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COMPREHENSIVE ENDODONTIC TREATMENT OF MANDIBULAR FIRST MOLARS WITH RADIX ENTOMOLARIS AND PARAMOLARIS VARIATIONS: FOUR CASE REPORTS

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ABSTRACT

Radix entomolaris (RE) is a distolingual supernumerary root most commonly associated with permanent mandibular first molars and presents diagnostic and therapeutic challenges during root canal treatment. This case report describes the clinical diagnosis and endodontic management of a mandibular first molar with RE in 4 cases, highlighting access refinement, glide path establishment, curvature negotiation, and obturation strategies tailored to the additional root.

INTRODUCTION

Although first mandibular molars typically have a single mesial and distal root, there are anatomical differences that can affect the number of roots and root canals. Radix entomolaris (RE) is the term for the additional lingual root that is present distally in mandibular molars. To guarantee a favorable treatment outcome, an appropriate diagnosis must be made before beginning a root canal therapy on these teeth. The endodontic procedure can be successful if the atypical root canal morphology is recognized and thoroughly understood. One mesial and one distal root, with two mesial canals and one distal canal, are seen in most mandibular first molars. The mesial root often ***has two root canals***, which can either join to produce a single foramen at the root end or terminate in two distinct apical foramina. One bean-shaped root canal is typically found in the distal root. Although they are uncommon, mandibular molars with varying numbers of roots and root canals have been seen during dental operations. It was **Carabelli who first identified** the

existence of a second root in the mandibular first molar, which he named radix entomolaris (RE).

This study focused on the case series of radix entomolaris, a developmental defect that affects mandibular molars and is associated with extra root and extra canal in an unusual position. Radix entomolaris is a kind where the canal is located between the mesiolingual and distal canals, and **the extra root is on the lingual side**. Another variation is known as **radix paramolaris**, where the canal is located between the mesio buccal and distal canals and the extra root is on the **buccal side.** As a result, it is necessary to take preoperative radiographs in both mesial and distal angulations and carefully review dentinal maps. The goal of the endodontic process is to eliminate bacteria from the root canal system and stop further reinfection by biomechanically cleaning the pulp area and then hermetically sealing it with an obturating material.

If the unusual root canal shape is identified and fully comprehended, the endodontic procedure can be successful. Most mandibular first molars have one mesial and one distal root, with two mesial canals and one distal canal.

Successful endodontic therapy depends on thorough knowledge of root canal morphology and its variations that may complicate debridement and obturation.[5] Conventional periapical radiographs with mesial- and distal-angled views can suggest RE by showing a double periodontal ligament space or a distolingual radiopaque outline; however, CBCT provides three-dimensional confirmation and aids in treatment planning.[8] Missed RE canals remain a common cause of persistent symptoms or endodontic failure; therefore, meticulous access extension toward the distolingual aspect, troughing, and exploration under magnification and ultrasonics are recommended best practices.[9,10]

Appropriate diagnosis is must before starting with root canal procedure in these teeth to ensure successful treatment outcome. The report describes the endodontic management of mandibular molar with RE.

ETIOLOGY

There is no clear explanation for why a mandibular molar develops an extra third root. The development of dysmorphic supernumerary roots may be caused by a polygenetic system, the appearance of an atavistic characteristic, or environmental factors during odontogenesis. In eumorphic roots, racial genetic factors influence the deepest expression of a gene, which influences the more prominent phenotypic manifestation of the gene. [6, 7]

MORPHOLOGY

1.Carlsen and Alexanderson classified radix entomolaris (RE) based on the location of its cervical part into four types: [8,9,10]

Type A– Distally located cervical part with two normal distal root components

Type B– Same as Type A; however, only one normal distal root component

Type C– Mesially located cervical part Type AC– Between the mesial and distal root components

2. De Moor et al. classified RE based on the curvature in buccolingual orientation into three types:[11]

Type I– Refers to a straight root/root canal

Type II– Refers to an initially curved entrance that continues as a straight root/root canal

Type III– Refers to a first curve in the coronal third of the root canal, followed by second curve which is buccally oriented initiating from the middle to the apical third.

