

An In-Vitro Study for Evaluating Accuracy of Replication of Implant Position with Different Implant Impression Techniques

¹Dr. Hitendra Shah, ²Dr. Bhagyashree Dave, ³Dr. Setu Patel, ⁴Dr. Shruti Mehta, ⁵Dr. Rahul Bhatt,
⁶Dr. Chirag Vaniya

¹Professor & PG Guide, College of Dental Sciences & Research Centre, Ahmedabad

²Senior Lecturer, College of Dental Sciences & Research Centre, Ahmedabad

³Post graduate student, College of Dental Sciences & Research Centre, Ahmedabad

⁴Professor & Head of the Department, College of Dental Sciences & Research Centre, Ahmedabad

⁵Senior Lecturer, College of Dental Sciences & Research Centre, Ahmedabad

⁶Senior Lecturer, College of Dental Sciences & Research Centre, Ahmedabad

Email :- chirag.vaniya011@gmail.com

ABSTRACT


Aim- The aim of the study was to evaluate and compare accuracy of implant impression between closed tray impression, open tray impression and modified custom tray impression technique.

Materials and Method- Three different impression techniques (closed tray, open tray and modified custom tray impression technique) were evaluated in this study. For impression taking procedure custom trays were fabricated with help of self cure acrylic resin material. One master model made & ten impression were taken for each impression technique using both A-silicone & polyether impression materials. Thus, total 60 impressions were taken. After taking impressions stone models were made. So total 60 specimens made. Digital microscope was used for calibration of inter-implant distance. All the data was statistically analysed using one way ANOVA and Post hoc Multiple Tukey test.

Results- In this study rigid custom trays & two impression materials were used to compare three types of tray design, amongst them modified custom tray impression technique was proven most accurate with polyether (-0.26 +/- 0.02) then subsequently addition silicone modified custom tray impression technique (-0.28 +/-0.08), polyether open tray impression technique (-0.39+/-0.06), addition silicone open tray impression technique (-0.45+/-0.11), polyether close tray impression technique (-0.51+/-0.10), addition silicone close tray impression technique (-0.46+/-0.14).

Conclusion- Compared to open tray & closed tray impression techniques, modified custom tray technique produced more accurate implant impressions.

Keywords- Implant impression technique, Implant position, modified custom tray technique

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Introduction

Implant restoration is becoming the first choice of restoration amongst the patient's for replacement of either single or multiple missing teeth.^{1,2} Prosthetic success of implant restoration demands accurate and passive fit of restoration with the implant placed intra-orally. It is of utmost importance for the cases where two or more implants have been placed to restore multiple teeth.^{1,2,3}

Inaccurate implant-prosthesis fit may lead to mechanical complications like porcelain chipping, screw loosening, screw fracture & biological complication like plaque lodgement, periimplantitis and severe bone loss leads to implant failure.^{4,5} Thus it is necessary to accurately transfer Depth and angulation of implant on working cast. Also, clinician should assure that the intra-oral implant position is accurately duplicated on the working cast. Accurate transfer of implant analogue on working cast depends on many factors like impression material, tray design & material of tray, impression technique, die material & technique of fabrication of working cast.^{5,6,7}

Two most widely accepted impression techniques for multiple implants are open tray technique and closed tray technique. The impression technique should be chosen wisely. E.g., when implants were placed divergently then open tray technique is used and close tray impression is better in patients with less mouth opening, hyper gagging reflex & limited area for access.⁸⁻¹¹ For better accuracy of impression in multiple implants, splinting of impression coping is required. However intra – oral splinting is a cumbersome chair side procedure with highest difficulty in application on posterior areas. Distortion of implant position also occurs due to shrinkage of self-cure resin.¹²⁻¹⁴

Some studies also suggest that splinting of implants leads to more distortion in implant position than non-splinting. Recently Liu et al suggested a modification in custom tray design which provides additional support for impression copings, reduces impression material being used, less dimensional distortion and hence no need for splinting. He found no significant difference between the non-splinted and splinted implant impression techniques.^{1,14-16} The new tray design concept explained in his study produced more accurate implant impressions. However he conducted the in vitro study with two implants only. So this study was carried out to check the accuracy of different implant impression techniques.

Null hypothesis of this study was that no significant difference will be seen in accuracy of replication of implant position with different implant impression techniques

Material & Method

Study model fabrication

In this study, prefabricated mandibular study model (replica of human mandible) made from gypsum product (Type IV). Cast was positioned on milling machine for adequate **Depth, Angulation & Diameter** of drill holes.^{16,17} After preparation of the drill holes 3 implant analogue of the size 3.5*11mm were positioned on the study model at the site of A, B and C. **B position:** Between two central incisors, **A & C position:** premolar region on contra lateral side (fig 1). Parallelism of all three implants was verified by

dentist surveyor. Reference rod was placed on study model for accurate repositioning of custom tray.¹⁸⁻²⁰
(Fig 2)

The total sample size **60** were selected divided in to **6** groups:

AMO: Addition silicone modified custom tray

PMO: Polyether modified custom tray

AC: Addition silicone close tray

PC: Polyether close tray

AO: Addition silicone open tray

PO: Polyether open tray

Custom tray fabrication

Study model was used for fabrication of custom tray. **1** Open tray **2** Close tray **3** Modified custom tray.

