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Original Research

Comparative evaluation of accuracy of different implant impression techniques: An in-vitro study

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***ABSTRACT*:**

Background: Using appropriate impression materials and techniques guarantees accurate transfer of implant position and precise surface details of prepared teeth to the definitive cast. Different implant impression techniques including direct (open tray) and indirect (closed tray) techniques are commonly used. This technique is frequently indicated when there is limited inter-arch space or tendency to gag, or working in the posterior region of the mouth. A variety of factors may affect the accuracy of implant impressions such as different impression techniques, impression materials, tray type, the number of implants, angulation of implants or abutments and prosthetic connection features. **Aim of the study:** To compare accuracy of different implant impression techniques. **Materials and methods:** The present study was conducted in the Department Prosthodontics of the dental institutions. An edentulous maxillary cast with six implant analogues in the anterior region was used as the reference model. Two types of impression trays were used; they were (i) closed custom trays, and (ii) open custom trays. Two impression techniques were studied. They were: Group I - Polyvinyl siloxane impressions (putty and light body) and Group II - Polyether impressions (medium body). All the impressions were poured using the same quantity of Type IV dental stone. The casts were allowed to set for 1 hour before removal from the impression. Only one cast was formed from one impression. The casts were subjected to measurement after 24 hours to simulate clinical situation. **Results:** It was observed that the average dimensional errors in impressions with open custom trays in Group 2 were comparatively less as compared to Group 1. However, the dimensional errors were similar in group 1 and group 2 when impressions were made using closed custom tray. On comparing the results, it was found that the results are statistically non-significant. **Conclusion**: Within the limitations of the present study, impressions made with polyvinyl siloxane material with closed custom tray were dimensionally accurate than polyether impressions. On the contrary, the impressions made with polyether impression material and polyvinyl siloxane were dimensionally similar with both types of custom trays. Thus, this can be concluded that polyvinyl siloxane material with closed custom tray is the most reliable impression technique for implants.

Keywords: Implant impression, maxillary implants, dental implant, impression technique,

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INTRODUCTION:

Using appropriate impression materials and techniques guarantees accurate transfer of implant position and precise surface details of prepared teeth to the definitive cast.[1] Making accurate impressions is necessary as the first step for achieving passive fit in implant-supported restorations. [2] Otherwise, many mechanical and biological complications such as screw loosening, fixture fracture, occlusal discrepancy and bone loss may occur.[3] Different implant impression techniques including direct (open tray) and indirect (closed tray) techniques are commonly used. [4] While most authors advocated the direct technique, some have found the indirect technique to be more accurate, requiring less

working time, and being easier for the operator and the patient. This technique is frequently indicated when there is limited inter-arch space or tendency to gag, or working in the posterior region of the mouth. A variety of factors may affect the accuracy of implant impressions such as different impression techniques,[1-4] impression materials, tray type, the number of implants, angulation of implants or abutments and prosthetic connection features. [3-6] Literature reveals limited information about the impression accuracy of partially edentulous arch with multiple non parallel implants compared to completely edentulous arch. Hence, the present study was conducted to compare accuracy of different implant impression techniques.

MATERIALS AND METHODS:

The present study was conducted in the Department Prosthodontics of the dental institutions. The ethical clearance for the study was approved from the ethical committee of the hospital. An edentulous maxillary cast with six implant analogues in the anterior region was used as the reference model. Two types of impression trays were used; they were (i) closed custom trays, and (ii) open custom trays. Custom impression trays were fabricated using autopolymerizing acrylic resin with 3 mm space for impression material. 10 identical custom trays were made by duplication. Windows were created in the same trays for making the open tray impressions after the completion of closed-tray impressions. Vertical stops were incorporated using autopolymerizing acrylic resin in all trays, to facilitate repeated positioning and to prevent over-seating of the impression tray. Two impression techniques were studied. They were:

- Group I - Polyvinyl siloxane impressions (putty and light body)
- Group II - Polyether impressions (medium body)

Polyvinyl siloxane impressions, the trays were coated with a uniform layer of tray adhesive and were allowed to dry for 15 minutes according to manufactures instructions. Impressions were made with putty and light body using Dual mix technique. The impressions were allowed to set for 10 minutes (twice the manufacturer's recommendation time) under a standard load of 500 gm. The load was applied uniformly on the tray using a tripod stand. All the impressions were poured using the same quantity of Type IV dental stone. The casts were allowed to set for 1 hour before removal from the impression. Only one cast was formed from one impression. The casts were subjected to measurement after 24 hours to simulate clinical situation.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

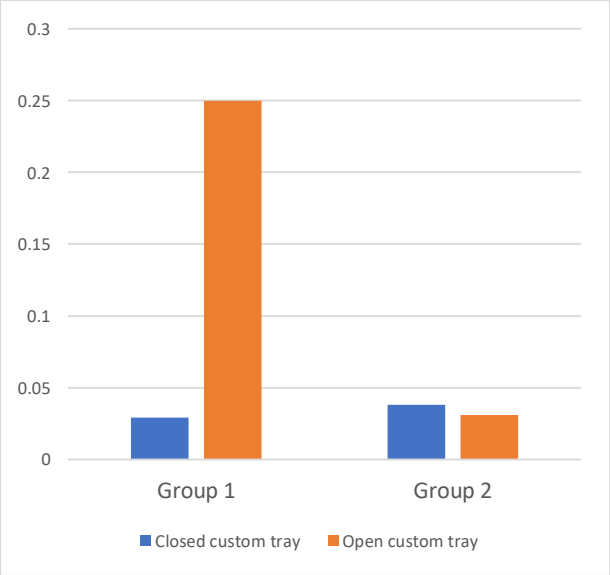
RESULTS:

Table 1 shows comparison of dimensional errors obtained from different tray types. It was observed that the average dimensional errors in impressions with open custom trays in Group 2 were comparatively less as compared to Group 1. However, the dimensional errors were similar in group 1 and group 2 when impressions were made using closed custom tray. On comparing the results, it was found that the results are statistically non-significant.

Table 1: Comparative analysis of dimensional errors in Group 1 and Group 2 using closed custom tray and open custom tray

Sub groups	Group 1	Group 2
Closed custom tray	0.029	0.038
Open custom tray	0.25	0.031

Fig 1: Dimensional errors in Group 1 and Group 2



DISCUSSION:

In the present study, we compared polyvinyl siloxane impression material and polyether impression material for implants using closed custom trays and open custom trays. We observed that the average dimensional errors in impressions with open custom trays in Group 2 were comparatively less as compared to Group 1. However, the dimensional errors were similar in group 1 and group 2 when impressions were made using closed custom tray. On comparing the results, it was found that the results are statistically non-significant. The results were compared with previous studies from the literature and were found to be consistent with them. Parameshwari G et al evaluated the effects of 0o, 15o

