Özden *et al. BMC Oral Health* (2025) 25:1169
https://doi.org/10.1186/s12903-025-06556-4

BMC Oral Health

RESEARCH

The effect of cavity depth on accuracy of intraoral scanners in intra-coronal restorations

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Abstract

Purpose This study aimed to evaluate the effect of cavity depth on the accuracy of intraoral scanners (IOS) in intra-coronal restorations, focusing on trueness and precision as defined by International Organization for Standardization (ISO) 5725 standards.

Materials and methods Three intra-coronal cavity designs with depths of 2.5 mm ($n=10$), 5 mm ($n=10$), and 7.5 mm ($n=10$) were fabricated using 3-Dimentional (3D) printed tooth models. Scans ($n=30$) were performed using the Trios 3 intraoral scanner, and accuracy was assessed by comparing scanned models to reference models. Trueness was measured as the root mean square (RMS) deviation, and precision was calculated from the interquartile range of average absolute distances. Statistical analyses were conducted using the Kruskal-Wallis test and Mann-Whitney U test with Bonferroni correction.

Results The accuracy of the IOS was significantly lower at a cavity depth of 7.5 mm compared to 5 mm and 2.5 mm ($p<0.05$). RMS values were highest for the 7.5 mm depth, while the lowest precision was observed at this depth.

Conclusion Cavity depth significantly affects the accuracy of IOS in intra-coronal restorations, with deeper cavities resulting in reduced accuracy. This highlights the importance of considering cavity depth when planning IOS workflows. This study shows that scanning accuracy decreases when the distance between the cavity floor and the cusp tip exceeds 5 mm. Elevating the cavity floor with direct methods may help improve scanning accuracy and enhance restoration outcomes.

Keywords Cavity depth, Intra-coronal restorations, Intraoral scanner accuracy

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Introduction

A fit of the prosthetic restoration not only provides a more natural appearance but also enhances biological compatibility [1]. Achieving a good fit for prosthetic restorations is directly related to the impression-taking process, which represents the initial phase of treatment. An accurate and well-adapted impression ensures proper marginal fit, thereby contributing to both functional and aesthetic outcomes.

The history of dental impressions dates back to ancient Egyptian, Etruscan, and Roman civilizations, where intraoral observations and manual shaping techniques were utilized [2]. Over the centuries, various technological advancements were introduced, including the invention of new impression materials, which enhanced the accuracy and efficiency of impression-taking. In 1987, François Duret introduced the first digital dental scanning system, representing a novel approach to impression techniques by transitioning from analog to digital methods [3]. This innovation marked the beginning of a new phase in dental impression technology, complementing traditional methods with digital alternatives. Despite this breakthrough, digital scanners were not widely adopted in clinical practice until the 2010s. After 2015, the use of intraoral scanners became increasingly prevalent, as evidenced by growing market shares and sales figures [4].

The accuracy of an intraoral scanner (IOS) is evaluated based on two fundamental parameters: trueness and precision, as described in ISO 5725 [5]. Trueness refers to how accurately the digital model replicates the physical reference model, reflecting the scanner's ability to capture the actual dimensions and geometry of the object. This parameter is essential for ensuring that the virtual representation aligns closely with clinical reality. Precision, on the other hand, measures the repeatability of the scanner by assessing how consistently it produces identical digital models across multiple scans of the same object. Together, these parameters offer a comprehensive evaluation of an IOS's performance, demonstrating its ability to deliver both accurate and reproducible results in clinical and laboratory applications [6].

Recently, factors affecting the accuracy of intraoral scanners have become a focal point for researchers [7–9]. Studies have identified numerous factors influencing IOS performance. These include various factors such as the technology of the scanner [10, 11], changes in ambient conditions [12, 13], operator experience [14], scanning area size [15, 16], rescanning strategies [17], scanning paths [18, 19], existing restorations [20], arch width [21], surface characteristics [22], distance from the adjacent tooth [23, 24], preparation depth [24, 25], preparation geometry [26–29], and scanning distance [30, 31].

Intraoral scanners function by recording the spatial coordinates of surface points and combining them to create a complete image. Literature reports indicate that accuracy decreases when the scanning distance exceeds 5 mm [31]. However, the surfaces scanned in dentistry are not one-dimensional. While it is feasible to maintain a scanning distance within the optimal range of 5 mm or less for extracoronal restorations, such as crowns, this is often challenging in cases involving deep intracoronal restorations. For example, restorations such as inlays and onlays, particularly those involving endodontically treated teeth with deep cavity floors, present unique challenges. Studies have shown that scanning accuracy is lower in intracoronal restorations compared to extracoronal ones [28, 32]. However, there is a lack of literature evaluating the impact of scanning distance on accuracy in deep intracoronal restorations.

The aim of this study is to investigate the effect of scanning distance on the accuracy of intraoral scanners in deep intracoronal cavity designs of 5 mm or more. The null hypothesis of this study is that cavity depth does not affect the accuracy of intraoral scanners in intra-coronal restorations.

