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An unconventional impression method using implant mount: an alternative to open- and closed-tray impression technique

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Abstract

Background: Various impression techniques have been proposed for making implant prostheses. Impressions are made at implant level – closed and open tray impressions, as well as abutment level impressions. Closed and open tray copings are used to make the impressions. The limitations associated with the implant impression copings, including expensive ones, pose a significant challenge in limited mouth-opening cases, and customization of copings is not feasible.

Aim: This study aimed to compare the dimensional accuracy of four impression methods, open-tray, closed-tray, disposable mount as coping and splinted mount as coping.

Materials and methods: An ideal maxillary edentulous acrylic model was used with windows created at the canine and molar regions. Four analogues were implanted in the canine and molar areas to represent implants. The analogues were parallel to one other and were orientated at 0 degrees using the surveyor's assistance. Four groups were made: closed-tray, open-tray, implant mount as coping and splinted mount as coping. The custom trays were fabricated, accordingly. The implant-level impressions were made in all the groups using polyether impression material. The impressions were fitted with their respective impression copings with the analogues. The impressions were poured using die stone type-IV, and the casts were made. The resulting casts were 3D scanned, and a virtual model (.stl File) was created. Each .stl file was subjected to Geomagic software to evaluate the three-dimensional accuracy of conventional implant copings and implant mount as copings.

Results: The Open-tray and the closed-tray groups exhibited the mean dimensional accuracy of 0.011±0.0016 µm and 0.018±0.0012 µm, respectively. The mount as coping and splinted mount displayed a mean dimensional accuracy of 0.017±0.0008 µm and 0.013±0.0020µm, respectively.

Conclusions: This pilot study concludes that the implant mount can be used as implant impression coping and an alternative to the conventional impression coping.

Keywords: Implant mount, Implant impression, Press-fit, open-tray and close-tray impression.

1. Introduction

Dental implants are fixtures that constitute the replacement of the root of missing natural teeth. Dental implant therapy has been widely employed for the restoration of partially and completely edentulous patients. The research on implants highlights the necessity of a passively fitting prosthesis to avoid problems of prosthodontic complications or even loss of fixture integration [1, 2].

The accuracy of the implant impression is influenced by various factors, including impression techniques, impression materials, impression trays, implant angulation and depth, and modified impression coping. The impression copings are typically transferred from the implant to the impression using the direct (open-tray) and indirect (closed-tray) impression techniques [3].

Another approach is the "Snap-On" method, in which the impression components are attached to the transmucosal neck of the implant and picked up in the impression without the need for any screw-like parts [4, 5]. This method enables the removal of the copings along with the impression and is quick, simple to use, and practical for the patient and clinician. It also solves the issue of coping displacement in the impression materials and has the advantages of both direct and indirect methods [6].

The implant mount or implant holder is the Implant accessory that goes with the implant. A temporary implant

mount is an attachment whose primary purpose is to transfer the sterile implant from its packaging to its location inside the mouth [Figure 1].

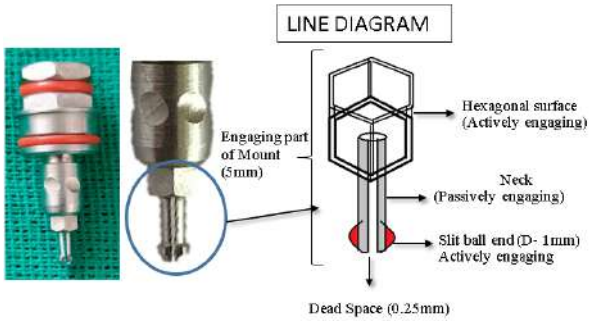


Figure 1. Parts of implant mount

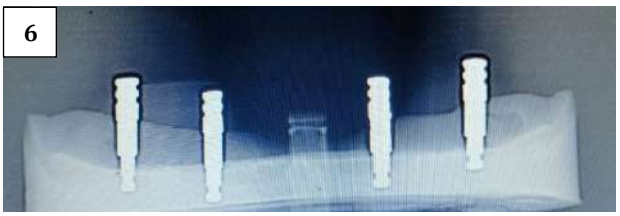
This study aimed to evaluate and compare the dimensional accuracy of the impressions made with four impression methods; open-tray, closed-tray, impression with disposable mount, and impression with splinted disposable mount. The null hypothesis of the current study was that there would be no differences in the dimensional accuracy of impressions made with the mentioned four techniques.

