



Comprehensive Management of Endodontic Variants Radix Entomolaris and Radix Paramolaris - A Case Series

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Abstract

Mandibular first molar is the first permanent tooth to erupt in the oral cavity and most commonly affected due to caries requiring an endodontic treatment. Presence of an extra root and canal in mandibular first molar is a common variation and referred to as radix entomolaris or radix paramolaris. The extra root and canal could become a potential source of infection when it remained undiagnosed or improperly prepared during root canal preparation, leading to abscess formation and endodontic failure. Such abscess when left untreated becomes chronic and might show its presence in the form of intraoral sinus tract. When this condition is still neglected, it might open extraorally through the buccal soft tissues as path of pus drainage. This article elaborates the comprehensive endodontic management of patients diagnosed with radix entomolaris and paramolaris associated with extraoral sinus tract.

Keywords: Extra Root; Radix Entomolaris; Radix Paramolaris; Extraoral Sinus Tract

Abbreviations

RE: Radix Entomolaris; RP: Radix Paramolaris; IOPA: Intra Oral Periapical; M: Mesio Buccal; D: Distal; MB: Distolingual; ML: Mesiolingual; DB: Distobuccal; DL: Distolingual; SLOB: Same Lingual Opposite Buccal; OSMF: Oral Submucous Fibrosis

Introduction

Endodontics is a branch of dentistry deals with etiology, diagnosis, prevention and treatment of diseases of pulp and peri-radicular tissues. Successful endodontic treatment requires knowledge of root canal anatomy, correct diagnosis and proper access to root canals, cleaning and shaping followed by three-dimensional sealing of root canal space. Mandibular first molar is the first permanent tooth to erupt in the oral cavity and most commonly affected due to caries requiring root canal treatment. Studies have shown that mandibular first molars usually have two roots and three or four canals i.e. M and D roots and MB, ML and D canals. Mesial root has two canals i.e. MB and ML [1-3]. Although number of roots and root canals may vary. In 1844, Carabelli [4] for first time reported an important anatomical variation in mandibular first molar i.e. presence of third distolingual root termed as the Radix Entomolaris (RE) [5] and Radix Paramolaris (RP) when root is placed buccally [6].

Mongoloids such as Chinese and Eskimos have higher preva-

lence of radix in the range of 5 - 30% [7-9] whereas, Caucasian, Eurasian and African (Bantu Bushmen) population showed this variation less frequently in about less than 5% cases. Factors during dentin formation or presence of an atavistic gene could affect the formation of supernumerary roots. De Moor proposed that particular racial genetic factors might affect the more profound expression of a specific gene leading to the more pronounced phenotypic eumorphic manifestation in roots [10]. Similarly, Curzon stated that, the genetic predilection of the 'three rooted molar is high [12].

Diagnosis and preparation of an extra root are important aspects in management of anatomical variations and to detect such variations such as an extra root, extra canal, dilacerations, curvatures etc. IOPA radiograph always play a vital role. Radiographs taken at two different angulations detect the presence of an extra root and root canal using SLOB rule. The inherent limitation of conventional radiograph and radio-visiograph is that, it gives two-dimensional image of a three-dimensional object which may result in the superimposition of anatomical structures. Advances in imaging technologies, such as cone-beam computed tomography (CBCT) have been proved to be a valuable tool to help in the diagnosis of complex root anatomy and anatomical variations [13,14]. CBCT could generate a three-dimensional reconstruction of oral hard tissues including teeth and surrounding bone. Also,

slicing at different horizontal levels with CBCT helps in diagnosis of root canal anatomy especially in middle and apical third.

Knowledge of anatomical variations is always beneficial in delivering better treatment to patients reported with anatomical complexities related to root canal system. The presented article describes a case series of comprehensive endodontic management of 5 patients diagnosed with RE and RP including management of 3 patients associated with extraoral sinus.

