Masterclass in Clinical Practice

Endodontics

with

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The MB2 canal in Maxillary Molars - Part 1: How to locate it

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Successful endodontic therapy requires thorough knowledge of the root and the root canal morphology.[1] According to Vertucci[2], a major cause of post-treatment disease is the inability to locate, debride and obturate all the canals of a root canal system. In general, there is an increase in the prevalence of missed roots and root canals that results in endodontic treatment failure.[3] According to Cleghorn et al[4], 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 second mesiobuccal canals.[5] With the advent of modern instruments, equipment and techniques (such as operating microscopes, ultrasonic instruments and CBCT), an increase in the number of second mesiobuccal canals is demonstrated in clinical investigations and case reports.

The mesiobuccal root is associated with the highest degree of anatomical variability compared to other roots of maxillary molar teeth. Frequently, this additional canal (mesiopalatal canal or MB2 canal) in the palatal portion of the root is not located and have been implicated in therapy-resistant endodontic infections.[6] Figure 1 illustrates a case where an MB2 canal was missed and resulted in a large periapical infection.

Most authors agree that in more than 50% of cases two root canal systems can exist in the mesiobuccal root (53% according to Hess[8], 64% according to Smith[9], 69.4% according to Acosta, Vigouroux and Trugeda Bosaans[10], 84% according to Aydos and Milano[11], and 96.1% according to Stropko[12]).

Cleghorn et al[4] 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 analysed). They also reported that a single canal at the apex of the mesiobuccal root was found 62% of the time (Figure 2A), while two separate canals at the apex were present 39% of the time (Figure 2b).

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% (Figure 3).[13]

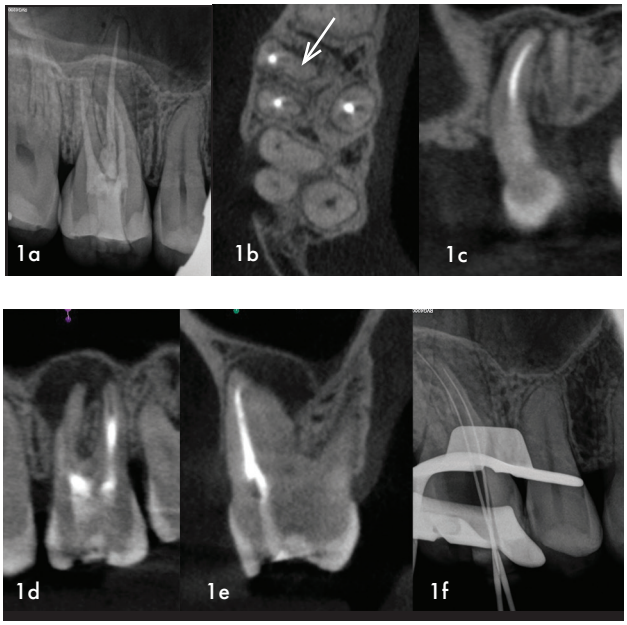
Is it critical to treat the MB2 canal?

Missed MB2 canals in mesiobuccal root of maxillary molars is the main cause of endodontic failure.[14] In vital cases that presented with irreversible pulpitis the missed MB2 canal can be responsible for ongoing pain to hot/cold after root canal treatment.[14] In necrotic cases with infected canals, the residual bacteria left in the untreated MB2 canal can lead to endodontic failure and apical pathology.[15]

What can help you to locate MB2 canals?

