

# The Evaluation of Mandibular First Permanent Molars to Determine the Incidence of Three Roots and Four Canals in Aljouf Region of Saudi Arabia

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## ABSTRACT

**Introduction:** The prime objective of the endodontic treatment is the restoration of function and esthetics of the involved tooth. The thorough debridement and the three dimensional root canal filling of the root canal system is the sole objective of the endodontic therapy. Therefore it is of utmost importance that the dentist must have a thorough knowledge of root canal morphology of the tooth being treated. This will enable the treating dentists to locate all root canals and to remove successfully all pulp tissue and debris during the treatment.

**Aims and Objectives:** The aim of this study is to evaluate the mandibular first permanent mandibular molars for the incidence of three roots and four canals in the population of Saudi Arabia of Aljouf region.

**Materials and Methods:** A total of 100 patients, requiring root canal treatment for first mandibular molar were included in this study. The patients from both genders, with age range 20- 50 years, having adequate mouth opening, and were cooperative were included in this study. The preoperative radiographs, working length radiographs and post obturation radiographs, were taken by buccal Buccal Object,s Rule technique (SLOB Rule). These x-rays were mounted on x-ray mounts, were projected on x-ray viewer and were evaluated by using magnifying glass. The number of roots and root canals were recorded. Roots with multiple canal systems were categorized according to whether the canals will exit the root by a common apical foramen or by separate apical foramen. The fourth canal was further categorized as separate from distal canal or joined by isthmus. The collected data was analyzed by using computer software SPSS version 21.

**Results:** In the present study, out of a total of 100 samples, 88 were males, 12 were females, 48 belonged to 20 to 30 years, 29 were in 30 to 40 years of age group and 23 were in 40 to

50 years of age groups. Further, a maximum of 44 were belonging to Saudi nationals followed by 17 each were Indians and Pakistanis, 12 were Egyptians and 10 were Jordanian. Six teeth out of a total of 100 samples were found to be three-rooted. Regarding the occurrence of the fourth canal, this study revealed that 63.0% had four root canals. No statistical difference between gender and nationalities was observed except the association between age groups and incidence of third root and fourth canal was found to be statistically not significant.

**Conclusion:** The observations of the present study are very significant in assisting the dental practitioners to provide adequate knowledge about the root canal morphology of the majority of population residing in Kingdom of Saudi Arabia and about the possible morphological variations.

**Keywords:** Mandibular First Molar, Third Root, Root Canal Morphology, Fourth Canal.


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## INTRODUCTION

The main goal of endodontics is to restore the function and esthetic of the involved tooth. In root canal treatment, complete debridement and obturation of the entire root canal system is considered to be the main objective of the therapy.<sup>1</sup> It is therefore of utmost importance that the dentist has a thorough knowledge of root canal morphology of the tooth being treated.<sup>2</sup>

The earliest permanent posterior tooth to erupt, the mandibular first molar seems to be the tooth that 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. Regarding the root canal morphology, previous in vitro and in vivo reports have indicated that the 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. The two canals in the mesial or distal root are often interconnected.<sup>3,4</sup>

Several methodologies have been used to study the root canal system configuration of the first mandibular molar. They include plastic resin injection, endodontic access and radiographs with files placed into the canals, retrospective radiographic evaluation, clearing of samples with or without injection of ink, scanning electron microscopy (SEM) evaluation, computed tomography (CT), spiral computed tomography (SCT), micro-computed tomography (mCT), and cone-beam computed tomography (CBCT). Although many modernized methodologies have been introduced for studying root canal system, and also the use of radiographic techniques might appear to have certain disadvantages, this method is still the most reliable and popular method in clinical setting.<sup>5</sup>

Apart from this the major variant in mandibular first molars is the presence of a supernumerary root that can be found distolingually and has a curve at the apex. This macrostructure, first mentioned by Carabelli, is called radix entomolaris, which in general is smaller than distobuccal and mesial roots and can be separate from or partially fused with other roots. The morphology and buccolingual width of the mesial root allow for intercanal communications and isthmuses.<sup>6</sup> Currently, the isthmus (anastomosis) is defined as a pulpal passageway connecting two or more canals in the same root.<sup>7</sup>

Although the incidence in different countries 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 incidence among the population of Saudi Arabia. Therefore, the purpose of this investigation was to study the prevalence of four root canals and third root in the permanent mandibular first molars in the population of Saudi Arabia of Aljouf region.

