Case Report

Anatomical Challenges in Endodontics – A Series of Case Reports

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ABSTRACT

Mandibular canine, molar and premolar presents a complex internal anatomy. Although the presence of three and four root canals are the most common anatomic configuration of the mandibular molar, other morphologies have also been reported. The purpose of this report is to show a clinical case of mandibular first molar with five root canals, mandibular canine with two root canals and mandibular first premolar with two root canals which lead us to conclude that such anatomical variations also occur in India as much as described in the international literature and cannot be overlooked when treating the teeth. Improved understanding of these uncommon anatomic configurations should lead to better clinical outcomes.

Keywords: anatomy, canine, molar, premolar, root canal therapy

INTRODUCTION

Knowledge of internal dental anatomy is fundamental to the success of endodontic treatment.

The anatomy of the root canal system determines the parameters under which the endodontic treatment is performed and directly affects the success of the root canal treatment. The majority of the problems that occur during the root canal treatment are due to the insufficient knowledge of the anatomy of the pulp space.[1] The main documented reason for failure of the endodontic treatment is the inability to obturate one of the root canal because of ignoring the variations of the internal and external dental anatomy of the tooth. In order to perform a quality endodontic treatment, which will ensure the tooth's long term durability, it is imperative that the dentist takes into account the morphology of the radicular pulp space and the variations of the entire canalicular system before initiating the endodontic treatment.[2]

A thorough understanding of root canal anatomy and morphology is required for achieving high levels of success in endodontic treatment. 42% incidence of missed roots or canals was reported by Hoen and Pink in their analysis on teeth requiring re-treatment.[3] Hess [4] conducted a study with 512 mandibular first molars and reported that 0.3% of the teeth had only one, 17.7% had two, 78% had three, and 4% had four canals. De Deus [5] studied 75 mandibular molars and found that 8% had two, 56% had three, and 36% had four canals. According to Martinez-Berna and Badanelli, [6] several in vitro and in vivo studies have investigated the anatomical configuration and the number of root canals of mandibular molars.

However, their studies did not report on any case of mandibular molars with five canals. Fabra-Campos [7] studied 145 mandibular first molars and found that 2.75% of the teeth had five canals.

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Martinez-Berna and Badanelli [6] conducted a clinical investigation and found 29 teeth with five root canals in a sample of 2362 mandibular permanent molars. Jacobsen et al. found a substantial rate of occurrence of a third mesial canal in mandibular first molars, and reported that 12 out of the 100 molars studied had a third mesial canal.[8] Mandibular premolars have earned the reputation for having the most aberrant anatomy. Numerous reports of root canal variations in these teeth have been reported in literature.[9,10] Vertucci in his series of studies conducted on extracted teeth, reported 2.5% incidence of a second canal.[11] Zilich and Dawson reported 11.7% occurrence of two canals and 0.4% of three canals.[12] According to Ingle, mandibular second premolars have only 12% chance of a second canal, 0.4% of a third canal and Harty has reported 11% possibility of second canal. In most instances they have had one canal, but teeth with two or more canals have also been reported.

From a morphological standpoint, mandibular canine is usually a monoradicular tooth. The internal anatomy of the radicular canals does not always correlate with the outer shape of the tooth. The mandibular canines do not always display the basic anatomy that we expect with one root and one canal. The proof is given by the various studies in which research was done on both the morphology of the monoradicular canines and the presence of those, which can display two canals. It is important that this fact be taken into account in order to prevent the failure of the endodontic treatment and the subsequent loss of the tooth. Generally, mandibular canines contain a single root and root canal.[13,14] The occurrence of two canals and even more two roots is rare, ranging from 1% to 5%.[15]

CASE REPORTS

Case Report 1

A healthy, 40 year old female was referred to the Department of Conservative Dentistry and Endodontics with a chief complaint of pain in lower left region. The pain lingered for several minutes even after removal of the stimulus and led to a disturbed sleep. Clinical examination revealed large carious lesions, associated with mandibular left canine and mandibular left premolar. Electric pulp test was done for both the teeth. Mandibular left canine gave an exaggerated response to the electric pulp test.

