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Effect of Plastic Impression-Transfer Copings on the Dimensional Accuracy of Implant Impressions

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Research Article

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ABSTRACT

Objective: The purpose of this in vitro study was to evaluate the effect of plastic impression-transfer copings on the dimensional accuracy of close tray implant impressions.

Material and Methods: A master model consisting of acrylic main material was created. Five parallel holes were drilled for the analogs. Special measuring spoons were prepared for the models created with self-hardening polymethyl methacrylate resin. Our research consisted of 2 groups. The first group consisted of five parts and the impression was taken using the Implant Plastic impression-transfer part coping method. The second group, on the other hand, consists of five parts, and this time measurements were taken without using the Plastic impression-transfer coping method. Vinylpolysiloxane impression material was used for both groups. At the end of the impression process, plaster models were made with type IV calculus. The plaster models were scanned with laboratory-type scanner and recorded in the measurement program. To create a standard operation between the groups, measurements were made of each analog from a certain reference point. Measurement results were recorded in millimeters and pairwise comparisons were made using Welch's t-test analysis.

Results: How the plastic impression caps affect the measures was concluded by applying the t-test to each point. The deterioration in the measurements taken with the cap was lower for all distances compared to the measurements taken without the cap, but the difference was not significant ($p>0.05$).

Conclusions: While the distortions seen in the right and left measured intervals were found as the expansion type, the distortions in the posterior and anterior intervals were determined as the compression type. Although there are dimensional changes in the measurements taken without the use of a cap, the findings were not found to be clinically significant.

Key words: Dental Implant, Implant Impression Material, Plastic Impression-Transfer Coping, Dimensional Accuracy, Dental Impression Technique.

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Introduction

Edentulism is decreasing due to current treatment modalities and preventive criteria, but the extent of the aged population will continue to expand.[1] Considering common global population aging, edentulism will not only influence persons in developing nations; there will be an appropriate proportion of edentulous individuals in aging communities worldwide.[1] Nowadays implant treatment is very common for edentulism and patients' long-term gratification has been observed by many clinical studies.[2] Studies found 96-99% implant success in the mandible and 80-90% in the maxilla.[3]

Stresses from inappropriate dental prostheses cannot be neutralized in implants because of not require periodontal ligament support. Thus, the manufacture of prosthesis has to obtain the most available passive fit.[2] The absence of passive fit can cause several complications in both implants and dental prostheses. Screw loosening, occlusal disharmony, loss of prosthesis, and fracture of implant components can count as these complications.[2]

Accuracy of impression which transfers the inter-implant dimensions exactly as it is the most important issue to fulfill passive fit.[2] There are very important issues to make an accurate impression. The material used for impression, impression technique, tray type, splinting of impression copings, and angulation of implants affect the accuracy of implant impressions.[2] So far, numerous implant impression techniques and different impression-transfer materials have been analyzed considering accuracy. In general, implant impressions can categorize as direct or indirect techniques. In the direct techniques, the tray has an open area on the tray for unscrewing the impression copings. This technique is also known as the

open tray impression technique. While impression removal, all pieces are unfastened at the same time, and copings are fixed on the same screws in the direct technique. Indirect techniques have transfers that remain on the implants during the impression. These transfers are fastened to the analog after the impression tray is removed from the mouth. So, this technique is also named as closed tray impression technique. Both close-tray impression and open-tray impression techniques are recommended for the fabrication of implant prostheses. The close tray impression technique is widely used because of practical clinical application.[4]

The accuracy of the close tray impression technique with plastic impression copings and a positioning cylinder is the same as the open tray impression technique with non-splinted and splinted impression copings, beyond impression and cast materials. Plastic impression copings remaining in the impression may improve accuracy by preventing both impression copings and the coping-analog unit from rotating within the impression.[4]

Up to now, open or close tray impression techniques, different impression materials, impression coping materials and splinted impression copings have been investigated for affecting factors on the accuracy of implant impressions. Nevertheless, the findings are not always constant. There is a lack of consensus about the effect of plastic impression transfer coping on the dimensional accuracy of implant impression. Therefore, the aim of this study was to be presenting to literature evidence of the effect of plastic impression-transfer copings on the dimensional accuracy of implant impression. Accuracy of two different impression techniques were compared: closed-tray impression with transfer impression copings and closed-tray impression without transfer impression copings. The research hypothesis was that using plastic impression copings would influence the dimensional accuracy of the impression.[5-6]

Material and Methods

Fabrication of the Master Model

In this in vitro study, the auto-polymerizing acrylic resin was used for a master model from an edentulous maxilla mold (Probase Cold, Ivoclar, Vivadent Inc, Zurich). Five parallel holes were drilled in the middle of the arch and on the both sides canine and first molar region. Next, implant analogs (Moment Dental Implant Systems, Turkey) were placed in the drilled holes. After ensuring that analogs were parallel to each other, they were secured using auto-polymerizing acrylic resin leaving 1 mm of the implant platforms above the acrylic resin. Analogs were named from A to E from the posterior left to the posterior right (Figure 1).

