

## Research Paper: The Radiographic Evaluation of Root Canal Morphology in Mandibular Premolars of an Iranian Population



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### ABSTRACT

**Introduction:** The aim of this study was to assess the morphology of canal and root of mandibular first and second premolars using CBCT.

**Materials and Methods:** In this descriptive cross-sectional study, 200 CBCT images were assessed if the CBCT image included at least one mandibular premolar, and had good quality. The CBCT images were excluded if the mandibular premolars had open apex, filling, calcification, previous root canal treatment, root fracture, post and core, root resorption, severe erosion or peri-apical lesion. A total of 800 premolars were assessed in this study. Patients' gender and tooth location (left/right) were recorded along with the number of canals and roots, morphology of root canals, the length of canals, the thickness of root and the presence of C-shape canals. Data were analyzed using SPSS version 20 and T test were applied at the significant level of 0.05%.

**Results:** 50% (400) of the studied teeth were first premolars and 50% (400) were second premolars. No gender tendency was found. The most prevalent canal type was type 1 according to Vertucci. The mean length of canals was 13.62±1.47 mm. The assessment of root thickness in MB, MM, ML and MD showed that, the thickest root wall was in the middle one-third and the thinnest was in the apical one-third. No C-shape canal was found in first and second premolars.

**Conclusion:** Within the limitation of this study, the most prevalent canal type was type 1 Vertucci; the thickest root wall was in the middle one-third and the thinnest was in the apical one-third; no C-shape canal was found in the Iranian population. Clinicians should be aware of the complexity of root canal anatomy to achieve favorable treatment outcomes.

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## Introduction

The keys to a favorable endodontic treatment are complete debridement and shaping followed by three-dimensional hermetic obturation.(1–3) Therefore, clinicians must have a comprehensive perception of the root canal anatomy and morphology. (4–6) According to literature, genetic and ethnic diversities are the two main parameters affecting anatomic variations.(7,8) Different classifications have been suggested for root canal morphology.(9,10) The most common systems are Wein that categorized into four types and Vertucci who classified it into eight groups.(9–11)

Approaches using for root canal morphology investigation were divided into two groups including laboratory methods such as root sectioning, electron microscopy, staining and clearing techniques and micro-computed tomography, and clinical methods like observation, previous records and radiography.(12–14)

Radiography is an important assessment tool for treatment quality.(15) The most common techniques are periapical and digital radiography which are easily approachable in clinical conditions, however, due to their two-dimensional imaging they cause missed buccolingual information, distortion and superimposition.(16–18)

CBCT is a three-dimensional imaging method with advanced sensitivity, eligible anatomic accuracy, high resolution, and minimal radiation exposure.(19) As a result of different visualization views, CBCT can lead clinicians to a more accurate diagnosis in extra canal, hard tissue pathologic lesion, root resorption and anatomical anomalies cases.(15,20)

Canal morphological anomalies appraisal in ethnic populations is important in clinical practice because it leads to the elimination of treatment complications.(10,21)

Although several similar studies have been conducted in Iranian population, yet very few studies have investigated premolar root and canal configurations. Therefore, the aim of this study is to assess the morphology of the canal and root of mandibu-

lar first and second premolars using CBCT.

## Methods and materials

In this descriptive cross-sectional study, 200 CBCT images from the archive of a maxillofacial radiography center were assessed if the CBCT image included at least one mandibular premolar and had good quality. The CBCT images were excluded if the mandibular premolars had open apex, filling, calcification, previous root canal treatment, root fracture, post and core, root resorption, severe erosion or peri-apical lesion.

Images were taken using CBCT system (NewTom 5G, Verona, Italy) with an exposure setting of 110 kV, 0.65 mA, 18 seconds scan time, 3.1 seconds exposure time, and 0.30mm voxel resolution. Axial plane and sagittal plane were evaluated in CBCT images respectively at the distances of 2 mm starting from orifice to the apex and at the distances of 1 mm starting from lingual to buccal.

