acta stomatologica croatica

Vol. 17, Br. 4

1983.

UDC 616.31:572.772
CODEN: ASCRBK
YUISSN: 0001—7019
Original paper

Investigation of the endodontic space in maxillary first permanent molars

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Summary

The purpose of the investigation was to establish the exact number of root canals in the maxillary first permanent molar, their direction, type and relation, based upon a large number of random samples.

Randomly chosen 443 maxillary first permanent molars (221 left and 222 right) were investigated with the aim to get more knowledge into the morphology of the endodontic space. One canal in the mesiobuccal root appeared in 366 teeth or 82.62% and three canals in mesiobuccal root were found in 25 teeth or 5.64%. In the distobuccal root two canals were found in 8 teeth or 1.81%. In palatal root two canals were found in 4 teeth or 0.9%. Analizing the obtained data it has been established that there was not a significant correlation between the appearence of two canals in the mesiobuccal root and the side of the jaw. There is also no relation between the type of the canals and splitting of the mesiobuccal root at the apex.

Key words: pulp, root canals, morphology

INTRODUCTION

A thorough knowledge of the morphology of the endodontic space is a supposition for successful treatment of pulpal affections. Owing to the complexity and variability of the pulpal chamber and root canals endodontia of molars is in general dental practice often avoided. Maxillary first permanent molars being the first teeth to erupt in the childhood are therefore more exposed to caries and dental pathosis more often develops.

Unfortunately many molars are extracted, because of various reasons. There is no doubt that to perform an exact endodontic treatment requires knowledge and practical skill of the dental surgeon combined with patience and appreciation of the person undergoing the complicated endodontic treatment.

It is my opinion that every dental student should become aware of the importance during his special education of endodontia, and to get the best knowledge of the endodontic morphology and become qualified to perform even the complicated endodontic treatment of molar teeth.

For some time the endodontic treatment was not regarded a difficult task, because the dental profession presumed each tooth has one canal only, based on the investigation of Carabelli[1] in 1844..

Numerous investigations have been performed with the aim to throw more light into this problem (Lenhossék[2], Barrett[3], Okumura[4], Hess[5], Meyer[6], Skilling[7], Weine[8], Wheeler[9]). But in spite of all the efforts of various experts in dental morphology many failures are encountered after endodontic treatment of the molar teeth.

Having in mind the fact that for a successful endodontic treatment it is obligatory to find and negotiate all root canals in the tooth to be treated and afterwards fill hermetically all the empty endodontic space, the task of the present investigation was a direct observation of the root canal in extracted maxillary first permanent molars placing endodontic files in mesiobuccal canals and drilling the root longitudinaly until the contact with the file. It was possible in this manner to expose all the existing root canals.

The purpose of this investigations was to established:

1. The number of canals in the mesiobuccal root
2. The number of canals and their types in the distobuccal root
3. The number of canals in the palatal root
4. The relation between root canals and side of jaw

MATERIAL AND METHODS

A random sample of 443 maxillary first permanent molars (221 left and 222 right) was collected following the extraction and stored in glass dishes filled with 5% formalin solution. Afterwards all samples were rinsed with running water and cleaned to remove remaining parodontal tissue and kept in a dish of 3% hydrogen peroxid for 24 hours, and then rinsed with 70% alcohol and dried with warm air.

All teeth were opened on the occlusal surface using high speed air turbine with a cylindrical diamond bur with water spray. The roof of the pulp chamber was removed with a low rotating fissure bur No. 2. After the removal of pulp tissue the entrance of the mesiobuccal, distobuccal and palatal canals were made visible. The entrance to the additional secondary mesiobuccal canal often can not be seen due to the inclination of the mesioaproximal surface of the pulpal wall, which covers the entrance to mesiobuccal additional-secondary canal. In order to expose this canal a part of the mesiobuccal surface of the pulpal wall was removed starting from the primary mesiobuccal canal towards the palatal wall approximately 1 mm wide and 2–4 mm long.

Kerr reamers No 0 8 and 0 10 were placed in the exposed canals. This was followed by longitudinal drilling of the mesiobuccal root until the first contact with reamers along the entire length of the root. Root canals were then dyed to make a better observation of relation and directions of root canals possible.

