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Evaluation of accuracy of Implant Impression made with open tray technique using two different elastomeric impression materials.

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Abstract: *Making an accurate impression is a critical step in implant supported restoration as these restorations cannot compensate even for minor discrepancy because of limited mobility of an implant. The aim of this study was to evaluate accuracy of implant impression made with two different type of elastomeric impression material using an open tray technique and thereby reducing chances of implant failure by exhibiting an accurate passive fit between implant and its superstructure. An edentulous model of maxillary arch was fabricated for the study on which 3 implant analogues were placed and reference bar was used to verify the accuracy of casts produced from impressions. In this study, open tray impression were made using custom tray made with pink cold cure acrylic resin and elastomeric impression materials used were Polyether and Vinyl siloxanether. The data were analyzed using independent sample t-test with the help of SPSS. . There was statistically significant difference between marginal discrepancies of implant impression made with Vinyl siloxanether elastomeric impression material and polyther elastomeric impression materials. Mean value of vertical discrepancies for vinyl siloxanether was significantly less than mean value of vertical discrepancies for polyether.*

Keywords: *Implant impressions, Marginal discrepancy, Reference bar, Polyether, Vinyl siloxanether*

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I. Introduction

A major objective for successful implant-supported restoration is the production of superstructures that exhibit passive fit[1-3]. This standard of fit is required because of the unique quality of the implant-bone relationship. The natural tooth moves up to 100μm within its periodontal ligament, thus compensating for a certain degree of misfit of a fixed partial denture, whereas an osseointegrated implant has extremely limited movement in the range of 10μm[1,4]. The lack of implant flexure means that any tensile, compressive, and bending forces introduced into an implant-supported restoration because of misfit will almost certainly remain there. When these forces are not relieved, problems ranging from screw loosening to loss of osseointegration have been reported to occur.[1, 3, 5-7]

Success in oral rehabilitation is partly dependent on the accurate registration of those structures that constitute the basis for prosthesis support. Reproducing the intraoral relationship of implants through impression procedures is the first step in achieving an accurate, passively fitting prosthesis. To achieve the passive fit, it is necessary to eliminate as much distortion as possible in the transfer and impression procedures. Either direct or indirect impression technique is recommended at the implant level impressions. In some studies comparing direct and indirect methods for dimensional stability of cast models, direct method was found to be more accurate[8, 9]. **Jason et al[10]** assured that as measured by vertical fit discrepancy, rigid custom close-fit trays and spaced custom trays produce significantly more accurate impressions.

Impression making is an important step in the complex process of fabricating a well fitting indirect prosthetic restoration. Accuracy of the impression material, in terms of both dimensional accuracy and detail reproduction, is an essential prerequisite for a successful impression. A number of impression materials are commercially available. Two widely used materials are vinyl polysiloxane (also called addition silicone) and polyether. The accuracy and dimensional stability of vinyl polysiloxane and polyether is well Documented. Recently, a new impression material, classified as a vinyl siloxanether by the manufacturer (Kettenbach, Identium), has been made commercially available. This material has been formulated by the manufacturer to possess good mechanical and flow properties, along with excellent wetting characteristics in the unset condition when applied to the prepared tooth, and also in the set condition. **Stober et al[11]** stated that accuracy for Vinyl siloxanether (VSE) and Polyether (PE) is clinically similar with VSE being comparably more accurate than PE.

The accuracy of the new vinyl siloxanether has not been established, and is needed, given the new and novel formulation.

This article outlines the comparison of the accuracy of implant impression made with open tray technique using two different elastomeric impression material which are polyether and vinyl siloxane-ether.

II. Materials And Method

In this study, elastomeric materials used are Polyether (3M Monophose Medium Body) and Vinyl siloxanether (Kettenbach Identium Medium). Figure 1 is showing materials used in the study. This study was done at Department of Prosthodontics, GDCH, Ahmedabad, GUJARAT.

Methodology is devided into following steps.

2.1. Fabrication of the master model
2.2. Fabrication of reference bar
2.3. Fabrication of custom tray
2.4. Impression procedure
2.5. Fabrication of cast
2.6. Measurement of cast
2.7. Statistical analysis

2.1. Fabrication of the master model: A clear heat cure acrylic resin (ASHWIN) edentulous model (fig 2) of maxillary arch was fabricated for the study. Three implant analogues (ADIN) were placed in the region of 14, 21 and 34 of the acrylic resin model. Dimensions of all three implant analogues were as below in TABLE 1.

