Research Square

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Effects of Post Drill Specification, Preparation Depth and Adjacent Tooth Status on the Scanning Accuracy of Post Space: An In Vitro Study

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Abstract

Background:

The indication for direct intraoral scanning of post spaces should be guided by the post drill. This study evaluated the influence of drill Specifications, preparation depth, and adjacent tooth status on the in vitro scanning trueness of post spaces using two intraoral scanners(IOSs).

Methods:

A standard maxillary denture model was scanned for virtual post spaces preparation of the right maxillary central incisor. Post spaces were designed based on the three-dimensional (3D) measurements of 4 drills (3M RelyX Fiber Post sizes 2 and 3; RTD Macro-Lock #4 and #6) and prepared at depths of 8 and 10 mm, with and without adjacent teeth. Sixteen models were fabricated using a high-precision 3D printer. Each model was scanned 10 times with two IOSs; the scanned data were exported as test files, with the design data serving as the reference. Following best-fit alignment, the root mean square error (RMSE) and recognizable depth were computed.

Results:

For the Trios 5 scanner, the median trueness ranged from 51.5 to 927.5μm. The median recognizable depth varied from 4.48 to 7.98mm in the 8 mm preparation group and from 4.45 to 9.94mm in the 10 mm preparation group. For the Primescan scanner, the median trueness of all groups ranged from 38.0 to 88.5μm. The median recognizable depth was 7.95 to 7.98mm in the 8mm group and 9.92 to 9.95mm in the 10mm group.

Conclusions:

Primescan identified post spaces prepared by all 4 drills at depths ≤ 10 mm, regardless of adjacent tooth obstruction. In the presence of obstruction, the Trios 5 scanner detected only the Macro-Lock #6 preparations at ≤ 10 mm depth. In the absence of obstruction, it further detected RelyX Size 3 and Macro-Lock #4 preparations at depths ≤ 8 mm.

1. Introduction

After extensive loss of tooth structure, post-and-core crown restoration serves as a crucial therapeutic method to r**esto**re the morphology and function of affected tooth. [1–3] For teeth with wide or irregular root canals, customized posts exhibit superior adaptability and more favorable clinical outcomes compared with prefabricated posts. [4]Silicone impression materials have been conventionally used to obtain post space impressions in clinical practice. With the advancement of intraoral scanning

technology in recent years, direct intraoral scanning of post spaces has emerged as an alternative impression-taking approach. [5–7]

Intraoral scanners (IOS) have been widely applied in various fields of prosthodontics, whereas certain challenges remain in post-and-core restoration. [8, 9] On the one hand, scanning accuracy is limited by the inherent performance of IOS, including optical scanning principles, depth of field of imaging components, and scattered light intensity. [10–12]On the other hand, clinical factors such as post space opening diameter and depth can also significantly influence scanning accuracy.[13]

Current in vitro studies on post space scanning mainly focus on the opening diameter and depth of post spaces. [14–18] Clinicians need to measure these parameters to determine the feasibility of direct scanning, which hinders rapid clinical decision-making. Accordingly, this innovative study took post drills as the core reference, selecting post drill specifications, preparation depth, and adjacent tooth status as research variables to explore their effects on the in vitro scanning trueness of post spaces. Based on the applied drill type and preparation depth, clinicians can rapidly evaluate the applicability of direct intraoral scanning without additional measurement of post space parameters. The findings provide practical references for routine clinical work. The null hypothesis was that different post drill specifications, preparation depth, and adjacent tooth status had no significant influence on the in vitro scanning trueness of post spaces obtained with the two IOSs.

2. Material and methods

2.1. Model design and fabrication

A standard maxillary denture model (D16FE-500H(GSF)-MF; Nissin Kushan, Suzhou, China) was scanned to obtain the original design data, which were imported into Exocad software (Exocad, Hessen, Germany) for virtual tooth preparation of the right maxillary central incisor (tooth 11). The coronal structure was designed as a residual root with a uniform and continuous 1.0 mm shoulder, and a 3.0 mm dentin ferrule was reserved coronally to the cementoenamel junction (CEJ). The internal morphology of post spaces was designed according to the three-dimensional(3D) dimensions of 4 commonly used post drills: The 3M RelyX Fiber Post drills (Size 2, Size 3; 3M, Maplewood, USA) and RTD drills (#4, #6; RTD, Saint-Égrève, France) (Table 1). Two post space depths (8.0 mm and 10.0 mm) and two adjacent tooth conditions (presence and absence of bilateral adjacent teeth) were set, generating a total of 16 groups of models (Fig. 1).