1. CBCT

Root canal morphology can be visualised in three dimensions by using CBCT and has become an indispensable tool in modern endodontics. A high resolution small field of view



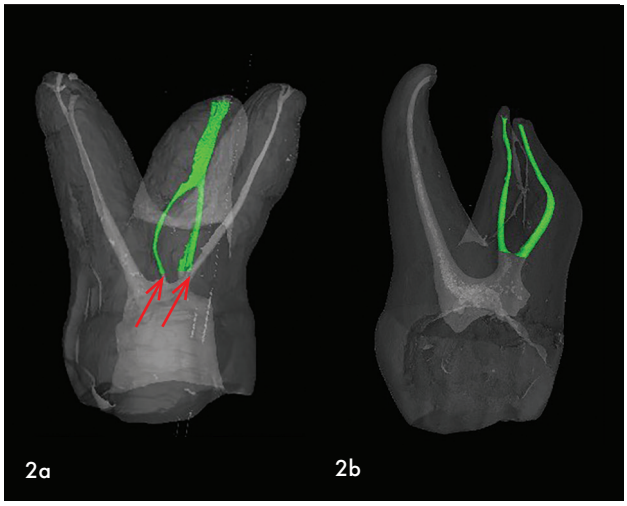


Figure 2. (a) Micro-CT image of maxillary molar showing 2 canals that merge in midroot area to end up in one single canal with one portal of exit; (b) Two separate canals with separate portals of exit.

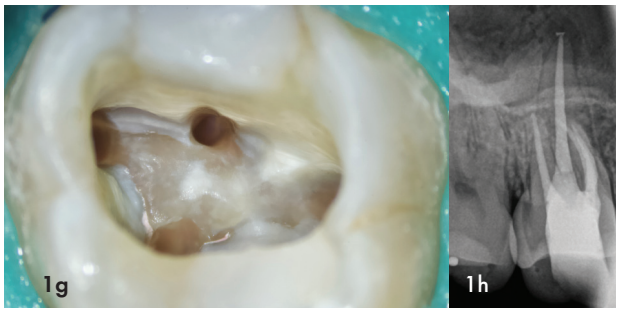


Figure 1. (a) Periapical radiograph showing a root canal treatment on first maxillary right molar tooth. The patient presented with severe percussion sensitivity on the tooth; (b) Axial slice of CBCT scan at coronal level of the tooth showing a very thick oval shaped MB root (buccal-palatal extension) and a thin root width (mesio-distal extension) that is indicative of a possible missed MB2 canal system (arrow);[7] (c) A sagittal slice of the CBCT at the level of the MB canal depicted no abnormality; (d) A sagittal slice of the CBCT at the level of the possible MB2 canal indicated a very large periapical radiolucency; (e) A coronal slice of the CBCT at the level of the MB root confirmed a very wide MB root with the obturated MB canal in an eccentric position and the root surrounded with an large periapical radiolucency; (f) Upon retreatment a second mesiobuccal was located as shown on this periapical radiograph; (g) A high magnification view of the pulp chamber illustrating the location and preparation of the MB2 canal system; (h) Final periapical radiograph after obturation of the four root canal systems.

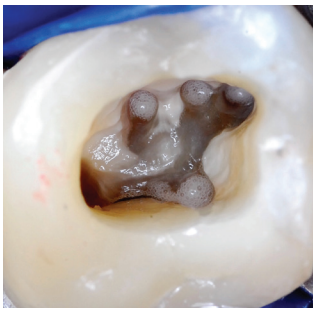


Figure 3. High magnification view of pulp chamber of a maxillary first molar where the mesio-buccal root presented with three MB canals.

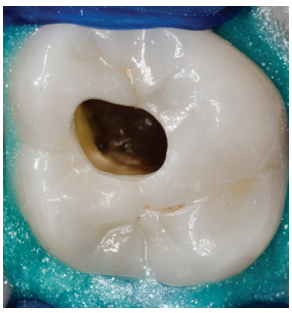


Figure 4. Access cavity preparation on a maxillary molar should be cut right in the centre of the tooth with triangular-trapezoidal shape.

scan is recommended to visualise and identify fine detail in endodontics. A recent systematic review by Carbella et al[16], showed the presence of 59.3% of MB2 canals in maxillary first molars when CBCT was used for assessment. It is important to note that several studies have indicated that MB2 canals can sometimes still be located clinically even if they were not seen and identified on the CBCT scan.[17,18]

