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## Exploring radix entomolaris in endodontic practice: A case series

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### Abstract

The success of endodontic therapy depends on the complete debridement of pulp tissue for which the anatomy of the root canal system is to be understood majority of the mandibular molar present with 2 roots with 3 to 4 canal. The presence of an additional root on the mandibular molar located lingually (radix entomolaris) located buccally (radix paramolaris) is an unusual occurrence. Managing procedural errors is demanded in the present scenario. This paper discuss the identification of the radix entomolaris and paramolaris clinically and using radiographs and classification of the radix entomolaris and paramolaris followed by management of the teeth with irreversible apical periodontitis.

**Keywords:** Radix entomolaris, endodontic therapy, necrotic teeth, apical periodontitis

### Introduction

Awareness and understanding of the root canal anatomy of mandibular molars are crucial for clinicians to achieve successful endodontic outcomes. One of the primary reasons for the failure of root canal treatment in molars is the oversight of canals during the procedure <sup>[1]</sup>.

Carabelli first described a significant anatomical variation of the mandibular first molar in 1844, noting the presence of a third root known as the Radix Entomolaris (RE). This additional root is situated distolingually <sup>[2]</sup>.

The permanent mandibular first molar typically erupts early among permanent posterior teeth and plays a crucial role in occlusion development and physiological functions like chewing. It is also frequently in need of endodontic treatment. Therefore, it is essential for clinicians to be well-versed in variations of the root and root canal anatomy of the mandibular first molar <sup>[3]</sup>.

Mandibular molars typically exhibit a two-rooted anatomy, consisting of distal and mesial roots, with an overall incidence of 85.6%. Asian populations exhibit approximately 20% to 25% of three roots <sup>[4]</sup>.

There is a higher occurrence of three roots, specifically the distolingual supplementary root, in Asian populations, including North American Aboriginal peoples of Mongoloid groups. Non-Asian groups showing lower ranges from 0% to 13.3%. Radix entomolaris, along with the single-rooted maxillary first premolar, can serve as markers for tracing Asian origins in both ancient and modern individuals or groups <sup>[4]</sup>.

According to Mohan and thakur <sup>[5]</sup>. The regional prevalence of radix entomolaris in mandibular first molars shows significant variation. In India, the highest incidence was found in North India at 24%, while globally, China reported the highest prevalence at 32%, and the lowest was observed in Africa at 0%. India predominantly relied on conventional radiography for diagnosis, whereas other regions primarily utilized in-vitro studies and advanced radiography techniques for detection <sup>[5]</sup>.

Chandra *et al.* stated that radix entomolaris (RE) is regarded as a characteristic of Asian populations. They found that in the South Indian population, the occurrence of this anatomical variation was 13.3%, which was lower compared to patients of Mongoloid descent <sup>[6]</sup>.

Chandra *et al.* stated that radix entomolaris (RE) is regarded as a characteristic of Asian populations. They found that in the South Indian population, the occurrence of this anatomical variation was 13.3%, which was lower compared to patients of Mongoloid descent <sup>[7]</sup>. In eumorphic roots, certain genes may exhibit a more pronounced phenotypic manifestation due

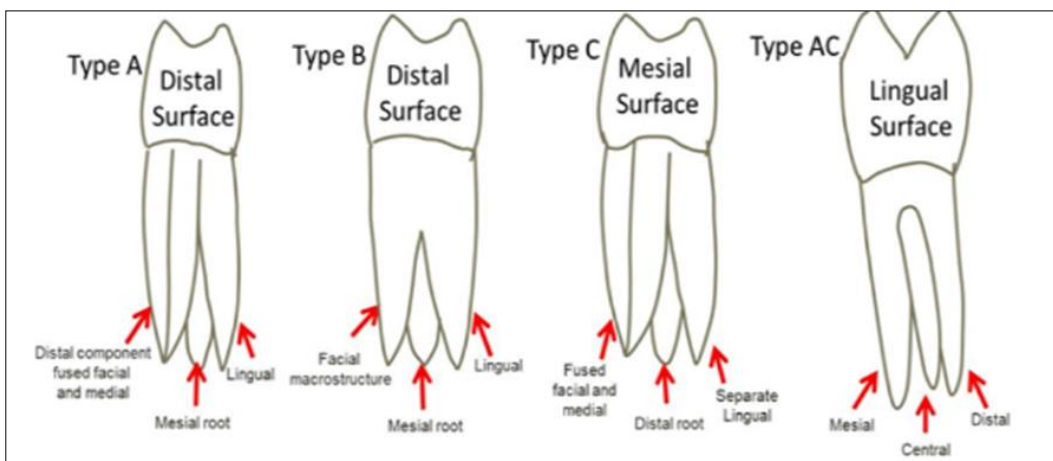
to the influence of racial genetic factors [8,9]. Curzon proposed that the trait of 'three-rooted molars' exhibits a high degree of genetic penetrance. This assertion was supported by the observation that the prevalence of the trait was consistent in both pure Eskimo populations and individuals of Eskimo/Caucasian mixed ancestry [10]. Field Developmental Theory highlights the interconnectedness of teeth and their roles within functional fields during development & RE [11].

