Dental Research Journal

Case Report

The role of cone beam computed tomography in the endodontic management of a mandibular first molar with three distal canals

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Received: October 2013
Accepted: November 2013

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ABSTRACT

The presence of three root canals in the distal root of the mandibular first permanent molars is rare; based on *in vitro* studies its incidence is reported to be between 0.2% and 3%. With the advent of cone beam computed tomography (CBCT) as an adjunctive diagnostic aid, the determination of root canal anatomy in teeth with extra canals and complex canal configurations has become more precise. CBCT provides three dimensional visualization of the pulp canal space, allowing the clinician in determining the spatial relationships of the root canals with each other at various cross sectional levels along the length of the root. The present report discusses the endodontic management of a mandibular first permanent molar with three canals in the distal root, employing CBCT as an adjunctive diagnostic aid to conventional radiography.

Key Words: Cone beam computed tomography, middle distal canal, three distal canals

INTRODUCTION

Thorough mechanical and chemical cleansing of the entire pulp cavity and its complete filling depends on detailed knowledge of the root canal system of the tooth being treated. Missed canals and inadequate shaping and cleaning of the root canal system can lead to post treatment disease.[1,2] Although mandibular first permanent molars usually have one to two root canals in the distal root, various *in vitro* studies have put the incidence of 3 canals in the distal root between 0.2% and 3%.[3-12] With an increasing number of case reports documenting the presence of extra canals, comprehensive knowledge of root canal configurations is important for clinicians performing endodontic treatment. Vertucci[13] in 1984 gave 8 types of canal configurations, to which 14 more were added in 2004 by Sert and Bayirli.[14] With the presence of such varied types of root canal configurations, the endodontic management of teeth with complex canal anatomies can be a challenging task for the clinician. With the approval of the first cone beam computed tomography (CBCT) unit by the Food and Drug Administration in 2001, it has gained wide acceptance as a complementary modality to conventional planar radiographic imaging techniques. CBCT plays an important role in the diagnosis of apical periodontitis, presurgical assessments in cases of periapical surgeries, assessment of tooth morphology and complications, assessment of traumatic injuries and vertical root fractures.[15] In the present case, the use of CBCT, apart from confirming the presence of three root canals in the distal root, has helped in determining the spatial relationship of these three canals with each other at different cross sectional levels of the root.

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Website: http//:drj.mui.ac.ir

CASE REPORT

This was a case report of a 23-year-old male patient who reported to the Department of Conservative Dentistry and Endodontics, with the chief complaint of severe, spontaneous pain in the right lower back side of the face since 3 days. His medical history

was noncontributory. Clinical examination revealed tooth colored restoration on the distal aspect of the crown of the mandibular right first permanent molar. Cold sensitivity test (Endo Frost, Roeko, Langenau, Germany) elicited pain which lingered on for a few seconds, whereas the electric pulp tester (Meditester, Medical S.R.L., Treviso, Italy) elicited a delayed response. Intra oral periapical radiograph showed a radiopaque filling material close to the pulp space [Figure 1a]. Based on the clinical and radiographic findings, a diagnosis of acute irreversible pulpitis was made. The patient was scheduled for endodontic management of the tooth. Following administration of local anesthetic, 2% lignocaine with 1:1,00,000 adrenaline, (Alcaine plus, Alpa Laboratories, Pigdamber, India) the tooth was isolated under rubber dam (Hygienic dental dam, Coltene, Whaledent, Germany). The existing restoration was removed, caries was excavated and an adequate access cavity was made using an endo access bur (Dentsply, Maillefer, Ballaigues, Switzerland). Removal of debris was facilitated by flushing the chamber with 4% sodium hypochlorite (Dr. Wadhwa Chemical Works, Delhi, India). Following exploration of the dentinal map with DG 16 endodontic explorer (Hu Friedy, Chicago, IL), pulp tissue was extirpated using barbed broaches (Dentsply, Maillefer, Tulsa, USA). Four distinct orifices were identified, the mesiobuccal, mesiolingual, distobuccal and distolingual. On inspection under a dental operating microscope (Carl Zeiss, Meditec, Inc., Dublin, California, USA), a third canal was located in the distal root between the previously identified distolingual and distobuccal canals [Figure 2]. The working length was determined with an electronic apex locator (J Morita, Kyoto, Japan), and confirmed radiographically [Figure 1b]. The tooth was temporized with cimpat pink (Septodont, Saint-Maur-des-Fosses, France) and a CBCT scan was planned for the assessment of the root canal morphology and confirmation of the clinical findings.

