

## Original Research

### A Comparative study of additional silicone and condensational silicone for the precision for duplicating master dies

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#### ABSTRACT:

**Background:** The prime goal of any prosthodontic treatment is to provide the patient with precisely fitting restorations or prosthesis. Various impression materials have been advocated for making the impressions in fabricating fixed partial dental prosthesis. Polyvinyl siloxane impression materials also known as addition silicones have been popularized recently. Based on literature review, the accuracy and dimensional stability of elastomeric impression materials have been the subjected to numerous investigations. **Aim of the study:** To compare additional silicone and condensational silicone for the precision for duplicating master dies. **Materials and methods:** The present study was conducted in the Department of Prosthodontics of the dental institution. For the study, an acrylic model of lower 1st molar tooth was prepared based on conventional shoulder type marginal preparation, supragingivally. Two step impression techniques were administered for both techniques. Two master dies were made by these impression materials. The prepared metal casts were polished and examined for any obvious positive defects to be removed by a small round carbide bur. **Results:** We observed significant discrepancies in mesial and buccal margins of the prepared models. We observed that overall discrepancy was more in model fabricated from condensation silicone as compared to additional silicone. On comparing we observed statistically significant difference in case of condensation silicone. **Conclusion:** Within the limitation of the current study we conclude that additional silicone is a better impression material as compared to condensational silicone.

**Keywords:** Polyvinylsiloxane, impression, restorations, prosthesis

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#### INTRODUCTION

The prime goal of any prosthodontic treatment is to provide the patient with precisely fitting restorations or prosthesis.<sup>1</sup> For accurate replication of tooth preparations and to register their precise arch position we require impression material with minimal distortion. Various impression materials have been advocated for making the impressions in fabricating fixed partial dental prosthesis. Polyvinyl siloxane impression materials also known as addition silicones have been popularized recently. Based on literature review, the accuracy and dimensional stability of elastomeric impression materials have been the subjected to numerous investigations.<sup>2</sup> The American Dental Association (ADA) Specification No. 19 identifies these

materials as “non aqueous elastomeric dental impression materials”. Out of different elastomers, polyvinyl siloxane or addition silicones have demonstrated superior physical properties and have attained clinical success. Polyvinyl siloxane possesses minimal permanent deformation values, excellent dimensional stability and produce accurate stone dies when compared to other impression materials.<sup>3, 4</sup> Several elastic impression material silicones are available for dental use: Synthetic elastomeric materials (polysulfide [PS], additional silicone [AS] and condensational silicone [CS], and polyether [PE]); and hydrocolloids. PE and silicones are accurate with high stability. They can maintain their accuracy even 1-week or later, however, they

are technique sensitive; for instance PE should be stored in <50% humidity.<sup>5,6</sup> Hence, the present study was conducted to compare additional silicone and condensational silicone for the precision for duplicating master dies.

**MATERIALS AND METHODS**

The present study was conducted in the Department of Prosthodontics of the dental institution. The ethical clearance for the study protocol was obtained from the ethical committee of the institute. For the study, an acrylic model of lower 1st molar tooth was prepared based on conventional shoulder type marginal preparation, supragingivally. Two step impression techniques were administered for both techniques. Two master dies were made by these impression materials. The prepared metal casts were polished and examined for any obvious positive defects to be removed by a small round carbide bur. The metal castings were transferred to the prepared acrylic model and observed under a stereomicroscope. A total of 100 successive impressions were made, 50 impressions for each of the three impression material. Dies were fabricated

with the same procedure. Each casting from each of the master dies was placed on each of the test dies which were made from the same respective impression material. The marginal discrepancy was recorded with the use of the described measuring technique.

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 statistical significant.

**RESULTS**

Table 1 shows mean discrepancies of various margins prepared by different impression materials compared to original acrylic model. We observed significant discrepancies in mesial and buccal margins of the prepared models. We observed that overall discrepancy was more in model fabricated from condensation silicone as compared to additional silicone. On comparing we observed statistically significant difference in case of condensation silicone (p<0.05).

Table 1: Mean discrepancies of various margins (um) prepared by different impression materials

Type of impression material		Mean discrepancies of various margins compared to original model (um)					p-value
		Buccal	Lingual	Mesial	Distal	Overall	
Addition silicone	Duplicated die	30.65	32.54	34.32	36.12	35.54	0.12
	Model	29.41	28.54	32.66	35.11	34.23	
Condensation silicone	Duplicated die	36.54	32.81	36.46	35.74	34.12	0.001
	Model	32.78	30.25	32.32	31.35	38.85	

Fig 1: Showing mean discrepancies of various margins (um) prepared with Addition silicone

