Endodontic Management of Maxillary First Molar with Four Roots & Five canals with the Aid of Cone-Beam Computed Tomography Scanning : A Clinical Report

Dr. Amit Jena
Reader

Dr. Shashirekha .G
Reader

Dept. of Conservative Dentistry & Endodontics , Institute of Dental Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, Orissa.

Abstract

An accurate diagnosis of the morphology of the root canal system is a prerequisite for successful root canal treatment. A review of the literature reveals a low incidence of four roots with five canals in maxillary first molar. The diagnostic and therapeutic problems concerning molars with unusual anatomy are described on the basis of clinical examples. Diagnostic means such as preoperative radiographs, examination of the pulp chamber floor and spiral CT aid the location of additional root canals and anatomical variations. This case report describes the unusual variation in roots and canal morphology of maxillary first molar and use of advanced adjuncts cone beam CT (CBCT) in successfully diagnosing and negotiating them, this report also describes the management of separated instrument during root canal preparation procedure in an unusual root.

Key words: Maxillary first molar, Four Roots, five root canals, Cone-Beam Computed Tomography Scan (CBCT), Broken instrument, Mesiopalatal Root.

Introduction

The possibility of additional roots and root canals should be considered even in teeth with a low frequency of abnormal root canal anatomy. Maxillary first molar usually represents three roots and three canals, along with greater incidence of second mesiobuccal canal between 18% and 96.1% [1,2]. Several studies revealed that the majority of these teeth had three roots (96.2% of 416 teeth)[3]. Martínez-Berná and Ruíz-Badanelli (1983) reported three cases of maxillary first molar with six canals: three mesio-buccal, two disto-buccal and one palatal roots. Adanir N (2007) reported a clinical case having four roots (mesiobuccal, mesiopalatal, distobuccal, and palatal) and six canals with one mesiobuccal, two mesiopalatal, two distobuccal, and one palatal. Whereas, Barbizam JV et al (2004) reported a clinical case of five roots (2 palatal, two mesiobuccal and one distobuccal). Maggiore et al (2002) reported the maxillary first molar having six canals with two mesiobuccal, three palatal, and one distobuccal. Barotto Filho et al[4] reported a maxillary first molar with three roots and seven root canals.

During biomechanical preparation in an unusual canal configuration, the potential for instrument breakage is always present. The consequences of leaving, versus removing broken instruments from the canal have been discussed in the literature and a variety of approaches for managing these obstructions have been presented. The ability to nonsurgically access and remove a broken instrument will be influenced by the diameter, length and position of the obstruction within a canal and also it depends on the anatomy, including the diameter, length, thickness of dentin, the depth of external concavities and curvature of the canal[5]. There are three possible outcomes that may be encountered when treating these cases: (i) Retrieval, (ii) Bypass and sealing the fragment within the root canal space, (iii) True blockage.

The present case report discusses the successful endodontic management of a maxillary first molar presenting with four roots (mesiobuccal, mesiopalatal, palatal and distobuccal) and five root canals (one mesiobuccal canal, two mesiopalatal canal with one apical foramen {weine's type II canal configuration}, one palatal and one distobuccal canal) and managing the broken instrument in one of the root (mesiopalatal). This unusual morphology was confirmed with the help of cone beam computerized tomography (CBCT).

Case report

A 21-Year-old male patient presented with a chief complaint of intermittent pain in the posterior left maxillary region for past 3 week. His past medical history was non-contributory. Clinical examination revealed a deep dental caries with pulpal cavity exposure in relation to left maxillary first molar, which was tender on percussion. The clinical findings, radiographic findings and vitality tests led to a diagnosis of chronic apical periodontitis, necessitating endodontic therapy.

Radiographic evaluation of the involved tooth did not indicate any variation in the canal anatomy (Fig. 1). The involved tooth was anesthetized using local anesthesia of 2% lidocaine with 1:100,000 epinephrine (Xylocaine; AstraZeneca Pharma Ind Ltd, Bangalore, India.) followed by rubber dam isolation. An endodontic access cavity was established. Clinical examination with a DG-16 endodontic explorer (Hu-Friedy, Chicago, IL) revealed one canal opening in each of the distobuccal, mesiobuccal, and palatal root. On further examination and exploring the pulp chamber, two orifices (MP1& MP2) were noticed between the mesiobuccal and palatal orifices. Coronal enlargement of the canals was done with a nickel-titanium ProTaper series orifice shaper (Dentsply Maillefer, Ballaigues, Switzerland) to improve the straight-line access. The working length was determined with the help of an apex locator (Root ZX; Morita, Tokyo, Japan) and later confirmed using a radiograph. Multiple working length radiographs were taken at different angulations. During removal of the No 20 K file from the mesiopalatal canal (MP2), the instrument got separated (appoximayely 4mm) due to presence of severely curved root apically. Radiograph revealed presence of broken file in middle third of the mesiopalatal root canal (Fig 2). The radiographs did not clearly reveal the number and morphology of root canal systems. As to confirm this unusual morphology, it was decided to perform CBCT imaging of the tooth.

Access cavity was sealed with IRM cement (Dentsply De Trey GmbH, Konstanz, Germany). An informed consent was obtained from the patient, and a multislice CBCT scan of the maxilla was performed with a tube voltage of 100 KV and a tube current of 8 mA. The involved tooth was focused, and the morphology was obtained in transverse, axial, and sagittal sections of 0.5-mm thickness. CBCT scan slices revealed five canals (one mesiobuccal, two mesiopalatal, one palatal, and one distobuccal) (Fig 3) in the left maxillary first molar and 3D imaging revealed 4 roots (Mesiobuccal, Mesiopalatal, Distobuccal, Palatal).

