ISSN 2347-5579

Unique Journal of Medical and Dental Sciences

Available online: www.ujconline.net

Case Report

BILATERAL RADIX ENTOMOLARIS

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Received: 11-09-2014; Revised: 09-10-2014; Accepted: 05-11-2014

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ABSTRACT

Aim: To report a case of three rooted mandibular right and left first permanent molars with additional distolingual roots in a 12 year old female patient and to search the available literature on this particular anatomical variation.

Background: Mandibular permanent first molar usually contains two roots, occurrence of third root is very uncommon. Anatomical variations in the root morphology and number pose a great challenge during the endodontic management of mandibular permanent molar teeth. The prevalence of these three rooted mandibular first permanent molars varies from one population group to another. Available literature shows prevalence of these three rooted "Radix entomolaris"(additional distolingual root) mandibular first permanent molar as 3.4–4.2% in European populations, 3% in African population, 7.67% in Indians, 5-30% in Chinese, Eskimo and American Indians. This paper presents a case of additional distolingual root in relation to mandibular first permanent molars and Literature review on this anatomic variation.

Keywords: Anatomical Variations, Distolingual, Endodontic Management, Radix Entomolaris, Radix Paramolaris.

INTRODUCTION

The success of endodontic treatment depends on the thorough chemomechanical cleaning, shaping of root canals followed by obturation with an appropriate material and a bacteria tight coronal seal. The main factors behind the failure of root canal treatment are incomplete removal of pulp, presence of bacteria in the pulp canals, incomplete bacteria tight coronal seal and incomplete obturation. In order to perform endodontic therapy in an effective manner, operator should have thorough knowledge of the anatomy of root canals and its variations[1,2].

The common morphology that mandibular molars exhibit is two rooted with two canals in mesial root and one in distal root. The first three rooted anatomic variation of permanent first mandibular molar in the literature was reported by Carabelli in the year 1844. Carabelli reported an additional third distolingual root in relation to first permanent mandibular molar on disto-lingual aspect which was later called as "Radix entomolaris" By Bolk in the year 1915[3,4]. Available literature shows prevalence of these three rooted (additional distolingual root) mandibular first permanent molar as 3.4–4.2% in European populations, 3% in African population, 7.67% in Indians, 5-30% in Chinese, Eskimo and American Indians[1,2]. Presence of additional root on the mesiobuccal aspect is known as "Radix paramolaris", which is very rare occurrence as described by Bolk in 1915[3]. Its prevalence varies from 0% (0/1954) for the mandibular first molar, 0.5% (11/2086) for the second and 2% (28/1405) for the third molar as repoted by Visser[5].

In a case report of five canals in mandibular first permanent molar, authors emphasized that it was the radiographic appearance which facilitated recognition of the complex canal and root morphology. They cautioned 'that any attempt to develop techniques that require fewer radiographs runs the risk of missing information which may be significant for the success of therapy'. So, radiographs should be taken at different angulations to confirm and locate the exact location of additional canals and roots[2,6].

The aim of this paper was to present morphology, clinical approach to diagnosis, and endodontic management of three rooted mandibular right and left first permanent molars with an additional distolingual root and to present comprehensive review of literature on the anatomic variations in mandibular permanent molars.

CASE DISCUSSION

A 12 year old, Indian female patient in good health sought treatment for pain in the region of the right and left

mandibular molar region since 1 month. The pain kept her awake at night and was radiating upto the side of her face. Patient's medical history was non contributory.

Clinical examination:

On clinical examination it was found that mandibular right (#46) and left (#36) permanent molars were deeply carious and the teeth (lower right and left mandibular first permanent molars) exhibited all the signs and symptoms of pulpal necrosis. Clinical examination revealed tenderness on vertical percussion and no response to thermal sensitivity tests in the tooth. There was no sinus formation or any extra-oral swelling in relation to both 36 and 46. Patient also gave history of pain relief after repeated application of cold fluids. Examination also revealed retained deciduous second molars. A diagnosis of chronic irreversible pulpitis was made in relation to both 36 and 46.