The CBCT scan was done using i-computed axial tomography cone beam three dimensional scanner (Imaging Sciences International, Hatfield, Pennsylvania, USA). All necessary precautions were taken to protect the patient from the radiation exposure. The patient was made to wear a lead apron during the scan, with the field of view limited to the area of interest. To further minimize exposure, an ultra-low radiation dose scan was done. For the determination of canal morphology, slices were obtained at the middle and apical levels of the distal root [Figures 3 and 4].

The CBCT scan revealed three distinct root canals which seemed to unite at the apical level [Figure 4]. Of the three canals evident at the middle-third of the root, the distobuccal was the most conspicuous and largest in diameter [Figure 3]. The distolingual and mid distal canals appeared narrow in diameter and their course was not distinctly visualized at the apical third, where they seemed to merge with the distobuccal canal to exit as a single canal through the apical foramen.

In the subsequent appointment, cleaning and shaping was done with rotary protaper system (Dentsply,

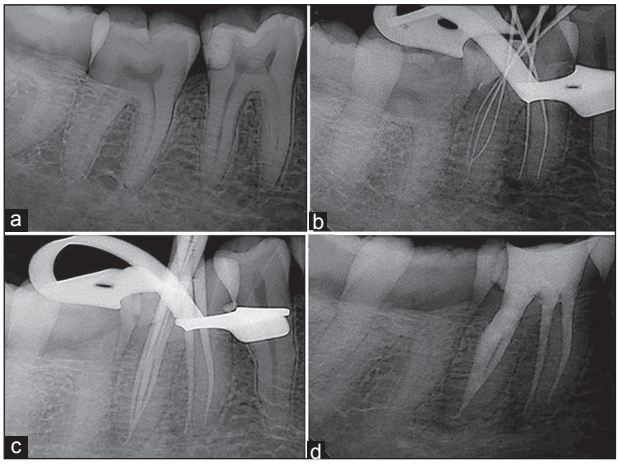

Figure 1: (a) Pre-operative radiograph of mandibular right first permanent molar (b) working length radiograph showing three distal canals merging in the apical third (c) master cone radiograph (d) post obturation radiograph

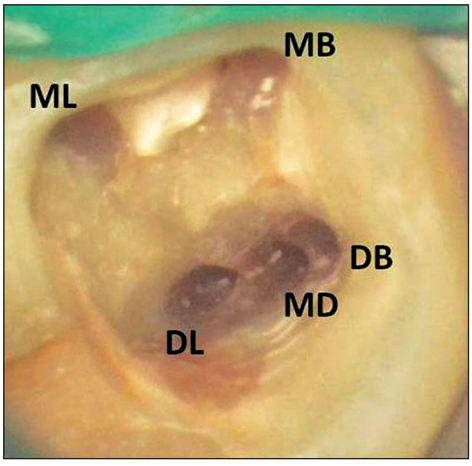

Figure 2: Clinical view of the access cavity preparation under the operating microscope showing five distinct root canal orifices; distolingual, middle distal, distobuccal, mesiolingual; mesiobuccal

Maillefer, Tulsa, USA) using the crown down technique. Irrigation between each instrument was performed using normal saline, 5.25% sodium hypochlorite and 17% ethylenediaminetetraacetic acid (Glyde File Prep, Dentsply, Maillefer, Tulsa, USA). The canals were finally irrigated with normal saline, dried with sterile absorbent paper points (Dentsply, Maillefer, Tulsa, Oklahoma, USA), master cone periapical radiograph taken [Figure 1c] and obturated with cold laterally condensed gutta percha (Dentsply, Maillefer, Tulsa, USA) and AH plus sealer (Dentsply Maillefer, Tulsa, USA). Post endodontic restoration was done with light cure composite (Filtek Z 350, 3 M ESPE, Minnesota, USA), following which a radiograph was taken [Figure 1d].

DISCUSSION

Departure from the normal root canal anatomy is not uncommon. With increasing documentation of cases with aberrant root canal morphology and extra canals, it has become imperative for the clinician to have thorough knowledge of such variations to ensure successful treatment outcomes.

The majority of mandibular first molars have two roots, one mesial and one distal and the usual canal distribution is two in the mesial and one or two in the distal root.[3] However, in the past few years, increasing number of workers have reported on the presence of extra canals in the mesial and distal roots. The incidence of three root canals in the mesial root is reported to be between 1% and 15%, but the occurrence of 3 canals in the distal root is very rare.[16] Reuben *et al*., using spiral computerized tomography examined 125 mandibular first molars in an Indian population and none of the teeth had three distal canals.[17] In 1983, Berthiaume reported the first case of a mandibular permanent molar with 3 distal canals.[18] Since then only a few case reports have documented the presence of three canals in the distal root(s) of mandibular first permanent molar [Table 1]. Most of these cases involved more than one distal root.[19-25] In 1998, Reeh reported the first case of three distal canals present within a single distal root of a left mandibular first molar in a 23-year-old male from the USA.[26] The distal root had a Sert and Bayirli type XV configuration with the three canals exiting as two at the apical foramen. Chandra *et al*. reported on a right mandibular first permanent molar with three canals in the distal root having a Sert and Bayirli type XV configuration.[27] The root canal morphology was studied with the help of scanning computed tomography, which revealed fusion of the distobuccal and middle distal canals at the apical third level of the distal root. Kottoor *et al*. in 2010 reported on a right mandibular first permanent molar having three canals in the distal root with a single

