

Original Article

Evaluation of the Accuracy of Intraoral and Extraoral Scanners in Recording Distances between Implant Abutments

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KEY WORDS

Intraoral;
Extraoral;
Scanners;
Implant abutments;
Distance;
Measurement accuracy;

ABSTRACT

Background: Precise measurement of distances between implant abutments and adjacent structures is essential for successful dental restorations, as inaccuracies may lead to complications such as suboptimal fit, food impaction, and periodontal issues.

Purpose: This study aimed to compare the accuracy of four intraoral scanners (3Shape Trios 3, Planmeca Emerald, Shining DX-CX, and Kodak Carestream CS3800) and one extra-oral scanner (Map 400 AG) in recording inter-implant abutment distances ranging from 1 to 6 mm.

Materials and Method: An *in vitro* experimental study simulating an edentulous maxillary arch was prepared with two implant analogs placed at controlled distances (1–6mm apart in 1mm increments). Five scanners were used for each distance to take three scans each, resulting in 90 datasets. Standardized ambient conditions were maintained throughout. The resulting scans, exported in STL format, were analyzed using Exocad software to measure the distance between abutments. A digital caliper provided reference measurements. We assessed data normality with the Kolmogorov-Smirnov and Shapiro-Wilk tests and performed statistical analyses using one-way ANOVA and LSD post hoc tests at a significance level of 0.05.

Results: One-way ANOVA followed by LSD post-hoc tests revealed statistically significant differences among the five scanners at all inter-abutment distances (1–6mm; p Value < 0.001 for each distance). The extraoral scanner Map 400 AG showed the highest overall accuracy, with mean measured distances closest to the reference values (e.g., 0.995 ± 0.006 mm at 1mm, 1.983 ± 0.007 mm at 2mm, 3.015 ± 0.012 mm at 3mm, 4.000 ± 0.001 mm at 4mm, 4.940 ± 0.026 mm at 5mm, and 5.990 ± 0.007 mm at 6mm). In contrast, the Planmeca Emerald intraoral scanner consistently exhibited the lowest accuracy and the largest deviations from the true distances across all intervals. Among the intraoral scanners, 3Shape Trios 3 and Carestream CS3800 demonstrated superior accuracy compared with Planmeca Emerald and, in most distances, also outperformed Shining DX-CX; the relative ranking of 3Shape Trios 3 and Carestream CS3800 varied slightly with distance (Carestream CS3800 was significantly more accurate than 3Shape Trios 3 only at 2 mm).

Conclusion: Scanner type significantly affected the precision of inter-implant distance measurements. The Map 400 AG extraoral scanner provided the highest accuracy, making it preferable for cases demanding exceptional precision. Select intraoral scanners carefully based on the specific clinical scenario.

Received: 16 September 2025;

Revised: 3 May 2026;

Accepted: 17 October 2026;

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Cite this article as:

Introduction

Precise measurement of the distance between prepared abutment teeth and adjacent teeth and between implant abutments and neighboring implants is critical in fabricating dental restorations. The accuracy of this measurement is critical, as any deviation may result in restorations with inadequate interproximal contacts, leading to food impaction and subsequent gingival inflammation. Moreover, one of the most significant complications associated with imprecise registration is the fabrication of ill-fitting restorations, which can adversely affect dental and periodontal health and compromise the long-term performance of the prosthesis [1]. To enhance the precision of distance measurements, intraoral scanners have been increasingly used over the past decade to measure the spacing between implant abutments instead of conventional impression techniques [1-2].

