

ORIGINAL RESEARCH

Comparative evaluation of accuracy of different implant impression techniques

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ABSTRACT:

Background: Dental implant in the alveolar bone is not surrounded by the periodontal ligament, and assembly of prosthesis over the implant yields a structure composed of prosthetic superstructure, implant fixture and bone as one unit. **Aim of the study:** To compare accuracy of different implant impression techniques. **Materials and methods:** The present study was conducted in the Department of Prosthodontics of the dental institutions. An edentulous mandibular cast with four implant analogues (5.6 mm) in the anterior region was used as the reference model. Two impression techniques were studied. Group I - Polyvinyl siloxane impressions (putty and light body) and Group II - Polyether impressions (medium body). **Results:** It was observed that impression in Group 2 was more superior as compared to Group 1 with open custom tray. With stock metal tray and closed custom tray, Group 1 impressions were more accurate. On comparing, the results were statistically non-significant. **Conclusion:** Within the limitations of the present study, it can be concluded that polyvinyl siloxane impressions were more accurate than polyether impressions when stock metal and closed custom trays were used. Polyether impressions made with open custom trays were more accurate when compared to polyvinyl siloxane impressions made with open custom trays.

Keywords: Implant impressions, polyether impression, polyvinylsiloxane

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INTRODUCTION

Dental implant in the alveolar bone is not surrounded by the periodontal ligament, and assembly of prosthesis over the implant yields a structure composed of prosthetic superstructure, implant fixture and bone as one unit.¹ Prosthesis-implant misfit causes internal stresses in these three components. Stresses due to the lack of passivity of prosthesis lead to mechanical and biological complications.² Accurate impression taking and transfer of implant position to the master cast is an important step in fabrication of prosthesis and achieving optimal fit. Impression technique and material are two important factors in obtaining precise fit of implant prostheses.³ Presence of uneven distribution of occlusal loads and torquing stresses on the various portion of implant elements causes problems related to poor fit of frameworks connected to implant and may also lead to marginal bone loss and failure of implants, as well as in relation to mechanical problems as loosening of screws and fatigue fractures of implant components.⁴ It may not be probably possible to connect a multi-unit implant prosthesis with a completely passive fit in clinical situation because there are many potential inaccuracies

with current materials and techniques, which include dimensional changes in impression materials, expansion of gypsum die product, dimensional changes in wax and acrylic pattern, dimensional changes in investment materials and volumetric shrinkage of metal casting on solidification and the clinician's skill.^{5, 6} 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 of Prosthodontics of the dental institutions. The ethical clearance for the study was approved from the ethical committee of the hospital. An edentulous mandibular cast with four implant analogues (5.6 mm) in the anterior region was used as the reference model. Three types of impression trays were used; they were (i) metal stock trays, (ii) closed custom trays, and (iii) open custom trays. Metal stock trays were selected such that at least a minimum of 3 mm space was obtained around the impression post. Custom impression trays were fabricated using autopolymerizing acrylic resin with 3 mm space for impression material. Five 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 manufacturer's 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 errors obtained from different tray types. It was observed that impression in Group 2 was more superior as compared to Group 1 with open custom tray. With stock metal tray and closed custom tray, Group 1 impressions were more accurate. On comparing, the results were statistically non-significant. (Fig 1).

Table 1: Comparison of errors obtained from different tray types

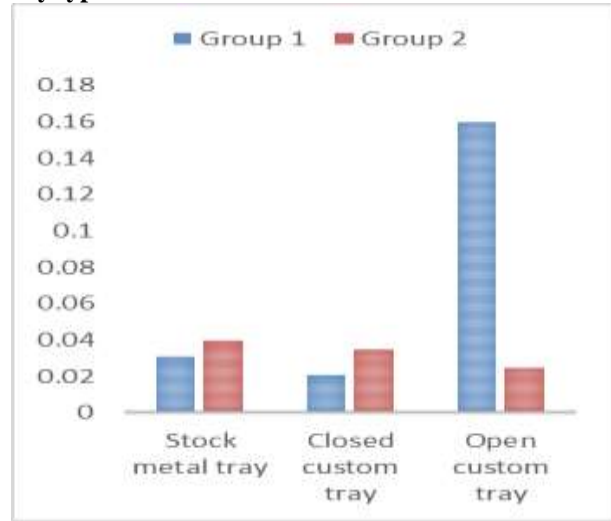
Sub groups	Group 1	Group 2	p-value
Stock metal tray	0.031	0.04	0.52
Closed custom tray	0.021	0.035	
Open custom tray	0.16	0.025	

DISCUSSION

In the present study, we observed that impression in Group 2 was more superior as compared to Group 1 with open custom tray. With stock metal tray and closed custom tray, Group 1 impressions were more accurate. Thus, polyvinyl siloxane impressions are more accurate as compared to polyether impressions. The results were statistically non-significant. The results were compared to previous studies in literature. Haghi HR et al evaluated the effects of the materials and techniques used to take an

impression on the vertical misfit of implant-supported, screw-retained, three-unit bridges.

