

## ORIGINAL RESEARCH

### Assessment of efficacy of custom tray and stock tray made up of polyvinylsiloxane to evaluate linear dimensional accuracy: A comparative study

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#### ABSTRACT:

**Background:** Making impressions to replicate oral conditions and tooth morphology is an integral part of prosthetic dentistry. Polyvinyl siloxane impression materials have the best fine detail reproduction and elastic recovery of all available materials. They are provided in wide range of viscosities, rigidities, and working and setting times. Impression techniques can be categorized as monophasic or dualphase. **Aim of the study:** To assess efficacy of custom tray and stock tray made up of polyvinylsiloxane to evaluate linear dimensional accuracy. **Materials and methods:** The present study was conducted in the Department of prosthodontics of institute of dental studies and technologies (IDST). For the study, a metallic mandibular dentulous die was fabricated to represent the mandibular dentulous arch. Prominent reference points for cast measurements on either side were marked. Stainless steel mandibular dentulous stock trays were selected for the putty wash 2-step impression techniques, to provide sufficient space for both putty and wash impression material. Perforated acrylic resin custom trays of thickness 3 mm with 2 mm space in between the occlusal surface of teeth and inner tray walls were fabricated. The impressions techniques of polyvinyl siloxanes, utilized in this study, were as follows. Group A: Putty wash 2-step technique with polyethylene spacer using stock tray, Group B: Single mix technique utilizing medium viscosity in a custom tray, Group C: Multiple mix technique utilizing heavy viscosity and low viscosity combination in custom trays. For each impression technique, 5 impressions were made and a total of 15 impressions were obtained. **Results:** We observed that the least change in dimension for antero posterior was observed to be in group C. For lateral dimension, the least change was seen in group A. For vertical dimension, Group A was seen to have least change in dimensions. The results on comparison were found to be statistically significant. **Conclusion:** Within the limitations of the present study, it can be concluded that two step impression technique with stock tray provide significant accuracy in impressions as compared to custom trays.

**Keywords:** Stock tray, polyvinylsiloxane impression, dimensional stability

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#### INTRODUCTION

Making impressions to replicate oral conditions and tooth morphology is an integral part of prosthetic dentistry. Polyvinyl siloxane impression materials have the best fine detail reproduction and elastic recovery of all available materials. Because there is no by-product, they possess remarkable dimensional stability and are odorless, tasteless and pleasant for patients. They are provided in wide range of viscosities, rigidities, and working and setting times. Impression techniques can be categorized as monophasic or dualphase. Techniques that use dual-phase materials such as the putty and light-body may be accomplished in one or two step. The one-step

putty/light-body technique requires less chair-side time. In the two-step putty/ light-body technique, the details are recorded by the light-body material only.<sup>1</sup>The problem of accuracy of impressions has reported that over 89% of the impressions investigated had one or more observable errors.<sup>2,3</sup> Variation exists in the type of tray used to capture the impression. One study examined 1403 impressions submitted to a commercial laboratory in the United States: a majority of the trays used were plastic (62%), and most were dual-arch (73%).<sup>4</sup> In a UK survey of dentists, 61% used a full-arch plastic tray for crown impressions.<sup>5</sup> Another UK survey reports 65% of impressions used a flexible tray.<sup>6</sup>Hence, the present study

was conducted to assess efficacy of custom tray and stock tray made up of polyvinylsiloxane to evaluate linear dimensional accuracy.

**MATERIALS AND METHODS**

The present study was conducted in the Department of Orthodontics of the Dental institution. The ethical clearance for the study was approved from the ethical committee of the hospital. For the study, a metallic mandibular dentulous die was fabricated to represent the mandibular dentulous arch. Prominent reference points for cast measurements on either side were marked. Stainless steel mandibular dentulous stock trays were selected for the putty wash 2-step impression techniques, to provide sufficient space for both putty and wash impression material. Perforated acrylic resin custom trays of thickness 3 mm with 2 mm space in between the occlusal surface of teeth and inner tray walls were fabricated. To standardize the size and critical spatial dimensions of the trays, each size of tray was fabricated using the same spacer and mold made from the additional silicone putty consistency material. 5 custom trays each for the single mix impression techniques utilizing medium viscosity and multiple mix impression techniques utilizing heavy viscosity and low viscosity combination were fabricated.