A total of 800 premolars were assessed in this study. Patients' gender and tooth location (left/right) were recorded along with the following parameters at each level of CBCT images:

The number of tooth canals and roots were recorded as one, two, three or more according to the assessment of the axial sections.

The morphology of root canals was categorized according to Vertucci by assessing the axial and sagittal sections. The length of canals was measured as the distance of the orifice to the apical foramen according to sagittal sections of CBCT images. The thickness of the root was reported at 4 points. At mid buccal (MB), mid mesial (MM), mid lingual (ML) and mid distal (MD) by measuring the distance between the internal and external surface of the roots at all axial levels of CBCT image. The presence of C-shape canals was also evaluated in the axial plane of the CBCT and was reported as class 1 to class 5 according to Melton's analysis.

Two researchers assessed the CBCT images separately. The results were compared and a third researcher was involved if there were any disagreements.

Data were analyzed using SPSS version 20 (IBM Corp, Armonk, NY, USA). To describe the data, frequency and percentage were used for qualitative data, and mean and standard deviation were used for quantitative data. T-test were applied to analyze the data at the significant level of 0.05%.

## Results

In this study, the root and canal morphology of 800 premolars were assessed. 50% (400) of the studied teeth were first premolars and 50% (400) were second premolars. Data distribution is presented in Table 1.

Table 1: Data distribution according to gender and location

	Gender		Location	
	Female	Male	Right	Left
Percent	47%	53%	50%	50%
Number	376	424	400	400
Total	100% (800)		100% (800)	

99.5% of premolars had one root and 94% of premolars had one canal. (Table 2) The prevalence of premolars with 1 root and 1 canal was significantly higher than premolars with 2 or 3 roots and canals. ( $p < 0.001$  and  $p < 0.001$ , respectively) No gender tendency was found when assessing the number of roots and canals.

Table 2: The number of roots and canals in premolars

Number of root and canals	First premolars	Second premolars	Total
1 root	99% (396)	100% (400)	99.5% (796)
2 roots	1% (4)	0% (0)	0.5% (4)
3 roots	0% (0)	0% (0)	0% (0)
1 canal	95% (380)	93% (372)	94% (752)
2 canals	5% (20)	7% (28)	6% (48)
3 canals	0% (0)	0% (0)	0% (0)

The type of canals was assessed according to Vertucci. The most prevalent canal type was type 1 (95%) which was significantly higher than type 2 to 5. ( $p < 0.001$ ) (Table 3) No difference was found between different types of Vertucci in terms of gender.

Table 3: The type of canals based on Vertucci in percent (number)

Type of canals	First premolars	Second premolars	In total
Type 1	95% (380)	96% (384)	95.5% (764)
Type 2	1% (4)	1% (4)	1% (8)
Type 3	2% (8)	1% (4)	1.5% (12)
Type 4	2% (8)	2% (8)	2% (16)
Type 5	0% (0)	0% (0)	0% (0)

The mean length of canals was  $13.62 \pm 1.47$  mm.

The mean thickness of root in each axial level of the CBCT image in 4 points of MB, MM, ML and MD are reported in table 4.

In MB, the thickest root wall was found in the 5th level and the thinnest root wall was found in the 8th axial level of CBCT. The difference was significant. ( $p < 0.001$ ) So that, in the middle third of the root the thickness is significantly more than the apical third.

In MM, at the sixth axial level, the root thickness was more than other levels and at the 8th axial level, the root was thinner than other levels. This difference was significant. ( $p < 0.001$ )

In ML and MD, the thickest root wall was found at the 4th axial level and 6th axial level respectively. And the thinnest root wall was at the 8th axial level in both ML and MD. The differences were significant. ( $p < 0.001$ ,  $p < 0.001$ )

In this study, no C-shape canal was found in the first and second premolars.

Table 4: The mean thickness of root wall at different axial levels at MB, MM, ML and MD.