Numerous studies [3-8] have evaluated the accuracy of intraoral and extraoral scanners compared to conventional impression techniques to assess their feasibility as an alternative. Haddadi *et al.* (2019) [3] conducted a comparative study on the accuracy of conventional silicone-based impressions versus intraoral scanning. Their findings indicated that the 3Shape Trios 3 intraoral scanner exhibited superior accuracy in capturing the margins of prepared teeth compared to conventional impressions and other intraoral scanning devices. Similarly, Huang *et al.* (2020) [4] investigated the impact of the distance between the prepared tooth and adjacent teeth on the accuracy of intraoral scanners, comparing the results to conventional agar-based impression techniques. Their results demonstrated that increasing the interproximal distance beyond 1.5 mm reduced scanning errors and improved the precision of the acquired data. Furthermore, Chiu *et al.* (2020) [5] conducted an *in vitro* study to evaluate the accuracy of CAD/CAM impressions obtained using various intraoral scanners. Their findings suggested that high-resolution scans achieved greater accuracy, though factors such as tooth preparation technique and margin configuration significantly influenced scanning precision. Although intraoral scanners have shown good results compared to conventional methods, another important aspect of their performance is the repeatability of results.

The repeatability and accuracy of intraoral scanners is crucial considerations. Cesur *et al.* (2016) [6] investi-

gated the accuracy of digitally scanned models and the time-dependent deformation of alginate-based conventional impressions. Their findings revealed that digital models demonstrated superior validity and accuracy, making them more suitable for dental applications. Camardella *et al.* (2016) [7] also examined the accuracy and repeatability of digital and plaster models obtained using intraoral scanners. Their results indicated that intraoral scanner-generated measurements were sufficiently accurate and exhibited high repeatability, although measurement methodologies could influence accuracy and reproducibility. Tomita *et al.* (2018) [8] further explored the accuracy of digital impressions derived from conventional impressions and intraoral scans, concluding that digital measurements obtained from stone models and digital scanners exhibited high clinical reliability, with intraoral scans potentially surpassing conventional methods in accuracy.

With the widespread adoption of intraoral and extraoral scanners, various manufacturers have developed scanning systems, prompting comparative studies on their accuracy. A study by Sung-Sook Kim *et al.* (2020) [9] compared the accuracy of one laboratory scanner (Ceramill Map 400) and three different intraoral scanners (CS3600, 3Shape Trios3, and CEREC Omnicam). Their findings revealed that the CS3600 and the laboratory scanner outperformed the other two intraoral scanners. Similarly, Michelinakis *et al.* (2019) [10] assessed the accuracy discrepancies between three intraoral scanners, concluding that the 3Shape Trios 3 scanner demonstrated significantly higher accuracy than the Planmeca Emerald scanner. Furthermore, Costa *et al.* (2022) [11] compared the accuracy and trueness of three intraoral scanners—iTero (Align Technology Inc.), Medit (Medit, Seoul, Korea), and Planmeca Emerald (Planmeca, Helsinki, Finland)- and found that the iTero scanner exhibited superior performance. Despite rapid advancements in intraoral scanner technology, few studies have compared the accuracy of intraoral and extraoral scanners in measuring inter-implant abutment distances. Additionally, comparing these scanning systems across varying inter-abutment distances remains particularly important. Therefore, this study was conducted to compare the measurement accuracy of implant abutment spacing between four intraoral scanners (3Shape Trios 3, Planmeca Emerald, Shining DX-CX, and Carestream CS3800) and one extraoral lab-

Table 1: Comparison of the measured mean distances of scanners at 1–6 mm distances between implant abutments

Scanner type	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm
Carestream CS3800	0.836 (0.049)	1.98 (0.029)	3.134 (0.119)	4.024 (0.019)	5.038 (0.031)	5.740 (0.129)
Mean (SD)	A	A	A	A	A	A
Shining DX-CX	0.836 (0.047)	1.89 (0.017)	3.223 (0.080)	4.011 (0.014)	4.820 (0.017)	5.926 (0.030)
Mean (SD)	AB	B	B	B	B	B
Planmeca Emerald	1.689 (0.051)	2.546 (0.021)	3.585 (0.061)	4.394 (0.011)	5.813 (0.052)	6.275 (0.096)
Mean (SD)	C	C	AC	AC	C	C
Map 400 AG	0.995 (0.006)	1.983 (0.007)	3.015 (0.012)	4.000 (0.001)	4.940 (0.026)	5.990 (0.007)
Mean (SD)	D	A	AD	AB	D	D
3Shape Trios 3	0.939 (0.014)	2.127 (0.030)	3.089 (0.015)	4.003 (0.003)	5.099 (0.010)	5.900 (0.030)
Mean (SD)	ABC	D	ABD	AB	A	ABD
p Value	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

