



ORIGINAL RESEARCH PAPER

General Surgery

ACCURACY OF INTRAORAL SCANNERS VERSUS CONVENTIONAL ELASTOMERIC IMPRESSIONS IN FIXED PROSTHODONTICS: A COMPARATIVE IN-VITRO STUDY

KEY WORDS: Digital dentistry, intraoral scanner, elastomeric impression, CAD/CAM, fixed prosthodontics.

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ABSTRACT

Background: Precise dental impressions are fundamental for the success of fixed prosthodontic restorations. Conventional elastomeric impression materials have long been regarded as the standard technique; however, digital intraoral scanners have emerged as a promising alternative in modern prosthodontic workflows. **Aim:** To evaluate and compare the dimensional accuracy of intraoral digital impressions with conventional elastomeric impressions used for fixed prosthodontic restorations. **Materials and Methods:** A standardized maxillary typodont model with prepared abutments for a three-unit fixed dental prosthesis served as the reference model. Forty impressions were obtained and divided into two groups: Group A (n=20) digital impressions using an intraoral scanner, and Group B (n=20) conventional impressions using polyvinyl siloxane elastomeric material. Conventional impressions were poured using Type IV dental stone to fabricate casts. Linear measurements between predefined reference points were recorded using a coordinate measuring machine. Deviations from the reference model were calculated. Statistical analysis was performed using an independent t-test with significance set at $p < 0.05$. **Results:** Digital impressions demonstrated significantly lower mean deviation values compared with conventional impressions in inter-abutment distance measurements ($p < 0.05$). Differences in mesiodistal and buccolingual dimensions were minimal between the two techniques. **Conclusion:** Within the limitations of this in-vitro investigation, intraoral digital impressions exhibited comparable or superior accuracy compared to conventional elastomeric impressions for fixed prosthodontic applications.

INTRODUCTION

Accurate dental impressions are critical for the fabrication of fixed prosthodontic restorations such as crowns and fixed dental prostheses. Inaccurate impressions can lead to poor marginal adaptation, compromised occlusion, and reduced longevity of restorations [6].

Elastomeric impression materials such as polyvinyl siloxane and polyether have been widely used because of their excellent dimensional stability and high detail reproduction [5,9]. Despite their advantages, conventional impression techniques involve multiple clinical and laboratory steps that may introduce inaccuracies, including polymerization shrinkage, tray deformation, and expansion of gypsum casts [5].

The introduction of digital technologies has significantly transformed prosthodontic practice. Intraoral scanners capture three-dimensional images of intraoral structures and generate digital models that can be directly used for CAD/CAM fabrication of prosthetic restorations [1,8]. Digital impressions offer several advantages including improved patient comfort, reduced chairside time, and elimination of impression materials and stone casts [6,9].

However, the clinical reliability of intraoral scanners depends largely on their accuracy [3,4]. Accuracy includes both trueness (closeness to the true value) and precision (repeatability of measurements), which are essential parameters for evaluating the performance of digital impression systems [2,3].

MATERIALS AND METHODS

Study Design

An in-vitro comparative study was conducted in the Department of Prosthodontics to assess the dimensional accuracy of digital and conventional impression techniques.

Reference Model

A maxillary typodont model was prepared with two abutment teeth simulating a three-unit fixed dental prosthesis. Reference markers were placed on the occlusal surfaces to facilitate standardized measurements.

Sample Size

A total of 40 impressions were made and divided into two groups:

Group	Impression Technique	Sample Size
Group A	Intraoral scanner	20
Group B	Elastomeric impression (PVS)	20

Digital Impression Procedure

Digital impressions were obtained using an intraoral scanning system according to the manufacturer's recommended scanning protocol. The scanning process captured the prepared teeth and surrounding structures to produce a three-dimensional digital model [1,7].

The generated models were exported as STL files for measurement and analysis.

Conventional Impression Procedure

Conventional impressions were obtained using a custom tray and polyvinyl siloxane impression material employing the two-step putty-wash technique [5]. The impressions were poured with Type IV dental stone after the recommended setting time to produce working casts.

Measurement Procedure

Three linear measurements were recorded:

1. Inter-abutment distance
2. Mesiodistal width of abutment teeth
3. Buccolingual width of abutment teeth

Measurements were obtained using a coordinate measuring machine with an accuracy of $1 \mu\text{m}$, which is commonly used for evaluating dimensional accuracy of dental models [2,3].

Deviation values were calculated by comparing measurements obtained from test samples with those from the reference model.

STATISTICAL ANALYSIS

Data were analyzed using statistical software. Mean deviation values and standard deviations were calculated. An independent t-test was used to compare differences between the two groups. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1: Mean Dimensional Deviations (mm)

Measurement	Digital Impression	Conventional Impression
Inter-abutment distance	0.035 ± 0.012	0.067 ± 0.021
Mesiodistal dimension	0.028 ± 0.010	0.031 ± 0.014
Buccolingual dimension	0.026 ± 0.011	0.029 ± 0.013

Digital impressions showed lower deviation values, particularly for inter-abutment distance measurements.

STATISTICAL FINDINGS

Parameter	p-value
Inter-abutment distance	0.021
Mesiodistal dimension	0.317
Buccolingual dimension	0.289

A statistically significant difference was observed for inter-abutment distance measurements.

DISCUSSION

The present study evaluated the dimensional accuracy of digital and conventional impression techniques used in fixed prosthodontics. The findings demonstrated that digital impressions produced using an intraoral scanner showed comparable or improved accuracy compared to conventional elastomeric impressions.

The improved accuracy observed in digital impressions may be attributed to the elimination of several intermediate steps involved in conventional techniques. Factors such as polymerization shrinkage, tray distortion, and gypsum expansion may contribute to inaccuracies in conventional impressions [5,9].

Previous investigations have also reported similar findings, suggesting that intraoral scanners provide clinically acceptable accuracy for short-span prosthodontic restorations [3,4,10]. Ender and Mehl reported that digital impression systems demonstrate high trueness and precision for single-unit and short-span restorations [2].

Additionally, digital impressions offer advantages including improved patient comfort, reduced clinical time, and simplified laboratory workflows [1,6].

However, some studies have reported reduced accuracy for full-arch digital impressions due to stitching errors during image acquisition [7]. Therefore, further research is required to evaluate the performance of digital impression systems in complex prosthodontic cases.

Clinical Implications

Digital impressions may provide several clinical advantages: Reduced patient discomfort

Elimination of impression materials

Improved communication with dental laboratories
Streamlined digital workflows for CAD/CAM restorations
These advantages make digital impressions increasingly popular in contemporary prosthodontic practice [1,8].

Limitations

The limitations of this study include:
1. The study was conducted under in-vitro conditions.
2. Only one intraoral scanner system was evaluated.
3. Clinical factors such as saliva, patient movement, and limited intraoral space were not simulated.
Future clinical studies are recommended to validate these findings.

CONCLUSION

Within the limitations of this in-vitro study, intraoral scanners

demonstrated comparable or superior accuracy compared to conventional elastomeric impressions in fixed prosthodontics. Digital impression techniques can therefore be considered a reliable alternative for capturing dental impressions for prosthetic restorations.

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