ORIGINAL ARTICLE

Dimensional Accuracy & Stability of Silicone Putty Wash Impression Technique with Different Thickness of Light Body Material

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Abstract

Objectives: *This study was designed to evaluate the effect of the different thickness of wash material (light body) on the dimensional accuracy and stability of putty wash impression when it is poured at different time intervals.* ***Materials & Methods:*** *Three thickness groups A (2mm), B (3mm) and C (4mm) were made which were subdivided into time intervals subgroups namely, E (1-hour), F (24-hour) and G (48-hour) consisting 15 of each. The percentage dimensional change of polyvinyl siloxane impression was calculated and dimensional stability was compared.* ***Results:*** *The impression made with 2mm thickness showed no significant difference from the baseline measurement.* ***Conclusion:*** *The two step polyvinyl siloxane putty wash impression is dimensionally most accurate when the light body material thickness is not more than 2mm. It remains dimensionally stable even after 48 hours irrespective of the thickness.*

Keywords: *Dimensional accuracy of putty wash impression, Dimensional stability of putty wash impression, Polyvinyl siloxane impression*

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Introduction

In present scenario with advanced material science of dentistry, there is a host of excellent impression materials available for making impressions in fixed prosthodontics, implant dentistry, and in restorative dentistry. The polyvinyl siloxane impression materials were first introduced in the 1970s. Since that time these materials have gained acceptance and have applications in fixed prosthodontics, removable prosthodontics, operative dentistry and implant dentistry.

Polyvinyl siloxane set by means of polymerization reactions with monomeric units forming polymer chains. During this polymerization, dimensional changes occur in the impression due to shrinkage[1]. In order to control this shrinkage, filler have been added. However, too much filler content also affects the flow of the material[2]. Hence, to obtain a dimensionally accurate result and at the same time incorporate stability to the material, various techniques of making polyvinyl siloxane impression have been advocated. These include either using a custom tray with a uniform thin relief space for the impression material or making the impression first with high filler containing polyvinyl siloxane and later relining it with low filler containing polyvinyl siloxane material. According to a study conducted by Reisbeck and Maytas[3], the putty consistency gives inaccurate impressions. Hence it is important to reline the putty impression with light body impression material after completion of polymerization reaction of putty impression.

The difference in cross-sectional thickness of material in a stock tray is about 1.5 to 2 mm thicker than that in a custom tray[4]. This mandates precision in fabrication of the custom tray because small differences in cross-sectional thickness can affect accuracy.

Studies have indicated the two step putty wash impression technique to be dimensionally more accurate, as uniform thickness of light body polyvinyl siloxane material is achieved by providing a relief space. The one step putty wash impression results in uncontrolled thickness of light body material[5]. The thickness of light body material in two step putty wash impression technique is a critical factor that influences the dimensional accuracy when using polyvinyl siloxane[6]. Thus this study was designed to evaluate the effect of the different

thickness of wash material (light body) on the dimensional accuracy and also to check dimensional stability of putty wash impression when it is poured at different time intervals.

Materials and Methods

Three thickness groups A (2mm), B (3mm) and C (4mm) were made which were subdivided into time intervals subgroups namely, E (1-hour), F (24-hour) and G (48-hour) consisting 15 of each. A standardized metal die model was designed in accordance to the ADA specification no. 19 [7]. The upper surface of the cylindrical metal die model was considered as the impression surface on which 3 horizontal & 2 vertical lines were scored. The horizontal lines were 2.5 mm apart from each other. The middle horizontal line passes through the centre of the circular impression surface of the die. The vertical lines are 12.5 mm away from the centre of the circular impression surface and cross the horizontal lines at right angle. Also the vertical lines were at a distance of 25mm from each other. Impressions were made with two step putty wash impression technique.