Values are presented as mean (standard deviation). Groups that do not share a letter are significantly different according to the least significant difference (LSD) post-hoc test (p Value < 0.05).

oratory scanner (Map 400 AG) across inter-abutment distances ranging from 1 to 6 mm.

Materials and Method

The present *in vitro* experimental study was conducted at the faculty of dentistry, Hamadan University of medical sciences, during the 2022–2023 academic year. The study protocol was reviewed and approved by the Research Committee and Ethics Committee of Hamadan University (Ethics Code: IR.UMSHA.RES.1401. 1049).

To determine the sample size for comparing the accuracy of the Map 400 AG, 3Shape Trios 3, Emerald, Carestream CS3800, Shining DX-CX, and Planmeca Emerald scanners at inter-abutment distances of 1, 2, 3, 4, 5, and 6 mm, data from previous studies were used. Using the pwr package in R 3.6.1, with a significance level of 5%, statistical power of 80%, and an effect size of 0.38 for ANOVA, the required sample size was estimated at 90 scans. Accordingly, the required sample size for each of the five groups was 18 scans.

For sample preparation, an implant analog (DIO laboratory fixture analog, Dio Implant System Co. Ltd.) was placed in the canine region of an edentulous maxillary denture model, ensuring parallel positioning. A straight abutment (DIO) was then secured onto the implant analog (Figure 1). To establish a reference point, a line parallel to the plane passing through the long axis of the abutment was drawn at the distalmost point of the abutment margin. A second implant analog with a straight DIO abutment was positioned 1 mm distal to the reference point of the first abutment. The margin of this second abutment was aligned parallel to the reference line of the first abutment. The distance between the two reference points was measured using a digital cali-



Figure 1: Sample created to measure the distance between implants on the edentulous maxillary arch

per (Insize model 150-1180, 150 mm size).

Five different 3D scanners were used to scan the abutments under controlled conditions at $23 \pm 2^\circ\text{C}$, each performing three scans per condition:

- (1) Map 400 AG (AmmanGirrbach, Germany)
- (2) 3Shape Trios 3 (3Shape, North America)
- (3) Planmeca Emerald (Planmeca/E4D, Texas, USA)
- (4) Shining DX-CX (Shining 3D Tech Co., Ltd, Hangzhou, China)
- (5) Kodak Carestream CS3800 (Kodak, France)

Following the scans at 1mm inter-abutment distance, the second implant analog and abutment were removed; the site was filled with resin, and the analog was repositioned at 2mm from the first abutment. The scanning procedure was repeated three times with each scanner. This process was successively repeated for 3-, 4-, 5-, and 6-mm inter-abutment distances, ensuring that each scanner performed 18 scans, leading to a total of 90 scanned datasets.

The scan data were exported in standard tessellation language format and analyzed using Exocad software. The inter-abutment distances were measured using the Measurement Tools and Distance function in Exocad

