J Dent Res Prac 2020; 2(3)

Journal of
Dental reserch and practice

Editorial

A Comparative Study of the Dimensional Accuracy of Intra-Oral and Extra-Oral Scanners with cartesian coordinates (x, y, and z): Review

Iman Shafiei

Associate Professor, Kerman University of Medical Sciences, Iran

ABSTRACT

Introduction: In this study, we investigated and compared the inherent trueness and precision of intra-oral and extra-oral scanner systems in different dimensions, regardless of how scanners work and the conditions that can affect their accuracy. Materials and Methods: In this experimental study, a mandible training dental model was used with two standard Dio implants that center distance implants were placed approximately 14 mm in parallel and in the first premolar area and first molar. Data from Planmeca Emerald, 3Shape Trios, CEREC Omnicam, 3shape D850, Cerec inEos X5, Amanngirrbach Ceramill Map+ and CMM scanners were transmitted to STL format to Geomagic Qualify software and superimposed data from scans (test groups) and data from the CMM (control group) was performed with the Best-Fit algorithm and the calculations were performed to determine precision and trueness. Results: A significant difference was seen among the extra-oral scanners used in the estimation of displacement variables, the intervals between the implants (ΔD), posterior scan body (Δθ1), anterior scan body (Δθ2), and distance displacement (ΔY2) in terms of the amount of the trueness; in addition, there was a significant difference in estimates of

variable distance displacement (ΔY1) in terms of precision (P <0.05). In the estimation of variables ΔD and ΔΘ1, intra-oral scanners also had a significant difference in trueness level; furthermore, in the estimation of variables ΔD, there was a significant difference in terms of precision (p <0.05) and extra-oral scanners had better performance. Conclusion: Extra-oral scanners have better trueness and precision than intra-oral scanners.

keywords : Intra-oral scanner; Extra-oral scanner; Trueness and precision.

Intraoral scanners (IOS) are devices for capturing direct optical impressions in dentistry [1–3]. The 3D surface models of the dent gingival tissues are the result of the optical impression and are the 'virtual' alternative to traditional plaster models [4, 5]. Intraoral scanners (IOS) are devices for capturing direct optical impressions in dentistry. The purpose of this narrative review on the use of IOS was to: (1) identify the advantages/disadvantages of using optical impressions compared to conventional impressions; (2) investigate if optical impressions are as accurate as conventional impressions; (3) evaluate the differences between the IOS currently available commercially; (4) determine the current clinical applications/limitations in the use of IOS.

The accuracy of a dental impression is determined by two factors: "trueness" and "precision." The scanners used in dentistry are relatively new in market, and very few studies have compared the "precision" and "trueness" of intraoral scanner with the extraoral scanner. The aim of this study was to evaluate and compare accuracy of intraoral and extraoral digital impressions. Ten dentulous participants (male/female) aged 18-45 years with an asymptomatic endodontically treated mandibular first molars with adjacent teeth present were selected for this study. The prepared test tooth was measured using a digital Vernier caliper to obtain reference datasets. The tooth was then scanned using the intraoral scanner, and the extraoral scans were obtained using the casts made from the impressions. The datasets were divided into four groups and then statistically analyzed. The test tooth preparation was done, and dimples were made using a round diamond point on the bucco-occlusal, mesio-occlusal, disto-occlusal, and linguo-occlusal lines angles, and these were used to obtain reference datasets intraorally using a digital Vernier caliper. The test tooth was then scanned with the IO scanner (CS 3500, Carestream dental) thrice and also impressions were made using addition silicone impression material (3M™ ESPE) and dental casts were poured in Type IV dental stone (Kalrock-Kalabhai Karson India Pvt. Ltd., India) which were later scanned with the EO scanner (LAVA™ Scan ST Design system [3M™ ESPE]) thrice. The Datasets obtained from Intraoral and Extraoral scanner were exported to Dental Wings software and readings were obtained. Repeated measures ANOVA test was used to compare differences between the groups and independent t-test for comparison between the readings of intraoral and extraoral scanner. Least significant difference test was used for comparison between reference datasets with intraoral and extraoral scanner, respectively. A level of statistical significance of $P < 0.05$ was set.

Purpose

The aim of this study was to compare the accuracy of different laboratory scanners using calibrated coordinate measuring machine as reference.

Methods

A sand blasted titanium reference model (RM) was scanned with

an industrial 3D scanner in order to obtain a reference digital model (dRM) that was saved in the standard tessellation format (.stl). RM was scanned ten times with each one of the tested scanners (GC Europe Aadva, Zfx Evolution, 3Shape D640, 3Shape D700, NobilMetal Sinergia, EGS DScan3, Open Technologies Concept Scan Top) and all the scans were exported in .stl format for the comparison. All files were imported in a dedicated software (Geomagic Qualify 2013). Accuracy was evaluated calculating trueness and precision.

Results

Trueness values (μm [95% confidence interval]) were: Aadva 7,7 [6,8–8,5]; Zfx Evolution 9,2 [8,6–9,8]; D640 18,1 [12,2–24,0]; D700 12,8 [12,4–13,3]; Sinergia 31,1 [26,3–35,9]; DScan3 15,6 [11,5–19,7]; Concept Scan Top 28,6 [25,6–31,6]. Differences between scanners were statistically significant ($p < .0005$). Precision values (μm [95% CI]) were: Aadva 4,0 [3,8–4,2]; Zfx Evolution 5,1 [4,4–5,9]; D640 12,7 [12,4–13,1]; D700 11,0 [10,7–11,3]; Sinergia 16,3 [15,0–17,5]; DScan3 9,5 [8,3–10,6]; Concept Scan Top 19,5 [19,1–19,8]. Differences between scanners were statistically significant ($p < .0005$).

Conclusions

The use a standardized scanning procedure fabricating a titanium reference model is useful to compare trueness and precision of different laboratory scanners; two laboratory scanners (Aadva, Zfx Evolution) were significantly better that other tested scanners.