

Anatomy of primary incisor and molar root canals

Fouad S. Salama, BDS, MS Ronald W. Anderson, DDS, MS
Carole McKnight-Hanes, DMD James T. Barenie, DDS, MS
David R. Myers, DDS, MS

SHORT COMMUNICATIONS

Introduction

Knowledge of the size, morphology, and variation of the root canals of a primary tooth is useful in visualizing the pulp cavity during treatment. The roots of the primary teeth are formed completely approximately 16 to 20 months following eruption.¹ In approximately three years the roots begin to resorb at the apex or on a lateral surface near the apex.² The form and shape of the root canals roughly correspond to the form and shape of the external anatomy of the teeth. However, as root resorption of primary teeth begins, dentin is deposited within the root canal system and may change the number, size, and/or shape of the root canals significantly.³ The presence of necrotic pulp or the unsuccessful outcome of pulpotomy procedures may make endodontic therapy of the root canal systems desirable if extraction of the tooth is to be avoided. The purpose of this study was to determine the length of the root canals of primary maxillary incisors and mandibular molars, and to examine the root canal anatomy visually using a clearing technique.

Materials and Methods

Forty primary teeth, including 10 maxillary central incisors, 10 maxillary lateral incisors, 10 mandibular first molars, and 10 mandibular second molars were included in this study. Only primary teeth were used in this study. These teeth, obtained from several dentists, were selected from a larger number of extracted teeth and preserved in 10% formalin. The dentists reported having extracted the teeth for a variety of reasons including abscess formation, pulpitis, trauma, and orthodontic considerations. The teeth selected were mild to moderately carious, without gross evidence of root resorption. The teeth were cleaned using a scaler to remove any attached soft tissue and a number 4 round bur was used to prepare an access preparation. For molar teeth, the bur was placed in the access preparation to the floor of the pulp chamber and the shaft was marked with a thin line pen at the level of the occlusal surface. The measurement from the floor of the pulp chamber to the occlusal surface was recorded. An endodontic file with a silicone rubber stop was used to measure the length of all root canals of all teeth from the cusp tip or incisal edge to the apical foramen. The teeth then were divided into two groups. Each group con-

tained five maxillary central incisors, five maxillary lateral incisors, five mandibular first molars, and five mandibular second molars. Group I was processed for clearing to demonstrate root canal morphology using the technique described by Robertson et al.⁴

The teeth in group II were sectioned either longitudinally or transversely. The teeth in both groups I and II were examined for the presence of accessory canals, intercanal branches, and apical ramifications, and photographed using a dissecting microscope.

Results

The measurements of the root canals of the maxillary incisors and the mandibular molars are presented in the table on the next page. The central incisors were very similar in length (range 16–17 mm). The lateral incisors were shorter and slightly more variable in length (range 14–16 mm). Examination of the maxillary incisors revealed no demarcation between the single root canal and the pulp chamber. Single root canals without bifurcation or accessory canals were observed in each incisor specimen. The incisor root canals generally curved labially in the apical one third to one half of the root. Cross sections at various levels revealed that the root canal anatomy varied from round to oval or triangular.

The apical foramen of the root canal usually was located near the anatomical apex of the root.

The number of root canals observed in mandibular molars varied from three to four. Eight mandibular first molars had four canals and two had three canals. The lengths of the molar roots were more variable than the incisors (Table), with the mesiolingual roots of the first molars being the most variable in length ($SD = 1.96$). For both first and second molars, the mesiobuccal canals tended to be the longest (\bar{x} 's = 16.4, 15.8). Overall, the average lengths of the root canals of the first molars were more variable than those of the second molars. Cross sections revealed thin ovoid canals, with the mesial root canals wider buccolingually than the distal canals.

Discussion

In this study we used carious, unresorbed primary teeth, in contrast to other studies which examined noncarious, unresorbed teeth^{5,6}. It is known that about

Table. Root canal length of maxillary incisors and mandibular molars

	Length in mm			
	Mean	Std Deviation	Std Error	Range
Tooth				
Central (10 teeth)	16.5	0.41	0.13	16-17
Lateral (10 teeth)	15.0	0.53	0.17	14-16
Tooth and Canal				
First molar (10 teeth)				
Mesiobuccal	16.4	0.69	0.22	15-17
Mesiolingual	14.2	1.96	0.62	09-15
Distobuccal	13.1	1.05	0.33	12-15
Distolingual	12.7	1.45	0.46	10-15
Second molar (10 teeth)				
Mesiobuccal	15.8	1.31	0.41	13-17
Mesiolingual	14.4	1.57	0.50	11-16
Distobuccal	14.9	1.01	0.32	13-16
Distolingual	14.9	1.34	0.42	12-16
Occlusal surface to pulp floor (First and second molars, 20 teeth)	5.79	0.63	0.14	04-06

rate periapical radiographs for evaluating the root canals of a tooth being considered for pulpectomy. However, these data provide a usable table of average lengths of mandibular molar root canals, which could be useful in clinical situations where it is impossible to expose a radiograph before attempting a pulpectomy.

Dr. Salama is lecturer, Division of Pedodontics, King Saud University, Riyadh, Saudi Arabia. Dr. Anderson is associate professor and chairman, Department of Endodontics; Dr. McKnight-Hanes is associate professor, Department of Pediatric Dentistry; Dr. Barenie is professor, Department of Pediatric Dentistry; and Dr. Myers is dean and Merritt professor of Pediatric Dentistry, School of Dentistry, Medical College of Georgia, Augusta, GA.

the time root resorption begins, deposition of secondary dentin starts at the apex⁷ and results in some changes to the anatomic apex of the root.³ The number of root canals in the mandibular molars varied from three to four differing slightly from a previous study that observed two to five root canals.⁷ Most of the variations within the root canals of the primary molars were observed in the buccolingual dimension which would not be detected in clinical radiographic examination.

The findings of this study indicated considerable variability in the lengths of the root canals of both first and second mandibular molars (Table). This variability in length of canals emphasizes the importance of accu-

1. Gorlin RJ, Pindborg JJ, Cohen MM: *Syndromes of the Head and Neck*. 2nd ed. New York: McGraw-Hill Book Co, 1976, p 779.
2. Woelfel JB: *Dental Anatomy: Its Relevance to Dentistry*. 4th ed. Philadelphia: Lea & Febiger, 1990, pp 201-30.
3. Camp JH: Pedodontic-endodontic treatment. In *Pathways of the Pulp*, S Cohen, RC Burns ed. 4th ed. St. Louis: The CV Mosby Co, 1987, pp 685-722.
4. Robertson D, Leeb JJ, McKee M, Brewer E: A clearing technique for the study of root canal systems. *J Endod* 6:421-24, 1980.
5. Zürcher E: *The Anatomy of the Root-Canals of the Teeth of the Deciduous Dentition, and of the First Permanent Molars*. New York: William Wood & Co, 1925, pp 163-93.
6. Barker BCW, Parsons KC, Williams GL, Mills PR: Anatomy of root canals. IV deciduous teeth. *Aust Dent J* 20:101-6, 1975.
7. Hibbard ED, Ireland RL: Morphology of the root canals of the primary molar teeth. *J Dent Child* 24:250-57, 1957.