2. Correct access cavity preparation

The access cavity should be cut right in the centre of the tooth with triangular-trapezoidal shape[19] (Figure 4) and not as a triangle with its opening displaced into the most mesial portion of the crown as suggested many years ago by Ingle.[20] This step should be completed by preserving as much sound dentine as possible taking into account that both canal location and instrumentation can be compromised when very small access cavities are prepared.[21]

3. Magnification

The use of magnification has been shown to increase the detection rate of MB2 canals. A study by Buhrley et al[22] illustrated that the frequency of the detection of MB2 canals for dental operating microscopes, dental loupes and no magnification were reported to be 71.1%, 62.5% and 17.2%, respectively.

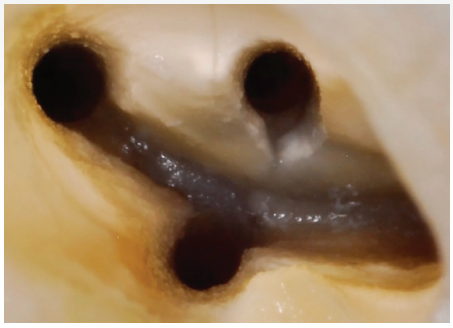


Figure 5. Developmental grooves or lines outline form a "map", also known rostrum canalis that can lead to canal orifices.

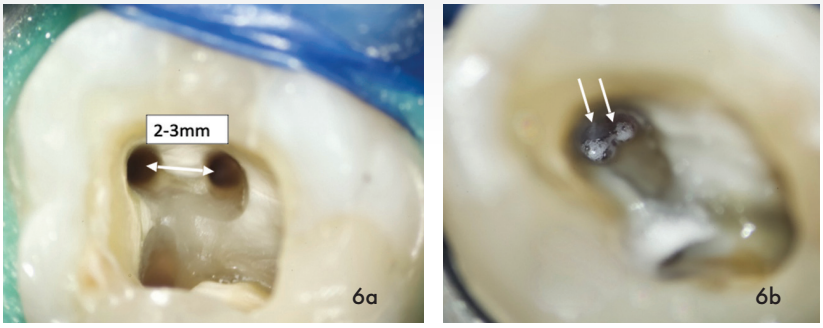


Figure 6. (a) MB2 canal usually lies approximately 2-3mm from the mesiobuccal canal and less frequently it can be found closer to the palatal canal orifice; (b) MB2 canal orifice was found inside the MB canal orifice.

4. Following the road map on the pulpal floor

The pulp chamber floor have some morphological characteristics that can help and guide the clinician in the location of MB2 canals. Developmental grooves or lines on the grey pulp floor outline form a "map", also known rostrum canalis (Figure 5). These lines usually lead to canal orifices and can be followed and probed with a sharp endodontic explorer. It usually lies approximately 2-3mm from the mesiobuccal canal and less frequently it can be found closer to the palatal canal orifice or even inside the MB canal orifice[14](Figure 6).

A study by Bentacourt, Navarro and Fuentes,[7] found that the MB2 canal was located 2.61 mm palatally to the MB1 canal and this was comparable with other investigations that placed the MB2 canal with respect to the MB1 canal at a distance of 2.31 mm by scanning electron microscopy and at 2 mm using light microscopy.[23] Kulid and Peters[24] reported shorter distances of 1.82 mm that is in agreement with a study by Gorduysus et al,[25] who located the MB2 canal in 45 extracted maxillary molars and found that the distance between MB1-MB2 was 1.81 ± 0.38 mm.

The location of the MB2 is also variable and in general it is located mesially to the MB1 and palatal canals as described by Vasudev and Goel.[26] Zhang et al[23] located the MB2 canal in less than 1 mm mesially to the MB-P line.