3. Recently, Wang et al. gave another classification for RE depending on its radiographic appearance.[12]

Type 1– Presents the most identifiable radiographic image

Type 2– A large beam angulation is necessary mesially or distally for their identification

Type 3– Merging of the adjacent distobuccal root makes identification extremely difficult.

Carlsen and Alexandersoncategorized RP into two types based on the location of its cervical part:[13]

Type A– Cervical part of an RP is located on the mesial root complex.

Type B– Cervical part of an RP resides centrally between the mesial and distal root complexes.

INCIDENCE AND PREVALENCE

Numerous anatomical investigations have found a relationship between the frequency of RE and particular ethnic groupings. The prevalence in Indian and Eurasian populations was less than 5%, whereas the incidence in African tribes was reported to be 3%. Among populations with Mongoloid characteristics (such as the **Chinese, Eskimo, and American Indians**), RE can range from 5% to >30%. It is regarded as a unique morphological difference because it is common in these individuals. Because it only happens at a high frequency of 3.4% to 4.2% (dysmorphic root morphology), the RE is uncommon in Caucasians. The second mandibular molar has the lowest incidence of RE, which can develop on the first, second, or third molar. Reports state that the bilateral incidence of RE ranges from 50% to 67%. [15.]

In populations with Mongoloid features (such as Chinese, Inuit, and Native Americans), the frequency of RE varies from 5% to >30%, while in Caucasians[3] and Africans[4], it is less than 5%. [5,6] It can be viewed as an Asiatic trait and is accepted as a typical morphological variation in these populations. Radix paramolaris is extremely uncommon, occurring with a prevalence of less than 0.5%.

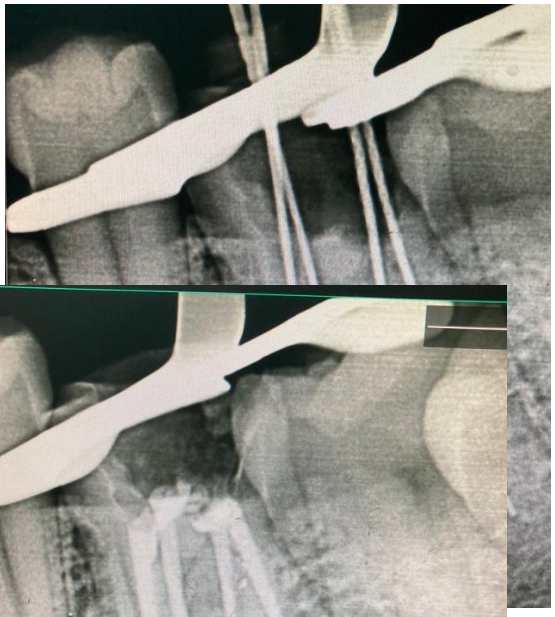
CASE REPORT -1

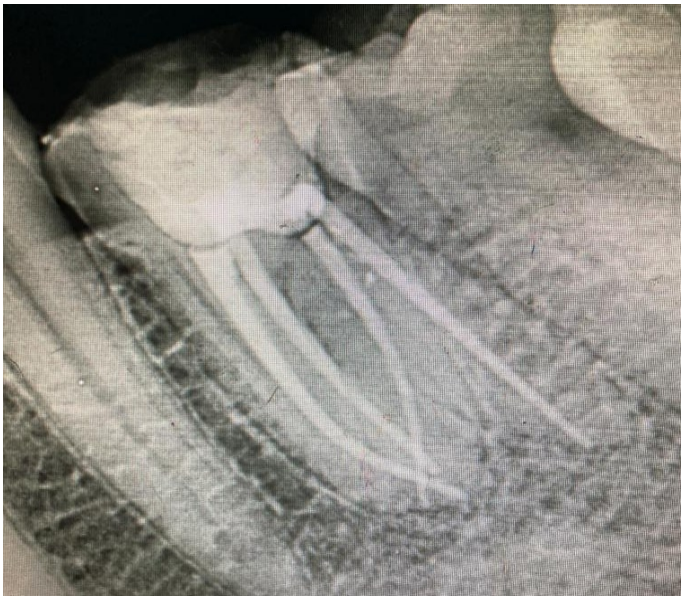
A 34-year-old male presented with spontaneous pain on the left mandibular posterior region for 4 days, exacerbated on chewing and thermal stimuli; medical history was non-contributory and vital signs were within normal limits.[11] Clinical examination revealed deep occlusal caries on tooth #36 with tenderness to percussion and biting; periodontal probing depths were within 3 mm circumferentially.[12] Cold testing with 1,1,1,2-tetrafluoroethane elicited an exaggerated lingering response; a provisional diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made.[13] Pre-operative periapical radiography with 25° mesial angulation showed an additional distolingual root outline and separation from the distal root, suggestive of RE; a contralateral distal-angled view corroborated the finding.[8,14]

