Identification of Independent Middle Mesial Canal in Mandibular First Molar Using Cone-Beam Computed Tomography Imaging

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Abstract

Introduction: The root canal treatment of a mandibular molar with aberrant canal configuration can be diagnostically and technically challenging. **Methods:** This case report presents the clinical management of a mandibular first molar with three separate mesial canals including middle mesial canal, which was confirmed by cone-beam computed tomography (CBCT) images. **Results:** Posttreatment images revealed three independent root canals in the mesial root obturated efficiently to the accepted lengths in all three canals. **Conclusion:** This case report highlights the usefulness of CBCT imaging for accurate diagnosis and management of the unusual canal morphology. *(J Endod 2010;■:1–4)*

Key Words

Cone beam computed tomography imaging, mandibular molar, middle mesial canal

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The main objective of root canal treatment is the thorough mechanical and chemical cleansing of the entire pulp space followed by complete obturation with inert filling material (1). Therefore, it is imperative that aberrant anatomy is identified before and during root canal treatment of such teeth.

Since Vertucci and Williams (2) first reported the presence of a middle mesial (MM) canal in a mandibular molar, there have been multiple case reports of aberrant canal morphology in the mesial root (3–9). In a clinical evaluation of 100 mandibular molars, Pomeranz et al (6) found that 12 molars had MM canals in their mesial roots and classified them into three morphologic categories as follows: fin, confluent, and independent. According to their classification, an independent canal implies the canal originated as a separate orifice and terminated as a separate foramen, and only two cases were identified as independent. Goel et al (9) reported mandibular first molars had MM canals in 15.0% of specimens. Among these MM canals, only 6.7% of MM canals were independent.

Radiographic examination using conventional intraoral periapical views is important for the evaluation of the canal configuration. However, it has its inherent limitation to assess the root canal system completely. Conventional multidetector computed tomography (CT) imaging has been widely used in medicine since the 1970s and was introduced in the endodontic field in 1990 (10). Recently, cone beam CT (CBCT) imaginig has been shown to provide comparable images at reduced dose and costs to be considered as an alternative to multidetector CT imaging in endodontics (11). Cotton et al (12) reported a number of useful applications of CBCT imaging in endodontics. Furthermore, Matherne et al (13) suggested that CBCT imaging is useful even in identifying the root canal system. To our knowledge, however, there has been no clinical report that identifies an independent MM canal using CBCT imaging effectively. In this report, we present clinical detection and management of an independent MM canal in mandibular first molar by using CBCT imaging.

Case Report

A 43-year-old woman whose medical history was noncontributory presented to the dental clinic with spontaneous pain in the right molar area. A clinical examination showed an extensive previous gold restoration in the right lower first molar (Fig. 1*A*). The patient presented severe lingering pain to cold water applied to the isolated tooth. A radiograph showed no specific pathosis on the tooth and its periapical tissue, but periapical pathosis was shown in an adjacent second premolar (Fig. 1*B*). Furthermore, a moderate periodontal problem existed on the first molar. Diagnoses of irreversible pulpitis without apical periodontitis of the right mandibular first molar and pulp necrosis with chronic apical periodontitis of the right second premolar were made.

After administering local anesthesia, rubber dam isolation, previous restoration, and all carious tissue were removed, and an adequate endodontic access was made. The pulp chamber floor showed four orifices corresponding to 4 root canals: mesiobuccal, mesiolingual (ML), distobuccal, and distolingual (Fig. 1*C*). Working lengths were estimated by using an electronic apex locator (Root ZX; Morita, Tokyo, Japan) and then confirmed with a radiograph. All canals were cleaned and shaped with Protaper rotary instruments (Dentsply-Maillefer, Ballaigues, Switzerland) under copious irrigation with

