ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 7, pp.5154-5159, July, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

MANDIBULAR FIRST MOLAR WITH A RADIX ENTOMOLARIS: AN ENDODONTIC CHALLENGE

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ARTICLE INFO

Article History:

Received 14th, June, 2015
Received in revised form 23th, June, 2015
Accepted 13th, July, 2015
Published online 28th, July, 2015

Key words:

anatomical variations, endodontic treatment, mandibular first molar, radix entomolaris(RE), radix paramolaris(RP).

ABSTRACT

Success of endodontic treatment depends on proper identification and localization 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. Mandibular first molar can show significant anatomical variations in number of roots, root canals and morphology. Mandibular first molar sometimes have an additional root located lingually (the radix entomolaris) or buccally (the radix paramolaris). So, proper awareness and understanding of this unusual root and its canal morphology can contribute to the successful outcome of root canal treatment.

This case series discusses endodontic treatment of mandibular first molar with radix entomolaris, which is rare entity and poses as an endodontic challenge for clinician to diagnose and further treatment. Clinician should be aware of this unusual root morphology in mandibular first molar which needs strategic treatment as unfilled canals remains a nidus for infection and can compromise treatment outcome.

INTRODUCTION

The prevention or healing of endodontic pathology depends on elimination of bacteria from infected root canals by thorough chemo-mechanical cleansing and shaping of the root canals followed by a dense root canal filling with a hermetic seal. For this, clinicians must have an in-depth knowledge of themorphology of root canal systems and its variations. This awareness and understanding of the presence of unusual root canal morphology can thus contribute to the successful outcome of root canal treatment.

The majority of mandibular first molars have two roots, mesial and distal and having three canals, two mesial and one distal canal.[1, 2] Different types of variations in root canal systems have been described. Fabra-Campos and Bond describes the presence of three mesial canals[3,4,5] while Stroner reported three distal canals.[6]There are also variations in number of roots in permanent mandibular first molar. A major variant is the presence of three roots in mandibular firstmolar, which was first mentioned in the literature by *Carabelli*[7] known as radixentomolaris (RE).[8] This supernumerary root in mandibular first molar is located in distolingual position(fig-1). When supernumerary root is located onmesiobuccal surface, the anomaly is known as radix paramolaris(RP). Carlsen and Alexandersen have described the identificatioan and external morphology of this anomaly having additional lingual orbuccal supernumerary root (fig-1).[9, 10]In white Caucasian, African, Eurasian and Indian populations, radix entomolaris has a frequency of less than 5%, while it appears with a frequency of 5-30% in races of Mongoloid traits such as the Chinese, Eskimos, and Native American populations.[11, 12, 13, 14]

Radiographic diagnosis plays an important role in successful endodontic treatment. Incomplete removal of pulp tissue and microorganisms from root canal appears to be one of the main reasons for failure of endodontic treatment. So, radiographs taken at two different angulations give an idea about extra canals or roots.[15]According to Garg *et al*, frequency of occurrence of an extra root in mandibular first molar is 5.27% in Indian population.[16]Clinician should be aware of this unusual root morphology in mandibular first molars. Radiographs exposed at two different horizontal angles are needed to identify this additional root.

The access cavity should be modified in a distolingual direction in order to clearly identify the extra canal and treat RE, resulting in trapezoidal shape of access cavity. In these case

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reports, thorough clinical approach for diagnosis and endodontic treatment of RE in mandibular first molars is presented.

