

Research Article

Symmetry of root and root canal morphology of maxillary and mandibular premolars using Cone Beam Computed Tomography

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ABSTRACT

Introduction: The purpose of this study was to determine root and root canal morphology of the first and second maxillary and mandibular premolars. **Methods and material:** Enrolling 57 CBCT images of patients who required CBCT examination with large FOV (Field Of View) as a part of their dental diagnosis in maxillofacial surgery or orthodontic treatment into the study, we studied CBCT images of 212 healthy, untreated, and well developed maxillary and mandibular premolars (44 maxillary first premolars, 36 maxillary second premolars, 84 mandibular first premolars and 48 mandibular second premolars) to establish the symmetry of root and root canal morphology between right and left sides in the same patient, using root numbers and Vertucci classification. **Results:** In this study, both maxillary first and second premolars showed greater asymmetry than the mandibular premolars. Maxillary first premolars were symmetrical in 90.9 % of patients, whereas maxillary second premolars were symmetrical in 94.4 %. The remaining of 9.1 % and 5.6 % respectively, showed asymmetry in canal configuration and/or root number. Only 0.1 % of mandibular first premolars and none of the mandibular second premolars showed asymmetry.

Conclusion: The results of the present study reported a percentage of symmetry that varied from 90 %-99.1 %. These variations in symmetry should be taken in high consideration when treating 2 opposite premolars in the same patient, because their anatomy may only be different in up to 9.1 % of the cases.

Keywords: Cone Beam Computed Tomography, mandibular premolars, root numbers, root canal morphology

INTRODUCTION

The main objectives of root canal therapy are thorough shaping and clearing of all pulp space and its complete obturation with an inert filling material. To achieve these goals, it is essential to have a thorough knowledge of root canal system and the features of different races (1,2). There are many methods to study root and root canal

morphology, including canal staining and clearing technique (3), radiographic examinations (4) and etc, but exact study of the root canal systems with the least harm for the patient in radiation and best resolution in three-dimensional images, is gained by CBCT images (2). As the study of anatomical symmetry of the teeth between right and left sides

in the same patient has never been performed in Persian population, and it is claimed that the most variation in root canal morphology is detected in premolars (5,6), it was decided to study root and root canal morphology and the symmetry of first and second maxillary and mandibular premolars between right and left sides in the same patient in a Persian population, Guilan, using CBCT as a noninvasive tool.

MATERIAL & METHODS

A total of 57 CBCT images of patients who required CBCT examination with large field of view, showing premolars of both sides, as a part of their diagnosis for reasons including facial trauma, maxillofacial surgery and orthodontic treatment in 2015, were selected from the archive of a radiology centers in Rasht. Thirty one women and twenty seven men with a mean age of 35.5 (19-62) years who had at least one element of premolar teeth in both sides were chosen by the practitioner. A total of 212 healthy, untreated, and well developed maxillary and mandibular premolars (44 maxillary first premolars, 36 maxillary second premolars, 84 mandibular first premolars and 48 mandibular second premolars) were analysed under supervision of an endodontist and a radiologist. All the CBCT radiographs were performed in the same situation without any contrast medium by using NewTom Giano vertical cone beam (NewTom, Verona, Italy). The following technical features were used to take 3_D images: 60-90 kVp, 1-10 mA, focal spot 0.5 mm, field of view 5X5-13X11 cm, amorphous silicone flat panel and cutting width of 75 micrometer. The images were assessed according to the axial, sagittal and coronal planes. CBCT images were examined in microsoft NNT viewer, according to the axial view, by scrolling the cursor in the coronal apical direction for three times to get a detailed view of the root canal system of examined teeth. If the image was not clear, other planes were used to get exact information. During examination of the teeth, number of the roots and configuration of the root canal system were recorded according

to Vertucci classification, and then the symmetry of roots and root canals between right and left sides were determined. The Vertucci classification (5,6) has been used to define the root canal configurations. Type I is a single canal that extends from the pulp chamber to the apex (1-1); type II is 2 separate canals leaving the pulp chamber and joining near the apex, forming a single canal (2-1); type III is a canal that leaves the pulp chamber, divides into two within the root, and unites again in a single canal (1-2-1); type IV is 2 separate and distinct canals that extend from the pulp chamber to the apex (2-2); type V is a canal that leaves the pulp chamber and divides into two near the apex, with distinct apical foramen (1-2); type VI is 2 separate canals that leave the pulp chamber, unite the body of the root, and redivide close to the apex, with distinct apical foramen (2-1-2); type VII is a canal that leaves the pulp chamber, divides into two, unites in the body of the root, and finally redivides on 2 canals near the apex (1-2-1-2); and type VIII is 3 separate and distinct canals that extend from the pulp chamber to the apex (3-3).

RESULTS

106 pairs (212) of premolars from 57 CBCT images were examined in this study. the mean age was 35.5 years and most of the patients were in the age group 25-50 years. Number of men and women enrolled in the study was almost the same (47.2 % and 52.8 % respectively). 130 (61.3%) premolars were maxillary and 82 (38.7%) were mandibular teeth. In brief, Most of the examined teeth were first premolars (61.3 %).

