

Gender difference and root canal morphology in mandibular premolars: A cone-beam computed tomography study in an Iranian population

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Abstract

Background: Mandibular premolars are of the most difficult teeth to treat endodontically. **Aims:** To compare the root canal morphology of mandibular premolars between two genders in an Iranian population. **Settings and Design:** Totally, 230 cone-beam computed tomography images of the mandibles belonged to 115 males and 115 females were evaluated in the three spatial planes. **Materials and Methods:** The total number of roots and canals in the mandibular premolars was counted, and the difference between males and females were analyzed. **Statistical Analysis:** Data were analyzed using Chi-square test. The significance level was set as $P < 0.05$. **Results:** The majority of mandibular first and second premolars had one root (85.7% and 94.8%, respectively) and one canal (63.9% and 78.3%, respectively). The number of roots in the mandibular first premolars had statistically significant difference between two genders ($P = 0.001$). There was no significant difference between two genders in the number of roots ($P = 0.208$) and canals ($P = 0.498$) in the mandibular second premolars. **Conclusion:** According to the results of this study, the root canal morphology in the mandibular first premolars had statistically significant difference between two genders.

Keywords: Cone-beam computed tomography, mandibular premolar, number of canals, number of roots, root canal morphology

Introduction

The main objectives of endodontic treatment are thorough shaping, cleaning, and obturation of the root canal spaces.^[1] The complexity of the spaces that must be accessed, cleaned, shaped, and filled may lead to failure of detection and decrease the success rate of treatment.^[2] Thorough knowledge of normal root canal geometry and its frequent variations is a prerequisite step for endodontic success.

Mandibular premolars, because of the high variability in canal anatomy are of the most difficult teeth to treat endodontically and have a high frequency of endodontic failures.^[3,4] Various factors including ethnicity,^[5,6] age,^[7] sex,^[8] study design (*ex vivo* vs. *in vivo*),^[9] position (left vs. right),^[10] and the method for assessment of root canal morphology^[11] can contribute to difference observed in the previous anatomic studies.

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During the last 30 years, various methods such as clearing,^[12,13] modeling,^[14] histological approaches,^[15] imaging techniques,^[16] etc., have been applied for evaluation of the root canal structure. Most of these methods are destructive and gave the two-dimensional evaluation of the root canal system.^[11] Recently, cone-beam computed tomography (CBCT) imaging technique has made possible the three-dimensional evaluation of the root canal system with high quality and without destructive effect on the tooth structure. The use of three-dimensional imaging methods may be practical for assessment of the occurrence and the frequency of anomalous canal morphology.^[10]

According to the existing studies, the genes, which codify the root canal morphology, are located on the X-chromosome.^[17] Comparatively, a few studies have evaluated the impact of gender difference in the various ethnic populations.^[4,18] The purpose of this study was to evaluate the difference of mandibular premolars' root canal morphology between the Iranian men and women using CBCT imaging technique.

Materials and Methods

All the experimental period in this study was approved by Shahid Sadoughi University of Medical Sciences Ethics Committee. CBCT images, which contained the mandibular first and second premolars bilaterally, were selected from an imaging center at Tehran City between March 2011 and July 2013. The samples belonged to 230 patients (115 females and 115 males) aged between 15 and 60 years old. CBCT images were captured by Scanora 3D (Soredex, Tuusula, Finland) with image capture parameters set at 90 Kvp and 13 mA and scan/exposure time of 16/3.75 s. The slice thickness was 0.5 mm, and the voxel size was 0.20 mm. The exclusion criteria was determined as follows: The presence of periapical

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radiolucency, root resorption, open apex, extensive apical curvature, root canal calcification, erosion and attrition, previous root canal treatment, the presence of post, and core and extensive restoration. The CBCT images were saved in the digital imaging and communications in medicine format and analyzed with OnDemand Three-dimensional Software (OnDemand 3D 1.0.7.0295, Cybermed, Seoul, South Korea) using a Toshiba Satellite A200-TH1 notebook (Toshiba Corporation, Class B, China). Two-dimensional sectional images at axial, coronal, and sagittal planes were displayed on a 15.40 inch, Toshiba Satellite liquid crystal display screen with a resolution of 1280 × 800 pixels in a semi dark room with fixed light intensity. The CBCT sections at the all three spatial planes (especially axial and sagittal) were assessed from the cemento-enamel junction to the apex, and the number of roots and canals were reported [Figure 1]. The resulted data were analyzed with Statistical Package for the Social Sciences 17 Software (SPSS Inc., Chicago, IL, USA) and Chi-square test. The statistical significance was set at $P < 0.05$.