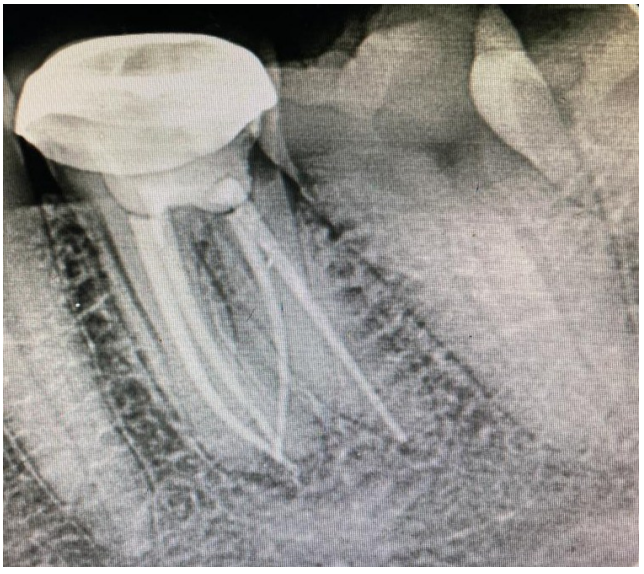
After local anesthesia (2% lidocaine with 1:100,000 epinephrine) and rubber dam isolation, an initial triangular access was refined to a modified trapezoidal outline extended toward the distolingual corner to locate the RE orifice using a DG-16 explorer and ultrasonic troughing under an operating microscope (×12).916 Four distinct orifices were identified: mesiobuccal, mesiolingual, distal, and distolingual (RE); patency was established with size 08-10 K-files and a #15 C-pilot file to negotiate curvature and minimize ledge risk in the RE canal.[9,17] Working length was determined with an apex locator and verified radiographically; glide path was prepared with size 15 K-file followed by 15/02 and 17/04 glide-path NiTi instruments, with special attention to pre-curving hand files for the RE canal due to its abrupt coronal curvature.[17]

Chemomechanical preparation was performed using a rotary/reciprocating hybrid protocol: mesial canals prepared to sizes equivalent to 25/08-30/09 depending on anatomy, the distal canal to 30/09, and the RE canal with martensitic heat-treated instruments (20/04 then 25/04) to respect curvature and reduce cyclic fatigue risk.18Irrigation was conducted with 3% sodium hypochlorite activated by passive ultrasonic irrigation for 20 seconds per cycle (three cycles) and 17% EDTA for smear layer removal, followed by a sterile saline flush; intracanal medicament was not required due to adequate debridement and absence of exudation.[19] The canals were obturated in a single visit using warm vertical compaction with gutta-percha and resin-based sealer; a cuspal coverage crown was planned to ensure coronal seal.[20] Post-operative radiographs confirmed dense three-dimensional obturation of all four canals including the RE canal; the patient was asymptomatic at 1-week review.[20]

A- PREOPERATIVE RADIOGRAPH, B-WORKING LENGTH DETERMINED, C-MASTER CONE, D-OBTURATION, B- E-POST ENDODONTIC TREATMENT , F-CROWN CEMENTATION



