

## Comparative evaluation of the accuracy of the condensation versus addition silicone with controlled dual step dual phase putty relined impression technique: An *in vitro* study

\*<sup>1</sup>Dr. Mohammad Altaf Tantray, <sup>2</sup>Shabir Ahmad Shah, <sup>3</sup>Sandeep Koul Bali

<sup>1</sup> PG Scholar, Department of Prosthodontics, Govt. Dental College Srinagar, Srinagar, Jammu and Kashmir, India

<sup>2</sup> Professor & Head, Department of Dental Materials, Govt. Dental College Srinagar, Srinagar, Jammu and Kashmir, India

<sup>3</sup> Professor & Head of Prosthodontics Srinagar, Govt. Dental College, Srinagar, Jammu and Kashmir, India

### Abstract

**Background:** Many materials and methods have been documented to produce dies as accurate as the abutment preparations in the oral cavity in order to generate precisely fitting indirect dental restorations without marginal and occlusal discrepancy.

**Aims:** Many materials and methods have been documented to produce dies as accurate as the abutment preparations in the oral cavity in order to generate precisely fitting indirect dental restorations without marginal and occlusal discrepancy.

**Materials and Methods:** The master model consisted of a dentate mandibular arch of an acrylic resin typodont (Columbia Dentoform Corp., Long Island City, USA) with second right premolar prepared to receive porcelain fused metal crown. The sharp notches are prepared on the buccal and lingual cusp tips of the abutment and at the mid facio-gingival margin with round bur. The master model abutment width and height are then measured by travelling microscope from buccal to lingual cusp tip notch and buccal cusp tip notch to mid facio-gingival margin notch respectively. The master model consisted of a dentate mandibular arch of an acrylic resin typodont (Columbia Dentoform Corp., Long Island City, USA) with second right premolar prepared to receive porcelain fused metal crown. The sharp notches are prepared on the buccal and lingual cusp tips of the abutment and at the mid facio-gingival margin with round bur. The master model abutment width and height are then measured by travelling microscope from buccal to lingual cusp tip notch and buccal cusp tip notch to mid facio-gingival margin notch respectively.

**Results:** The average height of the abutment on the group I, and II stone casts are 5.656 mm, and 5.5.739mm with standard deviation of 0.103 and 0.0344 respectively. Abutment height on group I, and II stone casts deviated from that of master model by -1.7% and -0.24% respectively. The abutment height measurements when subjected to one way ANOVA, p-Value was 0.025 that is significant at  $p < 0.05$ . The mean width of the abutment on the group I, and II stone casts are 4.356mm and 4.296mm with standard deviation of 0.083 and 0.087 respectively. Abutment width on group I and II stone casts deviated from that of master model by 2.3% and 0.91% respectively. The abutment width values when subjected to one way ANOVA, p-Value was 0.13 which is highly insignificant at  $p < 0.05$ .

**Conclusion:** Within the limitations of the study, it can be concluded that addition silicone produces more accurate dies as compared to condensation silicone.

**Keywords:** controlled dual step dual phase putty relined impression technique, condensation, polymerization shrinkage

### Introduction

Many materials and methods have been documented to produce dies as accurate as the abutment preparations in the oral cavity in order to generate precisely fitting indirect dental restorations without marginal and occlusal discrepancy.

Numerous impression materials are available for dental use like agar, alginate and elastomers. Elastomers including polysulfide, polyether, condensation and addition silicones have overcome the poor tear strength and poor dimensional stability of hydrocolloids.

Polysulfide's have good surface detail reproduction but poor dimensional stability. Polyether's produce good surface details because of hydrophilic nature. High cost, high stiffness, low setting and working time limits their wide use.

Dimensional changes after setting, for condensation curing silicones, may be due to continued slow setting or due to loss of alcohol produced as a byproduct of the setting reaction. The latter effect produces a measurable weight loss which is accompanied by shrinkage of the impression material.

The addition silicones have overcome the disadvantage of polymerization shrinkage over the condensation silicone as there is no by product release. Polyvinyl silicones are widely used due to their excellent elastic recovery, dimensional accuracy, ability to produce multiple casts from single impression, good detail reproducibility, ease of handling and moderately short working and setting time.

They are currently available in several viscosities leading to at least three choices for impressions: (1) a putty/wash (PW), (2) a single mix (SM) impression, and (3) a multiple mix (MM) impression. These three general techniques, combined with several combinations for trays and viscosities, present a dilemma to the dentist.

### Aims and Objectives

This study was conducted to evaluate the accuracy of condensation silicone in relation to addition silicone using putty using controlled dual step dual phase impression technique.

