

Root Canal Configuration of Maxillary First Permanent Molars in an Iranian Population

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Abstract

Background and aims. It is critical to have a proper knowledge of the normal anatomy of the pulp and its variations for the success of endodontic treatment. The purpose of this study was to investigate variations in the root canal system of maxillary first permanent molars in an Iranian population.

Materials and methods. In this study, 137 maxillary first molars were decalcified, dye-injected, cleared and studied.

Results. The results demonstrated that 37.96% of the maxillary first molars under study had three canals, 58.4% had four canals and 3.64% had five canals.

Conclusion. According to the results of this study and considering variations in the root canal systems of maxillary first molars, it seems that great care should be taken in the root canal treatment of these teeth.

Key words: Canal configuration, maxillary molar, root canal system.

Introduction

In dentistry the role of endodontics has greatly broadened in scope in the past decade. Although many factors are responsible, the most important reason behind this growth is the extremely high predictability of endodontic success. False assumptions about the root canal anatomy of teeth may lead to misdiagnosis, improper debridement, step formation and breakage of instruments during root canal treatment.¹

Problems during endodontic treatment of permanent maxillary molar teeth indicate the need for increased knowledge of the anatomy

of root canal systems. The mesiobuccal root of maxillary first molars has prompted more research and clinical investigation than any other tooth in the mouth.² Green reported that two foramina were present in 14% of the mesiobuccal roots in his study of upper first molars, and two orifices were noted in 36% of the casies.³ Pineda reported that 42% of these roots manifested two canals and two apical foramina.⁴ Kulid and Peters indicated that a second canal was present in the coronal half of 95.2% of the mesiobuccal roots examined.⁵ This study revealed that 71.1% had two patent canals at the apex. The root canal

configuration, according to the classification of Vertucci⁶, is usually type II (two separate root canals with a single apical exit); however, the presence of two root canals of type IV configuration with two separate apical foramina has been reported to be as high as 42%. Other investigators have reported the prevalence of maxillary first molars with four canals to be 28-62% in Caucasians.⁷⁻⁹ Weine et al reported that the mesiobuccal roots of maxillary first molar teeth of a Japanese subpopulation had two root canals (54%) of type II or type IV configuration.¹⁰ Because of this complexity, the clinician should always assume there are two canals in the mesiobuccal root until it is proven there is only one. The purpose of this in vitro study was to investigate variations in the root canal system of maxillary first molars in an Iranian population in the North-West of Iran.

Materials and Methods

One hundred thirty-seven maxillary first molar teeth were collected from a large supply of recently extracted teeth from dental faculty clinics and private offices in Tabriz, a city in the North-West of Iran. Teeth that demonstrated fully-formed roots and intact external morphology were selected for the study. The teeth were collected in a period of one year and were stored in 10% formalin. Each tooth was cleaned of any adherent soft tissues, bone fragments and calculus by scaling and polishing. An endodontic access cavity was then prepared in each tooth with diamond fissure burs (D&Z, Wisbaden, Germany). The pulp chamber was gently dried to allow examination of pulpal floor. The anatomic dark lines in the floor of the pulp chamber were examined with a DG16 endodontic explorer (Hu Freiday, Chicago, IL, USA) to identify the root canal orifices.

After locating the orifices, the teeth were placed in 5.25% sodium hypochlorite solution (Golrang, Tehran, Iran) for 48h to dissolve debris and pulp remnants. All the specimens were then thoroughly rinsed in running water for 4h to clean the root canals of any debris. Once washed, the teeth were demineralized for 3 days in 5% nitric acid (Merck, Darmstadt,

Germany) at room temperature. The nitric acid solution was renewed every day.

Subsequent to demineralization, the teeth were rinsed in running water for 4h. India ink (AB Chemi, England) was injected into the root canals before dehydration of the teeth. The dehydration process consisted of a series of ethyl alcohol (Ararat, Tehran, Iran) rinses starting with 80% solution over night, followed by 90% for 1h and then 100% ethyl alcohol rinse for 1h. The dehydrated teeth were placed in methyl salicylate (BP.63, Poland) for 2h to render them transparent. The cleared teeth were examined using a magnifying-glass (Lumagny, No.7540, Hong Kong) at $\times 5$ magnification. The root canal systems were classified according to the classification of Vertucci⁶ (1984) as follows:

Type I. one single root canal extending from the pulp chamber to the apex

Type II. separate root canals leaving the pulp chamber and joining short of the apex to form one canal

Type III. one root canal leaving the pulp chamber before dividing into two canals within the root and then merging to exit as one single canal

Type IV. two separate root canals extending from the pulp chamber to the apex

Type V. one root canal leaving the pulp chamber and dividing short of the apex into two separate and distinct root canals with separate apical foramina

Type VI. two separate root canals leaving the pulp chamber, merging in the body of the root, and again dividing short of the root apex to exit as two separate and distinct canals

Type VII. one root canal leaving the pulp chamber, dividing and rejoining within the body of the root canal and finally re-dividing into two distinct canals short of the apex

Type VIII. three separate and distinct root canals extending from the pulp chamber to the apex

Results

Out of 137 maxillary first permanent molar teeth studied, the mesiobuccal roots with a single canal were of type I (37.96%) or type V (9.5%) configuration. Those with two canals

were of type II (24.08%), type IV (24.18%) or type VI (4.38%) configuration. The distal and palatal roots that presented with a single canal were of type I or V configuration. No type III, VII or VIII canal configurations were found in the roots of these teeth. The percentage distribution is summarized in Table 2. The percentage distribution of accessory canals was 16.78% in the mesiobuccal roots, 2.91% in the distobuccal roots and 2.18% in the palatal roots.