Table 1
Size information of the post drills used in this study

Brand	post drill	r_{min}(mm)	r_{max}(mm)
3M	Size2	0.8	1.6
	Size3	0.9	1.9
RTD	#4	1.05	1.9
	#6	1.35	2.25

The finalized models were printed with a high-precision 3D printer (Dent-160HD; Yunxin, Shenzhen, China) using dedicated model resin (XD-M-B; Yunxin, Shenzhen, China). All resin models were ultrasonically cleaned and stored away from light. Two intraoral scanners were adopted in this study: Trios 5 (3Shape, Copenhagen, Denmark) and Primescan Connect (Dentsply Sirona, Bensheim, Germany). All scanning procedures were performed by a single well-trained and experienced operator, with standard equipment calibration conducted before scanning. The scanning route was arranged as follows: the occlusal, buccal, and lingual surfaces of the dentition were scanned first, followed by positioning the scanning head close to the opening plane of the post space of tooth 11. The angle of the scanning head was adjusted repeatedly to fully capture the internal 3D morphology of the post space. Each of the 16 models was scanned 10 times independently with each scanner, and all scanning data were exported and saved in standard tessellation language (STL) format. All scanning operations were completed within two weeks after 3D printing to reduce morphological errors caused by long-term storage of resin models.[19]

2.2. Data Analysis

Each set of scanned data and the corresponding designed reference data were imported into MEDIT LINK (Medit, Seoul, Korea).[20, 21] All datasets were first aligned using best-fit alignment, followed by cropping to remove redundant regions outside the post space. Based on the color deviation mapping, the software automatically calculated the root mean square error (RMSE) via formula $RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}$. The average RMSE value of ten repeated scans was adopted to evaluate scanning trueness. A two-dimensional section perpendicular to the opening plane of the post space was created to measure the actual scanned depth, and the average value of ten measurements was recorded.

2.3. Statistical Analysis

The collected data were analyzed using SPSS software (v.27.0, SPSS Inc., IBM Corp, NY, USA). The Shapiro-Wilk test for normality and Levene's test for homogeneity of variance confirmed non-normal distribution and heterogeneous variance across all datasets. Accordingly, all results are presented as the median (interquartile range, IQR). The Kruskal-Wallis H test was applied for overall group comparisons.

Where significant differences were identified, pairwise analyses between two subgroups were performed using the Mann-Whitney U test, while Dunn's post-hoc test with Bonferroni correction was adopted for comparisons involving three or more subgroups. A two-sided significance level was set at α = 0.05.

3. Results

Tables 2 and 3 present the median and IQR of trueness and recognizable depth among all groups for the Trios 5 scanner. The median trueness of Trios 5 ranged from 51.5 to 927.5μm; the median recognizable depth was 4.48 to 7.98 mm in the 8 mm group and 4.45 to 9.94mm in the 10 mm group. The Kruskal–Wallis H test revealed that drill type, preparation depth, and adjacent tooth status significantly influenced scanning trueness; furthermore, drill type and adjacent tooth status exerted significant effects on detectable depth ($P < 0.05$). Post - hoc pairwise comparisons demonstrated that smaller-diameter drills and interference from bilateral adjacent teeth reduced both scanning trueness and detectable depth. Increasing the post space preparation depth further decreased scanning trueness ($P < 0.05$).

Table 2
Median (IQR) of trueness represented by RMSE (μm) for the Trios 5 scanner across all groups.

Size	Depth	Presence of bilateral adjacent teeth	Absence of bilateral adjacent teeth
3M size2	8mm	845.0(108)$^{A,a,\#}$	467.0(107)^{A,a}
	10mm	927.5(90)$^{B,a,\#}$	712.5(100)^{B,a}
3M size3	8mm	383.0(58)$^{A,b,\#}$	132.5(14)^{A,b}
	10mm	608.0(98)$^{B,b,\#}$	580.5(200)^{B,b}
RTD#4	8mm	444.0(77)$^{A,b,\#}$	83.0(10)^{A,b}
	10mm	607.5(210)$^{B,b,\#}$	315.5(115)^{B,b}
RTD#6	8mm	113.0(11)$^{A,c,\#}$	51.5(9)^{A,c}
	10mm	576.0(175)$^{B,c,\#}$	85.0(48)^{B,c}
Same superscript uppercase letter indicates no significant difference in trueness values among different post space depths in the same drill size and adjacent tooth status group ($p > 0.05$).			
Same superscript lowercase letter indicates no significant difference in trueness values among different drill sizes with the same post space depth and adjacent tooth status ($p > 0.05$).			
The superscript # indicates a significant difference in trueness values between the presence and absence of bilateral adjacent teeth with the same drill size and post space depth ($p < 0.05$).			

Table 3
Detectable depth (mm) of post spaces for the Trios 5 scanner across all groups.