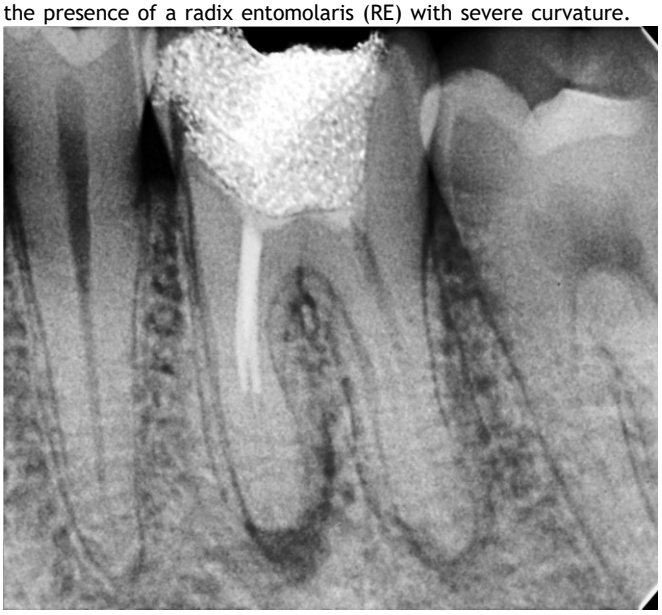


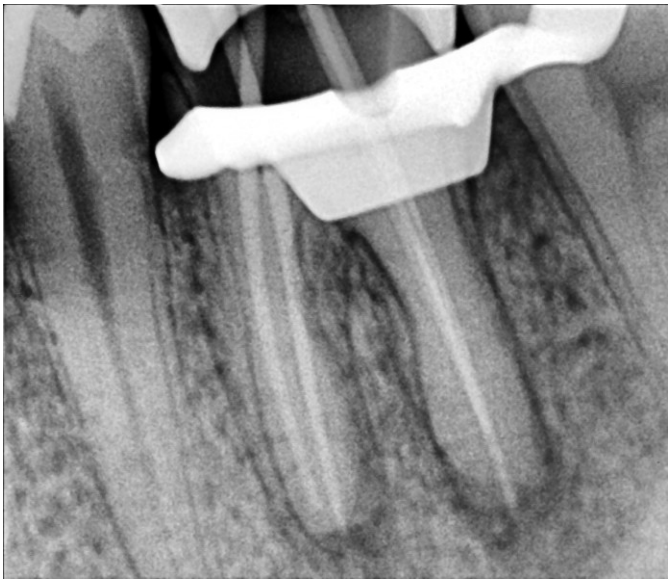


CASE REPORT 2

A 32-year-old male patient reported with spontaneous pain and lingering sensitivity in the mandibular left first molar (tooth 36). History of rct treated 4 years ago. Clinical examination revealed dislodged restoration -tooth 36 along with tenderness on percussion. Pre-operative periapical radiograph suggested faulty RCT along with an additional distolingual root. CBCT confirmed the presence of a radix entomolaris (RE) with severe curvature.

Following administration of local anesthesia and rubber dam isolation, access preparation was modified distolingually to locate the extra orifice. Working length was determined using an apex locator and verified radiographically. Cleaning and shaping were performed with NiTi rotary instruments under copious irrigation with 2.5% NaOCl and 17% EDTA. Obturation was completed with warm vertical compaction, and a full coverage restoration was advised.

