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Case Report

ENDODONTIC MANAGEMENT OF MAXILLARY FIRST MOLAR WITH FIVE ROOT CANALS DIAGNOSED WITH CONE-BEAM COMPUTED TOMOGRAPHY (CBCT) SCANNING: A CASE REPORT

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A B S T R A C T

Introduction: The purpose of this article was to enhance the importance of having a thorough knowledge about the root canal anatomy.
Methods: This case report presents the endodontic management of a maxillary first molar with three roots and five canals. The clinical detection of the five root canals was made using a dental operating microscope and confirmed using cone-beam computed tomography (CBCT) scanning.
Results: CBCT images confirmed the presence of five root canals that were not clearly seen in the conventional intraoral periapical radiograph. CBCT image sections of the present case showed broad disto-buccal root with two canals exiting separately, Vertucci type IV canal pattern. Whereas the mesio-buccal root presented the Vertucci type II canal pattern. Palatal root presented Vertucci type I canal pattern.
Conclusion: The present case report discusses the endodontic management of a maxillary molar with three root and five canals and also highlights the role of operating microscope and CBCT imaging as a valuable tool in modern endodontic practice to ascertain root canal morphology.

INTRODUCTION

The permanent maxillary first molar's morphology has been extensively studied. When planning endodontic therapy, understanding the root and internal root canal anatomy has been a dynamic and critical concern. Precise knowledge of root canal system and its frequent variations, integrate clinical skills and armamentarium are the keys for successful endodontic therapy.

Maxillary first molars commonly present with three roots and three canals, with a commonest variation is the presence of a second mesiobuccal canal (MB2) canal reported between 56.8% and 96.1% of the case[1-3] with a global prevalence of 73.8% [4]. Other variations include single root with a single canal[5], two roots[6], four roots[7], and five roots[8] with distinctive canal morphology within individual roots. Tooth with five[9] and six[10] root canals or with a C-shaped canal configuration[11]have also been reported. Kottoor *et al*[12,13] reported the endodontic management of a maxillary first molar with seven and eight root canals.

Martı´nez-Berna´ and Ruiz-Badanelli[14] reported six root canals with three mesiobuccal, two distobuccal, and one palatal, whereas de Almeida *et al*[10]and Bond *et al*[15]reported six root canals with two mesiobuccal, two distobuccal, and two palatal. Maggiore *et al*[16] reported the maxillary first molar having six canals with two mesiobuccal, three palatal, and one distobuccal, whereas Adanir[17]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. Alavi *et al*[18] and Thomas *et al*[19] reported the incidence of two canals in the distobuccalroot as 1.90% and 4.30%, respectively, and few other case reports have noted two canals in the distobuccal root[8,11,15,20]

Various authors have been reported the incidences of five or more root canals in maxillary first molars are summarized in table 1.

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Case reports of number of root canals in permanent maxillary first molars presenting five or more canals

Investigator	Year	Number of canals	Mesiobuccal	Distobuccal	Palatal
Cecic*et al*[21]	1982	5	2	1	2
Mart_ınez-Bern_a and Ruiz-Badanelli[14]	1983	6	3	2	1
Stabholz and Friedman[22]	1983	5	3	-	2
Beatty[23]	1984	5	3	1	1
Bond *et al*[15]	1988	6	2	2	2
Wong[24]	1991	5	1	1	3
Holtzman[25]	1997	5	2	1	2
Johal[26]	2001	5	2	1	2
Maggiore *et al*[16]	2002	6	2	1	3
Ferguson *et al.*[9]	2005	5	3	1	1
Favieri *et al*[27]	2006	5	3	1	1
Adanir[17]	2007	6	3	2	1
de Almeida-Gomes *et al*[10]	2009	6	2	2	2
Holderrieth and Gernhardt[28]	2009	5	2	1	2
Deepalakshmi*et al.*[29]	2009	5	2	1	2
Karthikeyan and Mahalaxmi[30]	2010	6	2	2	2
Kottoor*et al.*[12]	2010	7	3	2	2
Albuquerque *et al*[55]	2010	6	2	2	2
Kottoor*et al*[13]	2011	8	3	3	2
Kaushik M and Mehra N[46]	2013	6	2	2	2
Tahra Mohammad Al-Habboubi and Khalaf A. Al-Wasi[47]	2016	6	3	2	1
PremAnand and Sekar Mahalaxmi[48]	2016	5	2	2	1
VR Venumuddala *et al*[49]	2017	7	3	3	1
Fogel HM and Cunha RS[50]	2017	5	2	2	1
Hindlekar A *et al*[51]	2018	7	3	2	2
KishanKV*et al*[52]	2018	6	3	1	2
FarooqS *et al*[53]	2019	6	2	2	2
PriteshKisanlal Agrawal[54]	2019	6	3	2	1

The present case report discusses the successful endodontic management of maxillary first molar with an unusual morphology of three roots and five root canals. This unusual morphology was confirmed with the help of cone beam computed tomographyc(CBCT) scanning.

