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Original Article

A Laboratory Study on Evaluation of the Accuracy of Elastomeric Impressions

Milind Limaye[1], Kundendu A. Bishen[2], Koyena Mishra[3], Bhuvanesh Airen[4]

[1]Dean, Professor and Head, Dept. of Prosthodontics, [2]Professor and Head, Oral and Maxillofacial Pathology, [3]Professor, Oral and Maxillofacial Surgery, [4]Assistant Professor, Dept. of Public Health Dentistry, Index Institute of Dental Sciences, Malwanchal University, Indore-452016 M.P., India

***ABSTRACT*:**

Background: This laboratory study was carried out to find out the accuracy of the impression of a master die using polysulfide, polyether and addition silicone rubber base material in different consistencies and their combinations using custom made tray and readymade stock tray and using different techniques. **Methods:** Standardized type IV dental stone was poured into impressions immediately and obtained stone die was measured by using scanning electron microscope. Totally forty stone dies were prepared and measurements recorded and were compared with the master die. **Chi-square test** and **Anova-test** were used for comparing various measurements statistically and the level of significance was set at **0.05**. **Results:** The study revealed that, all the impressions were undersized in dimensions. Polysulfide elastomer impression material produces most accurate impressions. Single mix single impression technique produces most accurate impressions than any other type of impression techniques. Impressions made with custom tray are more accurate than impressions made with stock tray. **Conclusion:** This study forms the first part for the further clinical study. It is better to study the accuracy of impression material clinically as certain other factors like saliva, change in temperature from mouth to room temperature also contributes to the inaccuracy of the material.

Key words: Impression techniques, Polysulphides, Polyethers, Addition silicone, Elastomers.

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Corresponding Author: Dr. Kundendu A. Bishen, Professor and Head, Oral and Maxillofacial Pathology, Index Institute of Dental Sciences, Malwanchal University, Indore-452016 M.P., India

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INTRODUCTION:

No prosthesis can be fabricated directly in the oral cavity. They have to be fabricated in laboratory and then "fit" in the patient's oral cavity. Unless an accurately duplicated die or cast is available in the laboratory, which precisely represents the patient's oral cavity in absence of patient, no prosthesis can be fabricated with accuracy. Impression making is the most important clinical step in duplicating oral tissues. Unless the impression is accurate a die or cast cannot be accurate, even though suitable die material and technique is followed.

Since many decades number of impression materials, both rigid and elastic are being used for impression making in restorative dentistry. However, in the field of crown and bridge and in case of cast partial dentures, elastic impression materials are suitable to be used.

Due to poor flow and dimensional instability, Irreversible hydrocolloid, is not suitable for clinical use- except for study cast preparation. Reversible hydrocolloid even though having excellent flow properties is not used for clinical procedures because of the cumbersome procedures involved. It needs special equipment and instruments for manipulation. Hence, it is also restricted to laboratory work only.

Elastomers came into vogue since 1950s for use as impression materials, wherever accuracy is most important. Four types of elastomers viz., Polysulhide, Condensation Silicone, Polyether and Addition silicone in different consistencies and flow properties are available commercially.

The physical, chemical and biological properties of these materials varies from one another Depending on the requirement one is expected to choose one of the above mentioned materials for impression making. However, clinicians get confused with the variety of dental impression materials available and number of techniques advocated or will 'select' the material and technique randomly. It is generally observed that either the material

is selected on the cost effectiveness or with the notion "Anyone of the material will do".

No single property can be used as a measure of quality of the materials. Often several combined properties determined from standardized laboratory and service tests are employed to give a measure of quality. In spite of advent of new technologies and availability of choicest materials, still achievement of perfect restoration is a pursuit.

Hence, this laboratory study has been undertaken to find out,

1. Which one of the elastomeric materials, in which consistency gives accurate impression.
2. Effect of tray on the accuracy of the impression.
3. The effect of impression technique on the accuracy of impression.

