"EVALUATION OF ACCURACY OF TWO DIFFERENT IMPRESSION MATERIALS AND THREE DIFFERENT IMPRESSION TECHNIQUES ON THE VERTICAL MISFIT OF A THREE UNIT IMPLANT SUPPORTED FIXED DENTURE PROSTHESES: AN *IN VITRO* STUDY"

Research Article

Debajyoti Sarkar¹, Shitij Srivastava², Abhinav Shekhar³, Amrita Jayaswal⁴,
Love Bhatia⁵, Anshuman Chaturvedi⁶

¹⁻⁶Department of Prosthodontics,
Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow

ABSTRACT:

AIM : The aim of the study is to evaluate the accuracy of two different impression materials and three different impression techniques on the vertical misfit of a three-unit implant supported fixed denture prostheses.

Materials and Methods: A total of 60 casts were fabricated for the present study with closed tray, open tray and open tray splinted abutment impression technique. Two different commercially available impression materials were used - poly ether and addition silicone. Both the materials were used for all the above impression techniques.

Results: According to the result derived from this study polyether showed least marginal gap. On the other hand on the basis of impression techniques open tray impression with splinted transfer coping also exhibited minimum marginal gap.

Conclusion: 1. Higher marginal accuracy was found in impressions made by polyether compared to polyvinyl siloxane. 2. Open tray splinted technique exhibited minimum marginal gap when used with polyether as impression material compared to open tray non splinted technique and closed tray technique.

Key Word:

Open tray technique, closed tray technique, open tray splinted technique, implant impression, poly ether, poly vinyl siloxane, vertical misfit.

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INTRODUCTION: A dental impression is a negative imprint of oral structures utilized to produce a positive replica of the structure that can be used as a permanent record or in the production process of a dental restoration.[1, 2]

A passively fitting prosthesis is considered an essential pre-requisite for maintaining osseointegration. This is related to the fact that dental implant unlike natural teeth lack the cushioning effect of periodontal ligament fibers and cannot accommodate the demands of the superstructure.[3] A misfit in the prosthesis influences the pattern and magnitude of stress distribution in the prosthesis itself as well as the components of the implant and the surrounding bone that may lead to unfavorable complications.[4] Therefore fastidious and accurate implant prosthesis procedures are a necessity to achieve a passive fit and undoubtedly accurate impression

making is a crucial step in this process.[3] The implant impression material must exhibit appropriate resilience and should be dimensionally stable. They must also be sufficiently rigid to prevent the implant component from movement during the impression making procedure. Polyvinyl siloxane and poly ether are the most common implant impression materials.[5,6,7,8]

There are many methods for obtaining impression from dental implant of which two of the most common techniques are closed tray technique and open tray technique. The open-tray technique (also called pick-up/direct technique) uses a tray with an opening and square impression coping in which the screws are exposed outside the tray. After setting of the impression materials, first, the copings are unscrewed and then the impression is removed. The implant analogs are

connected to the copings, which are still in place in the impression. By contrast, the closed-tray technique (also called transfer/indirect technique) uses tapered impression copings with retaining screws that match the height of the copings. Using a closed-tray technique, an impression is made and separated from the mouth while the copings are still connected to the implants. Then, the copings are removed and connected to the implant analogs and reinserted in the impression.[9,3]

The common practice of joining the direct transfer copings with acrylic resin is an attempt to stabilize the copings against rotation during abutment analog fastening which controls the relationship between implants in a rigid fashion. However, various literature studies showed no significant differences between the values obtained with acrylic-splinted versus unsplinted groups in impression technique.[10,11,12,13]

MATERIALS AND METHODS : The main model was fabricated duplicating the mandibular arch of typodont of 43 44 45 46 47 48 regions. An addition silicone impression was made of the mandibular arch of the typodont. Then it was poured with self-cure methyl meth acrylate and left for 24 hours so polymerization could complete. Simulating the distance between first premolar and first molar. The two implant channel were made using a dental surveyor in an 8-degree convergence position, simulating condition which is more clinical. The two Adin implants were fixed into the channel using auto polymerizing resin and was left for 24 hrs, straight titanium abutments were attached to fixture with torque of 25 N cm. then wax pattern was made using inlay pattern wax. The base metal copings were built on the abutment in acrylic block, minimizing the gap within 10micro m, the coping was be inspected using light microscope. The master coping was utilized for accessing the accuracy of vertical fit of the master coping on the different experimental group casts was conducted.

