Variations of Palatal Canal Morphology in Maxillary Molars: A Case Series and Literature Review

Ali Nosrat, DDS, MS, MDS,[*†] *Prashant Verma, DDS, MS, FAGD,*[*] *M. Lamar Hicks, DDS, MS,*[*] *S. Craig Schneider, DDS, MAGD,*[*] *Ali Behnia, DMD, MS,*[*] *and Adham A. Azim, BDS*[‡]

Abstract

A series of challenging cases with unusual canal anatomy in the palatal roots of maxillary first and second molars is presented. A review of the literature was done to elucidate the prevalence of anatomic variations in the palatal canal of maxillary first and second molars. An uncertain or indefinite radiographic appearance of the palatal canal, or eccentric deviation of the master cone or previous root canal filling was considered an indication of a bifurcated palatal canal. Five maxillary molars with a bifurcated palatal canal were identified. A MEDLINE database search was performed to identify studies on the palatal canal morphology of maxillary first and second molars. Data were categorized based on the methodology used in each study. The overall prevalence of anatomic variations in the palatal canal of maxillary first and second molars was less than 2%; however, anatomic variations occurred more frequently in certain ethnic groups, reaching up to 33% in maxillary first molars and up to 14% in maxillary second molars. This case series showed that even experienced endodontic clinicians can miss a bifurcated palatal canal if they are not aware of or overlook the hidden clues for these anatomic variations. The traditional assumption of an exclusively single-canal anatomy in palatal canals of maxillary molars needs to be changed, even though it is the most prevalent anatomy. The overall low percentage of more than 1 palatal canal in maxillary molars is disturbingly misleading, because in certain ethnic groups this prevalence can be considerably higher. *(J Endod 2017;■:1–9)*

Key Words

Anatomic variation, maxillary first molar, maxillary second molar, palatal canal, root canal anatomy, root canal treatment

Significance

This article shows that experienced endodontic clinicians can miss a bifurcated palatal canal if they are not aware of anatomic variations. The review of literature revealed that despite the overall low prevalence of anatomic variations in the palatal canal of maxillary molars (<2%), it can reach up to 33% in maxillary first molars and up to 14% in maxillary second molars in certain ethnic groups.

The goal of chemomechanical preparation of the root canal system is to reduce intracanal bacterial populations to a level that can promote periapical tissue healing (1, 2). A detailed knowledge of root canal anatomy is necessary to effectively perform endodontic treatment (3, 4). Complex internal anatomy and missed canals are among the reasons for failure of endodontic treatment (5). Maxillary molars are the second most frequently treated group of teeth endodontically (6, 7). Historically, they are described as 3-rooted with 1 or 2 canals in the mesiobuccal root, 1 canal in the distobuccal root, and 1 canal in the palatal root (8, 9).

The mesiobuccal root has been thoroughly investigated using a variety of methods due to its complex internal anatomy (9–11). A second and sometimes a third mesiobuccal canal can make root canal treatment of the maxillary molars a challenge (12, 13). In contrast, root canal anatomy in the palatal root is usually reported as a single canal with 1 orifice and 1 apical foramen (1-1 anatomy), showing few variations (9). Treatment of a palatal canal, however, can be a challenge in unusual cases. Anatomy other than 1-1 is difficult to detect using 2-dimensional periapical radiographs, because of overlapping or superimposition of multiple anatomic structures in the maxillary posterior area. The primary aim of this study was to present a series of cases with unusual anatomy of the palatal canal in maxillary first and second molars. The secondary aim was to review in depth the anatomy of and variations in the palatal canal in maxillary first and second molars and to elucidate reported variations among different ethnicities. In this article, the numerical method of classification introduced by Vertucci (14) to describe the anatomy of the canals, was used.

Materials and Methods

Included in this case series were maxillary first and second molars referred for primary root canal treatment or nonsurgical retreatment that fulfilled the following criteria:

From the *Department of Endodontics, Periodontics, and Prosthodontics, School of Dentistry, University of Maryland, Baltimore, Maryland; †Iranian Center for Endodontic Research, Dental Research Center, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran; and ‡Department of Periodontics and Endodontics, School of Dental Medicine, State University of New York at Buffalo, Buffalo, New York.

Address requests for reprints to Dr Ali Nosrat, Department of Endodontics, Periodontics, and Prosthodontics, School of Dentistry, University of Maryland Baltimore, 650 West Baltimore Street, 4th floor, Baltimore, MD 21201. E-mail address: Nosrat@umaryland.edu

0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2017.04.006

1. "Unclear anatomy" of the palatal canal in the initial radiograph
2. Eccentric deviation of the master apical file/gutta-percha cone in the intraoperative radiograph
3. Eccentric deviation of the previous root canal filling material

