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Endodontic Management of Three-rooted Mandibular First Premolar Using Cone-beam Computed Tomography: A Case Report

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The anatomy of the root canal system always affects endodontic treatment outcomes. Mandibular premolar teeth demonstrate extreme variations in root canal morphology. Mandibular first premolars typically exhibit basic single-root and single-canal anatomy. The occurrence of three roots in the mandibular first premolar has not been commonly reported in the literature. This article reported a case of a 26-year-old male with spontaneous pain of the mandibular first premolar representing the presence of an extra canal on the periapical radiograph. Cone-beam computed tomography (CBCT) was used to assess the root canal details which led to the finding of three canals. Further, a periapical bone defect was detected, and finally, the nonsurgical endodontic management of the mandibular first premolar with three canals and three different apical foramina was performed in one session.

Keywords: Cone-beam Computed Tomography; Endodontic Treatment; Mandibular First Premolar; Three Canals

Introduction

The ultimate clinical objective of root canal treatment is the three-dimensional (3D) obturation of the endodontic spaces root canals after being cleaned, shaped, and disinfected completely. Therefore, for a successful endodontic treatment, clinicians should have a thorough knowledge of the root canal system [1].

The mandibular first premolar is normally a single-rooted tooth. However, some studies revealed an incidence of ~2.7% of bifurcated teeth. Three-rooted mandibular first premolars are extremely rare with an incidence of 0.2% [2-4]. Slowey suggested that mandibular premolars may present with the greatest difficulty of all teeth to treat endodontically [5]. A study at the University of Washington assessed the failure rate of non-surgical root canal treatment in all teeth, and the highest rate for the mandibular first premolar was 11.45% [6].

Conventional intraoral periapical views are used as diagnostic imaging; however, they provide 2D views of 3D objects. It is especially important in teeth with unusual root canal anatomy [7, 8]. Cone-beam computed tomography (CBCT) is an effective imaging technique for the evaluation of the root canal system in teeth with potentially complex anatomy [8].

This article aimed to report a case of three-rooted and three-canaled mandibular first premolar that was managed by CBCT scanning as an adjunct imaging technique and nonsurgical endodontic treatment.

Case Presentation

A 26-year-old male from Zanjan, Iran referred from a general dentist to the Endodontic Department of Shahed University, Tehran, Iran. The general dentist could only find the mesiobuccal canal and prepared it up to an f3 rotary file (Shenzhen Denco Medical Co, Shenzhen, China). The patient presented with spontaneous pain in the right mandibular first premolar. The percussion was in the normal range. There was no evidence of tenderness, swelling, or sinus tract. Graduated periodontal probing revealed a normal probing depth. No developmental abnormalities could be identified, and there was no contributable medical history. Preoperative periapical radiographic examinations demonstrated radiolucency in

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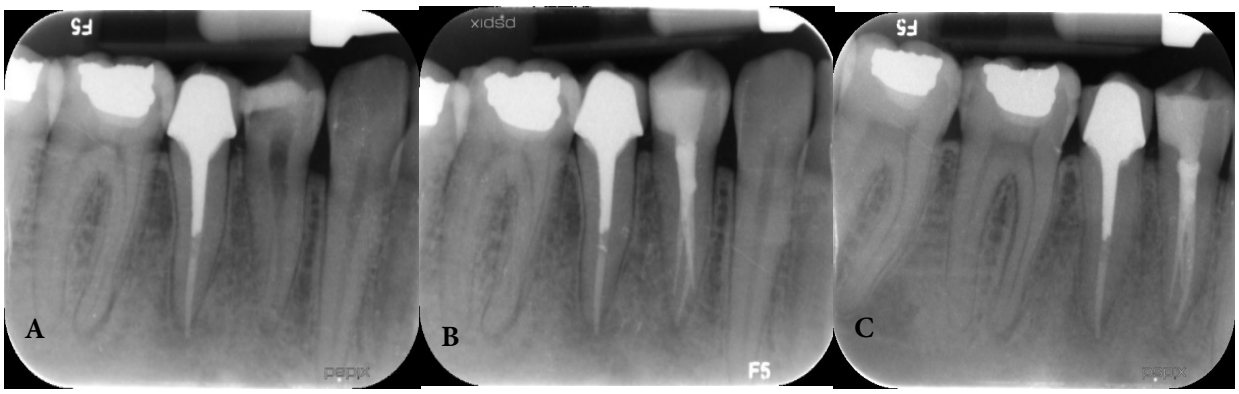