**Field Developmental Theory:** This theory emphasizes that teeth are not isolated entities but part of functional fields. Each field (incisors, canines, premolars, molars) has specific key teeth. Key teeth play a crucial role in shaping dental development [11]. The first permanent molar acts as the key tooth for the posterior region & Adjacent teeth develop based

on the first molar's influence [12]. Hence, it can be hypothesized that the development of an extra root is regulated by specific genes that influence dental fields. These genes are primarily active in the region of the first permanent molar and frequently in primary molars, which correspond to what is referred to as the mesial to the molar field [13].

**Classification**

Classification according to Alexadersen and Carlsen [14]:  
**Type A:** Distal part with three cone-shaped macrostructures (lingual, medial, and facial).  
**Type B:** Distal part with two roots (lingual and facial).  
**Type C:** Mesial part with three roots (lingual, medial, and facial).  
**Type AC:** Lingual part with three roots (central, mesial, and distal). (15)

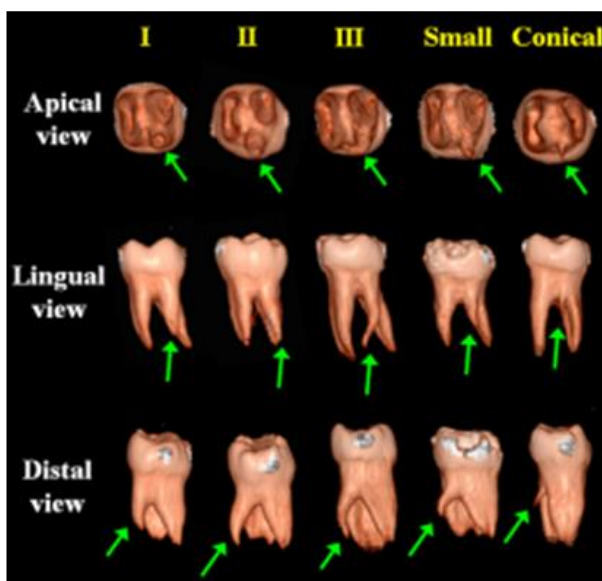


**Image 1:** Image reproduced from -Bhatia S, Parolia A. Prevalence of Radix Molar in Mandibular Permanent Molars: An Observational Study in Malaysian Population. 2015 [cited 2024 Jan 28]

De Moor *et al.* [16] classified RE-based on the curvature in buccolingual orientation into three types.

- Type I:** Straight root or root canal.
- Type II:** Initially curved entrance transitioning into a straight root or canal.
- Type III:** Initial coronal curve followed by a buccally oriented curve in the middle to apical third [15, 16].

Radix entomolaris (RE) has been classified into five types based on its morphological characteristics, utilizing 3D image reconstructions from cross-sectional CT images. The newly identified types of RE include the "small type," which exhibits a length half that of the distobuccal root, and the "conical type," which is even smaller than the small type and lacks a root canal [17, 18].



**Image 2:** Image reproduced from Song JS, Choi HJ, Jung IY, Jung HS, Kim SO. The prevalence and morphologic classification of distolingual roots in the mandibular molars in a Korean population. Journal of endodontics. 2010 Apr 1;36(4):653-7.

Three-dimensionally reconstructed images of molars displaying DL roots (indicated by arrows) are categorized into five types based on their morphologic characteristics

1. **Type I:** No curvature observed.
2. **Type II:** Curvature present in the coronal third, followed by a straight continuation to the apex.
3. **Type III:** Curvature in the coronal third, with an additional buccal curvature from the middle third to the apical third of the root.
4. **Small Type:** Root length is less than half that of the distobuccal root.
5. **Conical Type:** Exhibits a cone-shaped extension with no root canal<sup>[17]</sup>.