The special trays were made using auto polymerizing acrylic resin. To homogenize the acrylic custom tray one-layer base plate wax was used over the copings and acrylic model. All 60 trays were of 3mm in thickness. The trays were seated on the stops over the model using finger pressure and their complete seating was visually confirmed.

In the closed tray impression technique a custom tray was fabricated using self-cure acrylic resin. Closed tray impression post was placed on the implants and the impression was made using both the material. Once the impression material polymerizes the impression is dislodged from the closed tray impression copings.

The open-tray non splinted impression were conducted using a tray with an opening and square impression post in which the screws are exposed outside the tray. After setting of the impression materials, first, the copings are unscrewed and then the impression is removed. The implant analogs are connected to the posts, which are still in place in the impression.

In open tray splinted technique, impression posts were placed and a floss was looped around the open tray impression post then pattern resin was applied in increments till the surface of transfer coping was fully covered with a layer of thickness of 2mm. After the resin was set it was sectioned using a diamond disc. The impression post was then resplinted with the same pattern resin. Then the impression was made. After setting of the impression materials, first, the post are unscrewed and then the impression is removed.

The abutment was connected to the fixture analogs on every cast. The accuracy of every cast was accessed by measuring the marginal gap between the master copings (that was built on the abutment in acrylic block) and the fixture analogs using a microscope.

The vertical misfit was analyzed in terms of marginal gap between the framework and the abutments.

RESULT: The present in-vitro study evaluates and compares the accuracy of two different impression materials and three different impression techniques on the vertical misfit of a three-unit implant supported fixed denture prostheses. Total 60 casts/samples were selected and randomized equally (i.e. n=30 per group) into two groups and treated with two different impression materials viz. poly-ether (Poly ether, n=30) and addition silicone (PVS, n=30) and each materials were further treated with three different impression techniques (closed tray, n=10; open tray, n=10; open tray with splinted abutment technique, n=10).

The outcome measure of the study was marginal gap measured in microns (μm). The marginal gap was assessed at buccal, mesial and lingual sides of both premolar and molar tooth and the average of buccal, mesial and lingual sides were subjected for the statistical analysis. The objective of the study was to compare the efficacy of two different impression materials (Poly ether and PVS) and three different impression techniques (closed tray, open tray, and open tray with splinted) on marginal gap.

MARGINAL GAP

I. Premolar

The marginal gap of two materials (Poly ether and PVS) and three techniques (closed tray, open tray and open tray with

splinted) at premolar is summarized in Table 1 and also depicted in Graph 1. The mean marginal gap was comparatively higher in PVS than Poly ether at all techniques (Poly ether < PVS). Further, in both materials it was higher in closed tray followed by open tray and open tray with splinted the least (open tray with splinted < open tray < closed tray).

Further, for each material, comparing the difference in mean marginal gap between techniques (i.e. intra group), Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in closed tray as compared to both open tray and open tray with splinted in both materials (Table 2 and Graph 2). Further, in both materials, it was also found significantly ($p < 0.001$) different and higher in open tray as compared to open tray with splinted.

Similarly, for each technique, comparing the difference in mean marginal gap between materials (inter group), Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in PVS as compared to Poly ether at all techniques (Table 3 and Graph 3).

