

Root Canal Morphology of Mandibular Teeth: The Puzzle Report of Case Series

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Abstract

Root canal morphology is unique for every tooth but sometimes an extra root or extra canal can make it more complicated and challenging. Normally permanent mandibular first molar has two roots. Mesial and distal but an additional root can found either mesiobuccally or distolingually. It is termed as radix paramolaris and radix entomolaris, respectively. Now a extra canal between mesiobuccal canal and mesiolingual canal and extra root in mandibular premolar can make root canal treatment quite difficult for molar and premolar, respectively. Don't always think that single rooted teeth always have single root canal because mandibular central incisor is quite exceptional which can make case more challenging. Different teeth who having various root canal morphology and their interconnections are very unique. Successful treatment outcome depends mainly on the understanding of an additional root and root canal anatomy plus knowledge about its prevalence, diagnosis, morphology, canal configuration, and operator's skill. All above challenging cases can be detected by identifying the presence of a double or extra root outline in the preoperative IOPA, modifying the access opening and closely inspecting the pulp chamber and is treated by conventional root canal treatment involving cleaning, shaping, and obturation. Thorough examination and proper diagnosis of the root canal morphology are the success of an endodontic treatment so it is diagnosed radiographically using SLOB technique which confirms the extra root outline on IOPA. This article presents a case series on detection and endodontic management of radix entomolaris, mid mesial canal, two rooted mandibular premolar and mandibular central incisor with two root canals.

Keywords: Radix Entomolaris, Mid Mesial canal, Root canal Configuration, Endodontist Enigma

INTRODUCTION

Success of endodontic therapy is concerned with complete elimination of microbial infection, meticulous chemo mechanical cleaning, and shaping of the canals, followed by three-dimensional obturation of the root canal space. To perform thorough cleaning and shaping, it is mandatory for an endodontist to know the variations in anatomy of tooth of interest.^[1] Root canals are mostly left untreated because an endodontist fails to recognize their presence, especially in teeth with anatomic irregularities or accessory or aberrant root canals.^[2]

Radix entomolaris (RE) has a frequency of less than 5% in Indian populations.^[3] The etiology of such root formation is still not so clear, but its formation could be related to external factors such as tooth development (odontogenesis) and penetrance of an atavistic gene or polygenetic system (appearance of a trait belonging to a distant ancestor that has been dormant in recent generations).^[4]

Mid mesial canal often disregarded due to lack of detection.^[5] It requires proper knowledge.^[6] Slowey suggested mandibular root canal morphology as endodontist enigma.^[7,8] The presence of two roots in mandibular premolar is a morphological oddity with report incidence of 1.8%.^[9,10] Studies revealed that incidence of two root canal in extracted mandibular central incisor was 12–35%.^[11,12] According to Rahimi vs canine is higher (36.62% vs 20.48%),^[11] the incidence of double canal in mandibular central incisor ranges between 12 and 50%.^[13]

Above case series is about the detection and management of RE, mid mesial canal in a mandibular molar and two root canals in mandibular premolar and central incisor, respectively.

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MATERIAL USED

Case report: 1

A 24-year-old female patient was referred to the department of conservative dentistry and endodontics of Aditya Dental College, beed, with severe, throbbing, and constant pain in the mandibular left first molar, that is, tooth # 36, for the past 7–10 days. The medical history was not significant. On clinical examination, tooth # 36 had a deep carious lesion with fractured distolingual cusp (Figure 10). The tooth was severely tender on percussion. Pre-operative intraoral periapical radiograph revealed the presence of an extradistal root (Figure 9). Acute apical periodontitis was established as a diagnosis based on the patient's history and clinical and radiographic examination. The buccal object rule (same-lingual opposite-buccal rule) confirmed the additional root as a distolingual root (RE). After doing pre-endo build up with composite (Figure 11) local anesthesia using 2% lidocaine with 1:80,000 epinephrine (Figure 1) was administered and rubber dam isolation, tooth # 36 was accessed (Figure 13). Four distinct canal orifices were located (Figure 12) and negotiated using a K file. The working length was determined by an apex locator (Figure 8) and later confirmed

