Clinical Implications And Management Of Radix Entomolaris And Paramolaris-A Review

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Abstract: One of the main reasons for failure of root canal treatment in molars is because the clinician has not removed all the pulp tissue and microorganisms from the root canal system. An awareness and comprehensive knowledge of the unusual root canal morphology can contribute to success of the endodontic procedure. Radix entomolaris, an anatomical variant in permanent mandibular molar, is the presence of an extra root on the distolingual position, first described by Carabelli. If the extra root is on the buccal aspect, it is termed as radix paramolaris. Even though considered to be an Asiatic trait, its prevalence is very low in Indian population. However, its awareness and identification is inevitable to attain endodontic success. This review addresses the prevalence, diagnosis (clinical and radiographic), and endodontic management of mandibular teeth with extra roots/canals.

Keywords: Radix Entomolaris, Radix Paramolaris, Anatomical Variations, Endodontic treatment, Mandibular Molar.

INTRODUCTION:

According to Swartz and Griffen, mandibular first molars have a significantly lowest success rate compared with other teeth.¹ Missed canals and the failure to remove all the microorganisms and pulp remnants from the root canal system are perhaps the main reasons for persistent infection around endodontically- treated molars.² Carabelli (1844) was the first to highlight the presence of an additional root in mandibular molar which is usually seen distolingually and named it as ‘Radix entomolaris’ (RE) and when placed buccally it is known as ‘Radix paramolaris’ (RP), but the term RE was coined by Michaly Lenhossek in 1922.³ An endodontist needs to be competent in performing the root canal treatment uneventfully and for this he needs to have complete knowledge about the root canal system and the canals. For the success of endodontic treatment an endodontist must be aware and have a thorough knowledge of both the normal and abnormal anatomic diversities of the tooth. The anatomic variations in the root canal system present a major clinical challenge, which influences the final outcome of the treatment.⁴

PREVALENCE OF THE RE AND RP

RE-Literature suggests the presence of RE in less than 5% population in white Caucasian, African, Eurasian and Indians whereas it is present with a frequency of 5-30% in races with Mongoloid traits such as the Chinese, Eskimos, and Native Americans.⁵ Radix entomolaris can be found on first, second and third mandibular molar teeth, occurring less frequently on second molars. Studies have also reported a bilateral occurrence with as frequency of 50-67%.² RP- RP is very rare and occurs less frequently than the RE. RP is most commonly observed in 1.5–3% of the African population whereas RP is less frequent, and frequency of existence is around 2% in the Indian population. The prevalence of RP, as observed by Visser, was found to be 0% for the first mandibular molar, 0.5% for the second, and 2% for the third molar.⁶

ETIOLOGY

The etiology behind formation of RE and RP is still unclear. In dysmorphic roots, its formation could be related to external factors during odontogenesis or penetrance of an atavistic gene, while in eumorphic, racial genetic factors influence the profound expression of a particular gene resulting in more pronounced phenotypic manifestation. It is accepted that HERS plays an important role in root development; however, the precise nature of this role remains unclear. Amongst the various functions attributed to these cells are that of inducers and regulators of root formation, including the size, shape, and number of roots (Ten Cate, 1996). It has also been suggested that HERS cells deposit chemotactic proteins into the basement membrane to direct the migration of pre cementoblast cells (MacNeil and Thomas, 1993). Another role attributed to HERS cells is that of inducers of differentiation of odontoblast cells to form root dentine (Ten Cate, 1978) or dental sac cells to differentiate into cementoblasts (Paynter and Pudy, 1958). Some authors also suggest RE to have a genetic predisposition.⁸

MORPHOLOGY

Carlsen and Alexanderson classified RE based on the location of its cervical part into four types.⁹

Type A–Distally located cervical part with 2 normal distal root components
Type B–Same as Type A; however, only 1 normal distal root component
Type C–Mesially located cervical part Type AC–Central location between mesial and distal root components.

De Moor et al. classified RE-based on the curvature in buccolingual orientation into three types.¹⁰
Type I–Refers to a straight root/root canal
Type II–Refers to an initially curved entrance which mainly continues as a straight root/root canal
Type III–Refers to an initial curve in the coronal third of the root canal, and a second buccally oriented curve starting from middle to apical third.

Recently, Wang et al. gave another classification for RE depending on its radiographic appearance.11
Type 1: Represents the most identifiable radiographic image
Type 2: A large beam angulation is necessary mesially or distally for its identification
Type 3: Identification becomes extreme difficult because of the overlap of the adjacent distobuccal root.

Carlsen and Alexanderson classified RP based on the location of its cervical part into two types.12
Type A–Refers to an RP in which the cervical part is located on mesial root complex
Type B–Refers to an RP in which the cervical part is located centrally, between mesial and distal root complexes.

