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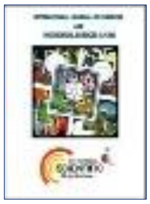

Effect of intracanal metal and fiber posts in adjacent teeth on detection of apical external root resorption defects in premolars using cone-beam computed tomography

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Abstract

This study aimed to assess the effect of intracanal metal and fiber posts in adjacent teeth on detection of apical external root resorption defects in premolars using cone-beam computed tomography (CBCT). In this in vitro experimental study, 16 extracted premolars were assigned to two groups based on the type of intracanal post of adjacent teeth (titanium and fiber posts). Also, each group was divided into two subgroups according to the depth of apical external resorption defect (0.3 and 0.6 mm). CBCT scans were obtained from the mounted teeth before and after intracanal post placement and artificial creation of apical external resorption defects. Data were analyzed by the Shapiro-Wilk test, Chi-square test, and independent t-test (alpha=0.05). Apical external resorption defects were not detected in 25% of the teeth in the metal post group, and 37.5% of the teeth in the fiber post group, but this difference was not significant (P=0.59). Apical external resorption defects with 0.6 mm depth were not detected in 25% of the teeth in the metal post group and 50% of the teeth in the fiber post group. This difference was not significant (P=0.46). Apical external resorption defects with 0.3 mm depth were not detected in 25% of the teeth in the metal post group and 25% of the teeth in the fiber post group with no significant difference between them (P=1). The present results showed no significant effect of presence of intracanal metal or fiber posts in adjacent teeth and depth of defect on detection of apical external root resorption defects in premolars using CBCT.

Keywords: Cone-Beam Computed Tomography, Bicuspid, Lightpost, Metals

Full-length article **Corresponding Author*, e-mail: kooksysan@yahoo.com

1. Introduction

Root resorption is defined as loss of tooth structure by the activity of odontoclasts. Pathological root resorption may occur due to a number of reasons, such as orthodontic treatment, internal bleaching treatment, traumatic tooth injuries, apical periodontitis, cysts such as dentigerous cyst, neoplasms, and idiopathic factors [1,2]. External root resorption is a multifactorial process that results in irreversible loss of tooth structure and can even lead to tooth loss [3]. Conventional radiographic modalities, such as periapical radiography, panoramic radiography, cephalometry, or a combination of them, are often used for detection and monitoring of external root resorption defects [4,5]. Cone-beam computed tomography (CBCT) is a valuable dental imaging modality with extensive applications in diagnosis, treatment planning, and follow-up of patients in different dental fields such as dental implantology, oral and maxillofacial surgery, endodontics, and orthodontics. It provides three-dimensional images in different planes with Lower cost, lower radiation dose, and lower sensitivity to patient's head deviation than computed tomography [6-8]. It has been reported that endodontically treated teeth cause high amounts of artifacts on CBCT scans, due to high density of root filling materials, such as gutta-percha, sealers and intracanal posts. Moreover, some differences have been reported in the frequency and intensity of artifacts generated by different sealer types [9,10]. In endodontics, periapical images are conventionally obtained before, during, and after completion of endodontic treatment. Periapical radiographs provide a two-dimensional view of three-dimensional structures, which may lead to interpretational errors [11]. Some apical resorption defects with endodontic origin may be missed on two-dimensional periapical radiographs [12]. However, they are more easily detectable on CBCT scans. Thus, CBCT is increasingly used as a novel imaging modality for evaluation of apical periodontitis and root resorption defects [13]. It has been shown that presence of intracanal metal posts in adjacent teeth can affect the detection of vertical root fractures in premolars on CBCT scans [14].

However, the effect of presence of intracanal posts and their type on detection of apical external root resorption defects with various depths on CBCT scans has not been previously evaluated. Thus, this study aimed to assess the effect of intracanal metal and fiber posts in adjacent teeth on detection of apical external root resorption in premolars using CBCT.

2. Materials and Methods

This in vitro, experimental study was conducted on 18 extracted completely sound premolars. The study protocol was approved by the ethics committee of School of dentistry of Ahwaz University of Medical Sciences (IR.AJUMS.REC.1401.342).

2.1. Eligibility criteria

The inclusion criteria were sound premolars extracted for purposes not related to this study such as orthodontic treatment, no calcification, no internal and external root resorption, no fracture, no restoration, closed apices, and straight roots. The teeth were radiographed to ensure absence of resorption defects. The exclusion criterion was presence of additional canals.