by intraoral periapical radiograph (Figure 14). After debriding pulp tissues, the canals were shaped with Nickel-titanium rotary instruments under copious irrigation with 5.25% sodium hypochlorite (Figure 4) and lubrication with EDTA (Figure 3). After drying the canals with paper points, the master gutta-percha points were fitted within the canals and a confirmation radiograph was taken (Figure 15). The root canal system was obturated with single cone GP technique (Figure 16) and Zical sealer (Figure 6). The access cavity was filled with composite, and the patient was referred to the prosthetic department.

Case report: 2

A 26-year-old male patient was referred to the department of conservative dentistry and endodontics of Aditya Dental College, beed without any pain and tenderness on percussion. Systemic or allergic problem was absent. The chief complaint was to complete remaining treatment with lower left first molar, that is, #36. Radiographic examination showed widening of lamina dura (Figure 17). After examination tooth was diagnosed as asymptomatic apical periodontitis.

The tooth was isolated with rubber dam and access opening finishing done (Figure 18). Pre endo build up done with

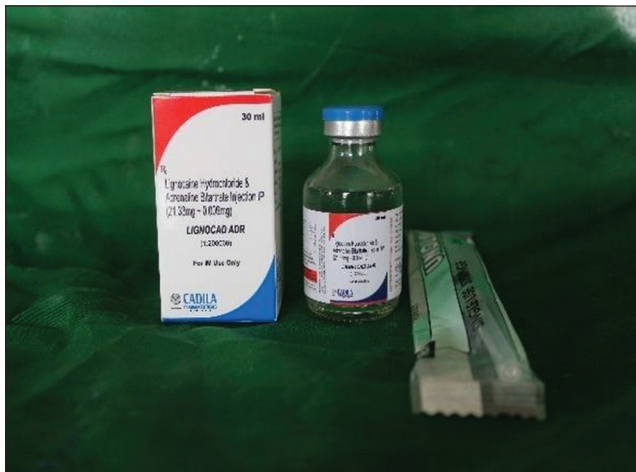


Figure 1: Local anesthetic solution



Figure 3: EDTA solution



Figure 2: Tween Kleen solution



Figure 4: Sodium hypochlorite solution



Figure 5: Calcium hydroxide solution



Figure 8: Apex Locator



Figure 6: Sealer for obturating canal



Figure 9: Pre-operative IOPA



Figure 7: Temporary filling material



Figure 10: Carious distolingual wall

composite (Figure 18). The mid mesial canal found between structural groove of mesio buccal and mesio lingual canal (Figure 19).

The working length taken using Apex locator (Figure 8) and confirmed with intra oral peri apical radiograph (Figure 20). Later on it is negotiated with no.8 and no. 10K hand files,

respectively, (Figure 21) canal continuously irrigated with 5.25% of sodium hypochlorite (Figure 4) and Saline. In between EDTA (Figure 3) had used for instrumentation. Biomechanical preparation successfully done (Figure 19) canal dried with paper points and given intracanal medicament (Figure 5) and Zinc oxide eugenol closed dressing given



Figure 11: Pre endo build up



Figure 14: Working length determination



Figure 12: Access opening

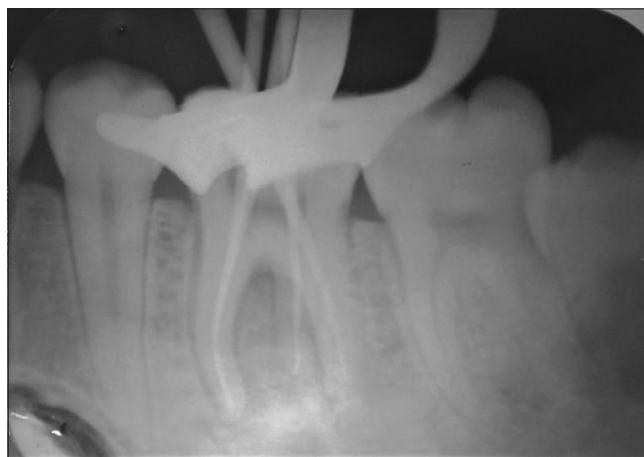


Figure 15: Master cone fit



Figure 13: Glide path



Figure 16: Final obturation

(Figure 7) after 2 week master cone X-ray has taken (Figure 22) obturation done (Figure 23) using Zical sealer (Figure 6).