Dimension of implant	Site of placement
3.5*11.5	14
3.5*11.5	21
4.2*11.5	24

TABLE 1

2.2. Fabrication of reference bar: The master model retained 3 implant analogs, in the approximate region corresponding to the maxillary premolars and central incisor teeth. UCLA Abutments were screwed to the implant analogue and they were examined under surveyor for bucco-lingual parallelism. All abutments were made parallel and casted in cobalt chromium alloy using conventional casting procedure to fabricate the reference bar (fig 6). Reference bar was cleaned, finished and polished. The accurate fit of the reference bar to abutments was verified by use of a travelling microscope. This reference bar was used to verify the accuracy of casts produced from impressions.

2.3. Fabrication of custom tray: Pink cold cure acrylic resin was used to fabricate custom tray for open tray impression procedure which was perforated according to implant positioned in the model. Perforation was provided to allow insertion and removal of open tray copings with hex driver (fig 3). Total 10 custom trays were prepared among which 5 trays were for polyether group of impression and rest were for vinyl siloxanether impressions.

2.4. Impression procedure: This study is divided into two groups. Group A included impression made with polyether medium body (3M monophase) and Group B comprised of impression made with vinylsiloxanether medium body (kettenbach Identium). Each group contained 5 impressions. Total 10 impressions were made.All impressions were made using open tray technique.

Group A impression procedure: Group A included impression made with polyether medium body (3M monophase). Polyether tray adhesive (3M ESPE) was applied on custom tray and open tray transfer copings were screwed to implants in master model using hex driver of ADIN IMPLANT SYSTEM. 3M pentamix lite automated mixing machine was used to mix polyether medium body impression material. Machine mixed material was loaded on custom tray and transfer copings. Custom tray loaded with polyether monophase material was placed on master model until material was set. After setting time, all three transfer copings were unscrewed using hex driver and impression was removed from master model. (fig 4)

Group B impression procedure: Group B comprised of impression made with vinylsiloxanether medium body (kettenbach Identium medium). Vinylsiloxanether tray adhesive (kettenbach Identium) was applied on custom tray and open tray transfer copings were screwed to implants in master model using hex driver of ADIN IMPLANT SYSTEM. DMG MIX STAR automated mixing machine was used to mix vinylsiloxanether medium body impression material. Machine mixed material was loaded on custom tray and transfer copings. Custom tray loaded with vinylsiloxanether medium body material was placed on master model until material is set. After setting time, all three transfer copings were unscrewed using hex driver and impression was removed from

master model. (fig 5)

2.5. Fabrication of cast: Both polyether and vinylsiloxanether impressions were having open tray transfer copings. Casts were poured with ADA type IV gypsum product (Die stone) as per manufacturer's instructions. All casts were stored at room temperature for a minimum of 24 hours before measurements were made. (fig 7)

2.6. Measurement of cast accuracy: Accuracy of casts produced by two different elastomeric impression materials was measured using reference bar which was screwed at one implant site and vertical gap was measured buccal and lingual to rest two unscrewed implants sites. Vertical gap is measured with help of Travelling microscope (fig 8 & fig 9). For example, reference bar was screwed first at 14 implant site and vertical gap between implant and reference bar abutment was measured buccally and also lingually on rest two other unscrewed implants sites (24 and 21). Same procedure was followed for measurement after screwing 21 and 24 implants sites. Mean of all 12 reading from the cast was used to calculate vertical gap descripancy.

2.7. Statistical analysis: Mean and standard deviation of specimens in each group was calculated. Comparison of marginal discrepancy caused by different impression material was done by independent sample t-test. Level of significance was set at the probability level of $P \leq 0.05$.