Two sheets of baseplate wax were used as a spacer over study model. Self-cure acrylic resin was used for fabrication of custom tray.²¹⁻²³

Close tray: Transfer copings were placed over each implant abutment. Spacer was adapted & custom tray was fabricated with dough method (fig 3).

Open tray: 3 implant impression post were screwed over implant analogue, spacer was adapted like impression post were projected out from it & custom tray was fabricated over it with dough method (fig 4).

Modified custom tray: 3 implant impression post were screwed like the same, spacer was adapted & custom modified tray was fabricated over it with three vertical height opening to cover impression post (fig 5).



Fig.-1



Fig.-2



Fig.-3



Fig.-4



Fig.-5

Impression making

Implant level impression were taken for each of six groups. Tray adhesive was painted inside the tray, left to dry it according to manufacturer (Fig 6). For open tray, impression post were splinted with dental floss & self-cure resin was painted, after curing splinting was separated from in between. Again after 24 hours self-cure resin was painted (Fig .7). PVS (addition silicone) elastomeric impression material in putty consistency was mixed & loaded on tray, light body was placed over impression copings & custom tray was seated over it.(Fig .8)

Polyether (two paste) hand mix elastomeric impression material mixed on paper pad , loaded in to tray & tray was seated over model.

AMO/PMO/AO/PO: Impression made with addition silicone & polyether, impression posts were unscrewed & impression were picked up with post & lab analogue was placed over it and impression post were screwed again. Excess material was trimmed with B.P blade.

AC/ PC: impression made with addition silicone & polyether, impressions were picked up with trasfer copings, lab analogue was placed over it . Excess material was trimmed with B.P blade.



Fig.-6



Fig.-7

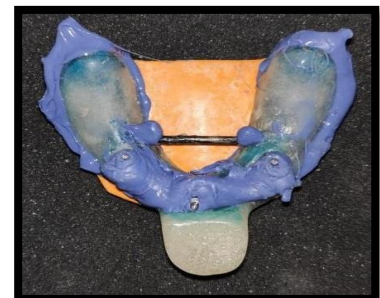


Fig.-8

Cast fabrication

All the impressions were inspected & after proper inspection all impressions were ready to pour with gypsum product (type 4) die stone. Mechanical vacuum mixer and a vibrator were used to pour the cast according to manufacturer w/p ratio. After adequate setting time cast were retrieved.

Measurements (Inter-implant distance)

Digital microscope named (in size microscope) 10X – 200X magnification, pixel 1.3 M, accuracy 8 -30 micrometre was used for calibration of inter-implant distance.^{24,25}(Fig. 9)

Study model was calibrated for inter implant distance from (centre of implant abutment) position

A-B, B-C, C-A (Fig. 10,11,12).



Fig.-9

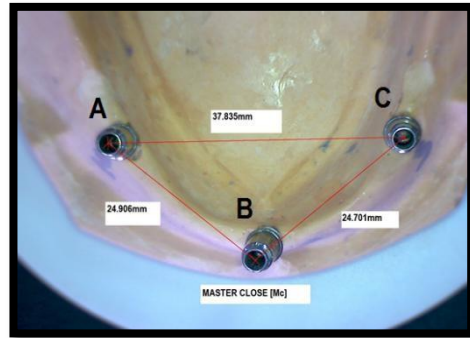


Fig.-10

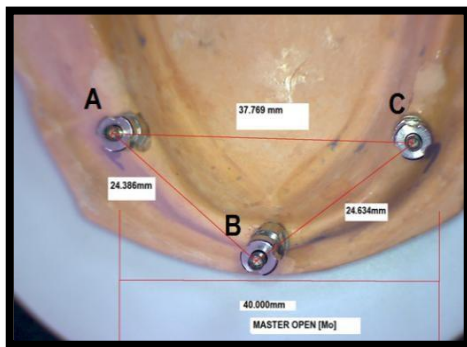


Fig.-11

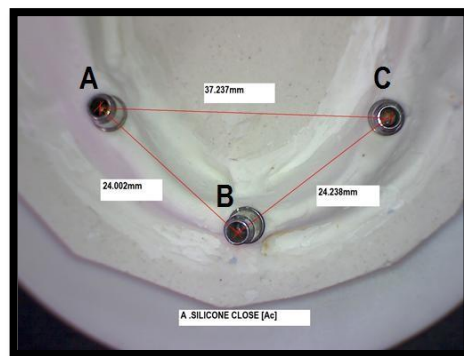


Fig.-12

Results

All cast were made and the data was measured by the primary investigator to minimise bias, Data collected was tabulated using Microsoft Excel 2010. Statistical analyses were performed using SPSS (SPSS Statistics software v20; IBM Corp). Level of significance was set at $\alpha = 0.05$

All the data was statistically analysed using **one way ANOVA** and Post hoc **Multiple Tukey test**.