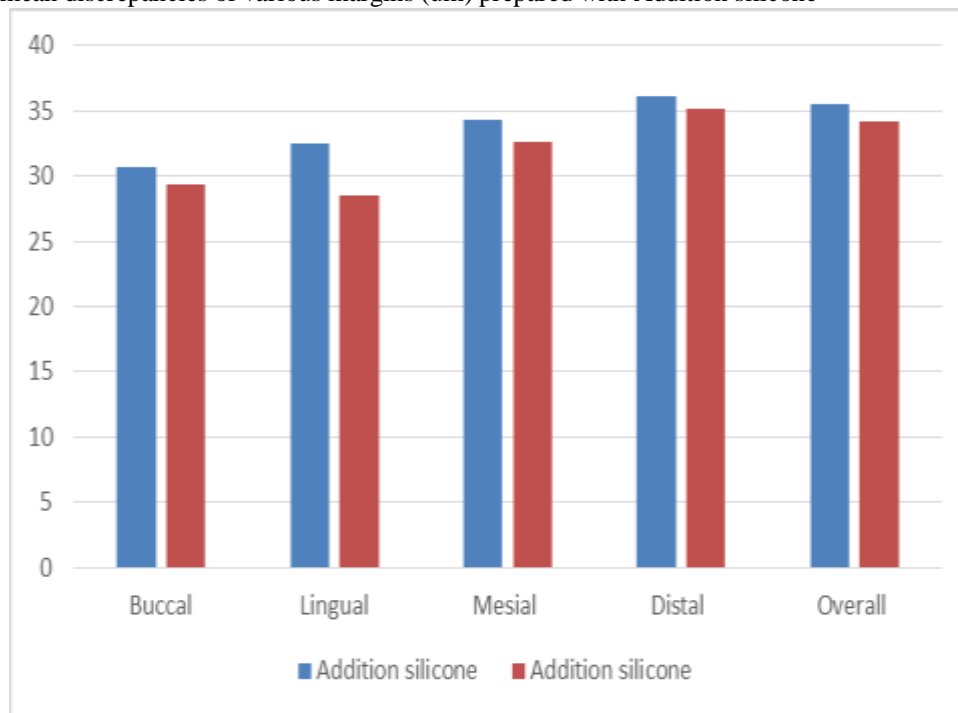
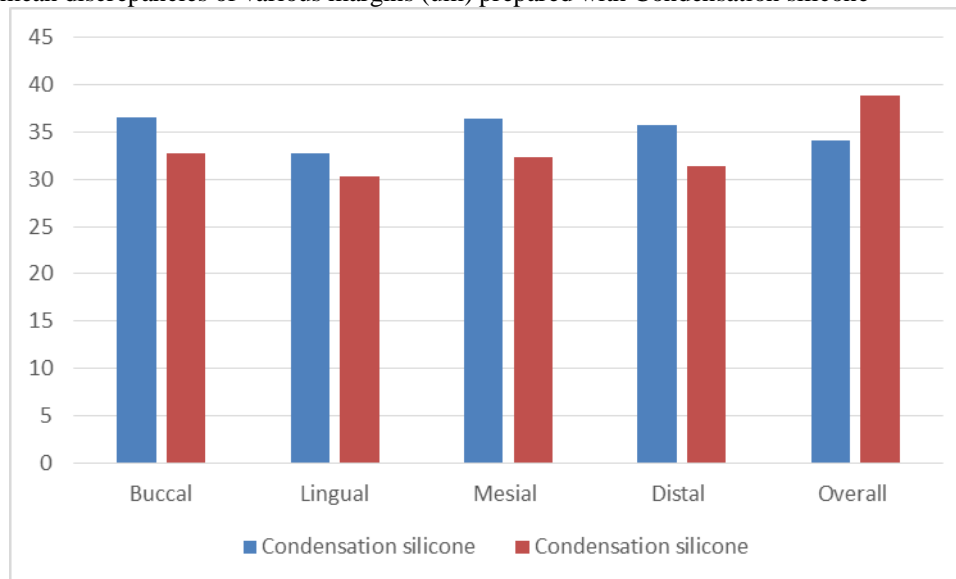


Fig 2: Showing mean discrepancies of various margins (um) prepared with Condensation silicone