Size	Depth	Presence of bilateral adjacent teeth	Absence of bilateral adjacent teeth
3M size2	8mm	4.48(0.21)[a,#]	5.33(0.42)[a]
	10mm	4.45(0.16)[a,#]	5.23(0.43)[a]
3M size3	8mm	5.85(0.28)[b,#]	7.75(0.37)[b]
	10mm	5.92(0.13)[b,#]	6.16(0.17)[b]
RTD #4	8mm	5.75(0.56)[b,#]	7.98(0.05)[b]
	10mm	5.66(0.15)[b,#]	6.65(0.44)[b]
RTD #6	8mm	7.98(0.04)[c,#]	7.98(0.05)[c]
	10mm	7.36(0.06)[c,#]	9.94(0.07)[c]
Depth (8 mm vs. 10 mm) was not subjected to statistical comparison because it served as the experimental gradient for assessing the detectability limit, rather than an independent variable for intergroup comparison.			
Same superscript lowercase letter indicates no significant difference in trueness values among different drill sizes with the same post space depth and adjacent tooth status ($p > 0.05$).			
The superscript # indicates a significant difference in trueness values between the presence and absence of bilateral adjacent teeth with the same drill size and post space depth ($p < 0.05$).			

Tables 4 and 5 summarize the median and IQR of trueness and recognizable depth across all groups for the Primescan Connect scanner. The median trueness ranged from 38.0 to 88.5μm; the median recognizable depth was 7.95 to 7.98 mm in the 8 mm group and 9.92 to 9.95 mm in the 10 mm group. The Kruskal–Wallis H test demonstrated that drill type and adjacent tooth status significantly affected scanning trueness ($P < 0.05$), whereas these two factors exerted no significant influence on detectable depth ($P > 0.05$). Due to potential interference from printing accuracy and superior scanning performance of the Primescan, the trend of trueness differences was not obvious in post-hoc comparisons. Since the detectable depth was not affected by the above two variables, further post-hoc pairwise comparisons were not performed for this indicator. (Fig. 2–3).

Table 4
Median (IQR) of trueness represented by RMSE (μm) for the Primescan connect scanner across all groups.

Size	Depth	Presence of bilateral adjacent teeth	Absence of bilateral adjacent teeth
3M size2	8mm	49.5(5)[a,#]	38.0(2)[a]
	10mm	72.0(9)[a.#]	45.0(5)[a]
3M size3	8mm	41.5(6)[b,#]	63.5(5)[b]
	10mm	44.5(2)[b,#]	33.0(8)[b]
RTD #4	8mm	40.5(6)[b,#]	64.0(1)[b]
	10mm	51.5(3)[b,#]	65.0(2)[b]
RTD #6	8mm	88.5(2)[c,#]	44.5(4)[c]
	10mm	43.5(3)[c,#]	45.5(3)[c]

Same superscript lowercase letter indicates no significant difference in trueness values among different drill sizes with the same post space depth and adjacent tooth status ($p > 0.05$).

The superscript # indicates a significant difference in trueness values between the presence and absence of bilateral adjacent teeth with the same drill size and post space depth ($p < 0.05$).

Table 5
Detectable depth (mm) of post spaces for the Primescan connect scanner across all groups.

Size	Depth	Presence of bilateral adjacent teeth	Absence of bilateral adjacent teeth
3M size2	8mm	7.95(0.02)	7.95(0.04)
	10mm	9.92(0.01)	9.94(0.04)
3M size3	8mm	7.98(0.04)	7.98(0.04)
	10mm	9.92(0.05)	9.95(0.04)
RTD #4	8mm	7.95(0.02)	7.95(0.04)
	10mm	9.92(0.01)	9.94(0.04)
RTD #6	8mm	7.95(0.02)	7.95(0.04)
	10mm	9.92(0.01)	9.94(0.04)
Depth (8 mm vs. 10 mm) was not subjected to statistical comparison because it served as the experimental gradient for assessing the detectability limit, rather than an independent variable for intergroup comparison.			
Since the detectable depth was not affected by drill type or adjacent tooth status, further post-hoc multiple comparisons were not performed for this outcome.			

4. Discussion

This in vitro study systematically evaluated the effects of 4 types of post drills, 2 preparation depths, and 2 adjacent tooth status on the scanning trueness using two mainstream IOSs. For the Trios 5 scanner, the null hypothesis was rejected; drill specification, post space depth, and adjacent tooth status all significantly influenced scanning trueness. In contrast, for the Primescan Connect scanner, drill type and adjacent tooth status exerted a significant effect on trueness, whereas post space depth showed no statistical significance.