Root Number and Root Canal Morphology

Evaluating number of the roots, single root premolars on the right side were 96.2 % (n=102) and only 3.8 % (n=4) premolars had 2 roots. On the left side almost all of the premolars had 1 root and only 2 premolars (1.9 %) had 2 roots. Evaluating root canal morphology, according to Vertucci classification, results showed 86.8 % (n=92) type I, 1.9 % (n=2), 0.9 % (n=1), type III, 1.9 % (n=2) type IV, 7.5 % (n=8) type V, and 0.9

(n=1) type VII on the right side. Root canal morphology of the left premolars were 88.7 % (n=94) type I, 1.9% (n= 2) type II, 0.9 % (n=1) type III and type IV, 4.7 % (n=5) type V, 1.9 % (n=2) type II and 0.9 % (n=1) type VII.

Anatomic symmetry

Maxillary first premolars were symmetrical in 90.9 % of patients, whereas maxillary second premolars were symmetrical in 94.4 %. The remaining of 9.1 % and 5.6 % respectively, showed asymmetry in canal configuration and/or

root number (table 1). Only 0.1 % of mandibular first premolars and none of the mandibular second premolars showed asymmetry (table 2). Evaluating symmetry of the roots according to age (P=0.539), sex (P=0.131), tooth type (P=0.74) and jaw (0.072), no significant statistical difference was observed. Also in symmetry of root canals morphology, the difference according to age (P=0.412), sex (P=0.882), jaw (P=0.021) and tooth type (P=0.259) was not statistically significant.

Table 1: symmetry of maxillary premolars

Maxillary First Premolars (n=44)		Maxillary Second Premolars (n=36)	
Symmetry: 90.9 % (n=40)	1 root with type I canal 1 root with type II canal 1 root with type III canal 1 root with type IV canal 1 root with type V canal 2 roots with type I canal	symmetry: 94.4 % (n=34)	1 root with type I canal
Asymmetry: 9.1 % (n=4)	1 root with type I and 1 root with type V canal 1 root with type V and 1 root with type IV 1 root with type V and 1 root with type VI canal 1 root with type VII and 2 roots with type VI canals 1 root with type I and 2 roots with type I canals	asymmetry: 5.6 % (n=2)	1 root with type V canal and 1 root with type VI canal 2 roots with type I canals and 1 root with type I canal

Table 2: symmetry of mandibular premolars

Mandibular First Premolars (n=84)		Mandibular Second Premolars (n=48)	
Symmetry: 99.9 % (n=83)	1 root with type I canal 1 root with type V canal	Symmetry: 100 % (n=48)	1 root with type I canal
Asymmetry: 0.1 % (n=1)	1root with type V and 1 root with type I canal	Asymmetry: 0 % (n=0)	

DISCUSSION

Successful endodontic therapy stems from thorough canal debridement and effective filling of the root canal system, for which knowledge of morphology of the root canals is a critical

prerequisite (3), so this study was done with the aim of having knowledge of the homonymous premolar on the other side in the same patient by studying symmetry of root and root canal morphology.

Using CBCT to study root and root canal morphology of the teeth has become popular recently (2,7,8,9,10,11,12,13), because it gives a three dimensional image of the whole tooth, with no need of extraction (3) and it is more precise than the conventional radiographies (4), also less dosage of exposure to the X-ray makes CBCT the first choice of studying oral cavity, so in our study CBCT was also used to examine the teeth.

As it has been claimed that the most variation in root canal morphology is detected in premolars (5,6), it was decided to study root and root canal morphology of both maxillary and mandibular premolars, and the symmetry of the opposite premolars in left and right side of the same patient. Huang (7) and Yang (8) also studied morphology of the premolars, but Poltino (2), Guo (9), Kim (10), Joao (11), Zhang (12) and Neelakantan (13) studied molars. Felsypmerilla (14) studied both premolars and molars. Only Poltino (2) and Felsypmerilla (14) studied symmetry.

The results of the present study confirm that 1 root (97.2 %) with type I (87.8 %) root canal configuration is the normal anatomy of maxillary and mandibular first and second premolars (7,8). Also no 3-root premolars has been found in the cases of this study which is similar to Yang's (8), and is different from Huang's (7) results that can claim the effect of ethnic.

Age and sex had no effect on the results of the study as been claimed in other studies (2,7,8,9,10,11,12,13,14).

Also tooth type (first or second premolar) had no effect on the results of this study as Felsypmerilla's (14), but jaw (being maxillary or mandibular) made statistically significant difference in results, similar to the studies of Felsypmerilla (14) which shows more asymmetry in maxillary premolars.

CONCLUSION

The results of the present study reported symmetry that varied from 90%-99.1%. This high percentage can be taken in consideration while

treating two opposite premolars in the same patient.

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