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Endodontic treatment of a mandibular second premolar with three root canals involving cone-beam computed tomography. A case report

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Abstract

Background and Objective: A thorough knowledge of basic root canal anatomy and its variations, and careful radiographic evaluation to determine the number of roots and the number of root canals is necessary for successful root canal treatment. Mandibular second premolars have earned the reputation for having aberrant anatomy. The aim of this article is to report a case of successful root canal treatment of a mandibular second premolar with two roots and three root canals, using cone-beam computed tomography (CBCT) as a confirmatory diagnostic tool.

Case Report: A 63-year-old male patient attended with intermittent pain from his right posterior teeth. Clinical examination revealed recurrent caries around the margins of a restoration in the right mandibular second premolar. The tooth was tender to percussion and showed no response on electric pulp testing. A periapical radiograph revealed recurrent caries in the tooth, encroaching the pulp from the distal aspect, with slight widening of the periodontal ligament space. Root canal treatment was initiated. An endodontic explorer was used to locate three canal orifices. A CBCT scan was used to evaluate the root canal anatomy. Following treatment the tooth was followed up for six years.

Conclusion: Clinicians should be aware of the atypical morphological variations of mandibular second premolars. Conventional intraoral radiography remains a cost-effective and front-line method of dental imaging; however, CBCT images allow precise identification of unusual canal morphology.

Introduction

Detailed knowledge of root canal anatomy and awareness and understanding of the presence of unusual external and internal root canal morphology contributes to the successful outcome of root canal treatment (Green, 1973; Borna et al., 2011). Clinicians must have a thorough understanding of normal anatomy and should also be able to recognise variations of the root canal system for consistent, high quality treatment results (Rödig and Hülsmann, 2003; Krasner and Rankow, 2004).

Mandibular second premolars are typically described as single rooted teeth with a single root canal (Ingle and Bakland, 2002; Ash and Nelson, 2003). A review of the literature reveals wide variations in their morphology (Green, 1973). In a study by Vertucci et al. (1974) it was observed that second premolars had only one root canal at the apex in 97.5% of the teeth studied and two canals in only 2.5%; the prevalence of three root canals was rare. Zillich and Dowson (1973) reported three canals in mandibular second premolars in 0.4% of teeth. In spite of this, the clinician should be aware of these variations, their clinical and radiographic anatomy, and the location of the canal orifices (Borna et al., 2011).

Cone-beam computed tomography (CBCT) allows a better understanding of complex and variable root canal anatomy (Han et al., 2012) and is a reliable method to explore atypical forms (Blattner et al., 2010). Neelakantan and co-workers concluded that CBCT is as accurate as a modified canal staining and clearing technique, which is a gold standard in identifying root canal anatomy (Neelakantan et al., 2010).

This case report presents the successful non-surgical management of a right mandibular second premolar with two separate roots and three root canals, with CBCT used as a confirmatory diagnostic tool.

Case Report

A 63-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Christian Dental College, Ludhiana, Punjab, India with a chief complaint of intermittent pain and food lodgement in the right posterior region. His medical history was non-contributory. Clinical examination revealed a Class II composite restoration in the right mandibular second premolar (tooth 45) with recurrent caries around the margins, and a defective restoration in the right mandibular first molar (tooth 46). There was an open contact between teeth 45 and 46. Tooth 45 was tender to percussion and showed no responses to cold and electric pulp testing. A periapical radiograph (Figure 1) revealed a radiolucency under the restoration in tooth 45, encroaching the pulp from the distal aspect, with slight widening of the periodontal ligament space and thickening of the

