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Comparative evaluation of the dimensional accuracy of resultant casts made by monophase polyether and monophase vinylsiloxanether impression materials

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Abstract

Background: The aim of this study was to carry out a comparative evaluation of the dimensional accuracy of resultant casts made by monophase polyether and monophasevinylsiloxaneether impression materials with the objective to evaluate and compare the dimensional accuracy of monophase polyether, as well as of monophasevinylsiloxaneether with standardized stainless steel model.

Materials and Methods: A stainless steel model was fabricated and impressions were recorded using the two materials that were to be compared and 40 casts (20 from impressions of each material) were prepared using die stone. Three different measurements were recorded on model as well as on casts prepared using a digital imaging system.

Results and Observations: The dimensional measurements of casts fabricated from monophasevinylsiloxaneether were found to be closer to control as compared to monophase polyether.

Introduction

Impression materials are used to record or mimic the form and relations of the teeth and the contiguous oral tissues. An exact impression will result in accurate fitting cast restoration. This is one factor that determines the restoration's longevity.[1]Advancement in dentistry has led to many innovations in improving the properties of impression materials, resulting in enhancement of their importance and popularity. There are extensive varieties of materials for making a precision negative mold of soft and hard tissues.[2,3]Preciseduplication of tooth preparations necessitate impression materials that demonstraterestricted distortion. This need for more stable, accurate and elastic impression material sponsored the introduction of elastomers into dentistry.[4]Currently, two of the utmostcommon elastomers used in dentistry are the polyethers and addition silicones, or vinyl polysiloxanes.[5]

Vinylsiloxanether is the newer material introduced in the market. Less studies have been taken to check the accuracy of this material. Hence this study has been carried out. The present study investigated the dimensional accuracy of resultant casts made by monophase polyether and monophasepolyvinylsiloxanether impression materials by comparing them with a master stainless steel model.

Materials and Methods:

A stainless steel model containing 2 complete-veneer, fixed partial denture abutment preparations was fabricated with standardized specifications. For reference measurements, the abutments were primed with cross-grooves on occlusal and mesial-distal surfaces. Dimensions of this stainless steel model were recorded and this model was used as the definitive standardized control model for the comparison of the casts of impression materials used in this study. (Figure 1).

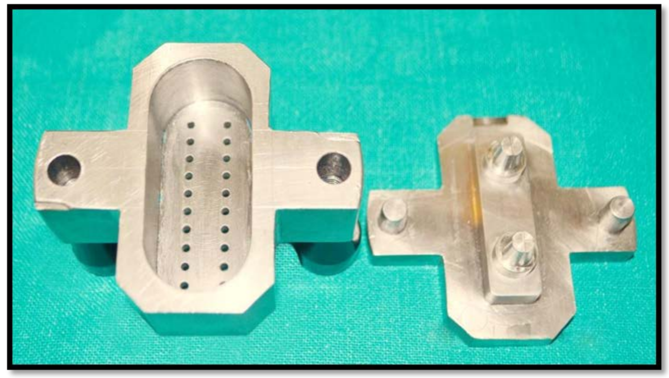


Figure 1: Stainless Steel Model

Procedure for impression: All the impressions were made in stainless steel perforated custom tray. A tray space of 2 mm was provided for the impression material. To ensure uniform positioning of the custom tray on the stainless steel model, two dowels were press-fit on either side of the model with recesses on the custom tray. Tray adhesive was applied before making the impressions and allowed to dry for 15 minutes.Impressions of the stainless steel model were made 20 times for each impression material.[6,7]The polymerization times used for each material were double than those recommended by the manufacturer to compensate for the impressions being made at room temperature (20°C) instead of at mouth temperature. Both impressions were made using Pentamix 2 (3M ESPE) device.(Figure 2)

Figure 2: Impression materials with tray adhesives and Die stone used in this study.

