

The prevalence of two canals in mesial root of endodontically treated maxillary first molars among a Saudi Arabian sub-population

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تهدف هذه الدراسة الى تحديد نسبة حدوث قناتين فى الجذر الانسى للرحى الاولى العلويه الدائمه والمعالجه لىبا لمرضى سعوديين. تمت الدراسه السريره على ٣٥٢ رضى اولى علويه دائمه وذلك بأستخدام الفحصين السريرى والشعاعى. بينت النتائج بأن ٢٣,٣ ٪ من الاسنان المفحوصه تحتوى على قناتين فى الجذر الانسى (٧١ ٪ بتقيه ذرويه واحده و ٣,٦ ٪ بتقبتين منفصلتين). يستنتج من هذه الدراسه أن وجود قناتين فى الجذر الانسى للرحى الاولى العلويه الدائمه بين السعوديين يعتبر ضمن الحد الطبيعى.

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 techniques¹⁻¹⁰ (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 reports¹³⁻¹⁵ 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

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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 <i>et al.</i> 1969	208	<i>In vitro</i> sections	48.5	37.5	14.0
Pineda and Kuttler 1972	262	<i>In vitro</i> radiographs	39.0	12.5	48.5
Pineda 1973	245	<i>In vitro</i> radiographs	41.0	17.0	42.0
Seidberg <i>et al.</i> 1973	100 201	<i>In vitro</i> sections <i>In vivo</i>	38.0 66.7	37.0 33.3	25.0
Pomeranz and Fishelberg 1974	71	<i>In vivo</i>	72.0	17.0	11.0
Hartwell and Bellizzi 1982	538	<i>In vivo</i>	80.7	18.6	
Vertucci 1984	100	<i>In vitro</i> clear and dyed sections	45.0	37.0	18.0
Neaverth <i>et al.</i> 1987	228	<i>In vivo</i>	19.3	16.7	60.0
Ibarrola <i>et al.</i> 1997	87	<i>In vitro</i> clearing	23	77	
Tam and Yu 2002	50	<i>In vitro</i> section	36	40	24

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.

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 ($P < 0.05$).

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%)

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}

Slowey¹⁶ 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 Buhrey *et al.*¹³ reported that the use of OM did help the identification of the extra canal of the mesiobuccal root. In other 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 Buhrey *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 4 mm. Its orifice is usually smaller in diameter compared to the main canal. Acosta and Trugeda¹⁴ 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 mesio-central 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 than Hartwell and Bellizzi⁶ 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 4 mm 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 always existed 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.

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