Tables No 1, 2 and 3 show the occurence of all canals in the mesiobuccal, distobuccal and palatal roots, and the percentage in relation to their total appearance.

Table 1

Mesiobuccal root	Occurrence	Percentage
1 canal	52	11.74
2 canals	366	82.62
3 canals	25	5.64
Total	433	100.00

Photographs 1, 2, 3 show the mesiobuccal root with various numbers of canals.

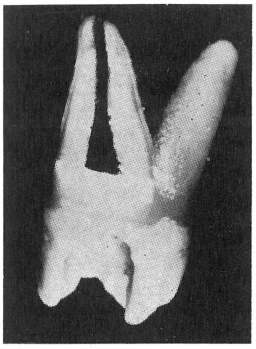

Fig. 1 One canal in the mesiobuccal root

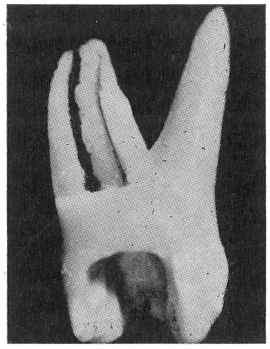

Fig. 2 Two canals in the mesiobuccal root

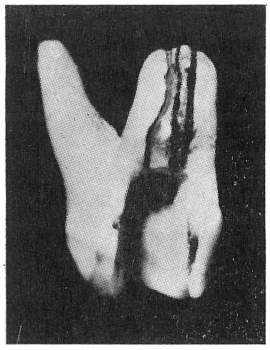

Fig. 3 Three canals in the mesiobuccal root

Table 2

Distobuccal root	Occurrence	Percentage
1 canal	435	98.19
2 canals	8	1.81
Total	443	100.00

Table 3

Palatal root	Occurrence	Percentage
1 canal	439	99.1
2 canals	4	0.9
Total	443	100.00

Table 4 show the appearance of various types of canals in the mesiobuccal root.

Table 4

Type of canal in the mesiobuccal root	Occurrence	Percentage
Two separated canals	172	46.99
Two partially connected canals	28	7.65
Two connected canal at hte apex region	166	43 35
T o t a l	366	100.00

The distribution of certain types of canals in the mesiobuccal root in relation ot the side of the jaw is shown in table 5.

Table 5

Number and type canals in the mesiobuccal root	Occurrence Left	Occurrence Right	Percentage Left	Percentage Right
Two separated canals	91	81	24.86	22.13
Two partialy connected canals	14	14	3.83	3.83
Two connected canals in the apex region	75	91	20.49	100.00

Figure 4 presents the occurence of two separated canals twoo partialy connected canals and two connected canals in the apical region.

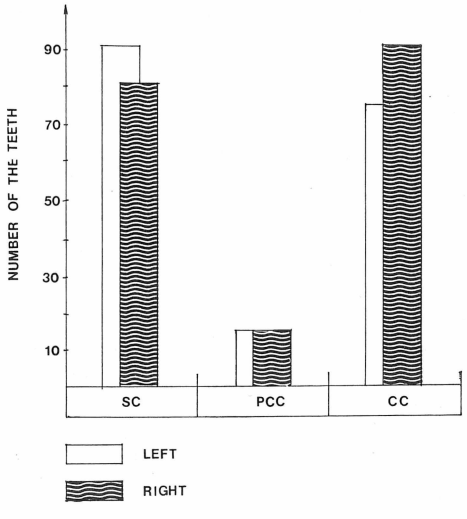

Fig. 4 Distribution of types of the canals in the mesiobuccal root in the relation to the side of the jaw

Figure 5, 6, 7 presents the section of the mesiobuccal root with different types of their canals.