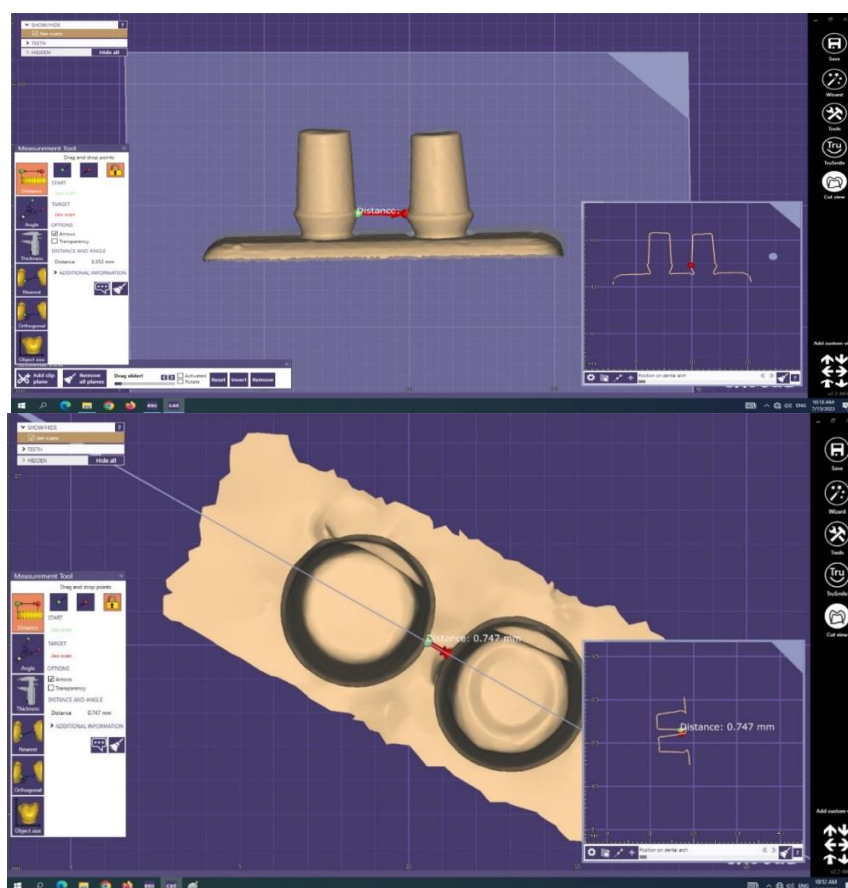


Figure 2: Measuring the distance between reference points in the Exocad program

(Figure 2). Data were analyzed using SPSS 24 (IBM Corp., Armonk, NY, USA). We used descriptive statistics, including means and standard deviations, to summarize the data. Normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Subsequently, one-way ANOVA and LSD post hoc tests were applied to compare the groups. A significance level of 0.05 was considered for all statistical tests.

Results

The results showed a statistically significant difference in the accuracy of five types of scanners at all distances from 1 to 6mm (p Value<0.001). The comparison at a distance of 1 mm indicated that the accuracy of Shining was higher than that of Planmeca Emerald but lower than that of Map 400 AG. The accuracy of Map 400 AG and 3Shape Trios 3 was also higher than that of Planmeca Emerald. The accuracy of Carestream CS3800 was higher than that of Planmeca Emerald but lower than that of Map 400 AG (Table 1).

At a distance of 2mm, the accuracy of Shining was higher than that of Planmeca Emerald but lower than that of Map 400 AG. The accuracy of Map 400 AG and

3Shape Trios 3 was also higher than that of Planmeca Emerald. At a distance of 3mm, the accuracy of Planmeca Emerald was lower than that of other scanners, and the accuracy of Map 400 AG was higher than that of Shining. At a distance of 4 mm, the accuracy of Planmeca Emerald was lower than that of other scanners, and the accuracy of Map 400 AG was higher than that of Shining (Table 1).

At a distance of 5 mm, the accuracy of the Map 400 AG scanner was lower than that of Carestream CS3800 but higher than that of other scanners. The accuracy of 3Shape Trios 3 was lower than that of Map 400 AG but higher than that of Shining DX-CX and Planmeca Emerald. The accuracy of the Shining DX-CX scanner was also lower than that of Map 400 AG, 3Shape Trios 3, and Carestream CS3800 but higher than that of Planmeca Emerald. The accuracy of Planmeca Emerald was lower than that of other scanners. The accuracy of Map 400 AG was also higher than that of Carestream CS3800 (Table 1).