III. ʾFigures

Fig 1. Materials used in the study

Fig 2. Fabrication of master model

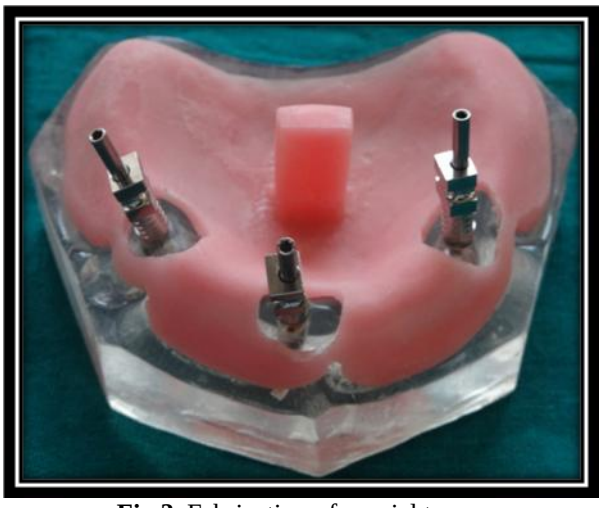


Fig 3. Fabrication of special tray

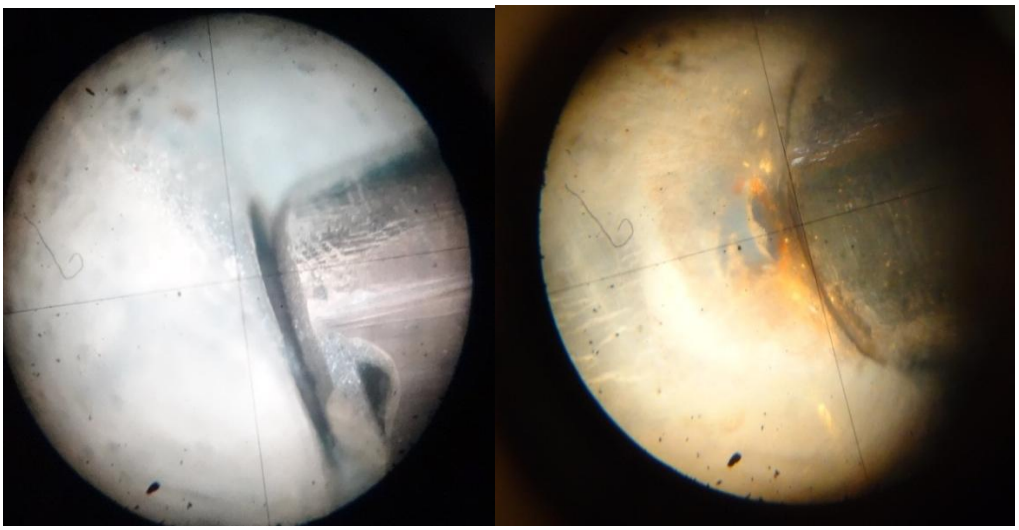
Fig 4. Group A impression

Fig 5. Group B impressions

Fig 6. Fabrication of reference bar

Fig 7. Cast produced by type IV dental stone

Fig 8. Measurement of cast with Travelling microscope



(A) **(B)**

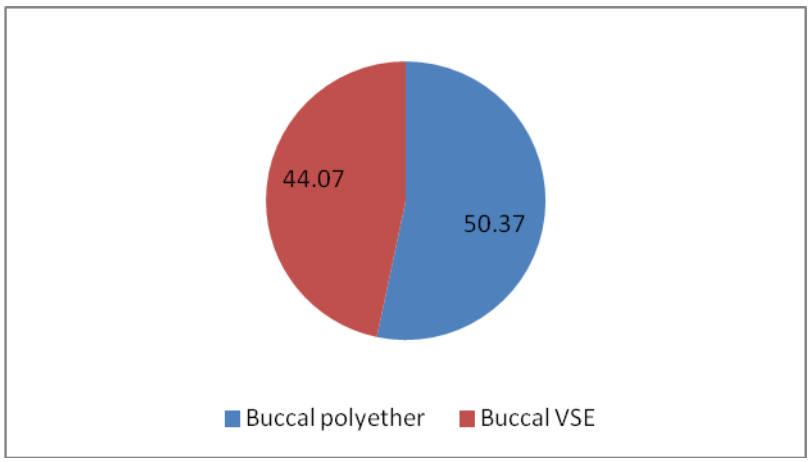
Fig 9. Vertical discrepancy (A) buccal (B) Lingual

IV. Results

Results of this study are presented in TABLE 2 and PIE CHART 1 as below.

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P VALUE
Buccal	Polyether	30	50.37	3.41	0.622	6.3	<0.001
	VSE	30	44.07	3.57	0.652		
Lingual	Polyether	30	50.07	3.45	0.631	6.9	<0.001
	VSE	30	43.20	3.40	0.620		

TABLE 2. Independent sample t-test for buccal and lingual marginal discrepancies recorded from casts of group A (polyether) and group B (vinyl siloxanether)



PIE CHART 1

According to table 2 the accuracy of VSE is better than Polyether. On buccal sides of unscrewed implants in all the casts, mean value of vertical discrepancies for vinyl siloxanether is 44.07±3.57µmwhich was significantly less than mean value of vertical discrepancies for polyether (50.37± 3.41µm). On lingual sides of unscrewed implants in all the casts, mean value of marginal discrepancies for vinyl siloxanether is 43.20±3.40µm which was significantly less than mean value of marginal discrepancies for polyether (50.07± 3.45µm).