Case Report 1

A 21-year-old healthy female patient from a remote village was reported to the Department of Conservative Dentistry and Endodontics, complaining of pus discharge from external skin surface of right cheek region since 1 week. Patient narrated that, she had pain 6 months back in tooth #46 for which she had visited a physician. The physician prescribed her antibiotics and analgesics for relieving her symptoms. Again, after a month she has noticed a small nodule on her right cheek. With time, the nodule has increased to about 1 cm in size in a month and pus drainage was observed through the nodule. She had then visited to a general surgeon, where the surgeon did curettage of nodular area from external skin surface. Patient was asymptomatic upto next month till she observed recurrent pus drainage from the operated site. The surgeon has then noticed a carious tooth #46 and referred the patient for dental treatment to our department. When the patient visited our department, a visible granulation tissue with small depressed area was observed in operated site of right cheek (Figure 1,2). Intra oral examination showed carious tooth #46 (Figure 3). Electric pulp test showed no response in tooth #46 and suggested pulp necrosis. IOPA radiograph showed three rooted tooth #46 and diagnosed as radix entomolaris with extraoral draining sinus in right buccal mucosa (Figure 4). Patient was explained about the condition and her informed consent was obtained for root canal treatment of tooth #46.



Figure 1: Preoperative extra oral photograph of patient (right side profile) showing extraoral scarring of tissues.



Figure 2: Preoperative extra oral photograph (front profile) of patient showing depressed area in mandibular right-side due to contracture of skin.



Figure 3: Clinical photograph of carious tooth #46.



Figure 4: Preoperative IOPA radiograph of tooth #46.

Local anaesthesia was secured and rubber dam was applied. Access cavity preparation was modified to explore additional root canal on buccal side. Four canal orifices i.e. MB, ML, DB and DL were explored and working length IOPA radiograph was taken in two different angulations i.e. straight on and distal angulation (Figure 5,6). Patient was then advised for computed cone beam tomography (CBCT) but she refused to give consent for the same. All four canals were prepared using hand files and Protaper universal rotary files. Coronal flaring was done with orifice opener file, Protaper Sx and canal preparation was completed sequentially upto 6% no.20, F1 Protaper file. Root canals were copiously irrigated during entire cleaning and shaping procedure using 5% sodium hypochlorite and final rinsing was done with saline. After completion of cleaning and shaping procedure, canals were flooded with 5% sodium hypochlorite and irrigant agitated with ultrasonics. Intracanal calcium hydroxide was placed and patient recalled after 2 weeks. After 2 weeks pus drainage was not evident but patient reported with mild pain. Canals were thoroughly irrigated to remove calcium hydroxide. In this visit, fresh calcium hydroxide was placed in the canals and patient recalled after 2 weeks for evaluation. In subsequent visit patient was asymptomatic with no evidence of pus discharge. After removal of calcium hydroxide root canals were dried using corresponding paper points. Obturation was done using AH plus sealer with 6% Protaper standardized gutta percha cones. Warm vertical condensation was done and confirmatory post-operative radiographs were taken in two angulations (Figure 7,8 and 9). Patient has been recalled for post endodontic restoration in tooth #46 after a week and was reported to be asymptomatic. The external, visible tissue overgrowth has resolved with small depression mark left behind in the operated site.

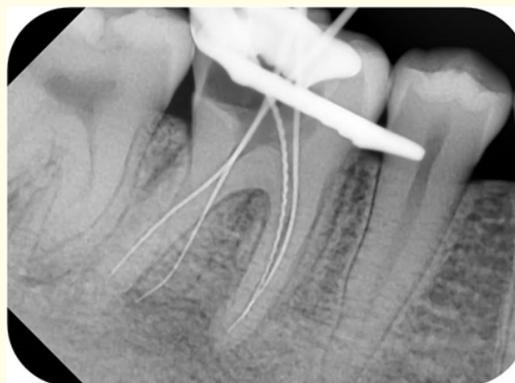


Figure 6: Working length IOPA radiograph of tooth #46 distal angulation.



Figure 7: Post obturation IOPA radiograph of tooth #46 with straight on angulation.

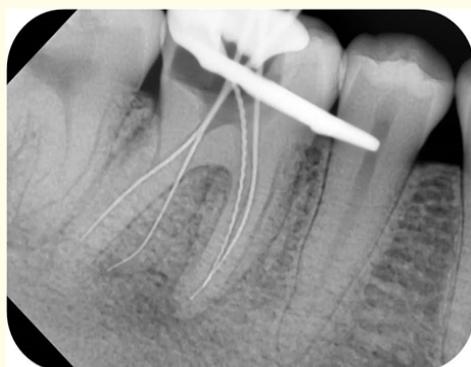


Figure 5: Working length IOPA radiograph of tooth #46 straight on angulation.