CLINICAL DIAGNOSIS
The radix entomolaris is located distolingually ranging from short, conical extension to normal mature root length within its coronal third partially or completely fixed to distal root. Generally, the radix entomolaris is smaller than mesio- and distobuccal roots and may contain pulp tissue.13 Externally, the distal furcation is slightly lower (1 mm.) than the furcation between mesial and distal roots14 Clinically, tooth with additional distolingual root may present a more bulbous crown outline, an additional cusp, a prominent distolingual lobe or a cervical prominence. These features can indicate the presence of additional root.15

The radix paramolaris (RP) is located mesiobuccally. The dimensions of RP may vary from short conical extension to a mature root which can be separated or fused. Few observations can be made from different studies, i.e. an increased number of cusps is not necessarily related to an increased number of the roots; however, an additional root is always associated with an increased number of cusps, and with an increased number of root canals.16-18

Figure 1. Clinical images of extracted mandibular molars with a radix entomolaris or a paramolaris. a- first molar with a radix entomolaris [distolingual view (left) and lingual view (right)]. b- radix entomolaris on third molar (lingual view). c- first molar with the separate radix paramolaris (buccal view). d- first molar with the fused radix paramolaris (buccal view).


RADIOGRAPHIC DIAGNOSIS
Radiographically, third root is visible in 90% of cases.19 Occasionally it may be missed because of its slender dimension or overlapping with distal root. Radiographs should be carefully inspected to reveal the presence of hidden radix entomolaris which might present as unclear outline of the distal root or root canal. Additional radiographs taken from different horizontal projections, 20 degree from mesial and 20 degree from distal reveals the basic information about the anatomy of an additional third root.20-21 In addition to this, magnifying loupes, dental microscope or an intraoral camera may also be useful. Recently, cone-beam computed tomography (CBCT) has emerged as an useful tool to aid in the diagnosis of teeth with complex root anatomies. However, cost and accessibility are the main limiting factors till now.22-23

DISCUSSION
There are various methods to locate additional canals such as, knowledge of law of symmetry, law of orifice location, visualizing the dentinal map and the canal bleeding points. The tactile sensation using hand instrument like Endodontic explorer, Pathfinder, DG 16 probe and Micro-openers are also very helpful. Champagne bubble test is an another useful means of locating the orifice. The remaining pulpal tissue in the canal produces effervescent bubbles when sodium hypochlorite is placed in the pulp chamber, indicating the location of canal orifice. Advanced imaging techniques can aid to locate and confirm additional canals in case of multirooted teeth, especially the molars. These techniques include digital radiography, fiber-optic illumination, dental endoscopy and oracopy, operating loupes, operating microscope, micro-computed tomography (CT), visualization endograph using Ruddle’s solution, and magnetic resonance microscopy.24 With the advent of a newer radiographic modalities such as radiovisiography and spiral CT, detection of RE is much easier. Although a spiral CT is a 3D modality, it is an expensive and inconvenient tool. Moreover, it is not appropriate to subject the patient to high dose of radiation of spiral CT for endodontic diagnostic purposes and can be used occasionally for study purposes only. Hence, conventional and digitalized radiography would suffice for the diagnosis of
The variations in the distal root anatomy were identified through careful reading of angled IOPA radiographs. The first radiograph was taken with a conventional angulation, and the second one with a mesial shift of approximately 20°. This buccal object rule has also been called same lingual, opposite buccal rule/Clark’s rule/Walton’s projection. An additional root appears as a shadow or a thin radiolucent line in the radiographs. In order to confirm the location of this additional root, an H-file was inserted in other canals and a K-file was introduced into the additional canal before taking the radiograph. The existence of an accessory cusp (tuberculum paramolare) and periodontal probing for cervical prominences can also provide an indication of an additional root. For the first 3 cases, an IOPAR imaged with the mesial angulation was used to identify and treat the RE, and for the fourth case, an IOPAR imaged with distal angulation was used to identify and treat the RP. When the third root is detected, it should be cleaned and shaped like every other canal.

Sometimes, radix canal orifice could be occluded by the secondary or calcified dentine. With every access preparation in a calcified root, there is a risk of perforation in the tooth. When searching for hidden canals, one should remember that the secondary dentine is generally whitish or opaque, whereas the floor chamber is darker and gray in appearance. Therefore, the visual access and superior control during access procedures make a convenient tool in such cases. Straight-line access in this respect has to be emphasized, as the majority of the radix root are curved. With the advent of the rotary instruments, access burs such as Endo Z, SS white access burs, access can be modified to get a straight line access. This was a part of our protocol for the treated cases.

The distal root ordinarily has one kidney-shaped root canal, if the orifice is particularly narrow and round, a second distal canal may be present. The conventional triangular access cavity should be modified into a more trapezoidal cavity in order to locate and open the orifice.

Thus, the knowledge of the location of additional roots and its root canal orifices, adapted clinical approach, avoids or overcomes procedural errors during endodontic therapy and reduces incidence of retreatment.

CONCLUSION

Clinicians should be acquainted with these unusual root morphologies in the mandibular first molars. The initial diagnosis of a radix entomolaris or a paramolaris before root canal treatment is important to facilitate the endodontic procedure, and to avoid the ‘missed’ canals. Pre-operative periapicals radiographs exposed at two different horizontal angles are required to identify these additional roots and its root canal orifice will result in a modified opening cavity with extension to the distolingual. The morphological variations of the RE and RP in terms of root inclination and root canal curvature demand a careful and adapted clinical approach to avoid or overcome procedural errors during endodontic therapy.

REFERENCES: