ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2018; 4(1): 193-196
www.allresearchjournal.com
Received: 02-11-2017
Accepted: 03-12-2017

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A study evaluating the effect of the bulk on the accuracy of an elastomeric impression material: An *in-vitro* study

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Abstract
Introduction: Precision in terms of the marginal seal and the occlusal seat of an indirect dental restoration is the result of the precisely made impression. Many factors that should receive proper attention to make precise impression are technique; tray type, impression type, thickness of wash bulk, impression bulk, polymerization and thermal shrinkage etc affect the accuracy and stability of the impression.
Aims and objectives: This study was conducted to evaluate the effect of the bulk on the accuracy of an elastomeric impression material.
Materials and methods: The impression of the stainless steel dies with 8mm base diameter and 8mm height with 6^0 taper was made in the perforated stainless steel cylindrical trays with inside diameter of 12mm, 14mm and 16mm to produce respective material thickness of 2mm, 3mm and 4mm in polysulfide, addition silicone and polyether impression materials. The impression was the poured in Type IV dental stone high strength (Ultrarock, Kalabhai, Karson Pvt. Ltd., India). The die dimensions were measured with the travelling microscope and compared with master die.
Results: The data upon statistical analysis revealed that impression bulk thickness affects the stone dies significantly.
Conclusion: Within the limitations of the study, it can be concluded that the impression bulk significantly affects the die dimensions

Keywords: Precision, bulk, marginal seal

Introduction
In fixed prosthodontics, the impression is made to fabricate the dies as accurate as the preparation in the oral cavity. Precisely fitting indirect dental restoration without marginal and occlusal discrepancy is the result of accurate and dimensionally stable impression.
Many factors like technique, tray type, impression type, thickness of wash bulk, impression bulk, polymerization and thermal shrinkage etc affect the accuracy and stability of the impression.
Many authors proposed that impression bulk in the form of space between tooth preparation and tray wall affects the accuracy. Philips documented maximum of 2mm space. Reisbick and Matyas suggested 2-4mm while as Asgar recommended 3-4mm space.
Aims and objectives: this study was conducted to evaluate the effect of impression bulk on the accuracy impression.

Materials and methods
Materials
1. A stainless steel dies with 8mm base diameter and 8mm height representing a complete crown preparation with 6^0 taper.
2. Perforated stainless steel cylindrical trays with inside diameter of 12mm, 14mm and 16mm to produce respective material thickness of 2mm, 3mm and 4mm. The material thickness was measured from gingival margin of the die to the internal surface of the tray. A spacer was used to create 2mm space between top surface of the die and the depth of the tray.

3. President regular body addition silicone (Affins Coltene Whaledent Pvt Ltd. Switzerland).
4. Regular body polysulfide (Kerr, Scafati, Italy).
5. Polyether (3M ESPE)
6. Type IV dental stone high strength (Ultrarock, Kalabhai, Karson Pvt. Ltd., India)
7. Debubblizer (dentofil)

Armamentarium

1. Rubber bowl
2. Vaccum mixer
3. Stop watch
4. Travelling microscope(ELFIN, India)
5. Verticulator

Methodology

The impression material was mixed in accordance with manufacturer instructions at room temperature. The tray was filled with the mixed impression material and the die was fixed centrally in the preloaded tray with the help of verticulator. The impression assembly was then immediately transferred to water bath at 37 ^{0}C temperature for the recommended setting time. The impression was separated from the master die, dried with air blast and allowed to cool for 10 minutes. The impression was the poured in Type IV dental stone high strength (Ultrarock, Kalabhai, Karson Pvt. Ltd., India). The stone die separated from the impression after 2 hours at room temperature was then transferred to travelling microscope(ELFIN, India) for measuring height and base diameter of the die. The stone die measurements were compared with the master stainless steel die.

Results

The average height of the die made with polyether at 2mm, 3mm and 4mm impression bulk are 7.969mm, 7.952mm and 7.893mm with standard deviation of 0.264, 0.022 and 0.094 respectively. The average width of the die made with polyether at 2mm, 3mm and 4mm impression bulk are 8.037mm, 8.058mm and 8.118mm with standard deviation of 0.019, 0.045 and 0.131 respectively as shown in table 1.The die dimensions showed statistically significant difference at p Value of 0.05 when subjected to F test.

Table 1: Comparison of die dimensions with master stainless steel die using polyether as impression

	Master model		2mm		3mm		4mm	
	Height	**width**	**Height**	**width**	**Height**	**width**	**Height**	**width**
1.			7.912	8.019	7.912	8.012	7.712	8.012
2.			7.978	8.022	7.932	8.022	7.932	8.022
3.			7.945	8.025	7.945	8.123	7.945	8.123
4.			7.984	8.004	7.951	8.004	7.751	8.204
5.			7.962	8.045	7.962	8.045	7.962	8.045
6.			7.984	8.071	7.984	8.071	7.874	8.071
7.			7.999	8.055	7.971	8.075	7.971	8.175
8.			7.959	8.042	7.937	8.142	7.857	8.442
9.			7.997	8.039	7.947	8.047	7.947	8.047
10.			7.979	8.047	7.979	8.045	7.979	8.045
mean	8	8	7.969	8.037	7.952	8.058	7.893	8.118
Standard deviation			0.264	0.019	0.022	0.045	0.0943	0.131
% Deviation			-0.38%	0.46%	-0.6%	0.72%	-1.3%	1.4%