Figure 1. *A*) Preoperative periapical radiograph; *B*) Postoperative periapical radiograph; *C*) Three-month follow up radiograph

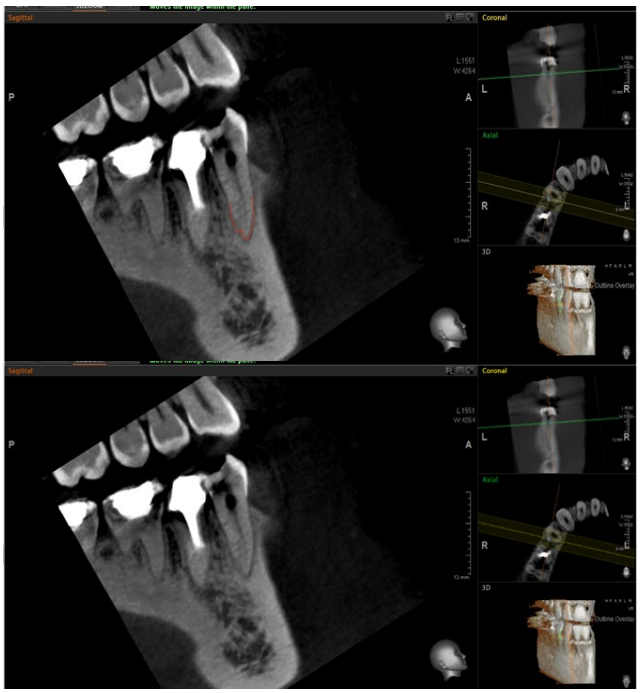

Figure 2. Sagittal section, including two roots and two canals at the buccal of the tooth

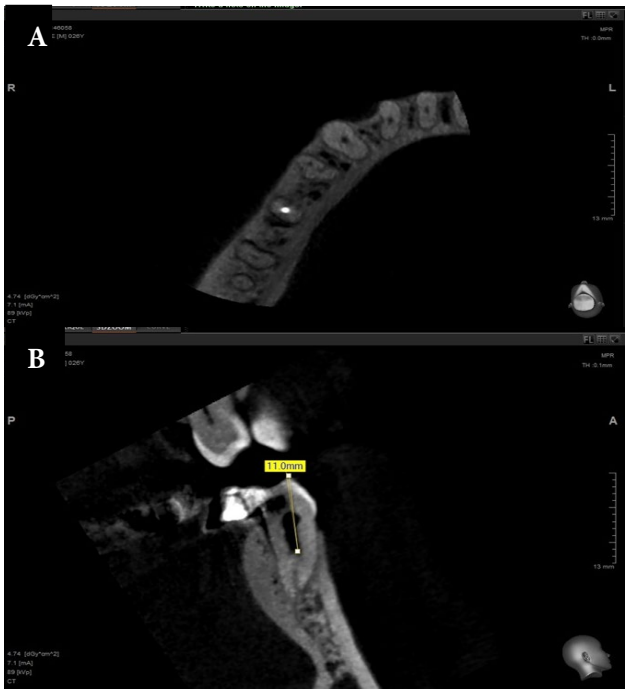

Figure 3. *A*) Axial section, including three roots and three canals; *B*) Coronal section

association with tooth #28. Based on clinical and radiographic evidence, chronic apical periodontitis was diagnosed, and partial pulpectomy was performed for pulp condition. The initial periapical radiograph showed that there was an extra canal (Figure 1A). CBCT scan with a small field of view was performed for a better survey. The sagittal and coronal sections of CBCT represented two roots and two canals at the buccal of the tooth, as well as two roots and two canals as the buccal and lingual of the tooth, respectively. Moreover, the axial section of CBCT indicated three roots and three canals, implying that the tooth has three roots as the mesiobuccal, distobuccal, and lingual of the tooth (Figures 2 and 3).