Case reports

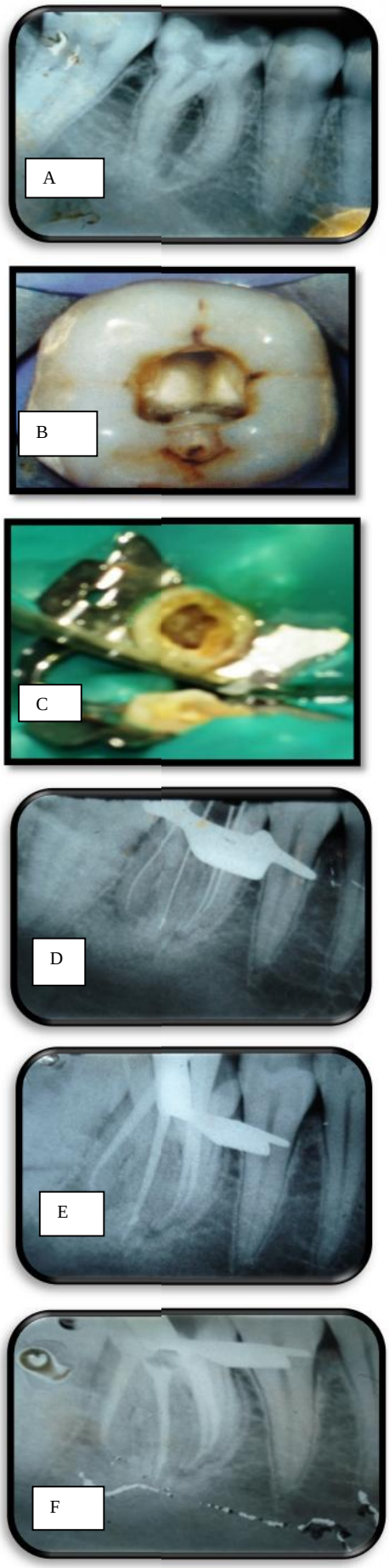
Case 1

A 23 yrs old female patient had a complaint of pain with lower right posterior region since 1 week reported in the department of dentistry, Grant medical college and JJ hospital. On clinical examination deep occlusal caries and tenderness on percussion with 46 was present. The involved tooth showed a delayed response upon electric pulp testing (Digitest, zeta dental, UK). Thermal testing with cold application(Endo Ice) induced pain that persisted for 5min. Preoperative radiograph (fig-2A) shows radiolucency involving the pulp. Provisional diagnosis with 46 was made as chronic irreversible pulpitis. Treatment plan was decided as RCT with 46 followed by full crown.

Inferior alveolar nerve block anesthesia (2% Lignocaine with 1:200000 epinephrines) was given. After anaesthesiaan isolationwas done with rubber dam, access cavity was prepared using an endo access bur and opening of pulp chamber was done. One distal and two mesial canal orifices were located using an endodontic explorer (fig-2B).After refinement of access opening & on visualization with a microscope at 10X magnification (SEILER, Germany),a dark line was observed between the distal canal orifice and the disto-lingual corner of the pulpal floor. This overlying dentin was removed with a safe-ended tip (Diamendo, DentsplyMaillefer) diamond bur and a second distal canal orifice was detected with endodontic explorer (fig-2C).

The canals were explored with K-file ISO 15 and radiographic working length was established (fig-2D).The root canals were shaped with Protaper rotary instruments (DentsplyMaillefer). During preparation, R.C Prep (17% EDTA) was used as lubricant with sodium hypochlorite as a disinfectant & followed by intermittent copious irrigation with normal saline. During finishing of the canal, file F1– 21 mm separated in radix (Radix Entomolaris) in apical 1/3rd region which was confirmed with a radiograph. The separated instrument fragment was successfully bypassed& thereafter the canals were instrumented with F2 shaping files. Mastercone IOPA was taken (fig-2E) and canals were obturated using ProtaperGP points F2 & AH-Plus sealer (fig-2F). The coronal cavity was sealed with glass ionomer cement followed by posterior composite. Routine follow up was done up to 6 months (Fig-2H).

Figure 1 Clinical images of extracted mandibular molars with a radix entomolaris.



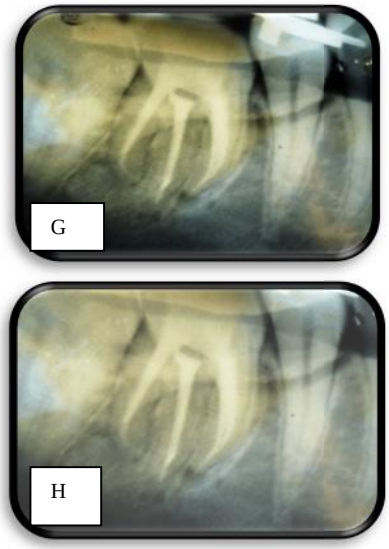


Figure- 2 (A) Preoperative radiograph with (46) shows radiolucency involving the pulp. (B) Initial access cavity preparation with two mesial and one distal canal orifices (C) Final access cavity preparation with four root canal orifices under rubber dam. (D) Working length IOPA with 46. (E) Master cone IOPA with 46. (F) Obturation with 46. (G) Post obturation restoration with 46. (H) Follow up after 6 six months.

Case 2

A 28 year-old female patient reported to the department of dentistry Grant medical college and JJ hospital with chief complaint of pain in lower right back region. On clinical examination deep occlusal caries involving pulp tissue and tenderness on percussion with 46 was present. Pain was moderate and intermittent and was experienced since last 2 weeks. Patient gave history of sensitivity to hot and cold. The pain persisted for at least 5mins after intake of any hot or cold liquid. The involved tooth showed a delayed response upon electric pulp testing (Digitest, zeta dental, UK). Pre-operative radiograph showed involvement of pulp and no periapicalwidening (fig-3A). Diagnosis of symptomatic irreversible pulpitis was made with 46.Radiographically, additional root was evident emerging from distolingual side of the tooth; an extra root appeared in between mesial and distal root. Based on the literature evidence, this additional distolingual root was diagnosed as Radix Entomolaris. Clinical, radiographical examination and pulp testing revealed that 46 was symptomatic and endodontic treatment was planned followed by full crown.