Materials and methods

This study is an in vitro study that did not involve human participants or animal subjects, ethical approval was not required in accordance with institutional and national guidelines.

Sample preparation

In this study, three different configurations of intracoronal preparation were utilized. Tooth-shaped models replicating the upper second premolar with original dimensions (shade A2) were fabricated using a 3D printer (Phrozen Mega 8 K, Phrozen, Taiwan) to ensure standardized preparations and eliminate potential variability due to arbitrary preparation methods [33]. The cavity designs, including rounded internal line angles, an occlusal isthmus width of 2.5 mm, and a contact opening of 0.5 mm on the mesial side adjacent to the neighboring tooth, were prepared using specialized software (ZBrush, Maxon Inc, Germany) and subsequently produced via 3D printing. All mesial cavity edges were finished with a 90° cavosurface angle. Additionally, an intact margin of 2.5 mm was preserved at the distal region, while the buccal and lingual cusp areas maintained an intact structure of 3 mm. (Fig. 1).

The different intra-coronal preparation configurations were as follows: three distinct models were designed, each with varying pulpal and gingival depths while maintaining a consistent preparation angle of 6°. The depths were set at 2.5 mm, 5 mm, and 7.5 mm. (Fig. 2).

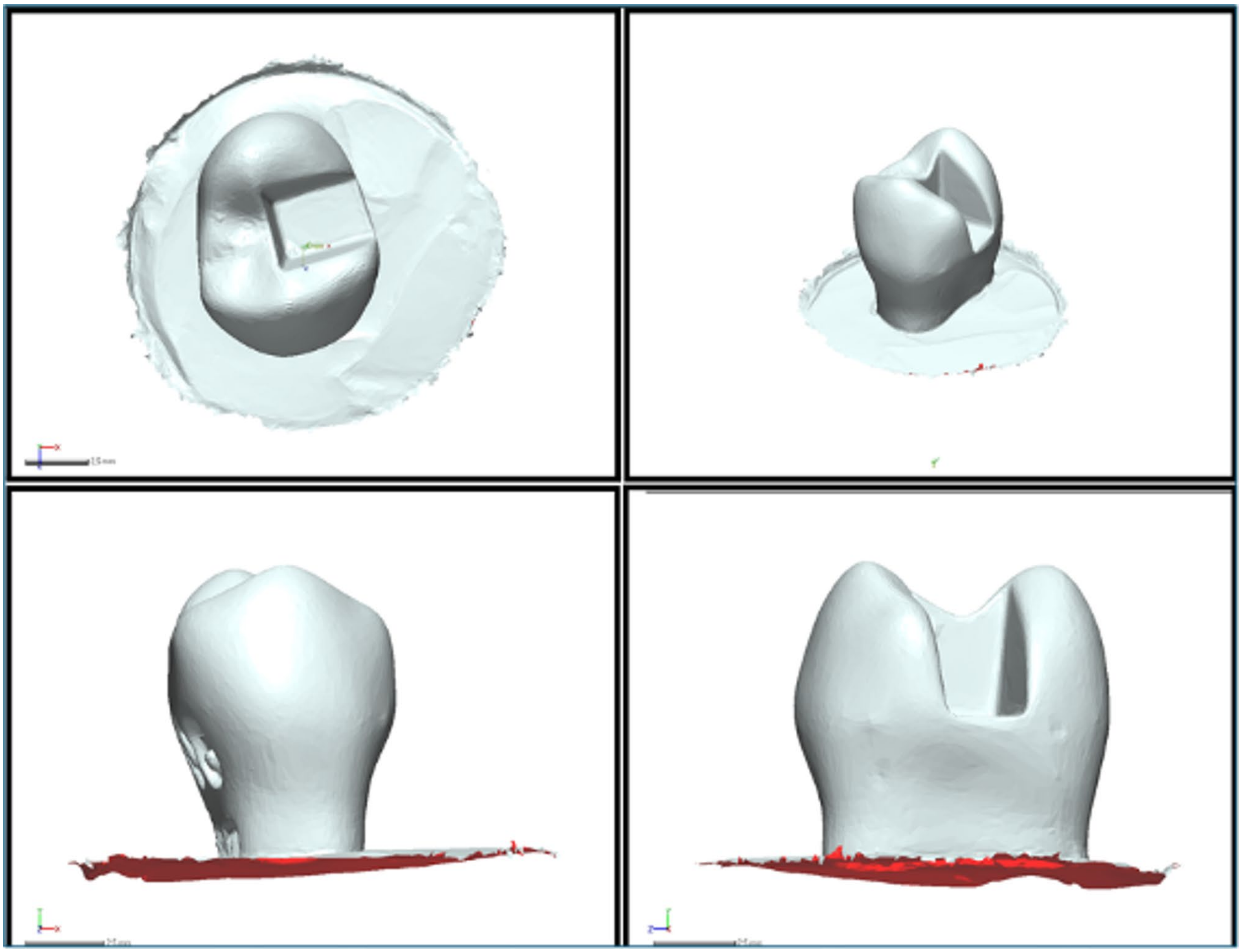

Fig. 1 Inlay preparation design: Preservation of 2.5 mm intact margin at distal and 3 mm at buccal/lingual cusps.

