Case Report

An unusual case of maxillary first molar with seven canals and the successful surgical recovery of a separated instrument

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Abstract

This case report highlights the intricate anatomy of root canals and the challenges they pose for clinicians. A 26-year-old female patient presented to the department with a chief complaint of pain in her left upper back tooth region. After thorough clinical and radiographical examinations, the diagnosis of pulpal necrosis with symptomatic apical periodontitis in the maxillary left first molar was confirmed. An intraoperative cone-beam computed tomography was performed. The axial imaging unveiled that there were, two distal (DB1 and DB2) canals, two palatal (P1 and P2) canals, and three mesiobuccal (MB1, MB2, and MB3) canals. The appearance of a convoluted root canal configuration serves to highlight the inherent complexity that clinicians may encounter during endodontic procedures. However, when this complexity is further compounded by the incident of separation of root canal instruments, the challenges faced by clinicians become significantly more demanding. It exemplifies the increased difficulty posed by the combination of tortuous root canal morphology and the additional complication of instrument separation, highlighting the importance of careful management and precise techniques in such scenarios and the significance of modern adjuncts, into the diagnostic process and magnification in the surgical and endodontic therapy.

Keywords: Apical periodontitis; cone-beam computed tomography; negotiating; root canal

INTRODUCTION

Endodontic treatment needs insightful knowledge and comprehension of the complexities and variability of root canals to obtain desired results. Root canal variations have led to a high incidence of missing canals, resulting in treatment failures. The anatomy of the maxillary first permanent molar was studied extensively. One study stated that a dental operating microscope has improved the identification of MB2 canals from 51% to 82%.[1]

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Multiple case reports, described a total of six root canals in the maxillary first molars (0.88%), including distobuccal (DB) (two canals), mesiobuccal (three canals), and palatal (one canal). One study, reported a total of six root canals: Two canals each in the mesiobuccal, DB, and palatal roots, whereas the other case report reported a total of six canals including DB (one canal), palatal (three canals), and mesiobuccal (two canals), in a typical maxillary first molar.[2,3]

In a clinical case of six canals, including mesiobuccal (two canal), DB (two canals), and palatal (two canals) were seen in a maxillary first molar.[4]

According to the researchers, the study indicated an incidence of 1.90% and 4.30% for the existence of both the canals in DB root, respectively.[5,6]

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Multiple case reports have also shown the existence of both the canals into DB root and the palatal root.[7,8]

Interestingly, in a few rare instances, the maxillary first molar has two canals and an unusual canal anatomy was documented. In one instance, maxillary first molar with three roots and seven canals including mesiobuccal (three canals), DB (three canals), and palatal (one canal),[9] whereas other instances have found similar outcomes and identified a total of seven canals in the maxillary first molar: mesial (three canals), distal (two canals), and palatal (two canals).[10]

Maxillary first molar teeth with seven canals and broken instruments cause significant difficulties for clinicians and complicated treatment situations.

A fractured instrument may be an impediment to the periapical healing.[11] In addition, the degree to which microbiological control was compromised during disinfection and biomechanical preparation at the time of fracture of the instrument may likely to impact the prognosis.[12]

On the basis of the methodology used for the retrieval, all possible outcomes including root perforations, transportation, and ledge formation of the canal, extravagant dentinal removal or fracture of an extrainstrument can lead to the weakening of the affected root. Therefore, risk assessment should be included in treatment planning. The radius of the curvature and angle of the afflicted root, the locus of the separated file, and the file type and length are the various factors for successful instrument retrieval.[13]

This case report provides a full overview of the method used to treat maxillary first molar with seven canals and focusing on the surgical care of a separated instrument.

CASE REPORT

A 26-year-old Asian female patient presented to the department of conservative dentistry and endodontics, for the first time with a chief complaint of pain in her upper left molar region from 4 days. Her medical history was noncontributory. Clinical evaluation revealed a negative response to cold testing with Endo-Frost (Coltene, Alstatten, Switzerland) and positive responses to tenderness to percussion. Periodontal probing was within the physiological limits. Radiographical evaluation using a radiovisiograph [Figure 1a] revealed radiolucency in the mesio-occlusal region, impending to the pulp of the mesiobuccal root with the periodontal space widening. Pulpal necrosis with symptomatic apical periodontitis was diagnosed, which warranted endodontic treatment. The endodontic therapy was commenced with an informed consent, followed by the sterilization protocol. The afflicted tooth was further locally anesthetized with the posterior–superior alveolar nerve block using a standard solution of lignocaine 2% with 1:200,000 adrenaline solution (Themicaine AD, Themis Medicare Ltd., Mumbai, Maharashtra, India) and isolated with a rubber dam, and the procedure progressed uneventfully. A conventional type of an endodontic access cavity was created. The seven canal openings in which the mesial (three canals), distal (two canals), and palatal (one canal) were located using a DG-16 probe [Figure 1b]. Cavit (3M ESPE, seefeld, Germany) was used for the temporization. Radiographical examination revealed two mesiobuccal (MB1 and MB2) canals, one DB, and one palatal (P) canal. Cone-beam computed tomography (CBCT) (Kodak Carestream 9300C, Atlanta, USA) was performed to assess the aberrancy of the canal, and CBCT axial section of which showed the seven canals which were two palatal canals (P1 and P2), three mesiobuccal canals (MB1, MB2, and MB3) and two distal canals (DB1 and DB2) [Figure 1c].