Radiographic examination:

Radiographic examination revealed occlusal dental caries approaching pulp with associated periapical radiolucency in relation to 36 & 46. Radiographic examination also revealed an additional third root between mesial and distal roots **(Fig. 1)**. Radiographically, the condition was diagnosed as chronic irreversible pulpitis in relation to both 36 and 46.

Based on clinical and radiographic examinations it was decided to perform root canal therapy for tooth no. 46, 36 and extraction of retained right and left deciduous second molars after obtaining consent from the parents. Entire treatment procedure was completed in 2 sessions on two separate occasions for both 36 and 46 separately. Root canal treatment procedure was first completed in relation to tooth no.46 followed by 36.

Treatment procedure:

Right Permanent Molar

Rubber dam isolation was not performed due to insufficient crown structure for clamp application. Inferior alveolar nerve block was given to achieve adequate anesthesia, this was followed by access cavity preparation using endo-access bur and canal orifices were located with DG 16 endodontic explorer. Initial negotiation of the root canals was performed with no. 10 k-file. Initially 3 canal orifices were identified, 2 in the mesial canal and 1 in the distal canal. On further exploration, it was found that the fourth distolingual canal orifice was present between the mesial and distal root canal orifices. The root canal orifices were enlarged using gates glidden drills (Mani Inc., Kiyohara industrial park, Utsunomiya, Japan) to obtain a straight line access which modified the access shape to a more trapezoidal form. The presence of an additional root was confirmed by the working length radiograph. Biomechanical preparation of all the canals was performed with rotary Nickel-Titanium protaper files (Dentsply Maillefer Ballaigues, Switzerland) up to F2 size file. Root canals were irrigated with 1% sodium hypochlorite and normal saline alternatively. Calcium hydroxide was used as intracanal medicament in between two sessions. Root canals were obturated with Zinc oxide eugenol sealer and Protaper gutta- percha cones using a single cone obturation technique. The access restoration was done with Fuji IX glass-ionomer cement followed by stainless steel crown restoration.

Left Permanent Molar

The above mentioned treatment procedure for 46 was followed while treating 36 also. During the procedure of Biomechanical preparation in tooth no. 36, protaper F2 file fractured (4mm) accidently in the apical third of the additional root, attempts were made to remove the broken segment of the file using Masserman Kit but we were unable to retrieve it. So, it was decided to obturate the canal with 4mm file fragment in the apical third of root canal **(Fig. 2)**.

This was followed by access restoration with Fuji IX glass-ionomer cement and restored later with stainless steel crown restoration.

Localization of third root using Tube shift technique: (Fig. 3)

Locations of the additional roots were confirmed using tube shift technique as per recommendations made by Ingle. In both the cases radiographs were taken at 3 different angulations, one with normal angulation without any shift, second radiograph taken at 20^0 mesial shift, and third radiograph taken at 20^0 distal shift. It was observed that in both the cases additional roots moved in the direction of shift given. Later, all the observations were analysed using SLOB rule and it was concluded that in both the cases additional roots were present on the Lingual aspect of molars.

Follow-up

Patient was recalled after six months to assess the treatment outcome. Treatment outcome was assessed both clinically and radiographically. Follow up radiographs were taken and full healing of the periapical tissues was observed in both the teeth **(Fig. 4)**. Clinically, patient was completely free of pain.

Review of Literature

Human mandibular molars contain 2 roots in general but may show various types of anatomical variations in crown, root, and number of root canals. Anatomical variations in number of molar roots vary from one population group to another. In most of the cases additional third root or supernumerary root has been noted. This third root is mainly seen on two specific anatomic locations of mandibular molars, namely—

Distolingual location—Radix entomolaris(RE)

Mesiobuccal location—Radix paramolaris(RP)

There are various classifications of this particular anatomical variation in Literature, depending on curvature and Location.

