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Original Research

Comparison of Intraoral and extraoral digital impressions - A clinical study

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ABSTRACT:
Background: An extraoral optical scanner can allow a fast and high-resolution data acquisition with the accuracy of 5–10μm, while the accuracy of intraoral scanning is stated to be 50μm. A direct intraoral scanning is truly free of a physical impression so that it is able to get rid of the errors derived from the distortion of elastomeric impressions, disproportionate water/powder ratio of dental plaster and unsuitable storage conditions of physical impressions or gypsum casts. **Aim of the study:** To compare Intraoral and extraoral digital impressions. **Materials and methods:** For the study, 10 dentulous patients with endodontically treated mandibular first molars with adjacent teeth present in the age range of 18-50 years were selected for the study. The tooth preparation was done according to the biomechanical principles. **Results:** We observed that mean deviation of measurements after from buccal lingual and mesio dimple was more accurate with intraoral scanner as compared to extraoral scanner. **Conclusion**: From the results of the present study, this can be concluded that intraoral and extraoral digital impression highly efficacious.
Key words: Digital impressions, dentulous patients, optical scanner.

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INTRODUCTION:

Plaster models that have been traditionally used in orthodontics for evaluating patients' occlusal status have several limitations. They are subject to physical and chemical damage and they wear when repeatedly measured. Models can also distort over time due to variation of humidity and temperature. Plaster models are also costly, both in terms of the time required for the impressions, model fabrication, and model storage. To solve these problems, digital models were introduced in the mid-1980s.[1] As the initial step of dental CAD/CAM (computer aided designed/computer aided manufactured) techniques, digital impression is increasingly applied in single crowns[2, 3], multi-unit fixed dental prostheses (FDPs), and has expanded in recent years in the field of oral implants[4, 5], complete denture prosthodontics[6] and obturator prostheses. There are two ways to create a digital impression: direct intraoral scanning or indirect extraoral scanning gypsum cast.[5]An extraoral optical scanner can allow a fast and high-resolution data acquisition with the accuracy of 5–10μm, while the accuracy of intraoral scanning is stated to be 50μm.[7] A direct intraoral scanning is truly free of a physical impression so that it is able to get rid of the errors derived from the distortion of elastomeric impressions, disproportionate water/powder ratio of dental plaster and unsuitable storage conditions of physical impressions or gypsum casts.[8] Hence, the present study was planned to compare Intraoral and extraoral digital impressions.

MATERIALS AND METHODS:

The ethical clearance for study protocol was obtained from ethical committee of the institution. For the study, 10 dentulous patients with endodontically treated mandibular first molars with adjacent teeth present in the age range of 18-50 years were selected for the study. The tooth preparation was done according to the biomechanical principles. A diamond round bur was used to make dimples in the center of bucco-occlusal, mesio-occlusal, disto-occlusal, and lingo-occlusal line angles to make measurements. For the measurement of distance between the dimples, a digital Vernier caliper was used. For intraoral digital impression, the teeth were scanned from second molar to second premolar using intraoral scanner. The scanning was initiated from occlusal surface of second molar tooth towards second premolar. After scanning of occlusal surface, lingual and buccal surfaces were scanned. For extraoral scanning, perforated sectional impression trays were selected and single step impression was made using silicone impression material. The casts were poured using dental stone after an hour and were scanned with the extraoral scanner. The images obtained from both the scanners were processed on the computer and were evaluated. The measurements of buccal dimple from lingual dimple and mesial dimple from distal dimple were evaluated in the intraoral and extraoral scanners and were compared to actual dimensions.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

