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Anatomical miscellany in molars: Their endodontic management

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Abstract
Root canal anatomy is highly complex and unpredictable. Success of endodontic treatment depends on proper identification of all the canals, thorough chemo-mechanical preparation followed by three dimensional obturation with hermetic seal. Failure of any of these steps may occur due to unusual tooth morphology. The risk of missing anatomy during root canal treatment is high because of the complexity of the root canal system. The knowledge of normal anatomy and its frequent variations can greatly enhance the success rate of endodontic practice.

Keywords: Anatomical variations, Extra canals, Ni-Ti instruments, Radix entomolaris

Introduction
The primary aim of endodontic treatment is the elimination of bacteria from the infected root canal and prevention of subsequent reinfection. This is mainly achieved by a thorough cleaning and shaping of the root canal, followed by a three-dimensional filling with a fluid tight seal. In order to achieve these endodontic goals, the clinician must have an in-depth knowledge of root canal anatomy and be aware of its anatomic diversities such as extra roots, extra canals, webs, fins, and isthmuses that may complicate the endodontic procedure.
All categories of teeth may have extra roots and/or canals, but the likelihood of finding aberrant canal configurations are higher in premolars and molars. Mandibular molars show considerable anatomic variations and abnormalities with respect to number of roots and root canals. Extra canals were seen in mesial root and more frequently in distal root. Anatomical variations can occur in maxillary permanent molars. There are reports of high incidence of two canals in the mesio-buccal root of the maxillary molars, and fewer reported cases of two root canals in the palatal root [1].
Exact mechanism behind these anomalies is still not known but, it has been postulated that secondary dentine apposition during tooth maturation will form a dentinal vertical partition inside the canal cavity, thus creating the root canals. The third root canal may be created inside the root cavity of the mandibular molar by this process. Other possible reasons for the presence of extra root canals include role of external factors during odontogenesis, penetrance of an atavistic gene and more importantly racial genetic factors [2].
Another major variant is the presence of an additional root called as the “Radix Entomolaris” that was first mentioned in the literature by Carabelli. Carlsen and Alexanderson suggested that the presence of additional root distolingual is termed as Radix Entomolaris and the presence of additional root mesiobuccal is termed as Radix Paramolaris [3].
This case series presents mandibular molars with extra roots and extra canals and maxillary molar with additional canals and their management using appropriate instruments and techniques.

Case 1 – Radix entomolaris
A 42 year old male patient reported with a chief complaint of severe pain in the left lower posterior region. Based on clinical and radiographic findings, case was diagnosed as chronic irreversible pulpitis and root canal treatment was planned for # 36. A diagnostic radiograph had shown indistinct root morphology of the distal root. Further, the presence of an additional distal root outline was observed with mesial and distal angulated radiographs.
After administration of inferior nerve block anesthesia, tooth was isolated with rubber dam. During the access cavity preparation an additional bleeding spot was observed lingual to the

distal canal orifice and access cavity was modified from a triangular shape to a trapezoidal form and the fourth canal (distolingual) was located. Working length radiographs has confirmed the presence of extra root distolingual (radix entomolaris). Cleaning and shaping of all the canals was completed by protaper rotary system. Both the mesial canals and distal canals were enlarged upto #F2 using copious irrigation with 3% sodium hypochlorite. Obturation was done with gutta percha and epoxy resin sealer using lateral condensation technique. Six months recall clinical and radiographic findings revealed asymptomatic tooth.

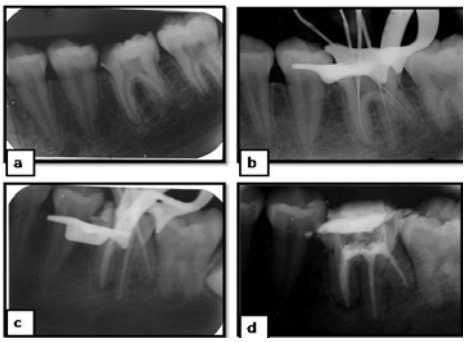

Fig 1: (a) Pre-operative view; (b) Working length; (c) Master cone; (d) Obturation radiographs

Case 2 – Radix entomolaris

A 30 year old male patient reported with a chief complaint of severe pain in the right lower back tooth region. Based on clinical and radiographic observations, case was diagnosed as chronic irreversible pulpitis and the root canal treatment was planned for # 46. Pre-operative radiograph revealed obscure distal root outline indicating the presence of an aberration.

On proper administration of local anesthesia, tooth was isolated and access cavity was prepared. On probing with DG16 endodontic explorer on the base of pulp chambers distal extra orifice was found and working length radiograph confirmed the presence of extra root distobucally (radix entomolaris) (fig: 2c). Cleaning and shaping was performed using protaper files upto #F2 (fig: 2c) with 3% sodium hypochlorite irrigation. The canals were obturated using standardized gutta-percha points and epoxy resin root canal sealer (fig: 2d).

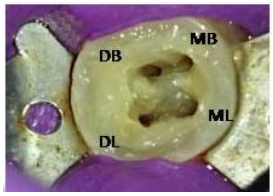

Fig 2a: An intraoral photograph showing 2Distal and 2Mesial orifices.

