The Prevalence of Two Canals in Mesial Root of Endodontically Treated Maxillary First Molars among a Saudi Arabian Sub-Population

<By **Saad Al-Nazhan***

Abstract

The aim of this in vivo study was to assess the incidence of two root canals in the mesial root of the endodontically treated permanent maxillary first molars of a Saudi Arabian sub-population. A clinical study of 352 root-canal treated permanent maxillary first molars was conducted. The teeth were examined clinically and radiographically. The results showed that 23.3% of the examined teeth had two canals in the mesial root (17.0% with one apical foramen and 6.3% with two separate foramens). The occurrence of two canals in the mesial root of the maxillary first molar of a Saudi Arabian sub-population was within the normal range.

Introduction

The mesiobuccal root of the maxillary first molar has generated more research, clinical investigation, and pure frustration than probably any other root in the mouth. Its morphology has attracted the attention of researchers and clinicians. The incidence of having two canals in the mesial root of the maxillary first molar has been reported and discussed by several authors using different techniques[1-10] (Table 1). *In vitro* studies have shown high percentage of up to 95% of two canals in the mesial root.[11] Clinically, the presence of two canals in the mesial root has been found less frequently from 18.6% to 78%.[4-6,12,13] According to several reports[13-15] limited access and visibility and non-constant location of the second canal as well as the risk of perforation may explain the lower incidence of having two canals in the mesial root of maxillary molars when compared with in vitro studies. The fact that almost half the mesial roots bear two canals is enough reason to always assume that two canals exist until careful examination proves otherwise.

Although the incidence of two root canals in the maxillary first molar has been published in scientific journals and reported in most endodontic textbooks, information regarding the nationality of the studied subjects was not mentioned. Therefore, the purpose of this investigation was to study the prevalence of two root canals in the mesial root of the endodontically treated permanent maxillary first molars of a Saudi Arabian sub-population.

Materials and methods

A total of 352 root canal-treated maxillary first molars of 332 Saudi patients were studied. The teeth were randomly selected. One hundred and seventy-one were from males and 181 were from females. These patients were treated by the undergraduate dental students, endodontic postgraduate students and endodontic staff at the University of King Saud, College of Dentistry in Riyadh, Saudi Arabia.

During the student's clinical endodontic course, the students were instructed to search for extra canals and each step of the treatment was carefully checked by the staff, then the findings were recorded on a special form. The students usually spend 3 hours in every clinical session and finish the root canal therapy in two to three visits. The endodontic postgraduate students were closely supervised by the staff during their clinical session.

continued p. 48

***BDS, MSD, Associate Professor and Chairman,**
Department of Restorative Dental Science
Division of Endodontics, College of Dentistry
King Saud University
P.O. Box 60169, Riyadh 11545, KSA

Correspondence address:
Saad Al-Nazhan
Department of Restorative Dental Science, Division of Endodontics
College of Dentistry, King Saud University
P.O. Box 60169, Riyadh 11545, KSA

The radiographic films of the working length and obturation at different angles of each tooth were mounted, projected and evaluated. All radiographs were viewed independently by two examiners. In addition, the clinical records were reviewed and the findings were then tabulated and recorded. 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. The examined teeth were free of root resorption, had no canal calcification, open apices, broken instrument and no previous root canal therapy.

Data were statistically analyzed using Chi-Square test, by comparing pairs of groups, with the significance level established at 5% ($P < 0.05$).

Results

Of the 352 root canal-treated, mesiobuccal roots of the maxillary first molar teeth in this study, 82 teeth (23.3%) had two root canals and the remaining 270 teeth (76.7%) had one root canal.

The two root canals in the mesial roots were mostly confluent in the apical third, ending in one foramen (17.0%). Results are summarized in Table 2.

The Chi-Square test showed a slight significant difference between male and female in the distribution of the root canals ($P < 0.05$).

Discussion

Location of the mesiolingual (ML) root canal of the first maxillary molar is usually very difficult and it is generally easy to miss. This is due to the small size of the canal orifice and its inconstant lingual position. In addition, early caries attack of the tooth structure and deep restorations prior to endodontic therapy cause chronic irritation of the pulp which leads to the formation of irritational dentine, canal calcification or formation of pulp stone.[9,14,15]

continued p. 50

Slowey[16] pointed out the importance of radiographic examination in detecting extra root canals. He reported that the most important film for detecting extra canals is the working length film. Bitewing radiographs should be used routinely to supplement the apical views, since it gives a more accurate view of the canals as they exit from the pulp chamber.[17] The use of radiographic techniques to study the morphology of the root canal system might appear to have certain disadvantages. The operator can only see the tooth in a two-dimensional image, and conceivably extra root canals could be missed in the radiograph. Unfortunately, radiographs are still the most reliable method in the clinical setting. Therefore, by strictly adhering to the radiographic criteria for determining the number of roots and root canals, the findings of this study were in accordance with the previously reported *in vivo* studies.[4-6]