and 25o implant angulations on impression accuracy in simulated master casts of unilateral partially edentulous situation using different impression materials and tray selections. 30 replicas (N = 30) of a resin matrix (control) containing four implant analogues placed unilaterally from the midline till the region of second molar at an angulation of 00, 00, 150 and 250 to the vertical axis of the ridge respectively were obtained by using three impression techniques (stock metal tray, closed custom tray, and open nonsplinted custom tray) and two different impression materials. Specific dimensions of the resultant casts were measured using coordinated measuring microscope. The casts obtained from all three impression techniques had significant differences in dimensions as compared to that of master model irrespective of impression materials. Comparing the techniques with regard to the parallel implants, no statistical significant difference was observed with custom tray techniques (closed/open). Whereas while comparing parallel versus non parallel, open tray technique showed superior accuracy compared to closed tray technique as the angulation increased more than 15 degrees. They concluded that the influence of material and technique appeared to be significant for highly non axial implant angulations, and increased angulation tended to decrease impression accuracy. The open tray technique was more accurate with highly nonaxially oriented implants for the small sample size investigated. Wafa Richi M et al compared the accuracy of different impression procedures in case of multiple and angulated implants. Three maxillary master models with 6 implants bilaterally positioned in anterior, premolar and molar regions were fabricated. In model 1, all implants were placed in parallel; in models 2 and 3, anterior implants were buccally inclined and posterior implants were distally inclined in 10- and 20-degrees, respectively. Three different impression copings (hexed, non-hex, multi-unit) and two different impression techniques (splinting and non-splinting) were tested. A total of 180 impressions (n = 10 per group) were made using mono-phase vinyl poly-siloxane. Master models and duplicate casts were scanned by a 5-axis laboratory scanner and data were transferred to a software program for the alignment of master and duplicate copings. Coronal and angular deviations were calculated, and data were statistically analyzed. For angulated models, the lowest deviation values were detected at the splinted non-hex coping group. They concluded that implant angulation, impression coping type, and splinting the impression copings had significant effects on the accuracy of impressions.

Nakhaei M et al compared the three-dimensional accuracy of open-tray and three closed-tray impression techniques. Three acrylic resin mandibular master models with four parallel implants were used: Biohorizons (BIO), Straumann tissue-level (STL), and Straumann bone-level (SBL). Forty-two putty/wash polyvinyl siloxane impressions of the models were made using open-tray and closed-tray techniques. Closed-tray impressions were made using snap-on (STL model), transfer coping (TC) (BIO model) and TC plus plastic cap (TC-Cap) (SBL model). The impressions were poured with type IV stone, and the positional accuracy of the implant analog heads in each dimension (x, y and z axes), and the linear displacement (ΔR) were evaluated using a coordinate measuring machine. Data were analyzed using ANOVA and post-hoc Tukey tests. The ΔR values of the snap-on technique were significantly lower than those of TC and TC-Cap techniques. No significant differences were found between closed and open impression techniques for STL in Δx, Δy, Δz and ΔR values. They concluded that the snap-on implant-level impression technique resulted in more three-dimensional accuracy than TC and TC-Cap, but it was similar to the open-tray technique. Tabesh M et al studied precision of implant impressions for long-term success of implant supported prostheses. Impression materials and impression techniques are two important factors that impression precision relies on. A model of edentulous maxilla containing four implants inserted by All-on-4 guide was constructed. Seventy two impressions using polyether (PE), polyvinyl siloxane (PVS), and vinyl siloxanether (VSE) materials with direct and indirect techniques were made (n=12). Coordinates of implants in casts were measured using coordinate measuring machine (CMM). With two-way ANOVA, mean values of linear displacements of implants were significantly different among materials and techniques. One-way ANOVA and Tukey showed significant difference between PE and VSE, PE and PVS in direct technique, and between PVS and PE, PVS and VSE in indirect technique. One-way ANOVA and t-test showed significant difference between the two techniques in PVS groups and in PE groups. Two-way ANOVA showed mean values of rotational displacement of implants were significantly different among materials. One-way ANOVA and Tukey test showed significant difference between PVS and PE and between PVS and VSE in indirect groups. They concluded that when deciding on the material to make an impression of implants, PE is recommended for direct technique while PE and VSE are recommended for indirect technique. Recommended technique for VSE is either direct or indirect; and for PE and PVS is direct.

CONCLUSION:

Within the limitations of the present study, impressions made with polyvinyl siloxane material with closed custom tray were dimensionally accurate than polyether impressions. On the contrary, the impressions made

with polyether impression material and polyvinyl siloxane were dimensionally similar with both types of custom trays. Thus, this can be concluded that polyvinyl siloxane material with closed custom tray is the most reliable impression technique for implants.

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