Source	Sum of squares	Df	Mean square	F	P	
Addition silicon	Between Groups	0.231	2	0.115	9.379	0.001
	Within Groups	0.332	27	0.012		
	Total	0.563	29			
POLYETHER	Between Groups	0.305	2	0.153	31.071	0.000
	Within Groups	0.133	27	0.005		
	Total	0.438	29			

Dependent Variable		Tray	Tray	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
							Lower Bound	Upper Bound
polyether	TUKEY HSD	Close tray	Open tray	-0.11700	0.03135	0.002	-0.1947	-0.0393
			Custom tray	-0.24700	0.03135	0.000	-0.3247	-0.1693
		Open tray	Close tray	0.11700	0.03135	0.002	0.0393	0.1947
			Custom tray	-0.13000	0.03135	0.001	-0.2077	-0.0523
		Custom tray	Close tray	0.24700	0.03135	0.000	0.1693	0.3247
			Open tray	0.13000	0.03135	0.001	0.0523	0.2077

Dependent Variable		Tray	Tray	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval	
							Lower Bound	Upper Bound
Addition Silicone	TUKEY HSD	Closed tray	Open tray	-0.00600	0.04961	0.992	-0.1290	0.1170
			Custom tray	-0.18900	0.04961	0.002	-0.3120	-0.0660
		Open tray	Close tray	0.00600	0.04961	0.992	-0.1170	0.1290
			Custom tray	-0.18300	0.04961	0.003	-0.3060	-0.0600
		Custom tray	Close tray	0.18900	0.04961	0.002	0.0660	0.3120
			Open tray	0.18300	0.04961	0.003	0.0600	0.3060

TRAY DESIGN	MEAN	SD
Addition silicone CLOSED tray	-0.46	0.14
Polyether CLOSED tray	-0.51	0.10
Addition silicone OPEN tray	-0.45	0.11
Polyether OPEN tray	-0.39	0.06
Addition silicone CUSTOM tray	-0.28	0.08
Polyether CUSTOM tray	-0.26	0.02

Discussion

In this study, we compare three different type of tray design for implant impression. Amongst them custom tray design is more accurate with inter implant distance measured for three position of implants being transferred on cast. Therefore the null hypothesis “all three tray design are accurate for implant impression” is rejected.

Major clinical benefits of custom tray are less chair side time, easy to handle, accurate transfer position of implant to the cast, rigid support for impression coping, conservative use of material, customised approach for each patient. Burns et al found custom tray with rigid material is more accurate than stock tray for open tray implant impression technique. Rigid tray material and impression material increases the accuracy of implant impression. Addition silicone and polyether are used in this study, polyether is more rigid and accurate amongst them. Dimensional distortion due to polymerization occurs in addition silicone rather than polyether. Excessive space for the material is leads to distortion of impression.^{18,26,27}

Liu et al founded chimney tray impression was accurate, no statistically significant difference seen between splinting and non-splinting of impression copings in a two-parallel-implant situation. The limitations of his study was lack of comparison with closed tray, Polyether was not used, and study was done on two parallel implant situation. Some studies suggested to accurate impression without splinting. Inturregui et al got accurate polyether impression with two parallel implants without splinting.^{1,28} Cabral LM concluded splinted and non-splinted impression had same accuracy.¹⁷ Cerqueira NM stated micro strain induced by various splinting methods and acrylic resin types for implant impressions. Tilted implants will distort the impression more while picking up the impression, so rigid impression material and rigid custom tray will eliminate distortion of impression and copings.^{13,29,30} So in this study rigid custom tray, two impression material were used to compare three design of tray, amongst them custom tray was proven most accurate with polyether (**-0.26 +/- 0.02**) then subsequently addition silicone custom (**-0.28 +/-0.08**), polyether open (**-0.39+/-0.06**), addition silicone open (**-0.45+/-0.11**), polyether close (**-0.51+/-0.10**), addition silicone close (**-0.46+/-0.14**).

Conclusion

Within limitations of this study, following conclusions can be made:

Compared to open tray & closed tray impression techniques, modified custom tray impression technique produces more accurate impressions.

In both open tray impression technique and custom tray impression technique, polyether had more accuracy in replicating implant position compared to Addition silicone impression material.

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