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A Comparative Analysis of The Accuracy of Implant Master Casts Constructed from Two Different Transfer Impression Techniques: An In Vitro Study

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ABSTRACT

Aim: To compare and evaluate the accuracy of two different implant transfer impression techniques.

Materials and Method: A resin master model with 3 implants in place of the maxillary left lateral incisor to first molar was fabricated. Impressions were made by direct and snap on impression techniques using polyether impression material. After impression making, all the casts were poured in dental stone. Linear changes between the inter abutment distance of all the master casts were quantified using a profile projector. The data were analyzed statistically using Wilcoxon's signed rank test (Iintra group comparisons) & Mann-whitney test (Interogroup conversions). For the entire test a p<0.05 was considered for statistical significance.

Results: The results showed significant deviations between master casts of 2 groups and master model (except for inter abutment distance and also in between the groups) with P < 0.05. Clinically these deviations were not significant as the values are within the accepted range.

Conclusion: The master casts obtained by using "direct impression" technique showed significantly less deviation from the ***"Snap-on impression"*** technique but clinically the deviations are within the accepted range. The positional accuracy of snap on impression technique was clinically acceptable.

Keywords: Dental Implants, Direct Impression Technique, Snap-on Impression Technique, Impression Material.

INTRODUCTION

The success of Osseo integrated implants has made their use acceptable for patients with complex prosthetic needs. The accurate impression making has been emphasized as an significant element in the obtainment of a ***"Passive fit "*** between implants and the superstructure. An understanding of biomechanics of implant prosthodontics necessitates the fabrication of a passively fitting prosthesis. Failure to do so may place undue forces on one of the implants and its associated components, leading to fatigue failure of prosthesis and / or loss of Osseointegration.[1] For implant impression technique, the impression material must rigidly hold the impression coping and to prevent accidental displacement of the coping when abutment analog or implant analog is connected, minimal positional distortion between abutment replicas or implant replicas as compared with their intra oral abutments or fixtures. To meet these requirements rigid and stable impression materials such as polyether and polyvinylsilioxane elestomeric impression materials have been used for implant impression procedures.[2, 3]

Numerous impression techniques have been proposed and studied for multiple implants which includes. Direct technique where in the impression transfer copings are picked up with the impression

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when it is removed from the mouth. However, the necessity of unscrewing the guide pin screws retaining the transfer copings before removing the impression can be a disadvantage in clinical practice.

In the recently introduced the snap-on impression technique,positioning cylinders with impression caps placed on the implants transmucosal neck are picked up in the impression without the use of screws. This method seems to be simple and easily handled in clinical practice.

However, there has been little evaluation of the accuracy of working cast in linear dimension. Therefore the present study was undertaken, to compare and evaluate the accuracy of two different implant transfer impression techniques.

MATERIALS AND METHOD

- Implant Fixture with internal hex (CSM, ITI, fixtures implant 4.1D,x 10mm, Daegu, Korea.)
- Heat polymerizing clear acrylic resin (Trevalon denture material, DENTSPLY limited, De Trey Division, Surrey England).
- Autoply merzing acrylic tray material (MP SAI ENTREPRISE, Mumbai).
- Tray adhesive (VPS Tray adhesive, 3 M ESPE AG, secfeld, Germany)
- Stock trays (Jabbar & Co. India)
- Square type impression coping with guide pins (CSM implant, Daegu, Korea)
- Snap on impression copings with positioning cylinder
- Polyether impression material (impregum, 3M ESPE AG, secfeld, Germany)
- Abutments (Octa abutments 4mm height COC abutment 5.5mm height)
- Abutments analogs (Replace analog implant 5.5 & 4 mm in Height)

Methods of Collection of Data

Preparation of Master model

The wax model was prepared using a maxillary Frasaco mould. The teeth were removed from left lateral incisor to first molar to simulate a partially edentulous situation. Three implant fixures with internal hex were positioned in the wax model at the edentulous sites A, B & C respectively with 7mm of minimum inter-implant distance. The wax model with the fixture was invested, dewaxed and acrylized. Heat polymerizing clear acrylic resin was used in the fabrication of the master model. Later, respective abutments were fastened to the fixture and a radiograph was taken to check the fit at implant abutment interface. The linear distance between the margins of the implant abutments in the master model was recorded using a profile projector. Two types of impression trays were used in this study i.e., custom made and stock trays. Two types of impression techniques i.e., direct impression technique and snap-on impression technique were used in this study.