Procedure for Fabrication of Stone Casts:All the impressions were stored at room temperature (20°C) for a period of time recommended by the manufacturer before pouring in improved Type IV stone (Fujirock, GC

Europe). The die stone was mixed according to the manufacturer's instructions, with a water-powder ratio of 20ml/100g.The improved stone was first mixed by hand to incorporate the water for 15 seconds and then mixed mechanically under vacuum for 45 seconds. All the mixes were vibrated into the impressions and allowed to set for 1 hour before being separated from the impressions.[8]

Procedure for recording Measurements:Three different dimensions were measured on the stainless steel model at room temperature (control) and on the stone casts from each of the impression materials: (A) the distance between the centres of the abutments determined by the crossing of the grooves, (B) the diameter of abutments and (C) the height of the abutments.The measurements were made using a **Machine Vision System** (**3-Dimensional Coordinate Imaging System**, (Figure 3) comprising of a high resolution camera mounted on a precision linear stage. The position of the linear stage was readout using a digital scale unit (Mituyoto, Japan) with a least count of 10 µm and accuracy of ± 10 µm mounted on the stage. A spacer and right angle jig were fabricated to ensure that the measuring point is in the centre of the field of view of the camera and is aligned perpendicular to the spacer jig.This image of the object to be measured is acquired by a PC connected to the camera over the USB. A cross-hair printed on a transparency sheet is mounted on the monitor (Figure 4) and is used as the datum reference to align image of the fiducially markings on the mould with the cross-hair between each measurement.[9,10]

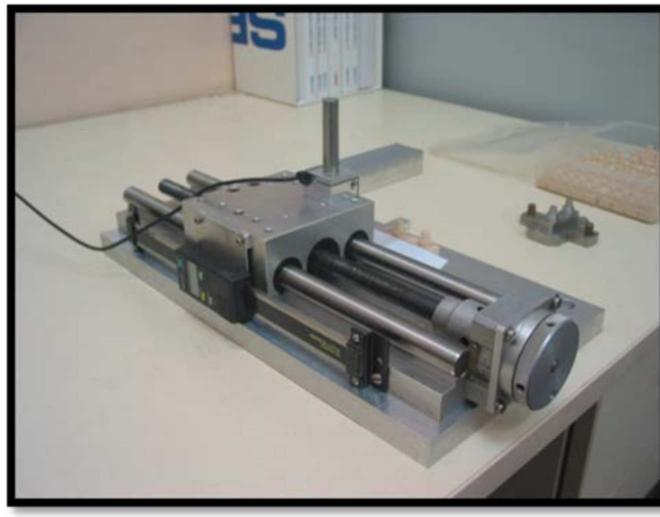


Figure 3: Three dimensional Coordinated Imaging System

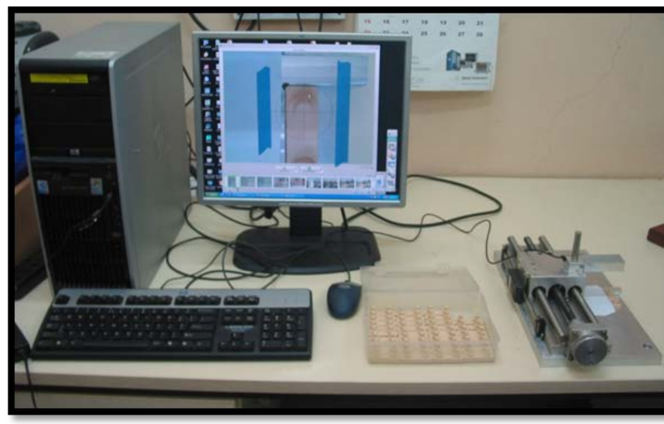


Figure 4: A cross-hair printed on a transparency sheet mounted on the monitor.