The operating microscope (OM) was recently introduced to endodontics and has significantly improved magnification and illumination. Kulild and Peter,[11] and Buhrley *et al*.[13] reported that the use of OM did help the identification of the extra canal of the mesiobuccal root. In another study, Gorduysus *et al*.[18] stated that the use of OM is not critical for the location of the ML canal. In addition, they reported that the negotiation of the second ML canal was much more challenging than their location. Unfortunately the cost of the OM is still high. The OM or dental loupes were not used in this study because it was not yet available to us when this study was conducted. According to Buhrley *et al*.,[13] there was no difference between the use of OM and dental loupes in locating the ML canal.

Ibarrola *et al*.[9] suggested the use of chelating agents and ultrasonic instrumentation to remove debris and anatomical irregularities that interfere with negotiation of the MB and ML canals.

The cases reported in this study were treated by the fourth year dental students, endodontic postgraduate students and endodontic staff. The students were closely observed by full-time endodontists with an average clinical experience of 15 years.

In this study, the orifice of the second mesiobuccal root canal was commonly located lingual to the main mesiobuccal (MB) canal orifice. Similar observation has been reported by Weine *et al*.,[1] Pomeranz and Fishelberg.[5] According to Slowey,[16] Kulild and Peters,[11] and Gorduysus *et al*.,[18] the distance between the ML and the MB canals is 1 to 4mm. Its orifice is usually smaller in diameter compared to the main canal. Acosta and Trugeda[14] reported that the orifice of the ML canal is usually covered by a dentinal rounded growth which conceals the view of the funnel-shaped structure of the canal. The growth needs to be removed so the mesiocentral area of the chamber can be seen. Care should be taken not to perforate the furcation area. In addition, modification of the access preparation of the treated teeth will give an adequate visualization of the chamber floor which will facilitate the search and location of the orifice of extra canals. Furthermore, the ML canal invariably emerges from the pulp chamber floor at a considerable mesial-buccal angle.[8,11]

In the present study, ML canal was found in 23.3% of the 352 cases reviewed. This percentage is slightly higher

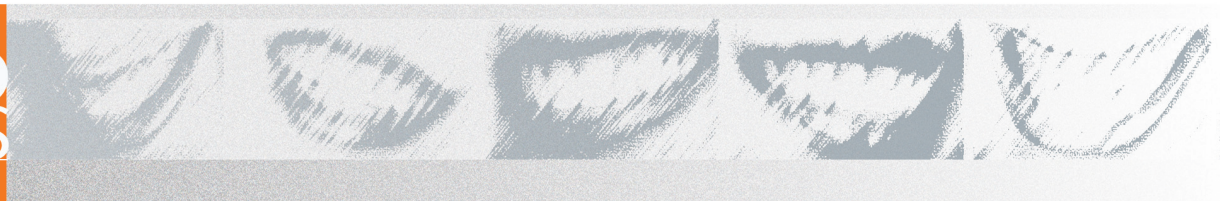
Table 1. Root canals and apical foramina in mesiobuccal root of maxillary first molar

Investigator(s)	Teeth sample	Method	One canal & one foramen (%)	Two canals & one foramen (%)	Two canals & two foramen (%)
Weine et al. 1969	208	In vitro sections	48.5	37.5	14.0
Pineda and Kuttler 1972	262	In vitro radiographs	39.0	12.5	48.5
Pineda 1973	245	In vitro radiographs	41.0	17.0	42.0
Seidberg et al. 1973	100 201	In vitro sections In vivo	38.0 66.7	37.0 33.3	25.0
Pomeranz and Fishelberg 1974	71	In vivo	72.0	17.0	11.0
Hartwell and Bellizzi 1982	538	In vivo	80.7	18.6	
Vertucci 1984	100	In vitro clear and dyed sections	45.0	37.0	18.0
Neaverth et al. 1987	228	In vivo	19.3	16.7	60.0
Ibarrola et al. 1997	87	In vitro clearing	23	77	
Tam and Yu 2002	50	In vitro section	36	40	24

Table 2. Percentages of root canals and apical foramina in mesiobuccal root of maxillary first molar

Sex	No. of patients	No. of teeth	One canal & one foramen (%)	Two canals & one foramen (%)	Two canals & two foramen (%)
Male	165	171	125 (73.1%)	38 (22.2%)	8 (4.7%)
Female	167	181	145 (80.1%)	22 (12.2%)	14 (7.7%)
Total	**332**	**352**	270 (76.7%)	60 (17.0%)	22 (6.3%)

continued p. 52



than Hartwell and Bellizzi[6] findings and significantly lower than the range reported for other *in vivo* studies.[4,5,8] However, the sample size in each of the latter three studies was much smaller than the size reported in this study and may have influenced their results.