Scanning election microscope has been used in this study for measuring accuracy due to the greater depth of field and ideal suitability for examining the surfaces. In addition, it (SEM) can measure distance between predetermined sites. Impression accuracy can be studied either by analyzing the impression itself or by analyzing the die from the impression or by analyzing the fit of the final restoration on the die.

As our aim is to find out the accuracy of the impression, the analyzing the accuracy of the restoration was not undertaken as it is a final product. As, impression undergoes distortion from time of impression making to the time of analyzing, impression as such was not analyzed. The stone die which was obtained by pouring the die stone immediately after obtaining the impression is analyzed in this study.

MATERIAL AND METHODS:

MATERIALS USED:

(1) Polysulfide rubber base impression material.
PERMLASTIC Type-Ill.
(a) High viscosity
(b) Regular viscosity
(c) Light viscosity
(2) Polyether rubber base impression material
IMPREGUM - F (ESPE - W.GERMANY)
(3) Addition silicone rubber base impression material
REPROSIL Type-I (CAULK/DENTSPLY USA)
(a) Very High viscosity
(b) High viscosity
(c) Regular viscosity
(d) Light viscosity
(4) Impression tray adhesive spray (HAGER & WERKEN - GERMANY)
(5) Type IV - Die stone material - Super - Die (WHIP - MIX USA)
(6) Self cur acrylic resin (DENTSPLY INDIA)

EQUIPMENTS USED:

(1) Vacuum mixer (MULTIVAC - 4, DEGUSSA GERMANY)
(2) Mini vibrator (DENTARUM GERMANY)
(1) Plaster trimmer (YOSHIDA JAPAN)

MEASURING INSTRUMENT USED:

(1) Scanning electron microscope (JEOL JAPAN)

METHODS USED:

STEP (1) Preparation of a Master die:

Master die of brass metal with mirror finish and having dimension of one inch length and half inch breadth and height was prepared. Handle was attached to one surface and on the opposite surface grooves were made for measurements. Two broad slots were prepared on both the side surfaces for orientation of impression trays. (Figure: 1)

STEP (2) Fabrication of a custom tray:

Alginate impression of the master die was made in a stock tray. From the impression, the cast was obtained. Wax spacer of two millimetre thickness was adapted over the stone die on all surfaces except the surface with the handle. Orientation slots were relieved of spacer. Separating media was applied over the slots. Then self clear acrylic resin tray was prepared. After de-waxing the spacer material, escape vents were made by using no.3 round bur. Good finish was given to the tray and it was made ready for impression making with elastomeric material. Following same procedure, 35 special trays were made.

STEP (3) Impression making:

Various types of impressions were made using different techniques and materials.

TECHNIQUE - I: Single mix-single impression technique:-The different materials used for making impressions by this technique were:

I (a) Polysulfide Elastomeric Impression Material (Regular body)
I (b) Polyether Elastomeric Impression Material
I (c) Addition Silicone Elastomeric Impression Material (Regular body)

TECHNIQUE – II: Double mix - single impression technique:- The different materials used for making impressions by this technique were :

II (a) Polysulfide Elastomeric Impression Material (Heavy plus light body)
II (b) Addition Silicone Elastomeric Impression Material (Heavy plus light body)

TECHNIQUE – III: Double mix - double impression technique (putty/wash or reline technique):- The different materials used for making impressions by this technique were:

III (a) Addition Silicone Elastomeric Impression Material (Putty plus light body)
III (b) Addition Silicone Elastomeric Impression Material (Putty plus Medium body)
III (c) Addition Silicone Elastomeric Impression Material (Putty plus Light body using a stock tray)

STEP (3) Pouring of an Impression:

Impression was poured immediately with type IV dental Stone plaster (Super-Die). Stone plaster was mixed in a

vacuum mixer (Figure 2) for 60 seconds in 10 gm powder with 2.2 ml of distilled water proportion. Stone plaster was poured into an impression with help of a vibrator. Stone die was removed from an impression after one hour. With the help of a plaster trimmer, base of stone die was made flat so that it can be mounted on a scanning electron microscope. This procedure was followed for pouring of all impressions made by different techniques. By each impression technique, five dies were made. Total forty stone dies were made.