CASE REPORT

A 25 year old female patient referred to the post graduate clinic of the Department of Conservative dentistry and Endodontics from department of orthodontics and Dentofacial Orthopedics, K.V.G Dental College and Hospital, Sullia, Karnataka, India with a chief complaint of fractured restoration and decayed tooth in the upper left posterior tooth. Patient's dental history revealed incomplete endodontic therapy in the same tooth. The patient's medical history was noncontributory. A clinical examination revealed carious maxillary left first molar with a fractured restoration(Fig.1). Tooth was non tender to percussion and palpation of the buccal and palatal aspect of tooth. Circumferential periodontal probing around the tooth and mobility were within the physiological limits. Preoperative intraoral periapical radiographs revealed anextensivemesio-occlusal radiolucency involving the pulp space with widened periodontal ligament space. The clinical and radiographic examination gives a diagnosis of chronic irreversible pulpitis with asymptomatic apical periodontitis with respect to maxillary left first molar was made, and nonsurgical endodontic therapy was decided to perform.

Intraoral periapical radiographic evaluation of the involved tooth did not reveal any variations in the root canal anatomy.(Fig.2) The tooth was anesthetized with 2.5 ml 2% lignocaine local anesthetic solution containing 1:80000 epinephrine (Warren Lignox 2%A, Indoco remedies Ltd, Mumbai, India.) followed by rubber dam isolation. Secondary caries and temporary restorations are removed with a round bur. An endodontic access cavity was prepared with an Endo Access bur and an Endo Z bur (DentsplyMaillefer, Tulsa, USA). On clinical examination with the help of DG-16 endodontic explorer revealed the mesiobuccal (MB1), distobuccal (DB1), and a single palatal (P) orifice. Examination with dental operating loops with 3.5x magnification two additional root canal orifices MB2 and DB2 were located palatally to MB1 and DB1 respectively (Fig.3). However several attempts to introduce the file in to MB2 orifice were unsuccessful. While viewing under the dental operating microscope (DOM) pulpal floor was extended mesially to gain access into MB2 canal orifice (Fig.4) as negotiation of the MB2 canal was difficult due to a ledge of dentin that sealed its orifices. Coronal enlargement was performed with a nickel-titanium ProTaper Gold SX rotary file (DentsplyMaillefer, Switzerland) to improve the straight-line access (Fig.4).

