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Radiographic Evaluation of Radix Entomolaris Variations in Permanent Mandibular First Molars: A Cone Beam CT Study

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Abstract

Purpose: The aim of this study is to identify the spatial position and variation of radix entomolaris in permanent mandibular first molar using CBCT

Methods: CBCT scan showing the presence of a completely formed radix entomolaris on the first permanent mandibular molar. A total of 289 scans were scrutinized.

Among a cohort of 27 patients, thirty-seven mandibular first molars, either unilaterally or bilaterally, exhibiting radix entomolaris were identified. The CBCT examination was performed at five different axial levels. The study assessed the spatial position namely buccal or lingual, mesial, or distal, variation, and incidence of unilateral or bilateral radix entomolaris in permanent mandibular first molars using Carlsen and Alexandersen's classification.

Results: The result showed that radix entomolaris is more towards the lingual position compared to the buccal position and this difference is statistically highly significant (p=0.000). It was also observed, that the majority of the radix entomolaris appeared more distally and less mesially, and this difference is statistically highly significant. (p=0.000). The frequency of unilateral and bilateral radix entomolaris was approximately the same, and this difference is statistically highly insignificant (p= 0.433).

Conclusion: Our investigation revealed that Cone Beam Computed Tomography (CBCT) is a precise, dependable, non-invasive, and pragmatic method for the identification of spatial position and morphologic variation of Radix entomolaris in mandibular first molars.

Keywords: Cone-Beam Computed Tomography, Permanent Mandibular First Molar, Radix Entomolaris, Spatial Position, Morphological Variations

Introduction

Radix entomolaris (RE) refers to the presence of an extra third root, a supernumerary root located distolingually in this microstructure[1]. A three-dimensional understanding of root morphology, related root canal architecture, and the range of usual variations is essential for successful molar endodontic therapy[2]. The permanent mandibular molars' root canals and root number can differ. Mandibular molars typically have two roots, however, the presence of a third root is a significant anatomic variance discovered by Carabelli in 1844[3]. Majority of mandibular first molars are two rooted; mesial and distal. Sometimes, an extra distobuccal or distolingual root may be encountered[4]. The position of the additional root can affect the morphology of the tooth, such as the crown outline, the presence of an additional cusp, or a cervical prominence, also the location of the canal orifices on the pulp chamber floor which can make it challenging to locate and treat all the canals[5]. The best possible treatment outcomes for endodontically treated cases are the goal of every practitioner. Thus, it is of utmost importance that the clinician be familiar with variations in the root and root canal anatomy of the mandibular first molar [6].The etiology behind the formation of RE is unclear. In dysmorphic, supernumerary roots, its formation may be attributed to extraneous causes during odontogenesis or to the penetrance of an atavistic gene or polygenetic system[7].Because of anatomical problems, instrumenting Radix entomolaris might result in consequences such as furcal or strip perforation, weakening of roots, vertical root fracture, root canal flattening and transportation, loss of study length, and fractured instruments[8].Two-dimensional periapical radiography is a frequently used diagnostic imaging technique for the evaluation of root morphology and the detection of probable apical lesions. However, several restrictions on routine periapical radiography could prevent a correct diagnosis of periapical pathological lesions or the delivery of the necessary care [9].The evaluation of root canal morphologies and configurations different techniques have been used to assess the root canal system[10]. These include cone-beam computed tomography (CBCT), CT and radiographs used in in vitro research. CBCTs have been claimed to be superior to traditional radiography because it can produce three-dimensional pictures, allow images to be broken into sections, and produce better-quality images that can be generated with lower doses of radiation. CBCTs which have become more common as the technology develops, enable morphological analysis of teeth, assessment of root canal anatomy and variations, and analysis of healthy teeth. CBCT is used most frequently in morphology studies in endodontics,

Clinicians should be knowledgeable about the localization, and canal designs of REs in order to improve the outcome of endodontic treatment8.Therefore, this research was carried out to identify the spatial position and morphologic variation of radix entomolaris in permanent mandibular 1st molar using CBCT.

