

Original Research Article

Canal Number and Configurations of the Permanent Mandibular First Molar in a Tunisian Population

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ABSTRACT

Introduction: Canal morphology of the mandibular first molar is very complex and the knowledge of root canal anatomy plays an important role in the success of endodontic therapy. The purpose of this study is to determine the frequencies of root and canal morphologies of permanent mandibular first molar in a sample of 82 molars in Tunisia.

Materials and methods: In this study, we used 82. Each tooth is macroscopically examined to determine the number of roots and then we grind progressively at the root surface to highlight the path of the root canals. Canal number and configurations of both mesial and distal roots are observed and analysed using buccolingual sections.

Results: Our results showed that the first lower molar has in 90.2% of cases two roots and 3 roots in 9.7% of cases. We have not found cases with a single root.

This study showed in the mesial root the predominance of the cases with two canals (91.9%) and rarely a single canal (4.1%) or 3 canals (4%). In the distal root, this study showed the presence of a single canal in 52.7% of cases and two canals in 47.3% of cases.

Conclusion: The prevalence of three roots was 9.7%. The majority of mesial root had three. The most prevalent canal configuration in the mesial root of first and second molars was type IV (60.8%) and in distal root type I configuration (52.7%).

Key words: Canal number, permanent mandibular first molar, Tunisia.

INTRODUCTION

The mandibular first molars have the most complex root and canal morphology of the mandibular dentition and many studies have attempted to assess their anatomic characteristics.

The most relevant variation related to the number of roots is the presence of a third root.

The knowledge of root canal anatomy plays an important role in the success of endodontic therapy. [1]

Complete knowledge of the root canal anatomy is mandatory because the inability to detect all of the canals can lead to endodontic failure. The variations in root canal morphology, especially in multirooted teeth, are a constant challenge for diagnosis and for successful endodontic therapy. [2]

The purpose of this study is to determine the frequencies of root and canal morphologies of permanent

mandibular first molar in a sample of 82 molars in Tunisia.

MATERIALS AND METHODS

In this study, we used 82 molars that have been extracted mainly for periodontal reasons. The teeth were stored in a Clona solution diluted to 5% during 3 days and then washed in running water and then dried.

Each tooth is macroscopically examined to determine the number of roots and then we grind progressively at the root

surface to highlight the path of the root canals.

Canal number and configurations of both mesial and distal roots are observed and analysed using buccolingual sections. [3]

RESULTS

Table 1: Number of roots by tooth :

1 root	2 roots	3 roots	4 roots
0 %	90.2%	9.7%	0%

Table 2: number of canals by root

	1 canal	2 canals	3canals
Mesial root	4.1%	91.9 %	4%
Distal root	52.7%	47.3%	0%

Table 3: canal configurations

Root	% canal configuration (class. Vertucci)							
	I	II	III	IV	V	VI	VII	VIII
M	4%	28.4%	1.35%	60.8%	1.35%	0%	0%	0%
D	52.7%	29.7%	1.35%	14.8%	1.35%	0%	0%	0%

Different canal configurations observed at the mesial root (Figures 1-8)



Figure 1 : type I (Vertucci)



Figure 2 : type II (Vertucci)



Figure 3 : type III (Vertucci)



Figure 4 : type IV (Vertucci)



Figure 5 : type V (Vertucci)



Figure 6 : type 2-3 (Gulabivala)



Figure 7 : type 3-1 (Gulabivala)



Figure 8 : type 3-2(Gulabivala)

At the mesial root, we found 1.35% type 2-3, 1.35% type 3-1 and 1.35% type 3-2 (as classified by Gulabivala).

Different canal configurations observed at the distal root (Figures 9-13)



Figure 9 : type I (Vertucci)



Figure 10 : type II (Vertucci)



Figure 11 : type III (Vertucci)



Figure 12 : type IV (Vertucci)



Figure 13 : type V (Vertucci)

DISCUSSION

Number of roots

Our results showed that the first lower molar has in 90.2% of cases two roots and 3 roots in 9.7% of cases. We have not found cases with a single root.

Various studies showed the percentage of teeth with three roots varying between 2.4% and 33.33%. The differences in results may be explained by variations in populations or to the number teeth per study.

Table 4: Prevalence of first molars with three roots according to some studies carried out on extracted teeth and retro alveolar radiographs (table 4).

Table 4: Prevalence of first molars with three roots

Authors	Year	Population	Sample	% of teeth with 3 roots
Gulabivala ^[4]	2001	birman	139	10,1%
Gulabivala ^[5]	2002	Tahiti	118	13,0%
Ming-Gene T et al ^[6]	2007	Taiwanese	332	17,8%
Al-Qudah A.A ^[7]	2009	Jordanian	330	3,93%
Ming-Gene T et al ^[8]	2009	taiwanese	123	33,33%
Song J.S ^[9]	2010	korean	3088	24,5%
Garg A.K ^[10]	2010	Indian	1054	4,55%
Wang Y ^[11]	2010	chinese	410	25,8%
Silva E ^[2]	2013	Brazilian	234	0%
Miloglu O ^[1]	2013	turkish	533	2,4%
Personal study	2015	Tunisian	82	9,7%

Number of canals

- Mesial root :

Our study showed the predominance of the cases with two canals (91.9%) and rarely a single canal (4.1%) or 3 canals (4%). Our results are similar to the study of Shahi et al ^[12] planned on 209 first lower molars and confirmed the presence of roots with two canals in 96.1%, a single

canal in 2.8% and 3 canals in 0.95% of cases.

Al-Qudah ^[7] confirmed our results with a percentage of 93% of two canals on a sample of 330 first mandibular molars, Vertucci ^[13] found more cases (12%) with a single canal.