Axial levels	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
Mid buccal	0.33±0.59	1.06±0.85	1.57±0.78	2.03±0.58	2.04±0.60	2±0.63	0.92±1.09	0.09±0.44
Mid mesial	0.26±0.48	0.76±0.63	1.10±0.60	1.43±0.43	1.53±0.46	1.56±0.48	0.77±0.93	0.07±0.35
Mid lingual	0.38±0.68	1.2±0.99	1.88±0.93	2.31±0.70	2.31±0.66	2.08±0.67	0.95±1.13	0.10±0.49
Mid distal	0.26±0.46	0.78±0.66	1.07±0.55	1.39±0.42	1.52±0.47	1.60±0.48	0.76±0.92	0.07±0.37

## Discussion

The results of this study showed no difference between male and female patients in terms of root and canal morphology. This finding is in consistent with the studies of Alenez et al., Mendez et al., Pan et al., Razumova et al., and Alfawaz et al. However, Ok et al. and Martins et al. reported that men had significantly more roots and root canals than women in mandibular first premolars.(8,9,11,17,20,22,23)

It was revealed that first and second premolars with 1 canal (94%) and 1 root (99.5%) were more common than premolars with 2 or 3 canals and roots. Similarly, Alenez et al. reported that 73.9% of first premolars had one root followed by 24.9% with two roots and 1.2% with three roots. They also, found that 79.2% of second premolars had 1 root, 20.8% had 2 roots and no second premolar had three roots.(8) Alfawaz et al. claimed that 96.4% of first premolars had 1 root, 3.1% had 2 roots and 0.5% had three roots. 95.6% of second premolars had a root, 3.8% had two roots and 0.6% had three roots.(17) Rozumova et al. stated that, respectively, 100% and 99.8% of first premolars and second premolars have 1 root. They also assessed the number of canals and reported that respectively, 89.2% and 90.1% of first and second premolars had 1 canal.(24) Pan et al. found similar findings. 81.3% of first premolars had 1 canal and 18.7% had 2 canals. And 95.5% of second premolars had 1 canal and 0.5% had 2 canals.(11) According to this study and the above-mentioned studies, most mandibular premolars had 1 root and 1

canal which is in accordance with the results of Bulut et al. and Llena et al. (25,26) Bulut et al. reported that the prevalence of premolars with one root and one canal was 94.2% and 98.9% respectively in Turkish population. Llena et al. reported that 78.1% of mandibular premolars had 1 root and 90.6% had 1 canal. (25,26)

Also, in the current study, it was found that Vertucci type 1 canals were more prevalent than other types. This finding was in agreement to the study of Alfawaz et al. In their study, 88% of first premolars and 90% of second premolars had type 1 Vertucci. (17) In the contrary, Alenez et al. claimed that the prevalence of type 2 Vertucci was higher than other types in the first and second premolars.(8) And Pan et al. claimed that type 4 Vertucci (23.8%) and type 5 Vertucci (58.2%) were more frequent in first and second premolars, respectively. (11)

The assessment of root thickness in MB, MM, ML and MD showed that the thickest root wall was in the middle third and the thinnest was in the apical third.

No C-shape morphology was reported in the premolars of the current study. Alenez et al. only found C-shape morphology in one-second mandibular premolar and reported no C-shape morphology in first mandibular premolars.(8)

Different study populations may explain the divergent results. As the population in the study of Alenez et al. were Kuwaiti and in the study of Pan et al. were Malaysian. A Saudi Arabia population was studied in the study of Alfawaz

et al. Ok et al. and Martins et al. studies the Turkish, Portuguese and German populations. In the current study, the Iranian population were involved. Also, another possible reason for this inconsistency may be as a result of using different CBCT systems. (8,9,17,23,27)

## Conclusion

Within the limitation of this study, the most prevalent canal type was type 1 according to Vertucci. The assessment of root thickness showed that the thickest root wall was in the middle third and the thinnest was in the apical third. No C-shape canal was found in the first and second premolars in the Iranian population. Further studies are required with larger sample size. Clinicians should be aware of the complexity of root canal anatomy to achieve favorable treatment outcomes.

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