2. Materials and methods

In this pilot study, four windows, two at the canine and two at the first molar areas [Figure 2], were made using a surveyor on a maxillary edentulous acrylic model. They were perpendicular to the axis and parallel to one another. In each of these windows, implant analogues with measurements of 3.8 X 10 millimetres were fixed in place by acrylic resin at zero degrees with the help of a surveyor [Figure 3,4].

Figure 2. Fixing the lab analogue with the help of surveyor at zero degrees

Figure 3. Ideal model with 4 windows, and Figure 4. Ideal model with 4 lab analogues



Figures 5 – 8. Open tray OPG, Closed tray, Mount as Coping OPG, and Splinted Mount OPG, respectively.

Press-fit metal implant fixture mounts and splinted mounts were employed for impression making instead of impression coping. The fit of the implant fixture mount was radio-graphically examined before making an impression. The primary acrylic model's open-tray and closed-tray impression copings were then coupled with a torque of 10 Ncm. Before performing an impression, radiographic confirmation is done with OPG [Figures 5 - 8]. Then, four custom trays were fabricated using cold cure acrylic for the closed-tray, open-tray, mount and splinted mount on the ideal model and polyvinyl siloxane tray adhesive was used 15 minutes before the impression process [Figures 9 - 12].

All four impressions were performed using respective trays with polyether impression material [Figure 13]. The impression was recorded, and the implant analogues were connected to the impression copings. Analogue units were inserted deeply into the impression by applying pressure with full or partial clockwise rotation until rotational resistance was felt. This contact sensation indicates that the

implant location was successfully transferred for the open-tray and closed-tray, whereas the mount and splinted mount impression method were verified by pressing on rather than screwing. Type IV die stone was poured into all four impressions. Casts are separated from impressions after it reaches to final set [Figure 14].

Then four scan bodies were placed on four implant analogues of the control group (ideal mould) for 3D scanning, and the location of the same was recorded. This scanner collects detailed pictures and converts them into a virtual model using sensitive three-dimensional sensors. For Virtual images of the test groups, the same scan bodies were placed on the implant analogues in each cast and scanned in a similar way as that of a control group. Standard Language (.stl) files were acquired after scanning the test group and control group (ideal mould). Each scan of the test groups was superimposed over the control scan for comparison. Geomagic Design X and Geomagic Control X software (3D Systems, Rock Hill, South Carolina, USA) were used to measure three-dimensional differences between the control .stl file and the 4 test STL files [Figures 15-18].

2.1 Statistical analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 21.0, USA. One-way analysis of variance (ANOVA) and Post hoc analysis was performed for intra- and inter group comparisons, respectively.

3. Results

Figure 19 shows the positional variation of various copings against the ideal mould. The Mean and standard deviation of dimensional accuracy of the Open-tray group and closed-tray group were 0.011±0.0016µm and 0.018±0.0012 µm, respectively. The mean and standard deviation for the mount as coping was 0.017±0.0008 µm, and for the splinted mount was 0.013±0.0020µm (Table 1). One-way ANOVA showed significant differences (p=0.000) among the groups [Figure 19].

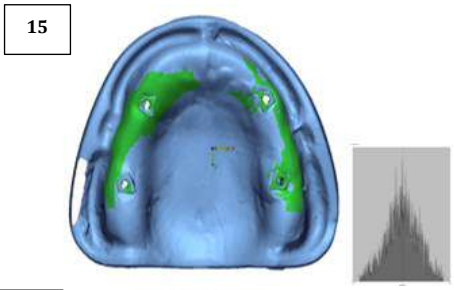
In post-hoc analysis, the open tray method displayed a significant difference with the closed tray (p=0.000) and mount methods (p=0.000). The splinted mouth method showed significant differences with the closed tray (p=0.002) and mount methods (p=0.008).

