ORIGINAL ARTICLE

# Accuracy of multiple implant impressions using different combinations of impression materials using closed tray technique: An *in vitro* study

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*J. Adv. Pharm. Technol. Res.*

## ABSTRACT

Decision for precision! The first stage in creating an accurate, passively fitting prosthesis is to replicate the intraoral relationship of implants using impression methods. The technique and the impression material utilized are the key elements that influence the accuracy of the implant imprint. The goal of this study was to assess the accuracy of the described implant impression technique using various impression materials, as well as to look into the clinical aspects that influence implant impression accuracy. Two holes (4.3 mm × 10 mm) were drilled in a U-shaped study plastic model representing the partially edentulous maxilla, and the appropriate Nobel Biocare Replace select implants were implanted. Closed tray copings were placed for the relevant implants, and closed tray impressions were taken with several impression materials (PVS-1) Dentsply, medium-bodied, and 2) Regular setting-Zhermack Elite HD+). To assess passive fit accuracy, a jig trial and RVG IOPA were used. Stereomicroscopy was used to evaluate the precision of the implant and analog interface from two perspectives: buccal and lingual. On the buccal aspect, Group 1 had a mean value of 13703.29, whereas Group 2 had a mean value of 11395.58. On the lingual aspect, Group 1's mean value was 8415.61, whereas Group 2's was 9192.01. In the closed tray technique, no statistically significant differences between different imprint materials were found. There was no significant difference in the accuracy of closed tray implant impression techniques with different impression materials, according to the findings.

**Key words:** Accuracy, implant impressions, implant techniques, innovation, PVS

## INTRODUCTION

Dental implants are now a common procedure for restoring oral tissues in partially and totally edentulous individuals, and clinical trials have shown that this treatment approach is beneficial over time. Endosseous implants lack the naturally present mobility of the periodontal ligament being functionally ankylosed to bone. As a result, they are unable to compensate for any distortions caused or mismatches at the level of implant–abutment interface. Although a perfect passive fit of implant-supported complete denture prosthesis has yet to be achieved, it is uncertain to what extent prosthesis misfit will result in biological or technological difficulties.

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**Submitted:** 09-May-2022 **Revised:** 27-Jun-2022
**Accepted:** 12-Aug-2022 **Published:** 30-Dec-2022

| Access this article online | |
|---|---|
| Quick Response Code: | Website: www.japtr.org |
| | DOI: 10.4103/japtr.japtr_330_22 |



**How to cite this article:** Deshmukh M, Ahmed N, Maiti S, Rajaraman V. Accuracy of multiple implant impressions using different combinations of impression materials using closed tray technique: An *in vitro* study. J Adv Pharm Technol Res 2022;13:S412-5.

The goal of achieving an accurate, passively fitting prosthesis[1] is by replicating the intraoral connection of implants through impression processes that act as a permanent record in the creation of a dental restoration or prosthesis.[2] Other than recreating surface detail, it is of main concern to preserve the 3D orientation of the implant same as present intraorally for successful implant prosthodontic treatment.[3,4]

Accuracy of the impression influences the precision of the definitive cast which in turn is critical for fabricating a prosthesis that fits correctly.[5] A misfitting prosthesis can result in mechanical and/or biological issues. Mechanical issues resulting from prosthesis mismatch have been documented as screw loosening/breakage, implant fracturing, and occlusal inaccuracies.[6] In terms of biology, the marginal mismatch caused by misfit increases plaque accumulation which causes soft and/or hard tissue reactions.[7,8] A minimal misfit of prosthesis avoids these issues and can be successful prosthetic rehabilitation.

To date, different implant impression procedures have been used to achieve accuracy. However, the results analyzed were not always constant, and other research claimed that different imprint processes were more accurate. Our project team has extensive research expertise and knowledge, which has resulted in high-caliber publications.[9-33]

The goal of the current research project was to assess the accuracy of the implant impression technique using various impression materials as described, as well as to look into the clinical aspects that influence implant impression accuracy.