Scanning process

A total of 30 3D images were obtained from each of the three models ($n=10$) using the Trios 3 intraoral scanner (3Shape, Denmark), with the resulting 3D images (samples) saved in Standard Tessellation Language (STL) format. The scanning process was conducted following the manufacturer's instructions, utilizing the intraoral scanner's integrated illumination. To acquire the reference data, each model with an intra-coronal cavity was scanned using an extraoral scanner (E1, 3Shape, Denmark), and the corresponding 3D image was also saved in STL format.

Assessment of accuracy

The accuracy of an intraoral scanner was determined by two factors: trueness and precision according to ISO:5725-1.

In order to assess the trueness of the models, a total of 60 STL files (n = 30 for intraoral scans, n = 30 for extraoral scans) were imported into Geomagic Control X 2022 software (3D Systems Inc., USA). Each file was then overlapped with the reference 3D image. The 'best-fit alignment' tool was utilized to analyze the 3D differences, with the discrepancy between the reference image and the samples recorded as RMS (root mean square) and SD (standard deviation) (Fig. 3). To assess the precision, it was defined in terms of the interquartile range of the average absolute distances measured between all scanned samples and the reference models [12, 34, 35] (Fig. 4).

Statistical analysis

IBM SPSS version 29 was used for data analysis. RMS and SD values were presented as median, 1^{st}– 3^{rd} percentiles, and interquartile range (IQR). Interquartile range, the range between the first and third quartiles, used to measure the dispersion in a dataset and in this study it is used for precision calculation. The differences in RMS distributions across different distances were analyzed using the Kruskal-Wallis Test, followed by pairwise comparisons with the Mann-Whitney U Test adjusted with Bonferroni correction. A Type I error rate of 5% was considered statistically significant for all analyses.

Fig. 2 Inlay preparation configurations with a 6° angle and pulpal/gingival depths of 2.5 mm, 5 mm, and 7.5 mm, respectively.

Results

The distribution of RMS and SD values calculated from scans of the produced material at different distances is presented in Table 1; Fig. 5. The RMS value, used to evaluate trueness, was highest at 7.5 mm, which were statistically significant ($p = 0.042$). On the other hand, the lowest SD was found at a depth of 5 mm ($p < 0.001$). The IQR values, used to represent precision, RMS were smallest at 2.5 mm. Similarly, the lowest SD was found at 2.5 mm (Table 1).

Discussion

The null hypothesis of this study, which stated that cavity depth does not affect the accuracy of intraoral scanners (IOS) in intra-coronal restorations, was rejected. The results demonstrated that cavity depth significantly impacts the accuracy of IOS, with scans of cavities measuring 7.5 mm in depth showing lower trueness and precision compared to those of 5 mm and 2.5 mm. This result aligns with the previous studies in the literature reporting that the accuracy of intraoral scanners decreases as the distance between the scanner tip and the measurement area increases [30, 31].

In this study, the maxillary second premolar was selected as the experimental tooth. In its two-rooted anatomical variation, the distance between the incisal cusp tip and the pulp chamber floor is approximately 7.5 mm [36]. This suggests that in a scenario involving a deep intracoronal cavity, the upper limit of the cavity depth would likely not exceed this range. Furthermore, in studies evaluating the effect of scanning distance in intraoral scanners, it has been reported that scanner accuracy may decrease beyond a depth of 5 mm [31]. Accordingly, while determining the experimental groups, reference was made to plausible clinical scenarios. The upper anatomical limit was set at 7.5 mm, the maximum scanning performance threshold at 5 mm, and an additional group at 2.5 mm was included to represent an equal interval below the scanner threshold.

One study demonstrated that a scanning distance of 7.5 mm significantly reduced the marginal fit of milled PMMA crowns, highlighting the clinical importance of