Informed consent was obtained from the patient. Local anesthesia was administered with 2% lidocaine and 1:100,000 epinephrine. Additionally, the tooth was isolated with a rubber dam, and the temporary restoration material was removed with high-speed fissure diamond bur. One root canal orifice was located at the coronal root level, and CBCT showed that the canals were separated at a length of about 11 mm from the reference (Figure 3B). The tactile examination of the walls of the major canal was performed with a size #10 precurved C file (VDW, Munich, Germany) at a length of about 11 mm from the reference. Finally, three canals were negotiated, and the working length was determined by an

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electronic apex locator (Root ZX; Morita, Tokyo, Japan) and radiographically confirmed as well.

The chemomechanical preparation of the canal included a glide path up to a size of #20 stainless steel hand K-file (Mani, Tochigi, Japan) followed by Denco Super Files (Shenzhen Denco Medical Co, Shenzhen, China) rotary files up to a size of 30/0.04. The irrigant solution
was 2.5% sodium hypochlorite (Golrang, Tehran, Iran) for all canals. After final irrigation with the normal saline solution, the canals were dried with paper points and obturated with gutta-percha and Neo-sealer Flo (Avalon Biomed, Houston, TX, USA) using the warm vertical compaction technique. The access cavity was filled with the resin composite (Z250; 3M-ESPE, St Paul, MN, USA). Root canal therapy was performed in one session. At the three-month follow-up, the treated tooth was functional and asymptomatic; radiographic evaluations demonstrated normal periradicular tissues (Figure 1C).

Discussion

Adequate cleaning and shaping of the root canal system are necessary for successful root canal therapy. For achieving this goal, the practitioner should be familiar with normal root canal anatomy and consider the presence of extra root canals. The mandibular first premolar is normally a single-rooted tooth. However, studies revealed an incidence of ~2.7% of bifurcated teeth. As mentioned earlier, three-rooted mandibular first premolars are highly scarce with an incidence of 0.2% [2-4]. The anatomical variations of mandibular premolars are well-documented in the literature both in terms of anatomic studies and clinically reported cases [9-11]. Three-rooted mandibular first and second premolars are rare but are occasionally found in case reports [12-17].

Trope *et al.* found significant ethnic variations in root anatomy when comparing African-American and Caucasian patients. They reported an incidence of two root canals in 5.5% and 16.2% of patients in Caucasian and African-American groups, respectively [13, 18].

The lowest incidence of mandibular premolars with more than one canal or root is likely to be greater than that reported/found rate because of hidden radiographical images.

Based on the findings of a study at the University of Washington, the highest failure rate of non-surgical root canal treatment in all teeth for the mandibular first premolar was 11.45% [6]. Possible reasons for a high failure rate are numerous variations in root canal morphology and difficult access, as well as the cleaning and sealing of a second canal.

Using pooled data that included first and second premolars, Kartal and Yanikoglu reported a 27.8% incidence of mandibular premolars with more than one canal [19].

A study of 45,X chromosome women (and 45,X/46,XX chromosome) demonstrated more than one canal in one or more mandibular premolars in almost half of the 87 studied patients who suffered from a genetic syndrome. Separate canals were found in 23% and 25% of the mandibular first and second premolars, respectively. The findings of the study represented that X-chromosomes might have a gene or genes with a regulatory function for root development [20].

Advanced imaging techniques are necessary for the assessment of unusual tooth anatomy [8]. In this case report, a limited field of view CBCT system was obtained after the intervention of the previous dentist to evaluate the details of root canal anatomy, which helped us to find the location and the length of the other two canals separate from the major canal. In addition, only two canals (Figure 1A) are found in the preoperative periapical radiograph, whereas CBCT revealed three canals (Figure 3A). The CBCT represented the presence of three roots as mesiobuccal, distobuccal, and lingual, and all the root canals had separate apical foramina.

Conclusion

In this case, additional canals in the mandibular first premolar were suspected in the periapical radiograph. CBCT scanning detected three separate roots and three root canals and provided a 3D analysis of root canal anatomy. Nonsurgical root canal treatment was performed in one session. It is well-established that extra roots and root canals in these teeth may occur far more than one can expect. The clinician should be astute enough to identify the presence of unusual numbers of roots and their morphology, and using advanced imaging techniques is necessary in complex cases.

Conflict of Interest: 'None declared'.

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