Endodontic Management of a Mandibular Second Premolar with Four Roots and Four Root Canals with the Aid of Spiral Computed Tomography: A Case Report

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Abstract

Aberrations in the root canal anatomy are a commonly occurring phenomenon. A thorough knowledge of the basic root canal anatomy and its variations is necessary for successful completion of the endodontic treatment. Mandibular second premolars usually have a single root and a single root canal. The incidence of three separate roots itself in this tooth is quite rare, and the presence of four separate roots and four distinct root canals has never been reported in literature so far. The use of spiral computed tomography scan in this rare case greatly contributed towards making a confirmatory diagnosis and successful nonsurgical endodontic management thereafter. *(J Endod 2008;34:104–107)*

Key Words

Anatomic variations, four-rooted mandibular second premolar, spiral computed tomography scan

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A thorough knowledge of the root canal anatomy is a basic prerequisite for successful completion of the endodontic treatment (1, 2). The main objective of endodontic therapy is thorough mechanical and chemical debridement of the entire root canal followed by a three-dimensional obturation with an inert filling material and a final coronal restoration, thereby preventing access to microorganisms (2). Awareness and understanding of the presence of unusual external and internal root canal morphology largely contributes to the successful outcome of the root canal treatment.

The literature reveals wide variations in root canal morphology of mandibular premolars. In studies done by Green (3), Kerekes and Tronstad (4), Mueller (5), Pineda and Kuttler (6), Vertucci (7), and Zillich and Dowson (8), only Zillich and Dowson found mandibular second premolars with three canals. Vertucci et al. reported that the 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 incidence of three root canals were scarce (9).

Rodig and Hulsmann (2) have reported a case of mandibular second premolar with three separate roots and root canals diagnosed using intraoral periapical radiographs. Wong (10), Bram and Fleisher (11), and Al-Fouzan (12) have published cases of mandibular second premolars with four canals. Tzanetakis et al. (13) have reported endodontic management of mandibular second premolar with four root canals diagnosed with the aid of operating microscope. The incidence of four separate roots and four distinct root canals in the mandibular second premolar has never been reported in the literature so far.

This case report presents a successful, nonsurgical endodontic management of mandibular left second premolar with four separate roots and four distinct root canals, wherein spiral computed tomography (SCT) was used as a confirmatory diagnostic tool.

Case Report

A 53-year-old female patient reported to our hospital with a chief complaint of intermittent pain in relation to tooth #20 (mandibular left second premolar) of 3 months duration. Medical history was noncontributory. Dental history revealed that she had undergone root canal treatment of the same tooth (tooth #20) 1 month earlier by a general dentist, but the pain still persisted and had increased in intensity since past 2 days. The patient also complained of episodes of sensitivity to hot and cold in the involved tooth.

On clinical examination, the patient's oral hygiene was found to be moderate, and there was a fractured temporary restoration in relation to tooth #20, with secondary caries around the margins. There was no evidence of either swelling or sinus tract in relation to it. The mesiodistal dimension of the tooth appeared to be wider than normal.

The involved tooth was tender on percussion. No periodontal pockets were present. Radiographic evaluation of the involved tooth revealed an unusual, complex root canal anatomy (Fig. 1). Vague outlines of three roots could be identified with radiopaque filling material in three (mesial, distobuccal, and distolingual) canals. The obturation in the distolingual canal was approximately 3 mm short of apex. There was widening of the periodontal ligament space with periapical radiolucency in relation to tooth #20. A radiopaque coronal restoration with radiolucent margins suggestive of secondary caries around the restoration was also evident on the radiograph.

Figure 1. Pre operative radiograph revealing unusual root canal anatomy of tooth #20 with distolingual canal obturation short of apex.

On the basis of the clinical and radiographic findings, a diagnosis of endodontically treated left mandibular second premolar with acute exacerbation of chronic apical periodontitis was made.

Since the anatomic make up of the root canal system of the involved tooth was quite unusual and the patient complained of persistence of pain along with occasional sensitivity to hot and cold even after the completion of root canal treatment, numerous doubts existed as to whether these postoperative symptoms were because of the underfilled distolingual canal obturation or the presence of a missed canal. Additional radiographs taken at different angulations revealed the presence of at least three distinct roots, but the confirmation of the number of roots or root canals could not be made with the help of intraoral periapical radiographs alone.