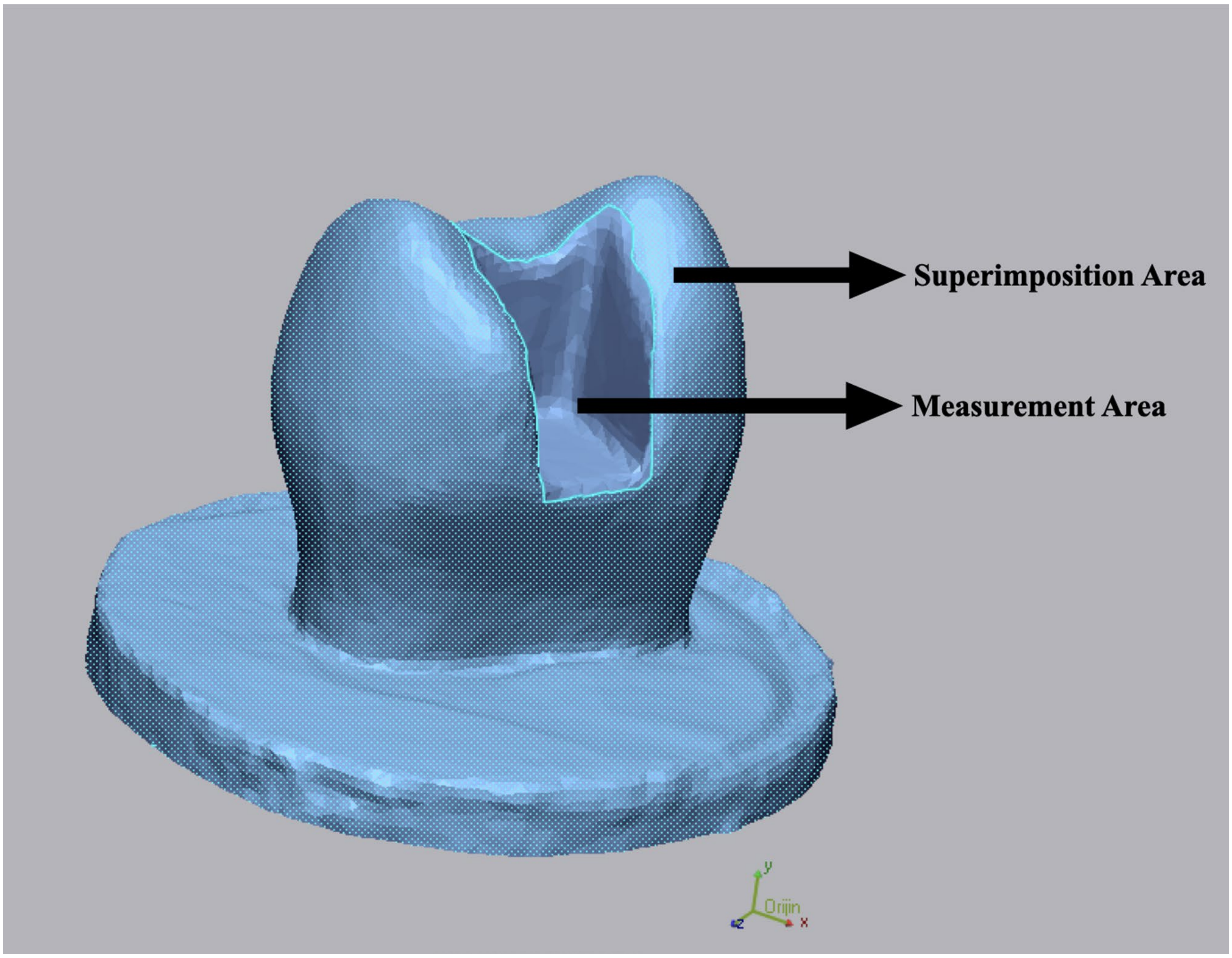

Fig. 3 Regions where the images were superimposed and the measurement areas within the images are indicated.

scanning accuracy as it directly influences marginal fit, supporting the results of the present study [1, 31]. A further study examined post space depths and reported that the trueness of digital scans is affected by the depth of the scanned area [37]. Although post space and its depth were not discussed in this study, the common conclusion is that intraoral scanners can be affected by cavity depth. In a different study that investigated the design of different inlay cavity configurations, the highest mean deviation for accuracy was observed in the narrow shallow group and the lowest in the wide deep group. With regard to precision, the narrow shallow group demonstrated the lowest mean deviation, while the narrow deep group exhibited the highest value [38]. In the present study, accuracy was found to be lower in the deeper cavity. However, the highest level of accuracy was found at a cavity depth of 5 mm, rather than in the shallowest (2.5 mm) cavity. This phenomenon can be attributed to the fact that the accuracy and precision of scanners can be affected by a multitude of environmental factors [19, 34]. Furthermore, the scanner utilised in this study incorporates confocal microscopy technology, and research has indicated that scanner technologies and depth of field values can exhibit variability, resulting in divergent outcomes [39, 40].

Another study reported that in endocrown cavities prepared at different depths, scans performed at pulpal chamber extension depths of 2 mm and 3.5 mm were more accurate than those at a depth of 5 mm [25]. However, the findings of this study differ, as no significant difference was observed between the accuracy of scans at depths of 5 mm and 2.5 mm. This discrepancy may be attributed to variations in experimental conditions and the type of restorations used. It should also be noted that restoration geometry may influence the accuracy of intraoral scanners.