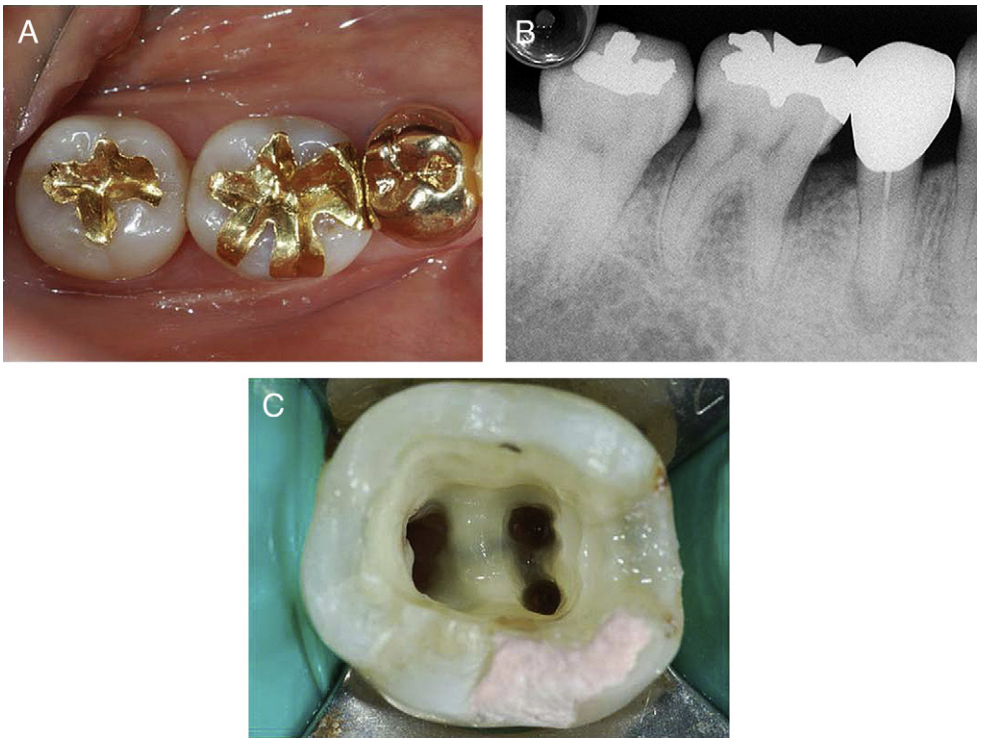

Figure 1. Pretreatment clinical (*A*) and radiographic view (*B*) of the right mandibular first molar with extensive gold restoration. (*C*) Floor of the pulp chamber showing conventional two orifices in the mesial root.

5.25% sodium hypochlorite. After preparation, the root canals were inserted with gutta-percha cones (Diadent, Seoul, Korea) to reconfirm working lengths. The angled radiograph implied the presence of an additional canal because the mesial root seemed to have another root apex (Fig. 2*A*).

By exploring the fissure located on the lingual aspect of the ML canal orifice with a sharp endodontic explorer, a "stick" was encountered. We decided to perform multisliced scans of the mandible with informed consent from the patient. The first molar was focused, and the morphology was obtained in transverse, axial, and sagittal sections

