

Evaluation of Permanent Mandibular First Molars to Determine the Incidence of Three Roots and Four Canals in Iraqi Population

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Abstract: *This study evaluates the incidence of three roots and four canals in the permanent mandibular first molars among the Iraqi population. A sample of 252 teeth was randomly selected and examined over two years. The results showed that 85.1% of teeth had two roots, while 14.9% had three roots. Additionally, 37.5% of the teeth had four canals, with a slightly higher prevalence among males than females. The study highlights the significance of understanding root canal morphology for successful endodontic treatments and suggests further studies to explore variations in different populations.*

Keywords: Mandibular first molar, root canal, Iraqi population, endodontic treatment, root morphology.

1. Introduction

In endodontic, complete debridement and obturation of the whole root canal system is considered to be the main purpose of the root canal therapy.¹

It is therefore of almost importance that the dentist has a thorough knowledge of root canal morphology of the tooth being treated.²

The earliest permanent posterior tooth to erupt, is the mandibular first molar, also this tooth most often requires root canal treatment and has a wide variety of root canal configurations.

It often is extensively restored, and it is subjected to heavy occlusal stress. The mandibular first molar tooth usually has two roots, but occasionally it has three, with two or three canals in the mesial root and one, two or three canals in the distal root. However, the presence of third (disto - lingual) root called radix entomolaris (RE) in some racial groups, initially recognized by Carabelli, as a variant in the mandibular first molar.³In spite of that the incidence in different nations of four root canals and third root in the mandibular first molar has been reported in most endodontic textbooks, there is a need to know the prevalence among the population of Iraqi.

Hence, this study was aimed to study the prevalence of four root canals and third root in the permanent mandibular first molars of Iraqi population.

2. Materials and Methods

Restorable 252 permanent mandibular first molars with complete roots maturation were randomly selected 126 male and 126 female patients with no age restriction⁴. The study was carried over a period of two years. The selected teeth were free of root resorption with closed apices, also had no canal calcification, no separated files and no previous root canal filing.⁵

A digital pre - operative radiograph for all cases was taken at different angles. A careful inspection of the pulp chamber and the number of root (s) / root canals was recognized.

A diamond round bur in a high speed hand piece was use to get access into the pulp chamber.

Firstly, a standard triangular access cavity was prepared. The pulp chamber was then dried and carefully explored and then the number and location of the canal orifices was identified and properly evaluated by an endodontist.⁴Then a modification of the access cavity was carried out to change the outline from a triangular to a quadrangular shape. The pulp chamber floor with further exploration carried out to locate the fourth canal in the distal and distolingual area. Any finding was noted on a special form.⁴

After that digital periapical radiographs at different angles were taken with 10 # K files in the root canals to verify the number of root canals located. A complete endodontic treatment was then preform under rubber dam.⁴

Then radiographic x - rays were taken at different angles by buccal object rule during gutta percha cone fit and post obturation.⁵

The radiographs were examined by an endodontist. The clinical records were analyzed and the findings were then tabulated and recorded on a special form. Roots with multiple canal systems were categorized according to whether the canals exited the root by a common apical foramen or by separate apical foramina.⁵

The collected data were entered on the SPSS version 26 and analyzed for the number of canals in each root, number of roots and the proportion of patients with a fourth canal and third root in relation to gender by applying chi square test (P value ≤ 0.05) statistically significance.⁴

3. Results

Results are summarized in tables 1 to 8 of the 252 root canal treated mandibular first molar teeth.

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- 1) In this study, most of teeth had two roots 211 (85.1%) and the remaining 37% (14.9%) had three roots (Table1) (Fig.1).
- 2) The incidence of third root was 24 (19.3%) in males and 13 (10.4%) in the female and there was a significant difference between male and female (Table2) (Fig.2).
- 3) In this study, 93 (37.5%) had four root canals and the remaining 155 (62.5%) had three root canals (Table3) (Fig.3).
- 4) The incidence of four root canals in male was 48 (38.7%) and in the female was 45 (36.2%) (Table4) (Fig.4).
- 5) There was no significant difference between males and females in the distribution of the root canal ($P > 0.05$). All mesial roots had two canals (Table5) while the distal root had two canals in 92 (37.1%) of the examined teeth (Table 6).
- 6) This study found that 96 (38.7%) of the mesial canals and 32 (12.9%) of the distal canals had separate apical foramina (Table5, 6). The two canals were confluent in one canal and ending in one foramen, in the mesial root was 152 (61.3%), in the distal root were 60 (24.2%) (Table5, 6).
- 7) In male the frequency of mesial canals that had joined apical foramina was 72, while the frequency of mesial canals that had separate apical foramina was 52, while in female the frequency of mesial canals that had joined apical foramina was 80, while the frequency of mesial canals that had separate apical foramina was 44 (Table 7) (Fig.5).
- 8) In male the frequency of one distal canal was 77 and the frequency of distal canals that had joined apical foramina was 27, while the frequency of distal canals that had separate apical foramina was 20, while in female the frequency of one distal canal was 79 and the frequency of distal canals that had joined apical foramina was 33, while the frequency of distal canals that had separate apical foramina was 32 (Table8) (Fig.6).