A further study demonstrated that scanning accuracy is affected by the scanning distance in overlay preparations [30]. In their study, accuracy generally decreased as the scanning distance increased; however, more accurate

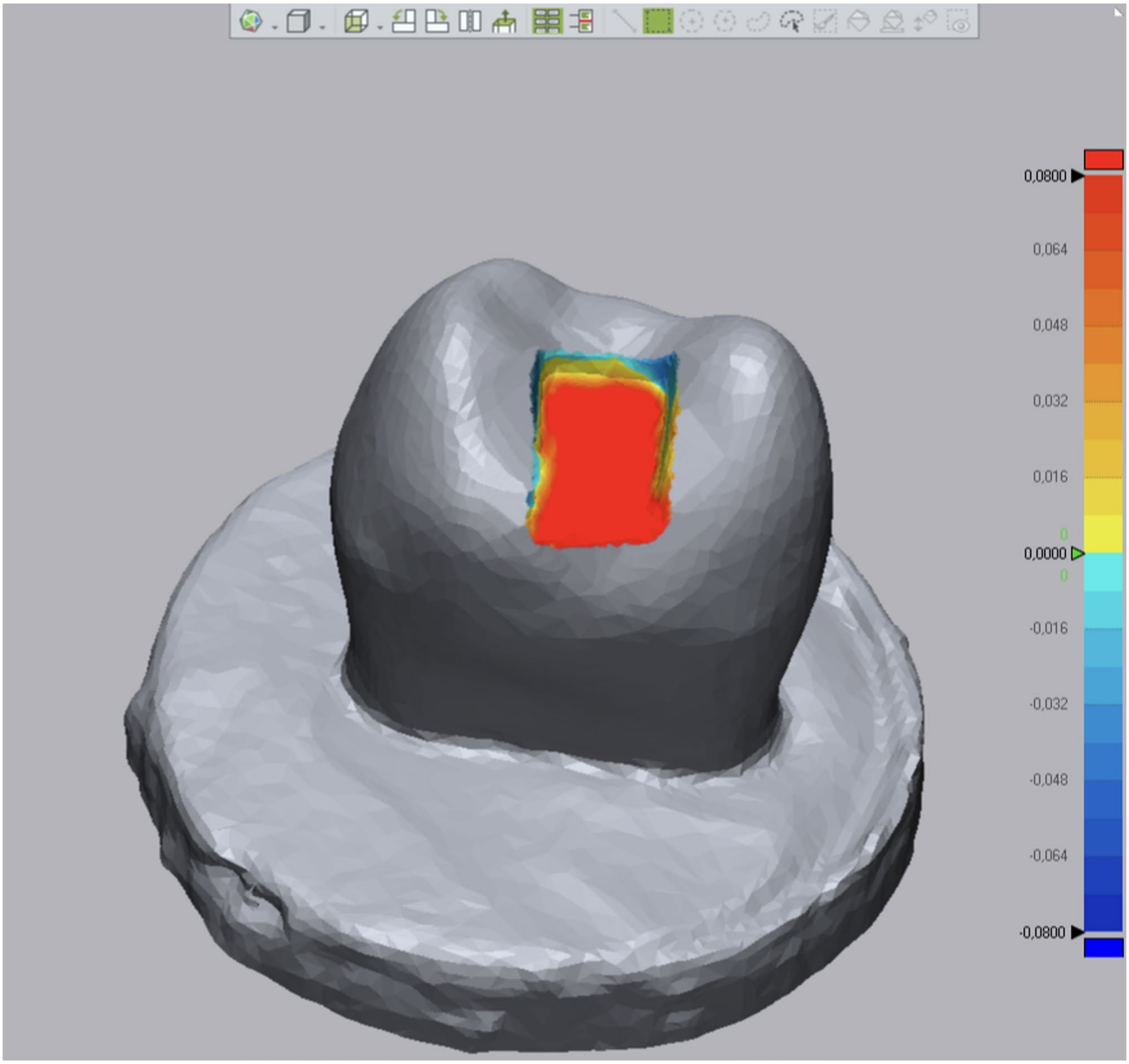

Fig. 4 Color map illustrating the amount of deviation between the images and the reference images.

measurements were obtained at 10 mm compared to 5 mm, underscoring the complex interplay of factors such as scanning distance and restoration geometry on the performance of intraoral scanners.

Research has also found that intraoral scanners exhibited higher accuracy in narrow and deep inlay cavities compared to wide and shallow cavities [23]. Additionally, it was reported that the distance to adjacent teeth affects the scanning accuracy of inlay restorations, with greater distances resulting in improved accuracy. In one study researchers reported that the presence of adjacent teeth influenced the scanning accuracy of Class II inlay restorations [24]. Previous studies have further demonstrated that scanning accuracy is affected by surface characteristics and the size of the scanning area [15, 16]. However, some researchers noted that they used fully dentate models to ensure proper mesh alignment during scanning and therefore did not remove adjacent teeth [30]. This study was conducted using an intracoronal design. As such, cusp tips and outer crown surfaces were used as reference points for alignment, and the study was planned on a single tooth model.

The models used in this study were produced using 3D printing technology to eliminate potential operator-induced variability during the preparation process. All scans were performed by a single, experienced operator who was trained in the use of intraoral scanners, under consistent environmental conditions [12, 14].

