Endodontic Management of a Mandibular First Molar with Four Canals in a Distal Root by Using Cone-Beam Computed Tomography: a Case Report

Hani Baziar¹, Farzaneh Daneshvar¹, Abbas Mohammadi², Hamid Jafarzadeh³

¹Department of Endodontics, Faculty of Dentistry, Zahedan University of Medical Sciences, Zahedan, Iran.
²Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Zahedan University of Medical Sciences, Zahedan, Iran.
³Dental Research Center, Department of Endodontics, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran.

ABSTRACT

Background: Aberrations in the root canal anatomy are clinically challenging for clinicians. Mandibular first molars usually have 2 roots and 3 or 4 canals, but various combinations may exist. A distal root with three canals is rare and its incidence in literature is about 0.2 - 3%. As a diagnostic tool, cone-beam computed tomography (CBCT) may be a better choice for diagnosis of extra roots or canals comparing to conventional radiography.

Methods: An endodontic management of a mandibular first molar with six canals was performed. CBCT was used to confirm the diagnosis and to understand the morphology of the canals.

Results: Evaluation of the axial and coronal slices of CBCT images confirmed the presence of 2 roots and 6 canals. The distal root had four distinct root canal orifices with two apical foramens, being described as type XIV canal configuration.

Conclusions: Dentists should be aware of unexpected canal morphology when performing endodontic treatment. The present case demonstrated the use of CBCT in diagnosis and negotiation of extra canals in a mandibular first molar.

Keywords: anatomy; cone-beam computed tomography; molar; tooth root; tooth canal.

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INTRODUCTION

The main objective of the root canal therapy is thorough debridement of the root canal space followed by complete obturation for creating the three-dimensional seal [1]. According to Nair [2], one of the main reasons associated with unsuccessful treatment is the survival of microorganisms within the root canal system. Vertucci [3] reported a substantial number of failures related to aberrant anatomy, such as missing canals. Therefore, a comprehensive knowledge of the root canal anatomy and its morphological variations is crucial for successful treatment [4].

Over the years, there have been numerous studies describing the internal morphology of teeth, including mandibular first molar [5-10]. The majority of mandibular first molars are two-rooted with two mesial and one or two distal canals. The major variant of the root canal system of mandibular first molar is the presence of a middle mesial canal with 1 - 15% incidence [6]. However, three canals have also been reported in the distal root [7,8] with an incidence of 0.2 - 3% [9]. The management of a mandibular first molar with four distal canals in two separate distal roots was reported by Ghoddusi et al. [10].

Since the introduction of CBCT, this three-dimensional technique has been established as important tool for diagnosis and treatment planning in an increasing number of fields in dentistry [11,12]. CBCT has the ability of overcoming the limitations of conventional radiography such as three-dimensional evaluation of the complex canal anatomy during endodontic treatment [13]. An important benefit of CBCT is in diagnosis of extra roots or canals. Tu et al. [14] showed a higher prevalence of extra roots in the mandibular first molars assessed by CBCT in comparison to conventional radiography. This case report presents the successful, non-surgical endodontic treatment of a mandibular first molar with four canals in a distal root diagnosed by cone-beam computed tomographic evaluation.

CASE DESCRIPTION AND RESULTS

A 42-year-old male patient was referred to the dental office with chief complaint of severe spontaneous pain in the left mandibular first molar. The patient’s medical history was non-contributory.

The clinical examination showed extensive amalgam restoration of this tooth. Vitality tests (cold by ice stick, heat by warm instrument, and electric test by a pulp tester) were negative; however, the tooth was tender to percussion. Periapical radiographic examination revealed a deep restoration near distal pulp horn with no signs of periapical radiolucency and aberrant anatomy (Figure 1A). The clinical diagnosis of necrotic pulp with acute apical periodontitis was made, and root canal therapy was planned.

