

Anatomic Variations in Number of Roots and Root Canals and Its Endodontic Management - A Series of Case Reports

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Abstract

The variations of number of roots and root canals are often a challenge to the endodontist. Beginning from the stage of diagnosis, each and every step should be carefully approached for the success of endodontic therapy in such cases. The current series of case reports present clinical cases of endodontic management of mandibular first molar with radix entomolaris, mandibular first molar with radix Paramolaris, maxillary first molar with 2 roots and 3 canals, and maxillary first molar with 3 roots and 5 canals. Thorough knowledge of these variations is very much important in the diagnosis and also in the further management including

identification and negotiation of canals, their chemo mechanical debridement and three-dimensional filling of the entire root canal system. Therefore, clinicians should be thoroughly aware of the common root canal morphology and their possible variations in order to improve the predictability of root canal treatment (RCT).
Keywords: Radix Entomolaris, Radix Paramolaris, Maxillary first molar with two roots, MB3 canal, anatomic variations.

Introduction

The variations in normal tooth anatomy have been extensively studied over years, although it is not always easy to define these variations precisely, as our

understanding in this field is changing and developing. The number of roots and root canals show a wide range of variation which makes the endodontic management more challenging. Thorough knowledge of the possible variations along with great skills improve the outcome of endodontic treatment.

This case series discusses clinical cases of endodontic management of mandibular first molar with radix entomolaris, mandibular first molar with radix Paramolaris, maxillary first molar with 2 roots and 3 canals, and maxillary first molar with 3 roots and 5 canals.

Mandibular first molars mostly are two rooted with two mesial and one distal canal, a second distal canal may also be present. Investigators have reported variations in number of root canals in mandibular first molars (1); the number of roots can also vary. An additional distolingual root often referred to as radix entomolaris (RE) (2), was first mentioned in literature by Carabelli (3), whereas an additional root in the Mesio Buccal side is termed as radix Paramolaris (RP). The prevalence of RE in mandibular first molars in Indian population is reported to be less than 5% (4). Visser et al reported the prevalence of RP to be 0% for the first mandibular molar, 0.5% for the second and 2% for the third molar (5).

Maxillary first molars are generally recognized as three rooted teeth although wide range of variations in number of roots and roots canals have been reported. However, two rooted maxillary first molars have rarely been reported. A review by Cleghorn BM et al extensively studied root and canal systems in the maxillary first molar and reported the incidence of occurrence of two rooted teeth to be 3.8% (6).

Maxillary first molars have a complex Mesio Buccal root canal system which has been extensively studied over

years. The MB root often have 2 canals MB1 and MB2 with the prevalence of MB2 as high as 93%, but occurrence of MB3 canal is regarded as a rare entity, the incidence of which is reported to be as low as 1.3% (7).

Although careful preoperative evaluation of the roots is important, approaching each and every tooth to be endodontically treated, with an expectation of having a variation in number of roots or root canals, and using a means of magnification always, can significantly eliminate the possibility of missed canals, thereby improving the predictability of root canal treatment.

Case Report 1: Mandibular First Molar with Radix Entomolaris

A 19- year- old female patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College, Thiruvananthapuram with a chief complaint of pain in relation to right lower back tooth for past 1 week. She had intermittent throbbing pain which disturbed her sleep. The patient's medical and allergic history was non-contributory. Clinical examination revealed that the right mandibular molar had deep caries which was tender on percussion. The periodontal status was within normal limits. The tooth gave positive response to cold test and electric pulp test and the pain persisted after removing the stimulus. Radiographic examination revealed radiolucency involving dentin extending to pulp with periodontal ligament widening and showed an unusual anatomy of additional distolingual root (Fig 1a). A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made and root canal treatment was advised.