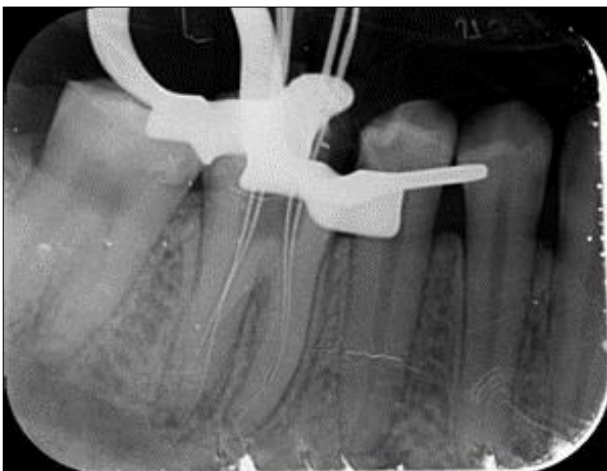
### Case report 1



**Fig 1:** Pre operative image



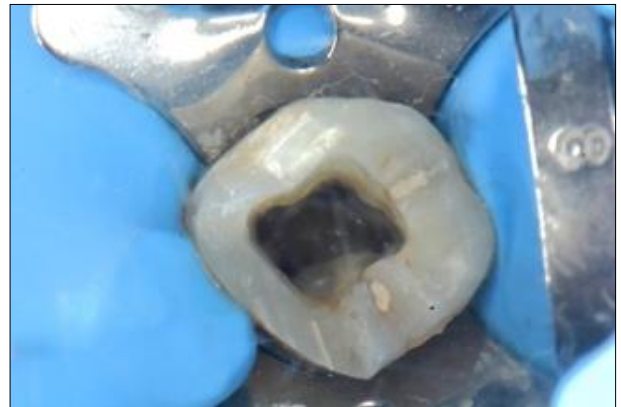
**Fig 2:** Preoperative IOPA



**Fig 3:** Working length determination



**Fig 4:** Obturation radiograph



**Fig 5:** Image of access cavity

The patient, a 32-year-old female patient, sought treatment at the Conservative Dentistry and Endodontics Department for spontaneous pain in her left mandibular posterior region. The pain intensified when lying down. An intraoral examination showed a Class II dental caries in left first molar. (TOP) tenderness on vertical percussion was observed, and both electric pulp testing and cold testing induced sharp pain, with lingering discomfort persisting for more than 30 seconds after stimulus removal. Radiographic examination showed lamina dura crossing the pulp chamber, hinting at an anomaly (FIG - 2). Further angled digital radiographs confirmed an extra root on the lingual side, consistent with radix entomolaris. The diagnosis was symptomatic apical periodontitis.

Local anesthesia was given, and the decay was removed, followed by a pre-endodontic restoration. A rubber dam was applied, and an access cavity was created. The typical triangular shape was adjusted to a trapezoidal one for better access to the distolingual root orifice. (FIG-5).

After removing the pulp chamber roof, two mesial canal orifices and one distal orifice were identified using DG 16. The distolingual canal orifice was located on the lingual aspect, positioned differently than usual. Working lengths were determined and confirmed with radiographs (FIG-3).

Glide path preparation with hand files was conducted, followed by irrigation with 2.5% sodium hypochlorite and rinsing with EDTA. The mesiobuccal and mesiolingual canals were enlarged to F2, and the distal canal and radix root were enlarged to F3 using ProTaper gold files. Calcium hydroxide intracanal medicament was placed, and after one week, the root canals were filled using the cold lateral compaction technique with AH Plus sealer (FIG-4).



The access cavity was sealed with composite restoration, and the root canal filling was evaluated radiographically to ensure proper obturation.