- **Classification based on Location of cervical part of RE[6]:**

Type A: Cervical part located Distally, with two normal distal root components

Type B: Cervical part located Distally, with one normal distal root component

Type C: Refers to a mesially located cervical part

Type AC: Located centrally, between the distal and mesial root component

- **Classification of RE based on Curvature[1]:**

Type I: A straight root/root canal

Type II: Initially curved entrance of the root canal and the continuation as a straight root/root canals

Type III: Initial curve in the coronal third of the root canal and a second buccally oriented curve starting from the middle third.

➢ **New classification RE based on Curvature[7]:**

Type I: No curvature seen

Type II: Curvature seen in the coronal third and straight continuation till the Apex

Type III: Curvature in the coronal third and additional buccal curvature from the middle third to the apical third of the root.

Small type: Root length less than half that of the distobuccal root.

Conical type: Cone-shaped extension without root canal.

➢ **Classification of RP[8]:**

Type A: Refers to an RP in which the cervical part is located on the mesial root Complex

Type B: Refers to an RP in which the cervical part is located centrally, between the mesial and distal root complexes

Type of radix entomolaris based on location and curvature in the present case:

After assessing the location and curvature of the 3rd root in both cases, both the RE's were classified as Type AC based on location and Type III based on curvature.

Table 1: Brief review of studies showing prevalence of RE among various population groups

Author/Year	Population group	Incidence (%)
Turner (1971)[22]	Aleut Eskimo American Indian	32 5.8
Curzon & Curzon (1971)[23]	Keewatin Eskimo	27
Curzon (1973)[24]	United Kingdom	3.4
Curzon (1974)[25]	Baffin eskimo	21.7
Vertucci & William (1974)[26]	America	0
Hochtstetter (1975)[27]	Guam	13
Sugiyama *et al.* (1976)[28]	Japanese	5.6
Jones (1980) [29]	Chinese Malaysian	13.4 16
Steelman(1986)[32]	Hispanic	3.2
Walker (1988)[33]	Hong Kong Chinese	15
Harada *et al.* (1989)[34]	Japanese	18.8
Younes (1990)[36]	Saudi Egyptian	2.92 0.01
Ferraz and Pecora (1992)[37]	Japanese Negroid Caucasian	11.4 2.8 4.2
Yew and chan (1993)[38]	Chinese	21.5
Steelman (1998)[40, 41]	Hispanic children	3.2
Wasti (2000)[42]	South asian Pakistanis	0
Gulabivala (2001)[43]	Burmese	10.1
Gulabivala (2002)[44]	Thai	13
Tu *et al.* (2007)[45]	Taiwanese	21.09
Peiris *et al.* (2007)[46]	Sri lanka	3
Song *et al.* (2009)[47]	Korean Primary molars (first and second) Permanent first molars	9.7, 27.8 33.1
Schafer *et al.* (2009)[48]	Germany	1.35
Chen (2009)[49]	Taiwan chinese	19.5
Tu *et al.* (2010)[50]	Taiwanese	5
Liu *et al.* (2010)[51]	Chinese	9
Garg *et al.* (2010)[52]	Indian	5.97
Song *et al.* (2010)[53]	Korean	24.5
Yang *et al.* (2010)[54]	Shanghai chinese	32.35
Huang *et al.* (2010)[55]	Taiwanese	22
Karale et al. (2013)[2]	Indian	7.67

Prevalence of RE/RP on gender basis:

Most of the studies suggests male predominance[19,20,21,32,51]. However, some other studies reported similar prevalence in both the sexes[35,50] or more in females[45]. Tratman reported that it is more common on the right side for males and bilaterally for females[12-15].

Association between RE and other developmental anomalies

According to some authors, in most of the cases RE was seen in association with an extra cusp on the buccal aspect, known as "Protostylid" and increased number of root canals but this may not be true in each and every case[16,17,18,39,56].

