Management of an upper first molar with three mesiobuccal root canals

Dr. Peet van der Vyver presents a case report to illustrate the clinical management of an upper first maxillary molar tooth with three mesiobuccal root canals, using the ProTaper Next system

Educational aims and objectives
This clinical article aims to illustrate the clinical management of an upper first maxillary molar tooth with three mesiobuccal root canals.

Expected outcomes
Correctly answering the questions on page 32, worth 2 hours of CE, will demonstrate the reader recognizes how to manage an upper first maxillary molar tooth with three mesiobuccal root canals using the ProTaper Next system.

Introduction

Successful endodontic therapy requires thorough knowledge of the root and the root canal morphology (Sert, Bayirili, 1997). According to Vertucci (2005), a major cause of post-treatment disease is the inability to locate, debride, and obturate all the canals in a root canal system. In general, there is an increased prevalence of missed roots and root canals that results in failure of endodontic treatment (Cantatore, et al., 2006).

According to Cleghorn, et al., (2006), the mesiobuccal root of the maxillary first molar has generated more research and clinical investigation than any other root in the oral cavity. Frequent failure of endodontic treatment in maxillary first permanent molars is likely due to the failure to locate and obturate the second mesiobuccal canal (Weine, 2004). With the advent of new instruments, equipment, and techniques (such as operating microscopes and ultrasonic instruments), an increase in the number of second mesiobuccal canals was demonstrated in clinical investigations (Vertucci, 2005).

Cleghorn, et al., (2006), demonstrated that two or more canals can be present in the mesiobuccal root (with 57% of 8,339 teeth of the 34 laboratory and clinical studies analyzed). They also reported that a single canal at the apex of the mesiobuccal root was found 62% of the time, while two separate canals at the apex were present 39% of the time. In a recent micro-CT study, it was demonstrated that the second mesiobuccal canal was present in 80% of the cases (24 teeth). In 42% of the specimens, it was a completely independent root canal.

In vitro and in vivo studies have also reported the incidence of a third canal in the mesiobuccal root of upper maxillary first molars to be between 0.5 and 9% (Table 1). Complete deroofing of the pulp chamber, straightline access, removal of pulp calcification and dentin ledges can help with the identification of supplemental root canal systems in the mesiobuccal root (Ahmed, Saini, 2012).

The purpose of this article is to present a case report to illustrate the clinical management of an upper first maxillary molar tooth with three mesiobuccal root canals, using the ProTaper Next system.

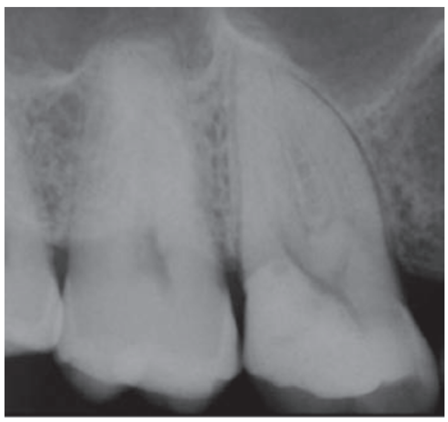
Figure 1: Preoperative radiograph showing a deep composite restoration on the upper right first maxillary molar

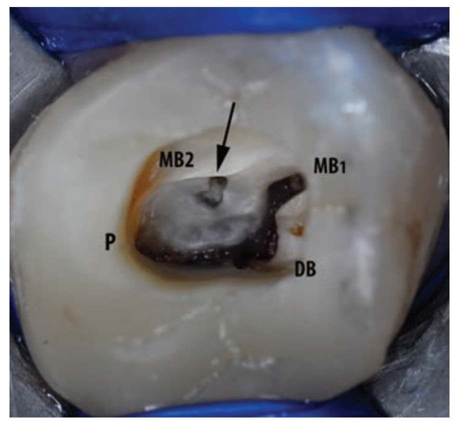

Figure 2: Occlusal view of the initial access cavity preparation. Note the presence of a second mesiobuccal root canal


Figure 3: Size 14 and 12 long shank stainless steel burs (Dentsply/Maillefer)

Case report

The patient, a 38-year-old male, presented with the main complaint of bite sensitivity on his upper right first molar. A clinical examination revealed that the tooth was previously restored with a large composite restoration. The tooth tested nonvital. Radiographic examination revealed that the composite restoration was placed very close to the pulp (Figure 1).

