

Root and Canal Morphology of Maxillary First Premolars in a Saudi Population

Momen A. Atieh, BDS, MSc



Abstract

Aim: The aim of this study was to determine the root and canal morphology of maxillary first premolars collected from an indigenous Saudi population.

Methods and Materials: A total of 246 extracted teeth were collected and washed immediately after extraction then stored in 10% formalin solution. The teeth were debrided then dehydrated with ascending concentrations of alcohol and cleared by immersion in methyl salicylate. Visual and radiographic examinations were done to determine the number of roots and canals, and the teeth were transversely sectioned to examine the internal anatomy.

Results: Forty-four teeth (17.9%) had one root, 199 (80.9%) had two roots, and three (1.2%) had three roots. The incidence of Type I canals (one canal) was 8.9% (22 teeth), 89.8% (221 teeth) had two canals (Type II and III), and 1.2% (three teeth) had three canals (Type IV).

Conclusion: This study showed a high incidence of two-rooted and two-canal maxillary first premolars in Saudis. Clinicians should be aware of the different variations in root morphology and canal configuration when performing an endodontic treatment.

Keywords: Root morphology, maxillary first premolar, dental anatomy, Saudi population

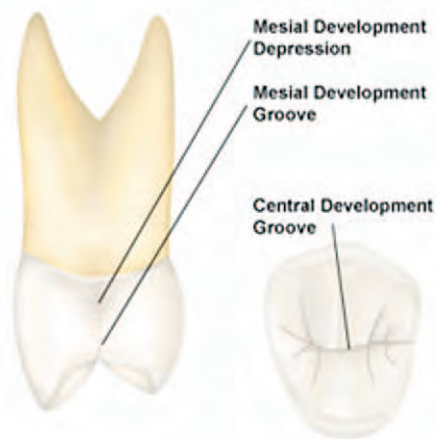
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Introduction

A sound knowledge of the number of roots and canals of a tooth receiving endodontic therapy is a prerequisite to proper instrumentation, obturation, and a successful outcome. One of the challenging tasks facing clinicians is performing proper endodontic therapy for a maxillary first premolar because the root and canal system of these teeth can vary significantly among different racial and ethnic groups.

The maxillary first premolar has a buccal cusp and a palatal cusp. The buccal cusp is usually about 1 mm longer than the lingual cusp. The crown is angular with prominent buccal line angles. One of the distinguishing features of this tooth is the mesial developmental depression which is a marked depression on the mesial surface of the crown, immediately cervical to the mesial contact area. Another distinguishing feature of the maxillary first premolar is a well defined developmental groove in the enamel of the mesial marginal ridge. The occlusal surface of this tooth has a well defined central developmental groove dividing the surface evenly buccolingually, with no supplemental grooves in most of the cases.¹



In literature reports show wide variations in the root and canal morphology of the maxillary first premolar suggesting individual and probably a genetic variation among different races.

A high incidence of one-root maxillary first premolars was reported in the East Greenland Eskimo dentition.² Loh³ reported the incidence of the two-root morphology was 50.6% in Singaporeans, while no three-root form was

detected. In another study the three-root form was reported at an incidence of 6%.⁴

The aim of this study was to investigate the external and internal anatomy of maxillary first premolars in a Saudi population and to compare the results with other reports in the literature.

Methods and Materials

In this study 246 extracted maxillary first premolars were included. These teeth were extracted from Saudi patients for different reasons including trauma, periodontal disease, or as prescribed by their orthodontist. The extractions were performed at Dammam Medical Center, Saudi Electricity Company in the Eastern Province of the Kingdom of Saudi Arabia.

Most teeth included in the sample were sound teeth as they were extracted as part of an orthodontic treatment plan. The teeth were washed immediately after extraction and stored in 10% formalin solution in a labeled container. After collection was complete, scaling and polishing was done and the pulp tissue was dissolved with sodium hypochlorite under ultrasonication. The teeth were then dehydrated with ascending concentrations of alcohol and were cleared by immersion in methyl salicylate.

Both the root and canal morphology of the collected samples were evaluated. Visual examination of the external root morphology was made and the findings were recorded. According to the number of roots, the teeth were divided into four groups:

- **Group I:** One-root form
- **Group II:** Two-root form
- **Group III:** Fused-root form
- **Group IV:** Three-root form

All teeth were examined using digital radiography then embedded in resin and transversely sectioned with a low speed diamond saw to evaluate the internal root canal anatomy according to Weine's classification (Table 1).⁵

Results

From the total sample of 246 maxillary first premolars, 44 teeth (17.9%) were identified as

Table 1. Classification of canal morphology of the maxillary first premolar.



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



Type II. Two separate root canals leave the pulp chamber and join short of the apex to form one canal.



Type III. Two separate root canals leave the pulp chamber and remain separate to the point of exit from the root apex.



