Case Reports on Rare Anatomical Variation-Radix Entomolaris

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Abstract

The first mandibular molars have usually one mesial and distal root but in some cases there are anatomical variations where in the number of roots and root canals vary. Presence of an additional lingual root distally in mandibular molars is called as Radix Entomolaris (RE). Appropriate diagnosis is must before starting with root canal procedure in these teeth to ensure successful treatment outcome. This report describes the endodontic management of

Introduction

Due to its root canal complexity mandibular first molars have a significantly lower success rate compared with other teeth [1]. Clinicians must have an in-depth knowledge of the morphology of root canal systems and its variations that may affect the outcome of the success of the treatment.

Generally mandibular first molars have two roots, mesial and distal with two mesial and one distal canal [2]. But the number of roots for the mandibular first molar teeth may also vary due to external factors during odontogenesis. Mandibular first molars with supernumerary roots were the first to report. The third root was located on the disto-lingual side and was called Radix Entomolaris (RE) [3]. The mandibular first molar can also have an additional root at the mesio-buccal side, called radix paramolaris.

Radix entomolaris has a less frequency of 5% in white Caucasian, African, Eurasian and Indian populations. It is most commonly present in races of Mongoloid traits such as the Chinese, Eskimos, and Native American populations with a frequency of 5%-30% [4].

Calberson et al. described 4 types of RE, classified REs evaluated from extracted teeth into types I– III [3,5,6]

- **Type A & B:** Distally located cervical part of the RE with two normal and one normal distal root components respectively
- **Type C:** Mesially located cervical part
- **Type A&C:** Central location between the distal and mesial root components.In apical two third of RE a moderate to severe mesially or distally oriented inclination can be present. Based on the curvature of the separate RE variants in buccolingual orientation [5]
- **Type I**: refers to a straight root/root canal
- **Type II:** refers to an initially curved entrance which continues as a straight root/root canal
- **Type III**: refers to an initial curve in the coronal third of root canal and a second curve beginning in the middle and continuing to the apical third
- Recently Song, et al. have suggested a new classification based on morphologic characteristics [7]
- **Type I:** No curvature
- **Type II:** Curvature in the coronal third and straight continuation to the apex.
- **Type III:** Curvature in the coronal third and additional buccal curvature from the middle third to the apical third of the root

Prevalence of RE

In populations with Mongoloid traits (for example Chinese, Eskimo and American Indians) the frequency can range from 5%-30% [8-13]. However, in Eurasian and Indian populations it is less than 5% and in African populations less than 3% [14,15]. Radix entomolaris can be found on first, second and third mandibular molar teeth, occurring least frequently on second molars [15]. Studies have also reported a bilateral occurrence with as frequency of 50%-67% [16].

Etiology of RE

According to Calberson, et al. the etiology behind the formation is still unclear but it could be related to external factors during odontogenesis [17]. Racial genetic factors can also influence profound expression of a particular gene that can result in the more pronounced phenotypic manifestation [3].

Morphology of RE

The coronal third of the disto-lingual root of RE can be fixed partially or completely to the distal root. Based on the curvature in a buccal-lingual orientation, the separate RE variants can be seen.

Radiographic diagnosis plays a pivotal role in successful endodontic treatment of tooth. Incomplete biomechanical preparation for all the root canals one of the main reasons for failure of endodontic treatment is. Radiographs taken at different angulations give more information about extra canals or roots [17].

Case Presentation

Case No 1

A 27 year-old Indian male patient reported with a chief complaint of pain in lower- right posterior tooth region of jaw since four days. When examined clinically, the lower right first molar tooth had deep occlusal caries and was tender on vertical percussion.

Periapical radiolucency was seen in relation to distal roots by radiographically. The additional root was present on the distal side. The extra root was originated from distolingual aspect of the tooth. The tooth was unresponsive on electric pulp testing (Figure 1). A diagnosis of chronic apical periodontitis in relation to lower right first molar was made. The tooth was anesthetized. Access opening was made; initial glide path was prepared by 10# kfile in all the canals root canals orifices were enlarged using Sx. The canal lengths were determined using an Electronic apex locator and confirmed using a radiograph. Cleaning and shaping was performed using protaper system upto F1 in MB, ML and DL canal and F1 in DB canal. Cleaning and shaping were supplemented with irrigation using 3.5% sodium hypochlorite and saline. RC-Help was used as a lubricant during instrumentation. A final rinse was done using 17% EDTA followed by 0.2% chlorhexidine. After the master cone selection, the canals were obturated using lateral condensation technique in all the canals. Post obturation radiograph was taken.