## DISCUSSION

In the present study, we observed that due to different methods and materials, achieving a technique which can provide a precise duplicate die seems to be inconceivable. Dimensions of fabricated dies could be affected by several factors like: impression technique, delay in pouring stone, type of stone, mixing time, etc. The present study was conducted to compare additional silicone and condensational silicone for the precision for duplicating master dies. We observed significant discrepancies in mesial and buccal margins of the prepared models. We observed that overall discrepancy was more in model fabricated from condensation silicone as compared to additional silicone. Kumar V et al investigated the effect of different tray spacer thickness on the accuracy and the dimensional stability of impressions made from monophasic condensation silicone, addition silicone and polyether impression materials. Three different types of elastomeric monophasic impression materials were used for making the impression of a master die with tray having tray spacer thickness of 2, 4 and 6 mm. Each type of impression was poured in die stone after 1 h. Each cast was analyzed by a travelling microscope and compared with the master die. The data was tabulated and subjected to statistical evaluation. The results of the study indicated that the impressions made from 2 to 4 mm spaced trays produced more accurate stone casts when compared to 6 mm spaced tray. No statistical significant differences were observed between the accuracy and dimensional stability of the three materials tested. Minimum changes were observed when the cast was poured after 1 h and the tray space was 2 mm for all the materials tested. It is therefore advisable not to exceed tray space of 2 mm. Gordon GE et al evaluated the accuracy of reproduction of stone casts made from impressions using different tray and impression materials.

The tray materials used were an acrylic resin, a thermoplastic, and a plastic. The impression materials used were an additional silicone, a polyether, and a polysulfide. Impressions were made of a stainless steel master die that simulated crown preparations for a fixed partial denture and an acrylic resin model with cross-arch and anteroposterior landmarks in stainless steel that typify clinical intra-arch distances. Impressions of the fixed partial denture simulation were made with all three impression materials and all three tray types. Impressions of the cross-arch and anteroposterior landmarks were made by using all three tray types with only the addition reaction silicone impression material. Impressions were poured at 1 hour with a type IV dental stone. Data were analyzed by using ANOVA with a sample size of five. Results indicated that custom-made trays of acrylic resin and the thermoplastic material performed similarly regarding die accuracy and produced clinically acceptable casts. The stock plastic tray consistently produced casts with greater dimensional change than the two custom trays.<sup>7,8</sup>

Thongthammachat S et al evaluated the influence on dimensional accuracy of dental casts made with different types of trays and impression materials and poured at different and multiple times. Two types of stock trays (plastic stock tray, perforated metal stock tray) and 4 types of custom tray materials (autopolymerizing acrylic resin, thermoplastic resin, and 2 types of light-polymerized acrylic resins) were used with 2 types of impression materials (addition polymerizing silicone and polyether), to make impressions of a metal master model. Each tray and impression material was used to make 5 impressions. Casts were made by multiple pourings at 30 minutes, 6 hours, 24 hours, and 30 days after impression making. Using a measuring microscope, 12 distances were calculated based on measurements of 8 reference points. The absolute value

of the difference of each measurement was calculated, as was the corresponding measurement on the master model. A Bayesian model using a simple noninformative prior was used to analyze these data. Statistical differences within 6 microm were found only with thermoplastic resin tray material for addition silicone, and for thermoplastic resin tray material and 1 type of light-polymerized acrylic resin for polyether. Neither stock trays nor custom trays contributed to the differences in accuracy of the casts. All deviations in casts made with silicone impression material were within a clinically acceptable range. For the polyether, distortions occurred that were clinically unacceptable. Impressions made from polyether distorted over time. Silicone impression material has dimensional stability up to 30 days. Accurate casts can be made with either stock trays or custom trays. An impression made from polyether should be poured only once and within 24 hours after impression making, because of the distortion of the material over time. Silicone impression material has better dimensional stability than polyether. Thota KK et al determined the effect of autoclaving on the dimensional stability of three different elastomeric impression materials at three different time intervals. Standardized stainless steel master die as per ADA specification number 19 was fabricated. The impression materials used for the study were condensation silicone (GP1), addition silicone (GP2) and polyether (GP3). A total of 45 samples of the stainless steel die were made (n = 45), that is 15 samples for each group. Impression materials were mixed according to the manufacturer's instructions and were loaded into the mold to make an impression of the die. Impressions were identified with the help of numerical coding system and measurements were made using stereomicroscope (MAGNUS MSZ-Bi) of 0.65x magnification with the help of image analysis software (IMACE PRO-INSIGHT VERSION). The results were subjected to statistical analysis using one way analysis of variance and student t-test for comparison between the groups. Within the limitations of the study statistically significant dimensional changes were observed for all the three impression materials at three different time intervals but this change was not clinically significant. It is well-known fact that all impressions should be disinfected to avoid possible transmission of infectious diseases either by direct contact or cross contamination. Immersion and spray disinfection as well as various disinfection solutions have been tested and proven to be

effective for this purpose. But for elastomeric impression materials these methods have proven to be ineffective as they do not prevent cross contamination among the dental team. So autoclaving was one of the most effective sterilization procedure for condensation silicone and addition silicone. Since polyether is hydrophilic it is better to disinfect the impressions as recommended by the manufacturer or by immersion or spray atomization.<sup>9,10</sup>

## CONCLUSION

Within the limitation of the current study we conclude that additional silicone is a better impression material as compared to condensational silicone.

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