Endodontic therapy was resumed after understanding the anatomy and perplexities of the canal, followed by local anesthesia and isolation with a rubber dam. The previous temporization was removed, and the procedure was resumed by locating the canals. Moreover, the working length was determined radiographically [Figure 1d] and

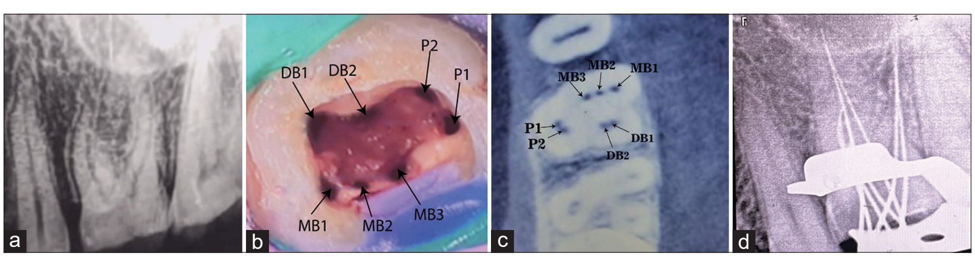

Figure 1: (a) Intraoral preoperative periapical radiograph of left maxillary first molar showing mesiocclusal radiolucencies suggestive of caries extending to the pulp with the periodontal space widening taken from the radiovisiography. (b) Intraoral image of left maxillary first molar showing the prepared conventional access cavity showing seven canals. The canals were assessed in the microscope with the × 3. The image was assessed on a 32″ LCD screen where image and brightness may vary. (c) The axial section of the cone beam computed tomography, with the large field of view, flat panel detector (17 mm × 13.5 mm cm in size) operating at 90 kv and 6 mA showing the seven canals. (d) The intraoral preoperative periapical radiograph showing the working length determination (radiographic working length measured from an incisal edge to the root apex)

was confirmed using the apex locator (E-PEX PRO apex locator, Orikam Healthcare Ltd., Gurgaon, Haryana, India). Biomechanical preparation was performed using Neoendo Flex Rotary Files (Orikam Healthcare Ltd., Gurgaon, Haryana, India) with the step-down technique. In addition, coronal flaring was performed using a Neoendo Flex Rotary Coronal Flaring File (Orikam Healthcare, Gurgaon, Haryana, India) of 30.08, 19 mm. Further cleaning and shaping were performed until 20.04%, and irrigation was achieved with 2.5 mL of 5% sodium hypochlorite (Neelkanth, Jodhpur, Rajasthan, India) using a 30-gauge side vented needle and normal saline. Then, the final irrigation was performed using 17% EDTA (Prevest Denpro, Jammu and Kashmir, India) and normal saline. However, an endodontic mishap occurred during cleaning and shaping, resulting of the separation of 20.04% of a rotary endodontic file of size 6.7 mm at the apex of the DB canal (DB2). Attempts were made to retrieve the separated instrument under the dental operating microscope (Global A-3 Series, Saint Louis, USA) using an ultrasonic tip (Woodpecker DTE ED18, Guilin, China), but the file was pushed even further, partially into the maxillary sinus. However, as the file could not be successfully retrieved and CBCT (Kodak Carestream 9300C, Atlanta, USA) [Figure 2a] was used to determine the specific location of the broken instrument, the treatment plan was modified to incorporate surgical intervention for managing the separated instrument, considering the potential risk of maxillary sinus perforation associated with further attempts of file retrieval.