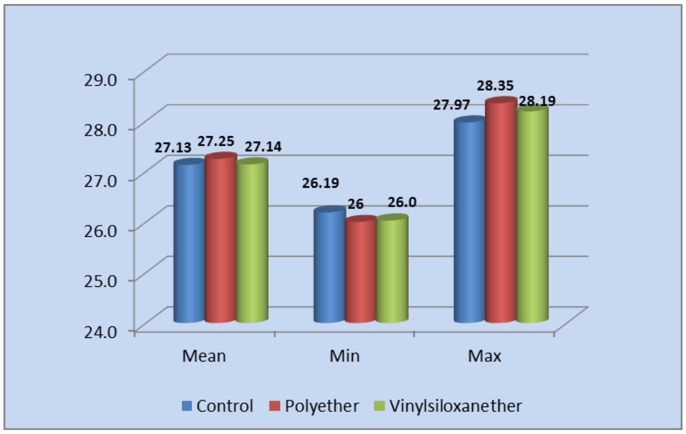
For each of the three dimensions on the stainless steel model, the measurements were made 15 times. The mean dimensions of the stainless steel model were used as definitive standardized model for comparison of the impression materials used in this study.

Results

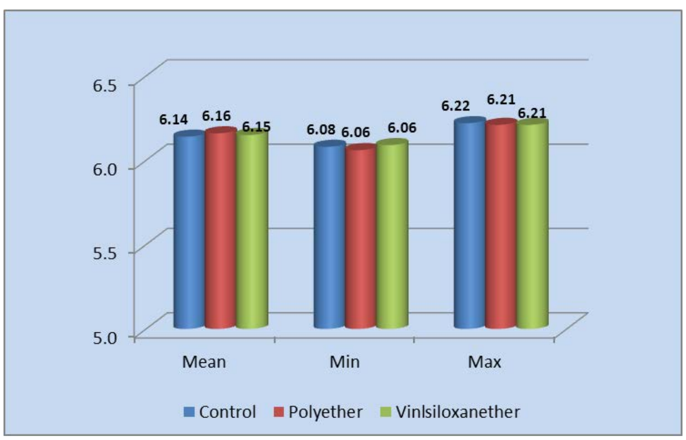
The mean distance between the centres of the abutments for vinylsiloxanether was close to the control as compared to polyether. (Graph 1) The mean diameter for vinylsiloxanether was closer to the control as compared to polyether. (Graph 2) The mean height for vinylsiloxanether was closer to the control as compared to polyether. (Graph 3)

Anova Test was applied to the findings of this study as well as paired ‘t’ test was used for statistical analysis and finding the significant difference if any between the materials used for impression.

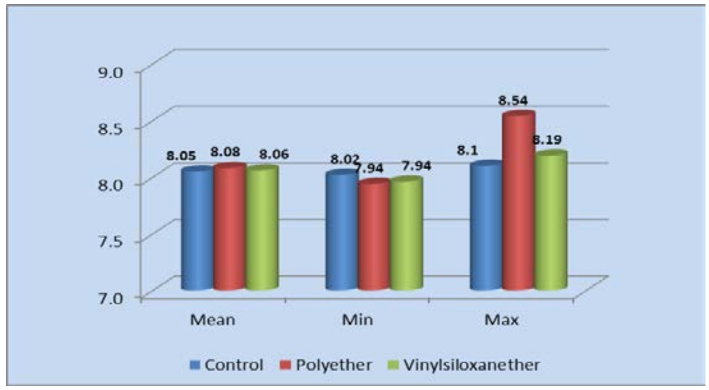
No significant difference was observed for distance between the centres of the abutments,diameter, height measured for control, polyether and vinylsiloxanether impression material.



Graph 1: Mean and range values of distance between the centres of the abutments for stainless steel model (control), polyether and vinylsiloxanether impression material



Graph 2: Mean and range values of diameter for stainless steel model (control), polyether and vinylsiloxanether impression material



Graph 3: Mean and range values of height for stainless steel model (control), polyether and vinylsiloxanether impression material

Table 1 shows that for distance between the centres of the abutments, no significant differences were observed for control & polyether (P = 0.955), control& addition silicone (P = 0.648) and polyether & addition silicone (P = 0.576).