Type IV. Three separate and distinct root canals extend from the pulp chamber to the apex of the root.

having one root and 199 (80.9%) had two roots. Of the two rooted premolars, 110 teeth (44.7%) had two separate roots, while 89 teeth (36.2%) had two fused roots with the furcation starting at a level about half or more of the length of the two roots. Only three teeth (1.2%) had three roots (Figure 1). All of the three-rooted premolars identified in this study had two fused buccal roots and one separate palatal root.

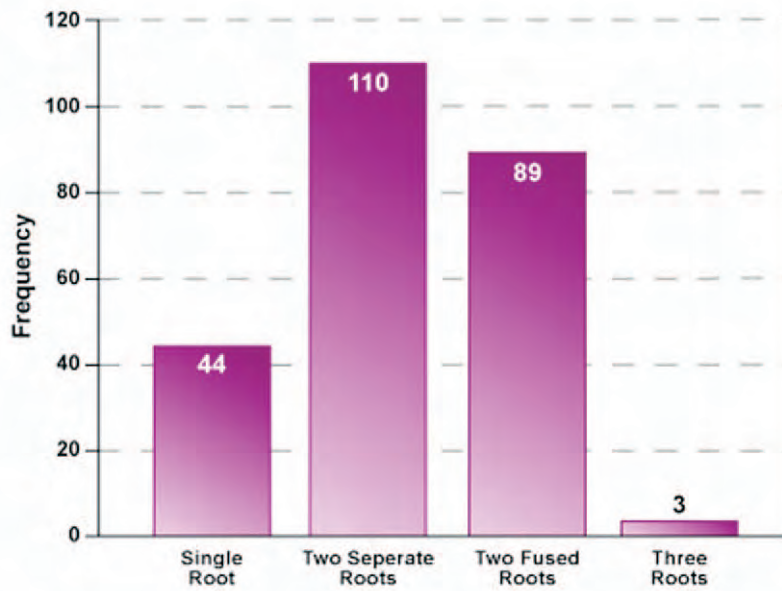
When the internal root anatomy was examined, 22 maxillary first premolars (8.9%) were classified as Type I with a single root canal extending from the pulp chamber to the apex, 66 teeth (26.8%) had two separate root canals but were joined short of the apex to form a single apical foramen (Type II), 155 (63.0%) had two separate root canals and remain separate with two apical foramina (Type III), and the incidence of type IV canals was 1.2% with only three teeth having three root canals (Figure 2).

Discussion

Several studies showed differences in the external and internal anatomy of the maxillary first premolar. Such variations affect clinical practice, and clinicians should be aware of the racial and individual differences in tooth morphology.

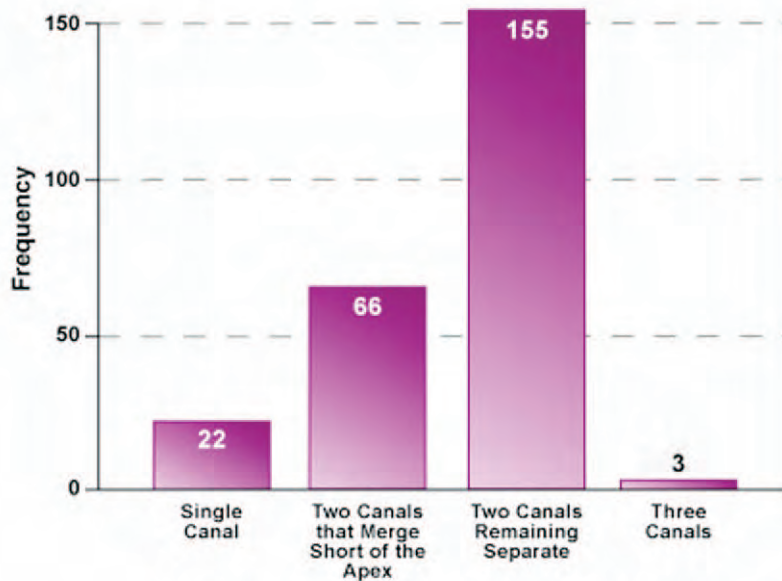
In this study extracted maxillary first premolars were collected from an indigenous Saudi population in the Eastern Province of the Kingdom of Saudi Arabia. The Kingdom of Saudi Arabia is a country occupying most of the Arabian Peninsula and inhabited since ancient times by nomadic Semitic tribes.

The methods used for anatomic investigations of the root canals were more advanced in some studies than the methods used in this study. However, this is the first study done to examine the root morphology of maxillary first premolars in the Arabian Peninsula.



Maxillary First Premolar Root Morphology

Figure 1. The distribution of root forms in maxillary first premolars.



Maxillary First Premolar Root Canal Morphology

Figure 2. The distribution of root canal forms in maxillary first premolars.