Fabrication of Custom Trays

Moment implant system's impression copings were fastened to the analogs. These conical impression copings which were fixed in the master model were covered with 2 layers of modeling wax to allow the standard thickness of impression material. Five identical 2 mm–thick custom impression trays were made using auto-polymerizing polymethyl methacrylate resin. Autopolymerizing polymethyl methacrylate resin was mixed by following the manufacturer's instructions. Each tray was customized perforated to relief pressure during the impression (Figure 2).

Impression Procedure

This in vitro study consisted of 10 specimens divided into 2 groups of 5 each (Table 1). For the PI group, the conical impression copings and then the plastic impression copings were fastened. All impressions were made with additional silicone (Zhermack Elite HD+ Regular Body, Kouigo, Italy) in a temperature-controlled environment (23 ± 1°C) according to the manufacturer's instructions and specification number 19 of ADA. Impression material was mixed by an auto-mixing cartridge.12 mL of the impression material was inserted around the copings to make sure covering they copings. The impression tray was filled with the rest of the impression material (35 mL). According to the manufacturer's recommendation, 12 minutes was the waiting time for impression material polymerization. Once the impression had been obtained, the conical transfer impression copings were removed from the mouth and fastened to the implant analogs. Then this analog and impression coping unit were positioned by firmly pushing in each plastic impression coping which was in the impression tray.

For the NON-PI group, only the conical impression copings were fastened to the analogs. Then same impressions protocol was repeated for this group. Once the impression had been obtained, the conical transfer impression copings were removed from the mouth and fastened to the implant analogs. Then this analog and impression coping unit were inserted by pushing into each respective notch (Figure 3).

Cast preparation

After impression protocol, casts were made from type IV dental stones (Herostonel Vigodent Inc., Rio de Janeiro, RJ, Brazil). According to the manufacturer's instructions, the powder/water ratio was 30 g/7 mL, and the dental stone was vacuum mixed. 120 minutes was the waiting time for pouring then the impression was separated from the cast (Figure 4). All laboratory procedures were performed by the same operator.

Measurement Protocol

The measurement phase started after completing laboratory procedures. Lab-type scanner (D15®; Camcube, Montreal, Canada) was used for scanning casts (Figure 5). After the scanning protocol, data were transferred to the measurement program (UP3D Manager).

Statistical Analysis

Data were saved as millimeters. Welch's t-test was used to make pairwise comparisons. t-test was applied for each distance. A significant level was $p<0.05$.

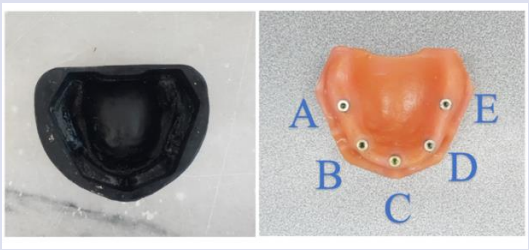

Figure 1. Edentulous maxilla mold (a), a master model with analogs (b)

Figure 2. Custom trays

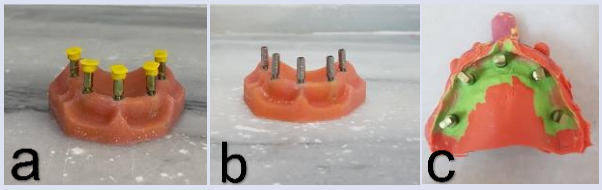

Figure 3. Master model was fastened impression copings and plastic transfer impression copings (a, group 1), master model was fastened impression copings (b, group 2), impression had been obtained and analog-impression coping unit positioned in the impression (c)

Figure 4. Casts before scanning

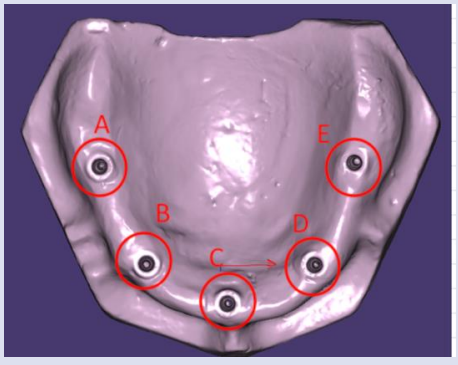

Figure 5. Scanned cast

Results

This study aimed to determine if plastic impression-transfer coping affects dimensional accuracy. For all impressions used one master model. Five casts were made for each study group (Table 2-3). All specimens were measured and involved in the analyses. A specific reference corner was chosen in each analog to ensure standardization. The distortion seen in the impression taken without the plastic impression-transfer coping was higher than the impression taken with the plastic impression-transfer coping for all the distances, but no significant differences were found ($p>0.05$).