## MATERIALS AND METHODS

A U-shaped study plastic model of a partly edentulous maxilla was employed as a reference model. The modeling wax was used to block out the undesired undercuts. With the Nobel Biocare Select implant system drill kit, two holes were bored sequentially to 10 mm (depth) and 4.3 mm (diameter), and implants were implanted. Closed tray copings were placed for the individual implants, and closed tray impressions were taken with various impression materials.

Impressions using two elastomeric impression materials were made:

1. PVS (Dentsply, medium-bodied)
2. PVS (Regular setting-Zhermack Elite HD+).

The given materials were mixed in a base and catalyst ratio of 1:1. Die stone was used to create the casts, which were then trimmed to fit. A jig trial had to be validated after laboratory analogs were inserted. With a paintbrush, pattern resin (GC ASIA) was mixed and adapted to the copings along with dental floss. The pattern resin was sectioned within the center after complete polymerization, using a diamond disk to create a niche of 0.2 mm between the two sections which compensated for the resin's shrinking. Before stereomicroscopy, the sectioned pieces were reassembled using the brush-bead technique.

To evaluate passive fit accuracy, the jig trial was retrofitted to a diagnostic cast, and an RVG IOPA was taken [Figure 1]. Stereomicroscopy was used to evaluate the precision of the implant and analog interface from two perspectives: buccal and lingual [Figure 2]. SPSS software (version 23.0) Developed by IBM company, University of Stanford, California, USA was used to tabulate the results [Table 1]. The independent *t*-test was employed to compare the mean values of group 1 and group 2 (group 1: PVS (Dentsply, medium-bodied), group 2: PVS (Regular setting-Zhermack Elite HD+) with regard to the buccal and lingual aspects of two implants to the master model.

## RESULTS

On the buccal aspect, group 1 had a mean value of 13703.29, whereas group 2 had a mean value of 11395.58. On the lingual aspect, group 1's mean was 8415.61, whereas group 2's was 9192.01 [Table 1]. In terms of the buccal aspect, we found no significant difference between the two groups ($P$ = 0.620). Similarly, we found there is no statistically significant difference between the groups in terms of linguistic aspects ($P$ = 0.823). The mean discrepancy between Groups 1 and 2 on buccal and thereby lingual aspects despite the fact that the difference is statistically

**Figure 1:** Diagnostic dummy model, Impressions for two groups, master cast, jig trial with pattern resin, Jig trial retro-fitted to a diagnostic cast to check passive fit accuracy and RVG was taken

**Table 1: Mean differences between groups to check accuracy at implant analog surface**

| | Groups | Mean | SD | *F* | *P* |
|---|---|---|---|---|---|
| Buccal | Monophase | 13703.29 | 2326.73 | 2.351 | 0.620 |
| | Putty light body | 11395.58 | 2054.37 | | |
| Lingual | Monophase | 8415.61 | 1663.89 | 1.075 | 0.823 |
| | Putty light body | 9192.01 | 1566.04 | | |

SD: Standard deviation

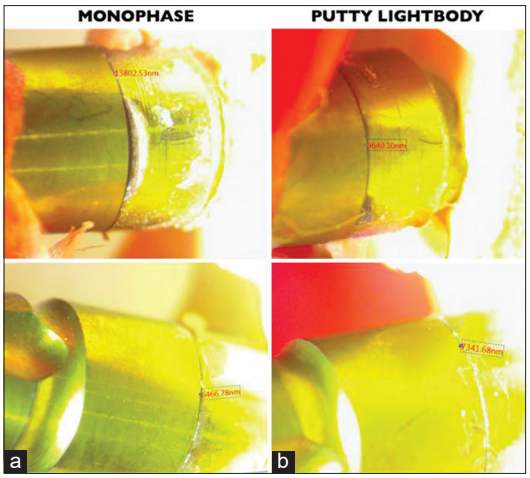


**Figure 2:** Stereomicroscopy at the implant and analog interface with respect to two aspects-buccal and lingual in (a) Monophase (b) Putty Lightbody