After informed consent, it was decided to do a root canal treatment. The tooth was anesthetized and isolated with a rubber dam. An initial access cavity was prepared using a diamond bur until the roof of the pulp floor was removed. The access cavity was extended to ensure straightline access into the mesial and distal root canals. Mesiobuccal, second mesiobuccal, distobuccal, and palatal root canal orifices were visible under magnification (Figure 2).

Size 14 and 12 long shank stainless steel burs (Dentsply/Maillefer) [Figure 3],

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Table 1: Review of the percentage of third mesiobuccal canals in the mesiobuccal roots of maxillary first molar teeth (adapted from Ahmed and Sani, 2012)

Author	Year	Type of Study	Percentage
Acosta Vigouroux and Trugeda Bosaans	1978	In vitro study (Visual examination) (n=134)	3/134 (2.25%)
Martínez-Berná and Ruiz-Badanelli	1983	In vivo study (Clinical investigation) (n=338)	3/338 (0.88%)
Neaverth et al.	1987	In vivo study (Clinical investigation) (n=228)	7/228 (3.1%)
Kulid and Peters	1990	In vitro study (Horizontal cross sections) (n=51)	1/51 (1.96%)
Sert and Bayirli	2004	In vitro study (Clearing method) (n=200)	1/200 (0.5%)
Rwenyonyi et al.	2007	In vitro study (Clearing method) (n=221)	1/221 (0.5%)
Baratto Filho et al.	2009	Ex vivo study (Operating microscope and radiographic examination) (n=140)	1/140 (0.72%)
Park et al.	2009	In vitro study (micro-CT) (n=46)	3/46 (6.5%)
Beljic-Ivanovic and Teodorovic	2010	In vitro study (Radiographic) (n=200)	18/200(9%)
Degerness and Bowles	2010	In vitro study (Stereomicroscope) (n=90)	1/90 (1.1%)
Neelakantan et al.	2010	In vitro study (CBCT) (n=220)	2/220 (1%)
Micro CT: micro-computed tomography; CBCT: Cone-beam computed tomography			

Figure 4: Global six-step dental operating microscope fitted with LED illumination

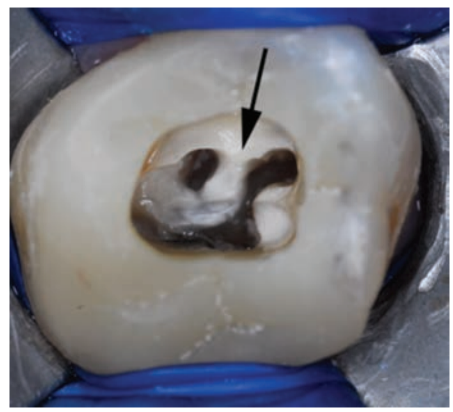

Figure 5: Occlusal view of the access cavity preparation after a No. 12 round bur was used to remove some of the dentin protuberance between the mesiobuccal and second mesiobuccal canal orifices. Note there was still evidence of an overlying dentin ledge covering the mesial aspect of the pulp floor (arrow)

Figure 6: Start-X ultrasonic tip No. 2 (Dentsply/Maillefer)

operating at a speed of 800rpm, were used to remove a dentin protuberance (arrow) between the mesiobuccal and second mesiobuccal canal orifices. This was done under 12x magnification using a six-step dental operating microscope (Global) [Figure 4]. Note there was still evidence of an overlying dentin ledge covering the mesial aspect of the pulp floor (arrow) [Figure 5].

Start-X™ tip No. 2 (Dentsply/Maillefer) [Figure 6] was used to remove the remaining dentin ledge, exposing the orifice of a third mesiobuccal root canal (Figure 7). An X-Gates instrument (Dentsply/Maillefer) [Figure 8] was used at a speed of 800rpm to enlarge all the located canal orifices as well as to remove the restricted dentin on the mesial aspects of the three mesiobuccal root canals. Figure 9 shows the final access cavity preparation after the walls were smoothed with a Start-X No. 1 ultrasonic tip (Figure 10).

The five located root canals were negotiated to working length using size 08 K- and C+ files (Dentsply/Maillefer) [Figure 11]. Figure 12 shows a radiographic view of the length determination. Note that the first and second mesiobuccal canals join, ending in one apical foramen.

