CASE REPORT

Anatomical aberrations in root canals of maxillary first and second molar teeth: an endodontic challenge

Manish Shah,¹ Pathik Patel,¹ Parth Desai,¹ Jayanti R Patel²

¹Department of Endodontics, Karnavati School of Dentistry, Gandhinagar, Gujarat, India
²Department of Prosthodontics, K M Shah Dental College & Hospital, Sumandeep Vidyapeeth, Vadodara, Gujarat, India

Correspondence to
 Professor Jayanti R Patel,
 drjrp33@yahoo.com

SUMMARY

Root canal anatomy variations present a constant challenge in successful diagnosis and endodontic treatment, especially the multirooted teeth. Maxillary first molar is the most commonly treated tooth yet with frequent failures because of undetected canals, especially the mesiobuccal second canal (MB2) with more frequency and distobuccal second canal (DB2) with quite a less frequency. Also, there are limited chances to find MB2 in maxillary second molars. We present two such cases, each of maxillary first and second molar with extra distobuccal and mesiobuccal canals, respectively.

BACKGROUND

The importance of having the knowledge of extra root canals especially in the maxillary molars and their locations with respect to the main respective canal depicts the success rate of their endodontic therapy.^{1 2}

CASE PRESENTATION

Case 1

A 37-year-old male patient presented to Karnavati school of dentistry college with pain and food lodgement on the left side of the upper jaw region. On radiographical examination, root canal involved maxillary first molar was detected and endodontic therapy was initiated. Access opening was performed in the first appointment and four canals were found, including mesiobuccal second canal (MB2; figure 1). Working length was determined by radiographs and electronic apex locator (figure 2), and cleaning and shaping by crown-down technique was carried out. When the patient was called for obturation in the next appointment, he had pain in relation to distobuccal orifice region on probing.

Figure 2 Working length Intraoral periapical. MB, mesiobucca; MB2, mesiobuccal second canal; DB, distobuccal; DB2, distobuccal second canal; P, palatal.

Search for the extra canal was initiated first with the naked eye. The dentinal map showed some kind of aberrancy which was depicted by slight change in the course of the dentinal lines joining the main distobuccal and palatal orifice with a slight grooving and the presence of minute amount of tissue approximating the middle region between the distobuccal root and palatal root (figure 1). But ultimately for better convenience, magnified vision of the area was initiated under $\times 1.6$ magnification (16 times) (Labomed dental operating microscope) to easily access the dentinal map as well as tingling of the small expected orifice for second distobuccal canal with the help of ultrasonic tip (Start X no. 3 from Dentsply) and 10 no. K file. Thus, distobuccal second canal (DB2) change was then found with the help of magnification, and was cleaned and shaped,

Figure 1 Occlusal view showing mesiobuccal (MB), mesiobuccal second canal (MB2), distobuccal (DB) and palatal (P).

Figure 3 Occlusal view showing mesiobuccal (MB), mesiobuccal second canal (MB2), distobuccal (DB), distobuccal second canal (DB2) and palatal (P).

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Figure 4 Obturation Intraoral periapical. MB, mesiobuccal; MB2, mesiobuccal second canal; DB, distobuccal; DB2, distobuccal second canal; P, palatal.

and obturation was performed (figures 3 and 4). DB2 ultimately got fused with the main distobuccal canal around the junction of middle and apical third. The patient was asymptomatic after a follow-up of 2 months. Final fixed prosthesis was then provided (figure 5).

Case 2

A 28-year-old male patient reported to Karnavati school of dentistry college with severe pain in relation to the upper left back teeth region since a week. A radiograph showed the presence of pulpal involvement of caries in 27, therefore, endodontic therapy was initiated (figure 6). Access opening was performed and all three main canals and extra MB2 canal were located; working length was determined and thorough cleaning and shaping was carried out under operating microscope at $\times 1.6$ magnification (figures 7 and 8). Calcium hydroxide dressing was given and recalled after a week. Obturation was completed in the recall visit and after a 1-month follow-up (figure 9), final fixed prosthesis was given as the patient was completely asymptomatic (figure 10).

In a nutshell, the methodology for identification of the aberrant canals in both the cases included:

- Careful visualisation of the dentinal map and preservation of the same while accessing cavity preparation using non-end cutting burs.
- Use of magnification (either by dental operating microscope (DOM) or surgical loupes).

Figure 5 Final prosthesis.

Figure 6 Preoperative Intraoral periapical.

- DG16 endodontic explorer for exact identification of the orifice.
- Ultrasonic tips were used in case 1 for troughing and tingling of the tissues at the suspected DB2 orifice location.

INVESTIGATIONS

Case 1

Intraoral periapical (IOPA) radiographs of 26 were taken at different intervals of treatment for proper identification and treatment of the extra canals.

Figure 2 shows IOPA of working length with smaller size files in MB2 and DB2.

Figure 4 shows obturation of 26 with single cone technique. Merging of MB2 and DB2 with their respective main canals is appreciable in radiograph.

Figure 5 shows IOPA of a completed root canal treatment along with full cast crowns over 26 and 27, respectively.

Case 2

IOPA radiographs of 27 were taken throughout the various steps of endodontic treatment

Figure 6 shows preoperative IOPA of 27 showing carious involvement onto the distal aspect and apical widening.

Figure 8 shows IOPA with inverted image to realise the separate MB2 root.

