Prevalence of Radix Molar in Mandibular Permanent Molars: An Observational Study in Malaysian Population

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Abstract

The significance of root canal morphology has been emphasized by studies demonstrating that variations in canal morphology may affect the endodontic outcome. Generally, mandibular molars have 2 roots; however, the presence of a third root, is a major anatomic variant among many population groups.

Aims and Objectives: To identify and report the prevalence of radix entomolaris or radix paramolaris in human permanent first, second and third mandibular molars in the Malaysian population.

Materials and Methods: A total of 2234 extracted human permanent mandibular molars were collected from the different locations of Klang Valley, Malaysia. Out of 2234 collected teeth 359 teeth were excluded and remaining 1875 teeth were included in the study. Teeth were divided into three groups and thereafter, each tooth was examined for radix molar (RE or RP).

Results: The prevalence of RE in mandibular first molars was 80(4.2%), in second molars 30(1.6%) and in third molars 45(2.4%), while RP 13(0.7%) in first, 8(0.4%) in second and 11(0.6%) in third molars. There was no significant difference observed when comparing the presence of RE and RP in mandibular 1st molars to 2nd and 3rd molars (p value>0.05).

Conclusion: The prevalence of radix molars in the Malaysian population was 9.9% (4.9% in first, 2% in second and 3% in third molar) with no significant difference among mandibular first, second and third molars. This data regarding the occurrence and morphology of radix molars will provide useful information for clinician to achieve the successful endodontic outcome.

Key Words: Radix Molar, Human teeth, Identification, Morphology, Permanent mandibular molars

Introduction

The awareness and understanding of root canal anatomy of mandibular molar is very essential for the clinician to achieve the successful endodontic outcome. One of the main reasons for failure of root canal treatment in molars is missed canal [1,2]. Therefore, remaining infected pulp tissue and microorganisms may not allow complete debridement of the root canal system, thereby influencing the long-term prognosis of the endodontically treated tooth [3].

The number, location of roots and root canals of permanent mandibular molars may vary. Generally, mandibular molars have 2 roots [1,4], however, the presence of a third root is a major anatomic variant, first identified by Carabelli in 1844 [5].This third root in human permanent mandibular molars can be located either lingually (radix entomolaris) [6] or facially (radix paramolaris) [7,8].

The Latin term Radix Entomolaris (RE) was coined by Mihaly Lenhossek in 1922 [9]. The Radix Entomolaris (RE) is generally located distolingually with its coronal third completely or partially fixed to the distal root. It can be presented as a short conical extension to full length root and separate or partially fused with the distal root [7,8,10,11]. Bolk reported the occurrence of RP in mandibular first molar and found to be less frequent than RE [12,13]. RP is generally located mesiobuccally and can have dimensions similar to RE [14].

The formation of Radix Molar is generally related to racial, genetic and external factors during odontogenesis [7]. Many studies have shown varied prevalence of three-rooted mandibular first molars (RE) in different population groups. The prevalence of these three-rooted mandibular first molars appears to be 3.4-4.2% in Europeans [15-18], 3% in Africans [19], less than 5% in Eurasians and Indians [20], 5% to 40% in Mongoloid traits, such as Chinese, Eskimo and American Indians [19-24] and 8.2% in Malaysian Borneos [25]. The prevalence of RP was found to be almost 0% for the first mandibular molar [8,23], 0.5% for the second and 2% for the third molar [14].

There are very few studies in the literature reporting the prevalence of RE ad RP in permanent mandibular first, second and third molars. Therefore, this research was carried out to identify and report the prevalence of radix entomolaris or radix paramolaris in human permanent first, second and third mandibular molars in the Malaysian population.

