

RADIX ENTOMOLARIS - ENDODONTIC CASE SERIES

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ABSTRACT

Treatment of mandibular molars has always been a challenge to endodontist as it shows variations in its external and internal morphology to the extreme. One such anatomical variation is the presence of an additional root which is named as radix entomolaris and radix paramolaris, depending on its location. An awareness and understanding of this unusual root and its canal morphology is important as it contributes to the outcome of root canal therapy. This case report discusses the diagnosis and endodontic treatment of mandibular molars with Radix Entomolaris

INTRODUCTION

A thorough knowledge of tooth morphology, careful interpretations of radiographs, proper access preparation and detailed exploration of the interior of the tooth are essential prerequisites for appropriate diagnosis, cleaning and shaping of the root canal system, which leads to a successful treatment outcome. As with any other tooth, the mandibular molars may show variations in its external and internal morphology that keeps the clinician at the risk of missing a root or root canal. One of the major variant is the occurrence of a third supernumerary root, first mentioned by Carabelli in 1844¹. If this additional root is located disto-lingually it is termed as radix entomolaris (RE)² or if it is located mesio-buccally then radix paramolaris (RP)³. This article provides a review on the incidence, diagnosis, implications and endodontic management of teeth with RE supported with the help of case reports.

FREQUENCY OF OCCURRENCE

The occurrence of RE in the mandibular



FIG 1a: CASE I: Preoperative radiograph

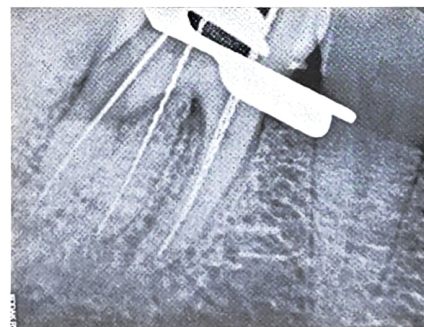


FIG 1c: CASE I: Working length radiograph

first molar is associated with certain ethnic groups that can be summarized as: Africans 3%; Eurasians/Indians <5%; East Asians, South East Asians and people of the Arctic region of North America 5 to 30%; Caucasians 4.2%^{4,5,6,7,8}. In a survey among German dental school patient populations the occurrence of three-rooted mandibular first molars was found to be rare with an overall incidence of 1.35%⁹.

In East Asians, South East Asians and people of the Arctic region of North America, the RE is considered to be a normal morphological variant (eumorphic root morphology) because of its high incidence. However, in Caucasians as RE

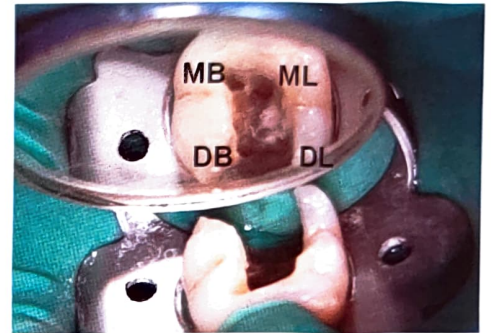


FIG 1b: CASE I: Access opening with Canal orifices (MB mesio-buccal; ML mesio-lingual; DB disto-buccal & DL disto-lingual)

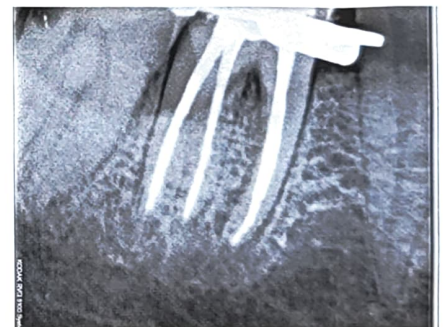


FIG 1d: CASE I: Oburation Radiograph

is not so common, it is considered unusual or dysmorphic root morphology¹⁰.

Midtbø and Halsell identified RE in several first molars while studying root length, crown height and root morphology in intra-oral and panoramic radiographs in patients with Turner Syndrome and concluded that X-chromosome deficiency influences its formation.

The prevalence of RE is almost similar in males and females¹². As observed by Visser¹³, the prevalence of RP/RE was found to be 0% for the first mandibular molar, 0.5% for the second and 2% for the third molar.