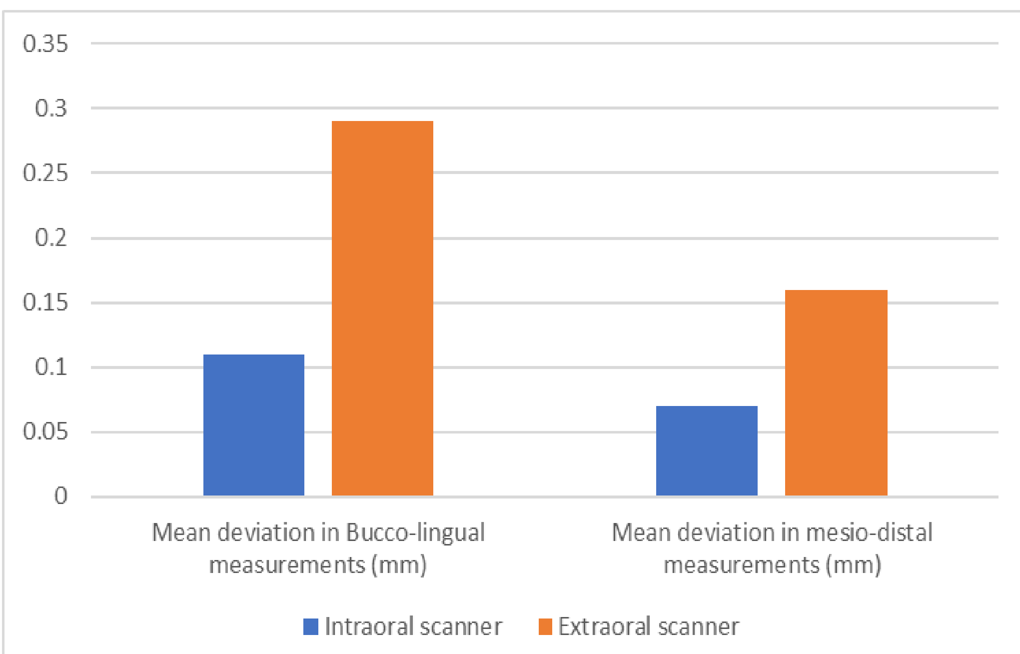
RESULTS:

Table 1 shows the mean deviation of measurements between dimples on buccolingual and mesio-distal landmarks of the tooth. We observed that mean deviation of measurements after from buccal lingual and mesio impels was more accurate with intraoral scanner as compared to extraoral scanner. $p<0.05$

Table 1: Mean deviation of measurements between dimples on buccolingual and mesio-distal landmarks

Scanner	Mean deviation in Bucco-lingual measurements (mm)	Mean deviation in mesio-distal measurements (mm)	p-value
Intraoral scanner	0.11	0.07	0.016
Extraoral scanner	0.29	0.16	

Figure 1:



DISCUSSION:

In the present study, we observed that intraoral and extraoral digital impression has a high accuracy of the dimple measurements. The results were compared with previous studies. Sason GK et al evaluated and compared 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. The precision values ranged from 20.7 to 33.35 µm for intraoral scanner and 19.5 to 37 µm for extraoral scanner. The mean deviations for intraoral scanner were 19.6 µmmesiodistally (MD) and 16.4 µm buccolingually (BL) and 24.0 µm MD and 22.5 µm BL for extraoral scanner. The mean values of the intraoral scanner (413 µm) for trueness were closest to the actual measurements (459 µm) than the extraoral scanner (396 µm). They concluded that the intraoral scanner showed higher "precision" and "trueness" values when compared with the extraoral scanner. Carbajal Mejía JB et al evaluated the influence of abutment tooth geometry on the accuracy of conventional and digital methods of obtaining dental impressions in terms of trueness and precision. Crown preparations with known total occlusal convergence (TOC) angles (-8, -6, -4, 0, 4, 8, 12, 16, and 22 degrees) were digitally created from a maxillary left central incisor and printed in acrylic resin. Each of these 9 reference models was scanned with a highly accurate reference scanner and saved in standard tessellation language (STL) format. Then, 5 conventional polyvinyl siloxane (PVS) impressions were made from each reference model, which was poured with Type IV dental stone scanned using both the reference scanner (group PVS) and the desktop scanner and exported as STL files. Additionally, direct digital impressions (intraoral group) of the reference models were made, and the STL files were exported. The STL files from the impressions obtained were compared with the original geometry of the reference model (trueness) and within each test group (precision). Overall trueness values were 19.1 µm, 23.5 µm, and 26.2 µm, whereas overall precision values were 11.9 µm, 18.0 µm, and 20.7 µm. Simple main effects analysis showed that impressions made with the intraoral scanner were significantly more accurate than those of the PVS and desktop groups when the TOC angle was less than 8 degrees. Also, a statistically significant interaction was found between the effects of the type of impression and the TOC angle on the precision of single-tooth dental impressions ($F=2.43$, $P=.002$). Visual analysis revealed that the intraoral scanner group showed a homogeneous deviation pattern across all TOC angles tested, whereas scans from the PVS and desktop scanner groups showed marked local deviations when undercuts (negative angles) were present. They concluded that conventional dental impressions alone or those further digitized with an extraoral digital scanner cannot reliably reproduce abutment tooth preparations when the TOC angle is close to 0 degrees. In contrast, digital impressions made with intraoral scanning can accurately record abutment tooth preparations independently of their geometry.[9,10]