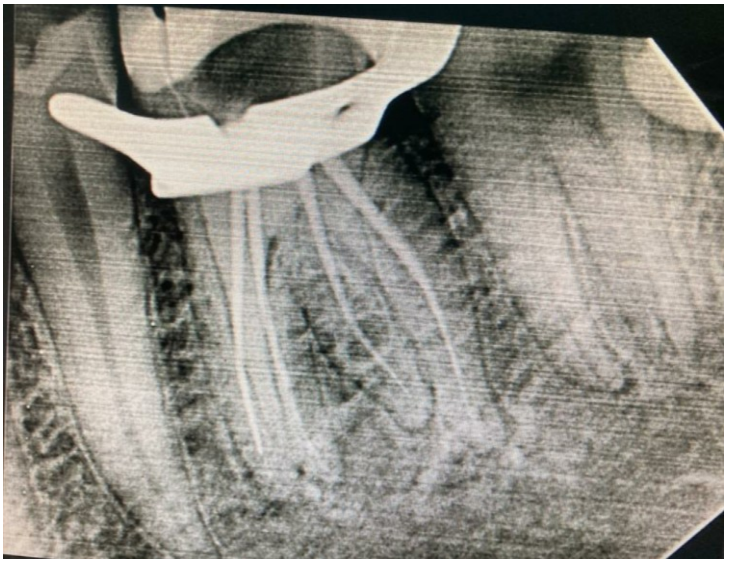


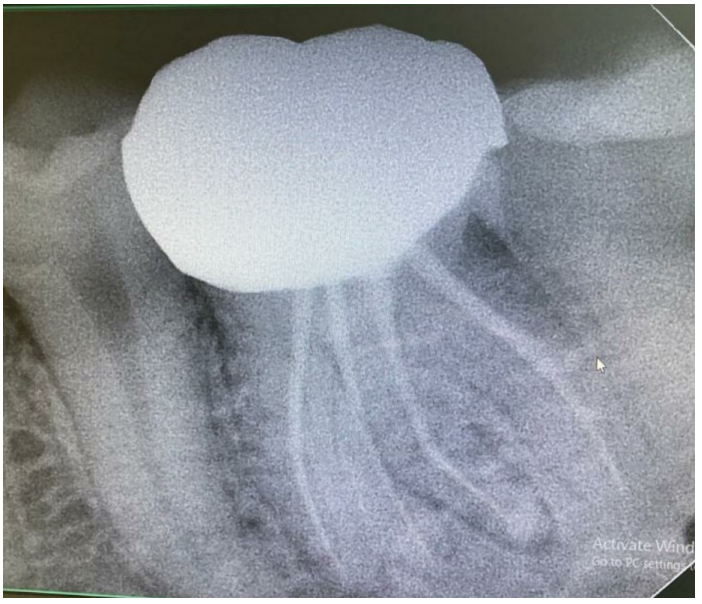


A- PREOPERATIVE RADIOGRAPH, B-WORKING LENGTH DETERMINED, C-MASTER CONE, D-OBTURATION ALONG WITH CROWN CEMENTATION

CASE REPORT 3

A 45-year-old female presented with recurrent pain in the mandibular right first molar (tooth 46). The tooth had a defective composite restoration. Radiographic evaluation suggested the presence of three roots. Under dental operating microscope (DOM) magnification, the access cavity was modified to reveal an additional orifice in the distolingual aspect. Negotiation was done with size 10 K-file, and the canal showed moderate curvature. Instrumentation was achieved using a hybrid technique (rotary and hand files), followed by passive ultrasonic irrigation with NaOCl and saline. Obturation was carried out using the single-cone technique with bioceramic sealer. Post-treatment radiograph confirmed satisfactory obturation of all four canals, and the tooth was asymptomatic on follow-up.