A recent study on the south Indian population by Chandra¹⁴ et al revealed a

Table 1. Groups containing bleaching agents and restorative materials

STUDY	YEAR	STUDY GROUP	TOTAL NUMBER OF TEETH	NUMBER OF TEETH WITH THREE ROOTS	PERCENTAGE
TAYLOR ³¹	1899	UNITED KINGDOM	119	4	3.4%
BOLK ¹⁵	1915	NETHERLANDS	1713	18	1.0%
CAMPBELL ¹⁶	1925	AUSTRALIAN ABORIGINE	176	0	0.0%
DRENNAN ²¹	1929	SOUTH AFRICAN BUSHMAN	23	0	0.0%
SHAW ³⁹	1931	AFRICAN BANTU	68	0	0.0%
TRATMAN ³²	1938	CHINESE	1615	95	5.8%
		MALAY	475	41	8.6%
		JAVANESE	110	12	10.9%
		INDIANS	453	1	0.2%
		EURASIANS	262	11	4.2%
		JAPANESE	168	2	1.2%
LABAND ²⁵	1914	MALAY IN N. BORNEO	134	11	8.2%
PEDERSEN ²⁶	1949	GREENLAND ESKIMO	64	8	12.5%
SOMOGYL- CSIZMAZIA & SIMONS ²⁷	1971	CANADIAN INDIANS	250	39	16.0%
DE SOUZA-DE FREITAS ET AL. ²⁰	1971	EUROPEAN	422	27	3.2%
		JAPANESE	233	83	17.8%
SKIDMORE & BJORND AHL ²⁹	1971	CAUCASIAN	45	1	2.2%
TURNER ³³	1971	ALEUT ESKIMO	263	84	32%
		AMERICAN INDIAN	1983	116	5.8%
CURZON & CURZON ¹⁹	1971	KEEWATIN ESKIMO	98	28	27%
CURZON ¹⁷	1973	UNITED KINGDOM	377	13	3.4%
CURZON ¹⁸	1974	BAFFIN ESKIMO	69	15	21.7%
HOCHTSTETTER ²³	1975	GUAM	400	52	13.0%
JONES ²⁴	1980	CHINESE	52	7	13.4%
		MALAYSIAN	149	25	16.0%
REICHART & METAH ¹⁰	1981	THAI	364	70	19.0%
WALKER & QUACKENBUSH ³⁸	1985	HONG KONG CHINESE	213	31	14.6%
STEELMAN ²⁸	1986	HISPANIC CHILDREN	156	5	3.2%
WALKER ³⁴	1988	HONG KONG CHINESES	100	15	15.0%
LOH HS ⁸	1990	CHINESES(SINGAPORE)	304	24	7.9%
YOUNES ET AL. ³⁶	1990	SAUDI EGYPTIAN	581 739	17 6	2.9% 0.01%

STUDY	YEAR	STUDY GROUP	TOTAL NUMBER OF TEETH	NUMBER OF TEETH WITH THREE ROOTS	PERCENTAGE
FERRAZ & PECORA ⁷	1992	JAPANESE	105	12	11.4%
YEW & CHAN ³⁵	1993	NEGROID	106	3	2.8%
SPERBER & MOREAU ³⁰	1998	CHINESE	832	179	21.5%
S AL-NAZHAN ¹²	1999	SENEGALESE	480	15	3.0%
GULABIVALA ET AL ²²	2001	SAUDI ARABIAN	251	15	5.97%
GULABIVALA ET AL ³⁷	2002	BURMESE	139	14	10.1%
CHANDRA ET AL ¹⁴	2011	THAI	118	15	12.7%
		SOUTH INDIAN	1000	150	13.3%

prevalence of 3-rooted mandibular first molar in 18.6% of the patients and 13.3% of the total teeth examined with bilateral incidence of 43.01% and no difference between gender or side of occurrence.

CASE REPORT 1

A 35-year-old female patient reported with a chief complaint of severe, intermittent radiating pain on the right mandibular posterior region of the mouth since 4-5 days. Patient gave history of a restoration two year back in # 36 which revealed defective margins with secondary caries on clinical examination. The tooth was tender on vertical percussion and abnormally responsive to thermal pulp sensitivity tests. Radiograph showed restoration in close proximity to pulp (**Fig 1a**). A diagnosis of symptomatic irreversible pulpitis with acute apical periodontitis was made. Root canal treatment was planned and consent was taken. Careful examination of the preoperative radiograph gave an indication of the presence of an additional root.