Table 1: Table summarizing previous case reports of mandibular first molars having more than two root canals in the distal root (s)

Investigator	Side	No. of distal roots	No. of canals
Reeh[26]	Left	1	3
Chandra *et al*.[27]	Right	1	3
Kottoor *et al*.[28]	Right	1	3
Jain[29]	Right	1	3
Stroner *et al*.[19]	Right	2	3
Beatty and Interian[20]	Right	2	3
Kimura and Matsumoto[21]	Right	2	3
Barletta *et al*.[22]	Right	2	3
Friedman *et al*.[23]	Right	3	3
Lee *et al*.[24]	Right	3	3
Ghoddusi *et al*.[25]	Left	2	4 (2 in each)

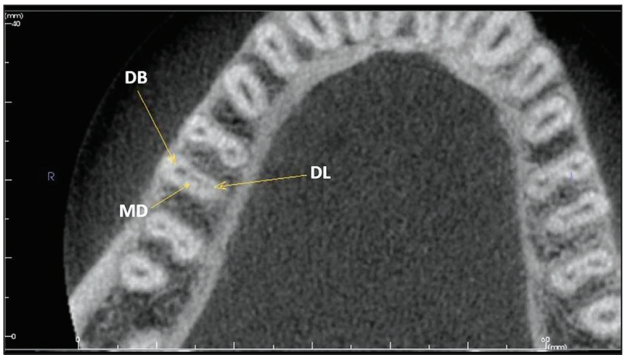

Figure 3: Cone beam computed tomography scan view at the middle third showing three distinct root canals; distobuccal; middle distal; distolingual

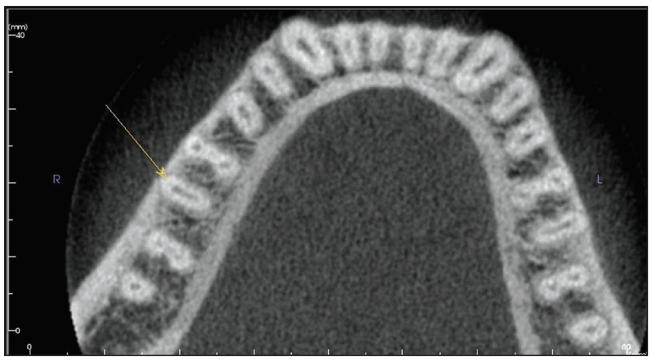

Figure 4: Cone beam computed tomography scan view at the apical third; the three distal canals appear to merge together to exit as a single canal

exit at the apical foramen (Sert and Bayirli type XVIII configuration).[28] Jain in 2011 described a right mandibular first permanent molar with three canals in the distal root.[29] All three canals joined at the apical level exiting through a single foramen (Sert and Bayirli type XVIII configuration). The use of CBCT in our case as an adjunct to conventional periapical radiograph confirmed the presence of three distinct canals in the distal root of tooth #46, as is evident in the mid root level scan view [Figure 3]. Also, the CBCT scan view at the apical level showed that all three canals joined at the apical third [Figure 4]. This could be correlated to the master cone intraoral periapical radiograph which clearly showed the merging of the Gutta-percha cones in the apical third [Figure 1c]. The information obtained from the periapical radiographs and CBCT scan views confirmed the root canal configuration of the distal root as Sert and Bayirli type XVIII.

The present report highlights the invaluable role played by CBCT in the diagnosis and management of a case of acute pulpitis involving the mandibular right first molar with three canals in the distal root.

CONCLUSION

Complex endodontic cases call for thorough knowledge, elaborate diagnostic work-up and clinical expertise on the part of the endodontist. The role of CBCT for the diagnostic work-up, as well as proficiency in the use of the dental operating microscope cannot be underestimated in modern endodontic practice.

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How to cite this article: Kaushik A, Talwar S, Yadav S, Chaudhary S, Nawal RR. The role of cone beam computed tomography in the endodontic management of a mandibular first molar with three distal canals. Dent Res J 2014;11:700-4.

Source of Support: Nil, **Conflict of Interest:** None declared.