Inferior alveolar nerve block anesthesia (2% Lignocaine with 1:200000 epinephrines) was given. Tooth was isolated under rubber dam. Access cavity preparation was done with an endoaccess bur no.1 (Dentsply Switzerland). Pulp chamber was opened and distal canal was negotiated first which was buccally placed slightly away from the centre, indicating that the other canal will be on lingual side. Because of this extra distal canal, access cavity preparation was modified from triangular shape to trapezoidal form. All the canals were located by using a DG 16 an endodontic explorer and patency of canals were made with 15 number K -file (Mani Japan). The canal lengths were determined radiographically with K file ISO size #15 (fig-3B) and electronically with an apex locater Root ZX, (J. Morita, Kyoto USA).

Cleaning and shaping of canals were done with Protaper rotary instruments (DentsplyMaillefer) in step -down fashion. During preparation, R.C Prep (17% EDTA) was used as lubricant with sodium hypochlorite as a disinfectant & followed by intermittent copious irrigation with normal saline. After cleaning and shaping, master cone radiograph was taken with 46 (fig-3C). Obturation was done using protapergutta- percha points and AH Plus sealer by lateral condensation technique. Post endodontic therapy, restoration of the tooth was done with composite restoration (fig-3D). Patient was followed up for 6 months for routine checkup and radiographic evaluation was done for 46 (fig- 3E).

Figure- 3 (A) Preoperative radiograph with (46) shows radíolucency involving the pulp. (B) Working length IOPA with 46. (C) Master cone IOPA with 46. (D) Post obturation restoration with 46. (E) Follow up after 6 six months.

DISCUSSION

Etiology of radix entomolaris

The etiology behind radix entomolaris formation is still unknown. External factors during dentin formation orpresence of an atavistic gene could affect the formation of dysmorphic supernumerary roots. Racial genetic factors are more responsible for expression of particular gene that results into pronounced manifestation phenotypically which is seen in eumorphic root.[17]

Radix Entomolaris can be found on first, second and third mandibular moral, occurring least frequently on second molar. Bilateral occurrence of radix entomolaris ranges from 50 to 67%.[18]

Classification of radix entomolaris

Carlsen&Alexandersen (1990)[9] classified radixentomolaris (RE) into four different types based on the location of its cervical part:

Type A: the RE is located lingually to the distal root complex which has two cone-shaped macrostructures.
Type B: the RE is located lingually to the distal root complex which has one cone-shaped macrostructures.
Type C: the RE is located lingually to the mesial root complex.
Type AC: the RE is located lingually between the mesial and distal root complexes.

This classification allows proper identification of separated and non separated radix entomolaris cases.

De Moor *et al.* (2004)[15] classified radix entomolaris based on thecurvature of the root or root canal:

Type 1: a straight root or root canal.
Type 2: a curved coronal third which becomes straighter in the middle and apical third.
Type 3: an initial curve in the coronal third of the root canal and a second buccally oriented curve beginning in the middle and continuing to the apical third.

Song JS *et al.* (2010)[19] further added two more newly defined variants of radixentomolaris

Small type: length shorter than half of the length of the distobuccal root.
Conical type: smaller than the small type and having no root canal within it.

Morphology of RE and clinical approach

Radix entomolaris is located distolingually with its coronal third fixed completely or partially with distal root. The dimensions of RE vary from a mature root with normal root length and canal to a small conical extension. Generally, the radix entomolaris is smaller than mesial roots and distobuccal root with having pulp tissue within it.[20] External appearance of RE shows that the distal furcation is slightly less (1mm) than the furcation between mesial and distal root.[21]