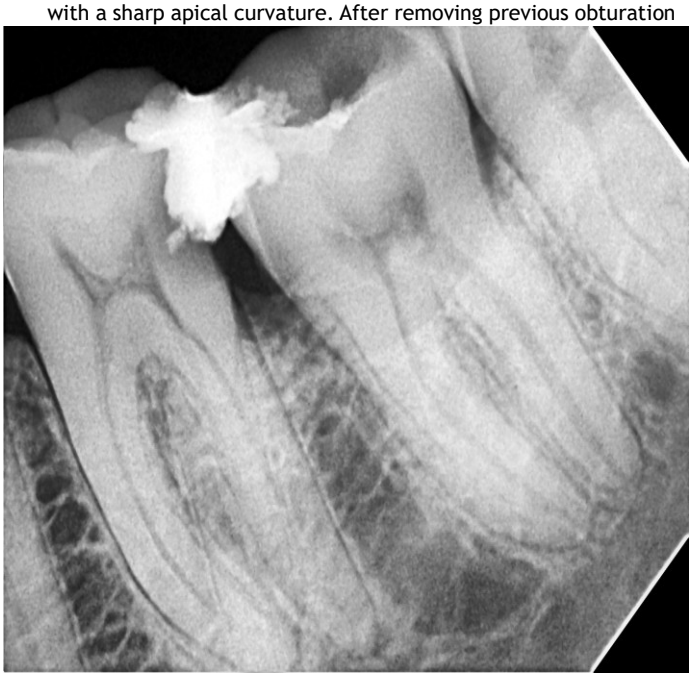


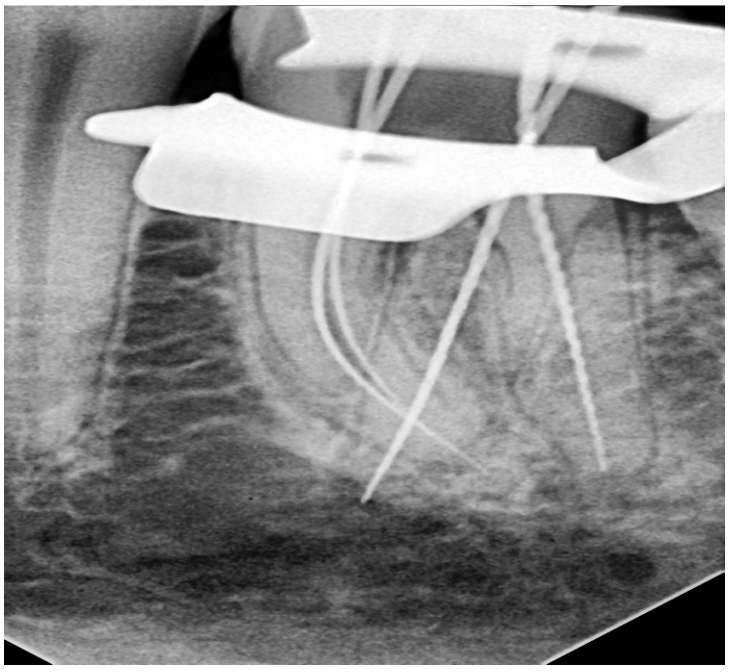


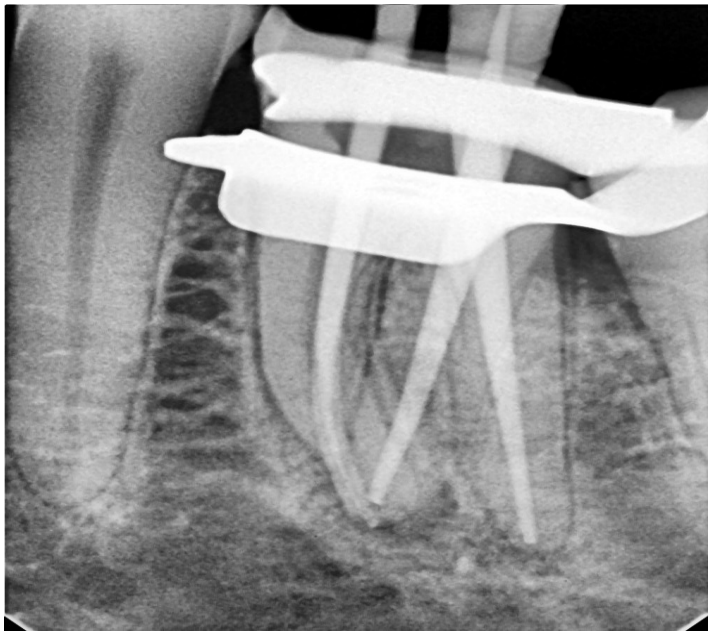
A-WORKING LENGTH DETERMINED, B-MASTER CONE, C-OBTURATION & POST ENDODONTIC TREATMENT, D-CROWN CEMENTATION