**Impression Making**

The impressions techniques of polyvinyl siloxanes, utilized in this study, were as follows.

- Group A: Putty wash 2-step technique with polyethylene spacer using stock tray.
- Group B: Single mix technique utilizing medium viscosity in a custom tray.
- Group C: Multiple mix technique utilizing heavy viscosity and low viscosity combination in custom trays

For each impression technique, 5 impressions were made and a total of 15 impressions were obtained.

One hour after the impressions were set, each of the 15 impressions were treated with a surface reducing agent. The impressions were poured with high strength dental stone. The vertical dimensions were measured with a non stretchable thread along the surface. The thread was then measured with the traveling microscope. Each dimension on the master model was measured 10 times. The mean for all the distance measurement was calculated and used as the control to compare the three impression techniques. The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student’s t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistically significant.

**RESULTS**

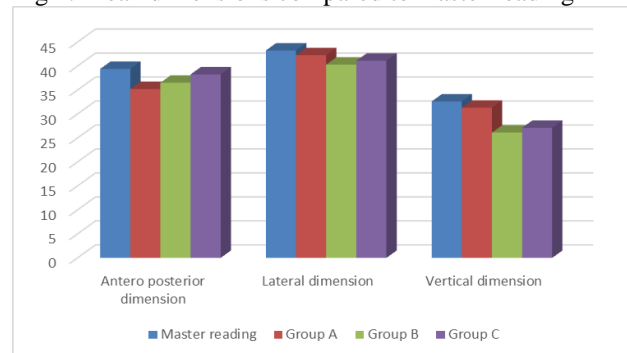
In the present study, we compared dimensional stability of stock trays and custom trays. We compared impressions techniques of polyvinyl siloxanes dimensional stability using 3 techniques, Group A: Putty wash 2-step technique with polyethylene spacer using stock tray, Group B: Single mix technique utilizing

medium viscosity in a custom tray, and Group C: Multiple mix technique utilizing heavy viscosity and low viscosity combination in custom trays. Table 1 shows comparative analysis of mean dimensions in antero-posterior, lateral and vertical sides of different groups. We observed that the least change in dimension for antero posterior was observed to be in group C. For lateral dimension, the least change was seen in group A. For vertical dimension, Group A was seen to have least change in dimensions. The results on comparison were found to be statistically significant. [Fig 1]

**Table 1:** Comparative analysis of mean dimensions in antero-posterior, lateral and vertical sides of different groups

	Antero posterior dimension	Lateral dimension	Vertical dimension
<b>Master reading</b>	39.39	43.25	32.61
<b>Group A</b>	35.21	42.26	31.29
<b>Group B</b>	36.52	40.29	26.12
<b>Group C</b>	38.25	41.10	27.11

Fig 1: Mean dimensions compared to master reading



**DISCUSSION**

In the present study, we observed that change in dimensions was seen in all the techniques. From the results, it can be observed that with use of custom trays with multiple mix technique, minimum dimensional change is seen in anteroposterior dimensions. The custom trays with multiple mix technique provides significant dimensional change in lateral and vertical dimensions. The stock trays provides minimal dimensional change in vertical and lateral dimensions. The results were compared with previous studies from the literature and found to be consistent with the results. Gupta S et al<sup>7</sup> evaluated dimensional accuracy of master casts obtained using different impression trays and materials with open tray impression technique. A machined aluminum reference model with four parallel implant analogues was fabricated. Forty implant level impressions were made. Eight groups (n = 5) were tested using impression materials (polyether and vinylsiloxanether) and four types of impression trays, two being custom (self-cure acrylic and light cure acrylic) and two being stock (plastic and metal). Statistically significant difference was found between the two impression materials. However, the