Table 1: Analysis and distribution of roots per tooth

No. of roots	Frequency	Percent
2	211	85.1
3	37	14.9
Total	248	100

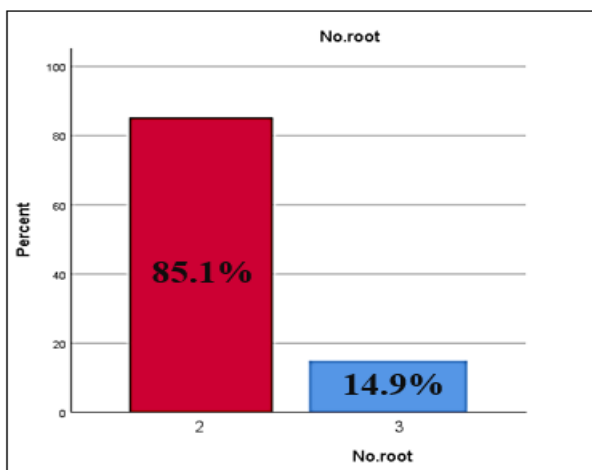


Figure 1: The percentage of 2 roots and 3 roots in permanent mandibular first molars

Table 2: Analysis and distribution of roots per tooth in male and female

Gender	2	%	3	%	Total
Male	100	80.6	24	19.3	124
Female	111	89.5	13	10.4	124
Total	211	85	37	14.9	248

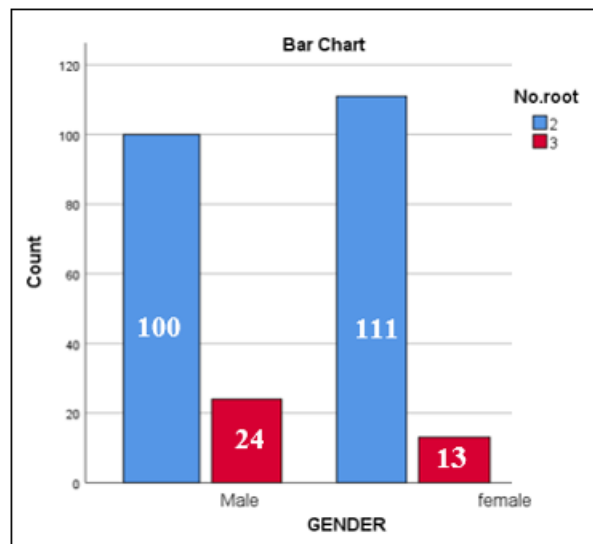


Figure 2: Frequency of roots per tooth in male and female

Table 3: Analysis and distribution of canals per root

No. of canals	Frequency	Percent
3	155	62.5
4	93	37.5
Total	248	100

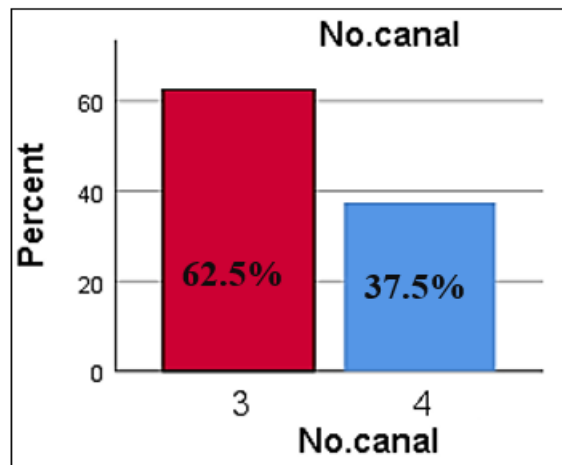


Figure 3: The percentage of 3 canals and 4 canals in permanent mandibular first molars