Amornvit et al. reported that previous generations of intraoral scanners (TRIOS 3 and TRIOS 4) achieved clinically acceptable accuracy only for post spaces within 8 mm in depth, with unsatisfactory performance in deeper post spaces exceeding 8 mm. [22]As the latest upgraded wireless model, the Trios 5 possesses optimized hardware and algorithms, thereby improving its scanning capability in narrow and deep areas compared with TRIOS 3 and TRIOS 4. Zhu et al. demonstrated that Trios 5 is suitable for scanning post spaces ≤ 10 mm deep when the remaining tooth height (RTH) ≥ 4 mm, or for post spaces ≤ 8 mm deep when RTH ≥ 2 mm.[23]The present study further indicated that even within the 8 mm depth range, an excessively narrow opening diameter may reduce light penetration, resulting in incomplete recognition of the apical portion of the post space. This finding suggests that when using Trios 5, clinicians should consider not only post space depth and remaining tooth height but also the opening diameter of the prepared post space.

This study revealed that the Primescan Connect scanner exhibited superior trueness and more complete detectable depth in direct post space scanning compared with the Trios 5 scanner. Even for narrow post spaces with adjacent tooth obstruction, the trueness of Primescan Connect remained below 100 μm, and nearly the full depth of the post space could be captured. These findings are consistent with previous studies by Elter et al. and Abouseif et al. who reported that Primescan enables reliable scanning of post spaces up to 14 mm or deeper.[14, 17]

Such performance differences are mainly attributed to distinct imaging principles. Primescan Connect applies high-frequency contrast analysis and dynamic depth scanning technologies, which substantially extend the depth of field and enhance accuracy within deep and narrow cavities. In contrast, although Trios 5 has been upgraded from Trios 4, it still adopts confocal microscopy as its core imaging mechanism.[24, 25] Confocal technology relies on signal filtering within a fixed focal plane; therefore, data acquisition efficiency decreases markedly when the scanning depth exceeds the effective focal range.[26]

The present results demonstrated that the trueness of Trios 5 decreased significantly with increasing post space depth, which supports the conclusions of Almalki et al. and Zhu et al. Higher accuracy was generally observed in the coronal portion of the post space, whereas trueness gradually declined toward deeper regions. [15, 16]At a depth of 10 mm, reduced light penetration and limited detectable angles impaired the ability of Trios 5 to recognize the apical portion of the post space. By comparison, Primescan Connect successfully captured complete apical data within clinically common post space depths while maintaining trueness below 100μm, further validating the advantages of its extended depth-of-field technology.

Clinicians routinely use dedicated drills for post space preparation. The most commonly applied drill kits are mainly provided by two mainstream brands: 3M (RelyX Fiber Post) and RTD (Macro-Lock). [27, 28] In the present study, two representative drill sizes from each brand combined with two clinical preparation depths were selected to clarify the applicable scope of intraoral scanning for post spaces. The 4 selected drills covered a wide range of clinically common post space diameters. A larger opening diameter allows greater light incidence, thereby facilitating more accurate imaging. Furthermore, drills from the 2 brands differ in taper design; RTD drills generally present a more pronounced taper. This geometric characteristic enables light to irradiate the inner wall at the post space base with a smaller projection angle, making reflected signals easier for imaging sensors to capture and improving overall scanning performance. [18, 29]

Zou et al. reported that the presence of bilateral adjacent teeth significantly reduces scanning trueness. [30] The present findings confirmed this influence: adjacent tooth interference markedly impaired the trueness and detectable depth of the Trios 5 scanner, whereas no significant impact was observed for Primescan Connect. Clinically, adjacent teeth restrict the scanner head from approaching the coronal plane of the post orifice. Increased scanning distance may exceed the effective depth of field and enlarge the illumination angle at the deep inner wall, compromising image quality. In contrast, Primescan

Connect possesses a dynamic depth of field close to 20 mm and an optical principle that tolerates wider illumination angles. Therefore, clear imaging of deep post regions can still be achieved even with adjacent tooth obstruction.

Previous studies, such as those by Zhu et al. and Elter et al. mostly adopted conventional indirect digital workflows: silicone impressions of post spaces were obtained and then scanned with high-precision desktop scanners to generate reference data.[14, 23]Nevertheless, this method introduces unavoidable confounding variables. For narrow and deep post spaces, silicone impressions are prone to elastic deformation or incomplete removal during demolding. Polymerization shrinkage of impression materials and inherent errors from desktop scanning may further deviate the benchmark data.[31] Compared with such strategies, the current study adopted a methodology similar to that of Zou et al. using original CAD design files as the reference for alignment and error evaluation. (30)This method eliminates the uncontrollable errors introduced by the aforementioned multi-step workflow

Nevertheless, potential manufacturing errors from 3D printing remain a limitation and may influence final measurements.[32, 33] Accordingly, a high-precision DLP 3D printer with a dimensional accuracy of 30–40μm was utilized in this study, and all specimens were fabricated strictly following the manufacturer's recommended parameters. The results revealed that the RMSE values of Primescan Connect remained approximately 50 μm even in the 10 mm depth groups, which was superior to several previous studies relying on impression-based reference models. [31] This outcome indirectly verifies that aligning scanned datasets with original CAD files is a reliable strategy for evaluating in vitro scanning accuracy of post spaces.