Local anesthesia (2% lidocaine hydrochloride with 1:80,000 epinephrine) (Lignospan Special, Septodont, Raigad, India) was administered, and a dental dam was placed. All procedures were performed under $\times 3.2$

magnification loupe (Admetec, Israel). Access opening was done using endo access bur #1 and endo- z tapered safe end bur. Two distal and two mesial canal orifices were located using an endodontic explorer (DG-16 Endodontic Explorer, Ash Instruments, Dentsply, Gloucester, United Kingdom) (Fig 1b, c). The root canals were explored with a K-file ISO 6 followed by 8, 10 and 15. #15 size K-files (Mani, Tochigi, Japan) were used to determine working length using electronic apex locator (Root ZX Mini, J Morita, Kyoto, Japan) which was then confirmed using radiographs (Fig 1d).

Biomechanical preparation was completed using rotary nickel-titanium files (Neo Endo and Orikam Healthcare India Private Limited)) under abundant irrigation with 5.25% sodium hypochlorite and normal saline. The mesial canals were confluent; Mesiolingual canal was first prepared followed by Mesiobuccal canal. Final irrigation was done with twin kleen (MAARC Dental). Irrigant activation was done using PATS plus (Pro Agitator Tip System). Master cone radiograph was taken (Fig 1e), and obturation was done using gutta-percha cones and Seal apex sealer (Sybron- Kerr, Romulus, MI, USA) using the lateral cold compaction technique (Fig 1f, g). Post endodontic restoration was done using composite resin (Tetric N Ceram, Ivoclar).

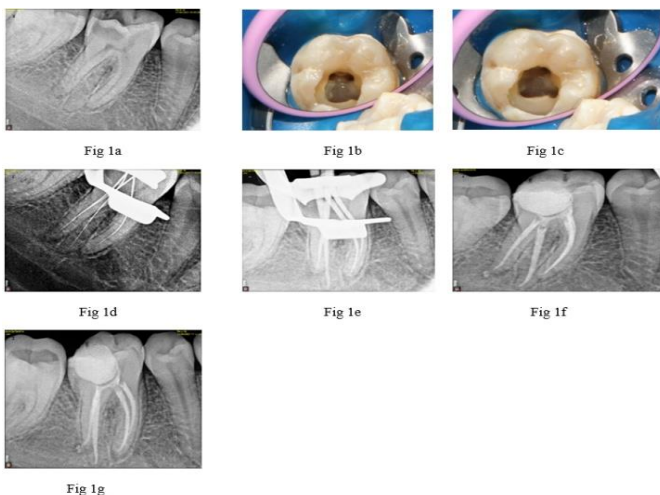


Figure 1

Case Report 2: Mandibular First Molar with Radix Paramolaris

A 24- year- old male patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College, Thiruvananthapuram with a chief complaint of pain in relation to right lower back tooth. He presented with a history of intermittent pain for past 3 months which increased in intensity in the past 2 days. The medical and allergy history of the patient was non-contributory. Clinical examination revealed that the right mandibular molar had deep caries on the mesial aspect with tenderness on percussion. The periodontal status was within normal limits. The tooth gave positive response to cold test and electric pulp test which was lingering. Radio graphic examination revealed radio lucency involving dentin extending to pulp with periodontal ligament widening. Angulated radiographs showed an unusual anatomy of additional Mesiobuccal root (Fig 2a, b). A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made and root canal treatment was advised.

Local anesthesia (2% lidocaine hydrochloride with 1:80,000 epinephrine) (Lignospan Special, Septodont, Raigad, India) was administered, and a dental dam was placed. All procedures were performed under $\times 3.2$ magnification loupe (Admetec, Israel). Access opening was done using endo access bur #1 and endo- z tapered safe end bur. Two distal and three mesial canal orifices were located using an endodontic explorer (DG-16 Endodontic Explorer, Ash Instruments, Dentsply, Gloucester, United Kingdom) (Fig 2c, d). Pre endo build up was done with composite. The root canals were explored with a K-file ISO 6 followed by 8, 10 and 15. #15 size K-files (Mani, Tochigi, Japan) were used to determine working length using electronic apex locator

(Root ZX Mini, J Morita, Kyoto, Japan) which was then confirmed using radiographs (Fig 2e, f).