**Case report 2**



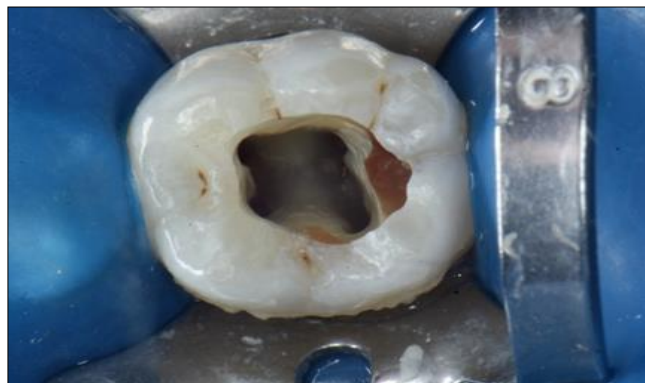
**Fig 6:** Preoperative IOPA



**Fig 7:** Working length determination



**Fig 8:** Obturation radiograph



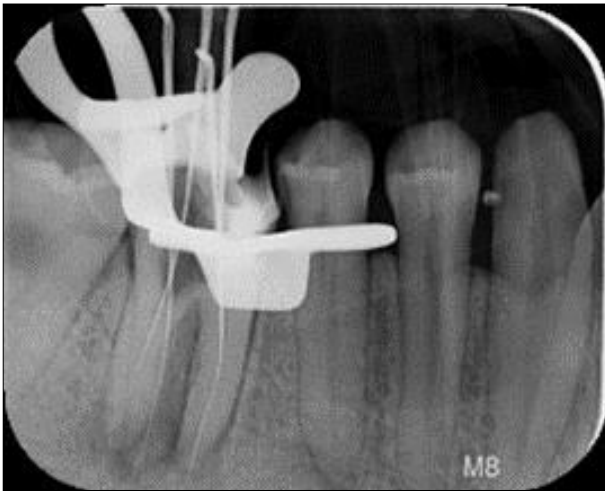
**Fig 9:** Access cavity

1. A 19-year-old female patient sought treatment at the Department of Conservative Dentistry and Endodontics at Bapuji Dental College and Hospital, Davangere, due to severe pain in the right lower posterior tooth region lasting for three days.
2. Clinical examination revealed Class I caries on the right mandibular first molar (tooth 46). A diagnostic radiograph indicated radiolucency crossing near the pulp and the presence of an additional root, consistent with radix entomolaris (RE) (FIG -6). The diagnosis was acute irreversible pulpitis and apical periodontitis of tooth 46. The treatment plan was root canal therapy to preserve the tooth.
3. Under local anesthesia, access cavity preparation was done using an endo Z bur. The first distal canal was found towards the buccal side, suggesting an additional canal on the lingual side. The access cavity shape was adjusted from triangular to trapezoidal (FIG-9) to aid in locating the fourth canal DG-16 endodontic explorer and #10 K-file were used to locate canal orifices and establish patency. Working length was determined electronically and confirmed radiographically (FIG -7). Cleaning and shaping were performed using rotary files up to 25/06 in the mesial canal and 30/06 in the distobuccal canal and radix entomolaris. Irrigation with 2.5% sodium hypochlorite and lubrication with 17% EDTA were carried out during instrumentation.
4. Obturation was done using gutta-percha points with the cold lateral condensation technique. The access cavity was restored with composite, and a post-obturation radiograph was taken (FIG-8).

**Case report 3**



**Fig 10:** Access cavity



**Fig 11:** Working length determination



**Fig 12:** Obturation radiograph

A 36-year-old female patient, without significant medical history, presented with severe pain in the right mandibular jaw. Intraoral examination showed a Class II mesio-occlusal dental caries on the mandibular right first molar (tooth 46), tender on percussion. A preoperative radiograph revealed widened periodontal space and loss of lamina dura in tooth 46, along with an extra root between mesial and distal roots. Radiolucent line crossing the pulp chamber indicated separate roots, identified by tracing it from the tooth's cervical region, indicating the periodontal space.

Under local anesthesia, an access cavity was prepared, followed by pre-endodontic restoration and rubber dam placement. DG16 was used to locate root canal orifices, revealing two mesial orifices, one distal orifice, and the radix entomolaris (RE). The access cavity was widened to locate the RE (FIG-10), resulting in a wide traditional access cavity. Working lengths were determined electronically and confirmed radiographically (FIG-11). Root canal negotiation was done with 10 K-files, and preparation was performed up to F2 in the mesiolingual, distolingual, and distal canals, and up to F3 in the radix entomolaris. Irrigation was done with 2.5% sodium hypochlorite and EDTA. Calcium hydroxide was applied as intracanal medicament, and the access cavity was temporarily sealed with Cavit G.