## Materials and Methods

### Materials

1. The master model consisted of a dentate mandibular arch of an acrylic resin typodont (Columbia Dentoform Corp., Long Island City, USA) with second right premolar prepared to receive porcelain fused metal crown.
2. Perforated stock tray.
3. Addition silicone impression material (Affins Coltene Whaledent Pvt. Ltd. Switzerland)
4. Condensation silicone (Affins Coltene Whaledent Pvt. Ltd. Switzerland).
5. Type IV dental stone high strength (Ultrarock, Kalabhai, Karson Pvt. Ltd., India)
6. Debubbler (dentofil)
7. 2mm thick temporary cap (Duralay, Reliance Dental Mfg. Co.).

### Armamentarium

1. Rubber bowl
2. Vacuum mixer
3. Automixing syringe and dispensing gun
4. Stop watch
5. Travelling microscope

### Methodology

The master model consisted of a dentate mandibular arch of an acrylic resin typodont (Columbia Dentoform Corp., Long Island City, USA) with second right premolar prepared to receive porcelain fused metal crown. The sharp notches are prepared on the buccal and lingual cusp tips of the abutment and at the mid facio-gingival margin with round bur. The master model abutment width and height are then measured by travelling microscope from buccal to lingual cusp tip notch and buccal cusp tip notch to mid facio-gingival margin notch respectively.

Putty wash technique: Two mm thick autopolymerising resin acrylic temporary cap (Duralay, Reliance Dental Mfg. Co) was placed on the master model abutment. Equal quantities of the base and catalyst of the putty (Affins Coltene Whaledent Pvt. Ltd. Switzerland) are mixed and loaded in the tray. The tray with putty was placed on the master model and allowed to polymerize. The tray with polymerized putty acts as custom tray. The temporary cap was then removed to create space for

wash bulk of light body. The light body (President, Coltene Whaledent Pvt. Ltd. Switzerland) was extruded from automixing and dispensing gun on to the putty custom tray. Tray with light body was placed on the master model for twice the recommended setting time. Ten impressions of the master model are made by condensation and addition silicone (Affins Coltene Whaledent Pvt. Ltd. Switzerland) each using controlled dual step dual mix putty reline impression techniques. Twenty casts are made by pouring the ten addition and ten condensation silicone impressions in Type IV dental stone high strength (Ultrarock, Kalabhai, Karson Pvt. Ltd., India). The casts are then grouped as under:

**Group I:** It consists of ten casts fabricated from condensation silicone impression

**Group II:** It includes the ten casts made with addition silicone impression.

The abutment die width and height on the group I, and group II casts are then measured with travelling microscope (ELFO, INDIA) and then compared with master model abutment width and height respectively.

### Results

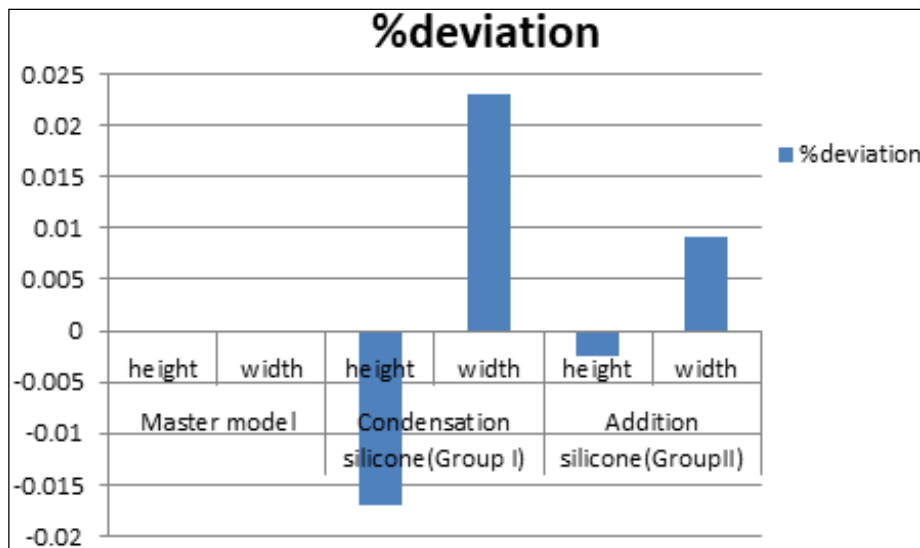
The average height of the abutment on the group I, and II stone casts are 5.656 mm, and 5.5.739mm with standard deviation of 0.103 and 0.0344 respectively. Abutment height on group I, and II stone casts deviated from that of master model by -1.7% and -0.24% respectively. The abutment height measurements when subjected to one way ANOVA, p-Value was 0.025 that is significant at  $p < 0.05$ .

The mean width of the abutment on the group I, and II stone casts are 4.356mm and 4.296mm with standard deviation of 0.083 and 0.087 respectively. Abutment width on group I and II stone casts deviated from that of master model by 2.3% and 0.91% respectively. The abutment width values when subjected to one way ANOVA, p-Value was 0.13 which is highly insignificant at  $p < 0.05$ .

Percentage deviation was measured by dividing the difference of mean of stone model (msm) and mean of master model (mmm) by mean of master model multiplied by 100. Percentage deviation =  $\frac{msm - mmm}{mmm} \times 100$ .

