

Presence and Clinical Significance of Radix Entomolaris and Radix Paramolaris

SUMMARY

Mandibular molars can have an additional root located disto-lingually, called radix entomolaris (RE) or mesio-buccally, called radix paramolaris (RP). An awareness and understanding of the complexity of root canal morphology contributes to the success of root canal treatment. The purpose of this study was to describe location and morphology of RE and RP in mandibular molars, their prevalence, internal anatomy, and clinical significance during endodontic procedures.

Keywords: Endodontic Treatment; Radix Entomolaris; Radix Paramolaris

Mastoras Konstantinos, Ioannidis Konstantinos, Beltes Panagiotis

Aristotle University of Thessaloniki
School of Dentistry, Department of Endodontology
Thessaloniki, Greece

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Introduction

The main objective of root canal treatment is the thorough mechanical and chemical cleaning and shaping of the root canals, before a dense root canal filling. Moreover, an awareness and understanding of the complexity of root canal morphology contributes to the success of root canal treatment.

It is well documented that mandibular molars often display several anatomical variations in the number of roots and root canals. In most cases the mesial root has 2 root canals, ending in 2 distinct apical foramina, or sometimes merging together at the root tip to end in 1 foramen. The distal root, in most cases has 1 root canal, but sometimes, if the orifice is particularly narrow and round, a second distal canal may be found.

An anatomical variation concerning the root number is the presence of an additional root named as radix entomolaris¹ (RE) or radix paramolaris² (RP). RE is located disto-lingually and RP is located buccally or mesio-buccally.

The aetiology behind the formation of RE and RP has not been elucidated yet. Recent data attribute their formation to racial genetic factors, external factors during odontogenesis and to distribution of an atavistic gene or polygenetic system³⁻⁵.

Prevalence of Radix Entomolaris and Radix Paramolaris

A RE can be found in European populations, mainly on the first and less frequently on the second and third mandibular molar⁶, with a frequency varying from 0.7% to 4.2%^{2,7-13} (Tab. 1). On the other hand, in population with Mongoloid characteristics, such as Chinese, Eskimo and American Indians, a RE occurs with a frequency varying from 5% to more than 50%^{3,5,8,12,14-33} (Tab. 2). Because of its high frequency in these populations, the RE is considered as a normal morphological variant. Curzon⁵ suggested that certain traits, such as the 3-rooted molar, had a high degree of genetic penetrance, as its dominance was reflected in the fact that pure Eskimo and Eskimo/Caucasian mixes had similar prevalence of the trait.

In a recent study³⁴, the radiological examination of 4050 children in a Korean population revealed a positive correlation between the presence of an additional root in primary and permanent molars. When an additional root was present in a primary molar, the probability of the posterior adjacent molar to have an additional root, too, was greater than 94.3%³⁴. This result indicates the existence of a significant prognostic factor for the correct diagnosis of a RE.

A RP can be found mainly on the third mandibular molars, and less frequently on the second and first mandibular molars, with a frequency varying from 0.5% - 1%⁶. This macrostructure is very rare and occurs less frequently than the RE.

Table 1. Prevalence of 3-rooted mandibular first molars in European population. Survey of available studies

Study	Origin	Total number of teeth	Number of teeth with 3 roots	Percentage (%)
Taylor 1899 7	United Kingdom	119	4	3.4
Bolk 1915 2	Netherlands	1713	18	1.0
De Souza-Freitas et al. 1971 8	European	422	27	3.2
Skidmore & Bjorndahl 1971 9	Caucasian	45	1	2.2
Curzon 1973 10	United Kingdom	377	13	3.4
Steelman 1986 11	Spanish	156	5	3.2
Ferraz & Pecora 1993 12	Caucasian	117	5	4.2
Schäfer et al. 2009 13	German	1024	7	0,7

Table 2. Prevalence of 3-rooted mandibular first molars in non-European population. Survey of available studies