Despite the clinically relevant conclusions drawn from this study, several limitations should be acknowledged. First, this was an in vitro study that could not fully simulate the complex clinical environment. Factors such as patient saliva, cooperation level, and lighting conditions may affect scanning accuracy in clinical practice.[34–38] Second, not all mainstream IOSs available on the market were included in this study. Third, this study only analyzed a limited range of post space morphologies; subsequent studies should expand the variety of post space morphologies to conduct more comprehensive investigations.

Declarations

Ethics approval and consent to participate

Ethical approval and informed consent were not required for this in vitro study, as no human or animal participants were involved.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests

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Author Contribution

K. and Y. wrote the main manuscript text.J. and H. acquired the data.K. and J. drafted the manuscript.All authors reviewed the manuscript.

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The authors declare that the funding bodies had no role in the design of the study, collection, analysis, and interpretation of data, or in writing the manuscript.

Clinical trial number: not applicable.

Data Availability

All data supporting the findings of this study, including images and STL files, are stored by the corresponding author. These data are available from the corresponding author upon reasonable request.

References

1. Tsintsadze N, Margvelashvili-Malament M, Natto ZS, Ferrari M. Comparing survival rates of endodontically treated teeth restored either with glass-fiber-reinforced or metal posts: A systematic review and meta-analyses. J Prosthet Dent. 2024;131(4):567–78.
2. Goracci C, Ferrari M. Current perspectives on post systems: A literature review. Aust Dent J. 2011;56(s1):77–83.
3. Maklennan A, Roccuzzo A, Kramer EJ, et al. Long-term success and survival of post-endodontic restorations without posts after up to 18 years: A practice-based study. J Dent. 2025;154:105569.
4. Gomes GM, Rezende EC, Gomes OM, Gomes JC, Loguercio AD, Reis A. Influence of the resin cement thickness on bond strength and gap formation of fiber posts bonded to root dentin. J Adhes Dent. 2014;16(1):71–8.
5. Kalyoncuoğlu E, Ural Ç, Aydemir H, Aslan MA, Balkaya V. Effect of 1-piece post and core fabrication techniques on fracture strength. J Appl Biomater Funct Mater. 2015;13(3):253–8.

6. Martins MD, Junqueira RB, De Carvalho RF, Lacerda MFLS, Faé DS, Lemos CAA. Is a fiber post better than a metal post for the restoration of endodontically treated teeth? A systematic review and meta-analysis. J Dent. 2021;112:103750.
7. Costa TS, Brandão RMR, Farias Vajgel BC, SoutoMaior JR. CAD-CAM glass fiber compared with conventional prefabricated glass fiber posts: A systematic review. J Prosthet Dent. 2024;132(2):337–42.
8. Shen J, Chen S, Chen R, Zheng Z, Lin J. Evaluation of the accuracy of direct digital impressions versus conventional silicone impressions for post-and-core with different root space diameters: a preliminary study in vitro. BMC Oral Health. 2026;26(1):251.
9. Jardim JS, Lemos CAA. The role of intraoral scanning in the fully digital workflow for post and core restorations: A scoping review. J Dent. 2024;147:105100.
10. Waldecker M, Rues S, Behnisch R, Rammelsberg P, Bömicke W. Effect of scan-path length on the scanning accuracy of completely dentate and partially edentulous maxillae. J Prosthet Dent. 2024;131(1):146–54.
11. Wahba M, ElBasty RS. In vitro assessment of the accuracy of two intra-oral scanners for post space scanning in a fully digital workflow. BMC Oral Health. 2025;25(1):407.
12. Fratila AM, Saceleanu A, Arcas VC, Fratila N, Earar K. Enhancing Intraoral Scanning Accuracy: From the Influencing Factors to a Procedural Guideline. J Clin Med. 2025;14(10):3562.
13. Alqahtani SM, Almalki MS, Almarzouki M, et al. Dimensional Accuracy of Intraoral Scanners in Recording Digital Impressions of Post and Core Preparations: A Systematic Review. Diagnostics. 2024;14(24):2890.
14. Elter B, Diker B, Tak Ö. The trueness of an intraoral scanner in scanning different post space depths. J Dent. 2022;127:104352.
15. Zhu J, Deng X, Jin C, Ma L, Huang C. The accuracy of direct digital impressions of post spaces with different diameters and depths scanned by a wireless intraoral scanner. J Dent. 2025;154:105599.
16. Almalki A, Conejo J, Kutkut N, Blatz M, Hai Q, Anadioti E. Evaluation of the accuracy of direct intraoral scanner impressions for digital post and core in various post lengths: An in-vitro study. J Esthet Restor Dent. 2024;36(4):673–9.
17. Abouseif AM, Abdelkader SH, Abdelraheem IM. Accuracy of various intraoral scanners in scanning post space preparation: An in vitro study. J Dent. 2025;155:105651.
18. Zaki MS, Mohsen CA, Mohamed ME. Trueness and depth discrepancy of post-space scans using an intraoral scanner: influence of preparation dimensions: an in vitro study. BMC Oral Health. 2025;25(1):702.
19. Lee Y, Wang S, Yan P, Zhao Y, Liu Y. Effect of storage temperature on the dimensional stability of DLP printed casts. J Prosthet Dent. 2024;131(2):331.e1-331.e7.
20. Wu WL, Wang CW, Nam HY, Lin WC. Trueness and precision analysis of crown margins on digital casts produced by various dental scanning systems. J Dent Sci. 2025;20(3):1447–53.