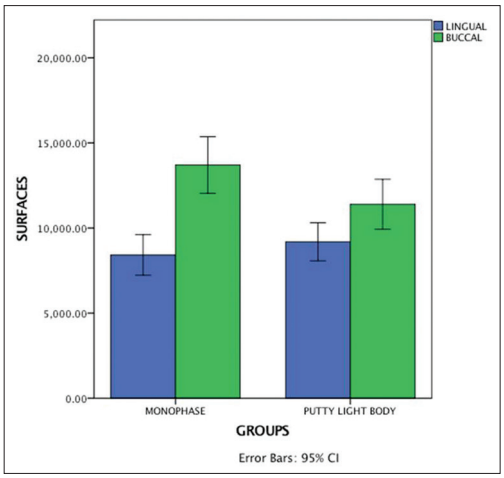


**Figure 3:** Bar depicting mean differences between groups, where X-axis represents impression materials (monophase and putty light body) and Y-axis represents mean values on the lingual and buccal aspects, respectively. The mean value of group 1 on the buccal aspect was 13703.29 whereas the mean value of group 2 was 11395.58, $P = 0.620$. The mean value of group 1 on lingual aspect was 8415.61 whereas for group 2 was 9192.01, $P = 0.823$ showing no statistical significant differences were observed between different impression materials

small, the buccal disparity of group 1 was discovered to be larger than that of Group 2 [Figure 3]. When it came to the lingual aspect, however, the difference between Groups 2 and 1 was only marginally bigger. The two groups' radiographic interpretations were identical.

## DISCUSSION

Only passively fitting prostheses are generally produced in implant prosthodontics to get a satisfactory result. To eliminate fit issues, work must be done on a secondary master cast that replicates the oral system as closely as possible; hence, the location of the abutments can be determined. The type of impression material utilized affects the precision of the multiple implant impression, which eventually results in an accurate cast from which a precisely fitting prosthesis is made. When selecting an imprint material, it is important to take into account a number of aspects, such as material accuracy, the amount of time before the impression is poured, and the depth of intraoral undercuts.[34]

When three or fewer implants were utilized, several studies revealed that the difference between open and closed impression techniques was not significant,[22,35] whereas another study stated the closed tray technique to be more accurate.[36,37] Various impression materials were examined in research done by Prithviraj *et al*., but it was reported that polyether and VPS were mostly used[18,21,38] and also the 11 studies that compared their accuracy-10 of them found no differences.

Accuracy of the closed tray impression technique and two impression materials, PVS (Dentsply, medium-bodied) and PVS (Regular setting-Zhermack Elite HD+), were investigated in this study. Because we found no differences among the groups in the statistical analysis, the null hypothesis could not be rejected.

Wenz *et al*. investigated several impression material mixing processes. Moreover, found that all other combinations of impression materials described are much less accurate than the two-step VPS impression. Wee *et al*. stated polyether had the best torque values, which could be of benefit for picking up a pick-up impression, whereas various materials such as condensation silicone and polysulfide did not outperform polyether or VPS in terms of precision.

The study does have certain drawbacks. This research could be expanded to look into other significant factors that affect the accuracy of implant-supported superstructures, such as flexure of mandible, the technique used for impression making and material used, and misfit of implant and abutment copings, all of which should be considered to come to a conclusion.

## CONCLUSION

There is no significant variation in the accuracy of the closed tray implant impression technique with different impression materials within the study's constraints.

### Financial support and sponsorship

The present study is funded by the:

- Saveetha Institute of Medical and Technical Sciences
- Saveetha Dental College and Hospitals
- Saveetha University
- Bhoomi Infra Engineers, Chenna.

### Conflicts of interest

There are no conflicts of interest.

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