Material and Method

The research was carried out in the Department of Oral and Maxillofacial Radiology of MGV KBH Dental College after obtaining institutional ethical clearance. The CBCT scan from the archives of CBCT. The 3D X–ray data was recorded using ORTHOPHOS XG 3D with cephalometric attachment manufactured by SIRONA, Germany with a field of view of 8 cm x 8cm. The data were visualized using SIDEXIS version 2.63 software the radiology section from the period between June 2023 to October of 2023 was screened. The patients were not exposed to radiation (CBCT) only for the purpose of the study. The images were studied on the desktop monitor having resolution- 1920-1080 ppi by a trained maxillofacial radiologist under the guidance of an experienced maxillofacial radiologist.

total of 289 CBCT scans were evaluated and 27 scans fulfilling the Inclusion criteria were selected.

Inclusion criteria

1. CBCT scan showing the presence of completely formed radix entomolaris on a permanent first mandibular molar.

Exclusion criteria

1. CBCT scans with low image quality, radiographic artifact, partial image in the region of interest
2. CBCT scans with impacted teeth in the area of interest
3. CBCT scans with pathological problems in the area of interest such as root resorption, root fracture, etc.
4. CBCT scans showing radiographic evidence of trauma and surgery in the area of interest.

The root canal morphology of the permanent mandibular first molar was assessed in the axial, sagittal, and coronal section

The following observations were recorded

1. Spatial position i.e. buccal or lingual position and mesial or distal (fig:1,2)
2. Unilateral or Bilateral of radix entomolaris, (fig:3)

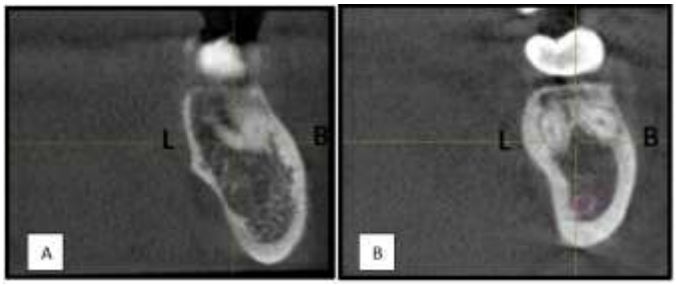

Figure 1: Spatial position of Radix Entomolaris. A- Buccal position, B- Lingual position

Figure 2: Spatial position of Radix Entomolaris. A- Mesial placed, B – Distally placed

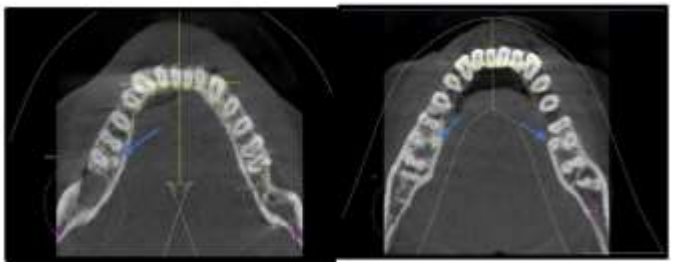

Figure 3: Unilateral and Bilateral Radix Entomolaris

Morphological variation Carlsen and Alexandersen's 8 classification according to the location of the cervical part:

- Type A: The distal part of the root complex consists of three cone-shaped macrostructures: a lingual, a medial, and a facial. Generally, it is presented either as a separate lingual structure and fused medial and facial structures or as all three fused together.
- Type B: The distal part of the root complex consists of two cone-shaped macrostructures that are nearly the same size: a lingual and a 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, a medial, and a facial. It can be presented either as separate lingual and fused medial and facial structures or as all three fused.
- 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 fused.

Statistical Analysis

Data obtained was entered and sorted in Microsoft Excel (v.2010). Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software (v.27.0). Frequency and Descriptive statistics were performed for all the parameters. The chi-square test of proportion was used to determine significant differences within the responses to each question. All statistical tests were performed at 95% confidence intervals; keeping a p-value of less than 0.05 as a statistically significant

Results

A total of 289 scans were scrutinized in a stipulated period, out of which thirty-seven mandibular 1stmolar (right and /or left side i.e. 36,46.) with radix entomolaris were found. (Table 1)

As per Table 1, it was found out that the majority of the radix entomolaris showed lingual propensity (81.1%) and only 18.9 % approx. showed buccal propensity.

It is found out that in the mandibular 1st molar the radix entomolaris are more towards the lingual position as compared to the buccal position and this difference is statistically highly significant (p=0.000).

As per Table 2, it was found out that the majority of the radix entomolaris showed more distally (83.8%) and only 16.2% approx. showed less towards mesially in axial view.

It is found out that in the mandibular 1st molar the radix entomolaris are more towards the distal as compared to the mesial and this difference is statistically highly significant (p=0.000).

As per Table 3, thus total of 27 patients were included out of these 27 patients, 17 patients showed unilateral mandibular 1st molar which shows radix entomolaris, and in the remaining 10 patients mandibular 1st molar on both sides (bilaterally) showed the presence of radix entomolaris.

It was found out that in the mandibular 1st molar, the unilateral and bilateral radix entomolaris were approximately the same and this was statistically insignificant (p= 0.433).

Table 1: The spatial position of radix entomolaris on permanent mandibular first molars

Spatial position (36/46)	Frequency	Percent
BUCCAL	7	18.9
LINGUAL	30	81.1
Total	37	100.0

Table 2: The spatial position of radix entomolaris on permanent mandibular first molars

Spatial position (36/46)	Frequency	Percent
DISTAL	31	83.8
MESIAL	6	16.2
Total	37	100.0

Table 3: incidence of radix entomolaris in permanent mandibular first molar

	Frequency	Percent
Unilateral	17	62.96
Bilateral	10	37.03
Total	27	100.0

Discussion

A variety of identification methods are used in the assessment of root canal systems and variation 8.Radix molar is one of the major variants observed in human permanent mandibular molars and failure to recognize this variant may jeopardize the prognosis of root canal therapy [3].The distal root of a two-rooted mandibular first molar usually has two distinguishable minor apices with one, two or more apical foramina 6.Studies have shown that a large number of dentists failed to appreciate this anatomic variant in mandibular molars [3].For diagnostic purposes, two-dimensional radiography methods are viewed as inadequate and standardizing complicated root canal anatomy. Furthermore, due to modelling constraints and dental problems such as pathologies and resorptions, in vitro investigations of teeth may not yield accurate and consistent data [11].

It is also necessary to understand the similarity and symmetry in the number and morphology of roots and root canals between the left and right sides when treating bilateral mandibular first molars[12]. The present study utilized CBCT to assess the occurrence of RM in permanent mandibular molars. Patel et al. reported that 3D imaging techniques provide better visualization of root morphology, the number of root canals, and their convergence or divergence from each other [13]. The use of CBCT provides the clinician with the ability to observe an area in 3 different planes namely sagittal, coronal, and axial which has been reported to eliminate the superimposition of anatomic structures [14,15]. In addition, Neelakantan et al. reported that CBCT and peripheral quantitative computed tomography were as accurate as the modified canal staining and tooth-clearing technique for the study of canal morphology [15]. Furthermore, Matherne et al. stated that CBCT could identify a greater No. of root canal systems than digital radiographs [16]. Compared to conventional medical computed tomography, CBCT allows less scan time, a lower radiation dose, and higher resolution imaging [17].

Mukherjee et al and Duman S et al have conducted a comprehensive study on the prevalence, localization, and canal configurations of RE. The incidence rates of these root variations vary depending on ethnicity [18]. REs was discovered to be more abundant in east asian population, REs was found to be less common in other populations 8,11. However, our study is different from Duman S and Mukherjee et al study where spatial position and radix molar of permanent mandibular first molar was considered. Type A canal variation was the most common and type AC canal variation the least common in Carlsen and Alexandersen and Bhatia studies8,Comparably in our study Type B was found often, and none Type A, Type C and Type AC was found, also radix entomolaris were found commonly on lingual position and more towards distally of mandibular first molar.

A thorough examination of pre-operative radiographs, along with a meticulous intra-operative assessment of the pulp chamber during access opening, is crucial. Clinicians should extend their search more distally to prevent overlooking the canal of an extra root during root canal treatment [19]. An important clinical implication of employing the correct classification system for canal configuration is its potential impact on both endodontic

treatment and the fatigue resistance of rotary instruments [20].

Conclusion

Our study concludes that the spatial position, variation of Radix Entomolaris in the Permanent mandibular first molar can be determined using CBCT and important for clinicians to accurately diagnose and treat mandibular molars with this additional root, and to avoid complications during dental procedures. In addition, we found that CBCT is an accurate, reliable, non-invasive, and practical technique for identifying Radix entomolaris in mandibular first molars

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