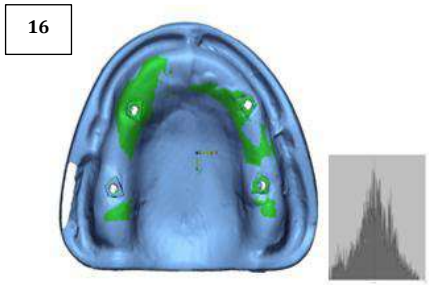
4. Discussion

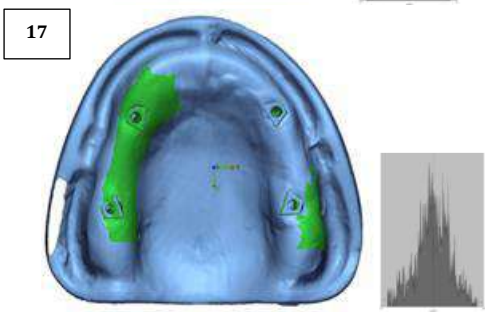
Passive fit is required for long-term effectiveness in implant-supported prosthetics. The first stage in ensuring the passive fit of the implant-supported structure is to accurately document the locations and distances of the implants during the impression process. Misfitting prostheses can cause mechanical and biological issues in supporting implants. Mechanical problems caused by prosthetic misfitting include screw fracture, abutment or implant screw breakage, and occlusal error. Furthermore, a misfit and, as a result, a marginal space between the abutment and prosthetic can lead to plaque build-up and unwanted responses in the soft and hard tissues surrounding dental implants [3-5]. Superstructure fabrication must guarantee the best possible passive fit. Making an accurate impression is the first and most important stage in achieving passive fit which transmits inter-implant dimensions exactly. Many variables impact implant impression precision, including impression material, impression method, splinting of impression copings, degree of impression and depth, and implant angulations [6-8]. Transferring the implant/abutment location from the oral cavity to the master cast is the main goal of the implant impression the impression material for implants should be rigid enough to hold the impression copings and minimize positional distortion [5]. The implant location, hex orientation, and soft tissue profile are all reproduced using the open-tray impression method [2]. Looking into the drawbacks of the open tray impressions there are more components to control. It is necessary to use a customized tray with access to the impression coping screws or a metal tray with windows. (In limited mouth opening cases and posterior regions it's difficult to engage the open tray coping).

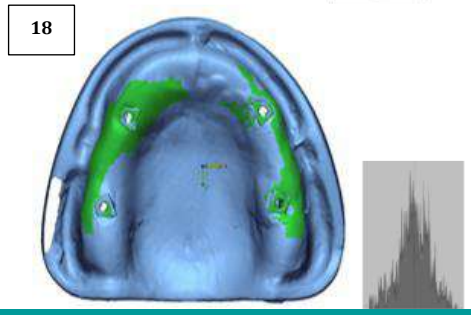
Figures 9 – 12. Closed-tray, Open-tray, Mount as Coping, and Splinted Mount, respectively.

FIG-13 impressions, and Figure 14. Casts made with the impressions









Figures 15 – 18. Open-tray super imposition, Close-tray super imposition, Mount coping super imposition and Splinted mount super imposition.

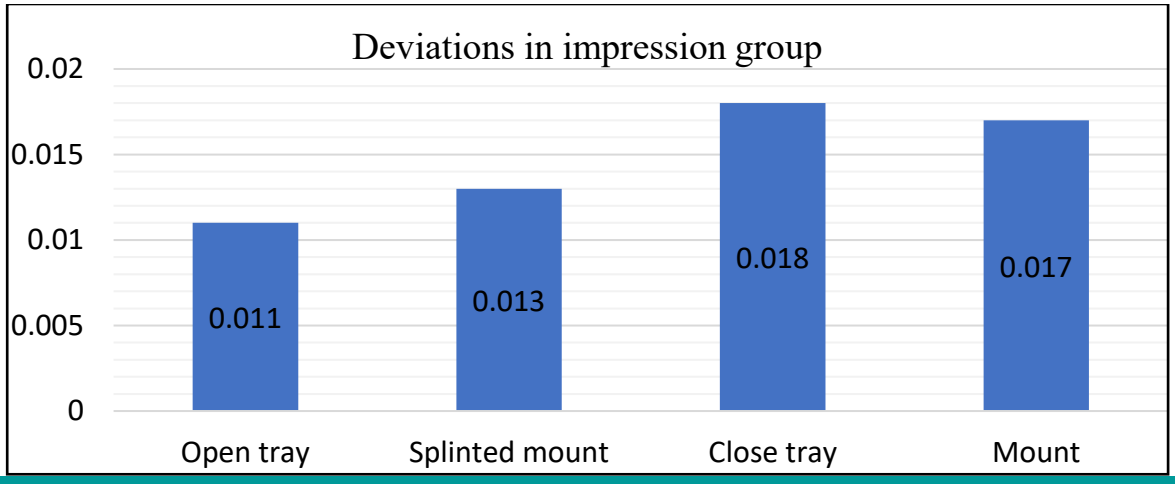


Figure 19. The positional variation of various copings against the ideal mould

Table 1. Mean and standard deviation of different methods used in the study (One-way ANOVA).

