Case Report

Endodontic Challenges in Managing Radix Entomolaris: A Case of Mandibular Third Molar

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Abstract

Radix entomolaris (RE) is an uncommon anatomical anomaly in mandibular molars, distinguished by the presence of an additional root. This case report details the endodontic management of a mandibular third molar exhibiting RE, highlighting the diagnostic and therapeutic challenges encountered. The variation was identified through comprehensive clinical assessment and radiographic evaluation, followed by successful root canal treatment. This report underscores the importance of thorough anatomical understanding, precise diagnostic techniques, and meticulous treatment planning in managing complex root canal systems to achieve optimal clinical outcomes.

Keywords: Accessory root, Complex root morphology, Mandibular molar variations, Radix entomolaris.

Introduction

Understanding the root canal anatomy of mandibular molars is crucial for clinicians to ensure successful endodontic treatment. One of the primary causes of failure in root canal therapy for molars is the presence of undetected canals.[1] If any pulp tissue or microorganisms remain within the canal system, complete debridement may not be achieved, potentially compromising the long-term prognosis of the treated tooth. The prevention and healing of endodontic pathology rely on thorough chemomechanical cleaning and shaping of the root canals, followed by a well-sealed, dense root canal filling.[2]

The number and arrangement of roots and canals in permanent mandibular molars can vary. While these molars typically have two roots, an additional third root is a notable anatomical variation. This extra root was first described by Carabelli in 1844 and can be located either on the lingual side, known as radix entomolaris (RE), or on the facial side, referred to as radix paramolaris. The term RE was introduced by Mihaly Lenhossek in 1922. Typically, the RE is positioned distolingually, with its coronal third either partially or fully fused with the distal root. It may present as a short conical projection or as a fully developed, separate root.[3]

Several classification systems have been proposed to categorize RE as follows:[4]

1. Carlsen and Alexanderson in (1991)[4] categorized RE based on the morphology of its cervical third. Their classification is detailed below (Table 1)
2. De Moor *et al*. (2004)[5] classified RE based on the curvature of the extra root. Their classification is presented in the (Table 2).

This classification helps clinicians in assessing the anatomical variations of the RE, which is crucial for successful endodontic treatment.

3. Wang classified RE based on its visibility and identification on periapical radiographs. This classification assists in determining the likelihood of detecting an extra root during radiographic examination. The classification is presented in the (Table 3) below.[5]

This classification aids clinicians in determining the need for advanced imaging techniques, such as using cone beam computed tomography (CBCT), for accurate diagnosis and treatment planning of cases involving RE.

This case report highlights the diagnosis and effective management of RE using CBCT.

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Table 1: Carlsen and Alexanderson classification on radix entomolaris

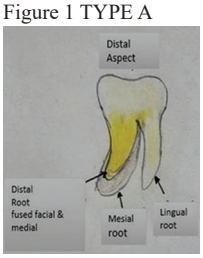
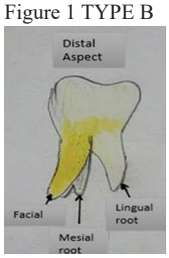
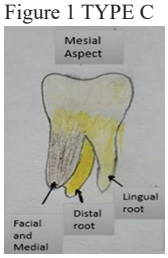
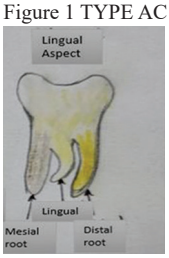
TYPE - A	TYPE - B	TYPE - C	TYPE - AC
The additional root is located entirely within the cervical outline, showing a fully separated root structure	The additional root is partially fused with the distal root at the cervical third	The additional root is completely fused with the distal root making it difficult to distinguish as a separate entity	A combination of Type A and Type C. The root starts fused (Type C), but as it progresses apically, the additional root structure becomes independent, resembling a typical Type A morphology at the apex.
Figure 1 TYPE A 	Figure 1 TYPE B 	Figure 1 TYPE C 	Figure 1 TYPE AC 

Table 2: De Moor *et al*. classification on radix entomolaris

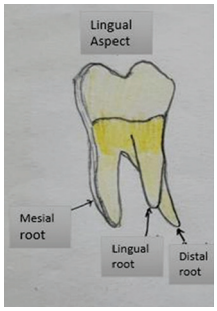
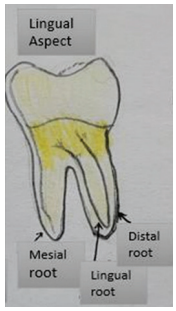
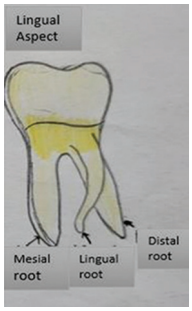
Type I	Type II	Type III
A straight extra root with no curvature.	An extra root with a curved coronal third and a straight middle and apical third.	An extra root with a curved coronal and apical third, forming a hook-like shape.
		