Study	Origin	Total number of teeth	Number of teeth with 3 roots	Percentage (%)
Tratman 1938 14	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 1941 15	Malay in N. Borneo	134	11	8.2
Pedersen 1949 16	Greenland Eskimo	64	8	12.5
Somogyi & Simons 1971 17	Canadian Indians	250	39	16
De Souza-Freitas et al. 1971 8	Japanese	233	73	17.8
Turner 1971 18	Aleut Eskimo	263	84	32
	American Indian	1983	116	5.8
Curzon & Curzon 1971 19	Keewatin Eskimo	98	28	27
Curzon 1974 5	Baffin Eskimo	69	15	21.7
Hochtstetter 1975 20	Guam	400	52	13
Jones 1980 21	Chinese	52	7	13.4
	Malaysian	149	25	16
Reichart & Metah 1981 3	Thai	364	70	19.0
Walker & Qackenbush 1985 22	Hong Kong Chinese	213	31	14.6
Walker 1988 23	Hong Kong Chinese	100	15	15
Harada et al. 1989 24	Japanese	2331	440	18,8
Loh 1990 25	Chinese (Singapore)	304	24	7.9
Younes et al. 1990 26	Saudi	581	17	2.92
	Egyptian	739	6	0.01
Ferraz & Pecora 1993 12	Japanese	105	12	11.4
	Negroid	106	3	2.8
Yew & Chan 1993 27	Chinese	832	179	21.5
Sperber & Moreau 1998 28	Senegalese	480	15	3
Gulabivala et al.2001 29	Burmese	139	14	10.1
Gulabivala et al 2002 30	Taiwanese	118	15	12,7
Ahmed et al. 2007 31	Sudanese	100	3	3
Peiris et al. 2007 32	Sri Lankan	100	3	3
Tu et al. 2007 33	Taiwanese	166	35	21

Radix Entomolaris

Carabelli¹ was the first investigator that mentioned the presence of an additional root in mandibular molars, which is called radix entomolaris (RE). RE is located disto-lingually, with its coronal third completely or partially fixed to the distal root. The dimensions of RE can vary from a short conical extension to a mature root with normal length.

RE morphology can be classified according to the classifications proposed and described by Carlsen and Alexandersen³⁵ and De Moor et al³⁶. Carlsen and Alexandersen³⁵ describe 4 types of RE according to the location of the cervical part of the RE. This classification allows for identification of separate and non-separate RE in conjunction with the location of the distal root.

- Type A: Distal location of the cervical part of the RE with 2 normal distal root components (Fig. 1a);
- Type B: Distal location of the cervical part of the RE with 1 normal distal root component (Fig. 1b);
- Type C: Mesial location of the cervical part (Fig. 1c);
- Type AC: Central location between the distal and mesial root components. The dimensions are almost vestigial (Fig. 1d).

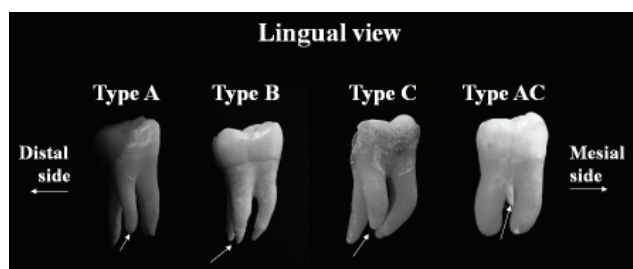


Figure 1.

De Moor et al³⁶ describe 3 types of RE according to the curvature variation in bucco-lingual orientation, based upon the bending of ISO #10 files after scouting of the root canal.

- Type I: Straight root/root canal (Fig. 2a);
- Type II: Initial curved entrance with straight continuation (Fig. 2b);
- Type III: Initial curve in the coronal third and second curve that continues in the middle and apical third (Fig. 2c).

Radix Paramolaris

Bolk² was the first investigator that reported the occurrence of an additional root which is called radix paramolaris (RP). RP is located buccally or mesio-

buccally. The RP dimensions may vary from a mature root to a vestigial conical component. As a supernumerary root, RP may be separated or partially fused to the buccal or mesio-buccal side of the tooth cervix.

According to the classification of Carlsen and Alexandersen³⁷ RP morphology can be classified in 2 types.

- Type A: Location of the cervical part on the mesial root complex. The dimensions of the RP vary and the length may be shorter (Fig. 3a) or equal (Fig. 3b) to the mesial root complex;
- Type B: Location of the cervical part centrally, between the mesial and distal root complexes. The dimensions are almost vestigial (Fig. 3c).