Figure 8: Post obturation IOPA radiograph of tooth #46 with distal angulation.



Figure 9: Post-operative photograph of patient (right side profile).



Figure 10: Preoperative extra oral photograph of patient (right side profile) showing extraoral nodule.

Case Report 2

A 26-year-old healthy male patient reported to the Department of Conservative Dentistry and Endodontics complaining of pus discharge externally from right cheek region since a month. Patient gave history of pain in tooth #46, 1 year back for which he visited a private dentist. The dentist advised him root canal treatment in tooth #46 and prescribed medicines. After relieving the symptoms, he had not visited to any dental practitioner for the treatment. Again after 6 months he found a small swelling on his skin of right cheek. With time, the swelling has increased and opened as small external opening with pus discharge. Frequency and quantity of pus discharged was increased with time and then patient visited another private dentist for its treatment. The dentist after examining the patient referred him to our department for the treatment.

Extraoral examination of patient showed a small nodule from skin surface of the right cheek (Figure 10,11). Intra oral examination showed carious tooth #46. IOPA radiograph showed tooth #46 with 3 roots (Figure 12). Electric pulp test showed no response, thus identified as necrosis of the pulp in tooth #46. Patient was thus diagnosed as radix paramolaris with tooth #46 with extraoral draining sinus in right buccal mucosa. Patient explained about the condition and his informed consent was obtained for root canal treatment in tooth #46.



Figure 11: Preoperative extra oral clinical photograph front profile of patient showing elevated area in mandibular right side.



Figure 12: Preoperative IOPA radiograph of tooth #46.

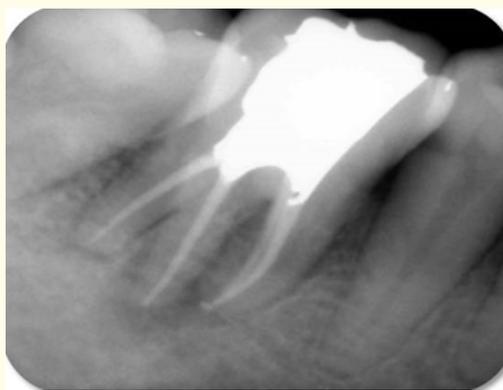


Figure 14: Post obturation IOPA radiograph of tooth #46 with distal angulation.

Rubber dam was applied after securing local anaesthesia for tooth #46. Access cavity preparation was done and four canal orifices i.e. MB, ML, DB and DL were explored. Working length IOPA radiograph was taken (Figure 13) and confirmed with electronics apex locator. All four canals were prepared using hand files and rotary Protaper universal files. Canal preparation was completed sequentially upto 6% no.20, F1 Protaper file. Root canals were copiously irrigated during entire cleaning and shaping procedure using 5% sodium hypochlorite followed by saline and irrigant was agitated with ultrasonics. Intracanal calcium hydroxide was placed and patient was recalled after 2 weeks. In next visit, pus drainage was not evident and patient was asymptomatic. After removal of calcium hydroxide, canals were dried using Protaper paper point and obturation was done using 6% Protaper gutta percha with AH plus sealer. Warm vertical condensation was done to seal canals optimally and post-operative radiograph was taken (Figure 14). Post endodontic restoration with amalgam was done in tooth #46 after a week. After 1-month recall, no nodule was seen except small depressed area in front profile (Figure 15,16).

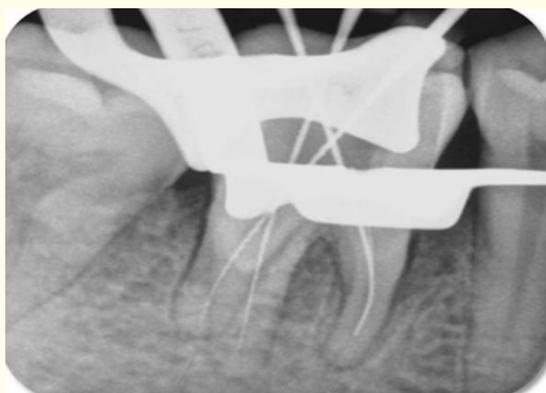


Figure 13: Working length IOPA radiograph of tooth #46 with distal angulation.



Figure 15: Post-operative photograph of patient (right side profile).



Figure 16: Post-operative photograph of patient (Front profile).

Case Report 3

A 22-year-old healthy male patient reported to the Department of Conservative Dentistry and Endodontics complaining of pus discharge externally from right cheek region since a week. Patient gave history of pain with swelling in right sub-mandibular region due to carious tooth #46. Two weeks back he visited to a private dentist who advised him root canal treatment in tooth #46 and prescribed analgesics. In a subsequent week, swelling was reduced and pus discharge with foul smell was observed by patient from the region of swelling through a small opening. The patient was then referred to our department for further treatment.

Patient was found to be very apprehensive towards dental procedures since childhood. Clinical examination of patient showed a small opening of extraoral sinus tract from skin surface of the right cheek with pus discharge (Figure 17). Intra oral examination showed carious tooth #46 and no response showed with electric pulp test, suggestive of necrotic pulp. IOPA radiographs showed three rooted tooth with periapical abscess in tooth #46 (Figure 18,19). Patient was thus diagnosed as radix paramolaris with tooth #46 with extraoral draining sinus in right buccal mucosa. Patient was explained regarding the clinical condition, treatment and informed consent was obtained for root canal treatment in tooth #46.



Figure 17: Pre-operative photograph of patient (right side profile) showing pus discharge from sinus tract.



Figure 18: Preoperative IOPA radiograph of tooth #46 with straight on angulation.



Figure 19: Preoperative IOPA radiograph of tooth #46 with mesial angulation.

Local anaesthesia was secured and rubber dam was applied of tooth #46. Access cavity preparation was done and MB, ML, DB and DL canal orifices were explored. Working length radiographs were taken at different angulations (Figure 20,21), as well as confirmed with electronics apex locator and all canals were prepared using hand files and Protaper rotary files. Root canals were thoroughly irrigated during entire cleaning and shaping procedure using 5% sodium hypochlorite followed by saline and agitated using ultrasonics. Intracanal calcium hydroxide was placed and patient was recalled after 2 weeks. In the next visit patient was asymptomatic and no sinus tract has been seen. Warm vertical condensation was done to obturate the canals and post-operative radiograph was taken (Figure 22). Patient was scheduled for post

endodontic restoration in tooth #46 after a week shown showed resolution of sinus tract (Figure 23).

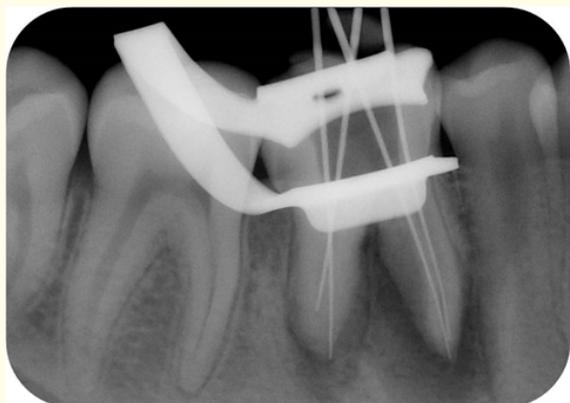


Figure 20: Working length IOPA radiograph of tooth #46 with straight on angulation.

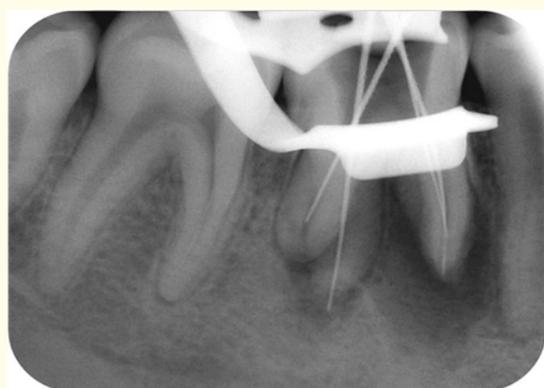


Figure 21: Working length IOPA radiograph of tooth #46 with mesial angulation.



Figure 22: Post obturation IOPA radiograph of tooth #46.



Figure 23: Post-operative photograph of patient (right side profile) showing resolution of sinus tract.

Case Report 4

A 51-year-old healthy, uneducated male patient; a farmer from remote village reported to the Department of Conservative Dentistry and Endodontics with complaint of swelling in right submandibular area since 3 weeks. Clinical examination showed soft, tender swelling in right submandibular region associated with carious tooth #46 with limited mouth opening (Figure 24,25). Patient narrated that, there was pus discharge from right cheek 6 months back for which he had taken medicines from nearby dentist. He also narrated that the swelling was initiated 3 weeks back and now increased to present size about 1 cm since then. Patient has betal but chewing habit since childhood and presented with fibrous bands all over lip and cheek mucosa, diagnosed with oral submucous fibrosis (OSMF). Intra oral examination showed poor oral hygiene and multiple carious teeth. There was grossly decayed tooth #46 and no response shown to electric pulp testing confirmed the pulp necrosis. IOPA radiograph showed three roots in tooth #46 and periapical abscess (Figure 26). Patient was identified as radix paramolaris with tooth #46 with history of extra-oral draining sinus in right buccal mucosa. Patient was explained about treatment and his informed consent was obtained.



Figure 24: Pre-operative photograph of patient (front profile) showing elevated nodular swelling on mandibular right side.



Figure 25: Pre-operative photograph of patient (right side profile) showing elevated nodular swelling on mandibular right side.



Figure 26: Preoperative IOPA radiograph of tooth #46 with straight on angulation.

Rubber dam was applied after administration of local anaesthesia. Access cavity preparation was done and modified to locate all four-canal orifice. Working length confirmed with electronics apex locator due to restricted mouth opening. Canal preparation was done with flexi hand NiTi files and Protaper universal rotary files. Root canals were copiously irrigated during entire cleaning and shaping procedure using 5% sodium hypochlorite followed by saline. No pus drainage was seen from root canal. After a week when patient was asymptomatic obturation was done and post-operative radiograph was taken (Figure 27). Post endodontic restoration was done in tooth #46 and patient was recalled for treatment of OSMF after a week but he did not reported back for further treatment.



Figure 27: Post obturation IOPA radiograph of tooth #46.

Case Report 5

A 35-year-old healthy, female patient reported to the Department of Conservative Dentistry and Endodontics with complaint of swelling in right submandibular region since 2 weeks. Clinical examination showed tender, soft swelling in right submandibular area associated with carious tooth #46 with reduced mouth opening due to swelling. Intra oral examination showed poor oral hygiene with multiple carious teeth. There was deep occlusal caries with pulp exposure seen in tooth #46. No response was present to electric pulp testing; thus, diagnosis of pulp necrosis was confirmed. Pre-operative IOPA radiograph showed three rooted tooth #46 and periapical abscess associated with extra root (Figure 28). Patient was identified as radix paramolaris with tooth #46. Patient was explained about root canal treatment and her informed consent was obtained.



Figure 28: Preoperative IOPA radiograph of tooth #46 with straight on angulation.

After local anaesthesia rubber dam was applied and access cavity was prepared to locate all four-canal orifice. Working length confirmed with electronics apex locator due to restricted mouth opening. Canal preparation was done with flexi hand NiTi files and rotary Protaper files. Root canals were copiously irrigated during entire cleaning and shaping procedure using 5% sodium hypochlorite. Patient recalled for obturation after a week. In the next visit, obturation was done and post-operative radiograph was taken (Figure 29). Patient was scheduled for post endodontic in tooth #46 after a week.



Figure 29: Post obturation IOPA radiograph of tooth #46.

Discussion

Successful endodontic treatment mandates knowledge of tooth anatomy and variations, proper access to all canals, thorough clean-

ing and shaping of canals and three dimensional obturation of root canal system. Mandibular first molars are most important teeth as they are first permanent teeth to erupt in oral cavity, most commonly affected tooth due to caries. It also determines the occlusal scheme and guide eruption pattern of second molars.