Discussion

The present study demonstrated a significant difference

in the accuracy of intraoral and extraoral scanners at various inter-abutment distances. Across all inter-abutment distances, except for the 5-mm distance, the Map 400 AG scanner exhibited notably high accuracy, significantly surpassing that of other scanners. In contrast, the Planmeca Emerald scanner consistently displayed the lowest accuracy at all distances, with a statistically significant difference from other scanners. Costa V. *et al.* (2022) [11] compared the accuracy and trueness of three intraoral and three extraoral scanners and reported that the Planmeca Emerald scanner had the lowest accuracy, consistent with the present study.

In the present study, significant differences were observed in measurement accuracy across the 1-6mm inter-abutment distances. These variations may be attributed to differences in data acquisition and stitching algorithms. In very narrow gaps (approximately 1mm), limited field of view and incomplete image overlap can increase error, whereas larger distances tend to accumulate stitching errors, particularly with intraoral scanners. Previous investigations have confirmed that increasing inter-implant distance generally reduces the trueness and precision of intraoral scanners, while laboratory scanners remain largely unaffected by this factor [12-13].

The superior performance of the extraoral Map 400 AG scanner compared with the intraoral devices can be explained by several technical advantages. Laboratory scanners operate under controlled lighting and temperature conditions, utilize a larger measuring field, and rely on structured-light technology with higher resolution sensors, which minimizes cumulative stitching errors and environmental interference that commonly affect intraoral scanners [14-15].

Regarding the Map 400 AG specifically, its highest overall accuracy is consistent with earlier studies. Kim *et al.* (2020) [9] reported that the Ceramill Map 400 laboratory scanner outperformed several intraoral scanners (including CS3600 and 3Shape Trios 3) in marginal and internal fit assessments. Similarly, other investigations found the Map 400 to provide superior accuracy in complete-arch implant digitization compared with both intraoral and other laboratory scanners [16-17]. These findings support the present results and indicate that the high accuracy of Map 400 AG observed across most distances is in agreement with previous literature rather than contradictory to it. At the 5 mm distance,

however, the Carestream CS3800 showed slightly higher accuracy than Map 400 AG. Such occasional ranking variations have also been noted in prior comparative studies and may result from algorithm-specific performance at certain distances or minor differences in calibration [9, 15]. Overall, the results reinforce the advantage of laboratory scanners such as Map 400 AG when maximum precision is required, while highlighting the need to consider inter-abutment distance when selecting an intraoral scanner.

The comparisons between intraoral scanners revealed statistically significant differences. The 3Shape Trios 3 scanner exhibited significantly higher accuracy at all inter-abutment distances compared to the Planmeca Emerald scanner. Similarly, Michelinakis *et al.* (2019) [10] assessed the accuracy discrepancies between three intraoral scanners and reported that the 3Shape Trios 3 scanner demonstrated significantly greater accuracy than the Planmeca Emerald scanner, further corroborating our findings.

The Carestream CS3800 intraoral scanner also exhibited significantly greater accuracy than the Planmeca Emerald scanner across all inter-abutment distances. Notably, at the 2-mm inter-abutment distance, the Carestream CS3800 scanner showed significantly higher accuracy than the 3Shape Trios 3 scanner, whereas no significant differences were observed between these two scanners at other distances. Overall, the accuracy of the Carestream CS3800 and 3Shape Trios 3 scanners did not differ significantly, but it was superior to that of the Planmeca Emerald scanner. The results of studies by Haddadi *et al.* (2019) [3], and Baghani *et al.* (2021) [16], which compared the accuracy of intraoral scanners, are consistent with the present study. Also, these results align with Khoshkharesh *et al.* (2024) [14] who evaluated substrate effects and, despite testing CS 3600 and 3Shape Trios 3, found substrate influence was significant yet scanner ranking remained the 3Shape Trios 3 showed higher trueness and precision.