Case report: 3

A 36-year-old male patient was referred to the department of conservative dentistry and endodontics of Aditya Dental

College, beed. Clinical examination showed deep proximal caries in mandibular first premolar, that is, #44 along with tenderness on percussion. After radiographic examination, there were root present in mandibular first premolar region with loss of lamina dura and abscess formation (Figure 25).

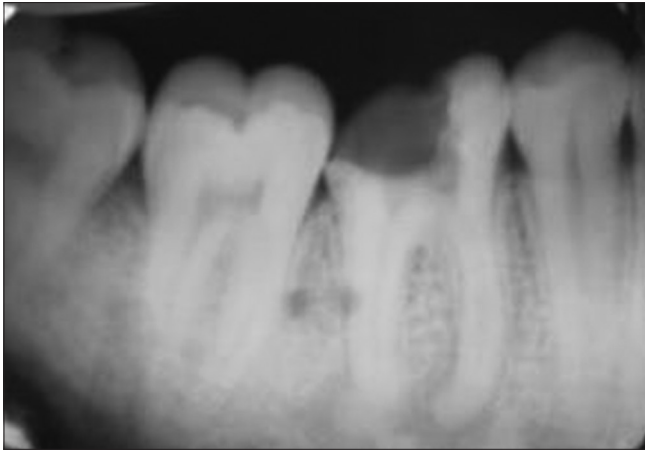


Figure 17: Pre-operative X-ray



Figure 20: Working length determination



Figure 18: Pre endo buildup



Figure 21: Glide Path



Figure 19: Biomechanical preparation



Figure 22: Master cone

For the confirmation basis, orthopantomogram (Figure 24) was taken which revealed presence of two roots. It was Vertucci's type four canal morphology. Access opening was difficult because presence of two canals which are very deep inside close to each other but use of magnifying loupes makes such cases easier for locating the canal. Two distinct canals with separate openings found and canal negotiation were done using no.10 K files (Figure 26). EDTA was used for lubrication (Figure 3) and removal of smear layer. Canal irrigated by copious irrigation of 5.25% concentrated sodium

hypochlorite (Figure 4). Master cone selection was done by tuck back effect and master cone-ray was taken (Figure 27). Zical sealer was used (Figure 6). Final obturation was done (Figure 28).