V. Discussion

In the process of making an implant-supported prosthesis, reproducing the intraoral relationship of implants through impression procedures is the first step in achieving an accurate, passively fitting prosthesis. Passive fit of implant prosthesis is essential to long term treatment success. Small discrepancies in clinical and laboratory procedures can lead to stresses on the implants when the framework is screwed onto the implants. To provide a passive fit, a framework should not induce any strain on the supporting implant components and the surrounding bone in the absence of an applied external load. Imprecise superstructure fit can have both mechanical and biologic consequences that disrupt continuous function of dental implant. Mechanical complications include loosening, bending, and fracture of implants and superstructure components. Biologic complications, though often involving infectious processes, can occur as a result of loads beyond physiologic tolerance levels.

Because of the precise fit of implant components and the rigid connection of implant to bone, the accuracy of the master cast is even more critical when compared to conventional fixed prosthodontics. The accuracy of a master cast depends on the type of impression material, the type of impression technique, die material accuracy during and implant master cast technique. Therefore, success in oral rehabilitation is dependent, in part, on the accurate registration of those structures that constitute the basis for prosthesis support.

The impression which allows replication must be accurate and reproducible so that the resultant master cast precisely duplicates the clinical condition. A variety of impression materials are currently available for implant impressions, which include poly vinylsiloxane, condensation silicone, polyether, polysulfide elastomeric impression materials, hydrocolloid and impression plaster. Two widely used materials are PVS and PE because they show a greater dimensional stability, hardness and elastic recovery. Traditionally PVS were hydrophobic: due to which accuracy of impression was questionable. The newer ones have added surfactants to counteract this. PVS has a very high dimensional stability over time and temperature. It is known for its superior elastic recovery even in moist environment. On the other hand polyether impression materials are hydrophilic and records good detail, but it is stiffest among all elastomer. This high stiffness is advantageous in making open tray impression during fabrication of implant supported prosthesis. However there are certain drawbacks of these materials. PVS is inherently hydrophobic in nature and has lower tear strength, whereas PE has bitter taste and being stiff with high modulus requires blocking of undercuts in most situations.

In 2009 the **Kettenbach Company** launched a new impression material called vinyl siloxanether. It is additional-curing, elastomeric impression materials with a chemical combination of a polyether and polyvinylsiloxane. According to information provided by the company, the combination of PE material and PVS components introduces theoretical advantages, given that it does maintain similar mechanical and hydrophilic properties (optimal flow properties in moist environments and achieve the lowest contact angles below 10^0 after 1 sec) providing maximum precision while achieving its final hardness more expeditiously.

Dimensional accuracy of impression materials is widely discussed in dental literature. There are five major sources of dimensional changes are polymerized shrinkage, loss of by-product, thermal contraction, imbibition when exposed to water and incomplete recovery of the deformation.

In table 2 and Pie chart 1, the difference in accuracy of both impression materials is very small with having VSE comparably more accurate than PE. These results support the study done by **Stober et all**[11] in which accuracy of newly formulated vinyl siloxanether was comparable to polyether and poly vinylsiloxanes after immersion disinfection. **Pratten and Craig**[12] also determined that the wettability of a new hydrophilic poly(vinyl siloxane) material was similar to the tested polyether impression material. Pratten and Craig concluded that addition of intrinsic surfactant improves wettablity of hydrophobic vinyl siloxane.**kang et al**[13] have also concluded that addition of surfactant in vinyl silicones produced clinically accepatable accuracy.

VI. Conclusion

The mean marginal discrepancy on buccal for vinyl siloxanether was 44.07±3.57µm and for polyether was 50.37± 3.41µm, whereas mean marginal discrepancy on lingual for vinyl siloxanether was 43.20±3.40 µm and for polyether was 50.07± 3.45 µm. In the present study VSE elastomeric impression material showed less marginal discrepancy than Polyether elastomeric impression material. There was statistically significant difference between marginal discrepancies of implant impression made with Vinyl siloxanether elastomeric impression material with polyther elastomeric impression materials.

From the results obtained from this study it was concluded that:

1 Both the impression materials used in the study exhibited some amount of marginally discrepancy. Vinyl siloxanether impression material shows less marginal discrepancy than polyether.
2 Statistically, the differences between VSE and PE were significant.
3 Both the impression materials tested in this study were in the clinical acceptable range.

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