Materials and Methods

A total of 2234 extracted human permanent mandibular molars were collected from the different locations of Klang Valley, Malaysia. According to the Malaysian Ministry of Health Guidelines for Ethical Review of Clinical Research or Research Involving Human Subjects (2006), studies involving biological specimens with no interaction with the human subjects involved; and with no collection of any identifiable private information are automatically exempted from obtaining informed consent from study subjects. After collection, teeth were thoroughly cleaned and inspected to confirm the type and morphological characteristics. Only sound mandibular molars with fully developed roots were included in this study to identify radix entomolaris and paramolaris, Teeth with severe attrition or grossly decayed or resorbed/immature roots were excluded. Out of 2234 collected teeth 359 teeth

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were excluded and remaining 1875 teeth were included in the study. Thereafter, selected teeth were divided into three groups i.e. first, second and third molar based on morphology and prevalence of radix molars (RE or RP) was recorded. Each group was examined by two experienced Endodontists and Kappa values (0.74) were calculated to quantify the inter examiner reliability.

To identify the presence of RE in permanent mandibular molars following types were included in the present study [26] (*Figure 1*).

Type A- The distal part of the root complex consists of three cone-shaped macrostructures: a lingual, medial and facial. Generally it is presented either as separate lingual structure and fused medial and facial structures or all three fused together.

Type B- The distal part of the root complex consists of two cone-shaped macrostructures that are practically of the same size; a lingual and facial. The structures are either separate or fused.

Type C- The mesial part of the root complex consists of three cone-shaped macrostructures: a lingual, medial and facial. It can be presented either as separate lingual and fused medial and facial structures or all three fused.

Type AC- The lingual part of the root complex consists of three cone-shaped macrostructures: a central, mesial and distal. The central of these structures is either separate or fused.

The following criteria were used to establish the presence of RP on permanent mandibular molars [12] (*Figure 2*):

Type A- The mesial part of the root complex consists of three cone-shaped macrostructures: a lingual, medial and facial. Generally it is presented either as separate facial structure and fused medial and lingual structures or all three fused together.

Type B- The facial part of the root complex consists of three cone-shaped macrostructures: a central, mesial, and distal. The central of these structures is either separate or fused.

The data collected was tabulated and analyzed by using the Epi-info version 5.0 and Statistical Package for Social Sciences (SPSS) version 17.0. The results were expressed in terms of proportion, chi-square test; odds ratio and its 95% confidence interval were applied for comparison purpose. In this study, a p-value <0.05 was considered as statistically significant.

Results

Out of the 1875 Mandibular molars, 890 (47.5%) were first, 437 (23.3%) second and 548 (29.2%) third molars. The total number of Radix molars (RE and RP) observed was 187 (9.9 %) in all molars. whereas 93 (4.9%) in mandibular first, 38 (2%) in second and 56 (3%) in third molars. The prevalence of RE in mandibular first molars was 80 (4.2%), in second molars 30 (1.6%) and in third molars 45 (2.4%), while RP 13 (0.7%) in first, 8 (0.4%) in second and 11 (0.6%) in third molars. There was no significant difference observed when