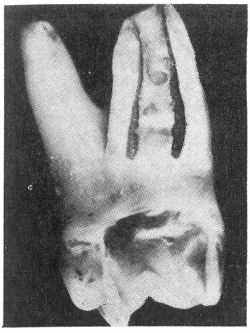

Fig. 5 Two separate canals in the mesiobuccal root

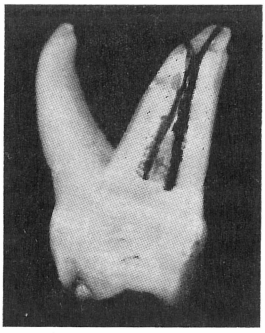

Fig. 6 Two partially connected canals in the mesiobuccal root

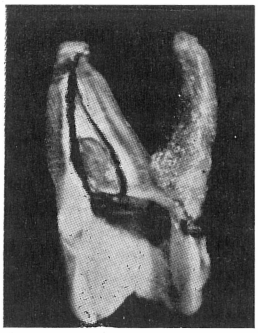

Fig. 7 Two connected canals in the mesiobuccal root at the apex region

It was established that the maxillary first permanent molars can have in their mesiobuccal root two separate canals, two partially connected canals and two canals which join in the apex region. This phenomenon does not depend upon the side of the jaw. In all types of canals in the mesiobuccal root a marked splitting on the apex of the root up to 1 mm was observed (Fig. 8).

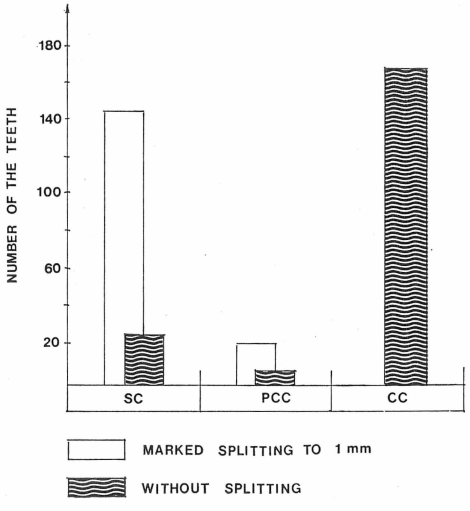

Fig. 8 Distribution of the three types of canals in the mesiobuccal root in relation to the marked splitting of the apex of the root

The obtained and analysed data show that the type of the canals does not depend on splitting of the root apex. This substantiates the hypothesis that in separated additional secondary canals three is the same percentage of teeth with splitting of the apex of the root and teeth without splitting (probability $p_1 = 0.81$, $p_2 = 0.86$).

Three canals were found in the mesiobuccal root in 5.6% They can be differently orientated:

a. Three canals connected at third of the apex
b. The third canal connected with the primary canal
c. Secondary canal connected with the primary canal, and
d. Three separated canals.

My observation regarding the distobuccal root of the maxillary first permanent molars. Two canals have found in 1.81%. In the palatal root two canals have found in 0,9% of the cases. These canals are also differntly orientated.

DISCUSSION

Numerous investigations performed during the past years have revealed that the maxillary first permanent molar has a very complex endodontic morphology. This refers especially to the mesiobuccal root.

Various data on the presence secondary canal in the mesiobuccal root of the maxillary permanent molar have been published. This variety is due to different methods applied in the investigations and to the fact that in the investigations the first and second molars were considered together. According to my clinical experience maxillary first and second permanent molars show a series of morphological differences which lead to different relations within the pulp space. Lenhossék[7] reports that the secondary canal was found in mesiobuccal root of the maxillary first molars in 62%. Hess[5] investigated maxillary first and second molars together, and concluded that the secondary canal was present in 53% of the cases only.

Green[10] reports double canals in the mesiobuccal root in 50%, Okumura[4] in 52%, Weine[8] in 51.5% of the cases. Nosonowitz and Brenner[11] in their in vivo reported 69%, and Pineda and Kuttler[13] in 74.7% of the cases. Acosta and Trugeda[14] reported on the presence of the secondary canal in 68.40%.

The comparison of the above data on occurrence of the secondary canals in the mesiobuccal root with my results shows somewhat a higher appearance of the additional secondary canals, which is due to simplicity of my method used and the objectivity of evaluation based upon direct observation using the discribed method.

The occurrence of the two separated canals varies from 8.2% (Bence[15]) to 47% (Pineda[16]). In this study two separated canals in mesiobuccal root have been found in 46.99% of the cases. In comparison the shape of the mesiobuccal root with the type of the canal, a regularity in the appearance of a marked saplitting on the apex of the root has been observed. However, by analyzing the data it was established that the type of the canal does not depend on the presence of

a splitting of the root. Kerekes and Tronstad[17], on the basis of the investigation carried out on 40 maxillary first permanent molars, have reported about in 10% two canals in the palatal root. Comparing this result with my own I believe that this percentage is too high, because I could not verify it on 443 maxillary first permanent molars (Šutalo[18]). My results are identical with results Cecic[19] and al. being 0.9%.