Results

The results of this study are summarized in Tables 1 and 2.

Mandibular first premolar

Number of roots

In total, of 460 teeth, 85.7% had one root and 14.3% had two roots. In the females, of 230 mandibular first premolars (MFPs), 213 teeth (92.6%) were one rooted, and 17 teeth (7.4%) were two rooted. In the males, of 230 MFPs, 181 teeth (78.7%) were one rooted, and 49 teeth (21.3%) were two rooted. Overall, the presence of MFP with one root is higher than two roots and the occurrence of the roots between the two genders had a significant difference ($P_v = 0.001$) [Table 1].

Number of canals

In total, of 460 teeth, 63.9% had one canal and 36.1% had two canals. In the females, of 230 MFPs, 156 teeth (67.8%) had one canal, and 74 teeth (32.2%) had two canals. In the males, of 230 MFPs, 138 teeth (60%) had one canal, and 92 teeth (40%) had two canals. Overall, the presence of MFP with one canal is higher than two canals, and the occurrence of the canals between the two genders did not display any significant difference ($P_v = 0.081$) [Table 1].

Mandibular second premolar

Number of roots

In total, of 460 teeth, 94.8% had one root and 5.2% had two roots. In the females, of 230 mandibular second premolars (MSPs), 221 teeth (96.1%) were one rooted, and 9 teeth (3.9%) were two rooted. In the males, of 230 MSPs, 215 teeth (93.5%) were one rooted, and 15 teeth (6.5%) were two rooted. Overall, the presence of MSP with one root is higher than two roots, and the occurrence of the roots between the two genders did not display any significant difference ($P_v = 0.208$) [Table 2].

Number of canals

In total, of 460 teeth, 78.3% had one canal and 21.7% had two canals. In the females, of 230 MSPs, 183 teeth (79.6%) had one canal, and 47 teeth (20.4%) had two canals. In the males, of 230 MSPs, 177 teeth (77%) had one canal, and 53 teeth (23%) had two canals. Overall, the presence of MSP with one canal is higher than two canals, and the occurrence of the canals between the two genders did not display any significant difference ($P_v = 0.498$) [Table 2].

Discussion

Mandibular premolars, in the literature review, have a great deal of variations with regard to root canal morphology.^[19,20] Numerous factors including ethnicity, age, the method of root canal morphology assessment and sex may contribute to variations found in the reported root canal studies.^[21] Since only a few studies report sex differences and root canal morphology in this tooth group, this survey was designed to evaluate and compare root canal morphology of these teeth between the two genders.

Based on our findings in an Iranian population, the majority of the MFPs and MSPs had one root (85.7% and 94.8%, respectively) and one canal (63.9% and 78.3%, respectively). In comparison between MFPs and MSPs, the prevalence of two roots and canals in MFPs was higher than MSPs. Vertucci^[22] has also determined the higher incidence of a second canal in MFPs compared to MSPs (25.5% vs. 2.5%).

Ethnic difference is an important factor that could interfere with the reporting data. Ethnic differences and root

Table 1: Number and percentage of roots and canals in the mandibular first premolars

Gender	Number (%)		
		Root	Canal
Male	1	181 (78.7)	138 (60)
	2	49 (21.3)	92 (40)
Female	1	213 (92.6)	156 (67.8)
	2	17 (7.4)	74 (32.2)
P^*	0.001		0.081

*Test: Chi-square

Table 2: Number and percentage of roots and canals in the mandibular second premolars

Gender	Number (%)		
		Root	Canal
Male	1	215 (93.5)	177 (77)
	2	15 (6.5)	53 (23)
Female	1	221 (96.1)	183 (79.6)
	2	9 (3.9)	47 (20.4)
P^*	0.208		0.498