The patient was anesthetized with 2% lidocaine with 1:80,000 epinephrine. After rubber dam isolation, endodontic access cavity was made. The pulp chamber was repeatedly flushed with 5% sodium hypochlorite to remove necrotic tissue and microorganisms. Inspection of the pulp chamber revealed four canal openings in the distal root and two in the mesial root. In the distal root, the third and fourth canals were located between distobuccal and distolingual canals. The working lengths were established with an electronic apex locator (Root ZX, Morita, Tokyo, Japan) and a radiograph was taken (Figure 1B). The presence of six canals was confirmed and pulpectomy was performed.

To confirm this unusual canal anatomy and to understand its configuration, CBCT imaging of the tooth was performed. Calcium hydroxide was placed as temporary dressing and the access cavity was sealed with zinc oxide-eugenol cement. After obtaining the informed consent from the patient, CBCT of the mandible with the focus on the left mandibular first molar was performed (Vatech, PaX-Reve 3D plus, 5.5 cm field of view, and voxel size of 0.08 mm). Axial, coronal, and sagittal CBCT slices revealed six canals (four in the distal root and two in the mesial root) in the referred tooth (Figure 1C - E).

At the next visit, the patient was asymptomatic. Root canal preparation was performed with ProTaper rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) in crown-down technique. Irrigation was performed with 2.5% sodium hypochlorite during instrumentation, followed by 17% EDTA. After a final rinse with normal saline, canals were dried with sterile paper points (Ariadent, Tehran, Iran) and obturated with gutta-percha (Ariadent, Tehran, Iran) and AH Plus sealer (Dentsply, Maillefer, Konstanz, Germany) using cold lateral condensation technique (Figure 1F).

Then, the patient was refereed for crown restoration. Six months after the endodontic treatment, the patient was asymptomatic (Figure 1G).

DISCUSSION

The diagnosis and treatment of extra roots or canals in mandibular first molars is definitely an endodontic challenge. A comprehensive understanding of
the most common root canal configuration and its variations is essential to achieve long-term success of the endodontic treatment. Hoen and Pink [15] reported 42% incidence of missed root or canals in the teeth that needed retreatment. Thus, complete debridement and obturation of the root canal system is an utmost important procedure in endodontics.

Diagnostic imaging is an important tool for locating canal orifices including a careful examination of the pulp chamber floor with a sharp explorer, staining with 1% methylene blue dye, sodium hypochlorite testing (Champagne bubble test), and visualizing canal bleeding points. Magnifier loupes and operating microscope would also increase the location of hidden canals [16].

Anatomical variations in the anatomy of the distal root of mandibular molars may be identified through careful evaluation of multiple angled pretreatment radiographs. Periapical radiographs produce only a two-dimensional image. Thus, they are decreased in value in cases of aberrant anatomy [17]. However, it should be noted that significant constraint in conventional periapical radiography is that it produces a two-dimensional image of a three-dimensional object. So, periapical radiographs are of limited value in cases with complex anatomy [18]. Recently, CBCT has been used in endodontics for the evaluation of the root canal anatomy. An advantage of the computed tomography (CT) scanning over the conventional radiograph is that it permits the operator to look at multiple sections of the roots and their canals [19]. Nance et al. [20] reported that the detection of canals increased significantly by CT scan compared with conventional radiography.

In this case report, CBCT imaging was used for a better understanding of the complex root canal anatomy. Evaluation of the axial and coronal slices of CBCT images confirmed the presence of 2 roots and 6 canals. The distal root had four distinct root canal orifices with two apical foramens, which could be described as type XIV canal configuration, according to Sert and Bayirli [21].

Treatment of extra canals may be challenging to each endodontist or general practitioner; however, the inability to find and properly treat the canals may cause failure. With advance diagnostic aids such as CBCT, these challenges may be overcome.

CONCLUSIONS

Dentists should be aware of unexpected canal morphology when performing endodontic treatment. The present report demonstrated the use of a cone-
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