The reports in the dental literature indicate the incidence of a single-rooted maxillary first premolar varied from 22.0% in one study⁴ to 55.8% in another one by Pecora et al.⁶, while the lowest incidence of two-rooted teeth was reported by Loh³ as 50.6% and the highest by Carns and

Skidmore⁴ as 72%. The three-rooted maxillary first premolar had the lowest incidence in all studies and ranged between 0%³ and 6%.⁴ The number of roots in the maxillary first premolar as reported in several studies along with the results of this study are summarized in Table 2.

Table 2. Percentage of root in the maxillary first premolars.

Author (Year)	One Root (%)	Two Roots (%)	Three Roots (%)
Ingle (1965)	43.0	55.0	2.0
Carns and Skidmore (1973)	22.0	72.0	6.0
Vertucci and Gegauff (1978)	26.0	70.0	4.0
Pecora et al. (1991)	55.8	41.7	2.5
Loh (1996)	49.4	50.6	0.0
Kartal et al. (1998)	37.3	61.3	1.3
Chaparro et. Al (1999)	40.0	56.7	3.3
The Present Study	17.9	80.9	1.2

In the present study all teeth were positively identified at the time of extraction as maxillary first premolars to avoid any identification problem. In the study sample 17.9% of extracted maxillary first premolars had a single root, which is a lower percentage than other reports but close to an earlier study by Carns and Skidmore.⁴ An interesting observation in the present study is the high prevalence of the two-root form (80.9%), which was slightly higher than previously reported in two studies^{4,7} conducted in North America and significantly higher than the studies of maxillary first premolars of the Turkish and Singaporean populations.^{3,8} The three-root form remains a rare finding with only 1.2% found in this study which was slightly a lower percentage than most other studies.⁶⁻¹⁰

An essential knowledge of the number of root canals is also important for every clinician. The percentage of two canals (Type II and III) in maxillary first premolars ranged from 73.3% as reported by Pineda and Kuttler¹¹ to 92% in another study.¹² Teeth with one root canal (Type I) were also reported ranging from 8%¹² to 26.2%.¹¹ The three root canals were a rare finding ranging from 0% as reported by Green¹² to 2.5% as reported by Pecora et al.⁶ Table 3 summarizes the percentage of root canals in maxillary first premolars reported in several studies, including this study.

Among the 246 teeth included in this study, 8.9% had one root (Type I), which is similar to several earlier studies.^{4,8,12} The percentage of two-canal premolars (Type II and III) was 89.8% of the teeth examined. This incidence is slightly different than other studies conducted in North America⁴ and Turkey.⁸ The three-canal premolars (Type IV) had the lowest percentage at 1.2%.

Another interesting finding in the present study is all the three-rooted premolars examined had two fused buccal roots and one palatal root with three root canals. Visualization of three-canal maxillary first premolars on operative radiographs is difficult, and the buccal orifices cannot be directly visualized by the dentist using a mouth mirror. As a result, a second buccal canal as part of two fused buccal roots can be easily overlooked which can lead to treatment failure. Therefore, the possibility of finding a three-rooted maxillary first premolar should always be considered.

The differences in the number of roots reported in the literature and present study can be primarily attributed to racial variations. Those findings emphasize the importance of a good knowledge of the external and internal anatomy of maxillary first premolars and the need for a careful radiographic examination in the success of endodontic treatment.

Table 3. Percentage of root canals in maxillary first premolars.

Author (Year)	One Root (%)	Two Roots (%)	Three Roots (%)
Pineda and Kuttler (1972)	26.2	73.3	0.5
Green (1973)	8.0	92.0	0.0
Carns and Skidmore (1973)	9.0	85.0	6.0
Pecora et al. (1991)	17.1	80.4	2.5
Kartal et al. (1998)	8.7	89.6	1.7
The Present Study	8.9	89.8	1.2

Clearly, further research is needed to study the tooth morphology in this geographic region using a larger sample size and more advanced techniques such as the use of dissecting light microscope and computed tomography to study root canal morphology.

Conclusion

The two-root form of a maxillary first premolar in a Saudi population showed a high incidence

at 80.9% when compared with European and American figures. However, the root canal morphology was similar to previous studies.

Although the three-root form was very rare, it is essential for every dentist to be aware of the possible existence of three canals in a maxillary first premolar; the knowledge of such variations will assist clinicians when diagnosing and treating endodontic cases.

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About the Author

Momen A. Atieh, BDS, MSc



Dr. Atieh is an Oral and Maxillofacial Surgeon at the Dammam Medical Center of the Eastern Region Branch of the Saudi Electricity Company. He received his dental degree from the University of Jordan in Amman, Jordan and his MSc in Oral and Maxillofacial Surgery from the University of Manchester in the UK.

e-mail: momen19@hotmail.com