Table 4: Analysis and distribution of canals per root in male and female

Gender	No. canal			%	Total
	3	4			
Male	76	61.2	48	38.7	124
Female	79	63.7	45	36.2	124
Total	155	62.5	93	37.5	248

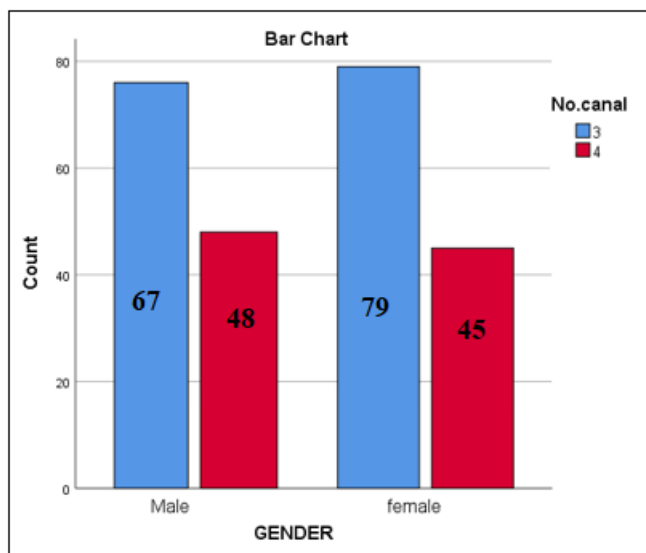


Figure 4: Frequency of Canals per root in male and female

Table 5: Number of canals in mesial root of mandibular first molar

No of canals in mesial root	Frequency	Percent
Two joined mesial canal	152	61.3
Two separated mesial canal	96	38.7
Total	248	100

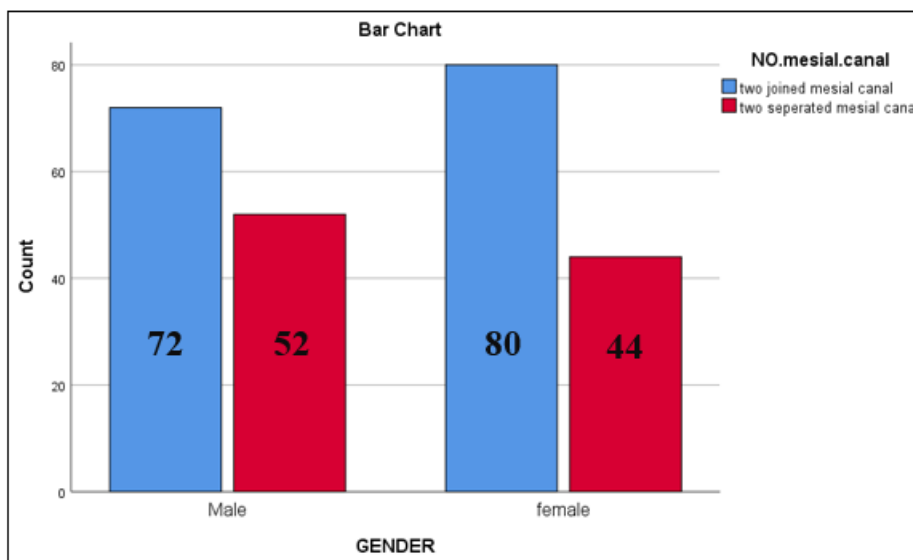


Figure 5: Frequency of canals in mesial root of mandibular first molar in female and male

Table 8: Analysis and distribution of the distal canals per examined root in male and female patients

Gender	One distal canal	two joined distal canal	two separated distal canal	Total
Male	77	27	20	124
female	79	33	12	124
Total	156	60	32	248

Table 6: Number of canals in distal root of mandibular first molar

No of canals in distal root	Frequency	Percent
One distal canal	156	62.9
Two joined distal canal	60	24.2
Two separated distal canal	32	12.9
Total	248	100

Table 3 Analysis and distribution of the two canals in each root of male patients

Table 7: Analysis and distribution of the mesial canals per examined root in male and female patients

Gender	Two joined mesial canal	Two separated mesial canal	Total
Male	72	52	124
female	80	44	124
Total	152	96	248