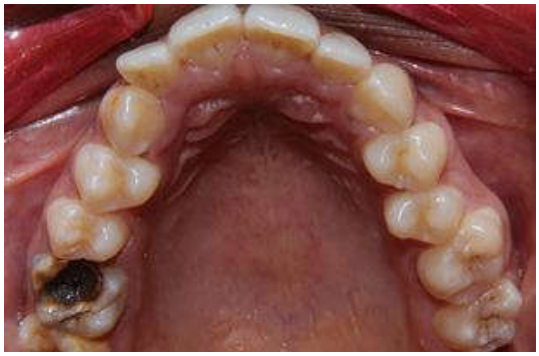

Fig 1

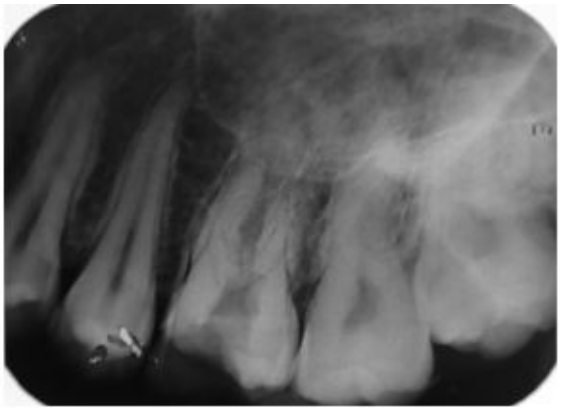

Fig 2

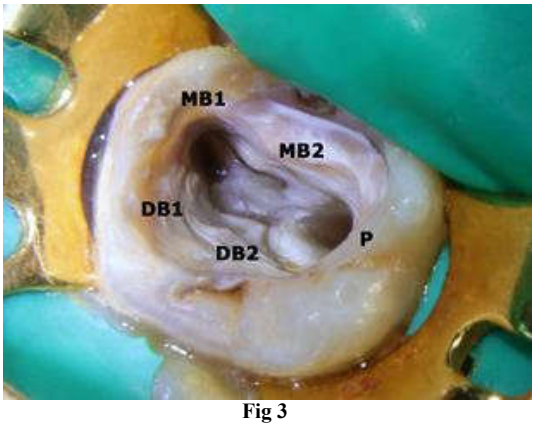

Fig 3

Fig 4

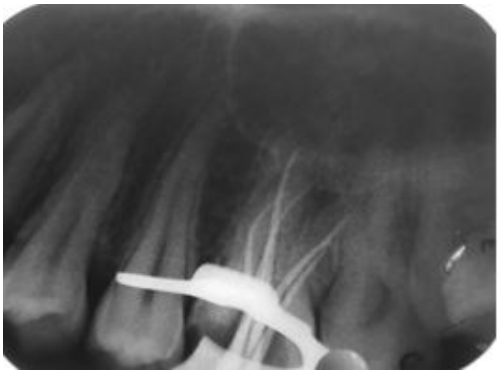

Fig 5

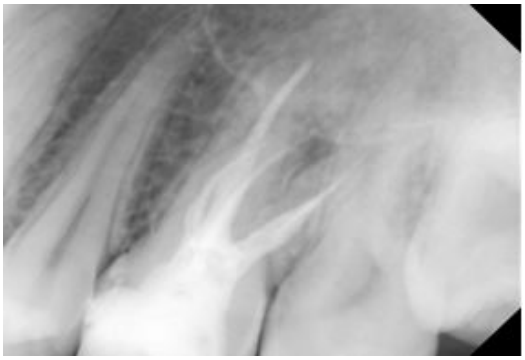

Fig 6

All the root canals were explored with ISO #10 K-fies. Working length was determined with the help of an apex locator (Econnect S, Eighteeth, Changzhou Medical technology co, Ltd) and later conformed using a intraoral periapical radiograph. Working length radiographs were taken at different angulations to confirm the root canal systems. Radiographs did not clearly reveal the number and morphology of root canal systems hence CBCT imaging of the tooth was done.

Access cavity was sealed with IRM cement (Prime TMP-RS, Prime dental products, Pvt Ltd, India). An informed consent was obtained from the patient for CBCT, and a multislice CBCT scan of the maxilla was performed (PLANMECA Promax 3D mid, Yenepoya dental college and hospital, Mangalore) with a small FOV 4*5 cm, tube voltage of 90 KV and a tube current of 10 mA. The involved tooth was focused, and the morphology was obtained in transverse, axial, and sagittal sections of 0.1mm thickness. CBCT scan slices revealed five canals (twomesiobuccal, one palatal, and two distobuccal) in the left maxillary first molar(Fig 7(a-d).

Fig 7 a

Fig 7 b

Fig 7c

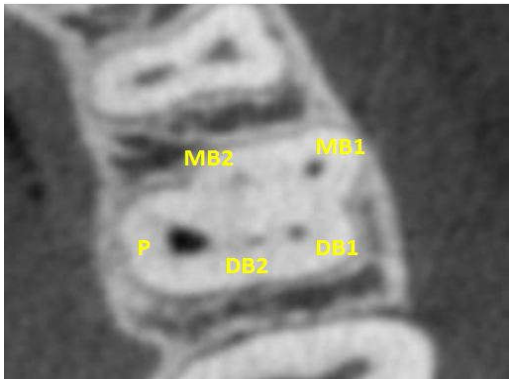

Fig 7 d

CBCT images confirmed the presence of five root canals that were not clearly seen in the conventional intraoral periapicalradiograph. Axial sections of CBCT images revealed MB2 orifice 1.41mmpalatally from MB1 orifice, DB2 orifice were 2.91mm palatally from DB1 orifice and palatal canal orifice were separated from MB2 and DB2 orifices by 2.63mm and 2.84mm respectively. At the second appointment, the patient was asymptomatic. After administering 2 ml 2% lignocaine containing 1:80000 epinephrine (Warren Lignox 2%A, Indoco remedies Ltd, Mumbai, India.), under rubber dam isolation cleaning and shaping was performed using ProTaper Gold nickel-titanium rotary instruments (DentsplyMaillefer) with a crown down technique. Root canal irrigation was performed using normal saline, 3% sodium hypochlorite solution, and 17% EDTA; 2% chlorhexidinedigluconate was used as the final irrigation. The canals were dried with absorbent points (DiaDent MMPP, DiaDent), and obturation was performed using continuous wavewarm vertical condensation techniqueby using both down pack and backfill handpieces(Elements, Sybron Endo,Kerr.) and zinc oxide eugenol as sealer (Fig.5,6). The tooth then restored with composite resin (Filtek Z350 XT, 3MEspe).The patient was advised a full-coverage metal ceramic crown and tooth was asymptomatic during the follow-up period of 2 months.