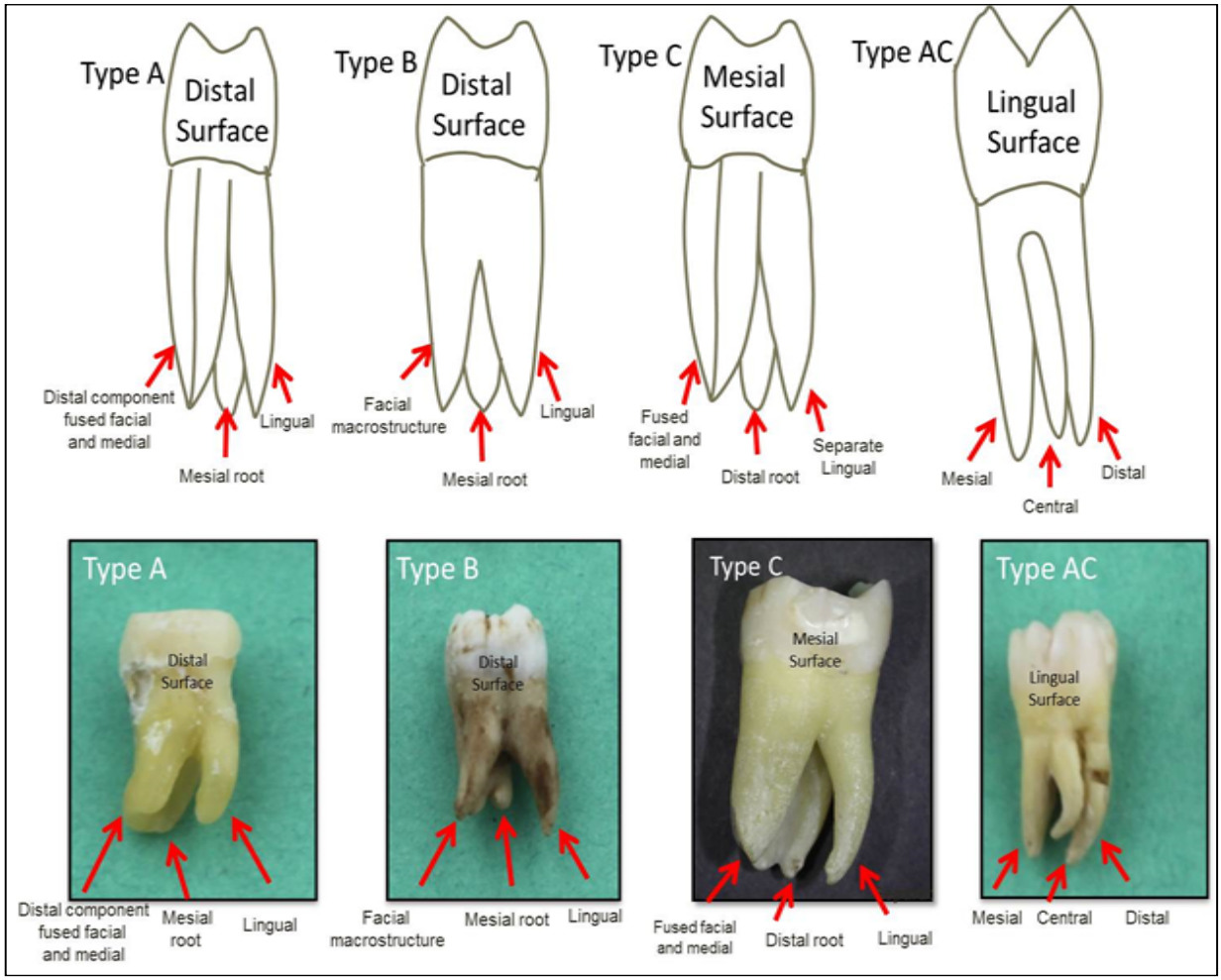

Figure 1. *Schematic and pictorial representation of types of Radix entomolaris (RE).*

