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RESEARCH ARTICLE

THE DIMENSIONAL ACCURACY OF VINYL SILOXANE ETHER AND POLYVINYL SILOXANE IN ONE STEP AND TWO STEP IMPRESSION TECHNIQUES WHEN THE FINISH LINE IS SUBGINGIVAL

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ABSTRACT

The accuracy of impression materials in terms of both dimensional stability and detail reproduction is necessary for FPD and implant prosthesis. For this purpose polyvinyl siloxane impression material have become extremely popular. This material is known for their excellent elastic recovery, optimal accuracy, adequate tear resistence, satisfactory handeling characteristics and virtually ideal dimentional stability. VSE (Vinyl siloxane ether) is newly introduced material with additional benefits of hydrophilic properties. In the present study we are comparing the effect of one step and two step impression technique on accuracy when finish line is within the sulcular area by using PVS (addition silicon) and VSE. A standardized stainless steel die was fabricated for making impressions with Polyvinyl Siloxane Ether (Group A) and Vinyl Polysiloxane (group B). 20 impressions of each group were made. Further the two groups were subdivided into one (one step impression technique) & two (two step impression technique). The accuracy of impression material was measured using 3 D scanner. The data obtained was subjected to statistical analysis. The mean difference in dimensional change between the four groups was not statistically significant (P(0.05). However the results revealed that there was higher mean dimensional accuracy with two step impression technique of vinyl polysiloxane impression material.

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INTRODUCTION

The accuracy of an impression material in terms of dimensional accuracy and detail reproduction is necessary for the precise fabrication of a well fitted fixed dental prosthesis (FDP). (Powers and Sakaguchi, 2006) The problem of accuracy has been stressed recently in a clinical study which reported that over 89% of the impressions investigated has 1 or more observable error; thus, a more critical evaluation of impressions on the part of dentist is recommended. (Samet *et al*., 2005) There are various factors that can influence the quality of impressions, including the impression technique, (Hung *et al*., 1992; Craig, 1988) the impression material, (Che *et al*., 2004; Che and Donovan, 1989) the bulk of the material, (Nissan *et al*., 2002; Che and Donovan, 1992; Lewistein, 1993) and others (Che *et al*., 2004; Boulton *et al*., 1996; Carrotte *et al*., 1998). It is known that addition-type silicones are among the most dimensionally accurate and stable materials available for impression making. (Samet *et al*., 2005; Che *et al*., 2004) Some studies have indicated that, as impression materials have improved, the dimensional accuracy is influenced more by technique used rather than by the material itself. (Hung *et al*., 1992; Craig, 1988) However some studies have indicated that it does not. (Idris Housto and Claffey, 1995; Lee *et al*., 1995) The recording of tissues in oral cavity is difficult due to the factors such as salivation, blood flow, sulcular fluid etc. This becomes critical especially in recording finish line for fixed dental restoration, when the margins lay subgingivally. Hence, most studies conducted correctly rate, hydrophillicity as the most important criteria to choose an impression material. Vinyl siloxane ether is an elastomeric impression material developed recently, combining the features of addition silicone and polyether. This newer elastomer facilitates hydrophilicity and other favourable characteristics of both polyether and addition silicone. The aim of the present study was to evaluate the effect of one step and two step impression techniques on dimensional accuracy of vinyl siloxane ether and polyvinyl siloxane impression materials. The null hypothesis were as follows

(1) There is no significant difference in the dimensional accuracies of impressions made with VSE and PVS.
(2) There is no significant difference in the dimensional accuracies of impressions made with one step and two step impression techniques.

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MATERIALS AND METHODS

A rectangular stainless steel master die containing two stainless steel abutement preparation was fabricated (Fig.1 A) The space around abutement (height 10mm, width 0.5mm, depth 0.6mm and 3° convergence angle) simulates the gingival sulcus. (Fig.1B) This master die served as a definitive standard cast for the comparision of various impression techniques and accuracy of impressions.

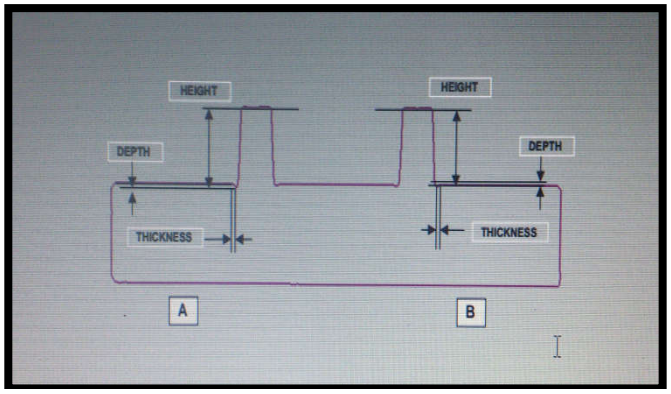

Fig. 1. A: Master die fabricated in stainless steel
B: Schematic diagram of master die

