

COMPARATIVE ACCURACY OF INTRAORAL SCANNERS AND CONVENTIONAL IMPRESSIONS IN RECORDING SULCULAR DEPTH: A CLINICAL STUDY

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Abstract:

Aim: To compare the accuracy of intraoral scanners and conventional impression techniques in recording gingival sulcular depth and to evaluate their clinical implications.

Materials and Methods: The prospective study involved the collection of 20 samples comprising 10 anterior central incisors and 10 posterior molars. Impressions for each tooth were recorded using polyvinyl siloxane material with 3M Astrigent Retraction Paste and scanned using a desktop scanner to acquire the STL files (Group I). The STL files of the master cast models made from these impressions were also acquired (Group M). STL files were acquired using intraoral scanning after retracting the gingiva (Group IOS). The deviation in sulcular depth measurement was assessed by superimposing all STL files using EXOCAD software.

Results: The mean deviation of the master cast group (M) was found to be 0.0661 ± 0.0349 mm, whereas the intraoral scanner group (IOS) had a greater deviation at 0.1062 ± 0.1473 mm. The accuracy of the conventional technique (93.39%) was significantly

higher than the accuracy of the intraoral scanner (89.38%). Nonetheless, there was no statistical difference observed among both groups ($p = 0.41$).

Conclusion: In light of the results obtained in this study, intraoral scanners are not as efficient as the master cast in comparison to conventional impressions in obtaining the sulcular depth. Despite the greater accuracy shown by the conventional approach, both methods are similar in their clinical efficiency. Intraoral scanners can be viewed as an effective clinical choice, but conventional impressions remain the most reliable approach.

Keywords: Intraoral scanner, conventional impression, sulcular depth, gingival retraction, accuracy

Introduction

The longevity of restorations is influenced by many factors. The final accuracy is often influenced by the type of impression making, setting accuracy, material flow, temperature, humidity, mixing, disinfection, and pouring time.¹⁻³ When taking an impression, the gingival

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margin should be clear and accessible so that the impression material can flow adequately. Additionally, the gingival sulcus needs to be sufficiently wide. The gingival displacement technique's inefficiency is the main cause of the faulty marginal detail record². Capturing the gingival sulcular depth is one of the most crucial steps in both traditional and digital impression production to guarantee a precise marginal and internal fit.

Accurate measurement is crucial for periodontal assessment and prosthodontic design. Gingival retraction cords or materials that temporarily alter the marginal soft tissues are frequently used in the traditional impression procedure to enlarge the gingival sulcus without damaging the delicate light material. However, it has a primary drawback of causing bleeding which will compromise the scanning accuracy. With the advancement of three-dimensional technology and the rising use of intraoral scanners in dental office it is necessary to assess the accuracy of scanners in capturing the gingival sulcular depth employing cordless displacement devices for fixed dental restoration ensuring proper fit.

The aim of this study was to compare the accuracy of intraoral scanners and conventional impression techniques in recording sulcular depth and evaluate their clinical implications. The null hypothesis is that there would exist no significant difference in the reliability of intraoral

scanner with the analog impression in capturing the sulcus depth of prepared tooth using cordless displacement system.

Materials and Methods

Sample Size Estimation

This prospective study was conducted at the department of Prosthodontics and crown and bridge at Rajas Dental College and Hospital after getting approval from Institutional Research Board. Consent was asked from every patient, explaining the study and its purpose. Total study of 20 subjects was selected of which 10 posterior teeth (molars) and 10 anterior teeth (Central Incisor) are selected with the presence of adjacent teeth (mesial and distal) without any prosthetic restoration, caries, periodontal problem and malalignment. The sample size estimation was done using G Power Software.

Study Design

For every subject analog impression was taken with polyvinyl siloxane impression material with 3M astrigent retraction paste. The impression was lab scanned (SHINING 3D EX PRO) and STL file was created (Group I) (Fig: 1-3). The master cast was poured from the impression and the master cast was lab scanned (SHINING 3D EX PRO) creating STL file (Group M) (Figure 4). Digital impression was also taken with intraoral scanner (CAMEO ELEGANT 3 IOS SCANNER)



Fig 1: Placement of 3M astrigent retraction paste



Fig 2: Conventional impression



Fig 3: Impression scanning with SHINING 3D EX PRO



Fig 4: Master cast lab scanned

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for which gingival retraction is done with 3M astrigent retraction paste and STL file is made (GROUP IOS) (Figure 5)

Superimposition of all the three STL files are done using EXOCAD software from which the data will be acquired (Figure 6). By using the Group I as control, deviation in recording the gingival sulcular depth of Group M and Group IOS measured (Figure 7)

Results

A total of 20 dental samples, which included ten posterior teeth molars and ten anterior central incisors, were used to compare intraoral scanning technique with conventional impressions for recording sulcular depth. In this experiment, conventional impression was taken using a desktop scanner as the reference/control, and then the deviation between master casts (STL file M) and intraoral scans (STL file IOS) was assessed based on the traditional impression with the help of EXOCAD.