STEP (4) Measurements:
Measurements were done under scanning electron microscope (SEM) (Figure 3) at 15 X magnification. Measurements were taken at four different sites on metal master die. As shown in figure (Figure 4), measurements were taken to find out the distance between A' - A", B' - B", - C - C" and D' - D". Distance between each was designated as A, B, C and D respectively. Same procedure was followed for measurements at four sites on each stone die. Total 40 stone dies were measured by same procedure. In each group, five samples of stone dies were measured.

STEP (5) Statistical Analysis:
The statistical procedures were performed in two steps:

A) Data Compilation and Presentation

The measurements obtained by measuring distances on various (40) dies using SEM was compiled systematically and was transferred to a computer to prepare a master table using Microsoft office tool- **Excel 2007**.

B) Statistical Analysis

Graphs and tables were generated using Word and Excel tools of **Microsoft office 2007**. The Statistical software **SPSS 16.0** was utilized for analyzing the measurements. **Chi-square test** and **Anova-test** were used for comparing various measurements statestically and assessing the significance in differences in precision in impressions made by various techniques. The level of significance was set at **0.05**.

Figure 1: Metal die, its impression made and stone die prepared

Figure 2: Vacuum mixer (Degussa)

Figure 3: Scanning electron microscope

Figure 4: Diagram representing grooves on metal and die stone and distance measured

	A	
A’	<----------> **B**	A”
B’	<----------> **C**	B”
C’	<----------> **D**	C”
D’	<---------->	D”

Figure 5: Graph showing comparison of average measurement in mm, of master die with die stones prepared by various impression techniques