Table 1. Measurements of Master die

Abutments	Height (mm)	Width (Thickness in mm)	Depth (mm)
Abutment a	10.22	0.53	0.64
Abutment b	10.2	0.53	0.64

A vaccum adapted sheet of 2mm thickness was adapted over the master die and custom trays were fabricated using light cure acrylic resin. Polymerization was carried in light polymerizing unit. The custom trays were used to make impressions of master die. A total of 40 impression were made. 20 impression of Polyvinyl Siloxane Ether (aquasil) (Group A) and 20 impression of Vinyl Polysiloxane (identium kettenbeck) (group B). In addition, impressions in each material were made using two techniques-one step impression technique and two step impression technique (Fig. 2-7). Ten impressions with one step impression technique out of which five impressions were made with polyvinyl siloxane and five impression with vinyl siloxane ether were made. Ten impressions with two step impression technique out of which five impressions were made with polyvinyl siloxane and five impression with vinyl siloxane ether were made (Fig.3-6). All the impression materials were mixed in standardized proportion using pentamix mixing unit (Fig.2A) and mixing gun (Fig.2B) for vinyl siloxane ether and polyvinyl siloxane impression material respectively.

Fig. 2. A: Dynamic mixing machine -Pentamix
B:Rubber base mixing gun

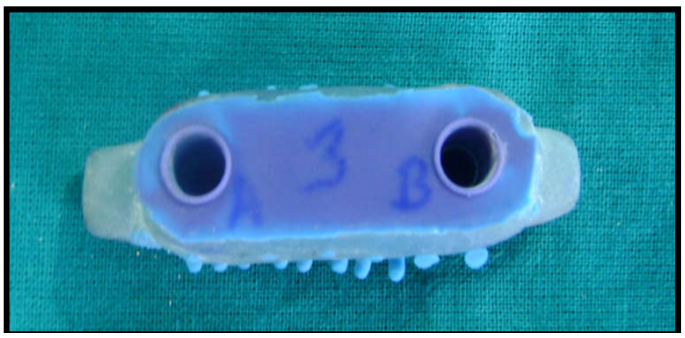

Fig.3. Impression by one step impression technique in Vinyl siloxane ether

Fig.4. Impression by two step impression techniques in Vinyl siloxane ether

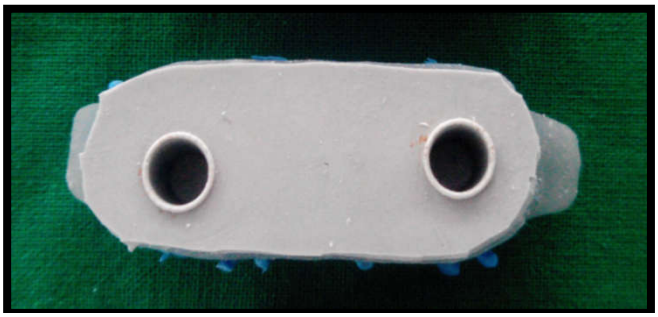

Fig.5. Impression by one step impression technique in Poly vinly siloxane

Fig.6. Impression by two step impression technique in Poly vinyl siloxane

Fig.7. 3D scanner (Solinix, Rexscan-3, Germany)

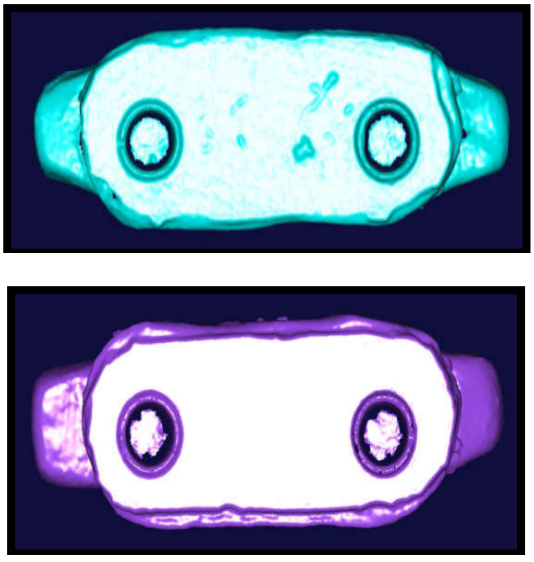

Fig. 8. A:Impression made with polyvinyl siloxane ether
B: Impression made with Vinyl siloxane ether

For one step technique heavy body and light body impression material were used simultaneously. For two step impression technique, the preliminary heavy body impressions were made first, with the cellophane sheet on the top of the master cast and were allowed to set for 5-6 minutes. In second step the plastic foil was removed, and the wash material was injected. Tray were seated on the cast without excessive pressure and was allowed to set for 5-6 minutes. All the impressions were scanned for their accuracy using 3 D scanner (Solinix, Rexscan-3, Germany). (Fig.7-8)