difference seen was small (36  $\mu\text{m}$ ) irrespective of the tray type used. No significant difference was observed between varied stock and custom trays. They concluded that the polyether impression material proved to be more accurate than vinylsiloxanether impression material. Parameshwari G et al <sup>8</sup> evaluated the effects of 0o, 15o and 25o implant angulations on impression accuracy in simulated master casts of unilateral partially edentulous situation using different impression materials and tray selections. 30 replicas (N = 30) of a resin matrix (control) containing four implant analogues placed unilaterally from the midline till the region of second molar at an angulation of 0o, 0o, 15o and 25o to the vertical axis of the ridge respectively were obtained by using three impression techniques (stock metal tray, closed custom tray, and open nonsplinted custom tray) and two different impression materials (Polyvinyl-siloxane and polyether). The casts obtained from all three impression techniques had significant differences in dimensions as compared to that of master model irrespective of impression materials. Comparing the techniques with regard to the parallel implants, no statistical significant difference was observed with custom tray techniques (closed/open). They concluded that the influence of material and technique appeared to be significant for highly non axial implant angulations, and increased angulation tended to decrease impression accuracy. The open tray technique was more accurate with highly nonaxially oriented implants for the small sample size investigated.

Pastoret MH et al <sup>9</sup> compared the dimensional accuracy of three impression techniques- a separating foil impression, a custom tray impression, and a stock tray impression. A machined mandibular complete-arch metal model with special modifications served as a master cast. Three different impression techniques were performed with addition-cured silicon materials: i) putty-wash technique with a prefabricated metal tray (MET) using putty and regular body, ii) single-phase impression with custom tray (CUS) using regular body material, and iii) two-stage technique with stock metal tray (SEP) using putty with a separating foil and regular body material. All impressions were poured with epoxy resin. Dimensional changes compared to reference values varied between -74.01 and 32.57  $\mu\text{m}$  (MET), -78.86 and 30.84 (CUS), and between -92.20 and 30.98 (SEP). For the intra-abutment distances, no significant differences among the experimental groups were detected. CUS showed a significantly higher dimensional accuracy for the inter-abutment distances with -0.02 and -0.08 percentage deviation compared to MET and SEP. They concluded that the separation foil technique is a simple alternative to the custom tray technique for single tooth restorations, while limitations may exist for extended restorations with multiple abutment teeth. Reddy SM et al <sup>10</sup> assessed the accuracy of newly introduced autoclavable polyvinyl siloxane impression material for its dimensional stability and accuracy. A standard metal model (Dentofom, U-501, Columbia) was customised for impression making. The impressions were made using the newly introduced polyvinyl siloxane impression materials (AFFINIS,

Coltene/Whaledent AG, 9450 Alstalten, Switzerland). Fifty impressions were made and were divided into two groups A and B of 25 each. Group A was the control sample (non-autoclaved impressions) and group B was the test sample (autoclaved impressions), which was subjected to the steam autoclave procedure at 134 °C for 18 min, casts were poured in type IV gypsum products. As a result, there was an average reduction of 0.016  $\mu\text{m}$  in overall dimension between the test and the control group when compared with the master model, which is not statistically or clinically significant. They concluded that the newly introduced polyvinyl siloxane impression material is accurate and dimensional stable for clinical use when steam autoclaved at 134 °C for 18 min.

Dugal R et al <sup>11</sup> compared the dimensional accuracy of the casts obtained from one step double mix, two step double mix polyvinyl siloxane putty- wash impression techniques using three different spacer thicknesses (0.5mm, 1mm and 1.5mm), in order to determine the impression technique that displays the maximum linear dimensional accuracy. A Mild steel model with 2 abutment preparations was fabricated, and impressions were made 15 times with each technique. All impressions were made with an addition-reaction silicone impression material (Express, 3M ESPE) and customarily made perforated metal trays. The stone dies obtained with all the techniques had significantly larger or smaller dimensions as compared to those of the mild steel model. The order for highest to lowest deviation from the mild steel model was: single step putty/light body, 2-step putty/light body with 0.5mm spacer thickness, 2-step putty/light body 1.5mm spacer thickness, and 2-step putty/light body with 1mm spacer thickness. Significant differences among all of the groups for both absolute dimensions of the stone dies, and their standard deviations from the master model, were noted. They concluded that the 2-step putty/light-body impression technique with 1mm spacer thickness was most dimensionally accurate impression methods in terms of resultant casts.

## CONCLUSION

Within the limitations of the present study, it can be concluded that two step impression technique with stock tray provide significant accuracy in impressions as compared to custom trays.

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