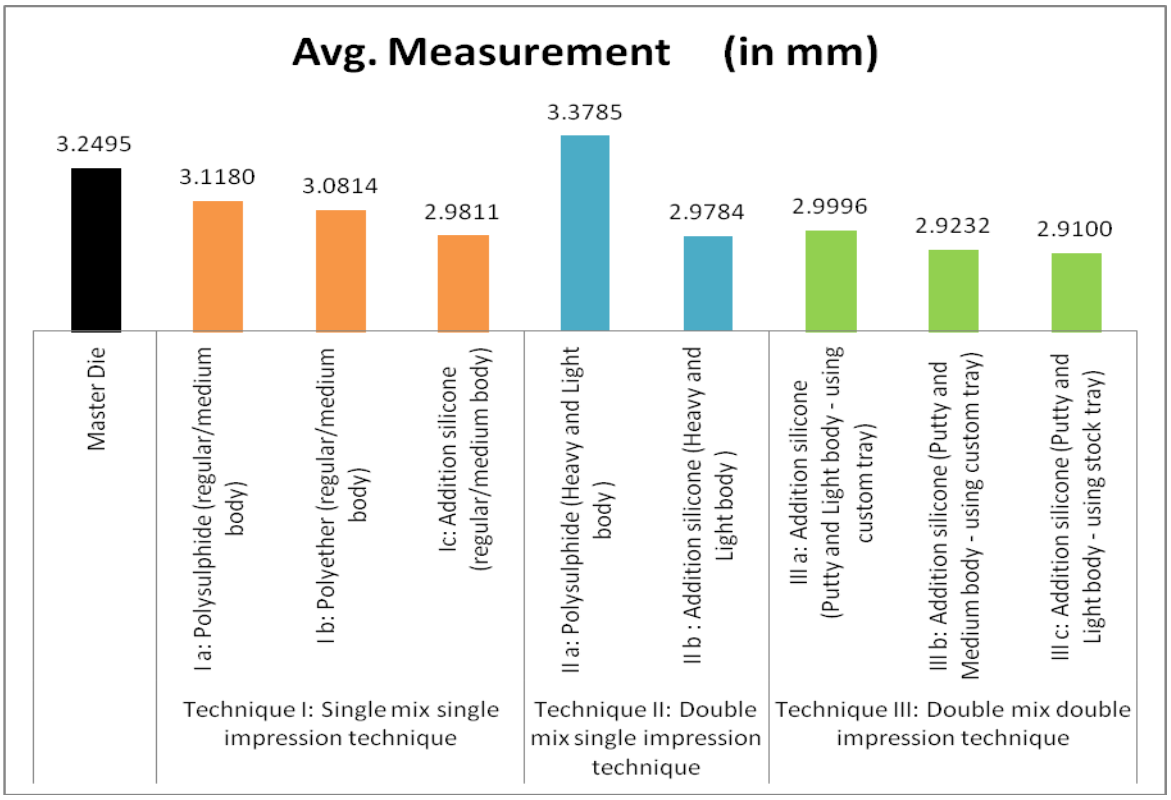
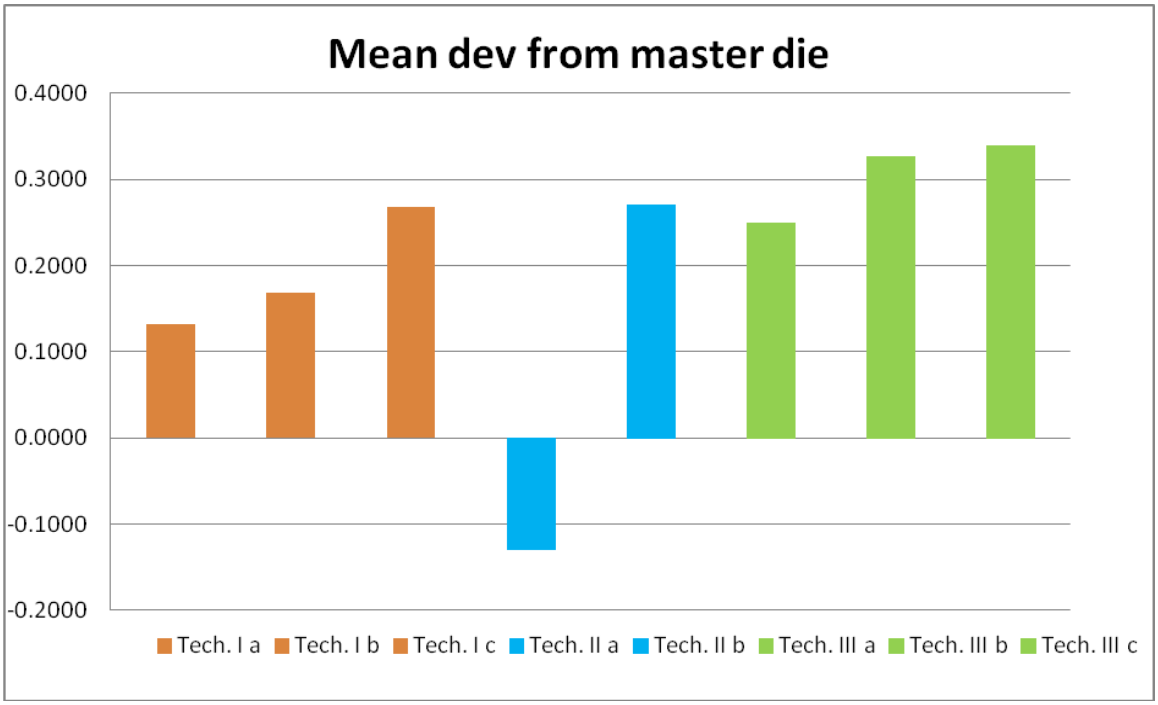


Figure 6: Graph showing values recorded for mean deviation of measurements on die stones obtained by various impression techniques from the master die



RESULTS:

Table I: Table showing measurements taken from master die and die stone at four different sites viz A,B,C,D along with average measurement in mm and its deviation from master die.