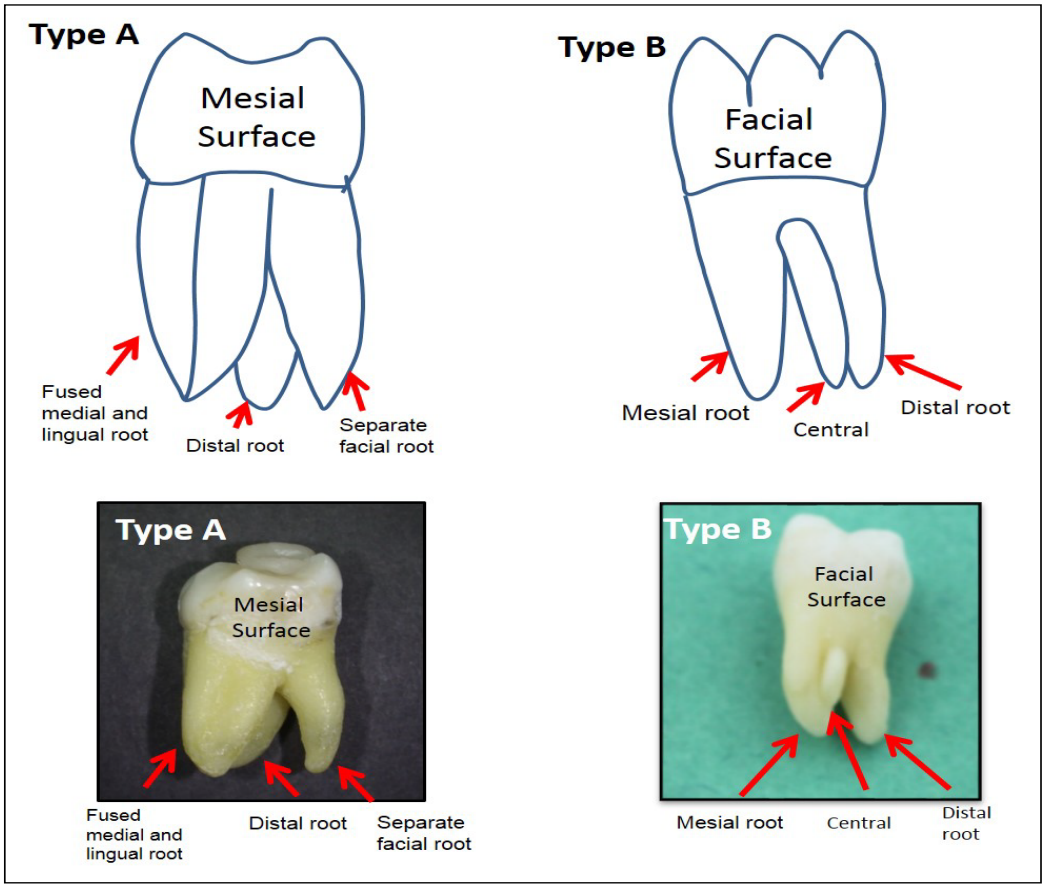

Figure 2. *Schematic and pictorial representation of types of Radix paramloaris (RP).*

comparing the presence of RE and RP in mandibular 1st molars to 2nd and 3rd molars (p value>0.05) (*Tables 1-4*).

Discussion

The clinician must have thorough knowledge of radix entomolaris and paramolaris to get the successful endodontic outcome. Radix molar is one of the major variants observed in human permanent mandibular molars [27] and failure to recognize this variant may jeopardize the prognosis of root canal therapy. Studies have shown that a large number of dentists failed to appreciate this anatomic variant in mandibular molars [28,29].

In previous studies, two main methods have been used to assess the prevalence of this anatomic macro-structure. Some authors studied this aberration using a radiographic approach [30-35] while others directly from extracted teeth [20, 36-38]. In the present study the morphology of teeth was studied directly using extracted teeth, as it gives a three dimensional picture of the tooth and allows precise identification of any morphological variation.

The present study observed 9.9 % RE and RP in mandibular molars of Malaysian population, which is in agreement of the study conducted by Tratman in 1938 in Malays and by Laband in 1941 in Malay in north Borneo but less than by Jones in 1980 in Malaysians [39-41].

Type A of RE and RP was found to be the most common variant while type AC of RE and type B of RP was the least, similar to the previous studies conducted by Carlsen and Alexandersen in Danish population [8,26]. The cause of this supernumerary root is still unclear but few theories have been proposed such as external factor leading to odontogenesis and atavistic gene or polygenetic system [42].

The present study has shown the maximum percentage of RE present in mandibular first molar, this can be explained by field developmental theory [43]. According to which, permanent mandibular canine and first molar are key teeth for the anterior and posterior fields of the jaws. Teeth those are more distant from a key tooth exhibit fewer characteristics of the field. The first permanent molar is the main site for field affecting genes [44]. Therefore, it can be conjectured that the formation of an additional root is controlled by certain field-affecting genes that are transcribed mainly in the first permanent molar area. According to Tratman in the Chinese, Malays, Javanese, Asiatic Indians, and Eurasians, the supernumerary root occurs four to eight times more often on the permanent first molar than on the deciduous second, suggesting that it is the permanent first molar which is the major site for a field-affecting gene.

To achieve the best endodontic outcome of these radix molars, it is utmost necessary to have a sound clinical approach as described by Calberson et al. [45]. Thorough knowledge of the location of additional roots and its root canal orifices, analyzing the cervical morphology of roots by means of periodontal probing, presence of an extra cusp or more prominent distolingual lobe in combination with a cervical prominence [2,45], use of an angled radiograph (SLOB technique) to identify an additional root that appears as a shadow or a thin radiolucent line in the radiograph [46] and use of advanced radiographic technology such as Cone Beam Computed Tomography (CBCT) [47,48] are ways to identify this morphological variant.

***Table 1**. Comparison of prevalence of RE and RP in Mandibular first, second and third molars.*

Type of Radix Molar	Mandibular 1st Molar Number (Percentage)	Mandibular 2nd Molar Number (Percentage)	Mandibular 3rd Molar Number (Percentage)	Total Number (Percentage)
RE	80 (51.6%)	30 (19.4%)	45(29%)	155 (100%)
RP	13 (40.6%)	8 (25%)	11 (34.4%)	32 (100%)
Total	93 (49.73%)	38 (20.32%)	56 (29.95%)	187 (100%)

RE-Radix Entomolaris; RP-Radix Paramolaris; X^2=1.31, df=2, p=0.519; X^2 for linear trend=0.929; p=0.335.
*Here p value <0.05 was considered as significant

***Table 2.** Comparison of prevalence of RE and RP in Mandibular first to second and third molars.*

Type of Radix Molar	Mandibular 1st molar Number (n)	Mandibular 2nd molar/3rd molar Number (n)	Chi-square	Odd ratio	95%Confidence value	p-value
RE	80	75	0.88	1.56	0.68-3.62	0.348
RP	13	19				

*Here p value <0.05 was considered as significant

***Table 3**. Comparison of prevalence of RE and RP in Mandibular second to first and third molars.*

Type of Radix Molar	Mandibular 2nd molar	Mandibular 1st molar/3rd molar	Chi-square	Odd ratio	95% Confidence value	p-value
RE	30	125	0.23	0.77	0.39-1.53	0.630
RP	8	24				

*Here p value <0.05 was considered as significant

***Table 4.** Comparison of prevalence of RE and RP in Mandibular third to first and second molars.*

Type of Radix Molar	Mandibular 3rd molar	Mandibular 1st molar/2nd molar	Chi-square	Odd ratio	95%Confidence value	p-value
RE	45	110	0.15	0.85	0.49-1.45	0.697
RP	11	21				

*Here p value <0.05 was considered as significant

While performing root canal therapy, coronal cavity preparation should be extended to expose all root canal orifices and carefully explored with an endodontic probe to identify the dentinal map [45].The use of magnification and advanced endodontic instruments such as operative microscope and ultrasonics have found to be very useful, especially to expose the root canal orifices covered by calcified dentinal tissue [45].

Thorough knowledge of dentinal map and its identification can also be helpful to detect this variant. Ming gene et al. observed the distances from the DL canal orifice to the DB, MB, and ML canal orifices and suggested the location of the extra distolingual root canal orifice in mandibular first molar. It is located a mean of 2.7 mm from the distobuccal root canal orifice, 4.4 mm from the mesiobuccal root canal orifice and 3.5 mm from the mesiolingual root canal orifice [49]. In order to reconfirm the location of this additional root radiographically, a Hedstrom file can be placed in the additional canal and a K-file into the main canal.

In this study the gender of teeth from subjects were not taking into consideration, as previous study has shown no statistically significant sex-based differences in tooth morphology [45].

Conclusion

The prevalence of radix molars in the Malaysian population was 9.9% (4.9% in first, 2% in second and 3% in third molar) with no significant difference among mandibular first, second and third molars. This data regarding the occurrence and morphology of radix molars will provide useful information for clinician to achieve the successful endodontic outcome.

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