At the second appointment, the patient was asymptomatic. After administering 1.8 mL (36 mg) 2% lignocaine with 1:200,000 epinephrine (Xylocaine), cleaning and shaping was performed under rubber dam isolation using ProTaper nickel-titanium rotary instruments (Dentsply Maillefer) with a crowndown technique. Irrigation was performed using normal saline, 2.5% sodium hypochlorite solution, and 17% EDTA; 2% chlorhexidine digluconate was used as the final irrigant. Multiple instrument removal methods like IRS and Masseran instrument removal system was implemented but it was unsuccessful, only bypassing the instrument was successful due to severe curvature in apical third. The canals were dried with absorbent points (Dentsply Maillefer), and obturated with 0.06 taper (ProTaper gutta-percha Dentsply), single cone obturation technique followed by warm vertical compaction with hand pluggers in the coronal third of each canal. Resin sealer (AH plus,

Maillefer, Dentsply, Ballaigues,Switzerland) was used (Fig 4). After completion of root canal treatment, the tooth was restored with a posterior composite filling (Ceram X mono Dentsply). Full-coverage porcelain crown was done after a week. The patient was asymptomatic clinically and radiograpically after 7 months (Fig 5).

Discussion

For a successful Endodontic treatment clinicians should have a sound knowledge of root canal morphology, application of modern diagnostic tools like digital radiography, dental microscope, spiral CT, micro CT, and cone beam CT.

In the present case, the presence of fourth root (mesiopalatal root) in the pre-operative radiograph was not noticed in the preliminary investigation of endodontic treatment due to 2-dimentional image of radiograph which was later found with 3D imaging CBCT. The K-file got separated during negotiating the apical curvature in the mesiopalatal root, this procedural error could have been prevented if various preliminary diagnostic methods have been implemented. The technique of by-passing the instrument was opted to prevent the potential complication of excess removal of root dentin at the expense of removing the instrument from the curved canal. Success rate can be quite variable because removal of fractured instrument is difficult and time consuming[5]

As to overcome the drawback of conventional and digital radiograph, an alternative new type of imaging apparatus cone beam CT system can be utilized for the examination of smaller parts of the dentomaxillofacial area. Literature revealed that CBCT technology aids in the diagnosis of endodontic pathosis, assessing root and alveolar fractures, analysis of resorptive lesion, identification of pathosis of nonendodontic origin and pre surgical assessment before root end surgery. The major advantage of CBCT scanning over the conventional CT-Scan are X-ray beam limitation, rapid scan time, effective dose reduction and high resolution 3D images and the disadvantages are scattered radiation and poor soft tissue visualization. The radiation dose (45µSv and 650µSv) is high in comparison with conventional intraoral radiographs. The approximate dose for a full mouth intra oral X ray examination using 21 analogue films is 150µSv. whilst an analogue panoramic examination results in an exposure of about 54µSv.[6,7,8,9]

Conclusion

A thorough knowledge of root canal anatomy, application of modern diagnostic tools (CBCT) and proper modification of the conventional access opening are essential for recognition and treatment of teeth with anatomical variations. Application of proven concepts, integrating best strategies and utilizing safe techniques during root canal preparation procedures in an aberrant root anatomy will virtually eliminate the broken instrument procedural accident.

References

1. Kulild JC, Peters DD. Incidence and configuration of canal systems in the mesiobuccal root of maxillary first and second molars. J Endod 1990;16:3117.
2. Buhrley LJ, Barrows MJ, BeGole EA, et al. Effect of magnification on locating the MB2 canal in maxillary molars. J Endod 2002;28:3247.
3. Blaine M. Cleghorn, DMD, MS, William H. Christie, DMD, MS, FRCD(C), and Cecilia C.S. Dong, DMD, BSc (Dent), MS, FRCD(C) Root and Root Canal Morphology of the Human Permanent Maxillary First Molar: A Literature Review JOE Volume 32, Number 9, September 2006 813-821.
4. Baratto Filho F, Zaitter S, Haragushiku GA, et al. Analysis of the internal anatomy of maxillary first molars by using different methods. J Endod 2009;35:33742.
5. Shen Y, Peng B, Cheung GS. Factors associated with the removal of fractured NiTi instruments from root canal systems. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004; 98: 60510.
6. Araki K, Maki K, Seki K et al. Characteristics of a newly developed dentomaxillofacial X-ray cone beam CT scanner (CB MercuRay): system configuration and physical properties. Dento Maxillo Facial Radiology2004: **33**:519.
7. Tyndall DA, Rathore S. Cone-beam CT diagnostic applications: caries, periodontal bone assessment, and endodontic applications. Dent Clin North Am 2008:52:82541.
8. Ludlow JB, Davies-Ludlow LE, Brooks SL, et al. Dosimetry of 3 CBCT devices for oral and maxillofacial radiology: CB Mercuray, NewTom 3G and i-CAT. Dentomaxillofac Radiol 2006;35:21926.
9. Mah JK, Danforth RA, Bumann A, et al. Radiation absorbed in maxillofacial imaging with a new dental computed tomography device. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;96:50813.

Legends

Figure 1: Preoperative radiograph of 26
Figure 2: Working length radiograph of 26
Figure 3: CBCT Scanning axial Image 26
Figure 4: Post-obturation Radiograph of 26.
Figure 5: Radiograph after 7months of 26.