Discussion

False assumptions about the root canal anatomy of teeth may lead to misdiagnosis, improper debridement, step formation and breakage of instruments during root canal treatment.

Problems faced during endodontic treatment of permanent molar teeth indicate the need for increased knowledge of root canal systems. The results of this study differ from those reported in investigations of samples obtained from Caucasians (Table 2). These differences relate principally to the presence of type V and type VI configurations, with a relatively low incidence of, in particular, type I configuration in the mesiobuccal root. There was a relatively high prevalence of type V configuration in the distal and palatal roots of maxillary first permanent molar teeth (Table 1).

Wasti et al¹ in a study (2001) on maxillary first molars in Asian Pakistanis found two canals in the mesiobuccal roots in 53% and one canal in 46.5% of cases. The configuration of root canal system in the study carried out by Wasti et al in the mesiobuccal root was type I (33.3%), type II (23.3%), type IV (23.3%), type V (13.3%) and type VI (6.8%). They

found type V root canal system in the distobuccal and palatal roots of maxillary first molars in 16.7% and 33.3% of cases, respectively. The results of this study are consistent with the results of the study carried out by Wasti¹. This relationship between the two studies, relates to the geographic region and ethnicity. Regarding the diversity and the number of the teeth studied (e.g. our study on 137 teeth and a study by Wasti et al on 30 teeth), it seems that racial/ethnic differences are important factors in the differences observed in the root canal configuration, as Sert and Bayirli concluded that both gender and ethnic origin should be considered during preoperative evaluation of root canal therapy.¹¹ Therefore, further studies are warranted in different parts of the world to prove that there is a relationship between the racial/ethnic differences and the anatomic differences in the first maxillary molars.

Conclusion

According to the results of the present study, there is a high prevalence of four root canals in the maxillary first permanent molars in the North-West of Iran. The distribution of different configurations of root canal system in the maxillary first permanent molars in North-Western Iranians differs from that in Caucasian groups.

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Table 1. The root canal system configuration of the teeth studied

Specimens (No)	Position of roots	No. of root canals %		Configuration of root canal systems %							
		1	2	I	II	III	IV	V	VI	VII	VIII
Maxillary First Molar (137)	Mesiobuccal	37.96	62.04	37.96	24.08	0	24.08	9.5	4.38	0	0
	Distobuccal	96.36	3.64	96.36	0	0	0	3.64	0	0	0
	Palatal	99.27	0.73	99.27	0	0	0	0.73	0	0	0

Table 2. Distribution of the root canal system configuration of the mesial root of maxillary first permanent molar teeth of Caucasians based on Vertucci's classification

Investigators	Teeth	Percentages for types I-V				
		I	II	III	IV	V
Pomeranz & Fishelberg (7)	71	72.0	17.0	0	11.0	0
Pineda & Kuttler(8)	262	39.3	12.2	0	35.7	12.7
Pineda(4)	245	41.0	17.0	0	42.0	0
Green(3)	100	64.0	22.0	0	14.0	0
Seidberg et al.(9)	100	38.0	37.0	0	25.0	0
Vertucci (6)	100	45.0	37.0	0	18.0	0

References

1. Wasti F, Shearer AC, Wilson NHF. Root canal systems of mandibular and maxillary first permanent molar teeth of South Asian Pakistanis. *Int Endod J* 2001; 34: 263-6.
2. Fogel HM, Peikof MD, Christie WH. Canal configuration in the mesiobuccal root of the maxillary first molar: a clinical study. *J Endod* 1994; 20: 135-8.
3. Green D. Double canal in single roots. *J Oral Surg* 1973; 35: 689-96.
4. Pineda F. Roentgenographic investigations of the mesiobuccal root of the maxillary first molar. *J Oral Surg* 1973; 36: 253-60.
5. Kulid JC, Peters DD. Incidence and configuration of canal systems in the

mesiobuccal root of maxillary first and second molars. *J Endod* 1990; 16: 311-7.

6. Vertucci FJ. Root canal anatomy of human permanent teeth. *Oral Surg, Oral Med, Oral Path* 1984; 58: 589-99.

7. Pomeranz HH, Fishelberg G. The secondary mesiobuccal canal of maxillary molars. *J Amer Dent Assoc* 1974; 88: 119-24.

8. Pineda F, Kuttler Y. Mesiobuccal and buccolingual roentgenographic investigation of 7275 root canals. *Oral Surg Oral Med Oral Pathol* 1997; 33: 101-10.

9. Seidberg BH, Altman M, Guttuso J, Suson M. Frequency of two mesiobuccal root canals in maxillary permanent first molars. *J Amer Dent Assoc* 1973; 87: 852-6.

10. Weine FS, Hayami S, Hata G, Toda T. Canal configuration of the mesiobuccal root of the maxillary first molar of a Japanese sub-population. *Int Endod J* 1999; 32: 79-87.

11. Sert S, Bayirli GS. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. *J Endod* 2004; 30: 391-8