Table 2: Examination of RE/RP

Clinical Examination	Radiographic Examination
It is very difficult to detect RE/RP by visual examination alone as the crown and 2 normal roots along with RE/RP resemble the features seen in normal molar very closely. Detection of RE/RP clinically is possible by the analysis of cervical morphology of the roots by using periodontal probing, presence of extra cusp or marked cervical prominence or convexity[56].	It has been suggested that RE/RP can be easily diagnosed with radiographic examination if correct interpretation is done. As the RE/RP is mostly located in the same buccolingual plane as the other two roots, a superimposition of both the roots can appear on the pre-operative radiographs & remain undiagnosed[56]. Ingle has recommended a thorough radiographic study of the involved tooth, using exposure from the standard buccal-to-lingual projection, one taken 20° from the mesial, and the third taken 20° from the distal to obtain basic information regarding the anatomy of the tooth[57]. Walker and Quackenbush claimed that panoramic radiographs resulted in an accuracy rate of approximately 90%[9,10,11,31].

Table 3: Significance of RE/RP in dentistry

Pediatric Dentistry	Endodontic implications	Surgical exodontia	Orthodontic implications	Contributing factor to Localized periodontitis	Forensic odontology
Studies have shown various endodontic, exodontic, orthodontic & periodontal implications of RE/RP[54, 55, 56, 57]. So same precautions should be followed during the treatment of primary molars with extra root as in case of permanent molars	Triangular access cavity should be modified to trapezoidal or rectangular in case of extra root[56]. Calberson et al recommended use of flexible Ni-Ti files in case of curved canals[56]. Tu et al did a CBCT study and found that mean interorifice distances from the distolingual canal to the distobuccal (DB), mesiobuccal (MB), and mesiolingual (ML) canals of the permanent three-rooted molars were 2.7, 4.4, and 3.5 mm, respectively. These values might help dentists to locate canals successfully[58].	Rotational movements should be avoided while extracting permanent molars with 3 roots as it might result in root fracture[1]. While removing primary molars with three roots one should make sure that crown of premolar is not trapped in the inter-radicular area of the primary molar as it may result in accidental removal of the permanent tooth bud[59].	It has been found that 3 rooted molars offer more resistance to orthodontic tooth movement. It is also hypothesized that extra roots add to the stability of molars by providing an increased surface area of attachment with the alveolus[35].	Huang et al reported that presence of an extra root may be a contributing factor in localized periodontitis[60].	RE/RP possess important role in personal identification[45] .

DISCUSSION

The exact etiological factors behind the formation/development of three roots are still poorly understood. In case of dysmorphic extra roots, its formation could be attributed to the developmental defects as during odontogenesis, mutation caused by any atavistic gene (atavism is the sudden re-appearance of any character or feature which was absent from many generations) or any other polygenetic variation. In case of eumorphic extra roots, racial genetic factors play an important role and cause more profound expression of a particular gene that could lead to development of extra roots[30, 61].

In population groups exhibiting mongoloid traits such as Chinese, Eskimo and American Indians, RE occurs with a frequency of 5%-30%, because of this high frequency, RE is considered as eumorphic or normal morphologic variant in these population groups. On the other hand in Caucasians, RE is not very common and the frequency varies from 3.4%-4.2% and therefore, is considered as unusual or dysmorphic root morphology.[56, 61] RE can be seen in relation to first, second and third molars, with least frequency seen in relation to second molar, and the occurrence of RP is very rare[61].

In the present paper, we reported a female patient with three rooted(RE) mandibular first right and left permanent molars bilaterally which matches with the findings of Tratman about

the increased frequency of bilateral RE among females[15]. The additional roots in present case report were found to be resembling the Type-III of classification of RE based on curvature.

