

# The Incidence of Three Roots and Four Root Canals in Endodontically Treated Mandibular First Molars in Iraqi Population

Hikmet A. Sh. Al-Gharrawi B.D.S., M.Sc.\*

## Abstract

It is of utmost importance that the clinician be familiar with the variations in root canal anatomy and the characteristics features in various racial groups, since such knowledge can aid location and negotiation of canals as well as their subsequent management. The aim of the present study is to investigate the incidence of three roots and four root canals in the mandibular first molar in Iraqi population. A total of 327 endodontically treated mandibular first molars were investigated in this study. Radiographs of working length determination and canal obturation at different angles of each tooth were mounted, projected and evaluated. The clinical records were reviewed and the findings for the number of roots and root canals were then recorded and tabulated. Roots with multiple canal systems were categorized according to whether the canals exited the root by a common apical foramen or by separated apical foramina. The results showed that 81.96% of the examined teeth had three root canals and the remaining 18.04% had four root canals. Most of the teeth ( 99.08% ) had two roots. Only three teeth ( 0.92% ) had three roots. There was no significant differences between males and females in the incidence of three roots and four root canals (  $P > 0.05$  ).

**Key words:** Mandibular first molar, root canals, variations.

## Introduction

The main objectives of root canal treatment is the thorough mechanical and chemical cleansing of the entire pulp cavity and its complete obturation with an inert filling material and a coronal filling preventing ingress of microorganisms. One of the main reasons for failure of root canal treatment in molars is because the clinician has not removed all of the pulp tissues and microorganisms from the root canal system.<sup>(1)</sup>

It is of utmost importance that the clinician be familiar with the variations in root canal anatomy and the characteristics features in various racial groups, since such knowledge can aid location and negotiation of canals as well as their subsequent management. Therefore a number of

studies have shown different trends in shape and numbers of roots and canals amongst the different races.<sup>(2-9)</sup> These variations appear to be genetically determined and are important in tracing the racial origins of different populations.<sup>(2)</sup>

The variations in the root canal morphology of mandibular first molars have been investigated by many authors in different populations. Some authors

reported that four canals are not unusual findings in this tooth (table 1) Others studied the presence of mandibular first molar with three roots and recorded a wide range of frequency (table 2). Although the incidence in different countries of four root canals and three roots in the mandibular first molar has been

\* Lecturer in Department of Conservative Dentistry, College of Dentistry, Al-Mustansiria University.

reported in most endodontic textbooks, there is a need to know this incidence among Iraqi population .The aim of the present study is to investigate the

incidence of three roots and four root canals in the mandibular first molar in Iraqi population.

**Table (1): Incidence of mandibular first molars with four canals**

Author / year	No. of teeth	Percentage of teeth with four canals
Skidmore & Bjorndal. 1971 <sup>(10)</sup>	45	28.9
Pineda & Kuttler .1972 <sup>(11)</sup>	300	27.0
Vertucci & Williams. 1974 <sup>(12)</sup>	100	30
Hartwell & Bellizzi. 1982 <sup>(13)</sup>	846	35.1
Fabra-Campos. 1985 <sup>(14)</sup>	145	47.6
Walker.1988 <sup>(15)</sup>	100	45.0
Yew & Chan.1993 <sup>(16)</sup>	832	31.5

**Table (2): Incidence of three-rooted mandibular first molar**

Author / year	No. of teeth	Percentage of teeth with three roots
Skidmore & Bjorndal. 1971 <sup>(10)</sup>	45	2.2
De Souza-Defreitas. 1971 <sup>(17)</sup>	422	3.2
Vertucci & Williams. 1974 <sup>(12)</sup>	100	0.0
Curzon & Curzon.1971 <sup>(18)</sup>	98	27.0
Curzon.1973 <sup>(19)</sup>	377	3.4
Curzon.1974 <sup>(2)</sup>	69	21.7
Hochtstetter. 1975 <sup>(20)</sup>	400	13.0
Reichart & Metah 1981 <sup>(21)</sup>	364	19.0
Walker 1988 <sup>(15)</sup>	100	15.0
Loh 1990 <sup>(22)</sup>	304	7.9
Younes et al.1990 <sup>(23)</sup>	581	2.92
Yew & Chan.1993 <sup>(16)</sup>	832	21.5
Gulabivala et al.2001 <sup>(6)</sup>	139	10.1

## Materials and methods

A total of 327 endodontically treated mandibular first molars were investigated in this study. These teeth were selected randomly from different dental clinics in Baghdad , all of these teeth were endodontically treated by a well qualified endodontists. Radiographs of working length determination and canal obturation at different angles of each tooth were mounted, projected and evaluated. In addition, the clinical records were reviewed and the findings for the number of roots and root canals were then recorded and tabulated. Roots with multiple canal systems were categorized according to whether the canals exited the root by a common apical foramen or by separated apical

foramina. The examined teeth were free of root resorption, had no canal calcification, open apices, broken instruments , and no previous root canal therapy.

## Results

The results of this study are summarized in tables 3 through 6 .