Table 1 The distribution of RMS and standard deviation values according to distance.

Distance	RMS Median (1st– 3rd Percentiles)	SD Median (1st– 3rd Percentiles)
7.5 mm	0.081 (0.077–0.090) [a]	0.072 (0.067–0.078) [a]
5 mm	0.073 (0.067–0.079) [b]	0.044 (0.038–0.047) [b]
2.5 mm	0.076 (0.073–0.080) [a,b]	0.062 (0.058–0.063) [a]
p value*	**0.042**	**< 0.001**
Distance	**IQR**	**IQR**
7.5 mm	0.013	0.011
5 mm	0.012	0.009
2.5 mm	0.007	0.005

RMS: root mean square, SD: standard deviation. *Kruskal Wallis Test. [a,b,c] There is no statistically significant difference between groups with the same letter (Mann-Whitney U Test, with Bonferroni correction)

It has been reported that different lighting conditions can affect the performance of intraoral scanners [12, 13]. This factor should be carefully considered in in vitro studies conducted in laboratory settings, such as this one. One study reported that ambient lighting was a significant factor in full-arch scans; however, for scans involving up to four units performed with Trios3, ambient lighting did not affect scanning accuracy [13]. In this study, all scans were performed on a single tooth using the same scanner.

The accuracy of intraoral scanners has been reported to be higher in extracoronal restorations than in intracoronal restorations [28, 32]. One study found that the marginal fit of crown-type restorations produced with CAD/CAM systems was superior to that of inlay and onlay restorations [32]. Similarly, another study revealed that as the axial wall angle increased, scanner accuracy improved [28]. Additionally, more precise measurements were obtained for full crowns compared to inlays, and the choice of scanner influenced the accuracy of the results. Another evaluation of the internal surfaces of inlay restorations found significantly better accuracy in non-box areas [29]. In the present study, intra-coronal restorations were prepared as non-box designs with an axial wall angle of 6 degrees.

This study has certain limitations that should be acknowledged. First, it was conducted under in vitro conditions, which may not fully replicate the complexities of the oral environment, such as patient movement, saliva, or variations in soft tissue. In addition, three dimensional printed artificial teeth were used in this study to ensure cavity standardization; however, scanner performance may vary under the surface characteristics of natural teeth. Moreover, only a single type of intraoral scanner and standard cavity configurations were utilized, which may limit the generalizability of the findings to other scanners or more complex clinical scenarios. Furthermore, the impact of factors such as operator fatigue, scanning strategies, and different ambient lighting conditions on accuracy were not evaluated.