Initial periapical radiographic examination revealed carious lesions approaching pulp in mandibular left canine [Fig 1(a)]. Another finding was presence of a large pulp canals in the coronal one third portion of the crown and root which got diminished in the middle third of the root, which was suspected to be indicative of separation of root canals. The root canal treatment was planned for this tooth.

Endodontic treatment was performed in a two sessions. After local anesthesia, rubber dam (Hygenic,Coltene WhaledentInc.,USA) was applied and secured with clamps. Endodontic access preparation was performed with Endo-Access round diamond bur (Dentsply,Maillefer, Ballaigues, Switzerland) and an Endo Z tapered safe-end bur (Dentsply/Maillefer, Ballaigues, Switzerland). Further lingual modification and careful exploration of the access cavity demonstrated the presence of a separate extra canal lingual to the main canal. Exploration and negotiation of two root canals were done with a size 15 K-file (Maillefer, Ballaigues, Switzerland). Root canal length estimation was done using apex locator (Propex II, DentsplyMaillefer, Switzerland), which was confirmed radiographically [Fig 1(b)]. The working length radiograph revealed separate buccal and the lingual canals which joined in the apical third of the root (Vertucci Type II). The working length was recorded. The canals were prepared with K-files (Maillefer, Ballaigues, Switzerland) in Step-back manner and irrigation with 5.25% sodium hypochlorite at each change of file. After the completion of the bio-mechanical preparation on first appointment, intra-canal dressing of calcium hydroxide (Prime Dental Products Pvt LTD, Mumbai, India) was placed and temporary dressing (Cavit G, 3M, ESPE, Germany) was placed. The patient was recalled after six days.

The patient was asymptomatic on next visit. The temporary dressing and intracanal medicament

were removed from the root canals & root canals were irrigated with 5.25% sodium hypochlorite (Amble healthcare Pvt. Ltd.,india) followed by saline & subsequently dried with the absorbent paper points. The master cones were placed in the canals and the radiograph was made [Fig 1(c)].

The root canals were obturated with gutta-percha cones using an epoxy resin-based root canal sealer (AH Plus Sealer; Dentsply/Maillefer) with lateral compaction technique. The final radiograph showed two well-obturated canals in mandibular left canine and restored mandibular left first premolar [Fig 1(d)]. The patient was rescheduled for permanent restoration and crown restorations. The recall was done at three and six months.

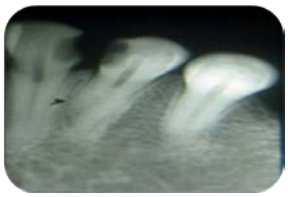

Fig 1(b) - Working length determination

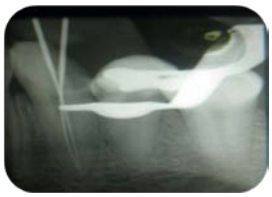

Fig 1(a) - Preoperative radiograph

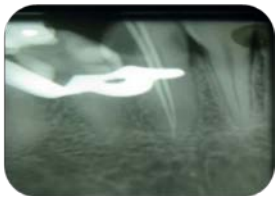

Fig 1(c) - Master cone radiograph

Fig 1(d) - Obturation

Case Report 2

A 45-year-old female patient was referred to our postgraduate endodontic department for management of lower right second premolar. History revealed that the patient had experienced sensitivity to cold drinks for the past six months and reported pain for the past two days. Pain was spontaneous in nature and aggravated on chewing and lying down. On intraoral clinical examination, there was a carious exposure of the pulp [Fig 2(a)].

Two roots were found and were distinguished as buccal and lingual based on the Clark's rule (SLOB same side lingual opposite buccal), which states that if the object moves from its reference point towards the distal side, while the tube is shifted mesially, then the object lies on the buccal aspect and vice versa.