## MATERIAL AND METHODS

A clinical, radiographical, prospective study was carried out in the Department of Restorative Dentistry, College of Dentistry, Aljouf University from June 2015 to Dec 2015. A total of 100 patients who were seeking root canal therapy for the mandibular first permanent molar (Both males and Females) were included in the present study.

These patients were treated by the Intern Dentists, Teaching Assistants and Consultant Endodontists. To carry out this study a written approval was taken from the Institutional Esthetical Committee. The informed consent was taken from the participants of this study. After the informed consent, the data was collected on specially designed proforma. The patient both male and female having age range 20 to 50 years, having adequate mouth opening, and cooperative were included in this study. The patients above 50 years, having medical problems, limited opening of mouth, macroglossia, unrestorable teeth, teeth with severe root resorption, dilacerated roots, pregnant women and malformed teeth were not included in the study. The fourth canal incidence was diagnosed by using the periapical radiographs taken by buccal object rule during the pulpectomy, working length determination, preparation and post obturation. The periapical radiographic film taken during working length determination and obturation at different angulations were mounted, projected and then evaluated. The distal canal if present was further categorized as separated from main distal canal, joined by isthmus, short or full length and size of preparation of the fourth canal (25,30,40 file size). A total of 135 root canal treated mandibular first molars

were studied. The teeth were randomly selected. Seventy three were from male and sixty two were from female patients. These patients were treated under strict supervision of an endodontist. After access cavity preparation and removal of coronal pulp of each tooth the floor morphology and the canal orifice identification were properly evaluated by an endodontist. The x rays were taken at different angles during working length determination and after obturating the root canals of each tooth were mounted and evaluated. The radiographs were examined by an expert having 10 years' experience. The clinical records were analyzed and the findings were then tabulated and recorded on a special form for each individual patient. 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. All the examined teeth were free of root resorption, had no canal calcification, open apices, broken instrument and no previous root canal therapy. The collected data was analyzed with computer software SPSS version 21 by using Chi Square test.

**Table 1: Distribution of samples by gender, age groups and nationality**

Factors	N	%
<b>Gender</b>		
Male	88	88.00
Female	12	12.00
<b>Age groups</b>		
Group 1 ( 20 to 30 )	48	48.00
Group 2 ( 30 to 40 )	29	29.00
Group 3 ( 40 to 50)	23	23.00
<b>Nationality</b>		
Saudi	44	44.00
Indian	17	17.00
Pakistani	17	17.00
Egyptian	12	12.00
Jordanian	10	10.00
<b>Total</b>	<b>100</b>	<b>100.00</b>

## RESULTS

In the present study, out of a total of 100 samples, 88 were males, 12 were females, 48 belonged to 20 to 30 years, 29 were in 30 to 40 years of age group and 23 were in 40 to 50 years of age groups. Further, a maximum of 44 were belonging to Saudi nationals followed by 17 each were Indians and Pakistanis, 12 were Egyptians and 10 were Jordanian (Table 1).

From the results of the table 2, it can be seen that,

- The incidence of third root in males was 6.82% and none of the female had incidence of third root. The difference was not found to be statistically significant (Yates corrected chi-square=0.0813, p=0.7756).
- A maximum of 10.34% of respondents belonging to 30 to 40 years of age group had incidence of third root as compared to 4.17% and 4.35% respectively in respondents belonging to 20 to 30 years and 40 to 50 years of age group. The association between age groups and incidence of third root was found to be statistically not significant (chi-square=1.3680, p=0.5046).

- A maximum of 11.76% of Pakistanis and 10.00% of Jordanian had incidence of third root followed by 6.82 % of Saudis had incidence of third root. But surprisingly, none of the Indians and Egyptians were having third root. The difference was not found to be statistically significant (chi-square=3.1886, p=0.5268).

From the results of the table 3, it can be seen that,

- Incidence of fourth canal was observed in males was 61.36% as compared to 75.00% of female having incidence of fourth canal. The difference was not found to be statistically significant (chi-square=0.3590, p=0.5491).
- A maximum of 72.92% of respondents belonging to 20 to 30 yrs of age group had incidence of fourth canal as compared to 51.72% and 56.52% respectively in respondents belonging to 30 to 40 years and 40 to 50 years of age group. The association between age groups and incidence of fourth canal was found to be statistically not significant (chi-square=4.0209, p=0.1339).
- A maximum of 80.00% of Jordanians, 68.18% of Saudis and 64.71% of Indian had incidence of fourth canal followed by

47.06 of Pakistanis and 50.00% Egyptian having incidence of fourth canal. The difference was not found to be statistically significant (chi-square=4.4912, p=0.3436).