21. Chuang CC, Cheng FC, Chen MH, Lin WC, Chiang CP. Comparisons of precision and trueness of digital dental casts produced by desktop scanners and intraoral scanners. J Dent Sci. 2025;20(1):137–46.
22. Amornvit P, Rokaya D, Peampring C, Sanohkan S. Confocal 3D Optical Intraoral Scanners and Comparison of Image Capturing Accuracy. Comput Mater Contin. 2020;66(1):303–14.
23. Zhu J, Deng X, Fu C, Li Z, Wang Y, Huang C. Effects of remaining tooth height and post space depth on the accuracy of a wireless intraoral scanner in post space scanning for maxillary incisor. J Dent. 2025;162:106050.
24. Shin SH, Yu HS, Cha JY, Kwon JS, Hwang CJ. Scanning Accuracy of Bracket Features and Slot Base Angle in Different Bracket Materials by Four Intraoral Scanners: An In Vitro Study. Materials. 2021;14(2):365.
25. Tunç H. Evaluation of the accuracy of digital impressions obtained with confocal microscopy and structured light triangulation systems in pediatric patients with different mouth opening: an in vitro study. BMC Oral Health. 2025;25(1):1225.
26. Ting-Shu S, Jian S. Intraoral Digital Impression Technique: A Review. J Prosthodont. 2015;24(4):313–21.
27. Jamleh A, Alghilan M, Alsharif A, Alqahtani N, Aloqayli A, Aljarrah A. Vertical Load and Torque during Postspace Preparation and Their Influence on Microcrack Development. J Prosthodont. 2022;31(3):252–6.
28. Roitman M, Pinasco L, Loiacono R, Panetta V, Anaise C, Rodríguez P. Efficacy of different instruments for the mechanical removal of the smear layer in immediate post preparations: a comparative study. Acta Odontológica Latinoam. 2021;34(2):166–72.
29. Emam M, Ghanem L, Sadek H. Effect of different intraoral scanners and post-space depths on the trueness of digital impressions. Dent Med Probl. 2023;61(4):577–84.
30. Zou JB, Huang. K, Yin L. Influence of scanning aid material and post space parameters on the trueness of intraoral scanners for post space: an in vitro study. Zhonghua Kou Qiang Yi Xue Za Zhi, 60(10), 1144–51.
31. Pinto A, Arcuri L, Carosi P, et al. In vitro evaluation of the post-space depth reading with an intraoral scanner (IOS) compared to a traditional silicon impression. Oral Implantol. 2017;10(4):360–8.
32. Yoo SY, Kim SK, Heo SJ, Koak JY, Kim JG. Dimensional accuracy of dental models for three-unit prostheses fabricated by various 3D printing technologies. Materials. 2021;14(6):1550.
33. Joteppa V, Niras S, Chokhani D, Jadhao TA, Bandgar ST, Bayaskar SG. Accuracy of 3D printed model acquired from different types of intra oral scanners and 3D printers. J Pharm Bioallied Sci. 2024;16(Suppl 2):S1433–4.
34. Park HN, Lim YJ, Yi WJ, Han JS, Lee SP. A comparison of the accuracy of intraoral scanners using an intraoral environment simulator. J Adv Prosthodont. 2018;10(1):58.
35. Revilla-León M, Subramanian SG, Att W, Krishnamurthy VR. 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. Wesemann C, Kienbaum H, Thun M, Spies BC, Beuer F, Bumann A. Does ambient light affect the accuracy and scanning time of intraoral scans? J Prosthet Dent. 2021;125(6):924–31.
37. Camcı H, Salmanpour F. Effect of saliva isolation and intraoral light levels on performance of intraoral scanners. Am J Orthod Dentofac Orthop. 2020;158(5):759–66.
38. Chen Y, Zhai Z, Li H, et al. Influence of Liquid on the Tooth Surface on the Accuracy of Intraoral Scanners: An In Vitro Study. J Prosthodont. 2022;31(1):59–64.