Of the 327 root canal treated mandibular first molar teeth in this study, 81.96% had three root canals and the remaining 18.04% had four root canals ( Table 3 ). The fourth root canals were usually located in the distal roots. Statistical analysis using chi-square showed that there was no significant difference between males and females in the incidence of four canals (  $P > 0.05$  ).

All the examined mesial roots were found to have two root canals while the distal root had two root canals only in 18.04% of the examined teeth. The two root canals in the mesial and distal roots were mostly confluent in the apical third ending in one foramen (Table 4 and 5). There was no significant difference between mesial

and distal roots in the incidence of confluent two canals in the apical third ( $P > 0.05$ ).

Most of the teeth ( 99.08% ) had two roots. Only three teeth ( 0.92% ) had three roots ( Table 6 ). There was no significant difference between males and females in the incidence of three roots ( $P > 0.05$ ).

**Table (3): Distribution of teeth according to the number of canals per tooth in each sex.**

Sex	No. of teeth	Teeth with 3 canals		Teeth with 4 canals	
		No.	%	No.	%
Male	154	123	79.87	31	20.13
Female	173	145	83.82	28	16.18
Total	327	268	81.96	59	18.04

**Table (4): Distribution of teeth according to the configuration of two canals in each root of male patients.**

Root	Apical foramen				
	joined	%	separated	%	total
Mesial	89	57.79	65	42.21	154
Distal	22	70.97	9	29.03	31

**Table (5): Distribution of teeth according to the configuration of two canals in each root of female patients.**

Root	Apical foramen				
	joined	%	separated	%	total
Mesial	98	56.65	75	43.35	173
Distal	16	57.14	12	42.86	28

**Table (6): Distribution of teeth according to the number of roots per tooth in each sex.**

Sex	No. of teeth	Teeth with 2 roots		Teeth with 3 roots	
		No.	%	No.	%
Male	154	152	98.7	2	1.3
Female	173	172	99.42	1	0.58
Total	327	324	99.08	3	0.92

## Discussion

Study of the morphology of the root canal system using radiographic techniques might appear to have certain shortcomings. The operator can only see the tooth in a two-dimensional image, and conceivably extra root canals can be missed on the radiograph. Unfortunately the

radiographic technique is still the most reliable method in the clinical setting. However, clinical examination remains the only noninvasive method available.

Previous studies revealed that the incidence of four root canals in mandibular first molars of different populations has been reported to range from 27% to 47.6 %.

(Table1). Two fine narrow canals (mesio-buccal & mesio-lingual ) are usually present in the mesial root. The possibility of three root canals in mesial root has been reported by Vertucci & Williams <sup>(12)</sup>, Fabra-Campos <sup>(14)</sup> and Martinez- Berna & Badanelli <sup>(25)</sup>. The distal root usually presents one wide canal that tapers evenly to the apex. However , a great variance in the number of canals in the distal root has been reported with up to 47.6 % having two canals, <sup>(14,15)</sup> few reports have indicated three canals in this root. <sup>(21,26)</sup> Although six root canals are rarely reported in mandibular first molars, four canals are not unusual. <sup>(25)</sup> In general a second distal root canal is the usual anatomy.

A comparison of the findings of this study with that of other studies (Table1) indicates that the incidence of four root canals in Iraqi population appears to be low. In addition, there was no significant differences in this finding between males and females patients.

Skidmore & Bjorndal <sup>(10)</sup> examined extracted mandibular first molar teeth and reported that 59.5 % of the two canals in the mesial roots and 38.5 % of the two canals in the distal roots had separate apical foramina . In this study these percentages were found to be low with one exception; the two canals in the distal roots of female patients is higher than that of previous study. On other hand the statistical analysis of the findings of the present study showed that there is no significant differences in the percentages of two canals having separated foramina between mesial and distal roots.

The incidence of three roots in mandibular first molars has been reported to range from 0.0 % to 32 % in different populations ( Table 2). In the present study three teeth ( 0.92 %) of 327 mandibular first molars ( two in male & one in female patients) were

found to have three roots. The findings of this study indicated that the frequency of occurrence of three rooted mandibular first molars is less than that reported by other studies. Furthermore there was no significant differences in this mentioned frequency between males and females.

The variations of the anatomy of the root canal system in molars are not appreciated by a great number of general practitioners. <sup>( 27,28 )</sup> The variability of root canal anatomy in the distal root of mandibular first molars may not be a common knowledge. Next to the fourth distolingual canal, a third distolingual root in mandibular first molars with a wide range of incidence is possible in different populations (Table 1& Table 2).

The differences seen in this study compared with those listed in Table 1 & Table 2 indicate that there may be a genetically determined differences related to racial backgrounds.

Clearly, these findings are important in assisting the dentists to provide a successful root canal therapy. The access opening of the tooth should be reevaluated to facilitate the search and location of the fourth root canal. Thus, the clinicians should develop skills necessary to locate, clean and shape the entire root canal system to ensure a predictable and favorable prognosis.