How to locate the MB2 canal

It is important to realise that the mesial wall of the pulp chamber forms a very acute angle with the pulp floor (Figure 7) and this often makes the visual and tactile detection of the MB2 canal impossible.

In some cases it actually forms a "dentine shelf" that hides the MB2 canal orifice and has to be removed in order to uncover the canal orifice (Figure 8).[27] According to a

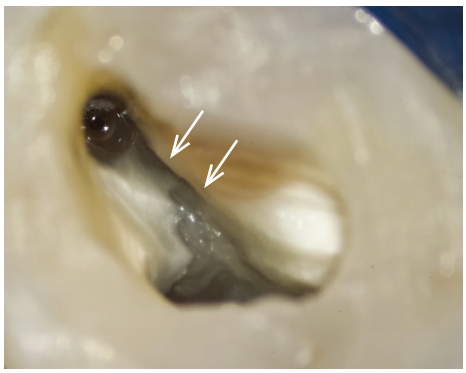


Figure 7. The mesial wall of the pulp chamber forms a very acute angle with the pulp chamber floor (arrows) and this often makes the visual and tactile detection of the MB2 canal impossible.

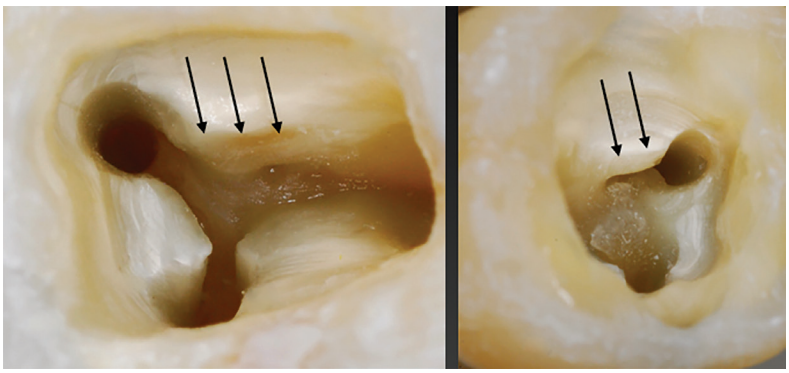


Figure 8: Two clinical examples showing the pulp chamber under high magnification. The arrows indicate the "dentine shelf" that hides the MB2 canal orifice that has to be removed in order to uncover the canal orifice.

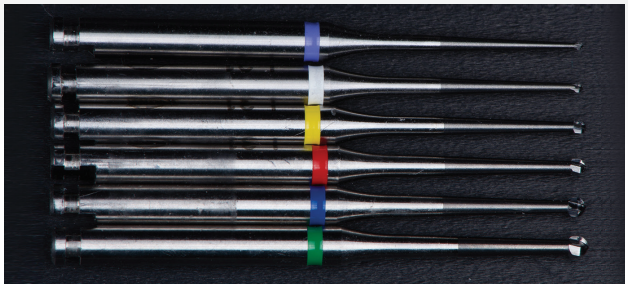


Figure 9: EndoTracer burs (Komet). Fabricated from tungsten carbide and operated at a maximum speed of 1500 rpm. Available in 6 different diameter thicknesses: Purple 004, White 006, Yellow 008, Red 010, Blue 012, and Green 014.

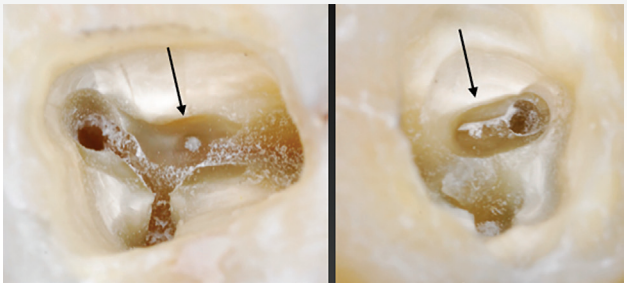


Figure 10: Same two clinical examples as depicted in Figure 8 showing the pulp chamber under high magnification. The arrows indicate where the "dentine shelf" was removed using the EndoTracer burs (Komet). Note the dot or white line form cutting debris that accumulated into the groove or orifice.