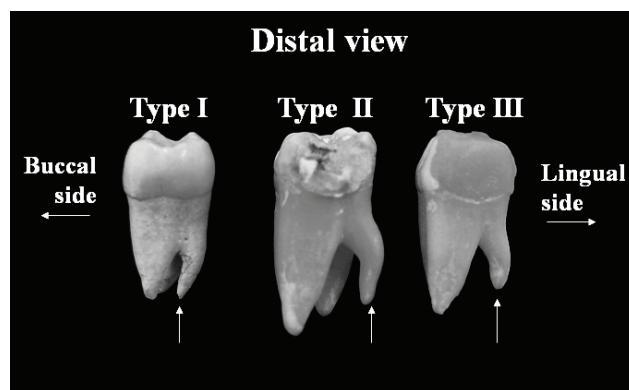


Figure 2.

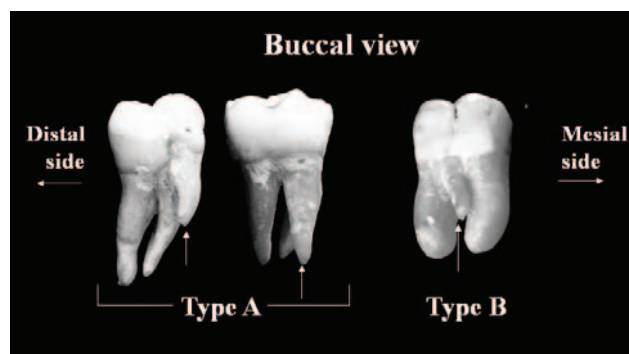


Figure 3.

Clinical Significance

The presence of a RE or a RP has clinical implications in endodontic treatment. Clinicians should take into consideration the presence of such anatomical variations, because an inaccurate diagnosis of these supernumerary roots may lead to complications or a missed canal during root canal therapy.

Concerning the RE, there are some existing traits of tooth crown and cervical morphology that may indicate the presence of an additional root during clinical inspection. These traits include the presence of a prominent occlusal, distal or disto-lingual lobe, in combination with a cervical prominence or convexity³⁸.

Concerning the RP, an additional root is nearly always associated with an extra cusp (tuberculum paramolare) at the buccal side (Fig. 4). Moreover, the cervical part of the RP is also more prominent and the convexity can be detected by means of a periodontal probe (Fig. 5).



Figure 4.

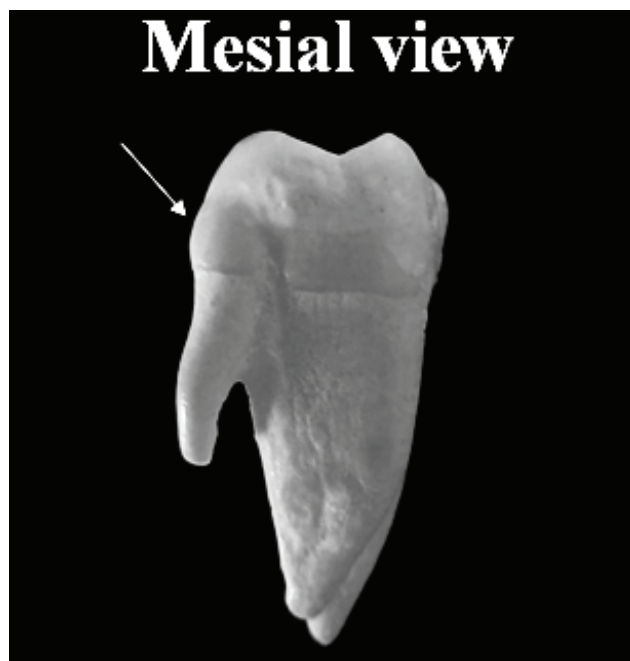


Figure 5.

During pre-operative radiographic examination, it is possible that the same bucco-lingual plane of RE and distal root, or RP and mesial root, may lead to a superimposition. This fact may possibly result in an inaccurate diagnosis. For this purpose, 2 radiographs exposed at 2 different horizontal angles (Buccal Object Rule) are needed to identify this additional root. Moreover, a primary interpretation of particular radiological marks, such as an unclear view or outline of the distal or mesial root, may indicate the presence of a RE (Fig. 6) or a RP (Fig. 7). The application of the Buccal Object Rule is also requisite during the radiological working length determination of the RE (Fig. 8) and RP (Fig. 9), respectively. If a RE or RP is diagnosed radiologically before endodontic treatment, the surgeon knows what to expect or where to look once the pulp chamber has been accessed.