Hence, to ascertain this rare and complex root canal anatomy of the tooth in a three-dimensional manner, dental imaging with the help of a SCT was planned. Informed consent from the patient was obtained and a multisliced or SCT of the mandible was performed by using the dental software Dentascan (GE Healthcare, Milwaukee, WI). A three-dimensional image of the mandible was obtained. The involved tooth was focused, and the morphology was obtained in transverse, axial, and sagittal sections of 0.5 mm thickness, along with three-dimensional reconstructed images (Fig. 2*A–F*).

The SCT images revealed that tooth #20 had four separate roots and four distinct root canals (mesiobuccal, mesiolingual, distobuccal, and distolingual), with no evidence of fusion of the root canals at any

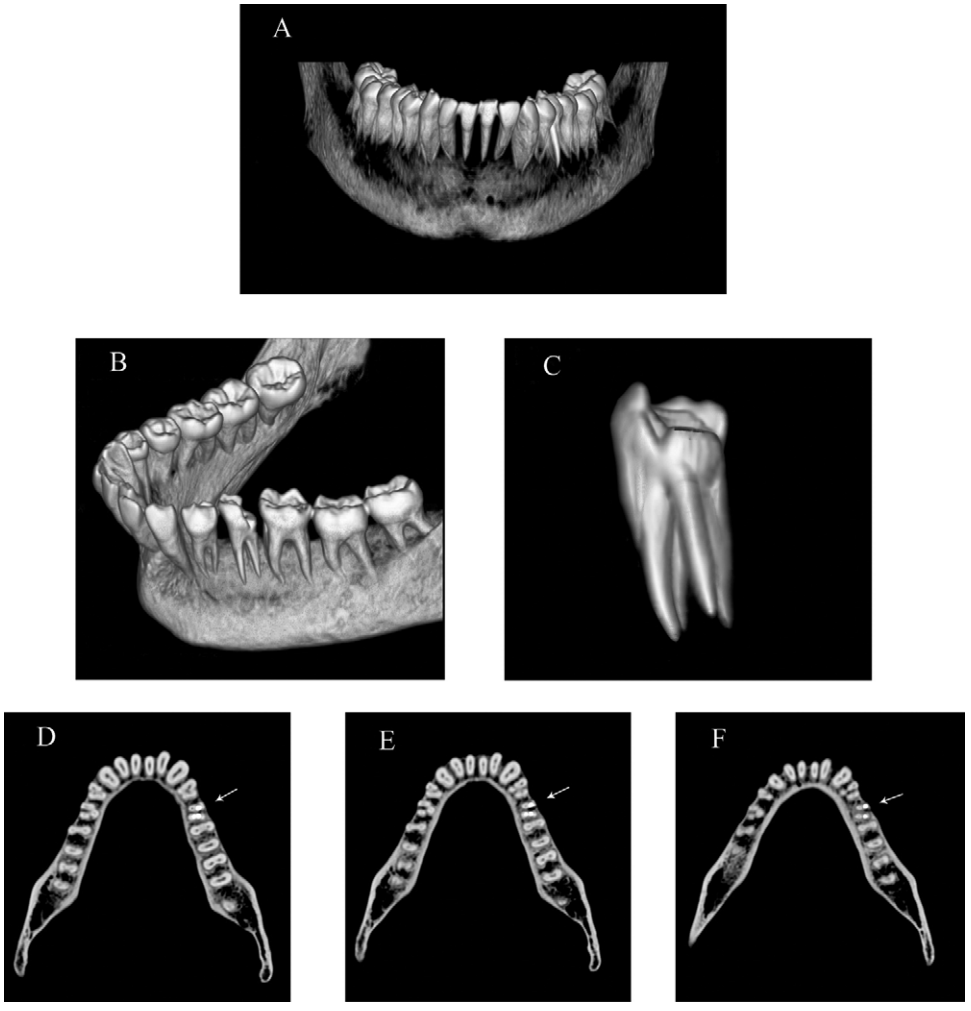

Figure 2. Spiral CT images. (A) Three-dimensional reconstruction of the mandible. (*B*) Three-dimensional reconstruction of the mandible (left oblique view). (*C*) Three-dimensional reconstruction of tooth #20. (*D*) Coronal third section of the roots of tooth #20 (arrow). (*E*) Middle third section of the roots of tooth #20 (arrow). (F) Apical third section of the roots of tooth #20 (arrow).

level. A radiopaque filling material was also observed in the mesiobuccal, distobuccal, and distolingual root canals. The distolingual root was noted to be longest amongst the four, and the obturation in this root canal was 3 mm short of apex.