In cases of two distal roots, clinician should always check for additional root canals especially in distobuccal root. Various methods for the detection of additional canals are as follows[62].

a. Knowledge of law of symmetry and law of orifice location.
b. Tactile sensation with hand instrument.
c. Using various instruments like endodontic explorer, pathfinder, DG 16 probe and mico-opener.
d. Champagne effect- bubbles produced by remaining pulp tissue in the canal, while using sodium hypochlorite in pulp chamber.
e. Introral periapical radiograph.
f. Digital radiography.
g. Using fiber-optic illumination dental edoscopy and orascopy.
h. Using surgical loupes.
i. Using Operating microscope.
j. Micro Computed Tomography.
k. Visualization endograph using Ruddle's solution.
l. Magnetic Resonance Microscopy

The limitation of the present case report is that we used only tube shift technique for the localization of the additional roots. Exact position of additional roots can also be located accurately using recent technologies like operating microscopes[63] and cone beam computed tomography (CBCT)[64].

CONCLUSION

In the present paper we found that RA is very common anatomical variation among people of mongoloid traits but very rare among Caucasians and other population groups. So, dentists must be aware of all possible anatomical variations in both primary and permanent dentitions to avoid any procedural error. Present case report also supports the observations of previous studies which reported prevalence of bilateral RE more among females. Presence of third root or any other anatomical variation should be confirmed both by clinical as well as radiographic examinations. We recommend that Periapical radiographs should be taken in the pre-operatory stage with different horizontal angulations help to identify these additional roots. The use of the operating microscope and the modification of the access cavity are also of fundamental importance for the location of the root canal orifice present in this extra root. Appropriate modifications should be made while performing extractions, orthodontic treatment, root canal treatment or any other dental procedure.

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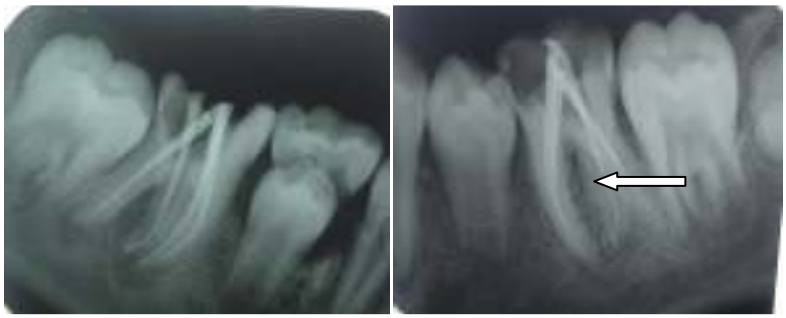
a) **b)**

Figure 1: Radiographs showing three roots, a) 46, b) 36.
***Arrows showing additional roots**

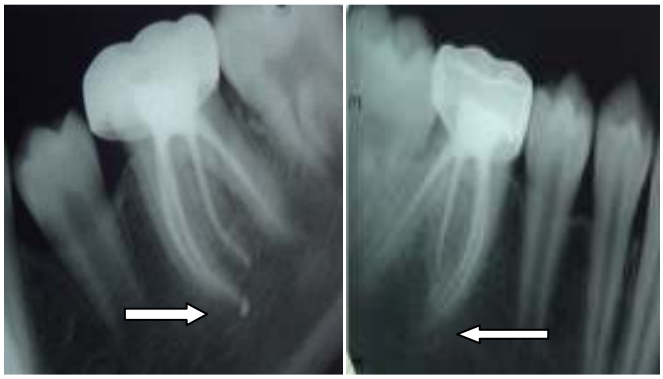


a) **b)**

Figure 2: Master cone selection radiograph, a) 46 b) 36, arrow showing the broken fragment of file

a) b) c)

Figure 3: Radiographs of tooth no. 36 taken at different angulations
a) normal angulation
b) taken at 20^0 mesial shift
c) taken at 20^0 distal shift



a) 46 b) 36

Figure 4: Follow up radiographs showing complete healing of periapical tissues.

Source of support: Nil, Conflict of interest: None Declared