**Table 1:** Comparison of abutment height and width on master model with the height and width of abutment on group I and II stone casts.

	Master model		Condensation silicone (Group I)		Addition silicone (Group II)	
	height	width	height	width	height	width
1.			5.717	4.247	5.734	4.234
2.			5.724	4.376	5.711	4.204
3.			5.624	4.347	5.723	4.421
4.			5.432	4.257	5.754	4.319
5.			5.641	4.475	5.672	4.253
6.			5.752	4.474	5.782	4.258
7.			5.717	4.257	5.759	4.249
8.			5.534	4.399	5.772	4.276
9.			5.749	4.369	5.773	4.267
10.			5.670	4.359	5.719	4.479
mean	5.753	4.257	5.656	4.356	5.739	4.296
Standard deviation			0.103	0.083	0.034	0.087
%deviation			-1.7%	2.3%	-0.24%	0.91%



**Fig 1:** Percentage deviation of group I and II cast abutment die height and width from the master model abutment height and width.

### Discussion

As is obvious from the results, the addition silicone produced dies more accurate as compared to those of condensation silicone using controlled putty wash technique.

The condensation silicone undergoes dimensional changes due to time dependent continued polymerization accompanied with loss of byproduct ethanol. That is why, the die fabricated from condensation silicone impression deviated from master model abutment in height and width by -1.7% and 2.3% respectively. Polymerization shrinkage of addition silicone is less as compared to condensation silicone due to lack of byproduct formation during addition silicone setting. The die fabricated from addition silicone impression deviated from master model abutment in height and width by -0.24% and 0.91% respectively.

The limitation of this study is that the ivory tooth of the typodont (Columbia Dentoform Corp., Long Island City, USA) instead of natural tooth. Affinity of the impression for ivory tooth is different from that of natural one. Oral temperature and oral moisture conditions were not simulated in this study.

### Conclusion

Within the limitations of the study, it can be concluded that addition silicone produces more accurate dies as compared to condensation silicone.

### References

1. Asgar K. Elastic impression materials. *Dent Clin North Am.* 1971; 15:81-98.
2. Anusavice KJ. *Philips Science of dental materials.* 10th edition. WB. Saunders Co. Philadelphia, 1996.
3. Adriana Claudia Lapria Faria. Accuracy of stone casts obtained from different impression materials. *Braz Oral Res.* 2008; 22(4):293.
4. Chee WW, Donovan TE. Polyvinyl siloxane impression materials: A review of properties and techniques. *J Prosthet Dent.* 1992; 68:728-32.
5. Craig RG, Sun Z. Trends in Elastomeric Impression Materials. *Oper Den.* 1994; 19:138-45.

6. Chai J, Pang IC. A study of the thixotropic property of elastomeric impression materials. *Int. J Prosthodont.* 1994; 7:155-8.
7. De Araujo PA, Jorgensen KD, Finger W. Viscoelastic properties of setting elastomeric impression materials. *J Prosthet Dent.* 1985; 54:633-6.
8. Glen Johnson, Robert Craig. Accuracy of addition silicone as a function of techniques. *J Prosthet Dent.* 1986; 55(2):197-202.
9. Gordon GE, Johnson GH, Drennon DG. The effect of tray selection on the accuracy of elastomeric impression materials. *J Prosthet Dent.* 1990; 63:12-5.
10. Johnson GH, Craig RG. Accuracy of four types of rubber impression materials compared with time of pour and a repeat pour of models *J Prosthet Dent.* 1985; 53:484-90.
11. Johnson GH, Craig RG. Accuracy of addition silicones as a function of technique. *J Prosthet Dent.* 1986; 55:197-203
12. Lacy AM, Fukui H, Bellman T, Jendresen MD. Time-dependent accuracy of elastomer impression materials. Part II: Polyether, polysulfides, a polyvinylsiloxane. *J Prosthet Dent.* 1981; 45:329-33.
13. Linke BA, Nicholls JI. The distortion analysis of stone casts made from impression materials. *J Prosthet Dent.* 1985; 54(6):794-802.
14. Marshak B, Assif D, Pilo R. A controlled putty-wash impression technique. *J Prosthet Dent.* 1990; 64(6):635-6.
15. Marcinal CF, Draughn RA. Linear dimensional changes in additional changes in addition curing silicone impression material. *J Prosthet Dent.* 1987; 41:4-11.
16. Morgano SM, Milot P, Ducharme P, Rose L. Ability of various impression materials to produce duplicate dies from successive impressions *J Prosthet Dent.* 1995; 73:333-40.
17. Reisbick MH, Matyas J. The accuracy of highly filled elastomeric impression materials. *J Prosthet Dent.* 1975; 33:67-72.
18. Tjan AH, Nemetz H, Nguyen LT, Contino R. Effect of tray space on the accuracy of monophasic polyvinylsiloxane impressions. *J Prosthet Dent.* 1992; 68:19-28.