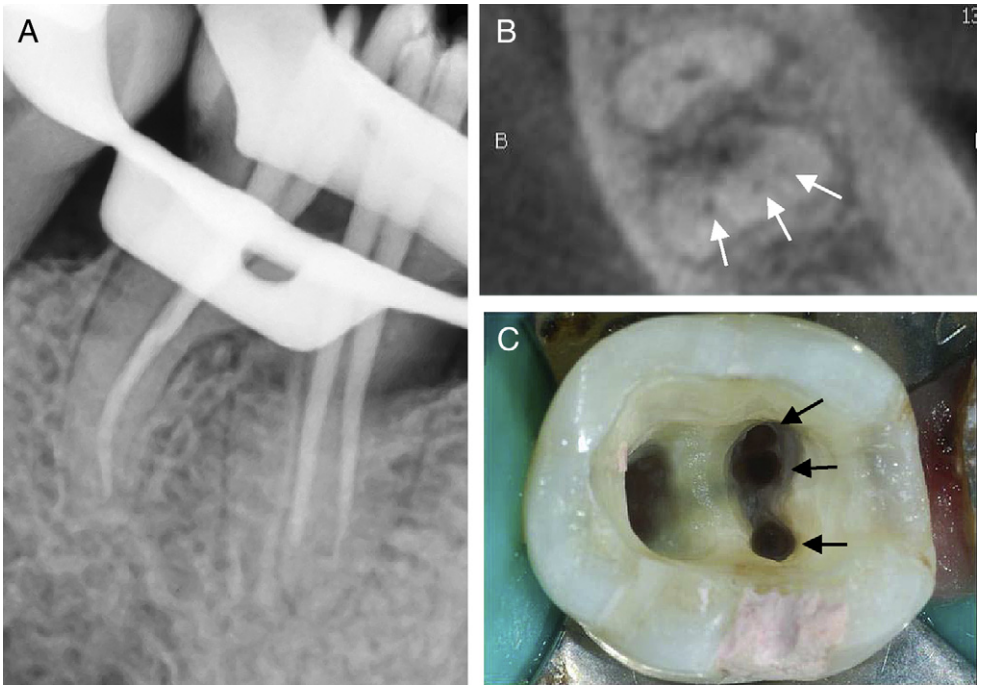

Figure 2. (*A*) A radiograph after master cone placement implies the possibility of additional canal in mesial root. (*B*) CBCT image showing three independent mesial canals (white arrows). (*C*) Pulpal floor showing three mesial canal orifices (black arrows).

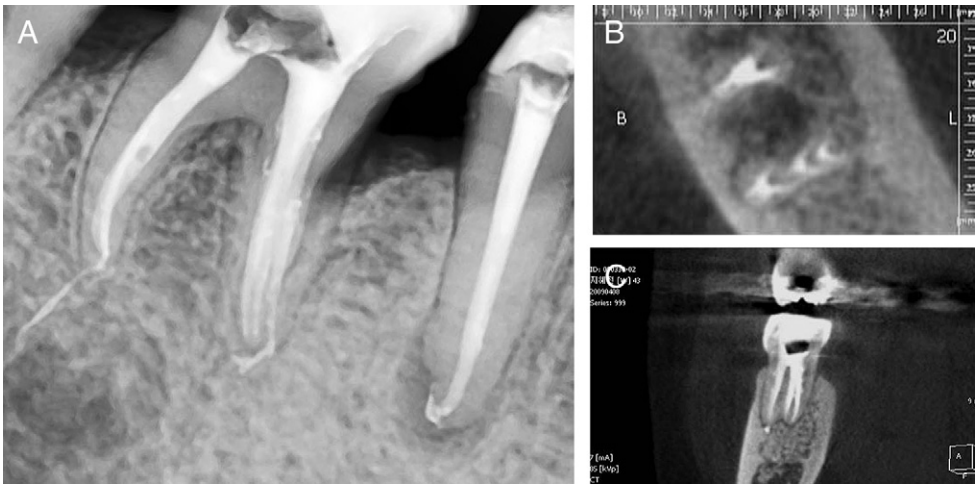

Figure 3. Posttreatment periapical radiograph (*A*) and CBCT images (*B*, transverse image and *C*, longitudinal image) showing three distinct and independent canals throughout their course.

of 1.0-mm thickness using the CBCT scan (Implagraphy; Vatech, Seoul, Korea). The transverse images revealed that the mesial root had three root canals, and the canal we had originally considered as ML canal was actually an MM canal (Fig. 2*B*). According to Pormeranz's classification, the MM canal was classified as "independent." The MM canal had a separate orifice and an apical foramen.

All three mesial canals including the MM canal were cleaned, shaped, and obturated by using Duo alpha & beta (BNL Co., Seoul, Korea) with gutta-percha and sealer (AH-plus, Dentsply-Maillifer) (Fig. 3*A*). The adjacent second premolar was also endodontically treated, and periodontal management was performed on these teeth. Posttreatment CT images revealed three independent root canals in the mesial root obturated efficiently with gutta-percha to the accepted lengths in all three canals (Fig. 3*B* and *C*). The patient experienced no posttreatment discomfort and was subsequently referred for appropriate coronal restoration.

Discussion

Many dental clinicians tend to perceive a given tooth will contain a predetermined number of roots and/or canals. However, a careful evaluation of the literature shows deviations from the norm in that tooth morphology is not uncommon. Among these anatomic variances, multiple canals in the mesial root of mandibular molars have been reported in the literature as having an incidence of 2.07% up to 13.3% of the examined cases (5, 9). Although many authors have agreed on the presence of three foramina in the mesial root, only a few have reported the presence of three independent canals, which presents itself as a rare anatomic variant (14).