Surgical access procedure

Under all sterile measures, following local anesthesia of posterior alveolar nerve block, the surgery was done in the dental operating microscope (Global A-3 Series, Saint Louis, USA), the intraoral vestibular incision was performed using a no. 15 blade, starting from the distal end of tooth 25 and ending at the proximal aspect of tooth 27 was given 2–3 mm from the apex of the tooth. The flap was reflected and proceeded further to the bone guttering using a no. 4 round-end cutting bur (SS White, Lakewood, USA). Then, a 2–3 mm window was created at the anterior wall of the sinus [Figure 2b], and the broken instrument was identified in the periapical region of 26 after the flap was retracted using Austin's retractor, appropriate hemostasis had been achieved, and the area had been thoroughly irrigated with normal saline. The file of size 7.5 mm [Figure 2c] was removed using mosquito forceps, and the area was sealed with MTA (Angelus, Londrina, PR, Brazil) [Figure 2d]. The wound was properly closed with the single interrupted suturing technique using 3-0 Vicryl sutures [Figure 2e]. The sutures were removed after 1 week, and access to the canals was reinstated. Cleaning and shaping were carried out till 25.04% in the mesial canals (MB1, MB2, and MB3) and 30.04% in both the distal canals (DB1 and DB2) and 25.06% in both palatal canals (P1 and P2). Obturation was performed using an AH Plus sealer (Dentsply Sirona, Charlotte, USA) [Figure 2f-h] with an equivalent size of gutta-percha cones (Dentsply Sirona, Charlotte, USA). Composite resin (Filtek Z350, 3M

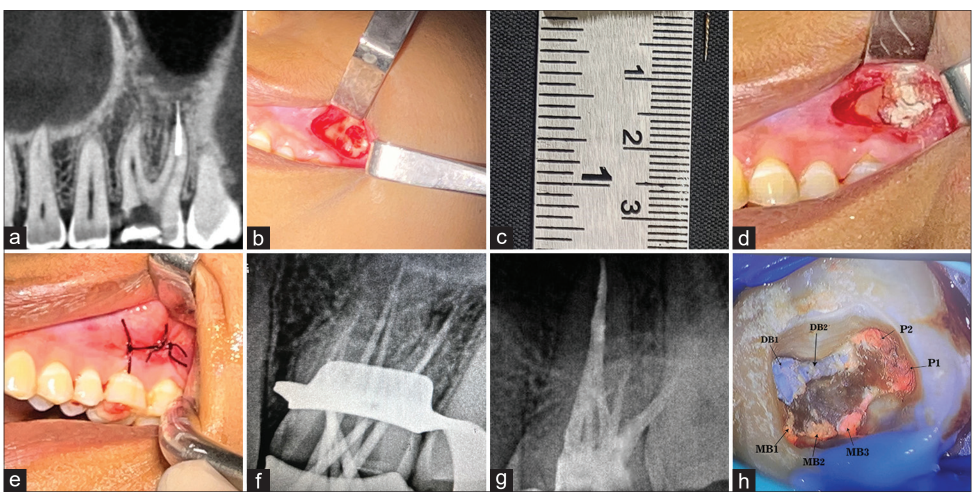

Figure 2: (a) The axial section of the cone beam computed tomography, with the large field of view, flat panel detector (17 mm × 13.5 mm cm in size) operating at 90 kv and 6 mA, showing the fractured instrument beyond the apex. (b) The intraoral image showing a 2–3 mm window created at the anterior wall of the sinus and the broken instrument was identified in the periapical region of 26 after the flap was retracted using Austin's retractor, (c) The image is showing the file of size 6.7 mm was removed using mosquito forceps. (d) The intraoral image showing the area was sealed with MTA (Angelus, Londrina-PR–Brazil). (e) The intraoral image showing the wound was properly closed with the single interrupted suturing technique using 3-0 vicryl sutures. (f) The intraoral preoperative periapical radiograph showing the master cone assessment with the accessory gutta-percha cones. (g) The intraoral preoperative periapical radiograph showing obturation was performed using an AH Plus sealer (Dentsply Sirona, Charlotte, USA) with an equivalent size of gutta-percha cones (Dentsply Sirona, Charlotte, USA). (h) The intraoral image showing the obturation that was performed using an AH Plus sealer (Dentsply Sirona, Charlotte, USA) with an equivalent size of gutta-percha cones (Dentsply Sirona, Charlotte, USA)

ESPE, Seefeld, Germany) was used for postendodontic restoration of the tooth.

Subsequently, the patient was included in a structured follow-up protocol to monitor the long-term outcomes of the endodontic intervention. Over a comprehensive follow-up period of 24 months [Figure 3] and reported no associated discomfort with the treated tooth. These findings indicate a favorable treatment outcome and suggest the effectiveness of the provided endodontic care in promoting patient comfort and satisfaction.

