracy of resultant models made of improved stone. To evaluate their accuracy of reproduction after first and second pour at time intervals of 15 min and 75 min the individual abutment (d1&d2) and interabutment dimensions (IAD) diameter on the stone casts obtained.

Table-1: Difference in d1, d2 and IAD between D2, E2 and F2 (at 15 min and 75 min) using ANOVA test

Distance	Group	Mean	Standard Deviation	Confidence Interval at 95%		F	P
				Lower	Upper		
d1	D2	6.2682	.01518	6.2296	6.2678	8.3641	.002
	E2	6.2689	.01628	6.1695	6.2780		
	F2	6.2674	.02233	6.1293	6.1656		
d2	D2	6.1670	.01545	6.2488	6.2590	8.406	.003
	E2	6.2341	.01512	6.2679	6.2785		
	F2	6.1674	.02231	6.2276	6.2763		
IAD	D2	27.7542	.02653	27.3142	27.4107	1.268	.217
	E2	26.2453	.02674	26.1708	24.3022		
	F2	25.3540	.01428	27.3323	26.4357		

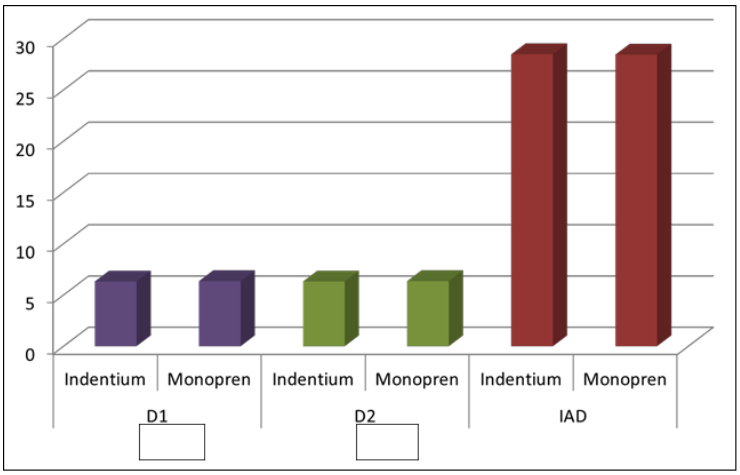
The group of Monopren Transfer impression materials enumerates the dimensional variation of diameter d1, diameter d2 and interabutment and distance shows statistical changes. The minimal variation is showed in Group F2.

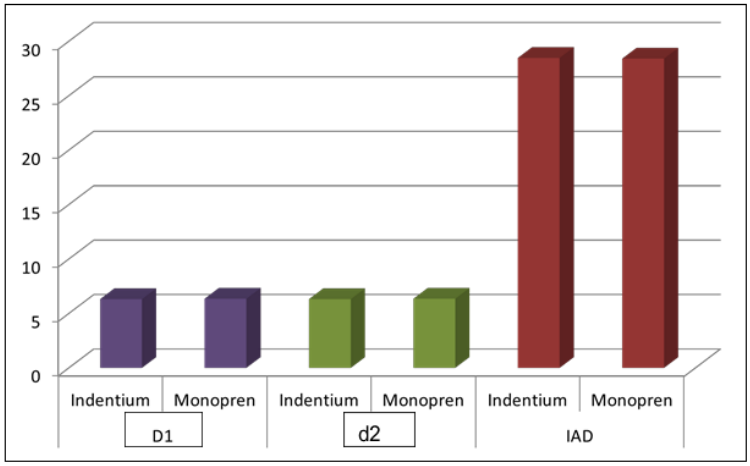
Table-2: Tukey's post-hoc Test for Multiple Comparison

Distance	Variable 1	Variable 2	Mean Differnce	P	Confidence Interval at 95%	
					Lower	Upper
d1	D2	E2	-.01229	.014	-.0236	-.0021
		F2	.00611	.431	-.0076	.0118
	E2	D2	.01665	.017	.0029	.0257
		F2	.01987	.001	.0211	.0296
	F2	D2	-.00610	.589	-.0119	.0076
		E2	-.03686	.002	-.0319	-.0201
d2	D2	E2	-.01278	.054	-.0216	-.0009
		F2	.01276	.133	-.0023	.0394
	E2	D2	.01472	.054	.007	.0413
		F2	.01382	.038	.0219	.0239
	F2	D2	-.02377	.213	-.0287	.0076
		E2	-.01892	.033	-.0276	-.0224
IAD	D2	E2	.06134	.256	-.0456	.2786
		F2	-.02654	.765	-.2765	.1321
	E2	D2	-.07085	.238	-.1979	.0432
		F2	-.07603	.341	-.1434	.0273
	F2	D2	.02765	.564	-.1549	.2676
		E2	.08904	.341	-.1713	.1876

A difference in d1, d2 and IAD between Indentium and Monopren at 15 min and 75 min

The dimensional variation of diameter d1, diameter d2, inter-abutment distance IAD of Monopren Transfer and Identium impression materials (at 15mins and 75 min) results in significant statistical changes. The minimal variation is shown in indentium.





STATISTICAL ANALYSIS INTERPRETATION

The first pour showed better results than second pour and Group C shows the best results. Group C> Group B > Group A> Group F> Group E > Group D.