Initial glide paths were established by using a size 10 K-file (Dentsply/Maillefer) until the file was loose in each canal. The initial reproducible glide paths were enlarged by taking PathFiles® No. 1 (0.13 mm) and 2 (0.16 mm) (Dentsply/Maillefer) [Figure 13] to full working length. Irrigation with 3.5% sodium hypochlorite and recapitulation to working length with a size

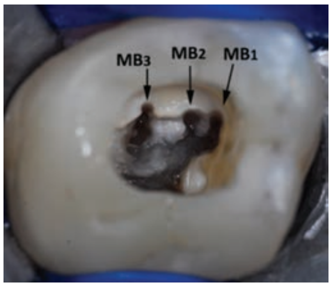

Figure 7: Three mesiobuccal root canals were visible after removal of the overlying dentin ledge


Figure 8: X-Gates bur (Dentsply/Maillefer)

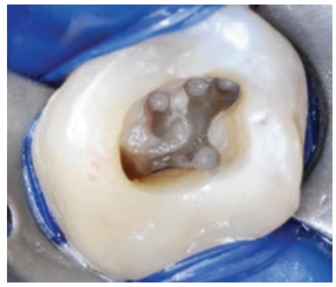
Figure 9: Final access cavity preparation after the walls were smoothed with a Start-X No. 1 ultrasonic tip and the mesial canal orifices were enlarged with an X-Gates bur


Figure 10: Start-X ultrasonic tip No. 1

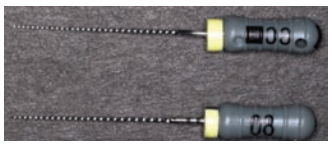
Figure 11: Size 08 C+ and 08 K-file (Dentsply/Maillefer)


Figure 12: Radiograph illustrating the length determination. Note that the first and second mesiobuccal canals join

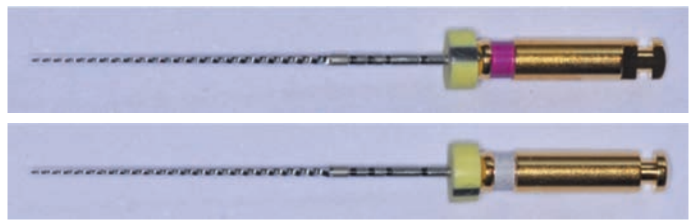
Figure 13: PathFiles No. 1 and 2 (Dentsply/Maillefer)

08 K-file was done after each instrument. Reproducible glide paths were confirmed when a size 15 K-file could travel 4-5 mm in each root canal without any difficulty or resistance to negotiation.

Root canal preparation was done with the ProTaper Next® system (Dentsply/Maillefer) [Figures 14A-14C]. ProTaper Next X1 (17/04) was introduced and slided down the glide path in a rotary motion (speed of 300rpm and torque of 3N/cm). A deliberate brushing motion was incorporated, especially when resistance to progress down a root canal was observed. The last 2 mm of each root canal was prepared by taking the file in controlled motion (without brushing) towards the full working length. The X1 file was taken three times up to working length and immediately withdrawn from each canal. Canals were irrigated with 3.5% sodium hypochlorite and recapitulated to working length with the size 08 K-file.

ProTaper Next X2 (25/06) was then used, using the same protocol as described above. Apical foramen gauging was done by trimming a non-standardized fine gutta-percha cone in an Endo Gutta Percha Gauge (Dentsply/Maillefer) to ISO size 025 (Figure 15). This trimmed gutta-percha cone was fitted to working length in each prepared root canal.

The trimmed gutta-percha cone fitted snug at working length in the first, second, and third mesiobuccal and distobuccal root canals. However, when this cone was fitted into the palatal root canal, it was observed that the cone could move 1.5 mm past the determined working length. This indicated that the apical foramen size was larger than a size 025.

ProTaper Next X3 (30/07) was then used to enlarge the preparation in the palatal root canal, using the same brushing protocol as described above for the use of X1 and X2. The last 2 mm of the root canal was prepared by taking the X3 file in controlled motion (without brushing) towards the full working length. The X3 file was taken twice up to working length and immediately withdrawn from the canal. Again, the apical foramen was gauged by trimming a non-standardized fine gutta-percha point to an ISO size 030, using the same gauge. This trimmed gutta-percha cone fitted snugly at working length.