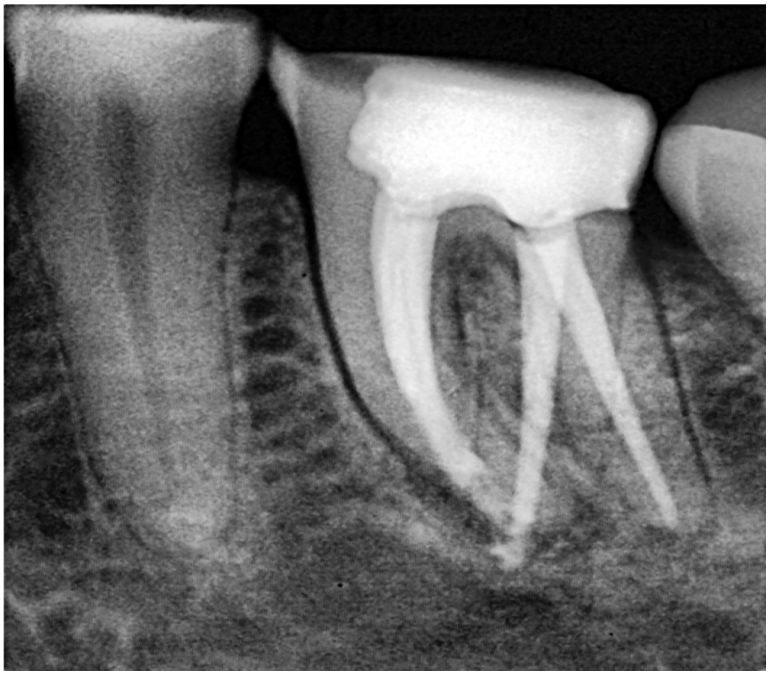
CASE REPORT 4

A 29-year-old male was referred for management of the mandibular left second molar (tooth 37) with a history of intermittent pain. The tooth had a previous incomplete endodontic attempt. Radiographs revealed a periapical lesion associated with the distal root and an additional root suspected distolingually. CBCT confirmed the presence of a radix entomolaris with a sharp apical curvature. After removing previous obturation material, the additional canal was located using DOM and DG16 explorer. Cleaning and shaping were done with controlled memory rotary NiTi instruments to negotiate the curvature safely. Irrigation was performed using an activated irrigation protocol with NaOCl and EDTA. Obturation was achieved with thermoplasticized gutta-percha. Follow-up after 6 months showed periapical healing.









A-PREOPERATIVE RADIOGRAPH, B-WORKING LENGTH DETERMINED, C-MASTER CONE, D-OBTURATION

DISCUSSION

RE represents a clinically significant variant that requires heightened suspicion in populations with higher prevalence; CBCT-based studies demonstrate wide ranges, underscoring ethnic and geographic influences and the impact of imaging protocols.[6,10,22] The RE orifice tends to be more lingual and apical with sharp buccolingual curvature, predisposing to ledging, transportation, and instrument separation if not managed with pre-curved stainless steel scouting files and martensitic NiTi systems.[9,17,18] Access refinement toward the distolingual aspect with ultrasonic troughing under magnification improves visualization and canal negotiation while preserving peri-cervical dentin; however, over-extension risks structural weakening and should be balanced with minimally invasive concepts.[9,16] Adjunctive passive ultrasonic irrigation enhances irrigant penetration in long, narrow, and curved canals and is associated with improved debris removal and disinfection; this is particularly relevant in RE where curvature limits mechanical contact of instruments with canal walls.19 While many RE cases can be treated predictably in a single visit when symptoms are controlled and canals are dry, multi-visit protocols with calcium hydroxide may be preferred in cases with exudation, acute apical abscess, or challenging anatomy; both approaches show favorable outcomes when disinfection is adequate.[19,21] Prognosis is determined primarily by the identification and management of the RE canal; missed canals remain a leading cause of post-treatment disease, reinforcing the need for pre-operative angled radiographs and, where indicated, CBCT imaging.[8,10,22]

CONCLUSION

Recognition of radix entomolaris through careful radiographic assessment, magnification-assisted access, conservative shaping with heat-treated NiTi, and activated irrigation can yield predictable outcomes comparable to teeth with conventional anatomy.[6,9,18,19] CBCT is a valuable adjunct when conventional imaging is inconclusive or when complex curvature is suspected, informing safe instrumentation strategies and reducing iatrogenic complications.[10,22]

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