Biomechanical preparation was completed using rotary nickel-titanium files (Neo Endo and Orikam Healthcare India Private Limited)) under abundant irrigation with 5.25% sodium hypochlorite and normal saline. Final irrigation was done with twin kleen (MAARC dental). Irrigant activation was done using PATS plus (Pro Agitator Tip System). Master cone radiograph was taken (Fig 2g), and obturation was done using gutta-percha cones and Bioceramic sealer (Nishika canal sealer bg), using the lateral cold compaction technique (Fig 2h, i). Post endodontic restoration was done using composite resin (Tetric N Ceram, Ivoclar).

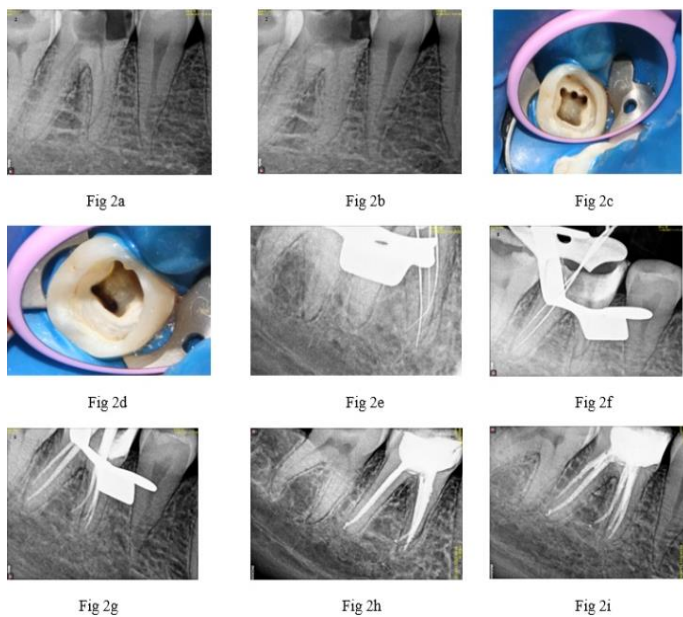


Figure 2

Case Report 3: Maxillary First Molar with Two Roots and Three Canals

A 27- year- old female patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College, Thiruvananthapuram with a chief complaint of pain in relation to right upper back tooth. She experienced intermittent pain for the past 1 month with a history of night pain for past 1 week. The

patient had no relevant medical or allergy history. Clinical examination revealed deep caries on the distal aspect of maxillary right first molar which was tender to percussion. The periodontal status was within normal limits. The tooth gave positive response to cold test and electric pulp test which was lingering. Radiographic examination revealed radiolucency involving dentin extending to pulp with periodontal ligament widening and showed an unusual anatomy of presence of only two roots (Fig 3a). A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made and root canal treatment was advised.

Local anaesthesia (2% lidocaine hydrochloride with 1:80,000 epinephrine) (Lignospan Special, Septodont, Raigad, India) was administered, and a dental dam was placed. All procedures were performed under $\times 3.2$ magnification loupe (Admetec, Israel). Access opening was done using endo access bur #1 and endo- z tapered safe end bur. One palatal and two buccal canal orifices were located using an endodontic explorer (DG-16 Endodontic Explorer, Ash Instruments, Dentsply, Gloucester, United Kingdom). The root canals were explored with a K-file ISO 6 followed by 8, 10 and 15. #15 size K-files (Mani, Tochigi, Japan) were used to determine working length using electronic apex locator (Root ZX Mini, J Morita, Kyoto, Japan) which was then confirmed using radiographs (Fig 3b).