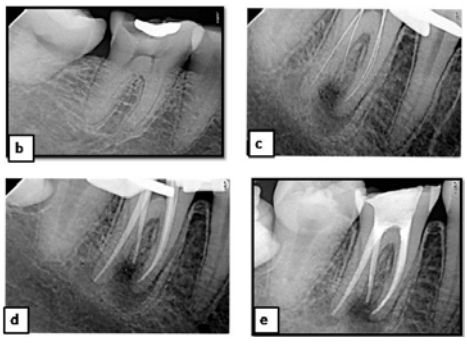

Fig 2: (b) Pre-operative view; (c) Working length; (d) Master cone; (e) Obturation radiographs

Case 3 – Middle distal canal

A 51 year old female patient was diagnosed with symptomatic apical periodontitis and endodontic therapy was planned for # 46. Following administration of local anaesthesia, an endodontic access cavity was prepared. Examination of pulp chamber floor revealed five distinct root canal orifices: two were detected mesially (mesiobuccal and mesiolingual); and, three distally (distobuccal, middle distal and distolingual). Patency of the root canals were checked with DG- 16 endodontic explorer and #15 K -files (Mani, prime dent, Japan). Three canals in the distal root were confirmed with working length radiograph (fig: 3C). Cleaning and shaping of canals was done in crown down technique with rotary Protaper instruments (fig: 3D) with copious irrigation using 3% sodium hypochlorite. The canals were obturated using standardized gutta-percha points and epoxy resin root canal sealer (fig: 3E) and post obturation radiograph was taken.

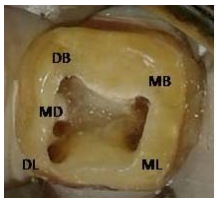

Fig 3a: An intraoral photograph showing the 3Distal and 32Mesial orifices.

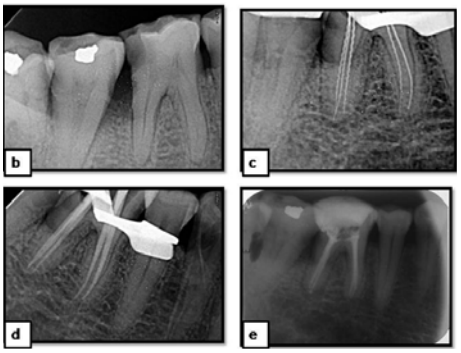

Fig 3: (b) Pre-operative view; (c) Working length; (d) Master cone; (e) Obturation radiographs

Case 4 – Mid mesial canal

A 52 year old female patient was diagnosed with chronic irreversible pulpitis in relation to lower left first molar (36) and root canal treatment was planned. After access cavity preparation, examination of the floor of the pulp chamber revealed five distinct root canal orifices: three were detected mesially (mesiobuccal, midmesial and mesiolingual); and, two distally (distobuccal and distolingual) and the patency of canals was made with #10 K –files and radiographic confirmation of working length was done. Cleaning and shaping was performed with protaper rotary system and 3% sodium hypochlorite irrigation. The canals were obturated with gutta percha and AH plus sealer using lateral condensation technique.

Fig 4a: An intraoral photograph showing 2Distal and 3 Mesial orifices.

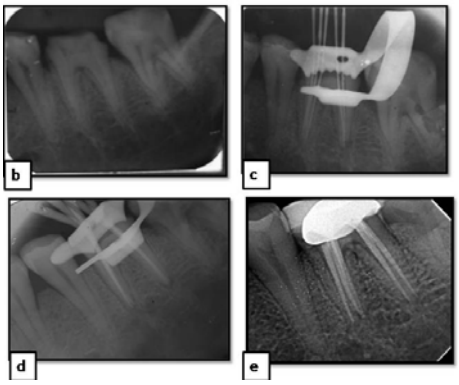

Fig 4: (a) Pre-operative view; (b) Working length; (c) Master cone; (d) Obturation radiographs

Case report 5

A 46 year old male patient reported with a chief complaint of severe pain in the right upper back tooth region and the diagnosis of necrotic pulp with symptomatic apical periodontitis was established and endodontic therapy was planned for # 16. After local anesthesia administration and proper isolation, a conventional access opening was done. After removing pulp tissue in the pulp chamber, 4 canals (MB, MB2, DB, P) were identified. A hemorrhagic point was noted near the main palatal orifice and a small dentin portion occluding the canals was removed and second palatal canal distal to the main palatal canal was found. Working length of all 5 canals was confirmed with radiograph, which revealed the joining of two canals at the apical third (Fig: 5c). Cleaning and shaping was performed with protaper upto #F1 for 2 mesio-buccal canals and #F2 for disto-buccal and 2 palatal canals with copious irrigation of 3% sodium hypochlorite. The canals were obturated with gutta percha and AH plus sealer using lateral condensation technique.

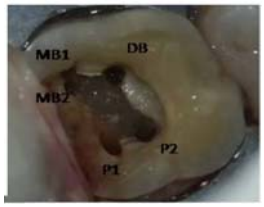

Fig 5a: An intraoral photograph showing the wide 2 palatal and 2Mesial and 1 Distal orifices.