GROUPING THE IMPRESSION:

Group I: In the direct impression technique an auto polymerizing acrylic custom made tray of 2 mm thick wax spacer and with three holes at the respective implant sites were used. The holes were made to secure the guide pin screws to the transfer coping. This technique required initial fastening of the transfer coping, however, a separate fastening guide screw projects above the height of the coping. The tray adhesive was applied 15 minutes before the impression was made. The impression was made with a hole in the tray, and after the material had set the guide screw was loosened and the tray was removed so that the impression retained the transfer coping. After the impression was removed an appropriate implant analog was carefully fastened to the transfer coping while it remained in the impression material. Ten such impressions were made using this technique.

Group II: In snap-on technique the transfer coping was snapped on the abutment with positioning cylinders. The impression was made with a stock tray and after complete setting of the material, the tray was removed so that the impression retains the transfer coping and positioning cylinder. Then the impression was removed and appropriate implant analog was carefully seated to the transfer coping while it remained in the impression material. Ten such impressions were made using this techniques. The impression trays (custom made and stock trays) were coated with a tray adhesive 7 minutes before the impression were made, and Twelve minutes were allowed for setting of the impression material in both the techniques.

Fig 1: Materials used in the study.

Fig 2: Master resin model with abutments.

Fig 3: Polyether impression with direct transfer coping and guide pins.

Fig 4: Polyether impression with snap on transfer copings and positioning cylinders.

PREPARATION OF THE MASTER CAST;

Once the impressions were made, all the impressions were stored at room temperature before being poured, then 12 ml of distilled water was dispensed in the jar of vacuum mixer and 50 gm of improved dental stone (type IV) was sifted

Fig 5: Polyether impression with analogues attached to transfer coping.

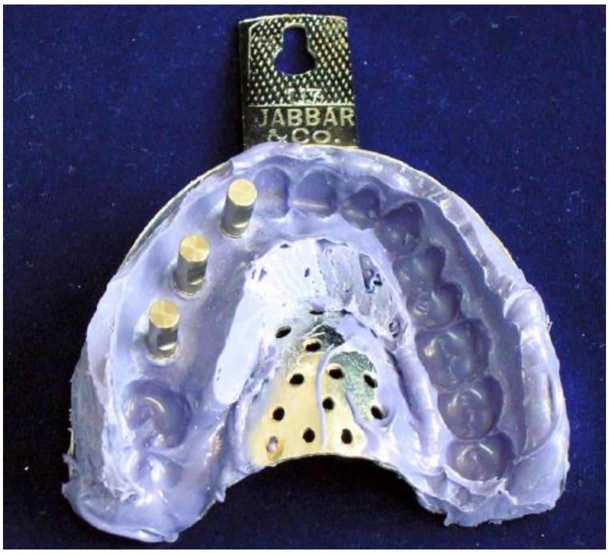

Fig 6: Polyether impression with analogues attached to snap on transfer coping.

Fig 7: Master cast of direct impression technique.

Fig 8: Master cast of snap on impression technique.

Fig 9: Nikon file projector.

gradually in to the water and allowed to soak for 30 seconds. Later the stone was mechanically mixed under vacuum for 30 seconds. The small increments of the stone mix was placed in the impression which was placed in the vibrator from one end of the impression . After pouring the casts, the improved stone was allowed to set for 24 hours before separating the casts from the impression.