Biomechanical preparation was completed using rotary nickel-titanium files (Neo Endo and Orikam Healthcare India Private Limited) under abundant irrigation with 5.25% sodium hypochlorite and normal saline. The buccal canals were confluent; Mesio Buccal canal was first prepared followed by distobuccal canal. Final irrigation was done with twin kleen (MAARC dental). Irrigant activation was done using PATS plus (Pro Agitator Tip System). Master cone radiograph was taken

(Fig 3c), and obturation was done using gutta-percha cones and bioceramic sealer (Nishika canal sealer bg), using the lateral cold compaction technique (Fig 3d). Post endodontic restoration was done using composite resin (Tetric N Ceram, Ivoclar).

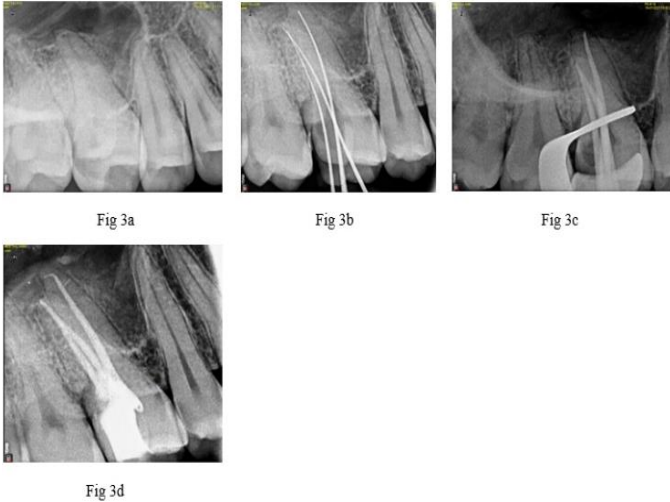


Figure 3

Case Report 4: Maxillary First Molar with 3 Roots and 5 Canals

A 21-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College, Thiruvananthapuram with a chief complaint of pain in relation to right upper back tooth for the past 6 days. He had a history of intermittent throbbing pain and night pain. The patient had non-contributory medical and allergy history. Clinical examination revealed deep caries on the distal aspect of maxillary right first molar which was tender to percussion. The periodontal status was within normal limits. The tooth gave positive response to cold test and electric pulp test which was lingering. Radiographic examination revealed radiolucency involving dentin extending to pulp with periodontal ligament widening (Fig 4a). A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made and root canal treatment was advised.

Local anaesthesia (2% lidocaine hydrochloride with 1:80,000 epinephrine) (Lignospan Special, Septodont, Raigad, India) was administered, and a dental dam was placed. All procedures were performed under $\times 3.2$ magnification loupe (Admetec, Israel). Access opening was done using endo access bur #1 and endo-z tapered safe end bur. One palatal and four buccal canal orifices were located using an endodontic explorer (DG-16 Endodontic Explorer, Ash Instruments, Dentsply, Gloucester, United Kingdom) (Fig 4b, c). The root canals were explored with a K-file ISO 6 followed by 8, 10 and 15. #15 size K-files (Mani, Tochigi, Japan) were used to determine working length using electronic apex locator (Root ZX Mini, J Morita, Kyoto, Japan) which was then confirmed using radiographs (Fig 4d, e).

Biomechanical preparation was completed using rotary nickel-titanium files (Neo Endo and Orikam Healthcare India Private Limited) under abundant irrigation with 5.25% sodium hypochlorite and normal saline. The buccal canals were confluent; Mesio Buccal canal was first prepared followed by distobuccal canal. Final irrigation was done with twin kleen (MAARC Dental). Irrigant activation was done using PATS plus (Pro Agitator Tip System). Master cone radiograph was taken (Fig 4f), and obturation was done using gutta-percha cones and bioceramic sealer (Nishika canal sealer bg), using the lateral cold compaction technique (Fig 4g, h). Post endodontic restoration was done using composite resin (Tetric N Ceram, Ivoclar).