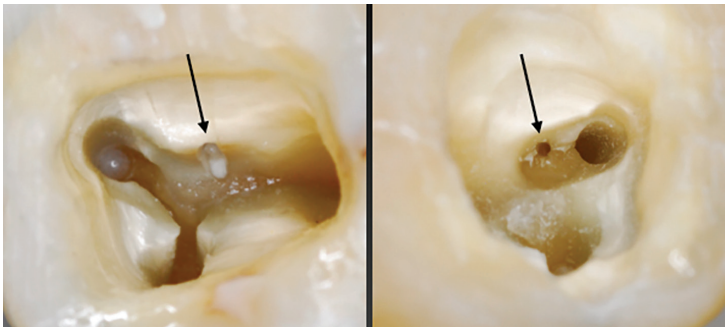


Figure 11: Same two clinical examples as depicted in Figure 8 and 10 showing the location of the MB2 canal orifices after two smaller size EndoTracer burs were used to trough deeper.

tomographic study by Reis et al[28] the age of the patient can impact on the clinical visualisation of MB2 canals. They demonstrated that patients ranging from 20-30 years and 60-70 years had their canals visualised 90.7% and 81.9% respectively.[27]

Ultrasonic tips are one of the tools recommended to remove the dentine shelf. It is effective, but the authors recommend to rather use small long shank burs like the Mueller (Brasseler) or EndoTracer burs (Komet)(Figure 9). The EndoTracer counter-angle burs have been specifically designed for cavity floor exposure and root canal detection. Thanks to its multiple sizes and lengths (31 and 34 mm) they can be adapted to any type of pulp cavity and guarantees more conservative procedures thanks to the thin long neck along with a good visibility and rear access to work with the best visibility under magnification.

The main advantage of using these burs at a maximum speed of 1500rpm, is that as you remove the dentine shelf, the groove where the MB2 canal orifice is located, is highlighted by the fact that cutting debris accumulates into the groove or orifice (Figure 10). This is generally visualised as a white line or dot under magnification.

In more calcified cases it is also necessary to trough deeper from the pulp floor level in an apical direction.[29] For this process it is recommended to use smaller size burs, as you trough deeper on this groove (white line) to locate the MB2 canal (Figure 11). Failure to use smaller burs can result in perforation of the mesial wall of the access cavity. Troughing with these burs should take place in a palatal direction on the groove and not directly towards the palatal canal orifice. The MB2 canal is generally located 1-2 mm more mesial from a direct line drawn from MB to palatal canal orifice. If the clinician troughs on a direct line from MB to palatal it can result in a perforation of the pulp floor over the furcation between the roots. As you progress deeper, following the groove or white line as a guideline and before switching to the next smaller sized bur, it is recommended to probe with an Orifice modifier to identify the entrance to a possible MB2 canal orifice. The key advantage of using long shank EndoTracer burs for troughing and a Micro-opener (Dentsply Sirona) for probing, is that you have full visibility of the pulp floor during the procedure. Using short

burs in an endodontic handpiece or endodontic files with your fingers to probe will result in complete obstruction of the visibility inside the pulp chamber as the hand piece or your fingers will be in your line of sight. It also helps to clean the pulp chamber with sodium hypochlorite activated with either the EDDY (VDW) irrigating tip or EndoActivator (Dentsply Sirona), after each troughing sequence before inspecting the progress achieved.

Conclusion

MB2 canal location and negotiation remain challenging. The high prevalence of missed MB2 canals and associated post-treament disease is a concern. This Masterclass article highlights some important aspects in literature and provide practitioners with some practical tips on locating these MB2 canals. Part 2 will discuss how to negotiate the MB2 canal to full working length.

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