Figures

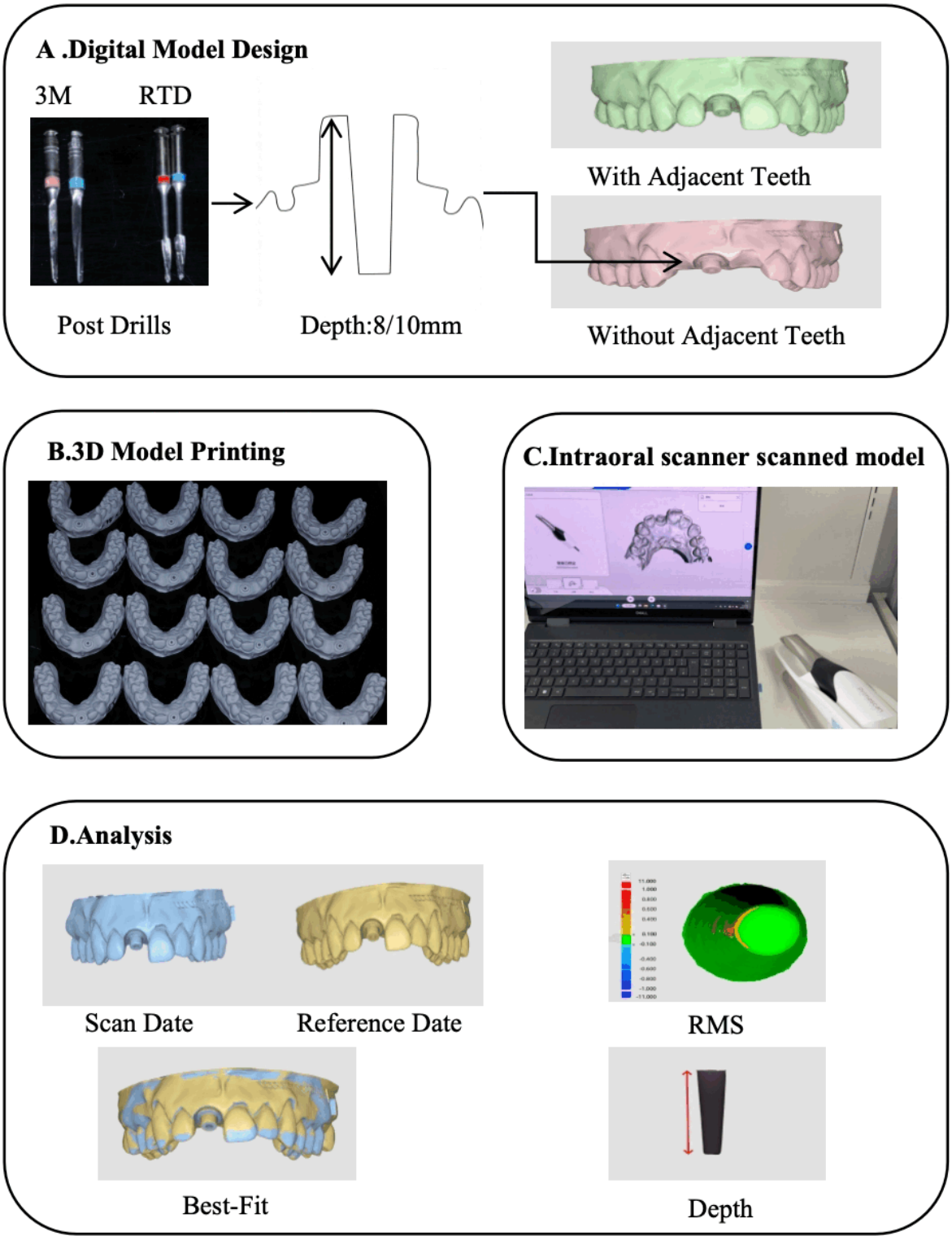


Figure 1

Workflow diagram of the study

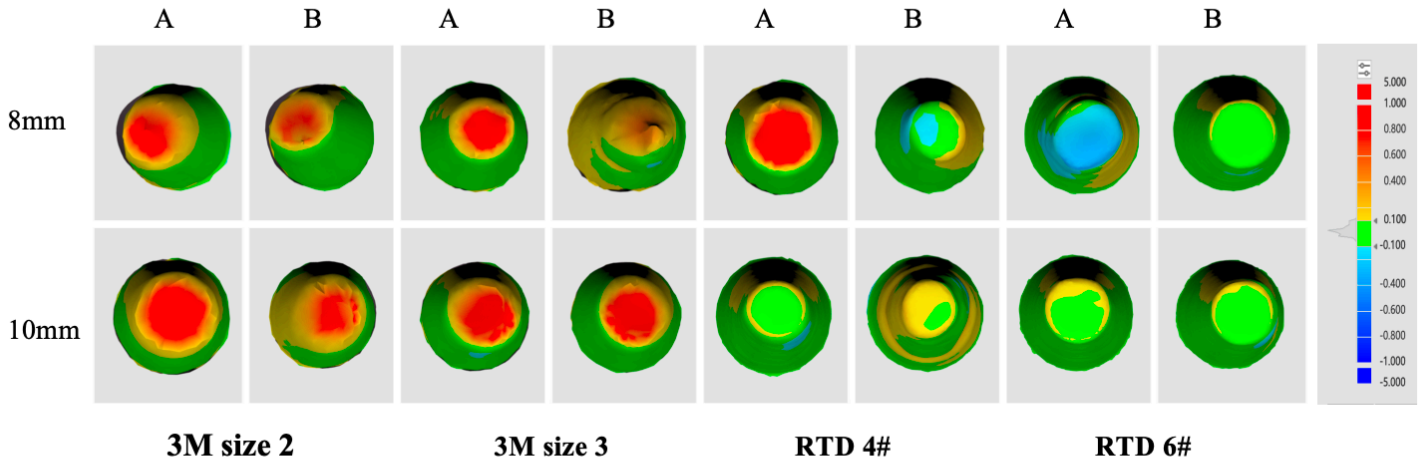


Figure 2. Deviation cloud maps of intraoral scanning of post spaces obtained with the 3Shape Trios 5 scanner under different drill types, preparation depths, and adjacent tooth conditions. Column labels A and B denote the presence and absence of adjacent teeth.