Table 5: Prevalence of thirds canal in the mesial root of first lower molars [14]

Authors	year	Study	sample	% 3 canals
Vertucci [13]	1974	In vitro	100	1%
Pomeranz et al	1981	In vivo	100	12%
Martinez-Berna et al	1983	In vivo	1418	1,5%
Fabra- Campos	1985	In vivo	145	2,1%
Fabra- Campos	1989	In vivo	760	2,6%
Goel et al	1991	In vivo	60	15%
Personnal study	2009	In vitro	74	4%

For many authors, the prevalence of mesial roots with 3 canals range from 1% to 15% which converges with our results (Table 5).

- Distal root

Table 6: prevalence of 2 canals in the distal root of first lower molars

Authors	Year	Population	technique	Sample	% of 2 canals
Vertucci et al [18]	1974	Caucasiens	Clearing technique	100	30%
Walker [19]	1988	Chinese	Clearing and radiograph	100	45%
Zaatar et al [20]	1997	Middle East	Radiograph	147	29,9%
Wasti et al [16]	2001	Pakistanais	clearing	30	47%
Gulabivala et al [4]	2001	Birman	clearing	139	20%
Gulabivala et al [5]	2002	Taiwanese	clearing	118	33,4%
Sert et al [15]	2004	Turkish	clearing	200	46%
Perez C.F et al [17]	2014	Brazilian	Micro-computed tomographic	100	13%
Personnal study	2015	Tunisian	sectionning	82	47,3%

Other recent studies, using cone beam, determined the total number of canals per tooth and claimed the predominance of canals 3 with a percentage of 45%, 69.9% and 74% respectively to Wang Y et al, [11] Miloglu et al [1] and Silva et al [2] (Table 7).

Table7I: number of canals per tooth

Authors And year	Sample	technique	population	Number of canals			
				2	3	4	5
Al-Qudah A.A [7] 2009	330	Clearing technique	Jordanian	1%	48%	46%	6%
Wang Y et al [11] 2010	558	cone beam	Turkish	1.4%	45%	51.4%	2.2%
Ozkan Miloglu et al [1] 2013	533	cone beam	Turkish	0.4%	69.9%	28.7%	1%
Silva E.L [2] 2013	234	cone beam	Brazilian	14%	74%	12%	0%

Canal configurations:

- Mesial root:

According to our study, the type IV is found in 60.8% of cases, type II in 28.4% of cases; Type III and V in 1.35% each and the type I in 4% of cases.

Our results agree with the results of Shahi et al [12] who found the type IV in 52.1% of cases and type II in 40.6% of cases and similarly Gulabivala et al [5] on a Thai sample (Type IV 57.4%, type II 20.4%) and Vertucci [13] (Type IV: 43% Type II: 28%).

The predominance of Type I and IV is also confirmed by the results of the study

This study showed the presence of a single canal in 52.7% of cases and two canals in 47.3% of cases. Our results converge with those of Sert et al, [15] Wasti et al. [16] Vertucci [13] found a higher percentage of configuring a single canal (70%).

The study of Perez [17] et al using the micro computed tomographic analysis, made out of 100 mandibular first molars confirmed the results of Vertucci [13] who found 76% with one canal (Table 6).

Miloglu et al [1] (59.8% and 32.8% of type IV type II) and Al-Qudah et al [7] (53% and 36% type IV Type II). Wang et al [11] found a much higher percentage for the type IV (93.9%) and lower for the type II (1.7%).

- Distal root:

In our sample, we found 52.7% of type I, type II 29.7%, 14.8% type IV and type V 1.35%

These results agree with those of shahi et al [12] who found the type I in 68.4% of cases, type II in 11.9% of cases and type IV in 17.2% of cases.

Skimore et al ^[19] found 71% of type I, 17.7% of type II and type IV 11.2%. The predominance of these three types is supported by the majority of studies (Table II).

Wang et al ^[11] found that the distal root showed wide variety of canals configurations: Type I (62.9%) was the prevalent, 36.1% had two distal canals (type II, III, IV, and V) and 1.0% had three distal canals (type 2-3 and 2-3-2).

Table III: Some results of studies on first lower molar distal root (percentage)

Authors	Sample	Canal Configuration of the distal root (class. Vertucci)							
		I	II	III	IV	V	VI	VII	VIII
Vertucci ^[13]	100	70%	15%	0%	5%	8%	2%	0%	0%
Gulabivala ^[4]	118	67.9%	4.8%	3.9%	16.5%	2.9%	0%	0%	1.9%
Razmi ^[21]	310	54.9%	19%	1.9%	14.2%	4.2%	1%	0.3%	0%
Miloglu ^[1]	533	73.7%	12.3%	1.5%	9.7%	1.8%	0%	0%	0%
Wang Y ^[11]	410	62.9%	36.1%				0%	0%	0%
Shahi e al ^[12]	290	68.4%	11.9%	1.9%	17.2%	0.49%	0%	0%	0%
Skidmore et al ^[19]	45	71%	17.7%	0%	11.2%	0%	0%	0%	0%
Al-QudahA.A ^[7]	317	0%	17%	0%	9%	11%	0%	0%	0%
Personnal study	82	52.7%	29.7%	1.35%	14.8%	1.35%	0%	0%	0%

CONCLUSION

The root and canal morphology of 82 Tunisian mandibular first molars were examined.

The findings are, on the whole, comparable with other studies. The prevalence of three roots was 9.7%. The majority of mesial root had three. The most prevalent canal configuration in the mesial root of first and second molars was type IV (60.8%) and in distal root type I configuration (52.7%).

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