RESULTS

In the present study, the statiscal analysis was performed using statistical product and service solution (SPSS) version 18 for windows (SPSS inc, Chicago, IL). Descriptive quantitative data was expressed in mean and standard deviation respectively. Intergroup comparison of dimensional accuracy of two different materials (VSE and PVS) using two different impression techniques (one step and two step impression techniques) was done by using unpaired 't' test in terms of height, width and depth. Confidence interval was set at 95% and probability of alpha error set at 5%. In the Table no 1, when dimensional accuracy was observed, the mean height using both the materials (VSE, PVS) with one step impression technique was 10.63 mm and 10.49 mm respectively. The mean width using VSE and PVS impression material with same technique was 0.572 mm and 0.57 mm respectively and the mean depth was 0.71mm and 0.724 mm respectively. After performing unpaired 't' test. The *P* value was non-significant (>0.05). In the Table 2, when dimensional accuracy was observed, the mean height using both the materials (VSE, PVS) with two step impression technique was 10.27 mm and 10.26 mm respectively. The mean width using VSE and PVS with same impression technique was 0.594 mm and 0.55 mm respectively and the mean depth was 0.72 mm and 0.70 mm respectively. After performing unpaired 't' test. The *P* value was non-significant (>0.05).

DISCUSSION

Impression materials physical properties directly affect the fit of FDPs in vivo. Therefore, an impressions' accuracy and its dimensional stability are important factors that influence long term clinical success. (Powers and Sakaguchi, 2006) The present study examined the effect of one step and two step impression techniques on dimensional accuracy of vinyl siloxane ether and polyvinyl siloxane when the margins were infrasulcular. Measurements were performed on the impression material itself, thus avoiding discrepancies related to expansion of stone or investment (Powers and Sakaguchi, 2006). In the study, a vaccum pressed polythene sheet (Bioplast Scheu-Dental Iserlohn, Germany) of 2mm thickness was adapted over master die to ensure equal spacer thickness for the fabrication of trays and also for the constant and equal pressure over the impression, one kilogram of weight was put over the custom tray when impressions were recorded. The above graph, showed that in one step impression technique, VSE impression material was more dimensionally accurate than PVS impression material in terms of height while its same in terms of width. PVS impression material showed more accuracy in terms of depth. However all the '*P*' values are > 0.05 hence

non significant. For two step impression technique, both the materials showed almost comparable dimensional accuracies, as the difference between them was non-significant. The impression materials examined possess different surface properties. Vinyl siloxane ether possesses greater degree of wettability and is therefore well suited for moist environment that exists intra-orally. (Thomas Stober *et al*., 2010) In contrast, vinyl poly siloxane is hydrophobic, due to its molecular chemistry; however, it is known for its superior elastic recovery. To improve wetting characteristics of vinyl polysiloxane materials, surfactants have been added by manufacturers. The platinum-initiated vinyl siloxanether consists of a copolymer of α, ω-divinyl polydimethyl siloxane and α, ω-divinyl polyether crosslinked by an organohydrogen polysiloxane. The composition is intended to incorporate the natural hydrophilicity of conventional polyether materials along with the desirable properties of vinyl polysiloxane materials, such as elastic recovery and tear resistance. (Shetty *et al*., 2014) Morgano *et al*. (1995) showed that the use of PVS with the one step impression technique produced mean marginal discrepencies that were significantly greater than those of other techniques. Caputi and Varvara (2008) demonstrated that the two step putty/light body and two step injection techniques were the most dimensionally accurate impression methods used. Levartovsky *et al*. showed that impression techniques affects the accuracy in the gingival sulcus area. (Shirfa Levartovsky *et al*., 2014) Additionally, Chee and Donovan (1992) and Nissan *et al*. (2000) reported that the one step impression technique produced less accurate results than did the two step impression technique. They concluded that the lack of control of wash bulk influenced the accuracy of the one step impression technique. In the present study, master die was made of stainless steel jig, the surface of which differs from dentin.

The conditions in which study was conducted differ from those of teeth in the natural oral environment, since soft tissue was not present, nor was saliva or sulcular fluid, and the intraoral temperature would be different. 3 D scanner was used to measure the dimensional accuracy of impressions, but t here is also a need to examine the biological, rheological, and wetting properties of this new material, to further ascertain equivalence with vinyl polysiloxane, and to lend additional support for clinical acceptability.

Conclusion

Within the limitation of this study ,following conclusions can be drawn:

1) The accuracy of poly vinyl siloxane and vinyl siloxane ether are comparable.
2) The impression technique does not affect the dimensional accuracy of impression material.

Vinyl polysiloxane ether is a recently developed material and further studies are needed. As it is hydrophilic material, flowability of the material is better in the oral condition. It represent dawn of next generation of materials, overcoming the drawbacks of previous impression materials, we clinician can expect more improvement ahead in times to come.

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