2.2. Methodology

Debris was removed from the external tooth surface, and the teeth were disinfected in 10% formalin (Neutron, Iran) for 48 hours. They were then stored in a solution of water and alcohol to prevent dehydration. Two teeth were randomly selected and underwent root canal treatment. They were cleaned and shaped, and were obturated with gutta-percha (Meta Biomed, Korea) and AH26 sealer (Dentsply, USA). After 72 hours, post space was prepared in endodontically treated teeth. For this purpose, root filling was removed by two-thirds of the canal length using #2 and #3 peeso reamers (Mani, Japan) such that 5 mm of gutta-percha remained in the apical region. Alcohol was used to eliminate the residual gutta-percha and sealer from the canal walls, and the root canals were rinsed with distilled water. A fiber post (Angelus, Brazil) was cemented with resin cement (Embrace, USA) in the root canal of one tooth, and titanium metal post (Angelus, Brazil) was cemented with glass ionomer cement (Gold Label, India) in the root canal of the other tooth. The remaining 16 teeth were first mounted in a dry sheep mandible and underwent CBCT to serve as the control group. Denture material was used to simulate the soft tissue. The CBCT images were obtained with NewTom CBCT scanner (Verona, Italy) with a standard tube, 15 mAs voltage, and 90 kVp voltage in high resolution mode with 12 x 8 cm field of view. The images were then transferred to NNT Viewer software. After CBCT scanning, the aforementioned 16 teeth were assigned to two groups of A and B (n=8). In group A, external root resorption defects were created in the apical third using a round bur (Diaswiss, Switzerland) with 0.6 mm diameter and high-speed hand-piece. In group B, external root resorption defects were created in the apical third using a round bur (Diaswiss, Switzerland) with 1.2 mm diameter and high-speed hand-piece. Defects were created in the external mesial wall of each root in the apical third. To create the desired depths, half of the bur diameter was inserted into the root surface. The teeth in each group were then randomly divided into two subgroups for mounting next to the tooth with metal post (subgroup 1), and mounting next to the tooth with fiber post (subgroup 2). The teeth were then coded. For mounting of the teeth in the dry sheep mandible, the tooth with metal post was mounted in one quadrant of the mandible and the tooth with fiber post was mounted in the other quadrant. One of the remaining teeth was mounted next to each tooth with intracanal post and underwent CBCT (Figure 1). Next, the adjacent teeth were removed and replaced with two other teeth. This process was continued until all teeth were radiographed. The CBCT scans were observed by two observers, including one oral and maxillofacial radiologist and one endodontist under similar conditions. The digital ruler of NNT Viewer software was used for the measurements. Presence/absence of apical external root resorption defects and their location were recorded.
The intra- and inter-examiner agreements.

2.3. Statistical analysis

Data were analyzed by SPSS version 22 (SPSS Inc., IL, USA) using the Shapiro-Wilk test, Chi-square test, and independent t-test, at 0.05 level of significance.

3. Results and discussions

3.1. Effect of type of intracanal post (metal/fiber) on detection of external root resorption defects in premolars on CBCT scans

As shown in Table 1, apical external root resorption defects were not detected in 25% of the teeth in the metal post group, and 37.5% of the teeth in the fiber post group, but this difference was not significant (P=0.59).

3.2. Effect of intracanal post (metal/fiber) on detection of 0.6 mm and 0.3 mm external root resorption defects in premolars on CBCT scans

As shown in Table 2, defects with 0.6 mm depth were not detected in 75.5% of the teeth while this rate was 0.25% for 0.3 mm defects. This difference was not significant (P=0.59).

3.3. Effect of type of intracanal post (metal/fiber) on detection of 6 mm and 0.3 mm external root resorption defects in premolars on CBCT scans

As shown in Table 3, apical external resorption defects with 0.6 mm depth were not detected in 25% of the teeth in the metal post group and 50% of the teeth in the fiber post group. This difference was not significant (P=0.46). Apical external resorption defects with 0.3 mm depth were not detected in 25% of the teeth in the metal post group and 25% of the teeth in the fiber post group with no significant difference between them (P=1). This study assessed the effect of intracanal metal and fiber posts in adjacent teeth on detection of apical external root resorption in premolars using CBCT. The present results showed that apical external resorption defects were not detected in 25% of the teeth in the metal post group, and 37.5% of the teeth in the fiber post group but this difference was not significant (P=0.59). Apical external resorption defects with 0.6 mm depth were not detected in 25% of the teeth in the metal post group and 50% of the teeth in the fiber post group. This difference was not significant (P=0.46). Apical external resorption defects with 0.3 mm depth were not detected in 25% of the teeth in the metal post group and 25% of the teeth in the fiber post group with no significant difference between them (P=1).