Table 1: Marginal gap (μm) (Mean $\pm$ SE, $n=10$) of two materials and three techniques at premolar

Techniques	Materials	
	Poly ether	PVS
Closed tray	20.308 $\pm$ 0.010	20.790 $\pm$ 0.010
Open tray	19.132 $\pm$ 0.012	19.691 $\pm$ 0.005
Open tray with splinted	17.220 $\pm$ 0.014	17.894 $\pm$ 0.008

Graph 1. For each material, bar graphs showing mean marginal gap (μm) between techniques at premolar.

Table 2: For each material, comparisons of difference in mean marginal gap (μm) between techniques by Tukey test at premolar

Comparison- Techniques	Materials			
	Poly ether		PVS	
	Mean diff.	p value	Mean diff.	p value
Closed tray vs. Open tray	1.176	<0.001	1.099	<0.001
Closed tray vs. Open tray with splinted	3.089	<0.001	2.896	<0.001
Open tray vs. Open tray with splinted	1.913	<0.001	1.797	<0.001

Diff: difference.

Marginal gap (μm)- Premolar

*** $p < 0.001$ - as compared to Closed tray

Graph 2. For each material, comparisons of difference in mean marginal gap (μm) between three techniques at premolar.

Table 3: For each techniques, comparisons of difference in mean marginal gap (μm) between materials by Tukey test at premolar

Techniques	Comparison- Materials (Poly ether vs. PVS)	
	Mean difference (%)	p value
Closed tray	0.482	<0.001
Open tray	0.559	<0.001
Open tray with splinted	0.675	<0.001

Marginal gap (μm)- Premolar

*** $p < 0.001$ - as compared to Poly ether

Graph 3. For each technique, comparisons of difference in mean marginal gap (μm) between materials at premolar.

II. Molar

The marginal gap of two materials (Poly ether and PVS) and three techniques (closed tray, open tray and open tray with splinted) at molar is summarized in Table 4 and also depicted in Graph 4. Like, premolar, the mean marginal gap was also comparatively higher in PVS than Poly ether at all techniques (Poly ether < PVS). Further, in both materials, like premolar, it was also higher in closed tray followed by open tray and open tray with splinted the least (open tray with splinted < open tray < closed tray).

Further, for each material, comparing the difference in mean marginal gap between techniques (i.e. intra group), Tukey test

showed significantly ($p < 0.001$) different and higher marginal gap in closed tray as compared to both open tray and open tray with splinted in both materials (Table 4 and Graph 4). Further, in both materials, it was also found significantly ($p < 0.001$) different and higher in open tray as compared to open tray with splinted.

Similarly, for each technique, comparing the difference in mean marginal gap between materials (inter group), Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in PVS as compared to Poly ether at all techniques (Table 5 and Graph 5).

Table 4: Marginal gap (μm) (Mean $\pm$ SE, $n=10$) of two materials and three techniques at molar

Techniques	Materials	
	Poly ether	PVS
Closed tray	20.235 $\pm$ 0.010	20.750 $\pm$ 0.008
Open tray	19.046 $\pm$ 0.013	19.316 $\pm$ 0.018
Open tray with splinted	17.022 $\pm$ 0.056	17.528 $\pm$ 0.012

Graph 4. For each material, bar graphs showing mean marginal gap (μm) between techniques at molar.

Table 5: For each techniques, comparisons of difference in mean marginal gap (μm) between materials by Tukey test at molar

Techniques	Comparison- Materials (Poly ether vs. PVS)	
	Mean difference (%)	p value
Closed tray	0.515	<0.001
Open tray	0.270	<0.001
Open tray with splinted	0.506	<0.001

*** $p < 0.001$ - as compared to Poly ether

Graph 5. For each technique, comparisons of difference in mean marginal gap (μm) between materials at molar.

DISCUSSION : The aim of the study was to evaluate the accuracy of two different impression materials (poly ether & poly vinyl siloxane) and three different impression techniques (closed tray, open tray non splinted & open tray splinted technique) on the vertical misfit of a three-unit implant supported fixed denture prostheses.