Mandibular first molars usually exhibit 2 roots and 3 canals. Presence of an extra root on lingual or buccal side is a common variation and first reported by Carabelli [4]. The presence of additional third root when present on lingual side it is referred to as radix entomolaris and when it is present on buccal side it is called as radix paramolaris. RE or RP show ethnic predilection and more prevalent in Mongoloid community including Chinese and Eskimos in about 5 - 30% population [7-10]. Whereas, a study in Indian population showed prevalence of RE in less (2.16%) than other Asian populations [15]. Bilateral occurrence of RE was found in about 60% of cases. There is a higher predilection of RE on right side teeth and higher prevalence in women. The rare occurrence of such anomaly requires that, the clinician must have knowledge of tooth anatomy and variation and at the same time must be cautious enough to diagnose the variation promptly. Clinically radix tooth could show bulbous crown or prominent distal or distolingual lobe or may present an extra cusp (tuberculum paramolare) [16].

IOPA radiograph could reveal presence of a third root in about 90% of cases [17]. Similarly, IOPA taken at different horizontal angulations i.e. 20 degrees mesial or distal could reveal the anatomical variation of the tooth [18,19]. Advance imaging tools like CBCT could be valuable in diagnosis of anatomical variation in more complex root canal anatomy. In endodontic treatment of such teeth, after establishing straight line access into the pulp chamber, access cavity should be modified to locate orifice of RE or RP root canal. The laws of orifice location given by Krasner and Rankow could help in identification of extra root canal orifice [20]. In the present case series, radiographs clearly revealed the presence of RE or RP in all the cases emphasizing the importance of radiographs in the detection variations like RE and RP; and might differ the need for expensive imaging such as CBCT especially for economically poor patients.

Usually the orifice of radix entomolaris is located distolingually, thus to locate distolingual canal orifice the shape of access cavity should be modified from triangular shaped to trapezoidal or rectangular form. The root canal orifices often follow the laws

of symmetry and canal orifices are usually equidistant from a line drawn in a mesiodistal direction through the pulpal floor and lie perpendicular to this mesiodistal line across the centre [6,20-22].

RE can be classified into four different types depending on the location of its cervical part [23]:

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

Each type has a sub-classification to allow for the identification of separate or non-separate RE.

Based on the study by Ribeiro, *et al.* another classification of RE was given by De Moor, *et al.* elaborating the curvature of the root or the root canal in to three types [11,24].

- Type 1: A straight root or root canal.
- Type 2: Curved coronal third which becomes straighter in the middle and apical third.
- Type 3: Initial curve in the coronal third with a second buccally oriented curve which begins in the middle or apical third.

Song JS, *et al.* (2010) further added two more variants of RE [25]:

1. Small type: Length shorter than half of the length of the distobuccal root.
2. Conical type: Smaller than the small type and having no root canal within it.

In cases of pulpal diseases, when infection left untreated, leads to spread of infection to peri radicular area. Periapical abscess often follows path of least resistance via soft tissues through the sinus tract usually in adjacent periodontal tissues. As in our cases, sinus tract opened to the buccal skin surface leading to poor aesthetics. Usually endodontic treatment of affected tooth results in resolution of sinus tract and does not require any special treatment for sinus tract.

In our case report 1, the previous surgeon could not diagnose the condition which was related to endodontic origin and treat the condition as regular abscess. Proper diagnosis using radiographs, clinical test and prompt treatment help in successful management of such cases of anatomical complexities. In Case report 4 OSMF patient require special consideration such as use of small length burs, modified files and flexi files etc. due to restricted mouth opening for access preparation, cleaning and shaping as well as in obturation.

Conclusion

Radix entomolaris or paramolaris is the most common variation observed in mandibular first molar with very low prevalence rate about 0.5 - 30% in various populations. Endodontic management of such cases associated with intraoral or extraoral sinus tracts require multi-angulated radiographs or CBCT evaluation. For successful endodontic treatment, the knowledge of tooth morphology including anatomical variations and canal configuration is necessary. In cases of a RE or RP the conventional triangular access preparation should be modified to a trapezoidal form to precisely locate the canal orifice of the extra root which might be situated buccally or lingually. Timely diagnosis, careful canal location, canal preparation and obturation of such canals resolve the sinus without any further separate treatment.

Conflict of Interest

No conflict of interest exists.

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