Bulletin of Environment, Pharmacology and Life Sciences Bull. Env. Pharmacol. Life Sci., Spl Issue [2] 2022 : 27-32 ©2022 Academy for Environment and Life Sciences, India Online ISSN 2277-1808 Journal's URL:http://www.bepls.com CODEN: BEPLAD ORIGINAL ARTICLE



Morphological Variations of Mandibular Molars: A Case Series

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ABSTRACT

All categories of teeth may have extra roots and/or canals, but there is more chance of finding aberrant canal configurations in premolars and molars. Failure to recognize these variations and inadequate removal of pulpal tissues and microorganisms from the pulp canal system may be one of the reasons of failure despite of following all principles and guidelines for endodontic treatment. There is a highest risk of missing anatomy because of the complexity of the root canal system. Hence, it is imperative for the dentist to have comprehensive information of normal as well as aberrant morphology of root canal system. The present case series elaborates variations of mandibular molars with the meticulous diagnosis and treatment along with relevant literature.

KEYWORDS: Mandibular molars, tooth anomaly, endodontics, root canals

Received 12.07.2022

Revised 08.08.2022

Accepted 13.10.2022

INTRODUCTION

Mandibular molars present with various anatomic variations such as taurodontism, supernumerary root, single root, extra canals, and C-shaped canal system [1]. But they generally have two roots, one mesial and other on distal side, but sometimes a supernumerary root is also found either on distolingual or on mesiobuccal aspect. This macrostructure was first mentioned in the literature by Carabelli (1844) and was later termed radix entomolaris (RE) and radix paramolaris (RP) which can be found in the first, second and third mandibular molars [2-3]. The global prevalence of mandibular molars with three roots is 3-13% percent in various groups of ethnic populations across the globe [4-7]. The bilateral incidence of a symmetrical distribution is 68.57% [8]. Usually, there are only two canals in the mesial root of mandibular molars, such as, mesiobuccal (MB) canal and mesiolingual (ML); however, although uncommon, a middle mesial canal (MM) may present in 1-13.3% of cases [9-10]. It is often located in the groove between the two canals. Fabra-Campos found 2.75 % of the mandibular first molars had five canals out of 145 teeth studied. 100 mandibular first molars and found 12 teeth having a third mesial canal [11]. Based on the method used of detecting the third mesial canal, its prevalence ranged from 0% to 36% [12]. Likewise mandibular second molar is no exception in having morphological variations. There are variations in number of roots and canal morphology which includes single canal, two canals, three and four canals, five canals and the C-shaped canal system [10-13].

A mandibular second molar with three roots is a rare clinical entity[14] that was reported about 13% in the study of De Pablo et al. [15] It was reported 2% in Iranian population, [16] 4% in Jordanian population, [17] and 2% in the study by Manning SA. [18]. The C-shaped root canal system is an unusual root canal morphology found primarily in mandibular second permanent molars. It is defined as a root canal that in transverse section is shaped like the letter C but it is not always C-shaped from orifice to apical foramen. This condition was termed as C-shaped root and C-shaped root canal system by Cooke and Cox in 1979 [19]. The reported prevalence of C-shaped canals varies across various ethnic groups from 2.7% to 32.7% with higher rates in Asian populations [20-27].

A dental practitioner shall bear in mind that root canal system may present morphological aberrations in terms of either extra roots or root canals or missing roots or root canals. Fused roots/root canals may manifest as a single root, conical or C-shape form [28]. The aim of this present case series was to evaluate the variations in roots and canal system in mandibular molars.

RESULT AND DISCUSSION

All the cases were presented to the Department of Conservative Dentistry and Endodontics, with noncontributary medical history.

Case No. 1: Permanent mandibular first molar with radix entomolaris

A 32 years male patient presented to the department with the chief complaint of pain in right side of lower jaw in the last 1 week. The pain was severe in intensity and continuous which aggravated on taking cold water and chewing food. Based on clinical and radiographic observations (Fig.1a), the tooth was diagnosed to have a symptomatic irreversible pulpitis with symptomatic apical periodontitis. Hence, an endodontic intervention was initiated. The standard triangular access was modified in a more trapezoidal form. Pulpal floor was examined with DG 16 endodontic explorer^{*} which revealed four canal orifices. All the canals were prepared with Hyflex CM files[†] with crown down technique. Obturation was done with cold lateral condensation technique after 3 weeks. (Fig 1 b).