Table 4 reveals that the incidence of third root in permanent mandibular first molar in left side was 66.67% and in right side is 33.33%. The difference was not found to be statistically significant (Yates correction chi-square=0.3334, p=0.5642).

From the observations of table 5, it can be seen that the incidence of fourth canal on left side was 49.21% and on right side was 50.79%. The difference was not found to be statistically significant (Chi-square=0.0321, p=0.8593).

From the results of the table 6, it can be seen that, the incidence of third root in preoperative periapical radiograph was 100% and also 100 % were located during determination of working length. The difference was not found to be statistically significant.

From the results of the table 7, it can be seen that, the incidence of fourth canal in preoperative periapical radiograph was 19.05% and those located during working length determination was 98.41%. The difference was found to be statistically significant (Yates correction chi-square=78.6192, p=0.0001).

**Table 2: Incidence of third root according to gender, age groups and nationality**

Factors	No	%	Yes	%	Total	Chi-square	P-value
<b>Sex</b>							
Male	82	93.18	6	6.82	88		
Female	12	100.00	0	0.00	12	0.0813	0.7756
<b>Age groups</b>							
Group 1 ( 20 to 30 )	46	95.83	2	4.17	48		
Group 2 ( 30 to 40 )	26	89.66	3	10.34	29	1.3680	0.5046
Group 3 ( 40 to 50)	22	95.65	1	4.35	23		
<b>Nationality</b>							
Saudi	41	93.18	3	6.82	44		
Indian	17	100.00	0	0.00	17		
Pakistani	15	88.24	2	11.76	17		
Egyptian	12	100.00	0	0.00	12	3.1886	0.5268
Jordanian	9	90.00	1	10.00	10		
<b>Total</b>	<b>94</b>	<b>94.00</b>	<b>6</b>	<b>6.00</b>	<b>100</b>		

**Table 3: Incidence of fourth canal according to gender, age groups and nationality**

Factors	No	%	Yes	%	Total	Chi-square	P-value
<b>Sex</b>							
Male	34	38.64	54	61.36	88		
Female	3	25.00	9	75.00	12	0.3590	0.5491
<b>Age groups</b>							
Group 1 ( 20 to 30 )	13	27.08	35	72.92	48		
Group 2 ( 30 to 40 )	14	48.28	15	51.72	29	4.0209	0.1339
Group 3 ( 40 to 50)	10	43.48	13	56.52	23		
<b>Nationality</b>							
Saudi	14	31.82	30	68.18	44		
Indian	6	35.29	11	64.71	17		
Pakistani	9	52.94	8	47.06	17	4.4912	0.3436
Egyptian	6	50.00	6	50.00	12		
Jordanian	2	20.00	8	80.00	10		
<b>Total</b>	<b>37</b>	<b>37.00</b>	<b>63</b>	<b>63.00</b>	<b>100</b>		

**Table 4: Incidence of third root in permanent mandibular first molar according side**

Third root	Mandibular Left First Molar	%	Mandibular Right First Molar	%	Chi-square	p-value
No	2	33.33	4	66.67	0.3334#	0.5642
Yes	4	66.67	2	33.33		
Total	6	6.00	6	6.00		

#applied chi-square with yates correction

**Table 5: Incidence of fourth canal in permanent mandibular first molar according side**

Fourth canal	Mandibular Left First Molar	%	Mandibular Right First Molar	%	Chi-square	p-value
No	32	50.79	31	49.21		
Yes	31	49.21	32	50.79	0.0321	0.8593
Total	63	63.00	63	63.00		