MEASUREMENT PROCEDURE

The linear distance between the three implant inter abutments were measured using a profile projector with an electronic digital micrometer mechanism having a measurement capability of 1 μm.

In the direct technique the distal margins of the each abutment was taken as reference plane. In the snap on technique the distal margin of each abutment was taken as reference plane.

The inter abutment distance was measured between the 3 reference margins of the abutment i.e., from A to B, B to C and A to C respectively.

Al the measurements were recorded three times by the same operators and the mean value was calculated. The measurements of the master model and the stone casts obtained with two impression techniques were tabulated and statistically analyzed.

STATISTICAL ANALYSIS

Descriptive data that included in standard deviation and percentage were calculated for each group and for deviation from master model for each distance intra group comparisons (from master model) were done by Wilcoxon's signed rank test and intra group comparisons by Mann – Whitney Test. For all the tests a P-value 0.05 or less was consider for statistical significance.

RESULT

The linear measurement of all intraabutment distance AB, BC and AC were presented as mean and standard deviation percentage between master model, Group I and Group II casts (in μm)(Table1and Graph 1 to Table 3 and Graph 3) by using Wilcoxon's signed rank test.

In Table1 and Graph 1 the mean and percentage deviations of intraabutment distance (AB) was found to be statistically non significant as in Table 2 and Graph 2. The mean and percentage deviations of the intraabutment distance (BC) was found to be statistically significant and in Table 3 and Graph 3 the mean and percentage deviation of intra abutment distance (AC) found to be statistically significant (except in Group I where it was found to be statistically non significant). The comparative analysis of the mean percentage deviation between the two groups of casts in μm was by Mann-Whitney test Table 4 shows the comparative analysis of mean percentage deviation of intra abutment distance AB, BC, CA between Group I and Group II was found to be statistically significant.

Table 1: Shows the mean and percentage deviation of interabutment distance (AB) between master model, group I and Group II, Casts (micro meter).

Groups	Master Model	Working Model		Deviation from MM	Percentage of Deviation	Significance	
		Mean	SD			Z-value	P-Level
Gr-1	11.411	11.427	0.051	(-) 0.016 ± 0.051	0.20%	1.07	0.28 , NS
Gr - II	11.285	11.358	0.177	0.073± 0.177	0.70%	0.87	0.39, NS

* Wilcoxon's Signed Rank test (Intragroup comparison)

Table 2: Shows the mean and percentage deviation of interabutment distance (BC) between master model, group I and Group II, Casts (micro meter).

Groups	Master Model	Working Model		Deviation from MM	Percentage of Deviation	Significance	
		Mean	SD			Z-value	P-Level
Gr-1	11.614	11.528	0.023	0.086± 0.023	0.70%	2.81	< .01 , S
Gr - II	11.674	11.485	0.056	0.189± 0.056	1.60%	2.8	< .01, S

* Wilcoxon's Signed Rank test (Intragroup comparison)

Table 3: Shows the mean and percentage deviation of interabutment distance (CA) between master model, group I and Group II, Casts (in um).

Groups	Master Model	Working Model		Deviation from MM	Percentage of Deviation	Significance	
		Mean	SD			Z-value	P-Level
Gr-1	23.031	23.042	0.041	[-] 0.011± 0.041	0.05%	1.68	0.09 NS
Gr - II	22.957	22.782	0.172	0.175± 0.172	0.76%	2.81	< .01, S

* Wilcoxon's Signed Rank test (Intragroup comparison)

Table 4: Shows the comparisions of much percengtage deviation between the group I & group II casts (micrometer).