Access was gained to the pulp chamber after administration of local anesthesia, under rubber dam isolation. To gain sufficient access to the canals, the conventional access opening was modified into one that was wider bucco-lingually as the roots were bucco-lingually oriented. Orifice location was not easy as the coronal pulp chamber was unusually long and the separation of the roots was from the middle third of the root. After careful inspection, two canal orifices were located and patency was ascertained using a small size K-file. To distinguish between the two roots and canals, one H-file and one K-file was inserted into each of the canals, before radiographic exposure. Then the working length radiograph was taken. [Fig2(b)]. Gates-Glidden drills 4, 3, 2 with a brushing motion, in a crown down fashion was used to enlarge the orifices to achieve a straight line access to the apex. The canal were sequentially irrigated using 5.25% Sodium hypochlorite and 17% EDTA during the cleaning and shaping procedure and master cone radiograph was taken [Fig 2(c)]. The canals were thoroughly dried and obturation was done using standardized Gutta-percha and Zinc Oxide Eugenol sealer by means of lateral condensation [Fig 2(d)].

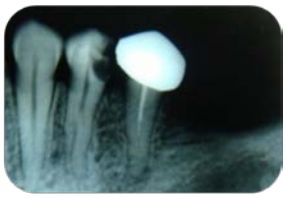

Fig 2(a) - Preoperative radiograph

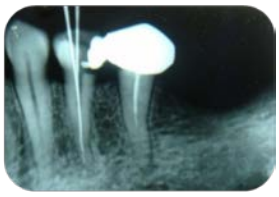

Fig 2(b) - Working length determination

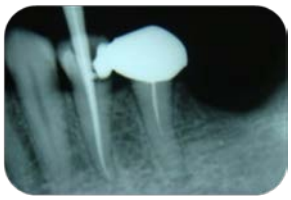

Fig 2(c) - Master cone radiograph

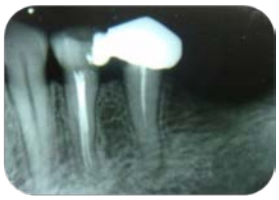

Fig 2(d) - Obturation

Occlusal access opening was sealed with temporary filling material and a final radiograph was taken. The two roots of the second premolar can be appreciated well in this post-obturation radiograph. The patient was reviewed for two weeks and the post-endodontic permanent**.**

Studies in the past reported a high incidence of about 1.33% on the presence of two roots in mandibular second premolars and also reported more than 20% incidence of extra canals. [19]

Case report 3

A 28-year-old patient presented with a complaint of diffuse pain in the right mandibular first molar. Pulp testing and percussion tests in the region revealed intense and continuous pain and confirmed irreversible acute pulpitis. Radiograph showed deep caries in the tooth and no changes in the apical region [Fig 3(a)]. No anatomical abnormality was observed on the radiographs. Endodontic treatment was performed as described below.

In the first visit adequate anaesthesia was obtained and the chamber accessed. As the negotiation of canals began with a no. 10 file, a third canal was found in the mesial root between the previously identified mesiolingual and mesiobuccal canals. After the instrumentation of the cervical third of the root canals, a dental operating microscope (8x magnification) was used to confirm the existence of the five root canals. The instrumentation of the initial 2/3 of the five visible canals was performed using the hybrid crown-down technique described by Marshall and Papin.[16,17] An apical locater (Endex, Osada, Japan) and a no. 15 file were used to establish working length that was confirmed radiographically [Fig3(b)]. The second phase of instrumentation, using the hybrid step-back technique, was performed with a no. 30 file for all canals. In the second visit, the canal was irrigated and master cone fit was checked [Fig 3(c)] and the root canals were dried with absorbing paper points. Root canals were obturated using the hybrid technique described by Tagger.[18] [Fig 3(d)] After obturation, glass ionomer cement was used for the temporary sealing.