There are several methods for obtaining impressions from dental implants, of which two of the most common techniques are closed tray and open tray & open tray with splinted technique. The open tray technique (also called pickup/direct technique) uses a tray with an opening and square impression coping in which the screws are exposed outside the tray. After setting of the impression materials, first, the copings are unscrewed and then the impression is removed. The implant analogs are connected to the copings, which are still in place in the impression.

In open tray splinted technique impression post floss was looped around the open tray impression post then pattern resin was applied in increments till the surface of transfer coping was fully covered with a layer of thickness of 2mm. After the resin was set it was sectioned using a diamond disc. The impression coping was then resplinted with the same pattern resin. Then the impression was made. After setting of the impression materials, first, the copings are unscrewed and then the impression is removed.

By contrast, the closed tray technique (also called transfer/indirect technique) uses tapered impression copings with retaining screws that match the height of the copings. Using a closed tray technique, an impression is made and separated from the mouth while the copings are still connected to the implants. Then, the copings are removed and connected to the implant analogs and reinserted in the impression.[4]

Based on the result of intergroup comparison in first premolar the difference in mean marginal gap between materials, Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in PVS as compared to Poly ether at all techniques.

In supporting to this study Sorrentino et al. also found same results that in the presence of parallel implants, a polyether impression material performed better than additional silicone material in terms of accuracy.[7]

Further in intragroup comparison in premolar region for each material, comparing the difference in mean marginal gap between techniques, Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in closed tray as compared to both open tray and open tray with splinted in both

materials. Further, in both materials, it was also found significantly ($p < 0.001$) different and higher in open tray as compared to open tray with splinted.

In supporting to this study Assif D, Marshak B, Schmidt A.14 in 1996, have also done a study to compare accuracy of implant impression techniques similarly he also found that technique using acrylic resin to splint transfer copings gave better results.

Based on the result in first molar region. Further, comparing the difference in mean marginal gap between techniques Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in closed tray as compared to both open tray and open tray with splinted in both materials.

Similar results in conjunction to the present study was also found by Cabral LM, Guedes CG. He investigated 4 impression techniques in comparison to standard impression technique and showed that the direct impression technique with squared transfer copings with acrylic resin splints sectioned and welded after setting had better results than the other techniques studied.[15]

Similarly, for inter group the difference in mean marginal gap between materials (inter group), Tukey test showed significantly ($p < 0.001$) different and higher marginal gap in PVS as compared to Poly ether at all techniques.

Aguilar et al. showed that hydrophilic addition silicone and polyether impression materials had similar distortion effects for implant impressions when using the open tray technique and machine mixing.[6]

CONCLUSION:

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

- Higher Marginal accuracy of closed tray impression technique was attained with polyether impression material compared with addition silicone during three-unit implant supported fixed prosthesis.
- Higher Marginal accuracy of open tray impression technique was attained with polyether impression material compared with addition silicone during three-unit implant supported fixed prosthesis.
- Higher Marginal accuracy of open tray splinted impression technique was attained with polyether impression material compared with addition silicone during three-unit implant supported fixed prosthesis.
- Polyether impression material performed better in all impression technique showing minimum marginal gap when compared to addition silicone.
- On comparison of impression techniques open tray

splinted technique yielded better result on comparison with open tray and closed tray.

- The marginal gap from lowest to highest is as follows:

Open tray splinted technique with polyether impression material, open tray splinted technique with poly vinyl siloxane impression material, Open tray non splinted technique with polyether impression material, open tray non splinted technique with poly vinyl siloxane impression material, closed tray technique with polyether impression material, closed tray technique with poly vinyl siloxane impression material.

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CORRESPONDING AUTHOR:

Dr. Debajyoti Sarkar

BF-97, Flat:C-1, Water Resources Housing Co-Op.,

Street No.-167, Action Area 1B, New Town,

Kolkata -700156 (W.B.)

Email: sarkardebajyoti1991@gmail.com