

**An In Vitro Study of The Dimensional Accuracy of Various Elastomeric Impression Techniques**

¹Dr. Rafi Fahim, Reader, Department of Prosthodontics, Teerthankar Mahaveer University, Moradabad, UP

²Dr. Suneel Patil, Associate professor, Department of Prosthodontics, Karnataka Institute of Medical Sciences, Hubli, Karnataka.

³Dr. Sankalp Verma, Sri Sai Hospital, Delhi Road, Moradabad, U.P.

Correspondence Author: Dr. Suneel Patil, Associate professor, Department of Prosthodontics, Karnataka institute of medical sciences, Hubli, Karnataka.

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Abstract

Objective: To determine which elastomeric impression technique given in standard textbooks gives dimensionally most accurate results and least discrepancy in final prosthodontic treatment outcome.

Material and Methods: Master model used in this study consisted of a dentate maxillary arch of an acrylic resin typhodont. Sharply defined pits were made on selected locations on ivory teeth on the model. 20 impressions were made by each of the following techniques and the cast were obtained in die stone.

They were coded as:

Group A: One-step putty wash impression technique.

Group B: Two-step putty wash impression technique.

Group C: Multiple mix impression technique.

Group D: Single mix impression technique.

The measurements between these sharply defined pits were made on a Coordinate measurement machine and compared using statistical analysis.

Results: The results obtained were compared with statistical analysis. It was observed from the study that none of the casts obtained were similar to master model in three dimensional measurements. Multiple mix technique was found to be most accurate.

Conclusion: In this study it was found that Group C (multiple mix technique) casts were most accurate and

Group A (one step putty wash technique) casts were least accurate.

Introduction

Making an accurate impression of dental and dentoalveolar structures is important and an essential requirement for the precise fit of the prosthesis. This is one of the important factors that determine the longevity of the restorations. Any inaccuracy incorporated during the first phase of impression making is carried till the last stage that is the finished casting. This leads to failure of the treatment. A wide variety of impression materials and techniques are available to avoid this failure.

Elastomeric impression materials are extremely popular because of their combination of excellent physical properties, handling characteristics and dimensional stability¹. Poly vinyl siloxanes (PVS) have been reported to be most accurate and dimensionally stable. They are least affected by pouring delays or by second pours². These materials are available in various consistencies: putty, heavy body, medium body, light body. Different techniques have been described for these materials, which combine one or more of these consistencies. The various techniques used with PVS materials are: single phase or monophasic impression technique, one step putty wash technique, two step putty wash technique and multiple mix technique^{3,4,5}. A number of studies have been done

comparing one step putty wash technique and two step putty wash technique and various other techniques but there are very few studies which compared these most commonly used techniques given in standard textbooks.

Oliver Schaefer et al in 2012 determined the accuracy of elastomeric impressions in 3 dimensions using 3D analysis and concluded that a spatial computer aided analysis was a viable option in determining accuracy of elastomeric impression materials. Vinyl siloxane ether, a new impression material has been compared to other elastomeric impression material. It has been established that its results are equivalent to polyether and addition silicone^{4,6,7,8}.

PVS impression materials are technique sensitive and care must be taken while using them to ensure optimum results. The 'Simultaneous technique' used for making putty wash impression should be avoided³. The various impression techniques with their advantages and disadvantages put the dentist into a dilemma as to which technique is the best. Hence this study was undertaken to evaluate and compare the dimensional accuracy of different elastomeric impression techniques.

Material and methods

Materials and Equipments

Preparation of Master models

The master model consisted of a dentate maxillary model of an acrylic resin typhodont mounted on a metallic platform made of aluminium alloy for mounting master model. Sharply defined pits were made on selected locations and the typhodont. The pits were referred as:- Point a –Mesiopalatal cusp tip of maxillary right third molar, Point b- Incisal edge of maxillary right central incisor, Point c- Mesiopalatal cusp of tip of maxillary left third molar, Point d- Palatal cusp tip of maxillary right second premolar, Point e- Palatal cusp tip of maxillary left second premolar, Point g- At the centre of an imaginary

line joining points d and e on the palate, Point f was the imaginary centre of a straight line between points d and e (Fig 1)

Poly vinyl siloxane impression material in various consistencies was used: Aquasil Soft putty Addition Reaction Silicone (Dentsply, Germany) Aquasil Ultra Heavy Addition Reaction Silicone (Dentsply/ Caulk USA) Monophase Addition Reaction Silicone (Dentsply /Caulk USA) Aquasil Ultra LV Addition Reaction Silicone (Dentsply/ Caulk USA). Tray Adhesive for Addition reaction silicone impression material (Dentsply/ Caulk USA).