According to the findings of the analysis, the mean deviation of the master cast (STL file M) in comparison with impression was 0.0661 ± 0.0349 , whereas the mean deviation of the intraoral scan (STL file IOS) compared with impression was 0.1062 ± 0.1473 . This proves the fact that the master cast was more consistent than the intraoral scanner.

As far as accuracy is concerned, the accuracy of the impression approach was higher (93.39%) than that of the intraoral scanning (89.38%). Nevertheless, there were no statistically significant differences between the two approaches ($p = 0.41$). (Table 1)

Conclusively, even though the conventional impression technique displayed a lower margin of error and greater precision, both methods were clinically equivalent, suggesting that intraoral scanners may be deemed an equally clinically viable option for recording sulcular depths.

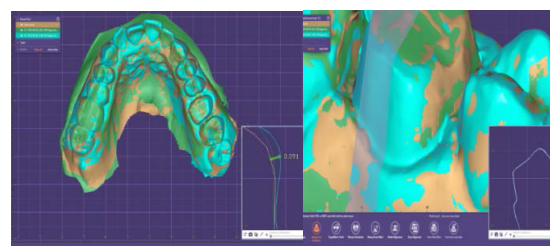
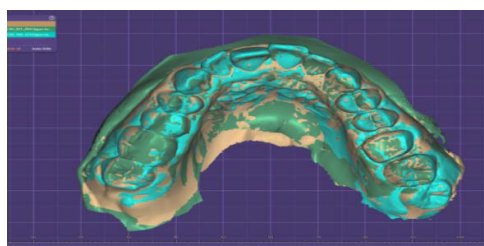


Fig 5: Digital impression with IOS

Fig 6: Superimposition of all three STL files

Fig 7: Deviations measured (mesio-distal and bucco-lingual)

Table 1 Comparison of Mean Deviation between Desktop Scanned master cast and IOS

Group	N	Mean Deviation	Standard Deviation	p-value
Master cast (Desktop Scan)	20	0.0661	0.0349	0.41
Intraoral Scanner (IOS)	20	0.1062	0.1473	0.41

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Discussion

Sulcular depth measurement is critical for restorative and prosthodontic success, influencing marginal fit, emergence profile, and periodontal health. Conventional impressions using polyvinyl siloxane (PVS) with retraction paste are considered highly reliable for capturing fine subgingival details, while intraoral scanners (IOS) offer advantages such as patient comfort, real-time visualization, and a streamlined digital workflow. However, IOS accuracy is limited by factors like moisture control, soft tissue interference, and restricted optical penetration.

In this study, the desktop-scanned impression served as the reference. The master cast showed better agreement with the control (0.0661 ± 0.0349 mm) compared to IOS (0.1062 ± 0.1473 mm), indicating greater variability with IOS. Conventional impressions demonstrated higher accuracy (93.39%) than IOS (89.38%), though the difference was not statistically significant ($p=0.41$), suggesting comparable clinical performance.

Previous systematic reviews indicate that while IOS performs well in capturing hard tissues, its accuracy decreases with mobile soft tissues and deeper sulcular regions. Some studies report superior or comparable accuracy of IOS in specific applications, highlighting ongoing advancements in digital technology.

Despite its limitations, IOS remains a promising alternative; however, conventional impressions continue to be more reliable, especially for deep sulcular recording. The null hypothesis was not rejected, as no significant difference was found between the two methods, although conventional techniques demonstrated greater precision.

Conclusion

Within the limitations of this study, the intraoral scanner (IOS) was found to be less efficient than the master cast when compared to the conventional impression (control) in recording gingival sulcular depth. The master cast demonstrated closer agreement with the control, indicating superior precision. However, with ongoing advancements in IOS technology and software, its accuracy is expected to improve in the future. Despite these developments, the conventional impression technique remains the gold standard for recording deep gingival sulcus.

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