Fig 1: Comparison of errors obtained from different tray types



The principal model used was an acrylic block with two ITI implants. A 1.5-mm abutment was attached to fixtures with torque of 25 N.cm. A base-metal framework was built on the abutment in the acrylic block. The abutments of the acrylic model were unscrewed and fixture-level impressions were made. The impression techniques included open/closed-tray techniques and the impression materials were polyether and polyvinyl siloxane. Forty acrylic custom trays were built for each impression. The marginal gap in the framework at three points (buccal, lingual, and distal) was measured using an optical microscope with $\times 250$. It is demonstrated that in all 360 evaluated samples, the mean vertical misfit in polyether samples of molar and premolar teeth was significantly lower than in polyvinyl siloxane in all three locations of the molar and lingual premolar examined (buccal, lingual, and distal), the mean vertical misfit of the polyether samples was significantly lower than those of polyvinyl siloxane. On the other hand, although the mean vertical misfit using the open-tray technique in the molar teeth was significantly lower than with the closed-tray method, no statistical difference was seen between the open-tray and closed-tray technique in general. They concluded that the impression method had no effect on marginal discrepancy of 3-unit screw retained fixed partial dentures. A higher marginal accuracy was obtained using polyether impression material compared to polyvinyl siloxane. Gupta S et al evaluated dimensional accuracy of master casts obtained using different impression trays and materials with open tray impression technique. Materials and Methods. A machined aluminum reference model with four parallel implant analogues was fabricated. Forty implant level impressions were made. Eight groups (n = 5) were tested using impression materials (polyether and vinylsiloxanether) and four types of impression trays, two being custom (self-cure acrylic and light cure acrylic) and two being stock (plastic and metal). The interimplant

distances were measured on master casts using a coordinate measuring machine. The collected data was compared with a standard reference model and was statistically analyzed using two-way ANOVA. Results. Statistically significant difference was found between the two impression materials. However, the difference seen was small (36 μm) irrespective of the tray type used. No significant difference ($p > 0.05$) was observed between varied stock and custom trays. Conclusions. The polyether impression material proved to be more accurate than vinylsiloxanether impression material. The rigid nonperforated stock trays, both plastic and metal, could be an alternative for custom trays for multi-implant impressions when used with medium viscosity impression materials.^{7,8}

Burns J et al investigated the accuracy of open tray implant impressions comparing polycarbonate stock impression trays and rigid custom-made impression trays to make implant fixture-level impressions. Gold cylinder pairs, splinted by gold bars (reference frameworks) were constructed on an aluminum typodont. Polyether impressions were made of 2 pairs of Brånemark 3.75-mm diameter fixtures mounted in an aluminium typodont, with 3 stock impression trays, 3 close-fit custom trays, and 3 spaced custom impression trays, by use of an open tray technique. The casts produced were assessed for accuracy by attaching the reference frameworks with alternate single screws and measuring the vertical fit discrepancy of these reference frameworks to the analogs within the working cast using a traveling microscope. The results showed that the mean fit accuracy, as measured by vertical fit discrepancy, of casts from the stock trays (23 +/- 20 microm) were statistically significantly less ($P < .001$) than the spaced custom trays (12 +/- 10 microm) or close fit custom trays (11 +/- 10 microm). The difference in median gap size for analogs with a 20-mm separation was 10 microm. They concluded that rigid custom trays produced significantly more accurate impressions than the polycarbonate stock trays. The stock trays used in this study could not produce accurate impressions consistently. For analogs with a 20-mm separation, there was a difference in medians of 10 microm in accuracy between the stock and custom trays. Osman M et al evaluated the accuracy of the open and closed implant impression techniques in partially edentulous patients who received two adjacent implants. Forty patients received Osstem Implants (Osstem Implant System, Seoul, Korea). Two impressions were made for each patient, one using an open tray and a second with a closed tray technique. The horizontal distances between two impression copings were measured and compared to similar measurements on the master casts. Also, under a stereomicroscope at a 50-fold magnification, the presence or absence of the marginal discrepancies was evaluated. There were no statistically significant differences regarding horizontal measurements and in the marginal relationship for the two impression techniques, except between the anterior and posterior regions, for the closed tray technique. There were also no statistically significant differences in the impression accuracy between maxillary

and the mandibular arches. In addition, there were no statistically significant differences for the intraoral horizontal distances, compared to similar horizontal measurements on master casts, between the open and closed tray techniques. It was concluded that there were generally no differences in the impression accuracy between the open and closed tray techniques in partially edentulous patients with two adjacent implants.^{9,10}

CONCLUSION

Within the limitations of the present study, it can be concluded that polyvinyl siloxane impressions were more accurate than polyether impressions when stock metal and closed custom trays were used. Polyether impressions made with open custom trays were more accurate when compared to polyvinyl siloxane impressions made with open custom trays.

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