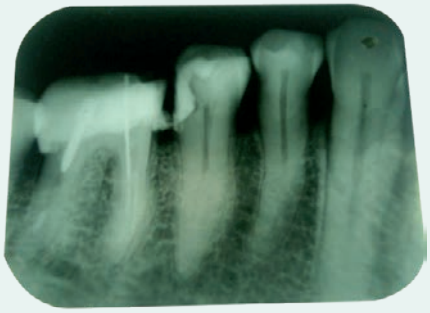

Figure 1: Preoperative radiograph of tooth 45 showing one canal dividing further at the middle third

lamina dura in the periapical region. Based on clinical and radiographic evidence, a diagnosis of irreversible pulpitis with apical periodontitis was made and root canal treatment was planned. The radiograph also showed incomplete root canal treatment of tooth 46 and its extraction was planned due to its poor prognosis. Tooth 45 was isolated using dental dam. An access cavity was prepared. On careful inspection of the pulp chamber, two root canal orifices were observed (buccal and lingual). Canal patency was established using ISO #8 and 10 K files (Mani Inc., Tochigi, Japan). Coronal flaring of the canals was performed with Gates-Glidden drills. The presence of more than two canals was suspected. Inspection of the pulp chamber floor was repeated using a DG16 endodontic explorer under 2.5× magnification using loupes to further explore the canal orifices. A third catch point was felt using the explorer, located very close and distal to the buccal orifice on the pulp chamber floor. The catch, however, unlike the other two orifices did not elicit any discomfort or haemorrhage.

Further periapical radiographs taken at different horizontal angulations could not identify the anatomy of the suspected third canal or its apex. Imaging of tooth 45 with CBCT was planned. The access cavity was sealed with IRM (Caulk, Dentsply, USA) and a CBCT (Kodak Dental Systems, Carestream Health, Rochester, NY, USA) scan done using a focused field of view. The images suggested the presence and location of a third canal in tooth 45 (Figure 2 a-c).

In a subsequent visit all three canals were located and working lengths were determined with the help of an electronic apex locator and confirmed radiographically (Figure 3). The canals were cleaned and shaped using a crown down technique with ProTaper series NiTi files (Dentsply Maillefer, Ballaigues, Switzerland) coated with lubricant (Glyde, Dentsply Maillefer). Copious irrigation with 5% sodium hypochlorite solution during instrumentation removed debris. Calcium hydroxide paste (ApexCal, Ivoclar Vivadent, Schaan, Liechtenstein, Germany) was placed in the canal as intracanal medicament and the tooth sealed with IRM cement.

Obturation was completed at the next visit with ProTaper gutta-percha and AH Plus sealer (Dentsply Maillefer) using a single cone obturation technique followed by warm vertical compaction (Figure 4).
The patient was referred to his dentist for treatment of tooth 46. Tooth 45 was asymptomatic and functional as a bridge abutment at the six year follow-up (Figure 5).

Discussion

Mandibular second premolars are among the most difficult teeth for root canal treatment (Awawdeh & Al-Qudah, 2008). This can be attributed to variations in their internal morphology, the number of root canals and apical deltas and lateral canals (de Moor & Calberson, 2005; Nallapati, 2005). In addition, the access cavities in these teeth may be prepared relatively small, reducing

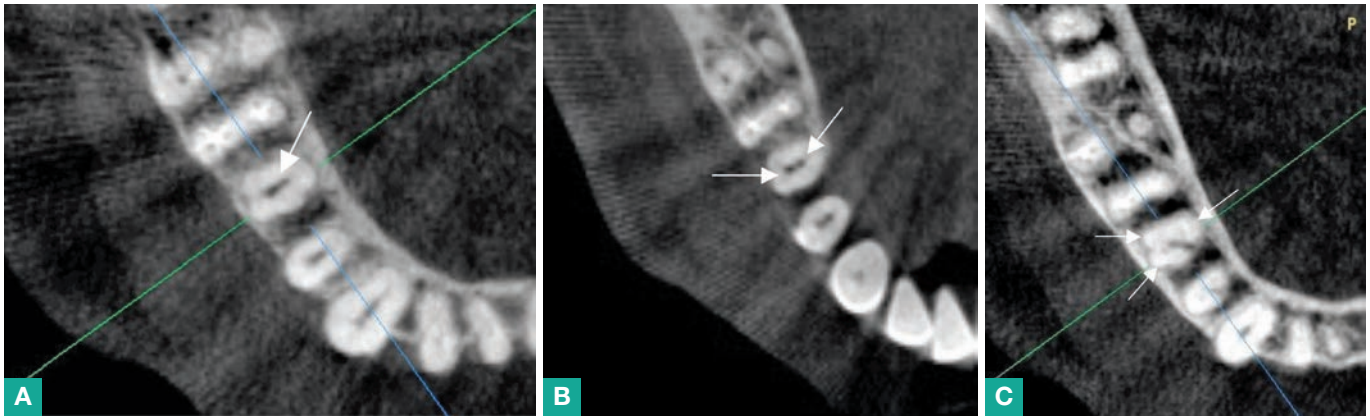

Figure 2: Enlarged axial section of CBCT images at three levels (a) coronal, (b) middle and (c) junction of middle and apical thirds of tooth 45, showing one, two and three canals respectively