Source	Mean	Mean	‘t’ value	Probability	Sig / N.Sig
Control & Polyether	27.13	27.25	0.055	0.955	N. Sig
Control &Vinylsiloxaneether	27.13	27.14	0.457	0.648	N. Sig
Polyether &Vinylsiloxaneether	27.25	27.14	0.562	0.576	N. Sig

Table 1: ‘t’ test for difference between centres of abutments for control & polyether, control & addition silicon and polyether & addition silicone (Sig – Significant, N.Sig – Non Significant)

Table 2 shows that for diameter, no significant differences were observed for control & polyether (P = 0.369), control & addition silicone (P = 0.454) and polyether& addition silicone (P = 0.133).

Source	Mean	Mean	‘t’ value	Probability	Sig / N.Sig
Control & Polyether	6.14	6.16	0.91	0.369	N. Sig
Control &Vinylsiloxaneether	6.14	6.15	0.75	0.454	N. Sig
Polyether &Vinylsiloxaneether	6.16	6.15	1.52	0.133	N. Sig

Table 2: 't' test for difference between diameters for control & polyether, control & addition silicon and polyether & addition silicone. (Sig – Significant, N.Sig – Non Significant)

Table 3 shows that for height, no significant differences were observed for control & polyether (P = 0.88), control &vinylsiloxanether (P = 0.399) and polyether &vinylsiloxanether (P = 0.349).

Source	Mean	Mean	't' value	Probability	Sig / N.Sig
Control & Polyether	8.05	8.08	0.15	0.88	N. Sig
Control &Vinylsiloxaneether	8.05	8.06	0.85	0.399	N. Sig
Polyether &Vinylsiloxaneether	8.08	8.06	0.94	0.349	N. Sig

Table 3: 't' test for difference between height for control & polyether, control & addition silicon and polyether & addition silicone. (Sig – Significant, N.Sig – Non Significant)

Discussion

This study was conducted to compare the dimensional accuracy of resultant casts made by monophase polyether and monophasevinylsiloxanether. According to Christensen in 1997, polyether and PVS most acceptable product for most prosthodontic uses. Spars studies have been published that compare the dimensional accuracy of resultant cast made by polyether and polyvinylsiloxane impression. Vinylsiloxanether (polyether+ polyvinylsiloxane) is a newer material introduce in the market and polyether is a most commonly used material. So in this study, we compared polyether and vinylsiloxanether. [11]

In this study, monophasic elastomeric impression materials were used which are specially formulated for a one-step, single mix impression technique. These material has been advocated by **Tjan AHL, Nemetz H, Nguyen LTP and Contino R.** and the dimensions of the stainless steel model were according to the ANSI/ADA specifications as advocated by **Ciesco et al,** are used.[12]

The results of the present study showed that the mean value of distance between the centres of the abutments for control is 27.13 mm, for polyether mean value is 27.25 mm, for vinylsiloxanether mean value is 27.14 mm. The mean value of diameter for control is 6.14 mm, for polyether, the mean value is 6.16 mm, for vinylsiloxanether mean value is 6.15 mm.The mean value of height for control is 8.05 mm, for polyether mean value is 8.08 mm, for vinylsiloxanether , mean value is 8.06 mm.So, for all the three dimensions measured, the dimensions of resultant casts made by monophasevinylsiloxanether were closer to the control as compared to monophase polyether. But, statistical analysis by unpaired "t" test indicates no significant differences for all the three dimensions measured for control, polyether and vinylsiloxanether.

Conclusion

The dimensional measurements of casts fabricated from monophasevinylsiloxanether were found to be closer to control as compared to monophase polyether. Larger sample size and multi centric approach may be required in future for finding the better of the two materials and also for evaluating the significant differences between the materials used in this study.

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