Fig 1: Mandibular left first molar having third root



Fig 2: Mandibular right first molar having third root



Fig 3: Mandibular left first with third root

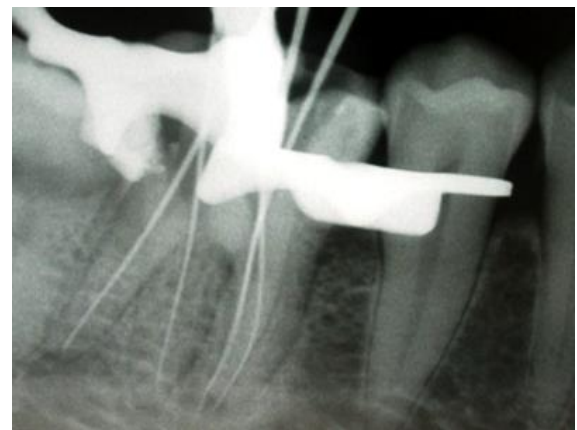


Fig 4: Mandibular right first molar having third root and fourth canal



Fig 5: Mandibular right first molar having third root



Fig 6: Mandibular right first molar with third root

**Table 6: Location of third root in permanent mandibular on preoperative periapical radiograph and located during working length determination**

Third root	Preoperative Periapical Radiograph	%	Located during working length determination	%	p-value
No	0	0.00	0	0.00	
Yes	6	100.00	6	100.00	1.0000
Total	6	6.00	6	6.00	

**Table 7: Location of fourth canal in permanent mandibular on preoperative periapical radiograph and located during working length determination**

Fourth canal	Preoperative Periapical Radiograph	%	Located during working length determination	%	Chi-square	p-value
No	51	80.95	1	1.59		
Yes	12	19.05	62	98.41	78.6192#	0.0001*
Total	63	63.00	63	63.00		

\*p<0.05, # applied chi-square with Yates correction

## DISCUSSION

Comprehensive knowledge of root and canal morphology is fundamental for successful root canal treatment. The complexity of the root canal system determines the difficulty of root canal treatment. The omission of root canals may leave microorganisms and infectious pulp tissue untouched, which could cause post-treatment disease.<sup>8</sup> It has been suggested that although various techniques have been used to evaluate root canal morphology, the most detailed information is obtained by demineralization and staining, which is superior for three-dimensional assessment of internal morphology of the root canal system.<sup>9,10</sup>

In Saudi Arabia, the occurrence of three-rooted mandibular first molars has been reported to range from 2.3% by Younes *et al.*<sup>11</sup> (1990) to 22.7% in Japan by de Souza-Freitas *et al.* (1971).<sup>12</sup> In a study done in Saudi Arabia among a sample of 251 root canals treated permanent mandibular first molars the results showed that 5.97% of treated cases had a three-rooted mandibular first molar.<sup>5</sup> In the present study, 6 mandibular first molars were found to be three-rooted.(Fig 1-6) The results of this study show a higher frequency of three-rooted first molar than reported by Younes *et al.*<sup>11</sup> and was in comparison to that reported by Al-Nazhan.<sup>5</sup> In Iran prevalence of three roots in mandibular first permanent molars was found to be 1.44% which was very less when compared to present study.<sup>13</sup> Zhang *et al.*, reported 21.8% prevalence of three roots with four root canals in mandibular first molars, a Chinese sub population.<sup>14</sup> Chandra *et al.*, observed a prevalence of 3-rooted mandibular first molars in 18.6% of the patients examined and 13.3% of the teeth examined. There was no statistically significant difference between genders or side of occurrence. The bilateral incidence of a symmetric distribution was 43.01%.<sup>15</sup> Gulabivala *et al.*, reported the prevalence of three-rooted mandibular first molars to be 13% in a Thai population.<sup>16</sup> Regarding the occurrence of the fourth canal, this study revealed that 63.0% had four root canals, which slightly more than reported by Al-Nazhan.<sup>5</sup> Whereas in a study carried out in Bangladesh by Khan *et al.*, 45.92% teeth were found with four canals, which was less than that of the present study.<sup>17</sup> The race and ethnicity differences among the populations may be the important factors observed in root canal configuration between the current study and the other studies.

## CONCLUSIONS

The observations of the present study are very significant in assisting the dental practitioners to provide adequate knowledge about the root canal morphology of the majority of population residing in Kingdom of Saudi Arabia and about the possible morphological variations. Thus, the dental practitioners will develop necessary skills to locate, clean and shape the entire root canal system and will lead to higher level of success in root canal treatment.

## LIMITATIONS

Less sample size

## FUTURE PERSPECTIVES

Further researches about this topic should be carried out in a larger and more varied population utilizing Cone Beam Computed Tomography.

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