Case No 2

A 26-year-old female patient presented with dull aching pain while

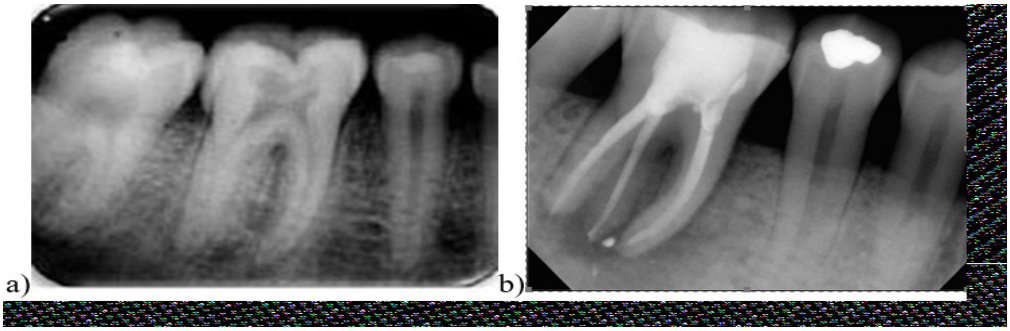

Figure 1. A 27-year-old Indian male patient reported with a chief complaint of pain in lower- right posterior tooth region of jaw since four days a) Radio Graphical view b) dentilingual aspect of the tooth.

Figure 2. A 26-year-old female patient presented with dull aching pain while chewing food on mandibular right first molar a) Clinical view b) Radio graphical view.

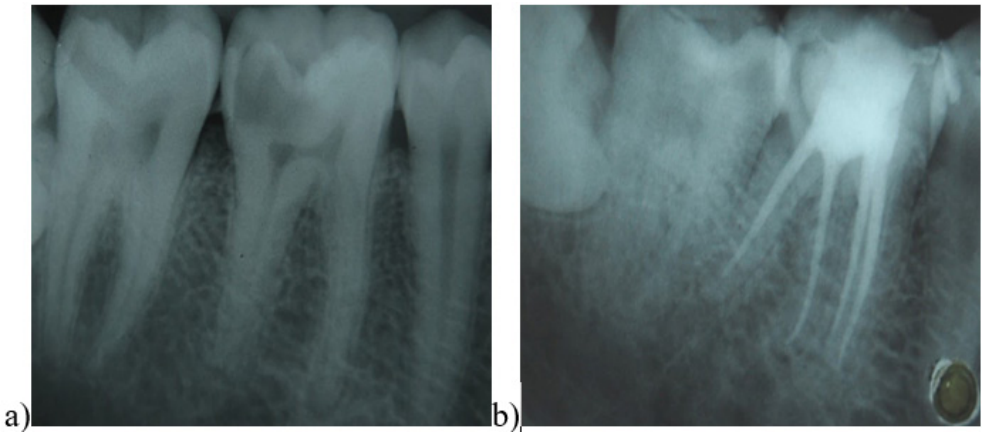

Figure 3. A 21-year-old female came with a chief complain of pain in lower right posterior tooth. Clinical examination revealed deep occlusal caries in mandibular right first molar (tooth 46) a) Clinical view b) Radio graphical view.

chewing food on mandibular right first molar (tooth 46). Following clinical and radiographic evaluation, a diagnosis of pulp necrosis was made and root canal treatment was started under rubber dam isolation. After achieving adequate anesthesia, access opening was performed (Figure 2). Exploration of the pulp chamber floor using an endodontic explorer revealed an extra canal orifice situated distolingually and confirmed the presence of RE. The endodontic treatment was carried out similar to Case 1 with radiographic confirmation of working length, mastercone fit and obturation.

Case No 3

A 21-year-old female came with a chief complain of pain in lower right posterior tooth. Clinical examination revealed deep occlusal caries in mandibular right first molar (tooth 46). Following clinical and radiographic evaluation and pulp testing, a diagnosis of pulp necrosis was made. The preoperative radiograph showed the presence of an additional distal root outline (Figure 3). The patient was advised to undergo root canal treatment. Root canal treatment was completed in the same manner as in Case 1 with radiographic confirmation of working length and obturation.