No significant difference ($P < 0.05$) was found between males and females in the present study. Similar findings were reported by Neaverth *et al*.[8]

In this study, most of the located two canals were joined in the apical 1 to 4mm of the root canal and exited through one foramen. This is similar to the findings of Neaverth *et al.,*[8] Kulild and Peters.[11] If one of the two canals is not properly cleaned, the chance of failure of the endodontic therapy may increase because of the retention of organic tissue and microorganisms.

When defined criteria of evaluation are followed, agreement among different observers should improve. This was clearly stated by several investigators.[19,20] According to Goldman *et al.,*[21] two observers will usually give the best agreement. In this study, two observers did the evaluation, separately, and the agreement was 98% which agrees with earlier reports.[19-21]

Finally, effort should be made to locate, clean and fill the entire root canal system to produce a more predictable and favorable prognosis. This can be done by better knowledge of the internal morphology, the use of magnifying tools and modification of the access preparation from classic triangle to rhomboidal shape. In addition, clinician should be warned that the presence of extra canal in the mesiobuccal root of the maxillary first molar should always be assumed until proven otherwise.

Conclusion

The occurrence of two canals in the mesial root of the maxillary first molar of a Saudi Arabian sub-population was within the normal range. No significant difference between male and female was found.

This article was reprinted with permission from the Saudi Dental Journal. Volume 17, No. 1, January - April 2005.

References

1. Healey H, Weine F, Gerstein H, Evanson L. Canal configuration in the mesiobuccal root of the maxillary first molar and its endodontic significance. Oral Surg 1969; 28: 419-425.

2. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. Oral Surg 1972; 33: 101-110.

3. Pineda F. Roentgenographic investigations of the mesiobuccal root of the maxillary first molar. Oral Surg 1973; 36: 253-260.

4. Seidberg B, Altman M, Guttoso J, Suson M. Frequency of two mesiobuccal root canals in maxillary first permanent molars. J Am Dent Assoc 1973; 87: 852-856.

5. Pomeranz H, Fishelberg G. The second mesiobuccal canal of maxillary molars. J Am Dent Assoc 1974; 88: 119-124.

6. Hartwell G, Bellizzi R. Clinical investigation of *in vivo* endodontically treated mandibular and maxillary molars. J Endod 1982; 8: 555-557.

7. Vertucci F. Root canal anatomy of the human permanent teeth. Oral Surg 1984; 58: 589-599.

8. Neaverth E, Kotler L, Kaltenbach R. Clinical investigation *(in vivo)* of endodontically treated maxillary first molars. J Endod 1987; 13: 506-512.

9. Ibarrola J, Knowles K, Ludlow M, McKinley B. Factors affecting the negotiability of second mesiobuccal canals in maxillary molars. J Endod 1997; 23: 236-238.

10. Tam A, Yu D. Location of canal isthmus and accessory canals in the mesiobuccal root of maxillary first permanent molars. J Can Dent Assoc 2002; 68: 28-33.

11. Kulild J, Peters D. Incidence and configuration of canal systems in the mesiobuccal root of maxillary first and second molars. J Endod 1990; 16: 311-317.

12. Henry B. The fourth canal: Its incidence in maxillary first molars. J Can Dent Assoc 1993; 12: 995-996.

13. Buhrley L, Barrows M, BeGole E, Wenckus C. Effect of magnification on locating the MB2 canal in maxillary molars. J Endod 2002; 28: 324-327.

14. Acosta V, Trugeda B. Anatomy of the pulp chamber floor of the permanent maxillary first molar. J Endod 1978; 4: 214-219.

15. Imura N, Hata G, Toda T, Otani S, Fagundes M. Two canals in mesiobuccal roots of maxillary molars. Int Endod J 1998; 31: 410-414.

16. Slowey R. Radiographic aids in the detection of extra root canals. Oral Surg 1974; 37: 762-772.

17. Green D. Double canals in single roots. Oral Surg 1973; 35: 689-696.

18. Gorduysus M, Gorduysus M, Friedman S. Operating microscope improves negotiation of second mesiobuccal canals in maxillary molars. J Endod 2001; 27: 683-686.

19. Reit C, Hollender L. Radiographic evaluation of endodontic therapy and the influence of the observer variation. Scand J Dent Res 1983; 91:205-212.

20. Reit C, Grondahl HG. Application of statistical decision theory to radiographic diagnosis of endodontically treated teeth. Scand J Dent Res 1983; 91:213-218.

21. Goldman M, Pearson AH, Darzenta N. Endodontic success - Who's reading the radiograph. Oral Surg 1972; 38:287-293.