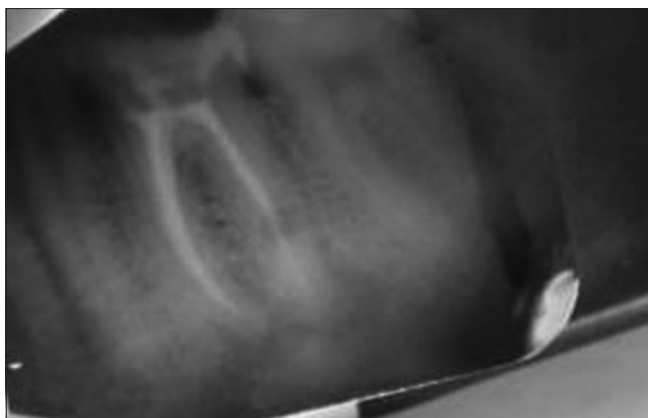


Figure 23: Final obturation



Figure 24: Orthopantomogram

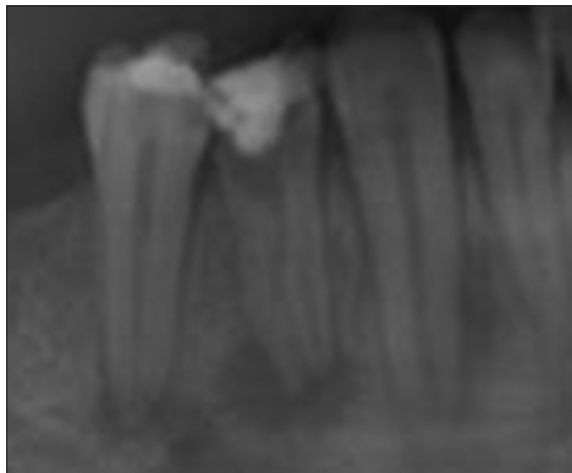


Figure 25: Pre-operative X-ray

Case Report: 04

A 64-year-old male patient was referred to the department of conservative dentistry and endodontics of Aditya Dental College and Hospital, beed. Clinical examination showed severe attrited mandibular teeth (Figure 30). Patient had edge to edge bite and mild, intermittent pain in mandibular left (front) side of the jaw. All mandibular incisors showed negative vitality test. For safety purpose, orthopantomogram (Figure 29) was taken which revealed large abscess formation in apical area

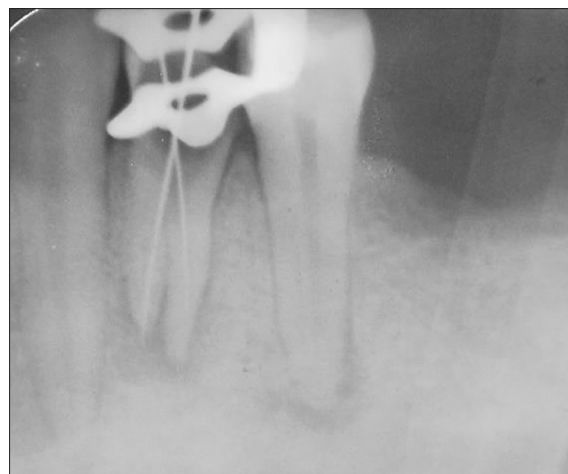


Figure 26: Working length determination



Figure 27: Master cone



Figure 28: Final obturation

of canine and first premolar. Intraoral periapical radiograph failed to show the presence of two canals in mandibular central incisor (Figure 31). Non-surgical root canal treatment planned for this case. But during access cavity preparation, it is revealed that it has two different canals (Figure 32) (vertucci's type two).



Figure 29: Orthopantomogram



Figure 32: Access opening



Figure 30: Clinical examination



Figure 33: Glide path



Figure 31: Pre-operative X-ray

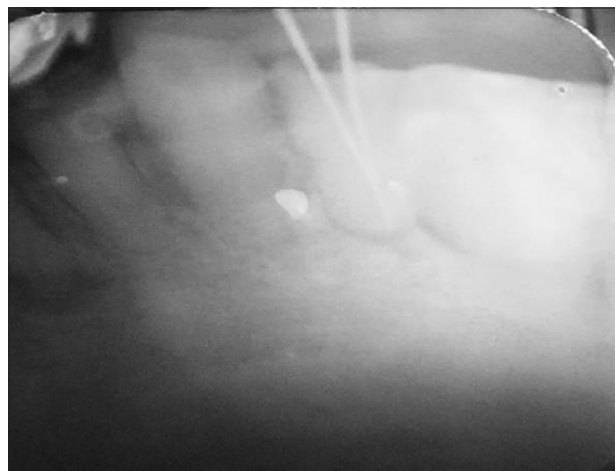


Figure 34: Working length determination

Canal negotiation was done using no. 10 K files. (Figure 33) and working length determined successfully (Figure 34).

Due to severe attrition, it was very difficult and challenging for rubber dam placement and patient was also uncomfortable for that. So isolation done by keeping cotton rolls next to respected tooth. Complete chemomechanical procedure was done using

EDTA (Figure 3) and Twin kleen (Figure 2) solution, followed by copious irrigation of 5.25% sodium hypochlorite (Figure 4). All the canals were filled with calcium hydroxide (Figure 5) as an intracanal medicament for a week due to pulp necrosis and zinc oxide eugenol closed dressig given (Figure 7).

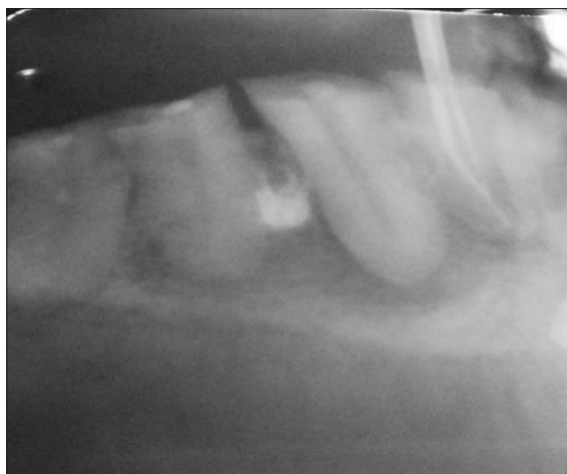


Figure 35: Master cone

On the next appointment, calcium hydroxide was removed and canals were irrigated with normal saline and hypochlorite (Figure 4). Canals were dried using paper points and selection of master cane was done (Figure 35) and canals were obturated by lateral condensation technique and Zical as a sealer (Figure 6).

DISCUSSION

It is not uncommon to find mandibular first molars with two roots; one mesial and another distal. Sometimes, an extra root may be encountered.^[1] One of the anatomical variations of tooth is presence of an extra root. Carabelli was the first to describe incidence of extra distolingual root in permanent mandibular molar. When the supernumerary root is present distolingually it is called as RE, on the other hand if it is present mesiobuccally, it is called as radix paramolaris. Carlsen and Alexandersen (1990) classified RE into four different types based on the presence of its cervical part.^[1]

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

The roots and canals of mandibular permanent first molars have typical anatomical features, and a great number of anomalies too. Studies focusing on morphology of canals in mandibular first molar have assessed that the presence of 2 roots (1 mesial and 1 distal) with 3 canals (2 in mesial root and 1 in distal root) is the common finding. Nevertheless, the presence of 2 roots (1 mesial and 1 distal) with 4 canals (2 in mesial root and 2 in distal root) is also relatively frequent, particularly with both the distal canals terminating in a single foramen. However, RE shows the presence of 2 distal roots, the second one being the extra distolingual root, is not very common as a morphologic variant.^[2] The infrequent occurrence of such an

anomaly requires that the clinician be careful in diagnosis and management of the lower molar teeth. The clinical examination of the tooth can reveal a more about the outline of the crown, an extra cusp (tuberculum paramolare), or a more prominent occlusodistal or distolingual lobe. These in combination with a cervical prominence or convexity can indicate the presence of an additional root. Aids for examination such as magnifying loupes, an intraoral camera, or a dental microscope can be used for this purpose. Radiographically a third root should normally be readily evident in about 90% of cases.^[3] After recognizing the RE form on the preoperative radiograph, to place the distolingual RE, following previous studies in mandibular first molars, the access cavity was revised into a trapezoidal outline. More rectangular or trapezoidal outline forms are made by the spreading the triangular cavity margins to the lingual. Visual supports such as a loupe, intra-oral camera, or dental microscope are beneficial while preparing it.

A dark line on the pulp chamber floor shows the exact place on the RE root canal aperture.^[4] Occasionally, it can be missed because of its slender dimension or overlapping with distal root.^[14]

The complexity of the anatomical variants seen in the first permanent mandibular molar, it proves to be invaluable in the clinical approach when treating such cases endodontically.^[15] The values based on the mean inter-orifice distance between an RE canal and remaining canals, as given in a study by Tu *et al.*,^[16] serve as a useful guideline to locate and treat an RE. In case of any calcification or overlying dentin or pulp roof remnants obscuring the orifice of an RE, use of an angled probe, ultrasonic cutting tips along with good illumination and visual aids is useful to locate RE.^[16] As the risk of instrument fracture increases with the decrease in the radius of curvature, canal preflaring with manual use of stainless steel files is suggested to control instrument fracture. Initial root canal exploration with small no. files (size 10 or less), creation of a glide path along with the correct determination of the canal curvature and working length would reduce the errors such as ledging and transportation. The use of flexible nickel-titanium rotary files allow a more centered preparation shape with minimal enlargement of the coronal canal third and canal orifice relocation.^[17]