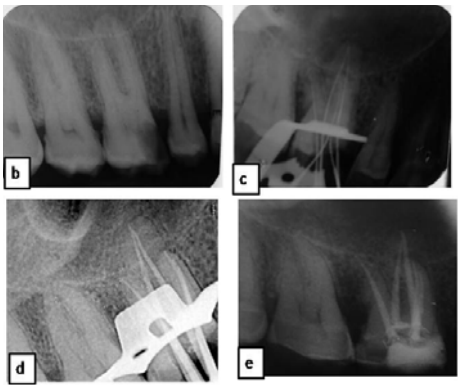

Fig 5: (b) Pre-operative view; (c) Working length; (d) Master cone; (e) Obturation radiographs

Discussion

Incompetence in locating, cleaning and shaping or obturating the complete root canal system often lead to endodontic treatment failures. Thus, it is critical to assess the numerous morphological variations of the root canal system before initiating endodontic procedures. The majority of mandibular first molars have two roots, one mesial and one distal, and their usual canal distribution is two in the mesial root and one or two in the distal root (Vertucci *et al*. 2006). The prevalence of 3 rooted mandibular molars in Indian population was found to be 0.2% to 5% [5].

However, successful endodontic therapy requires proper diagnosis, identification and location of additional canal(s). Diagnostic measures are important aids in location of root canal orifices including multiple pretreatment radiographs, examination of pulp chamber floor with a sharp explorer, troughing grooves with ultrasonic tips, staining of chamber floor with 1% methylene blue dye, performing sodium hypochlorite "Champagne bubble test", visualizing canal bleeding points, and use of dental operating microscope and magnification loupes. In these cases additional radiographic view from a 20-degree mesial or distal projection aids in the accurate detection of the periodontal ligament outlines, thus facilitating the interpretation of external root anatomy. In the present case series, radiographs alone, including preoperative ones, clearly showed the presence of radix entomolaris, in both the cases signifying the importance of radiographs in the detection of RE and, from patient's point of view, prevented the need for expensive investigations such as CBCT.

Morphologically, an RE can vary from a short conical extension to a mature root with normal length and root canal. It is generally smaller than the distobuccal and mesial roots and can be classified into separate and non-separate categories depending on the amount of its fusion with the other roots. Both the cases of RE presented mature extra root with normal length and in separated form. Canal configuration wise, despite these morphological variations, RE is reported to be typically rounder in shape with Vertucci type I configuration.

In case report 3, there exists presence of third canal in the mesial root of mandibular molars which is called as middle mesial canal. Baugh & Wallace (2004), reported that the prevalence of a middle mesial canal in mandibular first molar was 1–15% [5]. Pomeranz *et al.* classified middle mesial canal into three morphologic categories as fin, confluent and independent. According to their classification, an independent canal implies the canal originated as a separate orifice and terminated as a separate foramen and is usually rare. In the present case series, case 3 has confluent type of middle mesial canal i.e separate orifice but apically joined the mesiolingual canal.

In case report 4, distal root has three distinct root canal orifices called middle distal canal, with two separate apical terminus, that could be described as type XV canal configuration according to Sert and Bayirli supplemental canal configurations of root canal morphology.

The incidence of a maxillary first molar with two separate canals in the palatal root is less than 1%. Holderrieth and Gernhardt reported cases having two palatal canals in a single palatal root representing Vertucci type IV [7]. In the present case, 2 palatal canals, that are joining in the apical 3rd of root were evident.

After identifying extra roots or canals from the preoperative radiographs, the access cavity was modified into a trapezoidal outline for proper accessibility. Before initiating the mechanical instrumentation of the root canal, it is important to evaluate the dentine wall thickness and curvature of accessory roots. This is because, the accessory roots are relatively thin and the root canal instrumentation should be performed with caution to avoid perforation or stripping caused by over-

enlargement of the encased root canals. Therefore, after relocation and enlargement of the canal orifice, initial exploration of the root canal must be done with small files (size 10/15 or less) followed by creation of a glide path before shaping the canal, using flexible nickel titanium hand or rotary files of suitable taper with lubrication. This helps in preserving the normal root canal geometry, and also prevents the incidence of shaping aberrations such as instrument separation, ledge formation, root canal transportation, straightening of the root canal, and loss of working length [4]. The geometry of the mesial root shows it to be hourglass shaped and so a preparation of mid-mesial in the mid section of the root is automatically closer to the danger zone increasing the possibility of a perforation. Thus the preparation should be done cautiously and conservatively.

Obturation technique like vertical compaction with apical backfilling has been suggested as it creates an effective apical seal with proper adaptation of backfilling to apical plug and canal walls [8]. All the reported cases showed successful endodontic healing as in the follow-up visits teeth are asymptomatic with clinical and radiographic healing and normal functioning.

Conclusion

The root anatomy is highly complex and unpredictable. Clinicians should be constantly on the lookout for variations in anatomy, as the successful outcome of any case depends on the complete debridement and disinfection of all the canals.

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