P value =0.01of h
P value =0.08 of w

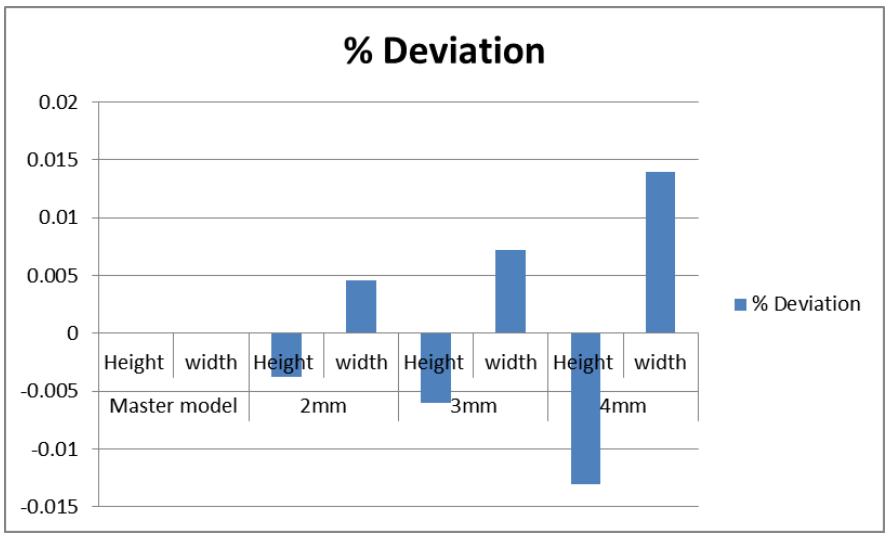

Fig 1: Percentage deviation of dimensions of the dies fabricated with polyether impression at 2mm, 3mm and 4mm bulks with respect to master die dimensions.

The average height of the die made with addition silicone as impression at 2mm, 3mm and 4mm impression bulk are 7.977mm, 7.972mm and 7.967mm with standard deviation of 0.014, 0.017 and 0.021 respectively. The average width

of the die made with polyether at 2mm, 3mm and 4mm impression bulk are 8.035mm, 8.039mm and 8.063mm with standard deviation of 0.022, 0.021 and 0.044 respectively as shown in table 2.The die dimensions showed statistically insignificant difference at p Value of 0.05 when subjected to F-test.

Table 2: Comparison of die dimensions with master stainless steel die using addition silicone as impression

	Master model		2mm		3mm		4mm	
	Height	**width**	**Height**	**width**	**Height**	**width**	**Height**	**width**
1.			7.982	8.017	7.972	8.022	7.992	8.082
2.			7.972	8.025	7.952	8.025	7.931	8.022
3.			7.945	8.015	7.975	8.023	7.945	8.023
4.			7.971	8.074	7.951	8.074	7.977	8.074
5.			7.992	8.021	7.992	8.041	7.962	8.045
6.			7.984	8.036	7.984	8.031	7.974	8.071
7.			7.971	8.075	7.971	8.075	7.971	8.175
8.			7.997	8.017	7.997	8.012	7.997	8.042
9.			7.978	8.047	7.947	8.044	7.947	8.047
10.	8	8	7.979	8.029	7.972	8.049	7.979	8.049
mean			7.977	8.035	7.971	8.039	7.967	8.063
Standard deviation			0.014	0.022	0.017	0.021	0.021	0.044
% Deviation			-0.28%	0.43%	-0.36%	0.48%	-0.41%	0.78%

P=0.4 of h

P=

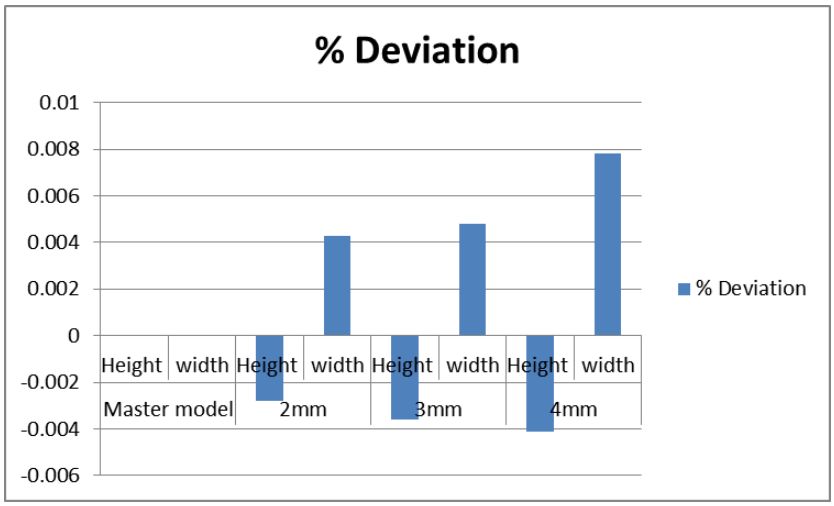

Fig 2: Percentage deviation of dimensions of the dies fabricated with addition silicone impression at 2mm, 3mm and 4mm bulks with respect to master die dimensions.