*Test: Chi-square

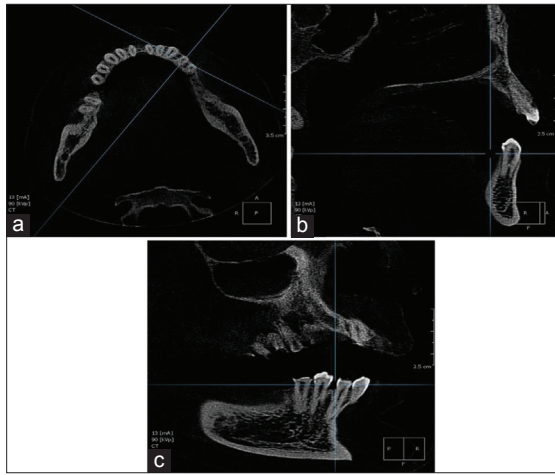


Figure 1: Cross-sectional cone-beam computed tomography images of mandibular first premolar with clearly distinguished two roots and canals in a male person. (a) Axial plane, (b) sagittal plane, (c) coronal plane

canal morphology have been evaluated in various surveys like, Trope *et al.*^[23] and Amos^[24] (African American and Caucasian), Caliskan *et al.*^[3] and Sert and Bayirli^[4] (Turkish population), Lu *et al.*^[25] and Walker^[26] (Chinese population), and Zaatar, *et al.*^[27] (Kuwaiti population).

Trope *et al.*,^[23] Sabala *et al.*,^[28] and Amos,^[24] in their *in vivo* study on different ethnic groups, reported the incidence of two or more canals in MFPs as 23.2%, 22.8%, 17.6% and in MSPs as 5.2%, 4.4%, and 2.5%, respectively. Reporting data by the number of patients rather than the number of teeth may lead to a higher incidence of the reported anomalies.

Aging and deposition of secondary dentin may lead to changes in the shape and dimension of the already formed root canals, especially in the root canals that are tapered in the midline.^[29] This factor could be controlled well in the clinical studies and not in the laboratory studies. In this clinical survey, the participants' age was 15–50 years. Under 15 years, the root development in this tooth group has not been completed, and many changes in the root canal structure may occur in this period of times (15–50 years).

Even though various methods have been introduced for the evaluation of root canal morphology, CBCT imaging technique, with three-dimensional reconstruction, may be a practical and noninvasive method in the morphologic analysis. Neelakantan *et al.*^[11] compared different methods for evaluation of root canal morphology. According to their results, CBCT imaging technique is as accurate as clearing method for assessment of root canal morphology.

Sex differences and its effect on the root canal morphology were reported in a few studies. In a study by Serman and Hasselgren,^[30] more women had multiple roots and/or canals in MFPs, whereas more men revealed multiple roots and/or canals

in MSPs. Sert and Bayirli^[4] also reported the higher incidence of MFPs with two or more canals in females (44% vs. 35%) and MSPs with two or more canals in males (43% vs. 15%).

Park *et al.*^[18] in a Korean population, and Aminsobhani *et al.*^[31] in an Iranian population assessed the CBCT images of the mandibular premolars with regard to gender. Although the root canal morphology was different between the two genders, there were not statistically significant differences.

Based on our findings, the prevalence of two roots and canals in MFPs and MSPs was higher in males (in contrast to the results of Sert and Bayirli and Serman and Hasselgren). The differences in the obtained results may be the results of sample size, the target ethnic groups, method of canal morphology assessment, and ignoring the age factor.

Sert and Bayirli^[4] applied decalcification and staining method that is destructive for root canal structure. Serman and Hasselgren^[30] evaluated the two-dimensional radiographic images of a three-dimensional object that does not reveal the complexity that is present in the root canal system.

In spite of the similar method applied in Park *et al.*^[18] study and the present survey, differences in sample size, ethnicity, age limit (38.1 ± 18 years), and unequal distribution of genders between groups are some reasons for different results.

Aminsobhani *et al.*^[31] reported a higher prevalence of MFPs and MSPs with two roots and canals in males, although this difference was not statistically different. The methods of assessment, age limit, and ethnicity were similar in the two aforementioned studies, whereas unequal distribution of genders between groups, type of CBCT equipment and its relevant software may lead to different results.

Mandibular premolars exhibited high variability and complexity in the root canal system. CBCT scanners are able to detect these complex variations and have potential to apply as an auxiliary tool in the evaluation of root canal morphology in this tooth group.

According to the results of this study, the incidence of MFPs and MSPs with two roots and canals in the males was more frequent than females. Since variations in the number of roots and canals might occur as a result of ethnicity, age, sex, and method of morphology assessment, more research considering these interfering factors is required to arrive on a definite conclusion.

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