Discussion

This in vitro study was aimed to evaluate plastic impression coping on the dimensional accuracy of the implant impression. Research hypothesis, using plastic impression copings would influence the dimensional accuracy of the impression, was rejected. Plastic impression copings influenced the dimensional accuracy of the impression but it was not statistically significant.

For a prosthesis to be successful, there must be a passive fit between the abutments and frameworks of the prosthesis.[7] Dimensional accuracy of impression is the key to a successful prosthesis and the impression must duplicate the clinical situation exactly.[8] To date, researchers focused on the aspects which affect the accuracy of impressions.[9]

First, implant components used in impression, conical impression copings, affect the accuracy.[7] According to Tan, impression copings significantly affect dimensional accuracy of impression.[9] Moment dental implant systems were used for this study. The second factor is the impression technique. Closed-tray technique was chosen in this in vitro study. In this point, several studies have evaluated and reported that the three-dimensional accuracy of the close tray impression technique is acceptable when inter-implant angulations were up to 15°.[2,10,11]

The type of the impression material is the third factor affects the accuracy of impression. There are plenty of in vitro studies that evaluated the dimensional accuracy of impression materials.[12,13] Additional silicone was used in this study. Because according to the literature, additional silicone has reasonable properties for implant impression.[7]

The dimensional change of dental stone is another aspect. This issue may cause the abutment replica's displacement in the cast. Type IV dental stone was used in this in vitro study. Anusavice[14] reports that type IV dental stone has at most 0.10% expansion of linear setting. Consequently, the expansion of dental stones can cause displace impression coping or abutment replicas. Nakhaei *et al.*[14] reports that the dimensional accuracy of implant impression techniques usually uses two-dimensional measurements. In this study, the lab-type scanner has been used to compare distances in the master model and in the definitive casts because it measures possible

distortions in three-dimension. This factor increases the veracity of this study.

The objective of this in vitro study was to be presenting new evidence to the literature about the effect of plastic impression-transfer copings on the dimensional accuracy of implant impressions. Thus, the null hypothesis indicating using plastic impression copings makes no difference in the dimensional accuracy of implant impressions was accepted. Results of this study show that plastic transfer impression copings increase measurement accuracy, but no clinically significant differences were found as consistent with the findings of Nakhaei *et al.* and Arieli *et al.*[14,15]

Also, methodological difficulty in the research design must be taken into account. As above mentioned above except for impression coping design, impression material, dental stone type; the presence of saliva, patient movement during the impression, change in the time from the impression until the master cast is obtained, the laboratory process may affect the definitive accuracy. Further studies are needed to determine the effect of plastic implant transfer coping on dimensional accuracy of implant impression with an angulated implant**.** This in vitro study is proof that using plastic impression-transfer copings help operators to transfer the exact position of an implant to the working cast.

Conclusions

According to this in vitro study:

1. Distortions in the anterior-posterior distances were found compression type.
2. Distortions in the right-left distances were found as expansion-type.
3. Dimensional change was found the impression using without plastic impression-transfer coping, but no clinically significant differences were found.

Table 1. Study Groups

Study Groups (n=5)	
PI	Close tray impression with plastic impression copings
NON-PI	Close tray impression without plastic impression copings

Table 2. Measurements of Group PI (Close tray impression with plastic impression copings).

MASTER MODEL		**1.MODEL**	
A1-B1	18.373	A1-B1	18.361
A1-C1	31.881	A1-C1	32.06
A1-D1	40.403	A1-D1	40.384
A1-E1	43.383	A1-E1	43.351
2.MODEL		**3.MODEL**	
A1-B1	18.367	A1-B1	18.622
A1-C1	31.834	A1-C1	32.197
A1-D1	40.486	A1-D1	40.602
A1-E1	43.105	A1-E1	43.718
4.MODEL		**5.MODEL**	
A1-B1	18.371	A1-B1	18.403
A1-C1	31.924	A1-C1	31.923
A1-D1	40.21	A1-D1	40.281
A1-E1	43.286	A1-E1	43.081

Table 3. Measurements of Group NON-PI (Close tray impression without plastic impression copings)

MASTER MODEL		**1.MODEL**	
A2-B2	18.373	A2-B2	18.528
A2-C2	31.881	A2-C2	32.166
A2-D2	40.403	A2-D2	40.374
A2-E2	43.383	A2-E2	43.687
2.MODEL		**3.MODEL**	
A2-B2	18.247	A2-B2	18.704
A2-C2	31.891	A2-C2	32.145
A2-D2	40.563	A2-D2	40.232
A2-E2	43.902	A2-E2	43.229
4.MODEL		**5.MODEL**	
A2-B2	18.468	A2-B2	18.432
A2-C2	31.992	A2-C2	31.998
A2-D2	40.34	A2-D2	40.19
A2-E2	43.34	A2-E2	43.25

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