Table 3:

Type I	Type II	Type III
Clearly visible on the periapical radiograph, showing a distinct and separate root.	Partially visible on the radiograph due to superimposition with other roots.	Not clearly visible on standard periapical radiographs, requiring additional imaging techniques for detection.

Case History

A 43-year-old Indian male patient visited the department with a primary complaint of pain in the lower right back region, persisting for 10–15 days and worsening while lying down. His medical history was unremarkable. Clinical examination revealed that the affected tooth did not respond to pulp sensibility testing and cold thermal testing. The radiographic evaluation indicated deep dental caries extending close to the pulp, along with signs of periapical pathosis (Figure 1a). Based on these findings, a diagnosis of symptomatic apical periodontitis was made concerning the right mandibular third molar (tooth 48). Since the contralateral tooth was present and the patient had adequate mouth opening, endodontic treatment was planned.

To obtain detailed anatomical information, a CBCT scan was advised. After securing informed consent, CBCT imaging of the right mandibular posterior region was performed using a Kodak 9200 scanner (tube voltage: 90 kV [kilovolt], current: 10 mA [milliampere]; Carestream Health Inc., Rochester, NY, USA). The transverse, axial, and sagittal sections of the affected tooth were analyzed using CS 3D imaging software (Carestream Dental LLC). The axial CBCT slices, obtained at 180 µm thickness, were examined at the cervical, middle, and apical thirds of the roots to assess canal morphology (Figure 1b-d).

The CBCT scans confirmed the presence of RE, revealing that tooth 48 had three roots and four root canals: Mesiobuccally, mesiolingually, distobuccal, and distolingual. The accessory distal root was located centrally and lingually between the mesial and distal roots. In addition, the distolingual root exhibited a slight curvature at the cervical area, bending buccally at the apex. The CBCT examination provided a comprehensive understanding of the root and canal anatomy, aiding in precise endodontic management.

After obtaining informed consent, local anesthesia (2% lignocaine with 1:2,00,000 adrenaline) was administered, and rubber dam isolation was applied before initiating endodontic treatment. The access cavity was prepared using an end access bur and an Endo Z bur (Dentsply Maillefer). The cavity shape was modified from a triangular to a trapezoidal outline to accommodate the complex root canal anatomy (Figure 1e).

Following pulp removal, canal exploration was performed using a DG16 (David Green-16) explorer and an International Organization for Standardization (ISO) #8 stainless steel K-file (Mani, Inc., Japan) to maintain patency. The working length was determined using an ISO #10 K-file, confirmed with an apex locator (NSK, Japan) and radiovisiography (Figure 1f). Manual instrumentation was carried out up to an ISO #20 K-file

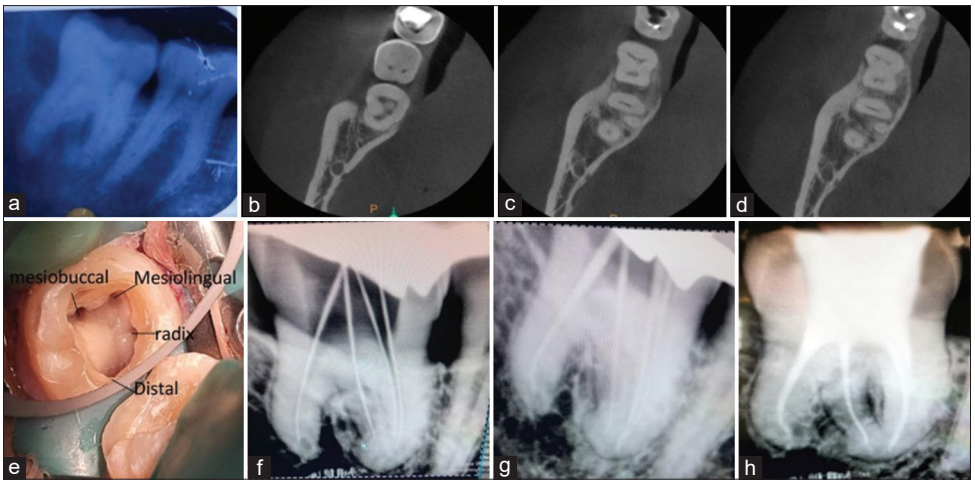


Figure 1: (a) Radiographic evaluation indicated deep dental caries extending close to the pulp, along with signs of periapical pathosis. (b-d) The axial CBCT slices, obtained at 180 μm thickness, were examined at the cervical, middle, and apical thirds of the roots to assess canal morphology. (e) The cavity shape was modified from a triangular to a trapezoidal outline to accommodate the complex root canal anatomy. (f) The working length was determined. (g) Master cone radiograph. (h) Obturation and post-obturation radiograph

in all four canals. Coronal flaring was achieved using a canal orifice opener, and canals were prepared using rotary shapers (Coltene GenENDO, France): 25/4% for the distolingual and mesiolingual canals, whereas the remaining canals were prepared to 20/6%. During instrumentation, irrigation was performed with 3% sodium hypochlorite and saline.

