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RESEARCH ARTICLE

USE OF INTRAORAL SCANNING DEVICE FOR THE IMPRESSION OF POST SPACE: AN IN-VITRO STUDY

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ABSTRACT

Objective: The objective of this in vitro study was to compare precision of impressions of post space preparations obtained from conventional and digital systems. **Material and Methods:** Twenty-four decoronated and endodontically treated maxillary central incisors were used for the study (n=12). Samples were embedded into acrylic resin molds and randomly divided into two groups. Impressions for post-space were obtained using two systems; group D (digital group), group C (conventional group). Digital impressions were obtained with an intraoral scanner and developed with the software of the system for measurements. Conventional impressions were obtained with silicone material. Statistical analyzes were performed with One-way Anova and paired-samples t-tests (α: .05). **Results:** Precision values were not statistically significantly influenced by the impression method in total discrepancy comparisons. Intraoral scanner group demonstrated similar depth, diameter, and surface values for the post space to conventional impression group. There was no statistically significant difference for precision values with respect to the groups (p>.001). **Conclusion:** Within the limitations of the study, impressions for post restorations obtained with digital workflow and conventional technique showed similar precision results.

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INTRODUCTION

Endodontic treatment increases the risk of fracture and mechanical failure in the remaining tooth structure due to loss of substance (Dietschi *et al*., 2008). To handle with this increased fracture risk, post procedures are recommended for the reconstruction of the tooth which has insufficient coronal structure (Pegoretti *et al*., 2002). The fit of post and the precision of the impression of the post-canal are affecting factors of the post survival (Balkenhol *et al*., 2007). For this reason, post restoration and post space preparation should be compatible with each other. Having similar mechanical and physical properties with tooth structures are another factors affecting the failure mode of post core restorations (Boschian Pest, 2002). Prefabricated glass fiber post materials are good options in this respect, but they are fabricated in standard shapes and dimensions (Plotino *et al*., 2007). Fiber posts cannot well adapt the post space preparation customly, so this lack of adaptation can lead to the presence of thick layer of cement which may induce the risk of failure (fractures, debonding ext.) (Vano *et al*., 2006). Endodontic treatment procedures, over instrumentation, internal resorption, developmental anomalies, incomplete root formation, cavity type, preparation, operational factors, and root canal differences affect the fit of post restorations to the post space preparation (Baba *et al*., 2009). These factors will increase the effect of polymerization shrinkage and resulting stress by increasing the cement thickness between the post restoration and the surface of the root canal (Gomes, 2014). In the literature, it is mentioned that post restorations which were cemented with a uniform, thin, and bubble free layer of cement material have higher survival rates (Boschian Pest *et al*., 2002). This requires the fit of the post restoration and root canal surface, also a good impression method to fabricate abovementioned type of post restorations. In fabricating customized post restorations, silicone impression technique is used for fabrication procedures conventionally (Pitigoi-Aron, 2012). Conventional impression materials are frequently used in general dental practice and have good properties, but they show some limitations in this respect (Christensen, 2005). Variational dimensional stability, low tear strength, margin detail reproducibility, and the risk of bubbles are the most common problems of conventional impression materials (Christensen, 2008). In addition, conventional impression technique has an error-prone characterization due to numerous external factors (Christensen, 2005; Christensen, 2008). To eliminate these disadvantages, intraoral digital systems have risen and are becoming popular day by day providing digital workflow (Ng, 2014).

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Due to having practical procedures and not needing physical impression materials, clinicians and patients prefer these intraoral digital systems (13). Also, good clinical and practical results have been reported about restorations fabricated with chairside (intraoral scanner systems) CAD/CAM systems (Fasbinder *et al*., 2010). Studies that evaluate the accuracy of digital impression systems on fixed prosthesis have enough data, but there is not much studies about the post restorations and precision evaluations. This study aims to eliminate this deficiency in the literature and evaluate the precision of impressions of post canals obtained from conventional and digital systems. The hypothesis tested was that the impression type affects the precision of the impression data.