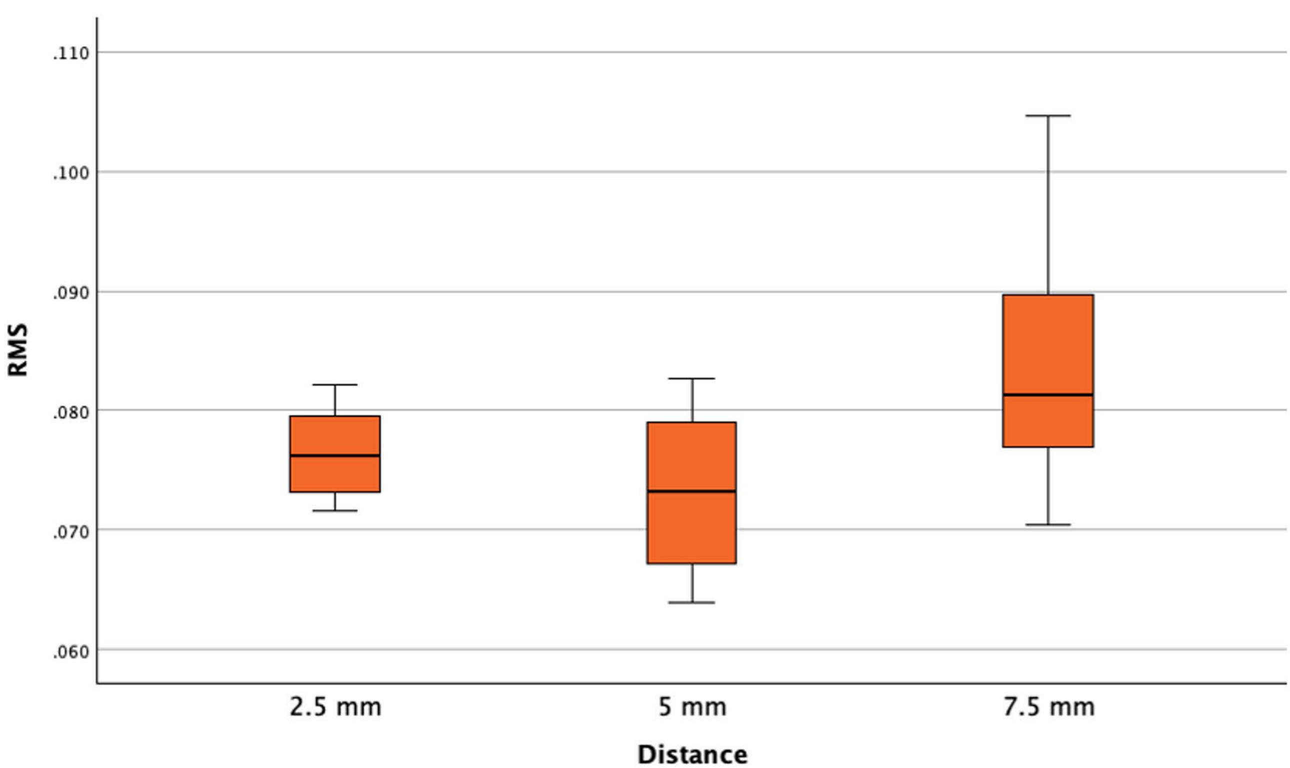

Fig. 5 The distribution of RMS values according to distance.

Finally; one another limitation of the present study is that the scanning was performed on samples without adjacent teeth. Future studies incorporating diverse scanner technologies, real clinical conditions, and broader experimental variables are needed to validate and extend these findings.

Conclusion

Within the limitations of this current study, it was concluded that:

1. Cavity depth significantly affects the accuracy of intraoral scanners in intra-coronal restorations. Specifically, deeper cavities (7.5 mm) demonstrated lower trueness and precision compared to shallower cavities (5 mm and 2.5 mm).
2. These findings emphasize the importance of considering cavity depth in clinical and laboratory workflows to minimize inaccuracies and optimize restorative outcomes.

Abbreviations

3D	Three dimensional
CAD/CAM	Computer-Aided Design/ Computer-Aided Manufacturing
IOS	Intraoral scanner
ISO	International Organization for Standardization
IQR	Interquartile range
RMS	Root mean square
PMMA	Polymethyl methacrylate

Acknowledgements
The authors would like to thank Dr. Mustafa Enes Özden for his valuable support in the analysis and interpretation of the data.

Author contributions
Conceptualization YEO, CA, and ZOK; methodology, YEO and BDK; software, YEO, BDK, CA; formal analysis, YEO, PYA, ZOK; investigation, YEO and CA; data curation, YEO and BDK; writing—original draft preparation, YEO and BDK; writing—review and editing, YEO, PYA, and ZOK; supervision, PYA and ZOK; administration, YEO. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Data availability
The data presented in this study are available on request from the corresponding authors.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 3 February 2025 / Accepted: 7 July 2025
Published online: 15 July 2025