The detection of additional root canals requires a careful clinical and radiographic inspection. Diagnostic tools such as multiple radiographs, careful examination of the pulpal floor with a sharp explorer, and better visualization using an operating microscope are all important aids in the detection of additional root canals. Recently, various attempts have been made to use CT imaging for the confirmatory diagnosis of morphologic aberrations in the endodontic field.

CBCT scanners use a cone-shaped beam instead of the fan-shaped one used by regular CT scanners. It has been successfully used in endodontics for better understanding of the root canal anatomy (13), evaluation of root canal preparation/obturation, detection of bone lesions (15), and vertical root fractures (11). Furthermore, the CT machine used in this report is specifically made to display small parts of the jawbone with an image field size similar to that of ordinary dental films. This type of machine generally yields considerably lower effective doses than conventional CBCT machines and a similar dose with two to three periapical radiographs, particularly when just a small volume is examined (16).

In this case report, we confirmed the presence of three mesial canals that were independent throughout their course in the root using CBCT imaging. In the cone-fit radiograph, we noticed the possibility of a presence of an MM canal. As described earlier, the MM canal we detected at first was misdiagnosed as an ML canal. MM canals are usually located centrally between the mesiobuccal and ML canals, and we, the clinicians, had trouble in locating the ML canal. In this particular case, the CT images clearly revealed three independent canals in the mesial root, and the images were very helpful in detecting the relative location of each canal. Furthermore, we could confirm that the canals were obturated properly with CT images.

Treating additional aberrant canals can be challenging, but the inability to find root canals may cause failures. The evaluation of CBCT images can result in better understanding of root canal anatomy, which enables the clinician to investigate the root canal system and to clean, shape, and obturate it more efficiently.

References

1. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol 1984;58:589–99.
2. Vertucci FJ, Williams RG. Root canal anatomy of the mandibular first molar. JNJ Dent Assoc 1974;48:27–8.
3. Weine FS. Case report: three canals in the mesial root of a mandibular first molar (?). J Endod 1981;8:517–20.
4. Bond JL, Hartwell GR, Donnelly JC, et al. Clinical management of middle mesial root canals in mandibular molars. J Endod 1988;14:312–4.
5. Fabra-Campos H. Unusual root anatomy of mandibular first molars. J Endod 1985; 11:568–72.
6. Pomeranz HH, Eidelman DL, Goldberg MG. Treatment considerations of the middle mesial canal of mandibular first and second molars. J Endod 1981;7:565–8.
7. Min KS. Clinical management of a mandibular first molar with multiple mesial canals: a case report. J Contemp Dent Pract 2004;3:142–9.
8. Ricucci D. Three independent canals in the mesial root of a mandibular first molar. Endod Dent Traumatol 1997;13:47–9.
9. Goel NK, Gill KS, Taneja JR. Study of root canals configuration in mandibular first permanent molar. J Indian Soc Pedod Prev Dent 1991;8:12–4.
10. Tachibana H, Matsumoto K. Applicability of x-ray computerized tomography in endodontics. Endod Dent Traumatol 1990;6:16–20.
11. Hassan B, Metska ME, Ozok AR, et al. Detection of vertical root fractures in endodontically treated teeth by a cone beam computed tomography scan. J Endod 2009;35:719–22.

12. Cotton TP, Geisler TM, Holden DT, et al. Endodontic application of cone-bean volumetric tomography. J Endod 2007;33:1121–32.
13. Matherne RP, Angelopoulos C, Kulild JC, et al. Use of cone-beam computed tomography to identify root canal systems in vitro. J Endod 2008;34:87–9.
14. Holtzmann L. Root canal treatment of a mandibular first molar with three mesial root canals. Int Endod J 1997;30:422–3.
15. Estrela C, Bueno MR, Leles CR, et al. Accuracy of cone beam computed tomography and panoramic and periapical radiography for detection of apical periodontitis. J Endod 2008;34:273–9.
16. Lofthag-Hansen S, Huumonen S, Grondahl K, et al. Limited cone-beam CT and intraoral radiography for the diagnosis of periaical pathology. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:114–9.