Once the confirmatory diagnosis was made, retreatment of the involved tooth was planned. After administration of local anesthesia, the tooth was isolated with a rubber dam. The fractured temporary restoration was removed (Fig. 3*A*), and secondary caries was completely excavated. The access opening was modified keeping in mind the probable location of the orifices of the four root canals.

On careful inspection of the pulp chamber floor, four separate root canal orifices were observed (one mesiobuccal, one mesiolingual, one distobuccal, and one distolingual). Gutta percha was carefully retrieved from the mesiobuccal, distobuccal, and distolingual root canals. Coronal flaring for all the four canals was performed with Gates Glidden drills (Fig. 3*B*), and working length was determined with the help of apex locator (Root ZX; Morita, Tokyo, Japan), which was later confirmed with a radiograph (Fig. 3*C*).

The canals were cleaned and shaped up to ISO #35 size master apical file under copious irrigation with 2.5% sodium hypochlorite and 17% EDTA. Root canals were dried with sterile paper points (Dentsply, Maillefer, Ballaiques, Switzerland). Calcium hydroxide paste (Calcicur; VOCO, Cuxhaven, Germany) was applied and access temporary sealed with Cavit (3M ESPE AG, Seefeld, Germany). The patient returned after 1 week. The tooth was completely asymptomatic. Calcium hydroxide paste was removed, and roots canals were obturated by cold lateral compaction of gutta percha using zinc oxide and eugenol sealer (Kemdent; Associated Dental Products Ltd, Wiltshire, UK). A postoperative radiograph was taken (Fig. 3*D*), and the access was restored permanently with universal composite resin restorative material (3M ESPE Dental Products, St Paul, MN). A 1 year recall radiograph showed satisfactory healing (Fig. 3*E*).

Discussion

The diagnosis and management of extra roots or root canals in mandibular premolars is undoubtedly an endodontic challenge. In order to achieve this, the clinician must have a thorough understanding of the normal root canal anatomy and of its common variations. Inability to find and obturate a root canal has been shown to be a major cause of failure in endodontic therapy (14). Hoen and Pink (15) found 42% incidence of missed roots or canals in the teeth that needed retreat-