A noteworthy pattern was also observed in the comparison of extraoral scanners. The Map 400 AG scanner exhibited greater accuracy than the Shining DX-CX scanner across all inter-abutment distances, with this difference reaching statistical significance at 1, 2, 3, and 5mm but not at 4 and 6mm. Zarone *et al.* (2020) [15] investigated the accuracy of extraoral scanners, support-

ing and validating the results of this part of our study.

A pairwise comparison of all scanners, whether intraoral or extraoral, also yielded significant results. The Map 400 AG extraoral scanner exhibited superior accuracy across all distances compared to the Planmeca Emerald and 3Shape Trios 3 intraoral scanners. This accuracy disparity with the Planmeca Emerald scanner was particularly pronounced. This accuracy difference was statistically significant when compared to the Planmeca Emerald scanner at all distances. However, the difference with the 3 Shape Trios 3 scanner was significant only at 2mm and 5mm distances but not significant at 1-, 3-, 4-, and 6-mm distances. A study by Vafaee *et al.* (2021) [18], which aimed to compare the accuracy of seven extraoral scanners with the intraoral 3 Shape Trios 3 scanner as a reference, found that the accuracy of the Map 400 AG scanner was significantly higher than that of 3 Shape Trios 3, supporting the findings of our study.

The comparison of the accuracy of the Map 400 AG scanner with the other intraoral scanner in our study, Carestream CS3800, showed somewhat different results. At inter-abutment distances of 1mm and 6mm, the accuracy of Map 400 AG was significantly higher than that of Carestream CS3800. However, at 2mm, 3mm, and 4mm distances, although the accuracy of Map 400 AG was still higher, these differences were not statistically significant. In contrast, at the 5 mm distance, the results were completely reversed, with the Carestream CS3800 scanner showing significantly greater accuracy. Sung-Sook Kim *et al.* (2020) [9] also reported inconsistent results but overall did not find a significant difference between these two scanners. Conversely, Jae-Hyun Kim *et al.* (2016) [19] reported that the accuracy of Carestream CS3800 was higher than that of Map 400 AG, which is somewhat inconsistent with the overall findings of our study. Moreover, Hashemi *et al.* (2023) [20], evaluating multiple uses of scan bodies, observed decreased positional accuracy after repeated scans, suggesting scan-body wear can influence scanner accuracy.

Conclusion

The accuracy of the Map 400 AG, 3Shape Trios 3, Carestream CS3800, Shining DX-CX, and Planmeca Emerald scanners showed significant differences at 1-, 2-, 3-, 4-, 5-, and 6-mm distances between the implants.

The highest accuracy was associated with the extraoral scanner Map 400 AG, while the lowest was associated with the intraoral scanner Planmeca Emerald.

Conflict of Interest

None declared.