Table 1: Detection of apical external root resorption defects in premolars based on the type of intracanal post

		Post type		P-value
CBCT		Metal	Fiber	
	Not detected	2 (25%)	3 (37.5%)	0.59
	Detected	6 (75%)	5(62.5%)	

Table 2. Detection of apical external root resorption defects in premolars based on the depth of defects

		Defect depth		P-value
CBCT		0.6 mm	0.3 mm	
	Not detected	3 (37.5%)	2 (25%)	0.59
	Detected	5(62.5%)	6 (75%)	

Table 3. Detection of apical external root resorption defects in premolars based on the type of intracanal post and depth of defects

			Type of post		P-value
			Metal	Fiber	
CBCT	0.6 mm	Not detected	1 (25%)	2 (50%)	0.46
		Detected	3 (75%)	2 (50%)	
	0.3 mm	Not detected	1 (25%)	1 (25%)	1
		Detected	3 (75%)	3 (75%)	

Figure 1. Mounted teeth in a dry sheep mandible to undergo CBCT

Not finding a significant difference can be due to small sample size, similar opacity of titanium post and gutta-percha, transparency of fiber post and creating a radiolucent pattern on radiographs, and presence of post in the initial two-thirds of the root of the adjacent teeth while resorption defects in the apical third were assessed. Pinto et al. [15] showed significantly different performance of 10 different CBCT scanners regarding root parameters. Three scanners were superior to others for detection of root parameters. Nonetheless, in presence of metal objects, only two scanners were highly capable of detection of root characteristics. They concluded that the accuracy of endodontic measurements depends on the type of CBCT scanner, and presence of metal objects can compromise the diagnoses. Their results were different from the present findings probably due to differences in sample size and type of CBCT scanners. Also, they evaluated teeth with intracanal posts while defects were evaluated in teeth adjacent to those with intracanal posts in the present study. Gaêta-Araujo et al. [16] indicated that presence of two adjacent teeth with metal posts complicated the detection of vertical root fracturs. However, increasing the tube amperage by up to 8 mA enhanced their detection. Also, the metal artifact reduction algorithm was proven to be ineffective. Despite differences in methodology, type of post, and type of CBCT scanners, their results were in line with the present findings since the tube amperage was 15 mA in the present study. Vasconcelos et al. [17] evaluated the effect of different intracanal posts on dimensional changes on CBCT scans. They found that anatomical fiberglass posts caused the smallest dimensional changes followed by tight fiberglass posts and metal posts on cone-beam scans. They concluded that all types of intracanal posts caused dimensional changes on CBCT scans, and fan-beam scanner yielded the highest dimensional changes on the images [17]. Their results were different from the present findings, which may be attributed to assessing different types of scanners, assessment of teeth with intracanal posts in their study, different types of fiber posts, and the fact that they measured canal diameter while we assessed the detection of resorption defects. Dabbaghi et al. [18] evaluated the efficacy of CBCT for detection of external root resorption defects in three sizes of small (0.3-0.6 mm), medium (0.6 to 1.2 mm), and large (0.9 to 1.8 mm) in the apical, middle and cervical thirds. They reported that the size of defect affected the diagnostic accuracy such that the diagnostic accuracy was significantly lower (0.79) for small-size defects compared with medium (0.94) and large (0.93) defects. However, the difference in diagnostic accuracy was not significant for medium and large defects. Their results for small-size defects were in line with the present findings despite using a different type of CBCT scanner with different resolution, indicating that presence of metal post does not affect the detection of small-size defects on CBCT scans, and even with lower doses of CBCT, accurate results may be obtained.

Small sample size was the main limitation of this study. Also, this study had an in vitro design, which limits the generalizability of the findings. Future studies are required to compare the diagnostic accuracy of different imaging modalities by using a larger sample size, different tooth types, and different depths (sizes) of defects.

4. Conclusions

The present results showed no significant effect of presence of intracanal metal or fiber posts in adjacent teeth and depth of defect on detection of apical external root resorption defects in premolars using CBCT.

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