Discussion

Radix entomolaris, first described by Carabelli, is an anatomical variant in the first permanent mandibular molar typically characterized by an additional third root located distolingually [14]. RE occurs in first, second and third molars with the lowest prevalence in second mandibular molars. Studies show no significant predilection for gender or side distribution with bilateral occurrence ranging between 50%-67% [16]. Understanding the complexity of the anatomical variants seen in the first permanent mandibular molar proves to be invaluable in the clinical approach when treating these cases endodontically. Magnification and illumination can substantially improve the visualisation of root canal orifices. De Carvalho and Zuolo et al. demonstrated in a study that the use of the DOM could increase the number of root canal orifices located in mandibular molars. In their study 111, 93 first and second molars were examined with the naked eye followed by examination with the DOM (8-13x magnification). With the naked eye, a total of 641 canals were located. After examination with the DOM, an additional 50 canals (7.8%) were located [18]. Limited field Cone Beam Computed Tomography (CBCT) with the Kodak 9000 3D (Carestream, Paris) was used as a diagnostic imaging modality for effective evaluation of the root canal morphology [19]. Matherne et al. showed that CBCT images result in the identification of a greater amount of root canal systems in teeth compared to conventional radiography [19]. The study also concluded that the combination of CBCT scanning with the

dental operating microscope were important diagnostic tools for locating and identifying root canals [19]. In general, limited Field of View (FOV) machines are preferred over larger field of view machines in Endodontics as very small structures (calcified, accessory and missed root canals) that require a high resolution for adequate interpretation are being visualized. Other advantages of the limited FOV machines include decreased radiation exposure for the patient and less responsibility for the clinician because a smaller volume needs to be interpreted [20]. The Kodak 9000 3D system (Care stream) generates 3D images that provide clinicians with anatomical detail and diagnostic possibilities in the field of endodontics, implantology and oral maxillofacial surgery, periodontics, general dentistry, forensic dentistry and orthodontics. The application of CBCT technology in endodontics is not just limited to determine root canal morphology, number of roots, canals and accessory canals. It can also be used to establish the correct working length, assess existing root canal fillings, and determine the exact position and angulation of fractured instruments and to detect the presence and extent of inflammatory root resorption, just to mention a few [21]. Protaper Next was used for root canal preparation for most of the cases depicted in this article. The key benefits of Protaper Next include simplicity, excellent cutting efficiency and predictable final canal shape to allow for cone fit with tug-back. The system also ensures a 6% taper in the apical third of a canal after preparation with only two instruments, the X1 and X2 [22]. The Protaper Next instruments make use of the progressively tapered design. Each file presents with an increasing and decreasing percentage tapered design on a single file concept. The design ensures that there is reduced contact between the cutting flutes of the instrument and dentine wall, and reduced chance for taper lock (screw effect). At the same time, it also increases flexibility and cutting efficiency [23]. Another benefit of the system is the fact that the instrument is manufactured from M-wire and not traditional nickel titanium alloy. Research demonstrated that the M-wire alloy could reduce cyclic fatigue by 400% compared with similar instruments manufactured from conventional nickel titanium alloys [24]. The added metallurgical benefit contributes towards more flexible instruments, increased safety and protection against instrument fracture. The last major advantage of root canal preparation with the Protaper Next system is the fact that the instruments present with a bilateral symmetrical, rectangular cross section (except in the last 3mm of the instrument, D0-D3). Rotation of the instrument produces a snake-like (swaggering) wave of movement. The benefits of this design characteristic include:

- It further reduces (in addition to the progressive tapered design) the engagement between the instrument and the dentine walls. This will contribute to a reduction in taper lock, screw-in effect and stress on the file [24]
- Removal of debris in a coronal direction because the offcentre cross-section that allows for more space around the flutes of the instrument. This will lead to improved cutting efficiency, as the blades will stay in contact with the surrounding dentine walls. Root canal preparation is done in a very fast and effortless manner Reduces the risk of instrument fracture because there is less stress on the file and more efficient debris removal. The swaggering motion of the instrument initiates activation of the irrigation solution during canal preparation improving debris removal [24]

In most of the cases depicted in this article, carrier based obturation was utilized for root canal obturation. Buchanan et al advocates the use of carrier-based obturators in long, narrow and severely curved canals [25]. The flexibility of the carrier allows for obturation of these canals, however, the stripping of the gutta-percha may cause direct contact between the plastic carrier and the dentine wall in curved canals [26]. This problem has been attributed to procedural errors such as improperly shaped canals. GuttaCore crosslinked gutta-percha core obturators (Dentsply/Maillefer) were recently introduced to overcome these clinical challenges. GuttaCore consists of a carrier/ core manufactured from a cross-linked, thermoset elastomer of gutta-percha coated in regular gutta-percha. The core is a poly-isoprene polymer cross-linked with peroxide for strength, designed to facilitate removal during retreatment and/or post space preparation by simply trephining through the core.

Conclusion

The successful outcome of root canal treatment depends to a large extend on access, cleaning and shaping and three dimensional obturation of the entire root canal system. CBCT technology as well as proper angulation when acquiring radiographic images proves helpful in locating canals in especially first mandibular molars with a high incidence of anatomical variations. A thorough understanding of the prevalence of RE, its anatomical variations as well as radiographic and clinical diagnosis will provide the clinician with a better understanding of its complexity in order to ensure successful treatment outcomes.

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