A important thing which can cause root canal therapy failure is the inability to understand the internal morphology of the tooth and subsequent incomplete endodontic treatment.^[18] A good pre-operative radiograph is essential for preventing missed anatomy but it does not always necessarily reveal the actual number of canals present in the root.^[5] According to Pormeranz's classification, the mid mesial canal was classified as "confluent" - The Mid mesial canal originates as a separate orifice but apically joins the MB or ML canal.^[19] They also reported significantly higher incidence of an mid mesial canal in the younger patient age group.^[20] Various diagnostic aids such as dyes, champagne bubble test, ultrasonics, micro openers and trans-illumination aids, irrigators to improve pulp chamber visibility (Stropko), and observing the chamber for bleeding spots could be used by the clinician as an effective

means to locate additional canal orifices.^[21] The ultimate purpose of endodontic management should be to preserve the tooth mechanism without discomfort through instrumentation, irrigation, and obturation of the root canal system. The lack of understanding of the anatomy in addition to the lack of ability to find all the root canals for consequent irrigation and obturation may promote failure and periapical diseases.^[6]

Before commencing the root canal treatment, the dental practitioner is not able to precisely determine the number of root canals.^[22] For the management of branched canal configuration wherein the clinician encounters difficulty in locating and preparing the canal, the use of magnification was necessary.^[23] Martinez-Lozano *et al.*^[29] stated that up to 40° mesial angulation from horizontal plane for identifying the extra canals. In mandibular first premolar deviation of the X-ray angle from 15° to 30° in vertical axis was effective in visualizing canal anatomy.^[7] Scott and Turner describe the accessory root of mandibular first premolar as Tome's root.^[24]

Object of the clinical dentistry is to institute preventive measures to relieve suffering, and to cure disease. To gain this goal clinician should have sound knowledge of dental anatomy, differential diagnostic modulates.^[25] Careful examinations of the tooth before and during access cavity preparation are essential along with thorough probing of the pulp chamber.^[26]

The eight groups according to the Vertucci root canal configurations.^[27]

1. Type 1: A single canal extends from the pulp chamber to the apex.
2. Type 2: Two separate canals leave the pulp chamber and join short of the apex to form one canal.
3. Type 3: One canal leaves the pulp chamber, divides into two canals within the root, and then merges to exit as one canal.
4. Type 4: Two separate and distinct canals extend from the pulp chamber to the apex.
5. Type 5: One canal leaves the pulp chamber and divides short of the apex into two separate and distinct canals with separate apical foramina.
6. Type 6: Two separate canals leave the pulp chamber, merge within the body of the root, and then redivide short of the apex to exit as two distinct canals.
7. Type 7: One canal leaves the pulp chamber, divides and then re-joins within the body of the root, and finally re-divides into two distinct canals short of the apex.
8. Type 8: Three separate canals extend from the pulp chamber to the apex

When there are two canals, the buccal canal is the easiest to locate and is usually straighter than the canal lingually, which is usually shielded by lingual shelf.^[28]

CONCLUSION

RE, mid mesial canal, mandibular central incisor with two canals and mandibular premolar with extra root are not only

canal morphological puzzle but also wake up call for respected clinician. Mandibular teeth always do have complicated root canal morphology so such awareness should be present in dentist. The root canal variation should be diagnosed by different angulation for future prognosis that tooth; it depends upon the skill and knowledge of that clinician. After diagnosis that root canal variation should be treated with proper armamentarium such as magnifying loupes, orifice opener, and endo activator for final irrigation. After completing chemomechanical preparation canal should be dried properly for final obturation.

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