Bohner LOL et al evaluated and compared the trueness of intraoral and extraoral scanners in scanning prepared teeth. Ten acrylic resin teeth to be used as a reference dataset were prepared according to standard guidelines and scanned with an industrial computed tomography system. Data were acquired with 4 scanner devices (n=10): the Trios intraoral scanner (TIS), the D250 extraoral scanner (DES), the CerecBluecam intraoral scanner (CBIS), and the Cerec InEosX5 extraoral scanner (CIES). For intraoral scanners, each tooth was digitized individually. Extraoral scanning was obtained from dental casts of each prepared tooth. The discrepancy between each scan and its respective reference model was obtained by deviation analysis (µm) and volume/area difference (µm). No significant differences in deviation values were found among scanners. For CBIS and CIES, the deviation was significantly higher for occlusal and cervical surfaces. With regard to volume differences, no statistically significant differences were found (TIS=340 ±230 µm; DES=380 ±360 µm; CBIS=780 ±770 µm; CIES=340 ±300 µm). They concluded that Intraoral and extraoral scanners showed similar trueness in scanning prepared teeth. Higher discrepancies are expected to occur in the cervical region and on the occlusal surface. Flügge TV et al evaluated the precision of digital intraoral scanning under clinical conditions (iTero; Align Technologies, San Jose, Calif) and to compare it with the precision of extraoral digitization. One patient received 10 full-arch intraoral scans with the iTero and conventional impressions with a polyether impression material (Impregum Penta; 3M ESPE, Seefeld, Germany). Stone cast models manufactured from the impressions were digitized 10 times with an extraoral scanner (D250; 3Shape, Copenhagen, Denmark) and 10 times with the iTero. Virtual models provided by each method were roughly aligned, and the model edges were trimmed with cutting planes to create common borders (Rapidform XOR; Inus Technologies, Seoul, Korea). A second model alignment was then performed along the closest distances of the surfaces (Artec Studio software; Artec Group, Luxembourg, Luxembourg). To assess precision, deviations between corresponding models were compared. Repeated intraoral scanning was evaluated in group 1, repeated extraoral model scanning with the iTero was assessed in group 2, and repeated model scanning with the D250 was assessed in group 3. Deviations between models were measured and expressed as maximums, means, medians, and root mean square errors for quantitative analysis. Color-coded displays of the deviations allowed qualitative visualization of the deviations. The greatest deviations and therefore the lowest precision were in group 1, with mean deviations of 50 µm, median deviations of 37 µm, and root mean square errors of 73 µm. Group 2 showed a higher precision, with mean deviations of 25 µm, median deviations of 18 µm, and root mean square errors of 51 µm. Scanning with the D250 had the highest precision, with mean deviations of 10 µm, median deviations of 5 µm, and root mean square errors of 20 µm. Intraoral and extraoral scanning with the iTero resulted in deviations at the facial surfaces of the anterior teeth and the buccal molar surfaces. They concluded that scanning with the iTero is less accurate than scanning with the D250. Intraoral scanning with the iTero is less accurate than model scanning with the iTero, suggesting that the intraoral conditions (saliva, limited spacing) contribute to the inaccuracy of a scan. For treatment planning and manufacturing of tooth-supported appliances, virtual models created with the iTero can be used. An extended scanning protocol could improve the scanning results in some regions.[11,12]