The treatment procedure was done similarly in all cases. After removal of any caries, an access cavity was prepared under local anesthesia and rubber dam isolation. The pulp chamber was examined under high magnification using a surgical operating microscope. After locating the orifices, root canals were negotiated using hand files of sizes #10 to 20 (Dentsply Maillefer, Ballaigues, Switzerland). Coronal flaring was done with Gates Glidden drills, sizes #2–4 (Dentsply Maillefer). In retreatment cases, the previous root canal filling material was removed using a crown-down sequence of Gates Glidden drills followed by a size 25/04 rotary Vortex file (Dentsply; Tulsa Dental, Tulsa, OK) used at 1000 rpm. The working length was determined with an electronic apex locator (Root ZX II; J Morita MFG Corp, Kyoto, Japan). Root canal preparation was continued by rotary instrumentation with Vortex files using a crown-down technique, and ending with a master apical rotary size 30–35/04 in buccal canals, and 40/04 in the palatal canal. The root canals were irrigated with 2.5% NaOCl between each instrument. The working length in all canals was confirmed by taking a periapical radiograph with the corresponding gutta-percha points fitted to the working length. If a deviation in the master cone or the previous root canal filling material in the palatal canal was seen, a C-file size #15 (Roydent, Johnson City, TN) with a sharp precurve at the tip was used with an up-down motion to locate the orifice of the second palatal canal. When a "catch point" was located, the clinician used a watch-winding motion with apical force using the same hand file to negotiate the branching canal. This canal was prepared to a size 30–35/04. All canals were dried and obturated using cold lateral compaction of gutta-percha in the apical third followed by vertical compaction of thermoplasticized gutta-percha (Calamus; Dentsply International, Johnson City, TN). The access cavity was temporarily restored with Cavit or permanently restored with composite resin. Then, final radiographs were taken.

Results

There were 5 maxillary molars with bifurcated palatal canals: 4 maxillary first molars and 1 maxillary second molar. In all 5 teeth, the easiest palatal canal to access initially was the distopalatal canal. In all 5 cases, the chief complaint was eliminated 1–2 weeks after the treatment.

Case 1

A 13-year-old African American boy was referred for root canal treatment of tooth #14. Tooth #14 was diagnosed with "irreversible pulpitis with symptomatic apical periodontitis" due to extensive caries. The anatomy of the palatal canal in the initial radiograph was unclear (Fig. 1*A*), and a single canal (1-1 anatomy) could not be detected. The master cone radiograph showed a distal deviation of the palatal canal (Fig. 1*B*), which prompted the clinician to search for a missed branching canal on the mesial side of the root in the apical third. The final radiographs (Fig. 1*C* and *D*) showed a 1-2 anatomy of the palatal canal.

Case 2

A 30-year-old white woman was referred because pain started after a crown preparation on tooth #15. An endodontic diagnosis of symptomatic irreversible pulpitis with normal apical tissues was made. Neither the palatal canal nor the palatal root could be clearly delineated in the initial radiograph (Fig. 2*A*), which raised a suspicion of a more complex internal anatomy of the palatal root. The master cone radiograph showed a distal deviation of the palatal canal (Fig. 2*B*). The access cavity was modified accordingly, and a second palatal canal was located in the middle third of the root (Fig. 2*C*). The final radiographs showed a 1-2 anatomy of the palatal canal (Fig. 2*D* and *E*).

Case 3

A 45-year-old white man was referred because of "recurring infection" associated with #14. The patient reported that the root canal treatment was done 6 years earlier, by a "root canal specialist." His dentist kept prescribing antibiotics to eliminate the infection. The general practitioner and the endodontist believed that the root canal treatment was adequate. Tooth #14 was diagnosed as "previously treated with chronic apical abscess." The initial radiograph showed a periapical lesion on the palatal root and a slight distal deviation of the root canal filling material in the apical third. It also showed that 2 palatal canals merged in the middle third of the root, indicating a 2-1-2 root canal anatomy (Fig. 3*A*). The 2 palatal orifices were joined during coronal flaring. After removal of the root canal filling material, a canal was located that branched to the mesial side of the root in the apical third (Fig. 3*B*). The final radiograph showed a 2-1-2 anatomy of the palatal canal (Fig. 3*C*). A 5.5-month recall showed that tooth #14 was asymptomatic and functional with no recurrence of the sinus tract. A significant reduction in the size of periapical lesion was noted (Fig. 3*D*).

Case 4

A 48-year-old Pacific Islander man was referred for endodontic evaluation of #14. The initial root canal treatment was done 3 years earlier, by an endodontist. The tooth recently became painful to biting. The tooth was diagnosed as "previously treated with symptomatic apical periodontitis." The initial radiograph showed a slight distal deviation of the root canal filling material in the apical third of the palatal canal (Fig. 4*A*), suggesting a possible branching on the mesial side. After removal of the root canal filling material, the mesial branching of the

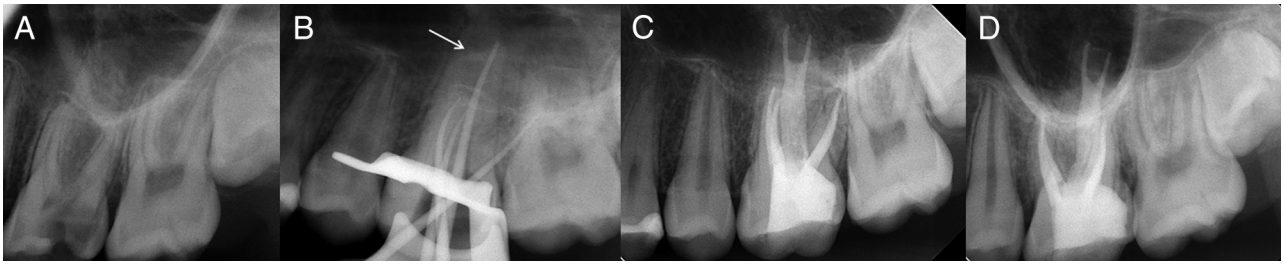

Figure 1. This case was referred to one of the authors (AN) for the root canal treatment of tooth #14. (*A*) Preoperative radiograph. (*B*) Intraoperative radiograph taken with master cones. The distal deviation of the master cone in the palatal canal indicates a possible second canal on the mesial side. The *arrow* shows the location of the second canal. (*C*) Postoperative radiograph showing 1-2 anatomy of the palatal canal. (*D*) Postoperative radiograph with a slight distal and vertical shift.