The different groups under study were:

Group A: One –step putty wash impression technique

Group B: Two- step putty wash impression technique

Group C: Multiple – mix impression technique

Group D: Single-mix impression technique

Methodology

The impressions of the master model were made using four different techniques: one step putty – wash technique, two-step putty – wash technique, multiple mix technique and single mix technique. Custom tray was used for multiple mix and single mix technique and stock tray was used for one step putty wash and two step putty wash technique. For each impression technique, 20 impressions were made from the master model, using one technique at a time. The impressions were examined carefully after removal from master model for the presence of voids and to ensure that all areas of measurement were included in the impression. The impressions were divided into four groups:

Group A (one – step putty wash impression technique), Group B (two-step putty wash technique), Group C (multiple - mix technique), Group D (single - mix technique). The impressions were poured with super hard gypsum type 4. At room temperature. After the removal of

the working models, they were checked for the presence of air bubbles. The various measurements of master model and the stone casts were measured with the help of Coordinate measuring machine.

The measurements done were a-b, b-c, c-a, d-e, f-g. After the readings were obtained, they were compared with the dimensions on master model using Dunnet's q-test. The difference between readings of stone cast and master model were calculated as follows.

mean difference = mean(distance on master model) - mean(distance on stone model).

The distances measured on stone cast obtained from four different groups were compared amongst each other. ANOVA test was used to compare the difference within group and between groups.

Results

Distance obtained by different techniques was compared together by ANOVA and the significance of mean difference between techniques was done by Tukey's multiple comparison test. All the impressions had a tendency to be slightly undersized in the vertical dimension (palatal depth) and oversized in horizontal dimension. The cast were most accurately reproduced by multiple mix technique (Group C).

The order in which various distances measured on the stone casts produced by different techniques deviated from distances on master model was:

GroupA > GroupB > GroupD > GroupC.

Shows that the mean difference of f-g distance(vertical distance) of the stone cast produced by multiple mix technique compared to the master model was 0.10% where as the mean difference of the f-g distance of the stone cast produced by one -step putty wash technique was 0.55% which was statically significant. For the two-step putty-wash technique this distance was 0.47% which was also significant.

The mean difference in horizontal distances was 0.03% to 0.12% for multiple mix technique and for one - step putty wash technique it ranged from 0.25% to 0.68%. The difference in b-c distance in casts obtained from one -step putty wash technique was statistically significant. This occurred because of the contraction of the impression material towards the tray walls, making the stone casts wider in the horizontal aspect and the largest distance in this study was b-c.

Discussion

The one-step putty wash technique should not be used as it is practically impossible to control the bulk of wash material and critical areas are sometimes duplicated in putty and because most putty materials are somewhat resilient, hydraulic pressure creates undetectable discrepancies in the impression^{9,10}. It has been described as the least accurate method of making a putty wash impression because in most situations part of the prepared teeth including margins, were duplicated with putty instead of syringe materials. Another disadvantage is that by mixing the putty material and syringe material at the same time, the setting distortion of the putty is included in the overall distortion of the impression^{11,12}.

Multiple mix technique is the most accurate because heavy body material does not displace light body rather it forces the syringe material to adapt to the prepared tissues. So critical areas and minute details are accurately recorded. In the monophase(single mix)technique, single consistency of the material is used which is neither too stiff nor too light. The medium body material is used in tray as well as syringe and due to pseudoplastic properties of the material, syringe material records the details of the preparation and the tray material allows the syringe material to adapt well to the preparations and record minute details^{13,14}.

On the basis of this study it can be recommended that multiple mix technique is the most accurate technique. But there are no statically significant differences between the various techniques used in the study except for b-c and f-g distance. So, in certain situations other techniques may also be used successfully. For example, in gaggers single mix technique should be used because light body used with other techniques may initiate gagging in some patients.

Conclusion

This study was conducted to compare and evaluate the accuracy of various elastomeric impression techniques that are commonly used. Within the limitations of this in vitro study it can be concluded that all the impressions had a tendency to be oversized in horizontal dimensions and undersized in vertical dimension. When comparing the accuracy of the casts as per statistical analysis, Group C (multiple mix technique) casts were most accurate and Group A casts (one step putty-wash) were least accurate. The order in which the various distances measured on the stone cast produced by different techniques deviated from the distance on the master model was

Group A > Group B > Group D > Group C.



Figure: 1

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