Tooth isolation and application of visual aids, such as loupes or operating dental microscope, are useful during negotiating and scouting of the canal orifices.

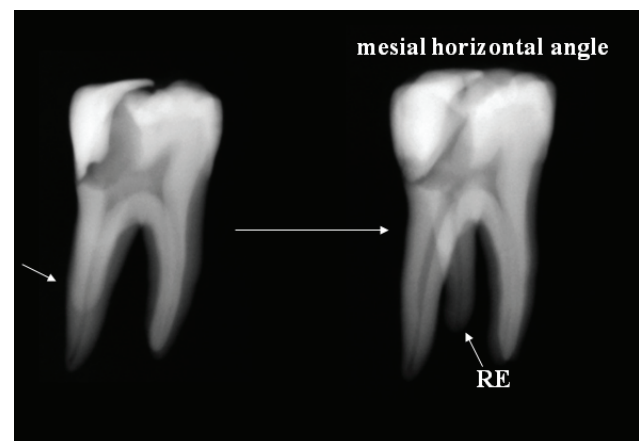


Figure 6.

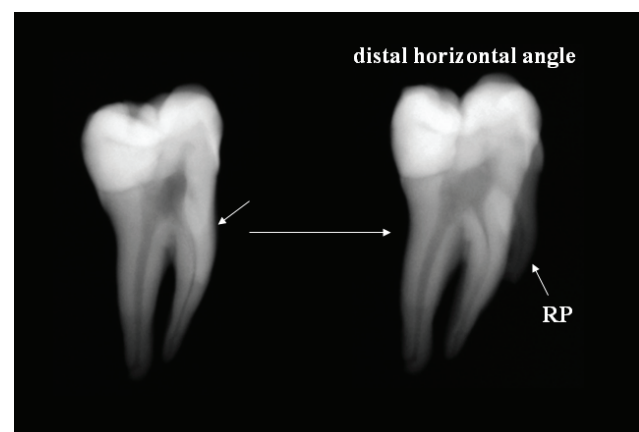


Figure 7.

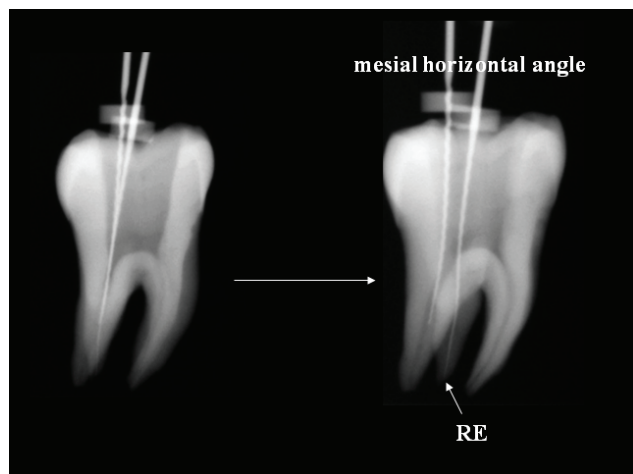


Figure 8.

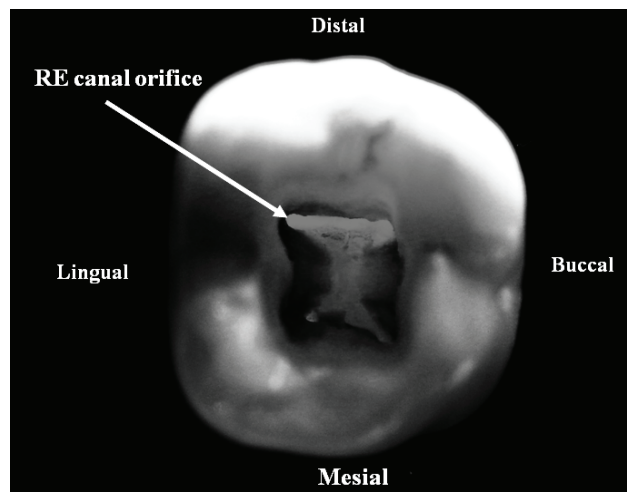


Figure 10.