After administration of local anesthesia and proper isolation with rubber dam, access preparation was made. On inspecting the pulp chamber floor, three discrete root canal orifices were identified. On further exploration with DG 16 probe (Dentsply), an additional canal orifice was found that was located at the distolingual aspect of the pulpal floor (**Fig 1b**). The presence of the additional root was confirmed in the working length radiograph and was identified as RE (**Fig**

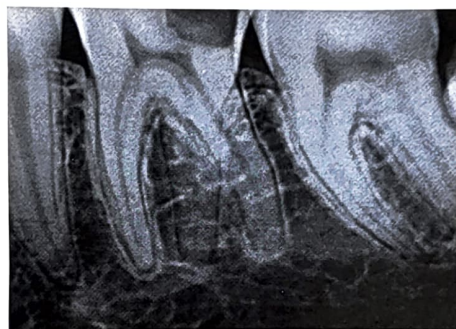


FIG 2a: CASE II: Preoperative radiograph

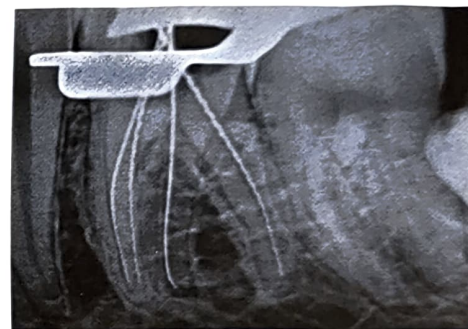


FIG 2b: CASE II: Working length radiograph

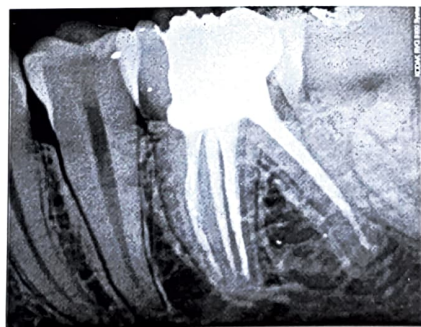


FIG 2c: CASE II: Obturation radiograph

1c). Root canal therapy was completed that included canal preparation with rotary Protaper instruments (Dentsply Maillefer, Ballaigues, Switzerland) and obturation with lateral compaction technique using gutta-percha cones and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) (**Fig 1d**). In between the root canals were irrigated with 2.5% NaOCl solution followed by saline just prior to obturation. Subsequently a permanent adhesive coronal restoration was done.

CASE REPORT 2

A 18 years old female patient reported with the chief complaint of pain during mastication in the mandibular right posterior region of the mouth. Intraoral examination revealed deep carious lesion in mandibular right first molar which showed no response to thermal pulp sensitivity tests but was tender on vertical percussion. The patient gave a previous history of severe pain in the same region about a year back that subsided on taking medication. Radiograph confirmed the presence of deep caries approaching the pulp with slight widening of PDL space (**Fig 2a**). A diagnosis of chronic irreversible pulpitis was made. Root canal treatment was planned and consent was taken.

Careful evaluation of the preoperative radiograph revealed the presence of an extra root between mesial and distal roots for # 46 that was identified as RE (**Fig 2a**). The root canal therapy was com-

Table 2. Individual case reports with RE

AUTHOR	YEAR	NO. OF CASE REPORTS	TOOTH NUMBER (FDI NOTATION)
DE MOOR RJG ET AL ⁴	2004	5 (TOTAL PATIENTS: 4)	46(3) 46,36 (BILATERAL)
CALBERSON ET AL ⁶	2007	3	46(2) 37(1)
SCHUMACHER C ⁵⁰	2008	1	46
BAINS R ET AL ⁴⁹	2009	1	36
MIRIKAR ET AL ⁵²	2009	1	36
PAROLIA A ET AL ⁵³	2009	2	46
REDDY J S ⁵⁴	2010	3	46
POORNI S ET AL ⁵⁵	2010	1	37
RAMBABU T ⁵⁶	2010	2	46
PAI V ET AL ⁵⁷	2010	1	46
BORUAH L ET AL ⁵⁸	2010	6 (TOTAL PATIENTS: 5)	46(3),36, 46,36 (BILATERAL)
FAROOQ R ET AL ⁵⁹	2010	3	46
REDDYVK AND MATHEW VB ⁶⁰	2010	2	46
VINOD MA AND MANWAR NU ⁶¹	2010	1	46
GUPTA S ET AL ⁶²	2011	2	46
IRODI S AND FAROOK AZ ⁶³	2011	3	46(2),37
NAGAVENI NB ET AL ⁶⁴	2011	2	36

pleted in a similar way as for the first case (Fig 2b, c).

DISCUSSION

Numerous researchers that have investigated the prevalence of this anatomic variant till date has been summarized in table1 while a consolidation of the individual tooth case reports are mentioned in table 2.

The etiology behind the formation of RE is unclear. Still it has been proposed that in dysmorphic supernumerary roots, its formation could be related to external factors during odontogenesis, or to penetrance of an atavistic gene or polygenetic system (atavism is the reappearance of a trait after several generations of absence)¹⁰. In eumorphic roots,

racial genetic factors may influence the more profound expression of a particular gene that results in the more pronounced phenotypic manifestation¹⁰.