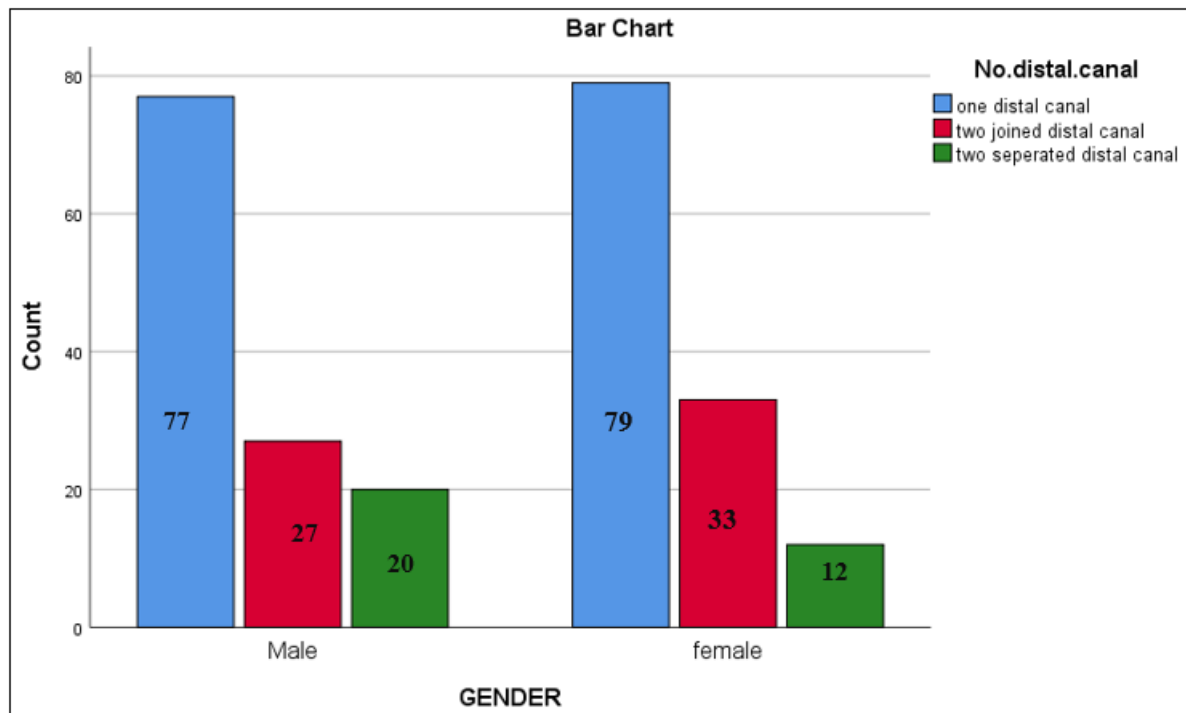


Figure 6: Frequency of the distal canals per examined root in male and female patients

4. Discussion

Digital periapical radiographs have been selected for the present study as - they are regularly used as a base for collecting diagnostic information. Moreover, reduction in radiation than conventional radiograph, inexpensive, noninvasive technique and examiners can digitally manipulate the images for comparing anatomical variation of mandibular first molar regarding to gender.⁷

The radiographs were found to be an integral part of the diagnostic as well as the procedural phases of endodontic treatment. The multiple periapical radiographs taken at different angles are considered as accepted methods because they create a three dimensional image and help to diagnose extra canals.^{8, 9, 10, 4}

Different methodologies have been used to study the root canal morphology of the permanent mandibular first molar including clearing technique^{11, 12}, replication technique¹³, sectioning and macroscopic or Scanning Electron Microscopy (SEM) evaluation¹⁴, Radiographs, use of radiopaque dyes¹⁵, plastic resin injection, micro Computed tomography (MCT), spiral computed tomography (SCT)¹⁶, Cone Beam Computed Tomography (CBCT)¹⁷.

Number of roots:

The result of current study shows that the percentage of 2 root was 85.1 and of three root was 14.9 which is higher than what found in **Maha A. Elhousiny and Zienab S., 2002** study that show the prevalence of third root was 2.91% (4/10) in male, 3.42% (6/10) in female and total prevalence of third root was 3.12. Variation in the prevalence of third molar among population mainly regarding to different ethnical background. Number of the previous studies estimate the prevalence of third root were 3 % in Sudanese population, 2.9% in Saudi Arabian population, 3.052% in Yemeni population, 3.37% in Palestinian population, 3.12%

in Egyptian population, 4% in Jordanian population, 3.3% in Iranian population, 0.5% in Turkish population, 5.7% in Nepal population, and 20 - 22% in Chines population^{7, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27}. The prevalence of third root in this study was higher in males (19.3%) then female (10.4%) with a significance difference regarding to gender with the number of root (P value = 0.05) this finding is in accordance with **Kim Y, Roh BD et al., 2018** study which reported significance difference in number of root regarding to gender.