CONCLUSION:

From the results of the present study, this can be concluded that intraoral and extraoral digital impression are highly efficacious.

REFERENCES:

1. Sweeney WT, Taylor DF. Dimensional changes in dental stone and plaster. J Dent Res. 1950;29:749–55. doi: 10.1177/00220345500290060601.
2. Phillips RW. Skinner’s science of dental materials. 7. Philadelphia PA: WB Saunders Co; 1973. p. p682.
3. Brawek PK, Wolfart S, Endres L, Kirsten A, Reich S. The clinical accuracy of single crowns exclusively fabricated by digital workflow—the comparison of two systems. Clin Oral Investig. 2013;17(9):2119–25. 10.1007/s00784-013-0923-5.
4. Moreno A, Gimenez B, Ozcan M, Pradies G. A clinical protocol for intraoral digital impression of screw-retained CAD/CAM framework on multiple implants based on wavefront sampling technology. Implant dentistry. 2013;22(4):320–5. 10.1097/ID.0b013e3182980fe9.
5. Lee SJ, Betensky RA, Gianneschi GE, Gallucci GO. Accuracy of digital versus conventional implant impressions. Clin Oral Implants Res. 2015;26(6):715–9. 10.1111/clr.12375.
6. Goodacre CJ, Garbacea A, Naylor WP, Daher T, Marchack CB, Lowry J. CAD/CAM fabricated complete dentures: concepts and clinical methods of obtaining required morphological data. The Journal of prosthetic dentistry. 2012;107(1):34–46. 10.1016/S0022-3913(12)60015-8.
7. Jiao T, Zhu C, Dong X, Gu X. Rehabilitation of maxillectomy defects with obturator prostheses fabricated using computer-aided design and rapid prototyping: a pilot study. Int J Prosthodont. 2014;27(5):480–6. 10.11607/ijp.3733.
8. Quaas S, Rudolph H, Luthardt RG. Direct mechanical data acquisition of dental impressions for the manufacturing of CAD/CAM restorations. Journal of dentistry. 2007;35(12):903–8.
9. Sason GK, Mistry G, Tabassum R, Shetty O. A comparative evaluation of intraoral and extraoral digital impressions: An in vivo study.J Indian Prosthodont Soc. 2018 Apr-Jun;18(2):108-116. doi: 10.4103/jips.jips_224_17.
10. Carbajal Mejía JB, Wakabayashi K, Nakamura T, Yatani H. Influence of abutment tooth geometry on the accuracy of conventional and digital methods of obtaining dental impressions. J Prosthet Dent. 2017 Sep;118(3):392-399.
11. Bohner LOL, De Luca Canto G, Marció BS, Laganá DC, Sesma N, TortamanoNeto P. Computer-aided analysis of digital dental impressions obtained from intraoral and extraoral scanners.J Prosthet Dent. 2017 Nov;118(5):617-623.
12. Flügge TV, Schlager S, Nelson K, Nahles S, Metzger MC. Precision of intraoral digital dental impressions with iTero and extraoral digitization with the iTero and a model scanner.Am J Orthod Dentofacial Orthop. 2013 Sep;144(3):471-8.