At the second visit, one week later, the patient was asymptomatic. Gutta-percha master cones were selected for the four root canals, and obturation was done using AH-Plus sealer and the cold lateral compaction technique. Stainless steel finger spreaders were used for gutta-percha compaction,

matching sizes with corresponding gutta-percha points. Excess gutta-percha was removed, and the access cavity was temporarily sealed with Cavit G and verified radiographically (FIG-12). After three weeks, the patient was advised to undergo end crown restoration.

### Discussion

When Radix Entomolaris (RE) is found in mandibular molars, the extra root is usually positioned distolingually, below the cervical border of the tooth. It's uncommon for the distolingual supernumerary root to be equal in size (length or diameter) to the distal root, and it typically has a more circular cross-section. Additionally, the distolingual root is inclined lingually at around a 45° angle to the tooth's long axis and often exhibits a type I canal system<sup>[13]</sup>.

In cases like Radix Entomolaris, the additional root isn't just a division of the distal root; it's a separate entity with its own distinct orifice and apex. This distinction is crucial for accurate diagnosis and successful treatment. The presence of a third root in a mandibular molar suggests the likelihood of two distal canals, with the distolingual canal typically displaying a type I configuration. This canal often exits the pulp chamber with a pronounced lingual orientation and may exhibit a subtle curve in the buccal direction at its apex. Challenges in locating and navigating this narrow additional distolingual canal may arise during root canal treatment and could contribute to treatment difficulties or failure<sup>[19]</sup>. Approximately thirty percent of mandibular first molars have four root canals, a percentage consistent with findings from various studies on root canal morphology in mandibular molars. This variability emphasizes the importance of comprehensive examination and treatment planning in endodontic procedures<sup>[20, 21]</sup>. It's important to diligently search for additional orifices even after initial preparation and debridement of the pulp chamber and canals are completed. This meticulous approach ensures identification and proper treatment of all potential root canals, thereby enhancing the success of the endodontic procedure and minimizing the risk of treatment failure due to missed canals.

In cases where a radix entomolaris is present in the permanent mandibular first molar, it's often observed that primary molars anterior to it may also have an additional distolingual root. This extra root may occur in the second primary molar alone or in both the first and second primary molars. This suggests a possible genetic influence on dental anomalies and emphasizes the importance of comprehensive examination in such cases<sup>[22]</sup>. Field Developmental Theory highlights the interconnectedness of teeth and their roles within functional fields during development & RE<sup>[11]</sup>. Field Developmental Theory: This theory emphasizes that teeth are not isolated entities but part of functional fields. Each field (incisors, canines, premolars, molars) has specific key teeth. Key teeth play a crucial role in shaping dental development<sup>[11]</sup>. The first permanent molar acts as the key tooth for the posterior region & Adjacent teeth develop based on the first molar's influence.<sup>[12]</sup> Hence, it can be hypothesized that the development of an extra root is regulated by specific genes that influence dental fields. These genes are primarily active in the region of the first permanent molar and frequently in primary molars, which correspond to what is referred to as the mesial to the molar field.<sup>[13]</sup>

Three-rooted mandibular first molars are commonly observed in Asian and Asian-derived populations, especially among Aleuts and Eskimos, with the highest frequency worldwide. Interestingly, American Indians exhibit a frequency more akin

to contemporary Southeast Asian populations, indicating a closer relationship between these groups than between American Indians and Aleut-Eskimos. These dental traits offer valuable insights into population migrations and relationships<sup>[12]</sup>.

This paper underscores the critical importance of comprehensive knowledge in endodontics, particularly in identifying additional roots and root canal orifices. Such knowledge empowers dentists to customize their clinical approach, thereby minimizing procedural errors during endodontic therapy. By addressing these aspects thoroughly, the likelihood of retreatment is diminished, thereby enhancing the overall success of the treatment.

### Conclusion

The frequent occurrence of RE in mandibular first molars underscores the importance of anticipating and identifying all canals during non surgical root canal treatment. Adopting a proactive approach is crucial to facilitate the endodontic procedure effectively, ensuring comprehensive treatment and minimizing the risk of missed canals. This meticulous approach improves the chances of successful treatment outcomes and reduces the need for retreatment.

### Conflict of Interest

Not available

### Financial Support

Not available

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