The average height of the die made with polysulfide as impression at 2mm, 3mm and 4mm impression bulk are 7.964mm, 7.958mm and 7.932mm with standard deviation of 0.0152, 0.013 and 0.024 respectively. The average width of the die made with polyether at 2mm, 3mm and 4mm impression bulk are 8.053mm, 8.073mm and 8.102mm with standard deviation of 0.039, 0.05 and 0.07 respectively as shown in table 3.The die height showed statistically significant difference at p Value of 0.05 when subjected to F-test and die width statistically insignificant result.

Table 3: Comparison of die dimensions with master stainless steel die using polysulfide as impression

	Master model		2mm		3mm		4mm	
	Height	**width**	**Height**	**width**	**Height**	**width**	**Height**	**width**
1.			7.947	8.024	7.942	8.024	7.902	8.022
2.			7.972	8.025	7.974	8.042	7.913	8.042
3.			7.947	8.024	7.945	8.024	7.945	8.124
4.			7.951	8.109	7.953	8.109	7.921	8.107
5.			7.962	8.045	7.952	8.045	7.962	8.045
6.			7.984	8.045	7.984	8.175	7.944	8.175
7.			7.979	8.025	7.971	8.075	7.921	8.175
8.			7.977	8.139	7.957	8.149	7.931	8.242
9.			7.948	8.047	7.947	8.047	7.904	8.047
10.			7.979	8.045	7.957	8.045	7.976	8.045
mean	8	8	7.964	8.053	7.958	8.073	7.932	8.102
Standard deviation			0.0152	0.039	0.013	0.05	0.24	0.07
% Deviation			-0.45%	0.66%	-0.5%	0.9%	-0.85%	1.2%

P=0.01

P=0.17

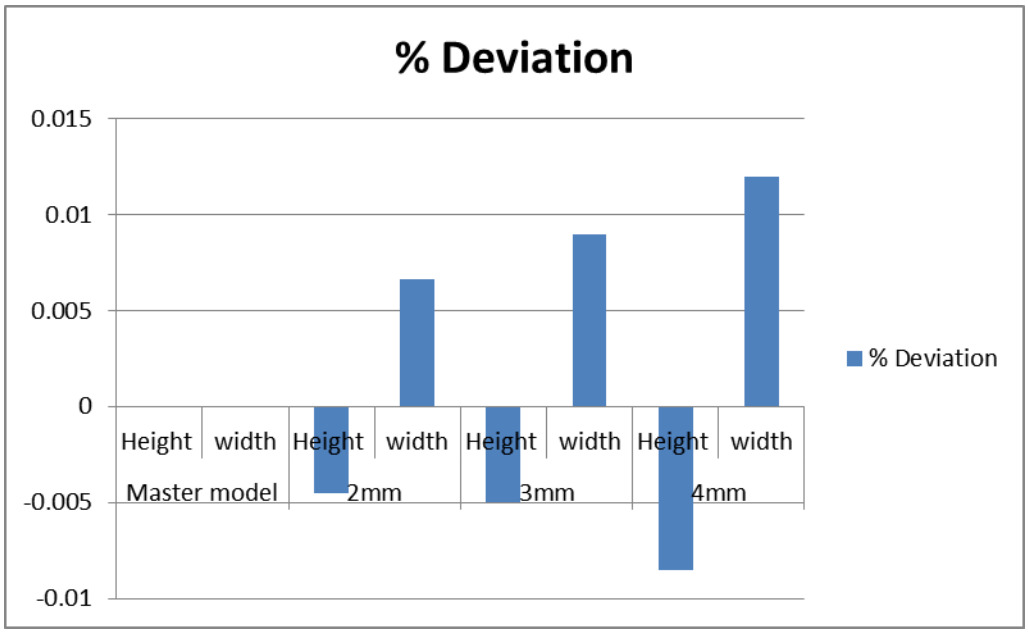

Fig 3: Percentage deviation of dimensions of the dies fabricated with polysulfide impression at 2mm, 3mm and 4mm bulks with respect to master die dimensions.

Discussion: The thickness of the impression material has been shown to affect the die dimensions. The centre ward polymerization shrinkage accompanied with thermal contraction resulted in distortion of the stone dies made from different elastomeric materials. The data showed that with increase in thickness of impression bulk from 2mm to 4mm between the surface of the abutment and tray the distortion of the stone dies increased.

DeAraju proposed that pouring the dies at 37^0C significantly reduces the die distortion because of the effect of thickness of impression bulk.

Jorgensen KD stated that that the die deviations may be minimal but may result in indirect dental restorations with marginal sealing discrepancy

Conclusion: Within the limitations of the study, it can be concluded that the impression bulk significantly affects the die dimensions. Further studies are to be carried out to determine the impression bulk that produces the minimum die distortion.

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