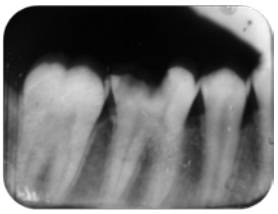

Fig 3(a) - Preoperative radiograph

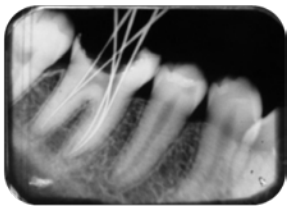

Fig 3(b) - Working length determination

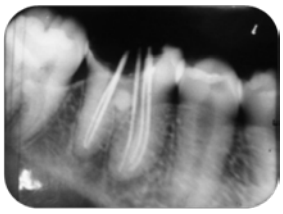

Fig 3(c) - Master cone radiograph

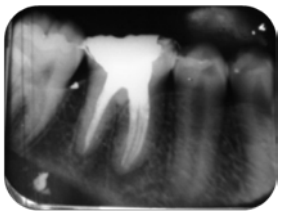

Fig 3(d) - Obturation

DISCUSSION

Root canal anomalies, usually those caused by fusion or gemination, are revealed when coronal anomalies occur. However, some teeth with clinically normal crowns can have root canal anomalies. Several studies investigated the anatomy of root canal systems and the anatomical variations found in the different types of teeth to provide information that might improve the outcome of endodontic treatment. The mandibular canine is the second longest tooth in human dentition. It is only few millimeters shorter than the maxillary canine. There is usually one canal present which usually exits in a single foramen at the apex. At times, two root canals, rarely three root canals or two roots can be present. So, the complex nature of root canal morphology of mandibular canines should be thoroughly understood because additional root canals if not detected, can be a major reason for failure of root canal treatment. Care should be taken during initial radiographic examination as well as during access preparation because exploration and location of canal orifices act as a guide to navigate the canals.[25]

Pineda F and Kuttler Y (1972) reported 18.5% of the mandibular canines having two canals in a study on 187 radiological images. A very similar

result was obtained by Calişkan MK et al (1995),[26] in a study of 100 mandibular canines, the actual number being 19.5%. Much greater percentages were observed by Sert S et al.(2004) and by Vertucci FJ (1974) with 24% and 22% respectively.

On the other hand, the study of Bellizzi R and Hartwell G (1983),[27] which included examination of 195 mandibular canine X-rays showed a low percentage of 4.1%. In a rare case report, Orguneser A and Kartal N (1998) reported mandibular canine with three root canals.

Heling I et al (1995) reported a case of mandibular canine with two roots and three root canals. D'Arcangelo C (2001) carried out root canal treatment in mandibular canines with two roots.

The presence of extra roots or canals in mandibular premolars is undoubtedly an endodontic challenge. A wide range of opinions are reported in the literature regarding the number of root canals, but there are very few reports on the variations in the number of roots that occur in the mandibular second premolars.[24] Failure to recognize the presence of extra root or canals can often lead to acute flare-ups during treatment and subsequent failure of endodontic therapy.

Studies about the anatomy of root canals conducted by VandeVoorde *et al.* Badanelli and Martinez-Berna and Fabra-Campos,[20] reinforced the importance of an accurate clinical evaluation of a possible fourth or fifth root canal to ensure success of endodontic treatment. Martinez-Berna and Badanelli drew attention to the importance of investigating the existence of a fourth and even a fifth root canal. Jacobsen *et al* [21] found a substantial rate of occurrence of a third mesial canal in mandibular first molars: they reported that 12 out of the 100 molars studied had a third mesial canal. Clinical evaluations have shown a small but significant number of mandibular molars with five canals.

New technologies, such as the dental operating microscope offer great magnification and illumination of the operating field and substantially improves the visualisation of root canal orifices. Carvalho and Zuolo [22] described the usefulness of microscopes in the accurate location of root canal orifices, which may substantially improve treatment outcomes.

Clinical evaluations have shown a small but significant number of mandibular molars with five canals.[23] The region between the mesiolingual and mesiobuccal canals should be carefully examined in case of the possible occurrence of a fifth canal.

CONCLUSION

Thorough knowledge of dental anatomy of how many canals to expect, their location, length and relationship to each other and its possible complexities/variations is a pillar stone for endodontic success. The clinician should be astute enough to identify the presence of unusual numbers of roots and their morphology by carefully examining and interpretating the radiographs and by close clinical inspection of the floor of the pulp chamber assisted with the use of auxiliaries like loupes or the operating microscopes beacuse proper and ideal access to the root canal is essential for a successful treatment outcome.

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