After canal preparation, the canals were copiously irrigated by activating 3.5% sodium hypochlorite with the EndoActivator® (Dentsply/Maillefer) for 1 minute in each canal followed by activating 17% EDTA for 30 seconds in each root canal. A final rinse of sodium hypochlorite for 1 minute was done before the canals were dried with paper points.

Matching ProTaper Next gutta-percha points were fitted into the prepared canals, and cone fit was confirmed with a radiograph. The gutta-percha cones were buttered with AH Plus Jet™ Root Canal Cement (Dentsply/Maillefer) before all five root canals were obturated with the continuous wave of condensation technique using Calamus® Dual (Dentsply/Maillefer) downpack and backfill technology. Figure 16 demonstrates the immediate postoperative result after obturation.

Discussion

The upper first maxillary molar can present to the clinician as an endodontic challenge (Ahmed, Saini, 2012). It can have a wide range of internal and external radicular morphological variations that can complicate treatment. In addition, their close relationship to the floor of the maxillary sinus and superimposition of the zygomatic arch can often obscure their accurate interpretation (Cantatore, et al., 2006; Cleghorn, et al., 2006).

One of the main challenges of treating maxillary upper molars with multiple root canals is to locate all the canal orifices. Examination of the pulp chamber and pulp chamber floor under high magnification and bright illumination can provide the clinician with valuable information. The dentin protuberances or ledges generally obscure the access to additional canals in the mesiobuccal root canal system. It can be removed with a combination of

Figure 14A: ProTaper Next X1 (yellow ring)

Figure 14B: ProTaper Next X2 (red ring)

Figure 14C: ProTaper Next X3 (blue ring)

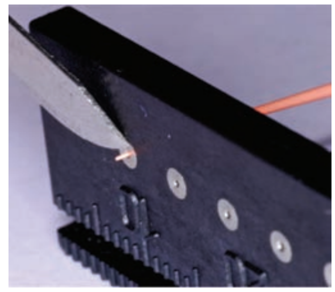

Figure 15: Non-standardized fine gutta-percha cone trimmed to size 025 in Endo Gutta Percha Gauge

Figure 16: Immediate postoperative result after obturation

different sizes of long shank round burs and ultrasonic instruments, using the developmental grooves as guidelines.

It is important to note that the nickel-titanium PathFiles were only used for glide path enlargement. After the initial canal negotiation with the size 08 C+ and K-files, a size 10 K-file was used to create an initial reproducible glide path in all the root canals, before the size 13 and 16 PathFiles were used to enlarge the glide path.

ProTaper Next was used for root canal preparation in this case report. The key benefits of ProTaper Next include simplicity, excellent cutting efficiency, and predictable final canal shape to allow for cone fit with tug-back. The system also ensures a 6% taper in the apical third of a canal after preparation with only two instruments, the X1 and X2.

The ProTaper Next instruments make use of the progressively tapered design. Each file presents with an increasing and decreasing percentage tapered design on a single file concept. The design ensures that there is reduced contact between the cutting flutes of the instrument and dentin wall, and reduced chance for taper lock (screw effect). At the same time, it also increases flexibility and cutting efficiency (Ruddle, 2001).

Another benefit of the system is the fact that the instrument is manufactured from M-wire and not traditional nickel-titanium alloy. Research by Johnson, et al., (2008), demonstrated that the M-wire alloy could reduce cyclic fatigue by 400% compared to similar instruments manufactured from conventional nickel-titanium alloys. The added metallurgical benefit contributes towards more flexible instruments, increased safety, and protection against instrument fracture (Gutmann, 2012).

All of these benefits allow the clinician with more confidence to attempt average, as well as more challenging, endodontic cases.

The last major advantage towards root canal preparation with the ProTaper Next system is the fact that the instruments present with an asymmetrical, rectangular cross section (except in the last 3 mm of the instrument, D0-D3). Rotation of the instrument produces a snake-like (swaggering) wave of movement. The benefits of this design characteristic include:

- It further reduces (in addition to the progressive tapered design) the engagement between the instrument and the dentin walls. This will contribute to a reduction in taper lock, screw-in effect, and stress on the file
- Removal of debris in a coronal direction because of the off-center cross section that allows for more space around the flutes of the instrument. This will lead to improved cutting efficiency, as the blades will stay in contact with the surrounding dentin walls. Root canal preparation is done in a very fast and effortless manner
- Reduces the risk of instrument fracture because there is less stress on the file and more efficient debris removal.

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