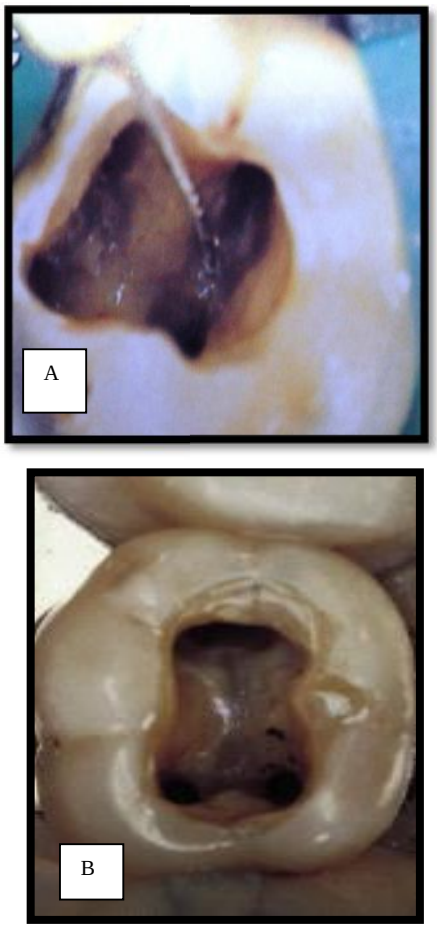


Figure- 4 (A) Showing second distal canal orifice was explored with endodontic explorer. (B) Clinical view of access cavity opening with distolingual extension of cavity revealsthe orifice of radix entomolaris.

Clinically, tooth with supernumerary root appears to be more bulbous with additional cusp and prominent distolingual lobe. Radiographically, third root can be recognised in 90% of cases. However it might be difficult to see because of its slender dimensions.[22] In addition, file placed in such root might give an appearance of an artifactual perforation. A detail inspection of the preoperative radiograph and identification of particular marks or some characteristics, such as an unclear outline of the distal root contour or the root canal, indicates the presence of a 'hidden' RE.A proper diagnosis of these supernumerary roots can prevent complications or missing a canal during the root canal treatment.[23] An inaccuratediagnosis may occur on the radiograph due to superimposition of the distobuccal root over the radix as they are mostly located in the same plane. In such cases an angled view of radiograph (vertical and horizontal view) are always beneficial.[24]

Thorough clinical examination along with radiographic diagnosis can give an idea about additional root. Clinical inspection of tooth crown and examination of cervical morphology of roots with periodontal probing with endodontic DG-16 explorer, JW-17 explorer, pathfinder or micro-opener gives an idea about identification of additional root (fig-4A). Troughing of grooves with ultrasonic tips, staining the pulp chamber floor with 1% methylene blue dye, clearly

visualization of dentinal map and canal bleeding points, magnetic resonance microscopy, and visual aids such as a loupe, intra-oral camera or dental microscope can be useful to locate the canals. A dark line on the pulp chamber floor can hint towards the precise location of RE canal orifice.[25]

Recently, cone-beam computed tomography (CBCT) has emerged as a useful tool to aid in the diagnosis of extra root, extra canal or any other complex root anatomies. However, cost and accessibility are the main limiting factors even today.[26, 27]other techniques like, use of sodium hypochlorite in the pulp chamber to see if bubbles are produced by remaining pulp tissue in the canal called as the "champagne effect". Sometimes an additional cusp (tuberculin paramolaris) gives hint about an extra root. Extending the triangular access cavity opening to the (disto) lingual results in a rectangular or trapezoidal outline form along with the complete removal of roof of pulp chamber may help in finding distolingual orifice (fig-4B). The root canal orifices follow the laws of symmetry which help in locating the radix entomolaris. Canal orifices are equidistant from a line drawn in a mesiodistal direction through the pulpal floor and lie perpendicular to this mesiodistal line across the centre.[24,28,29]

The distal and lingual pulp chamber wall can be explored with an angled probe to reveal overlying dentin or pulp roof remnants which covering the root canal entrance. Also the calcification, covering canal orifice of RE has to be removed for a better view and access. Once the relocation of orifices done, canal orifice of RE has been enlarged. Initial root canal exploration has to be done with small files (size 10 or 8). It has to be done with proper radiographic assessment of root canal length and curvature determination avoiding procedural errors.

CONCLUSION

Clinician while performing endodontic therapy in mandibular first molar should be aware of unusual root morphologies and variation in the anatomy of tooth. Initial diagnosis of such cases is utmost important to facilitate the endodontic procedure and avoid treatment failure. One should properly evaluate the radiographs to interpret the root canal anatomy and its variations. Radiographs taken two or more angulations either mesial or distal are helpful in the proper diagnosis of radix entomolaris cases. Once diagnosis has been done as a radix entomolaris, the conventional triangular cavity should be modified to a trapezoidal form distolingually to locate the orifice of the additional root. Curvatures are seen in most of radix cases, so moe attention has to be given to straight line access and glide path. Morphological variations of radix entomolarislike root inclination and root curvature demands a careful attention and successful endodontic intervention to overcome procedural errors during endodontic treatment.

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How to cite this article:
Sandeep Pimpale *et al*., Mandibular First Molar With A Radix Entomolaris: An Endodontic Challenge. *International Journal of Recent Scientific Research Vol. 6, Issue, 7, pp.5154-5159, July, 2015*

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