TECHNIQUES	MATERIALS	A	B	C	D	Avg. Measurement (in mm)	Mean dev. from master die
	Master Die	3.3150	3.2630	3.2630	3.1570	3.2495	
Technique I: Single mix single impression technique	I a: Polysulphide (regular/medium body)	3.1574	3.1154	3.1364	3.0626	3.1180	0.1315
	I b: Polyether (regular/medium body)	3.1364	3.1050	3.0632	3.0208	3.0814	0.1681
	Ic: Addition silicone (regular/medium body)	2.9576	2.9784	3.0206	2.9678	2.9811	0.2684
Technique II: Double mix single impression technique	II a: Polysulphide (Heavy and Light body)	3.2940	3.3680	3.4102	3.4416	3.3785	-0.129
	II b : Addition silicone (Heavy and Light body)	2.9782	2.9784	2.9890	2.9678	2.9784	0.2711
Technique III: Double mix double impression technique	III a: Addition silicone (Putty and Light body - using custom tray)	2.9890	2.9996	2.9996	3.0102	2.9996	0.2499
	III b: Addition silicone (Putty and Medium body - using custom tray)	2.9256	2.9050	2.9154	2.9468	2.9232	0.3263
	III c: Addition silicone (Putty and Light body - using stock tray)	2.9784	2.9996	2.8836	2.7784	2.9100	0.3395

Measurements taken from master die and stone dies at four different sites viz A, B, C, and D (as shown in figure 5) has been tabulated in table shown in Figure 5. The comparison of various measurements has been shown in graph shown in Figure 6. The values recorded for mean deviation of measurements on die stones obtained by various impression techniques from the master die in this study have been shown in graph shown in Figure 7.

DISCUSSION

Prosthetic restoration is prepared in the laboratory and "fitted" into the oral cavity. Accurate fit' of the restoration is very important to avoid failures in treatment. Fit' means perfect adaptation of the restoration to the tooth prepared, to receive restoration. Accurate fabrication of the restoration in the laboratory is very essential.

Generally accuracy is expressed in terms of percent deviation from the master model dimensions rather than by absolute values to facilitate comparison of relative amounts of change.

The first step in accurate reproduction of the restoration in the laboratory is obtaining the impression. If impression is not accurate all proceeding procedures will be inaccurate. Hence, impression should be accurate. Inaccuracy of an impression is caused by one or more factors viz., impression material, impression technique, impression material in thickness, seating pressure, removal of the impression from the mouth, polymerization of a material, relaxation of stresses and storage of impression. However, accuracy is basically controlled by flow character of the impression material. Accuracy of the impression can be studied by finding out the effect of each of the above said factors.

ELASTOMERS & ACCURACY:

From the study, it is noted that, polysulfide elastomers produce more accurate impressions, then polyether and addition silicone in order. The values recorded in this study 0.131 mm., 0.168 mm., and 0.284 mm., mean deviation from the master die respectively proved the observation made. This observation is supported by the flow characters of the above stated elastomers recorded by Lemons.[1]

The material which has better flow gives more accurate impressions. In the statistical analysis the values obtained in this study, were not statistically significant. The values recorded by t-test', however, reveal that poly-sulfide and polyether behave in the same pattern. Whereas, values recorded are significant (95% confidence level) for polyether and addition silicone and polysul-fide and addition silicone. This shows that, polysulfide and polyether are superior to addition silicone as far as accurate impression is concerned. Hence, we can conclude that, accurate impression can be obtained by using polysulfide, polyether and addition silicone in degrading order.

IMPRESSION TECHNIQUES AND ACCURACY:

Superiority of one technique over other techniques in producing accurate impressions is probably, due to stress release immediately after impression is removed. In single mix single impression technique, material is allowed to move freely and very little stress is produced to get freed later. Hence, impressions were produced more accurately. In other techniques, though material is made to move freely, the material will be under stress because of the presence of the material of different consistencies. The wash impression material sets under compression and

stress gets released immediately after impression is removed, leading to less accuracy. [2,3]

From these observations it can be concluded that irrespective of impression material used, single mix single impression technique produces more accurate impressions. Double mix single impression technique and double mix double impression technique in order, produce lesser accurate impression.