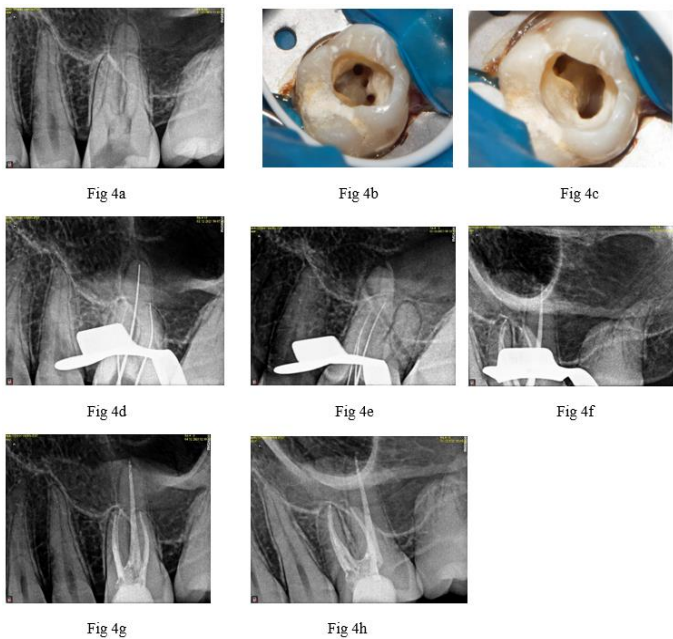


Figure 4

Discussion

The success of root canal treatment greatly depends on adequate debridement and filling of the entire root canal complex(8–12). Often variations from normal anatomy in the form of additional roots and root canals may be encountered. This is a real challenge to the clinician and failure to identify and treat these variations can result in failure of the entire treatment, ultimately leading to post treatment disease.

It is difficult to determine the variations in number of root and root canals without the aid of extensive radiologic examination. For this reason, radiographs exposed at different horizontal angulations are often helpful in visualization of number of roots ad root canals. Clark’s rule or SLOB technique can be applied in these clinical situations (13). When in doubt, extensive imaging modalities like cone beam computed tomography (CBCT) can also be used to accurately determine the number of roots, curvatures, and bifurcations in both sagittal and axial planes (14).

Mandibular first molar with radix entomolaris and radix Paramolaris is an endodontic challenge, starting from the

phase of diagnosis. Current case report presented a mandibular molar with type I RE according to De Moor et al (15), a mandibular molar with type A RP as classified by Carlsen and Alexandersen (1991) and a maxillary molar with MB3 canal. Maxillary first molar with two roots is considered to be a rare occurrence with few case reports available in literature. Neelakandan P et al studied root canal morphology of molars in an Indian population and reported that two-rooted first molars without fusion to be found in 1.3% of the first molars studied (16).

The outline of the additional root or root canal may not be always clear in the radiograph. Multiple radiographs at different horizontal angulations are mandatory to reveal the hidden roots and root canals. Clinically, with a good knowledge of law of symmetry and law of orifices, various methods like, visualizing the dentinal map and canal bleeding points, using DG-16 explorer, micro-opener, toughing of the grooves with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, champagne bubble test, magnetic resonance microscopy and micro computed tomography will be useful to locate the canals (17).

Operator experience plays a significant role in the location and negotiation of extra canals, especially MB3 canal of maxillary molar. The access cavity should be modified in such a way that allows straight line access to the canal, which helps in better visualisation and accessibility for negotiation of canals. Studies have shown better identification of additional canals with the help of higher magnification and illumination (18,19). Any form of magnification must be used during endodontic therapy which markedly increase the quality of treatment.

Presence of anatomical difficulties will affect the process of chemo-mechanical cleaning and shaping which ends

up in a potential reduction in the success rate of RCT (20). Therefore, clinicians should be thoroughly aware of the common root canal morphology and their possible variations in order to improve the predictability of RCT.

Conclusion

The series of case reports in the current article discusses variations in the number of roots and root canals and its implications in endodontic therapy. Thorough knowledge of these variations is very much important in the diagnosis and also in the further management including identification and negotiation of canals, their chemo mechanical debridement and three-dimensional filling of the entire root canal system.

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