The cylindrical metal die model was placed over the metal stand. Metal coping of a particular thickness was placed over the metal die model. Tray adhesive was applied over the inner side of metal tray and allowed to dry for 5 minutes. Equal amount of base and catalyst material of polyvinyl siloxane addition silicone putty material (Affinis® putty super soft impression material manufactured by Coltene) was taken with a scoop. The base and catalyst were then mixed by kneading together with fingertips for 30 seconds until the color of the mix is uniform. This homogenous mix was then loaded in the metal tray and impression of the cylindrical metal die model was made with the metal coping of particular thickness (2mm/3mm/4mm) in place. The impression was then allowed to set for 2 minutes and then separated from the metal die. The metal coping was then removed from the putty impression. The impression was relined with light body material using an automixer gun with a mixing and dispensing tip For measuring the dimensional accuracy the distance between point A and Point B, i.e. the distance between the two points located over the central horizontal line was measured first over metal die and later on over samples. The percentage dimensional change was then calculated with the formula mentioned below

$$\textit{Dimensional Change (\%)} = \frac{\textit{(Average measurements on the sample) – (Measurement on metal die)}}{\textbf{(Measurement on metal die)}} \times 100$$

The impression was said to be dimensionally accurate if the mean percentage dimensional change was less 0.5% as per the ADA specification no. 19. The dimensional stability of polyvinyl siloxane impression was compared between samples poured after 24 hours and 48 hours with samples which were poured after 1 h. attached to it. Samples were obtained by pouring Type IV dental stone at time intervals of 1 hour, 24 hours and 48 hours.

Figure- 1: Metal die model assembly

Results

Samples of Group A (2mm) showed mean percentage dimensional change of 0.315% (Subgroup E), 0.421% (Subgroup F) and 0.408% (Subgroup G). Group B (3mm) showed mean percentage dimensional change of 1.949% (Subgroup E), 2.139% (Subgroup F) and 2.163% (Subgroup G). Group C (4mm) showed mean percentage dimensional change of 2.656% (Subgroup E), 2.845% (Subgroup F) and 2.779% (Subgroup G). The samples of Group A showed percentage dimensional change less than 0.5% and hence can be considered as dimensionally accurate as per the ADA Specification no.19. However, the samples obtained from Group B and Group C showed percentage dimension change more than 0.5%, which was considered dimensionally inaccurate as per the ADA Specification no.19 (Table- 1)

The results after ANOVA followed by Scheffe's fully significant difference (SFSD) test show that the samples obtained from impressions made with 2mm thickness of light body material were dimensionally accurate irrespective of the time of pour. All the impressions made with 3mm and 4mm light body thickness were

dimensionally inaccurate as the mean percentage was more than 0.5%. It was observed that the impression made with 4mm thickness of light body material showed the least dimensional accuracy (Table- 2).

Figure- 2: A- Impression surface, B- Putty impression with metal coping, C- Putty impression relined with light body impression material, D- Sample obtained after pouring the impression with type IV die stone

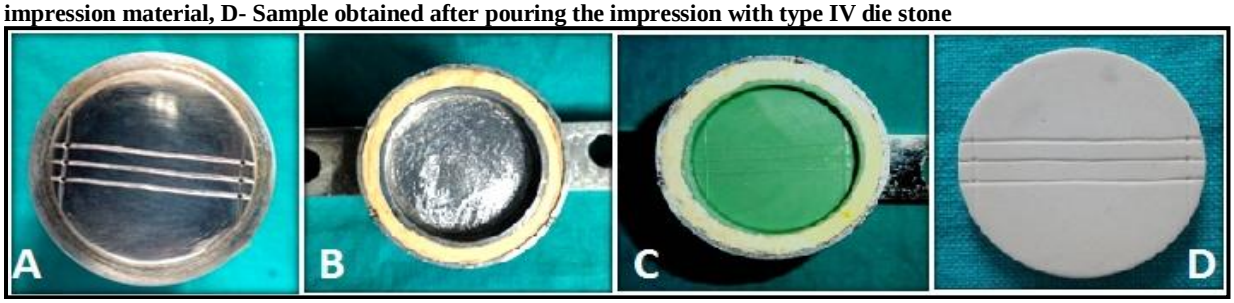

Table- 1: Impressions of light body material with type IV die stone

Thickness	Time interval	N	Mean (%)	Std. Deviation
Group A (2mm)	Subgroup E (1 hour)	15	0.315	0.3480
	Subgroup F (24 hours)	15	0.421	0.3860
	Subgroup G(48 hours)	15	0.408	0.3415
Group B (3mm)	Subgroup E (1 hour)	15	1.949	0.3963
	Subgroup F (24 hours)	15	2.139	0.4908
	Subgroup G(48 hours)	15	2.163	0.3293
Group C (4mm)	Subgroup E (1 hour)	15	2.656	0.3959
	Subgroup F (24 hours)	15	2.845	0.1851
	Subgroup G(48 hours)	15	2.779	0.2302
Total		**135**	**1.742**	**1.0647**