MATERIALS AND METHODS

Twenty-four permanent human extracted maxillary central incisors were used for the study (n=12). Samples were decoronated by sectioning the coronal part of each tooth levelling 1 mm coronally to the cement enamel junction. All samples were prepared for the study by the same operator. Root canals were prepared with pro taper nickel-titanium rotary system by enlarging F4 size.5.25% NaOCl solution (Akkim, Istanbul, Turkey) was used for irrigation canals between file sizes during preparation. Root canals were dried with absorbent paper points before obturating procedures. For obturation, lateral condensation multiple cone technique was used with gutta-percha (MTwo Gutta-percha, Munich, Germany) and ADSeal sealer (Meta Biomed, Inc.). Post spaces were prepared by using Gates Glidden drills removing gutta-percha and keeping the shape of the canal. Post space preparations were obtained within the range of 9.2 mm and 11 mm for depth. Samples were embedded into acrylic resin (Leaddent SC Akrilik Serdent, Adana, Turkey) molds and randomly divided into two groups according to impression system. Impressions for post-space were obtained using two systems; group D (digital group), group C (conventional group).Digital impressions were obtained with an intraoral scanner (CEREC AC Omnicam, Sirona Dental Systems, Bensheim, Germany) and developed with the software of the system for measurements. Conventional impressions were obtained with polyvinyl siloxane material, PVS (Imprint 3, 3 M ESPE, Seefeld, Germany). Digital impressions were firstly obtained as the remaining silicone material after conventional impression technique may affect the precision or depth size of the digital impression data. In the group D, the samples placed in the acrylic molds were used for scanning directly as this system does not require the use of powder for scanning. During optical recording, the intra-oral scanner was positioned at an angle of 45 ° with the sample and successive images were obtained by moving the scanner to the mesial, lingual, distal, and buccal sides, respectively, starting from the center of the corresponding root canal. The digital models in the system were created by combining these images. All digital data obtained with the intraoral scanner were processed using a CEREC Connect software v4.3 based application program. Using the obtained data, the samples of group D were produced in a direct digital method. In the group C, individual trays were prepared from acrylic resin material (Leaddent SC Akrilik Serdent, Adana, Turkey) to enhance the impression and optimize the thickness of the silicone. To support the silicone material which transfers the post space, plastic posts were placed into the post canal cavity at the beginning of the impression procedure. By using single-phase impression technique, impression datas were obtained for each sample. For depth measurements of the samples, digital caliper was utilised to measure the length of the post spaces for the group D, while a H-file was used for the silicone impressions for the group C. For width measurements, system's software program was preferred for the digital data, and conventional width determination formula was used for the conventional impression data. Statistical analyzes were performed by using the NCSS program (Number Cruncher Statistical System). Shapiro Wilk test was utilized to control the normality distribution. As the data were in agreed with normal distribution, the one-way analysis of variance (ANOVA) and paired-samples t-test were used in the comparison. Analysis results were presented as mean ± standard deviation (SD). The results were assessed at $p < 0.05$ significance level.

RESULTS

Depth, diameter, and surface measurements of the post spaces were displayed for each test group in Table 1 and Table 2. Obtained values were not influenced statistically significantly by the impression method in total discrepancy comparisons. Group D, in which intraoral scanner was used, demonstrated similar precision to conventional silicone impression group for the post space. There was no statistically significant difference for precision values with respect to the groups ($p<.001$).

Table 1. Comparison of depth values of post spaces between groups (mm)

Group	Mean	SD	N	Statistical group
D	10.5	1.1	12	A
C	10.3	1.2	12	A

There is no difference between groups with same letter for each group.
SD: Standard deviation
N:Number of samples

Table 2. Comparison of diameter and surface values of post-space entrance between groups

Group	Diameter(mm)	Surface(mm^2)	Statistical group
D	2.84-2.12	4.82	B
C	2.67-2.33	4.90	B

There is no difference between groups with same letter for each group.

DISCUSSION

The aim of this in vitro study was to investigate the effect of different impression techniques (CAD-CAM vs. conventional) on the precision of impression data of post space preparations. The null hypothesis that the impression type affects the precision of the impression data was rejected. Obtained data and statistical analyzes have shown that there was not significant precision discrepancy between different impression techniques. Digital impression technique gave similar results for evaluating parameters compared with the conventional group indicating that digital technique can be a good alternative for obtaining the impression data of post-space. The present study is convenient with the recent study performed by Falcão Spina *et al*. for this respect (Falcão Spina *et al*., 2017). With the use of digital systems, greater fit values for the post restorations can be reach and sustain more survival rates (Awad, 2007). According to the results of the present study, intraoral scanners give higher precision for the impression, thus it can lead the production of post restorations that fit all root canal surface clearly. This advantage is especially important for root canal types that have dimensional or

developmental differences from normal root canal structures, like anomalies in shape (Baba *et al*., 2009). As it is shown that prefabricated fiber post restorations cannot be well adapted to the root canal surface in wide, non-sircular, or tapered teeth and can increase the risk of retention or survival of the restorations (Hochman *et al*., 1999; Lee *et al*., 2014). However, further studies are needed with respect to the survival rate of restorations fabricated with this technique. Well adapted post and core restorations reduce the thickness of the cement material and can avoid structural discontinuity (Gomes *et al*., 2014).

The proposed technique lessen the clinical time for both clinician and patient when taking impression data. But, this situation is valid for experienced clinicians, as it takes time to learn intraoral scanning procedure totally from the beginning. Furthermore, intraoral scanning eliminates the use of conventional impression materials and its possible disadvantages like taste, smell, or gagging reflex for the patient comfort. Thus, this technique may be useful for the patients who had traumatic injuries or severe reflex. The main variables may influence the precision of the intraoral scanning system are operator variables, and the level of specialty with the system's machine. The others are devices' intrinsic restrictions such as the milling machine, the software program, hardware restrictions within scanning equipment, and the design algorithms employed to create proposed restoration. With the growing progress of the technology, design algorithms, milling machines, and software programs, the precision of the CAD/CAM system has been developed day by day. Obtained values in the present study which support the knowledge of similar precision values can be derived from these factors. The limitation of the present study contained that the study design was in vitro style, so the results may not express clinical situation. Also, only one type of sample, central incisor, was used for the groups. Different types of teeth and root canals may have different results. For this reason, further studies with different samples and scanning systems are still necessary.

Conclusion

In this study, it is shown that intraoral scanners can be used to obtain post space impression data as an alternative to conventional silicone impression method. This system has good and reliable results in reading post space preparation.

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