Groups	N	Mean ± Standard Deviation	F-Value	P-Value
Open Tray	5	0.011±0.0016	21.913	0.000*
Closed tray	5	0.018±0.0012		
Mount	5	0.017±0.0008		
Splinted Mount	5	0.013±0.0020		

***Significant difference**

Table 2. Post hoc analysis of different methods used in the study.

Groups		Mean difference	P-Value	95% Confidence Interval	
				Lower Bound	Upper Bound
Open tray	Closed tray	0.0680	0.000*	0.0954	0.0406
	Mount	0.0600	0.000*	0.0874	0.0326
	Splinted mouth	0.02400	0.098	0.0514	0.034
Closed tray	Mount	0.0800	0.838	0.0994	0.0354
	Splinted mount	0.0440	0.002*	0.0166	0.0714
Mount	Splinted mount	0.0360	0.008*	0.086	0.0634

***Significant difference**

Table 3. Differences between screw fixed mount and snap-on mount [1]

Screw fixed mount	Snap-on mount
Time consuming	Time saving
More precise	Imprecise
Outdated	Currently in use
Presence of single threaded screw for engaging the implant	Presence of slit-ball end for engaging the implant
Available as 2 units	Available as single unit

Both the procedure and the tray utilised have a considerable impact on how accurately an impression is made. In the open-tray impression method, both customised and stock trays can be used. According to a survey, rigid custom trays are preferred over plastic stock trays. Less precise impressions were obtained using stock trays. The level of accuracy between stock and custom trays varies by 10 micrometres for analogues by 20 mm. Only the implant's position and hex orientation are transferred using the closed-tray impression procedure. Indirect transfers remain attached to the implants when the impression is taken from the mouth. Coping might be displaced when the impression is removed. Coping must remain attached to the implant, which presents the possibility of inaccuracy. The size and shape of open tray or close tray copings cannot be altered and soft tissue transfer is not precise. Similarly, it's very tough to remove an impression [2].

An implant carrier also known as disposable mount is a component of an implant that was initially intended to convey the implant from its sterilized container to the implant location. They are of two types (i) screw fixed mount and (ii) Snap-On mount [tab 3]. It allows the clinician to attach the implant to the ratchet, or manual driver while also preventing direct touch with the sterilized implant [3]. After implant insertion, the clinician usually discards the implant carrier.

When planning and designing an implant-supported fixed restoration, an implant-level impression is frequently required, particularly when two or more implants have been put in. The exact fit of the fixed implant-supported restoration is contingent on the accuracy of implant analogue placement within the final cast. When creating implant impressions, metal, screw-retained, open- or closed-tray impression copings are used to place these analogues. The traditional impression coping takes more time to ensure full seating, which is a more time-consuming and uncomfortable process.

In 2014, Mahoorkar S *et al.* concluded that a metal implant fixture mount can be used as an implant impression coping because it is easier to manipulate, timesaving and more comfortable for both the clinician and patient. It has retentive grooves on its surface and can be modified in contrast to plastic press fit impression coping in closely placed implants [8].

A fixture mount that has been easily fixed to the implant before packing or implant insertion can thus significantly decrease chair time while ensuring interface accuracy. In addition, there is no need to buy a distinct impression coping, lowering the cost of restorations and benefiting patients. As a result, we can alter the implant fixture to serve as an impression coping. Furthermore, the sterilisation of the impression coping can be avoided during immediate impressions because each implant has its unique mount that can be discarded after use [tab 3].

The hexagonal platform, slit ball end, and single path of insertion are the primary reasons behind the mount's tug fit. The hexagonal platform and screw allow this tug to fit in both closed and open trays. Because of all these characteristics, the mount produced results that were comparable to those of an open and closed tray. There was no statistically significant difference between the open and

splinted mount impression techniques, as well as the closed tray and mount impression technique, in the current experimental research. Closed tray and mount imprint technique readings differed by 0.01mm, whereas open tray and splinted mount readings differed by 0.02mm.

The quantity of samples, type of impression material, implant angulations are the limitations of the present study.

5. Conclusion

Within the limitation of the study, mount as impression coping and closed tray impression technique gave similar levels of accuracy whereas splinted mount and open tray impression technique gave similar levels of accuracy. Hence, this proves that the mount can be used as an impression coping as it is economical, timesaving, and comfortable for both patient and the clinician.

Conflicts of interest: Authors declared no conflicts of interest.

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