Figure 9 shows IOPA with obturated and filled 27.

Figure 10 shows IOPA of full cast crown cemented.

Figure 7 Occlusal view showing mesiobuccal (MB), mesiobuccal second canal (MB2), distobuccal (DB) and palatal (P).

Figure 8 Inverted image of temporarily restored and root canal filled 27.

TREATMENT

In both cases, root canal therapy was performed in carious and pulpally involved 26 and 27, respectively. Later on, full cast crowns were made for each.

OUTCOME AND FOLLOW-UP

Case 1

The patient was asymptomatic after 2 months of follow-up.

Figure 9 Obturation intraoral periapical.

Figure 10 Final prosthesis.

Case 2

The patient was asymptomatic after 1 month of follow-up.

DISCUSSION

Case 1

Anatomical variations can be found commonly in permanent maxillary first molars.³ In the present case, DB2 was the off-routine extra canal to be found other than MB2 which is nowadays considered quite common in maxillary first molars. Caliskan *et al* emphasised that 1.64% of cases have two distobuccal canals and 98.40% of them ended as a single canal at the apex.⁴ Cleghorn *et al* discovered the most common canal system morphology of the distobuccal root of maxillary first molar to be a single canal (98.3%).⁵ Two distobuccal canals were found only in 1.7% of cases in which a single apical foramen was present 98% of the times. Alavi *et al*⁶ and Thomas *et al*⁷ reported that two canals were present in distobuccal roots between 1.90% and 4.30% of the times. Sert and Bayirli found two or more distobuccal canals in about 9.50% of the teeth studied, and 97% of them terminated into a single apex.⁸ From the entire literature available to date, it can be concluded that the overall incidence of two distobuccal canals ranges from 1.64% to 9.5% in the maxillary first molar teeth, which is quite a rare occurrence.

In the present case, both distobuccal orifices were located very close with thin dentinal isthmus between them. DB2 opening was pear shaped, located slight distal to the imaginary line joining distobuccal and palatal canals (figure 3). Such precise work was possible because of the help of microscope.

Dental operating microscope (DOM) in recent years has proved to be a boon for endodontists. Advantages of DOM mainly include one most important aspect, that is, lighting. It is significantly improved because the light of a microscope is parallel to the line of sight and will provide two to three times the light of a surgical headlamp. The enhanced illumination and visibility enable endodontists to improve the predictability of their procedures.⁹

Maxillary first molar has predominantly three roots with the presence of one canal per root except mesiobuccal root where the second canal can be found in the range of 57.1% to 61.1% times.¹⁰ In the previous studies, five canals have been found in 2.25% to 2.4% of maxillary first molars which were conducted by Acosta Vigorans and Gray, respectively,¹¹ out of which the majority of fifth canal was found in the palatal root, then the mesiobuccal and finally in the distobuccal root. Owing to the latter fact, this case can be considered quite an aberrant one.

Case 2

Weine suggests that angulation from distal to mesial provides a profile type of view of the mesiobuccal root of maxillary second molar, and thereby allows a convenient visualisation of the presence of extra canals.¹²

Generally, MB2 is present 1–3 mm deeper than the main mesiobuccal canal just mesial to a line drawn from mesiobuccal to palatal canal orifice. Also, there is a marked incline immediately apical to its orifice in the coronal 1–3 mm. In the study of Kulild and Peters, they found that MB2 canal orifice averaged 1.82 mm lingual to the MB canal orifice.¹³ Location of MB2 in maxillary second molars is generally (a) just adjacent to the mesiobuccal canal, (b) may be even in a single opening, (c) two separate openings but adjacent to each other and (d) two openings which are somewhat at a distance from each other. This case is interesting as MB2 is entirely a separate canal if not root which can be well appreciated in figure 8. The chances of having separate MB2 canal throughout its length are uncommon in maxillary second permanent molars.

Two previous studies have concluded that 43% of maxillary second molars had fused roots and a total of 58% of mesiobuc-

cal roots had MB2 canals in Irish population in maxillary second molars.^{14 15}

Few investigations that can help identify extra canals especially MB2 include the Champagne bubble test with warmed 2.6% NaOCl and observed under magnification, staining the chamber with 1% methylene blue as well as fiber optic illumination and CT scans.¹⁶

Sempira and Hartwell found in their study that the use of an operating microscope did increase the incidence of MB2.⁹

Weine was one of the first to acknowledge that the failure of endodontic treatment of maxillary molars is likely because of the failure to locate and fill the MB2 canal.¹²

The significant difference in the incidence of MB2 canal between initial treatment and retreatment *suggests* that failure to find and treat existing MB2 canals will decrease the long-term prognosis.¹⁷

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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Learning points

- Owing to very high incidence of MB2 canals in maxillary molars, always search for it if possible under magnification and by taking angulated radiographs.
- MB2 canal orifices are commonly located mesial to the main mesiobuccal canal orifice while DB2 canal orifice can be found distal to the main distobuccal canal orifice.
- Various investigations other than radiographs can be used for identification of extra canals such as Champagne bubble effect, staining and fiber optic illumination.
- Failure of maxillary molar root canals is very high if extra canals are not located, cleaned and filled.
- Knowing that the success of endodontic treatment depends on complete debridement and disinfection of all canals, an endodontist should constantly a search for 'occult' morphology.

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