## References

- 1- Cohen AS, Brown DC: Orofacial dental pain emergencies: endodontic diagnosis and management. In: Cohen S, Burns RC, eds. Pathways of the Pulp, 8<sup>th</sup> edn. Boston, MA, USA: Mosby, 2002; pp. 31-75.
- 2- Curzon MEJ: Miscegenation and the prevalence of three-rooted mandibular first molars in Baffin Eskimo. Community Dentistry and Oral Epidemiology 1974; 2: 130-1.
- 3- Cooke HG, Cox F. C-shaped canal configuration in mandibular molars. Journal of American Dental Association 1979; 90: 836-9.

- 4- Weine FS, Pasiewicz RA, Rice RT. Canal configuration of the mandibular second molar using a clinically oriented in vitro method. *Journal of Endodontics* 1988; 14: 207-13.
- 5- Weine FS, members of the Arizona Endodontic Association: The C-shaped mandibular second molar: incidence and other considerations. *Journal of Endodontics* 1998 ; 24: 372-5.
- 6- Gulabivala K, Aung TH, Alavi A, Ng Y-L: Root and canal morphology of Burmese mandibular molars. *Int Endodontic Journal* 2001; 34: 359-70.
- 7- Gulabivala K, Opananon A, Ng Y-L, Alavi A: Root and canal morphology of Thia mandibular molars. *Int Endodontic Journal* 2002; 35:56-62.
- 8- Sert S, Alsanalp V, Tanalp J: Investigation of the root canal configurations of mandibular permanent teeth in the Turkish population. *Int Endodontic Journal* 2004; 37: 494-9.
- 9- De Moor RJG, Deroose CAJG, Calberson FLG: The radix entomolaris in mandibular first molars: an edodontic challenge. *Int Endodontic Journal* 2004;
- 10- Skidmore A, & Bjorndal A. Root canal morphology of the human mandibular first molar. *Oral Surgery, Oral Medicine, Oral Pathology* 1971; 32:778- 84.
- 11- Pineda, F & Kuttler, Y Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. *Oral Surgery, Oral Medicine, Oral Pathology* 1972 ; 33:101-10.
- 12- Vertucci, F & Williams, R Root canal anatomy of the mandibular first molar. *Journal of New Jersey Dental Association* 1974; 45: 27- 8.
- 13- Hartwell, G & Bellizzi, R Clinical investigation of in vivo endodontically treated mandibular and maxillary molars. *Journal of Endodontics* 1982; 8: 555-7.
- 14- Fabra-Campos, H. Unusual root anatomy of mandibular first molars. *Journal of Endodontics* 1985 12: 568-72.
- 15- Walker, R . Root form and canal anatomy of mandibular first molars in a southern Chinese population. *Endodontics and Dental Traumatology* 1988; 4: 19-22.
- 16- Yew, S-C & Chan, K . A retrospective study of endodontically treated mandibular first molars in a Chinese population. *Journal of Endodontics* 1993; 19: 471-3.
- 17- De Souza-Freitas JA, Lopes ES, Casati-Alvares L Anatomic variations of lower first permanent molar roots in two ethnic groups. *Oral Surgery* 1971; 31: 274-8 .
- 18- Curzon MEJ, Curzon JA . Three-rooted mandibular molars in the Keewatin Eskimo. *Canadian Dental Association Journal* 1971; 37: 874-8.
- 19- Curzon MEJ . Three-rooted mandibular permanent molars in English Caucasians. *Journal of Dental Research* 1973; 52: 181.
- 20- Hochstetter RL . Incidence of trifurcated mandibular first permanent molars in the population of Guam. *Journal of Dental Research* 1975; 54: 1097.
- 21- Reichart PA, Metah D . Three-rooted permanent mandibular first molars in the Thai. *Community Dentistry and Oral Epidemiology* 1981; 9: 191-2.
- 22-Loh HS . Incidence and features of three-rooted permanent mandibular molars. *Australian Dental Journal* 1990; 35: 434-7.
- 23- Younes SA, Al-Shammery AR, El-Angbawi AF . Three-rooted permanent mandibular first molars of Asian and black groups in the Middle East. *Oral Surgery Oral Medicine Oral Pathology* 1990; 69: 102-5.
- 24- Yew S-C, Chan K . A retrospective study of endodontically treated mandibular first molars in a Chinese population. *Journal of Endodontics* 1993; 19: 471-3.
- 25- Martinez-Berna A, Badanelli P: Mandibular first molars with six root canals. *Journal of Endodontics* 1985; 11: 348-52.
- 26- Stroner W, Remeikis N, Carr G: Mandibular first molar with three distal canals. *Oral Surgery Oral Medicine Oral Pathology* 1984; 57: 554-7.
- 27- Slaus G, Bottenberg P: A survey of endodontic practice amongst Flemish dentists. *Int Endodontic Journal* 2002; 35: 759-67.
- 28- Hommez GMG, Braem M, De Moor RJG: Root canal treatment performed by Flemish dentists. Part 1. Cleaning and shaping. *Int Endodontic Journal* 2003; 36: 166-