Distance	Master Model	Group - I		Group - II		Grade I Vs Grade II
		Mean /SD	Percentage of Deviation	Mean /SD	Percentage of Deviation	Significance
A B		0.016 ± 0.051	0.20%	0.073 ± 0.177	0.70%	P < 0.05, S
B C		0.086 ± 0.023	0.70%	0.189 ± 0.056	1.60%	P < 0.001, HS
C A		0.011 ± 0.041	0.10%	0.175 ± 0.172	0.80%	P < 0.01, S

DISCUSSION

The mechanical adaptation and biologic seal of mating implant components are two major prerequisites for the fabrication of well – fitting implant supported fixed prostheses. The mechanical complications that arise from imprecise fit of superstructure include loosening, bending, and fracture of the prosthetic or implant components. Biologic consequences can occur as a result of loading beyond physiologic tolerance levels, that arise from imprecise fit of superstructure, and often involve an infectious process. Eventual loss of integration may arise from either source [18]. The accurate transfer of the intraoral implant position to the laboratory is critical for the eventual fit of the superstructure.

In this context, studies related to impression making have focused on impression techniques and for materials. Impression techniques are based on either the direct or indirect transfer of components. However, different impression materials and trays can be used depending on the chosen impression technique.[36] A number of techniques are available for transferring implant positions to a working cast[37,38,39]. In the present study a single material was chosen for the purpose of investigation, as the attention was on efficacy of the two different transfer impression techniques.[2,3,15,26,38.] Two impression techniques used in the present study were of abutment level and direct in nature. The direct impression transfer technique was found to be a better technique than the indirect technique in the earlier study.[26]

In one study conducted to investigate the accuracy of indirect impression technique at the implant level and abutment level using polyether and poly vinyl siloxane showed that indirect pickup impression technique at the abutment level as the more accurate technique.[38] In another study it was found that the tapered transfer impression copings were unable to consistently and accurately reposition the analoges as that of the original position. [18] The unmodified sand blasted adhesive coated screw retained pickup transfer copings used for direct impression technique produced lower rotational movements. [32]

However, in our study we have used only the transfer coping which are direct in nature for the impression purpose. In the light of these studies, it is hard to determine which technique is clinically superior. However there has been little evaluation of the accuracy of the master cast constructed from the snap-on impression technique. Hence the present study was carried out. The results showed that Group I and Group II casts showed a little increase in inter-abutment distance, which could be attributed to the linear setting expansion of the die stone[26]. And also after making the impressions the implant analogs were attached using guide pin screws, this might have resulted in rotation of transfer coping within the impression material or as there were no recrientation grooves in the analoges, that would help in repositioning. Spector and associates attributed the inaccuracies in repositioning the abutment analogues to the dimensional instability of materials as well as the mechanical errors in positioning the components during the impression procedure. [11]

In the present study stock trays were used to fabricate the master casts of this group and this could have lead to some amount of distortion. Earlier studies have shown that the custom trays produced more accurate casts then the stock trays.[8] Although statistical analysis showed significant deviations between the master casts of two groups & master model, and also in between the groups, the clinical relevance of these differences is questionable and the application of these findings to clinical situations could be a complex task.

Despite the differences found, the outcome using both techniques appears to be comparable which is in agreement with earlier studies[1,42,43]. In the previous study the mean distortions between the original model and master casts were about 100 µm, Therefore, the absolutely precise fit may be unattainable.[1] Another study has shown that biologic response for misfit levels between 38 µm and 345 µm is similar.[42] Misch CE [43] reported that the implant prostheses distortions ranging from 291 to 357 µm may be observed during the fabrication of the prostheses, because the final impression material shrinks while setting, dental stone expands and also implant component misfit.

The similarity in outcome between the direct impression technique and snap-on impression technique may imply that the snap on impression technique can be efficient and cost effective and may result in well fitting superstructures. However, further clinical studies are required to elucidate the effects of impression material thickness as well as the outcome of these impression techniques on superstructure fit.

CONCLUSION

The master casts obtained by using direct impression technique showed significantly less deviation from the snap on impression technique but clinically the deviations are within the accepted range.The positional accuracy of snap on impression technique was clinically acceptable and this technique was found to be cost effective and convenient for multiple implant transfer.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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