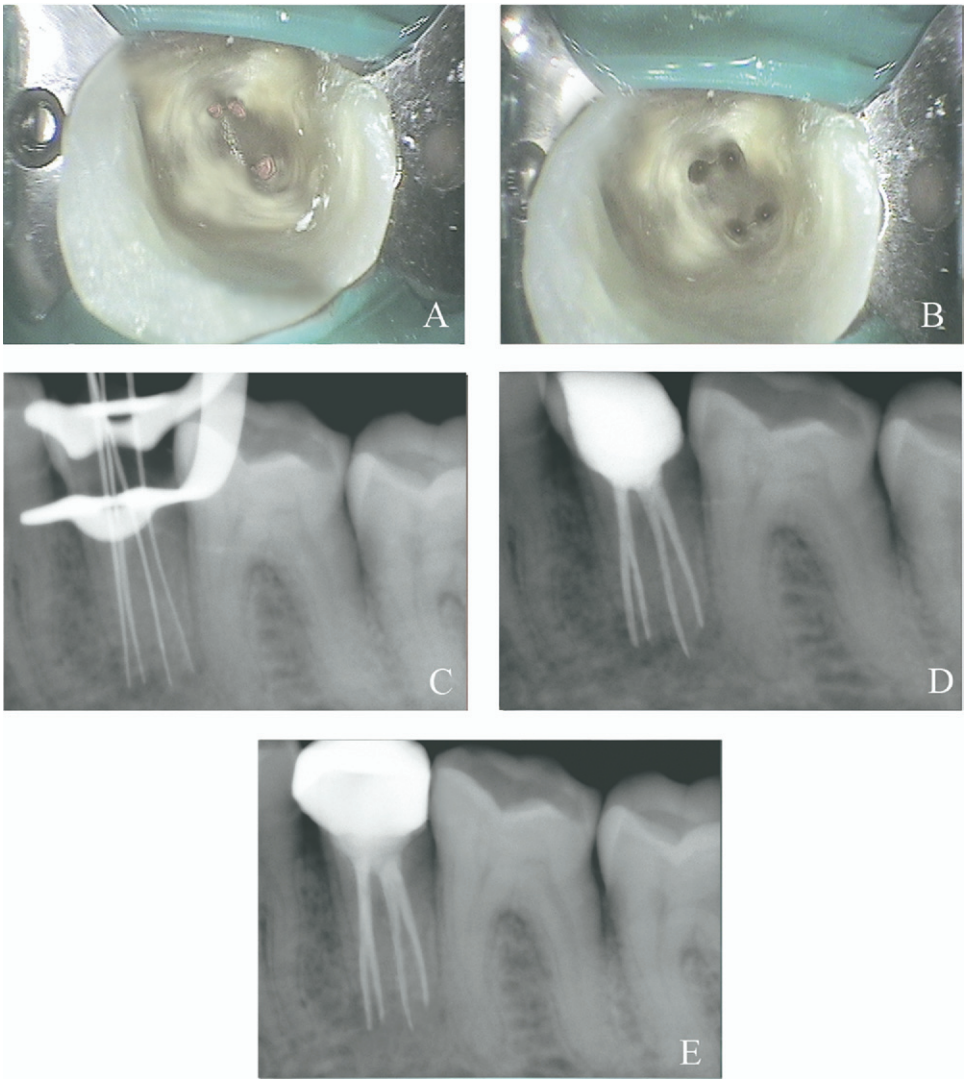

Figure 3. (*A*) Initial access opening view after the removal of temporary restoration. (*B*) Access opening showing orifices of the four root canals. (*C*) Working length determination. (*D*) Immediate postoperative radiograph. (*E*) Recall radiograph 1 year postoperatively.

ment). Hence, it is of utmost importance that all the canals be located and treated during the course of nonsurgical endodontic therapy.

Mandibular premolars have gained a reputation of having an aberrant anatomy (16). Different studies have reported a fairly high percentage of mandibular premolars to have more than one canal (17–20). Considering the fact that so much of aberrations exist in these teeth, it becomes mandatory that when a patient comes with persistent pain or sensitivity to hot and cold after root canal treatment the clinician must suspect the presence of missed canals. Judicious use of high-end diagnostic aids should also be considered in such complex situations.

Radiographs produce only a two-dimensional image of a three-dimensional object resulting in superimposition of images. Hence, they are of rather limited value in cases with complex root canal anatomy. Interpretation and appraisal based on a two-dimensional radiograph may alert the clinician to the presence of aberrant anatomy but would not be able to present the variable morphological structure of root canals and their interrelations (21). Based on previous studies performed by Ballal et al. (22), Gopikrishna et al. (23), Robinson et al. (24), and Sponchiado et al. (25) wherein spiral CT was used for the confirmatory diagnosis of morphological aberrations in the root canal anatomy, SCT of the involved tooth was planned.

The SCT images revealed that the tooth had four separate roots (one mesiobuccal, one mesiolingual, one distobuccal, and one distolingual) with four distinct root canals. All the root canals had separate portals of exit. Although the vague outlines of the three roots could be observed on the radiograph, the confirmatory diagnosis of the fourth root (mesiolingual) could only be made with the help of SCT.

Clearly, these findings are clinically important as in a study at the University of Washington assessing the results of endodontic therapy, the mandibular first and second premolars showed a failure rate of 11.45% and 4.54% of all types of the teeth (26). Conceivably, these findings could be due to the complex root canal anatomy of a large number of these teeth. A wide range of opinions are reported in literature regarding the number of root canals, but there are very few reports on the variations in the numbers of roots that occur in mandibular premolars (27, 28).

One of the problems of root canal retreatment is that the anatomic landmarks might have been eliminated or altered by the access cavity preparation. In such cases, the reliability of morphologic landmarks as a guide to the position of root canals is questionable and may make it difficult to locate the root canal system (21).

These discussions also validate an important consideration that must not be overlooked (ie, the anatomic position of the mental foramen and the neurovascular structures that pass through it in close proximity to the apices of mandibular premolars). There are reports of flare-ups in mandibular premolars with associated paresthesia of the inferior alveolar and mental nerves because of missed root canals published in literature (29).

In this case, the presence of a missed and incompletely obturated root canal could have probably led to the persistence of clinical symptoms and subsequent failure of endodontic therapy.

Conclusion

Successful nonsurgical endodontic management of a mandibular second premolar with four separate roots and root canals has been presented. It is a well-established fact that the presence of extra roots and root canals in these teeth may occur far more than one can expect. In this case, exact root canal anatomy could not be ascertained by using periapical radiographs alone. Hence, the use of SCT helped us in making a confirmatory diagnosis. Perhaps the success of this case could be attributed to the successful diagnosis, thorough chemomechanical debridement, and complete obturation of all the four root canals.

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