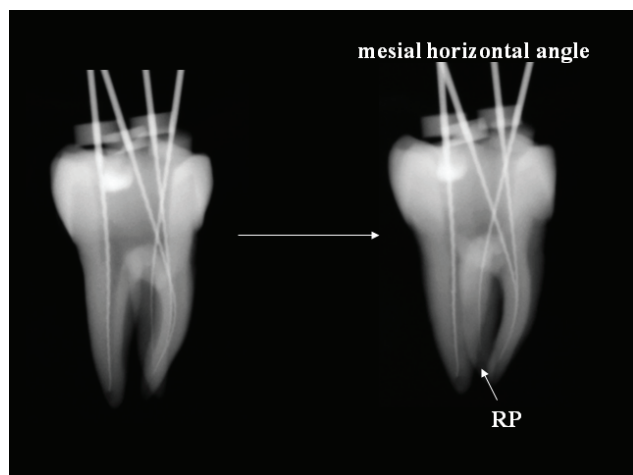


Figure 9.

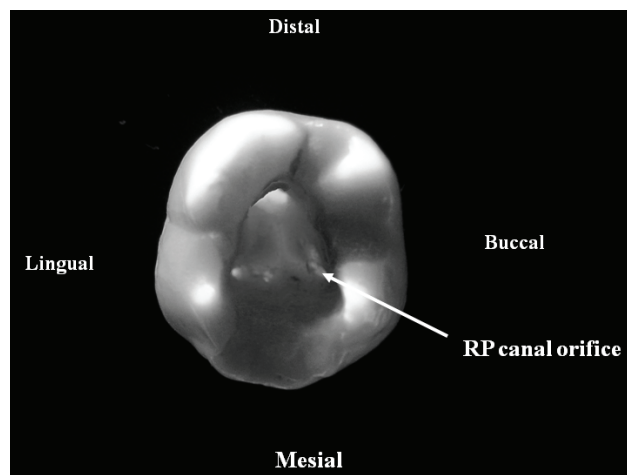


Figure 11.

Concerning the access cavity preparation in the presence of a RE, it is mandatory for the clinician to extend the typical trapezoidal access cavity disto-lingually in a more rectangular outline form. The orifice of the RE is located disto- to mesio-lingually from the main root canal/canals in the distal root (Fig. 10). A dark line on the pulp chamber floor, disto-lingually, may indicate the precise location of the RE orifice. During the exploration of the pulp chamber floor with angled probes, disto-lingually, the removal of the calcification above the orifice leads to a better access to the RE.

Concerning the access cavity preparation in the presence of a RP, an extension of the trapezoidal access cavity mesio-buccally is requisite. The distance between the RP canal orifice and the mesial root canal complex is almost double than the distance between the 2 mesial canal orifices. After the enlargement of the access cavity and the removal of the mesio-buccal overlying edge of the pulp chamber floor, the orifice of the RP is revealed (Fig. 11).

A severe bucco-lingual root inclination in the apical third of type III RE can cause different procedural errors, such as straightening of the root canal or a ledge, with root transportation and loss of working length. The use of flexible nickel-titanium rotary files is advisable, because they allow a more centred preparation with restricted enlargement of the coronal third and orifice relocation. Straight-line access has to be emphasized because the majority of RE are curved.

Conclusions

- The frequency of a RE in mandibular molars varies in accordance with specific racial traits. The incidence of a RP is very rare and occurs less frequently than the RE.

- Clinicians should take into consideration the existence of such anatomical variations in the number of roots.
- Pre-operative diagnosis of RE and RP is essential for the clinician to avoid procedural errors that may compromise the root canal treatment result.
- Careful clinical inspection of tooth crown and cervical morphology is necessary.
- Pre-operative periapical radiographs exposed at 2 different horizontal angles are required to reveal the presence of an additional third root, that may be hindered in cases of superimposition.

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- Correspondence and request for offprints to:
- Mastoras Konstantinos
Aristotle University of Thessaloniki, School of Dentistry
Department of Endodontology
GR-54124 Thessaloniki (Greece)
kmastoras@gmail.com