IMPRESSION TRAYS AND ACCURACY:

Observations in this study reveal that, impression made in custom tray produce more accurate impression than those made using stock tray. This is probably due to uniform space available around the master die in custom trays. The stress induced during impression making gets released after removal of impression in uniform fashion producing near accurate impressions. Where as in stock trays, stresses are released un-uniformly and produce less accurate impressions. Hence, it can be advocated that custom trays help in producing more accurate impressions than stock trays. This observation is supported by the studies conducted by Phil lips, [4] DeAraujo, [5] Ciesco, [6] and Eames. [7]

GENERAL OBSERVATIONS:

In general, all the stone dies made from different impression material and techniques show undersized dies. The difference in mean deviation for their accuracy amongst all types of impression stone dies is not significant statistically. The reason for their minute differences can be explained on the basis of,

1) Insufficient escape of impression material as the master die shape is wedge shape, which will act like a hydraulic chamber causing the hydrostatic pressure on the impression. [8]

2) Continuous polymerization of elastomer and evaporation of volatile substances. [8]

3) Water absorption of impression material from the poured stone plaster or from the atmosphere which will cause swelling up of an impression. [9]

4) Combination of above all factors may have given minute deviation from the master die.

In this laboratory study only one character that is flow of the material is made to be differentially effective in producing the accurate impression. It is necessary, to study the effect of the flow property of material along with the effect of dimensional stability of the impression material in producing accurate impression.

This laboratory study forms the basis for further clinical study in which, apart from the factors discussed so far, other factors which contribute for inaccurate impression in the oral cavity, such as saliva; change in temperature from mouth to room temperature etc are also assessed.Ultimately, clinical study only will give definite indications about the best choice of the material and techniques to be used in producing accurate impressions.

CONCLUSIONS

From this laboratory study it can be concluded that,

- Polysulfide elastomeric impression material produces more accurate impression than polyether and addition silicone elastomers in order, when using with single mix single impression technique or double mix single impression technique.
- Statistically there is no significant difference regarding accuracy between polysulfide and polyether material.
- Overall single mix single impression technique produces more accurate impressions than double mix single impression technique and double mix double impression technique in order.
- Impressions made by using custom tray are more accurate than the one produced by using stock tray.

REFERENSES:

1. Lemons J. E.: Clinical restorative materials and techniques. Pheladalphia, 1988; Lea and Febiger. Ed. 1. Pg 180.
2. Podshadley, A. G., Dilts, W. E., Neiman, R., and Ellison, E. Accuracy of relined mercaptan rubber impressions. J. Pros. D., 24: 5, 503–511 (Nov.) 1970
3. Myers, GE and Stockman, DG. Factors that affect the accuracy and dimensional stability of the mercaptan rubber-base impression materials. J Prosthet Dent. 1960; 10: 525
4. RW Phillips. Science of dental materials. (9th ed.)WB Saunders, Philadelphia, PA (1991), p. 151.
5. Araujo PA, Jorgensen KD; Effect of material bulk and undercuts on the accuracy of impression materials. J Prosthet Dent, 1985;54: p. 791
6. Ciesco JN, Malone WFP, Sandrik JL, Mazur B. Comparison of elastomeric impression materials used in fixed prosthodontics. J Prosthet Dent 1981;45:p 89
7. Eames WB, Sieweke JC, Wallace SW, Rogers LB. Elastomeric impression materials: effect of bulk on accuracy. J Prosthet Dent 1979;41:304
8. JA Stackhouse; A comparison of elastic impression materials. J Prosthet Dent 1975;34: p. 305
9. Sawyer, HF, Birtles JT, Neiman, R., Podshadley AG : Accuracy of Casts Produced from Seven Rubber Impression Materials. JADA, 1973;87:126.

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