DISCUSSION

Radiographic examination is an essential diagnostic component for the management of endodontic root canal morphologic variations. Despite widespread use, periapical images yield limited informationby the fact that three dimensional anatomies being converted into a two dimensional image which is greatly limiting diagnostic performance[31]. Based on the literature data maxillary first molar is considered one of the most complex teeth with anatomical variations in the dental arch. A thorough understanding of the anatomic morphology is essential for the success of endodontic therapy.

Case reports of five to eight root canals have been reported in various literatures[9,12-13,17, 21-30,46-55]. Kottoor*et al*. reported three roots and seven canals with three mesiobuccal, two distobuccal, and two palatal canals[12]. Almeida *et al*. reported a case of maxillary first molar having three roots and eight root canals with three mesiobuccal, three distobuccal, and two palatal canals[32]. Maggiore *et al*. reported the maxillary first molar with two mesiobuccal, three palatal, and one distobuccal canal[16]. Adanir reported a case of maxillary first molar having four roots (mesiobuccal, mesiopalatal, distobuccal, and palatal) and six canals with one mesiobuccal, two mesiopalatal, two distobuccal, and one palatal[17].

This case report demonstrates the successful management of a five canal maxillary first molar with two distobucccal, two mesiobuccal canals and one palatal canal.The incidence of having two canals in the disto-buccal root has been reported to be between 1.6% and 9.5%[33]. The presence of two canals in the disto-buccal root in the present case could possibly due to the broad root morphology buccolingually or fusion between two roots[34].

In this present case CBCT evaluation was performed prior to the root canal preparation. CBCT imaging confirmed the presence of the three roots and five root canals.The axial and transverse CBCT image sections of the present case showed broad disto-buccal root with two canals exiting separately, Vertucci type IV canal pattern. Whereas the mesio-buccal root presented the Vertucci type II canal pattern.Palatal root presented Vertucci type I canal pattern.Internal and external configurations of teeth may vary considerably among geographic locations[35]and various factors such as age[36,37]gender[38,39,40] and ethinicity[41,42]. Asians represented a high prevalence of root canal morphology with Vertucci type I(35.0%) and type IV(45.0%) configuration when compared with white who have type I(23.4%), type IV(36.3%)[43]. The opposite prevalence was also reported regarding Vertucci type II configuratuon, which was more common finding in whites (36.3%) compared with Asians(15.0%)[43].

It is very difficult to predict the root canal anatomy on the basis of preoperative intraoral periapical radiograph alone. There are various methods for locating extra canals such as examination of the pulp floor withDG 16 explorer, troughing of grooves with ultrasonic tips, use of dye, champagne bubble test, and visualizing canal bleeding points. The routine use of the DOM and specific instruments are necessary to enhance the efficiency and the effectiveness of the clinical procedure.

CBCT imaging is the most promising diagnostic modality in endodontic practice with various applications which include diagnosis of endodontic pathologies,evaluation of root canal morphological variations, assessment of pathosis of non-endodontic origin, evaluation of root fractures and trauma, analysis of external and internal root resorption and invasive cervical resorption, and presurgical planning[44].Matherne *et al* conducted an in vitro study evaluating digital radiography systems with CBCT. The greater number of root canal systems were identified using CBCT imaging than radiographic images[45].

It is foremostimportant for a clinician to look for anatomical variations that may occur in a tooth that might otherwise seem normal. Based on the present case, the use oftechnology such as CBCT and magnification is important for the success of endodontictreatment, as they allow the endodontist to identify the extra canals that wouldbe missed with a conventional periapical radiographic imaging and with no magnification.

CONCLUSION

The present case report discusses the endodontic management of a maxillary molar with three root and five canals and also highlights the role of operating microscope and CBCT imaging as a valuable tool in modern endodontic practice to ascertain root canal morphology.

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