Figure 2

See image above for figure legend

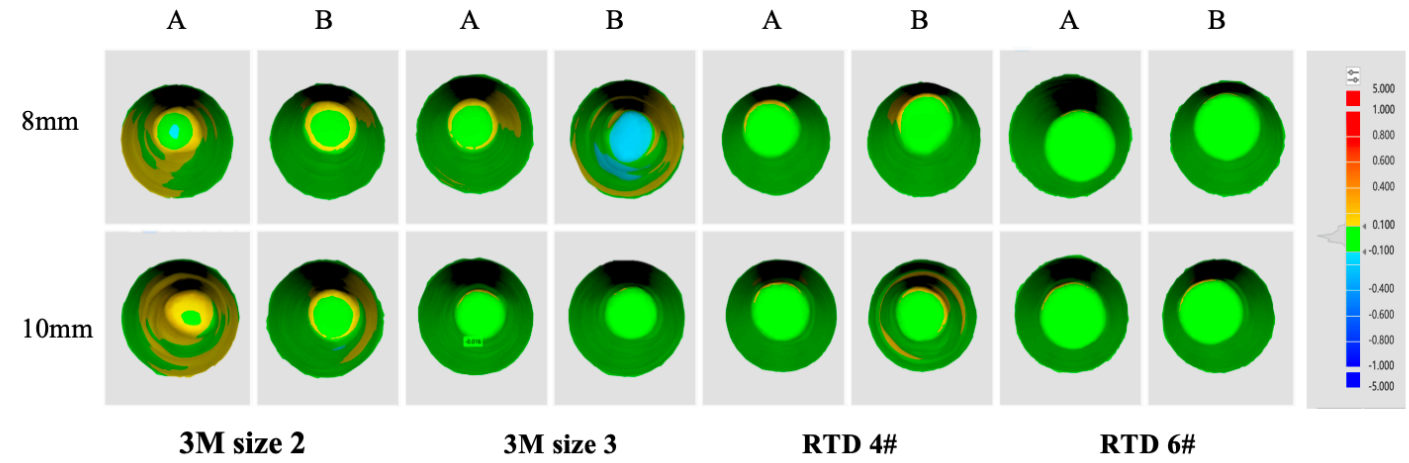


Figure 3. Deviation cloud maps of intraoral scanning of post spaces obtained with the Primescan scanner under different drill types, preparation depths, and adjacent tooth conditions. Column labels A and B denote the presence and absence of adjacent teeth.

Figure 3

See image above for figure legend