DISCUSSION

A fundamental necessity for endodontic therapy is an understanding of canal anatomy and its regular changes. One of the conventional reasons root canal therapies fails is because not every canal in the root canal system is properly identified and treated.[13] Endodontic treatment is based on the quality and the amount of radiographic information as it influences diagnosis, treatment planning, and results.[14]

CBCT scanning is a diagnostic imaging technique utilized in endodontics for reliable root canal anatomy assessment. The value of CBCT in identifying root canal anatomy and its correlation to digital radiography images was investigated by Matherne *et al*. It was determined that root canal anatomy was identified using CBCT images and correlates it with digital radiographic images. They concluded that CBCT images signify the diagnosis of the root canal systems.[15,16] Baratto Filho *et al*.[9] analyzed the internal anatomy of the upper first molar using an *ex vivo* study and conducted a clinical evaluation using an operational microscope and CBCT scans. CBCT scanning was performed to further comprehend the complicated root canal architecture in this case.[9] Herein, three roots and seven canals were identified on axial CBCT scans at 90 kv and 60 mA.

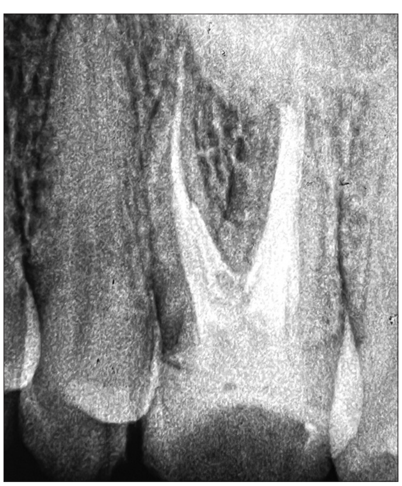

Figure 3: The intraoral preoperative periapical radiograph showing the follow-up after 24 months

The mesiobuccal canals were determined to have a Gulabivala type I canal pattern (3-1). Nonetheless, a Vertucci type II canal pattern was identified in the palatal and DB canals (wherein two canal orifices join and exit as a single apical foramen).

The fracture of an endodontic instrument during endodontic therapy also hampers the further endodontic treatment. Separation rates for nickel–titanium instruments have been recorded, ranging from 1.3% to 10%, whereas the reported rates of fracture for stainless steel instruments are between 0.2% and 6%. The management of separated instruments is essential due to the prevalence of torsional failure and cyclic fatigue as the primary etiology of rotary file fracture.[17]

There are various methods to deal with the broken instruments, which can be orthograde and surgical. The orthograde approach includes instrument bypass, retrieval, or obturation at the level of the fractured instrument. Because of the separation of the instrument beyond the apex, orthograde methods are ineffective. The nonsurgical removal of a broken file is affected by its length, diameter, and location inside the canal. Furthermore, the dentinal width of the root, depth of external concavities, and canal anatomy influence the retrieval of the separated fragment. The fragmented instrument's material type should also be considered before attempting to retrieve it. When removed with ultrasonics, stainless steel files do not crack, but nickel–titanium instruments may crack owing to the increased temperature.[18] Magnification entitled for a thorough examination to rule out fractures, isthmuses, and additional canals; as in this case report, magnification helped in determining the location of the seven canals, fractured instrument and the surgical repair.[19] This case report emphasizes how magnification may be used to pinpoint the precise position of the canals, the broken instrument, and the surgical repair of the separated instrument.

To improve visibility under an endodontic microscope, ultrasonic tips should be activated in a dry area without concomitant coolant irrigation. Better root canal disinfection is achieved with the retrieval of the separated instrument. However, this technique often involves the removal of dentin and may result in the instrument slipping beyond the apex. When nonsurgical treatment is unsuccessful, symptoms continue or periapical radiolucencies are observed radiographically during follow-up visits, surgery may be an option to explore the separated instrument. In this case report, an attempt to remove the separated instrument was performed using an ultrasonic tip (Woodpecker DTE ED18, Guilin, China) under dental operating microscope (Global A-3 Series, Saint Louis, USA). Unfortunately, at the time of retrieving the instrument using an ultrasonic tip (Woodpecker DTE ED18, Guilin, China), the mishap of the further stumbled of the instrument beyond the apex and near to the floor of the sinus. Thus, further attempts at nonsurgical retrieval of the instrument were impracticable, and surgical intervention was taken into consideration. Removal of the instrument should be attempted only after careful consideration of the case and assessment of the risks involved. The root canal anatomy and patient's prognosis must all be considered for the treatment.[20]

CONCLUSION

The endodontic treatment of a maxillary first molar with an unusual morphology of three roots and seven canals is presented as a unique and complex situation in this case report. Herein, CBCT scanning was used as an analytical technique to correctly analyze the intricate root canal anatomy and pinpointing the broken instrument. This ultramodern imaging method aided in understanding the complicated root canal system, which in turn allowed for more individualized treatment planning. Using ultramodern diagnostic adjuncts such as CBCT and dental operating microscope in endodontics and surgical repair of the broken instrument was crucial for the successful treatment of this difficult case. This case report highlights the need for frequent use of modern diagnostic tools in endodontic therapy for the best possible patient outcomes.

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Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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