Table- 2: Scheffe multiple comparison tests

K	L	Mean Difference (K-L)	Std. Error	Significance
Subgroup E (1 hour)				
Group A	Group B	-1.635(S)	.1298	.000
	Group C	-2.341(S)	.1298	.000
Group B	Group A	1.635(S)	.1298	.000
	Group C	-0.707(S)	.1298	.001
Subgroup F (24 hours)				
Group A	Group B	-1.717(S)	0.1298	0.000
	Group C	-2.424(S)	0.1298	0.000
Group B	Group A	1.717(S)	0.1298	0.000
	Group C	-0.707(S)	0.1298	0.001
Subgroup G (48 hours)				
Group A	Group B	-1.755(S)	0.1298	0.000
	Group C	-2.371(S)	0.1298	0.000
Group B	Group A	1.755(S)	0.1298	0.000
	Group C	-0.616(S)	0.1298	0.007

Discussion

In the present study, the impression made with 2mm thickness of light body material showed mean percentage dimensional change of 0.315% at 1 hour interval, 0.421% at 24 hour interval and 0.408% at 48 hour interval. This percentage difference is clinically acceptable as per the ADA specification no.19. In other words, the impression made with 2mm thickness showed no significant difference from the baseline measurement, i.e. the measurements on the metal die model when poured at different time intervals. This is in accordance to different studies where relief space of up to 2mm thickness give accurate impressions for two step putty wash impression technique[8,9].

The percentage dimensional change in impressions, made with light body material thickness 3mm and 4mm, were significantly inaccurate as per the ADA specification no.19.

Statistically significant difference was seen in the mean percentage dimensional change between impressions made with 2mm, 3mm and 4mm light body thickness at all the time intervals. The results manifest that, all the stone dies showed dimensional changes in comparison to the dimensions of the metal die model. The impression made with 2mm thickness of light body showed lesser dimensional changes compared with impression made with 3mm thickness of light body at 1 hour interval. Also, the impressions made with 2mm thickness of light body material gave the die with the least dimensional changes while the die obtained by pouring impression made with 4mm thickness of light body gave the highest dimensional changes. Similar results were observed at 24 hours interval and 48 hours interval. This was because of the impression material contraction due to polymerization shrinkage. Since the presence of high filler content in putty addition silicone material limits this shrinkage[2, 9], the amount of shrinkage occurring in two step addition silicone putty wash impression is mainly influenced by the thickness of light body present in the impression[8,9].

This result is in agreement with other studies which have shown that impression material of thickness 2mm gives better dimensional accuracy and as the thickness of the material increases more than 2mm the dimensional accuracy decreases[8,10,11]. However some authors have mentioned that if the thickness of light body is less than 1mm then also the dimensional accuracy of the impression is affected[11,12].

Difference in dimensions of samples poured at 1 hour, 24 hours and 48 hours was not significant, this observation was found to be clinically irrelevant because, polyvinyl siloxane impression materials are not susceptible to changes in humidity, and they do not undergo any further chemical reactions or release any by-products[13]. This result is in agreement with other studies which concluded that addition silicone impression show no dimensional changes after 24 hours[13], 1 week[14], 2 weeks[15] and even 3 months[16].

Conclusion

The two step polyvinyl siloxane putty wash impression is dimensionally most accurate when the light body material thickness is not more than 2mm. The dimensional change of the impression increases as the thickness of the light body material increases. It remains dimensionally stable even after 48 hours irrespective of the thickness of the light body material. Hence, it can be recommended that in clinical practice the two step putty wash polyvinyl siloxane impression should be made using light body thickness not more than 2mm. Also, it is not necessary to pour the impression immediately as the material remains dimensionally stable even after 48 hours.

Conflict of Interest: *None declared*
Source of Support: *Nil*
Ethical Permission: *Obtained*

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