To eliminate the smear layer, 17% ethylenediaminetetraacetic acid (EDTA; Prevest, India) was applied as a lubricant, followed by final irrigation with saline. The canals were then dried using sterile paper points (Dentsply Maillefer, Switzerland), and a calcium hydroxide dressing (Prevest DentPro, India) was placed as an intracanal medicament for 1 week. The access cavity was sealed with a sterile cotton pellet and temporary cement (Cavit, 3M ESPE).

Upon recall, after 7 days, the calcium hydroxide dressing was removed, and master cone selection was confirmed radiographically before obturation (Figure 1g). The canals were filled using the single-cone technique, and post-obturation restoration was performed with resin-modified glass ionomer cement (Figure 1h).

Discussion

Endodontic treatment of third molars presents unique challenges due to their posterior location, complex internal anatomy, irregular occlusal morphology, and unpredictable eruption patterns. As a result, they are often considered difficult to manage in both endodontic and periodontal treatments. While extraction is commonly the preferred treatment approach, certain clinical situations may necessitate the retention of third molars. For instance, when second molars are missing, third molars can serve as abutments for removable partial dentures or fixed prostheses. In addition, the primary objective of endodontics is to preserve all functional components of the dental arch. Anatomical variations frequently observed in third molars include dilacerations, fused canals, C-shaped canals, additional roots such as RE, curved roots, and bayonet-shaped roots.[5]

The success of root canal treatment depends on three key factors: Accurate diagnosis, proper chemomechanical preparation, and effective three-dimensional obturation. Among these, precise diagnosis is fundamental to achieving favorable endodontic outcomes. A major cause of root canal failure is the incomplete removal of pulpal tissue and microbial infection from all root canals. Therefore, thorough radiographic assessment is essential to enhance the success rate of endodontic therapy.[6]

To reduce the likelihood of missing canals, radiographs were obtained at multiple angulations. RE is a rare anatomical variation, with a prevalence of <5% in the Indian population, making its occurrence uncommon in routine dental treatments. While the exact cause of RE remains uncertain, some researchers suggest that it may result from disturbances during odontogenesis or a high degree of genetic penetrance.[7]

To minimize the risk of iatrogenic errors, it is essential to obtain at least two diagnostic radiographs from different angles, along with a thorough clinical examination.[2]

The occurrence of RE has been linked to specific ethnic groups. Studies indicate a higher prevalence (5–30%) among populations with Mongoloid characteristics, including Chinese, Eskimos, and Native Americans.[4,8,9]

Loh[10] in the year 1990, conducted a study on the Chinese population with 1000 mandibular first molars. Clinical examination and radiographic analysis (periapical X-rays) showed a prevalence of 14% RE and observed that RE is more frequent in the Chinese population compared to other ethnicities studied at the time. Tu *et al*.[11] in the year 2007 conducted a study on 523 patients using CBCT for precise

identification of additional roots in Taiwanese individuals showed a high prevalence of RE 33.5%, emphasizing ethnic variation in root morphology. Rahimi *et al*.[12] in the year 2017, they conducted in their study on 500 patients in the Iranian population, showing a lower prevalence of 7.5%, suggesting ethnic differences in root anatomy. Kuzekanani *et al*.[13] in the year 2018 conducted a retrospective analysis of CBCT scans for root morphology on 1200 patients. The Iranian population showed a very low prevalence, indicating the minimal occurrence of RE in this population. Gökdeniz *et al*.[14] in the year 2022, a CBCT-based study on 400 patients in the Turkish population showed one of the lowest RE prevalence rates among studied groups, i.e., 2.38%.

In our case report, CBCT helped us to confirm the presence of RE in the mandibular third molar and to classify it. Our case was classified as type B, and CBCT sagittal images confirmed the presence of type III curvature according to De Moor classification. According to Wang, it was classified as type I since it was evident clearly on the radiograph. According to Carlson and Alexanderson classification, the RE was classified as type B, in which the distal part of the root has two cone-shaped macrostructures of nearly the same size.

Conclusion

The successful management of mandibular third molars with anatomical variations like radix entomolaris requires a thorough understanding of root canal morphology, supported by advanced diagnostic tools such as CBCT. In this case, precise radiographic evaluation enabled accurate identification and classification of the extra root, facilitating effective chemomechanical preparation and obturation. Awareness and early detection of such anatomical anomalies are critical to prevent endodontic failures and ensure long-term clinical success.

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