Further thoroughly investigations are necessary to clarify the problem of endodontic space in maxillary first permanent molars.

CONCLUSION

Based on results in the investigation of 443 randomly chosen maxillary first permanent molars, the following may be drawn:

1. One canal in the mesiobuccal root was found in 52 samples or 11.74%.
2. The occurence two canals in the mesiobuccal root was found in 366 samples or 82.62%.
3. Three canals in the mesiobuccal root of the maxillary first molars were found in 25 or 5.6% of the cases.
4. Two canals in the distobuccal root were found in 8 samples or 1.81%.
5. Two canals in the palatal root were found in 4 specimen or 0.9%.

Analyzing the obtained data, it has been established that there is no significant difference between the occurrence of two canals and in the respect of the left and the right side of the jaw.. There has not been a relation between the type of the canal and the splitting at apex of the mesiobuccal root.

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Sažetak

U ovom je radu ispitivana morfologija endodontskih prostora prvih gornjih kutnjaka. Poznata je činjenica da se neuspjesi u endodontskom tretmanu prvog gornjeg kutnjaka osim neadekvatnog tehničkog pristupa mogu pripisati i nedovoljnom poznavanju morfologije endodontskog prostora.

Činjenica da se u stomatološkoj literaturi dugi niz godina raspravlja o endodonskoj morfologiji prvog gornjeg kutnjaka nije bila zapreka da se pristupi ovom istraživanju iz razumljivog razloga što su podaci iz literature vrlo različiti, a kadikad i oprečni. U nakani da se ustanovi stvaran broj kanala u korjenovima prvog gornjeg kutnjaka, njihov međusobni odnos kao i moguće morfološke varijacije, nasumce je uzeto 443 ekstrahiranih prvih gornjih kutnjaka (221 lijevih i 223 desnih). Nakon čišćenja i sušenja svi su uzorci otvarani na okluzijskoj plohi turbo-bušilicom i dijamantnim brusnim tijelom do krova pulpne komorice, koji je zatim odstranjen čeličnim svrdlom br. 2 do potpunog nestanka rogova pulpe. Ulazi u primarni mezio — bukalni, disto-bukalni i palatinalni kanal su uvijek bili vidljivi, dok se ulaz u sekundarni mezio — bukalni kanal nije mogao vidjeti bez dodatnog uklanjanja dijela mezioaproksimalne stijenke pulpne komorice.

U ovako prikazane kanale postavljeni su Kerr proširivači No 008-0010, a zatim je izvršeno uzdužno brušenje mezio-bukalnog i disto-bukalnog korijena do prvog kontakta s površinom proširivača. Nakon uklanjanja proširivača izvršeno je bojenje kanala polikolor bojama.

U raspravi o rezultatima se govori o broju kanala u pojedinim korijenovima prvog gornjeg kutnjaka. Najveću pažnju je privukao meziobukalni korijen zbog složenosti svoje morfologije. Od sveukupno ispitanih 443 prvih gornjih kutnjaka u meziobukalnom korijenu utvrđeno je 52 zuba s jednim kanalom ili 11.74%, 366 zubi ili 82. 62% s dva kanala i 25 zubi ili 5.64% s tri kanala. U distobukalnom korijenu su dva kanala utvrđena u 8 zubi ili 1.81%, dok su u palatinalnom korijenu dva kanala nađena samo u 4 zuba ili 0.9%. Korijenski kanali mogu imati različite međusobne odnose. U meziobukalnom korijenu susreću se potpuno separirana dva kanala u 172 uzorka ili 46.99%, dva djelomično spojena kanala u 28 uzoraka ili 7.65% u dva kanala koji se međusobno spajaju u predjelu apeksne trećine korijena u 166 uzoraka ili 43 35%.

U daljnjem tijeku rada se raspravljalo o povezanosti između pojave separiarnih kanala u meziobukalnom korijenu sa znakovima kalanja na apeksu korijena, kao i korelaciji između pojave dvostrukih kanala i strane čeljusti. Utvrđeno je da ne postoji signifikantna razlika između ove dvije pojave.

Ključne riječi: pulpa, korjenski kanali, morfologija