DISCUSSION

In the past four decades, more research and development has led to the establishment of a filtering to a selected number and or preferred method [17-24]. The impression material registers the accurate details of the teeth and the supporting tissues. The dimensional accuracy of impressions by impression material plays an important role in the success of fixed prosthesis [40]. Research studies show that addition silicone impression material reproduced a die which has got increased in diameter compared to standard master dies. The dies were shorter in dimensions and addition silicone impression material showed more variations in dimensions [25]. The research study performed by Johnson & Craig, silicones impression material showed best results arising from the removal of repeated pours in the impression compared to polyethers and also addition silicone shows less value than it as per the study of Yeh *et al.* These are the aspects meant to be a crucial factor during multiple pours was desired for determining/selecting an impression material [26-29]. The study shows very different from evaluating the dimensional stability of elastomeric impression material for a given period of time because of induced distortion, while repoured casts withdrawing from the same impression. The dimensional changes of the impression materials evaluation study were carried out by comparison between stone casts made from an impression of the master die and the die [16]. Precision measurement was done using instruments like a microscope, micrometre, vernier calliper, and laser probes. And the Computerized coordinated measuring system was used [30-33].

In intragroup studies using ANOVA test and Tukey's post-hoc test when Monopren Transfer groups were repoured at 75 min i.e. (D2, E2, F2) it was observed that there are statistically significant changes (ANOVA test and Tukey's posthoc test) but among all the group, group F2 showed the better results. When Identium impression materials were poured with three different types of die stones (A1, B1, C1), the results showed that group C1 showed better results through the differences in the results are minimal and also these differences are that group C die stone (Alpenrock) shows minimal expansion properties when compared with group A die stone Ultrarock and group B die stone (Elite rock). The Identium material groups were repoured at 75 min i.e. (A2, B2, C2) and observed that there are statistically significant changes in ANOVA test and Tukey's posthoc test because, among all the groups, group C2 showed the better results. During second intragroup studies using ANOVA test and Tukey's post-hoc test when Monopren Transfer impression materials were poured with three different types of die stones (D1, E1, F1) and it was observed that group F1 showed the better results through the differences in the results are minimal [34]. The reason for these differences could be that group F dies stone i.e Alpenrock might be showing minimal expansion properties when compared with group D die stone (Ultrarock) and group E die stone (Elite rock). The dimensional accuracy of impression materials is a primary basis to all the factors that could influence on dimensional accuracy standardized in the current study [35-37]. It should keep in mind according to clinicians and laboratory technicians that it is always better to pour the impressions and concluded that when poured at multiple time intervals there are dimensional changes for all the materials. It is seen that better fit of the prosthesis the impressions should be poured at the earliest [38].

The study limitations

The impressions were made on a modified stainless steel model, the surface differed and Retraction cord, as well as haemostatic agents, is used when making impressions not simulated in the study. The temperature of the intraoral environment was not taken into consideration. It cannot be simulated for the

biofilm that exists on the oral surfaces and also varies from the natural oral environment.

CONCLUSION

The newly formulated Vinyl Siloxanether impression material resulted in more accurate casts: yielded more accurate results than those of Addition Silicone. It also yielded dimensional changes when it was poured and repoured from the same impression. It was observed that there were statistically significant differences and among both the impression materials. It can be concluded that the accuracy of the casts obtained from Vinyl Siloxanether and considered was high and always better to pour the impressions immediately to obtain a perfect prosthesis.

Summary

The present in vitro study analysis to compare the dimensional accuracy of resultant models made of improved stone poured at two different time intervals using vinyl siloxane ether and addition silicone impression materials.

The cross-reference grooves abutments were of equal size facilitated the measurements and metal tray impression with the perforations provided for retention of the impression materials. It facilitates the escape of excess impression material because hydraulic pressure prevented from being built up during impression tray seating. Tray adhesives were applied on to the trays and allowed to dry and the impressions were made at a temperature of 23 degree Celsius. A total number of 90 impressions were made from a stainless steel die and Each impression was equally divided into groups of 15 each (A-F) and was poured by three different commercially available die stones at two different time intervals (15 min & 75 min) and used to make 45 impressions. The Diameter of the abutment and the inter-abutment distance measured. And the values were compared with the dimensions of the master die to assess any dimensional change and comparisons assessment were made between the casts of two impression groups. Between the group of samples of the first pour were measured and analyzed with each other and the impression was then repoured to obtain the second set of the above samples. The 1st pour group sample and 2nd pour group sample were also compared for dimensional accuracy changes observed. The data obtained were analyzed and measurements were made using a Computerized coordinated measuring system. The diameter d1 &d2 observed an increase in dimension. The fact that this impression material shows polymerization shrinkage in impression tray walls resulting in a die diameter increase. It was observed in the study might be that there was a decrease in the inter-abutment distance on the basis of impression material polymerization shrinkage. The impression material polymerization shrinkage towards the mass centre or bulk of the material. The use of tray adhesive polymerization shrinkage impression tray walls. The impression material around each abutment contracted towards the walls of the impression tray and in between two abutments, tray adhesive redirected the polymerization shrinkage around each abutment towards the tray wall, the position of the midpoint of both abutments came closer. The medium body vinyl siloxane ether impression materials concluded that the new vinyl siloxane ether impression materials gave more accurate cast in compare to the addition silicone impression material. The clinically acceptable variations among both the materials are minimal.

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