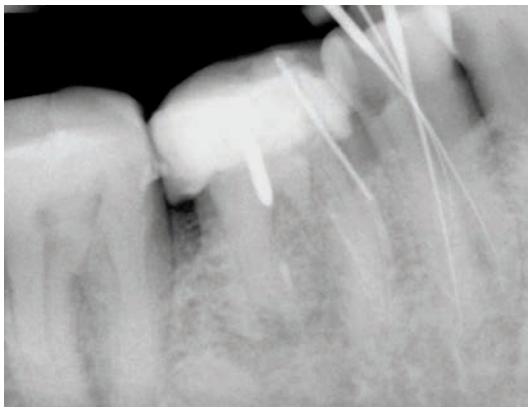

Figure 3: Working length determination, tooth 45.

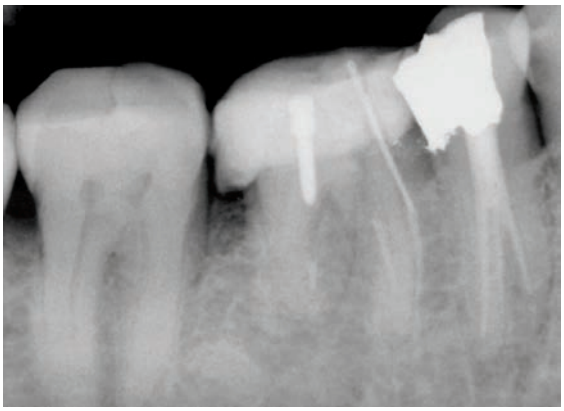

Figure 4: Tooth 45 root canal filled.

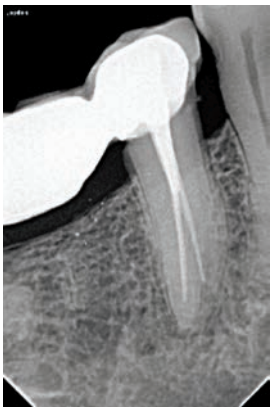

Figure 5: Periapical radiograph of tooth 45 at six year follow up.

the field of view. Wider access is necessary to locate extra canals (Tzanetakis et al., 2007).

Multiple pre- and perioperative periapical radiographs can help to determine the number of roots. Care should be taken when there is a sudden change in radiographic density of the root canal space (RCS) (narrowing or even disappearing) that could suggest a second root canal or more. We found this in our case (Figure 1). Periapical radiographs produce only a two-dimensional image of a three-dimensional object, resulting in superimposition of features. They are of rather limited value in cases with complex root canal anatomy. Radiographically undiscovered RCSs should be found with the aid of appropriate armamentarium and operator skill (Matherne et al., 2008). The expertise of the clinician along with meticulous examination of the pulpal floor using an endodontic explorer under magnification for detecting any variations is emphasized in this report. Interpretation and appraisal based on a two-dimensional radiograph may alert the clinician to the presence of aberrant anatomy but cannot present the variable morphological structure of root canals and their interrelations (Holtzman, 1998). The outline of the buccal canal in this tooth could not be delineated clearly on the radiographs. Cotton et al. (2007) have reported the endodontic applications of CBCT. The main benefits of this technique include producing high quality, accurate three-dimensional images compared to conventional radiography (Liang et al., 2011), being non-invasive, reducing superimpositions of intraoral and extraoral anatomy and their surrounding structures, and lower radiation doses and costs compared to conventional CT (Neelakantan et al., 2010). CBCT of tooth 45 in this case confirmed the existence of two canals in the buccal root.

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