MORPHOLOGY OF RADIX ENTOMOLARIS

Carlsen and Alexandersen² have described the external morphology of these root complexes containing either a lingual or buccal supernumerary root into four types of variants: A, B, C, and AC 2.

Type A - The distal part of the root complex consists of three cone-shaped macrostructures: a lingual, a medial, and a facial. Either the lingual structure is separate while the medial and facial structures are non-separate, or all three

macrostructures are non-separate. Under these circumstances, the lingual of the three distal root structures, is identified as RE, separate or non-separate.

Type B - The distal part of the root complex consists of two cone-shaped macrostructures that are practically the same size; a lingual and a facial. The structures are either separate or non-separate. Under these circumstances, the lingual of the two distal root structures is identified as RE, separate or non-separate.

Type C - The mesial part of the root complex consists of three cone-shaped macrostructures: a lingual, a medial, and a facial. Either the lingual of these structures is separate while the medial and facial structures are non-separate, or all

three macrostructures are non-separate. Under these circumstances, the lingual of the three mesial root structures is identified as RE, separate or non-separate.

Type AC - The lingual part of the root complex consists of three cone-shaped macrostructures: a central, a mesial, and a distal. The central of these structures is either separate or non-separate. The centrally-located, non-separate macrostructure is demarcated from the mesial and distal structure by two grooves which converge slightly in cervicoapical direction. Under these circumstances, the central of the three lingual root structures is identified as RE, separate or non-separate.

De Moor *et al*⁴ classified the RE into three types according to buccolingual configuration: type I, straight root/root canal; type II, initially curved entrance that continues as a straight root/root canal; type III, initial curve in the coronal third and a second curve beginning in the middle and continuing to the apical third (Fig 3).

The RE mostly has the Vertucci type I canal configuration⁴⁰.

Based on the criteria mentioned above, teeth in case report I and II can be considered as type B variant as per Carlsen and Alexandersen while according to De Moor, case I can be categorized as type I and case II as type III depending on the curvatures reproduced on the hand files during instrumentation.

CLINICAL IMPLICATION

Endodontic

An accurate diagnosis of these supernumerary roots can avoid complications of a missed canal during root canal treatment. The RE is usually situated in the same buccolingual plane as the distobuccal root, so a superimposition of both roots can occur on the preoperative radiograph a result in inaccurate diagnosis⁴¹.

Following methods can help in detecting additional root or canal⁴²⁻⁴⁷:

1. The application of Clark's rule may facilitate identification and location of additional canals or roots that have been superimposed. Hence, to reveal RE,

additional radiographs should be taken from a more mesial or distal angulation.

2. Use of computed tomography.
3. Use of magnification (loupes or dental operating microscopes)

4. Examine dentinal map minutely and use DG 16 to explore the pulp chamber floor.

5. Look for hemorrhagic spots (indicate the presence of extra canals).

6. Perform champagne or bubble test with sodium hypochlorite

7. Staining the pulp chamber with dye (eg, 1% methylene blue).

8. Use of ultrasonic tips, special round burs, and thin tapering finishing burs to remove a small amount of tooth structure or calcification and trough the line angles of the pulp chamber will help.

9. Modify the conventional outline form to include the extra canals.

10. Ensure adequate straight-line access to improve visibility

11. An extension of the triangular opening cavity to the (disto) lingual on the pulp chamber floor can indicate the precise location of the RE canal orifice⁴⁸.

A severe root inclination or canal curvature, particularly in the apical third of the root (as in type III RE)⁴⁸, can cause shaping aberrations such as straightening of the root canal or a ledge formation, with root canal transportation and loss of working length resulting. The use of flexible nickel-titanium rotary files may allow a more centered preparation with restricted enlargement of the coronal canal third and orifice relocation⁵.

PERIODONTAL

RE has been found to be a contributing factor to localized periodontal destruction⁴⁹. In addition, greater probing depths and attachment loss at the distolingual aspect have been reported as a common finding for three rooted mandibular molars³⁴

ORTHODONTIC

The authors of the articles are of the opinion that because of additional root (RE) this molar variant can provide better anchorage than two rooted molars

Conclusion

Clinicians should be aware of the morphological variations of the tooth like presence of additional roots/ root canals. The variations of the radix entomolaris and paramolaris in terms of diagnosis of root inclination and root canal curvature demand careful and adaptive clinical approach to avoid procedural errors during endodontic therapy.

REFERENCES

On request

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