References

- [1] Maeng J, Lim YJ, Kim B, Kim MJ, Kwon HB. A new approach to accuracy evaluation of single-tooth abutment using two-dimensional analysis in two intraoral scanners. *Int J Environ Res Public Health*. 2019; 16: 1021.
- [2] Sason GK, Mistry G, Tabassum R, Shetty O. A comparative evaluation of intraoral and extraoral digital impressions: An in vivo study. *J Indian Prosth Soc*. 2018; 18: 108-116.
- [3] Haddadi Y, Bahrami G, Isidor F. Accuracy of intra-oral scans compared to conventional impression in vitro. *Primary Dent J*. 2019; 8: 34-39.
- [4] Huang MY, Son K, Lee KB. Effect of distance between the abutment and the adjacent teeth on intraoral scanning: An in vitro study. *J Prosth Dent*. 2021; 125: 911-917.
- [5] Chiu A, Chen YW, Hayashi J, Sadr A. Accuracy of CAD/CAM digital impressions with different intraoral scanner parameters. *Sensors*. 2020; 20: 1157.
- [6] Cesur M, Omurlu I, Ozer T. Evaluation of Digital Model Accuracy and Time-dependent Deformation of Alginate Impressions. *Nigerian J Clin Prac*. 2017; 20: 1175-1181.
- [7] Camardella L, Breuning H, Vasconcellos Vilella O. Accuracy and reproducibility of measurements on plaster models and digital models created using an intraoral scanner. *J Orofac Orthop*. 2017; 78: 211-220.
- [8] Tomita Y, Uechi J, Konno M, Sasamoto S, Iijima M, Mizoguchi I. Accuracy of digital models generated by conventional impression/plaster-model methods and intraoral scanning. *Dent Mater J*. 2018; 37: 628-633.
- [9] Kim SS, Jeong JH, Lee JI, Cho HW. Effect of digital scans on marginal and internal discrepancies of zirconia crowns. *J Prosth Dent*. 2020; 124: 461-467.
- [10] Michelinakis G, Apostolakis D, Tsagarakis A, Kourakis G, Pavlakis E. A comparison of accuracy of 3 intraoral scanners: A single-blinded in vitro study. *J Prosthe Dent*. 2020; 124: 581-588.
- [11] Costa V, Silva AS, Costa R, Barreiros P, Mendes J, Mendes JM. In Vitro Comparison of Three Intraoral Scanners for Implant-Supported Dental Prostheses. *Dent*

- J. 2022; 10: 112.
- [12] Thanasrisuebwong P, Kulchotirat T, Anunmana C. Effects of inter-implant distance on the accuracy of intraoral scanner: An in vitro study. *J Advanc Prosthodontol*. 2021; 13: 107.
- [13] Tan MY, Yee SHX, Wong KM, Tan YH, Tan KBC. Comparison of Three-Dimensional Accuracy of Digital and Conventional Implant Impressions: Effect of Inter-implant Distance in an Edentulous Arch. *Int J Oral Maxillofac Implants*. 2019; 34: 366–380.
- [14] Khoshkharesh M, Enteghad S, Aghasadeghi K, Farzin M, Taghva M, Mosadad SA. Evaluation of the effect of different core substrates on the accuracy of intraoral scanners. *Clin Exp Dent Res*. 2024; 10: e899.
- [15] Zarone F, Ruggiero G, Ferrari M, Mangano F, Joda T, Sorrentino R. Accuracy of a chairside intraoral scanner compared with a laboratory scanner for the completely edentulous maxilla: An in vitro 3-dimensional comparative analysis. *J Prosth Dent*. 2020; 124: 761.
- [16] Baghani MT, Shayegh SS, Johnston WM, Shidfar S, Hakimaneh SMR. In vitro evaluation of the accuracy and precision of intraoral and extraoral complete-arch scans. *J Prosth Dent*. 2021; 126: 665-670.
- [17] Gomes GF, Aroni MET, Oliveira LP, Arioli Filho JN, Binda CM, Mollo FdA. Implant digital impression accuracy using extraoral scanners: a three-dimensional analysis. *Brazilian J Oral Sci*. 2023; 22: e238354.
- [18] Vafae F, Firouz F, Mohajeri M, Hashemi R, Gholiabad SG. In vitro comparison of the accuracy (precision and trueness) of seven dental scanners. *J Dent*. 2021; 22: 8.
- [19] Kim JH, Jeong JH, Lee JH, Cho HW. Fit of lithium disilicate crowns fabricated from conventional and digital impressions assessed with micro-CT. *J Prosth Dent*. 2016; 116: 551-557.
- [20] Hashemi AM, Hasanzadeh M, Payaminia L, Alikhasi M. Effect of repeated use of different types of scan bodies on transfer accuracy of implant position. *J Dent*. 2023; 24: 410.