Number of canals of each root of permanent first mandibular molar:

For the presence of fourth canal in the current study there was insignificant difference between genders which agree with the result conducted by **Al - Nazhan S in 1999, Pattanshetti N in 2008, Atiquzzaman Khan et al., 2014, Fozia Rajput et al., 2014 and, Kim SY et al., 2018**. The findings of present study showed that 36.2% female patients and 38.7% male patients treated had a fourth canal which is nearly equal to **Fozia Rajput et al., 2014** study which reported that (34%) female and (38%) male patients treated had a fourth canal but less than in **Atiquzzaman Khan et al., 2014** study (45.21%) male and (46.77 %) female patients treated had a fourth canal. This study showed that 62.5% of mandibular first molars had three canals and 37.5% had four canals which is approximate to **Fozia Rajput et al., 2014** study which reported that (64%) of mandibular first molars had three canals and (36%) had four canals. **Raed Hakam Mukhaimer 2014** study Showed that 54.4% of mandibular first molars had three canals and (41.3%) had four canals while **Zhang et al.** study reported an incidence of a fourth canal in (43%) of a Chinese population, **Chen et al.** reported an incidence of four canals in (45.9%) of a Taiwanese population., **Al - Qudah and Awawdeh** in their study on mandibular molars in a Jordanian population using clearing technique reported a fourth canal in 46% of the studied sample while the incidence of fourth canal was (57.8%) in a

Saudi population, ¹⁸ and was (45.9%) in bangladeshi population.⁵ The finding from this study show that all mesial roots in mandibular molars exhibited two root canals, which is similar to **Habiba Suleiman Madjapa et al., 2018** study but 62.9% of distal root, had only one canal which is approximate to **Habiba Suleiman Madjapa et al., 2018** result which found that 59.6% of distal root had only one distal canal. This study reported that 38.7% of the mesial root canals and 12.9% of the distal root canals had separate apical foramina, while 61.3% of the mesial root canals and 24.2% of the distal root canals had joined apical foramina which is approximate the result of **Habiba Suleiman Madjapa et al., 2018** study which found that 34% of the mesial canals and 13.7% of the distal canals had separate apical foramina and 65.1% of the mesial canals and 26.7% of the distal root canals had joined apical foramina. The frequency of a fourth canal was high in this study, which leads us to believe that the fourth canal is a very frequently happening variation in the permanent mandibular first molars, so every effort should be done to find fourth canal till proven there are only three canals. The most important step in successfully locating the fourth canal is to create excellent access to the entire pulp chamber. Since the shape of the pulp chamber reflects the number of roots and canals. Teeth with three root canals have a triangular pulp chamber, while teeth with four canals have a quadrangular pulp chamber.¹⁴ Due to the high incidence of fourth canal in permanent mandibular first molars, the standard triangular access cavity preparation does not permit to explore the pulp chamber floor for a fourth canal. For that reason the conventional triangular should be extended towards the distolingual direction to improve canal identification.³⁴ In this research it is thought that there was a combination of factors in purpose of finding the fourth canal including pre-treatment radiographs, quadrangular access cavity shape, good exploration, and thorough radiographic analysis using the image cone shift technique.

More research is suggested to study root morphology that will use a larger sample from different parts of the country to get a more representative sample, which would increase the chance of detecting rare morphological variations, via using new techniques for example Micro - Computed Tomography and Cone - Beam Computed Tomography.

5. Conclusion

The most common anatomy of mandibular first molar in this study population was 2 roots with 3 canals. The prevalence of third root was 14.9% in Iraqi population. The most prevalent canal configuration in mesial root is type II and in distal root is type I. Present study demonstrated that, there is a greater frequency of a fourth canal in the permanent mandibular first molar. Based on this information more attention should be given to searching for locating and treating this canal. A mesial shift provides a better radiographic view of the roots helping in diagnosing canal structure. The shape of the access cavity should be either trapezoidal or quadrangular with rounded corners not triangular, so that chance of missing a canal is minimized. In light of the above findings, it is recommended that further studies with larger sample population should be carried out by using of CBCT with comparison between right and left

side may be more valuable to note all the variations in root canal morphology of permanent mandibular first molars in the local population.

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