References

1. Larson TD. The clinical significance of marginal fit. Northwest Dent. 2012;91(1):22–9.
2. Papadiochos I, Papadiochou S, Emmanouil I. The historical evolution of dental impression materials. J History Dentistry. 2017;65(2):79–89.
3. Birnbaum NS, Aaronson HB. *Dental impressions using 3D digital scanners: virtual becomes reality*. Compendium of continuing education in dentistry (Jamesburg, NJ: 1995), 2008. 29(8): p. 494, 496, 498–505.
4. Global intraoral scanner market size and trends report. 2023. Available at: https://exactitudeconsultancy.com. Accessed 11 January 2025.
5. ISO I. 5725-1: 1994, accuracy (trueness and precision) of measurement methods and results-Part 1: general principles and definitions. Geneva: International Organization for Standardization; 1994. p. 2.
6. Mutwalli H, et al. Trueness and precision of three-dimensional digitizing intraoral devices. Int J Dent. 2018;2018(1):5189761.
7. Alkadi L. A comprehensive review of factors that influence the accuracy of intraoral scanners. Diagnostics. 2023;13(21):3291.
8. Revilla-León M, Kois DE, Kois JC. A guide for maximizing the accuracy of intraoral digital scans. Part 1: operator factors. J Esthetic Restor Dentistry. 2023;35(1):230–40.
9. Revilla-León M, Kois DE, Kois JC. A guide for maximizing the accuracy of intraoral digital scans: part 2—Patient factors. J Esthetic Restor Dentistry. 2023;35(1):241–9.
10. Osman RB, Alharbi NM. Influence of scan technology on the accuracy and speed of intraoral scanning systems for the edentulous maxilla: an in vitro study. J Prosthodont. 2023;32(9):821–8.
11. Dutton E, et al. The effect different substrates have on the trueness and precision of eight different intraoral scanners. J Esthetic Restor Dentistry. 2020;32(2):204–18.
12. Revilla-León M, et al. Clinical study of the influence of ambient light scanning conditions on the accuracy (trueness and precision) of an intraoral scanner. J Prosthodont. 2020;29(2):107–13.
13. Wesemann C, et al. Does ambient light affect the accuracy and scanning time of intraoral scans? J Prosthet Dent. 2021;125(6):924–31.
14. Zarauz C, et al. Influence of age, training, intraoral scanner, and software version on the scan accuracy of inexperienced operators. J Prosthodont. 2023;32(S2):135–41.
15. Yilmaz B, et al. The effect of scanned area on the accuracy and time of anterior single implant scans: an in vitro study. J Dent. 2021;109:103620.
16. Marques VR, et al. Effect of scanned area and operator on the accuracy of dentate arch scans with a single implant. J Clin Med. 2022;11(14):4125.
17. Revilla-León M, et al. Influence of rescanning mesh holes on the accuracy of an intraoral scanner: an in vivo study. J Dent. 2021;115:103851.
18. Gavounelis NA, Gogola C-MC, Halazonetis DJ. The effect of scanning strategy on intraoral scanner's accuracy. Dentistry J. 2022;10(7):123.
19. Salem MM, Elmahy WA, Nasr DM. Effect of different intraoral scanning strategies on the marginal and internal fit of CAD-CAM inlay restorations: an in vitro study. J Prosthet Dent. 2024;131(3):518. e1-518. e9.
20. Lim J-H et al. *A comparison of accuracy of different dental restorative materials between intraoral scanning and conventional impression-taking: An in vitro study*. Materials, 2021. 14(8): p. 2060.
21. Kaewbuasa N, Ongthiemsak C. Effect of different arch widths on the accuracy of three intraoral scanners. J Adv Prosthodont. 2021;13(4):205.
22. Ammoun R, et al. Influence of tooth Preparation design and scan angulations on the accuracy of two intraoral digital scanners: an in vitro study based on 3-dimensional comparisons. J Prosthodont. 2020;29(3):201–6.
23. Son S-A, et al. Influence of different inlay configurations and distance from the adjacent tooth on the accuracy of an intraoral scan. J Prosthet Dent. 2022;128(4):680–7.
24. Kim JH, et al. Influence of adjacent teeth on the accuracy of intraoral scanning systems for class II inlay Preparation. J Esthetic Restor Dentistry. 2022;34(5):826–32.
25. Gurpinar B, Tak O. Effect of pulp chamber depth on the accuracy of endocrown scans made with different intraoral scanners versus an industrial scanner: an in vitro study. J Prosthet Dent. 2022;127(3):430–7.
26. Chiu A, et al. Accuracy of CAD/CAM digital impressions with different intraoral scanner parameters. Sensors. 2020;20(4):1157.
27. Özden YE, et al. Marginal fit of 3D printed interim crowns fabricated with intraoral scanners over conventional and reverse-tapered preparations. Balkan J Dent Med. 2024;28(2):133–7.
28. Ashraf Y, et al. Influence of Preparation type and tooth geometry on the accuracy of different intraoral scanners. J Prosthodont. 2020;29(9):800–4.

29. Park J-M. Comparative analysis on reproducibility among 5 intraoral scanners: sectional analysis according to restoration type and Preparation outline form. J Adv Prosthodont. 2016;8(5):354.
30. Rotar RN, et al. Scanning distance influence on the intraoral scanning accuracy—An in vitro study. Materials. 2022;15(9):3061.
31. Ozden YE, Ozkurt-Kayahan Z, Kazazoglu E. Effect of intraoral scanning distance on the marginal discrepancy of milled interim crowns. J Prosthodont. 2024;33(1):41–5.
32. Merrill T, et al. Effect of chairside CAD/CAM restoration type on marginal fit accuracy: A comparison of crown, inlay and onlay restorations. Eur J Prosthodont Restor Dent. 2021;29(2):119–27.
33. Taha D, et al. Assessment of marginal adaptation and fracture resistance of endocrown restorations utilizing different machinable blocks subjected to thermomechanical aging. J Esthetic Restor Dentistry. 2018;30(4):319–28.
34. Revilla-León M, et al. Intraoral digital scans—Part 1: influence of ambient scanning light conditions on the accuracy (trueness and precision) of different intraoral scanners. J Prosthet Dent. 2020;124(3):372–8.
35. Revilla-León M, et al. Analysis of different illuminance of the room lighting condition on the accuracy (trueness and precision) of an intraoral scanner. J Prosthodont. 2021;30(2):157–62.
36. Deutsch AS, et al. Morphological measurements of anatomic landmarks in pulp chambers of human maxillary furcated bicuspids. J Endod. 2005;31(8):570–3.
37. Elter B, Diker B, Tak Ö. The trueness of an intraoral scanner in scanning different post space depths. J Dent. 2022;127:104352.
38. Park Y, et al. Scanning accuracy of an intraoral scanner according to different inlay Preparation designs. BMC Oral Health. 2023;23(1):515.
39. Waldecker M, et al. Accuracy of complete-arch intraoral scans based on confocal microscopy versus optical triangulation: A comparative in vitro study. J Prosthet Dent. 2021;126(3):414–20.
40. Braian M, Wennerberg A. Trueness and precision of 5 intraoral scanners for scanning edentulous and dentate complete-arch mandibular casts: A comparative in vitro study. J Prosthet Dent. 2019;122(2):129–36. e2.

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