Figure 1a- Pre Operative X-Ray Figure 1b Post Obturation X- ray



Case No. 2: Middle mesial canals in permanent mandibular molar

A female subject aged 17 years reported to the department and provided the history of pain in lower left quadrant from past one week. The pain was severe in intensity, lancinating in nature and continuous which aggravated on taking cold drinks. The clinical and radiographic impression pointed towards diagnosis of symptomatic irreversible pulpitis and apical periodontitis (Fig.2a), and hence, an endodontic intervention was initiated. After access opening, the groove joining the MB-ML canals and DB-DL canals were troughed. Pulpal floor was examined with DG 16 endodontic explorer which revealed three canal orifices in mesial root and two orifices in distal root. (Fig. 2b) The IOPAR revealed five canals. All the canals were prepared with Hyflex CM files with crown down technique and obturation was done with lateral condensation technique (Fig 2c).



Figure 2a Pre operative Xray Figure 2b Clinical Picture Figure 2c. Post Operative Xray

Case No. 3- C-shaped canal configuration in Permanent mandibular second molar

A female subject aged 21 years reported to the OPD with the chief complaint of pain in right side of lower jaw in the last 2 weeks. Past dental history elicited restoration of the same tooth 1 month back. From the clinical and radiographic findings (Fig 3a), diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made. On exploration of pulp chamber, two orifices were recognized that were connected by connecting slit. (Fig 3b) The intra-oral radiograph revealed conjoined canals at apical third of the root. Then, cleaning and shaping was done using hybrid technique and



obturation was done using cold lateral compaction technique. (Fig. 3c) **Figure 3a Pre-Operative Xray Figure 3b C-shape Figure 3c Post Obturation**

Case No. 4 Permanent mandibular second molar with single root and single canal

A 29 years female reported to the department with the chief complaint sensitivity to cold water in lower right back region of jaw. Patient had undergone treatment of the same tooth 6 months back. On clinical examination metal ceramic crown was given on mandibular right second molar. (Fig 4a) After pulpal and percussion test, a diagnosis of symptomatic irreversible pulpitis was made. The access cavity preparation was done and the view of pulpal chamber showed a large canal orifice located in the center of the floor of pulpal chamber. IOPAR revealed a single root and canal. BMP was done by using a step back technique and gutta- percha was compacted using cold lateral compaction technique for obturation. (Fig-4b)



Figure 4a - Preoperative Xray

Figure 4b -Post Obturation Xray

This series describes the various morphological variations that can be present in mandibular molars. The mandibular first molar in the present case series here had 3 roots with 1 mesial root and 2 distal roots with 2 canals and one canal in each of them respectively. Similar canal configuration was present in mandibular second molar also. Although 4 canals are frequently found in mandibular first molar but the presence of 2 distal roots is not common [29]. The third root if present in disto- lingual aspect, then it's called RE [30] and if on mesio-buccal aspect, it's called RP. The identifying characteristics and external morphology of these roots having either a lingual or buccal supernumerary root [31]. The RE mostly has Vertucci type I canal configuration. It is smaller than the disto-buccal root and is normally curved which poses challenges during instrumentation and filling [32].

Many authors have reported mandibular first molar with RE but mandibular second molar with RE is extremely rare. Various classifications had been given by various authors based on buccolingual variations [33], morphological characteristics. Till date, there is no clarity on etiopathogenesis of development of RE, although many plausible explanations include external disturbances during morphogenesis in odontogenic development, expression of atavistic trait or polygeny with/without influence of racial genetic factors may cause expression of these aberrant phenotypic traits. RE in mandibular second molar is a dysmorphic alteration (rare or unusual morphological alteration) even in ethnic populations with high prevalence of RE in mandibular first molars [34]. The prevalence is equal in both male and female but it is more frequently found on left side. As the superimposition of DB and DL roots may appear on the pre-operative radiograph, it may pose a difficulty in identifying the extra canal. So, an accurate diagnosis is mandatory to avoid complications or missed canal during endodontic

treatment. Apart from complicating the endodontic procedure, it has been found to be a contributing factor to localized periodontal destruction. A mesial and/or distal parallax view using a beam aiming device may provide additional information not readily available from the conventional periapical radiograph. Three radiographic view with three varying horizontal projections including conventional buccal-to-lingual projection with 20° shift in mesial and distal directions may offer better radiographic observation of radicular anatomy. As per the Clark's/SLOB rule, two radiographic views with varying horizontal angulations may help locating the position of the lingual root; however multiple intraoral radiographic projections/views do not warrant the revelation of all anatomic aberrations [35]. Three-dimensional imaging overcomes this major limitation by allowing the visualization of the third dimension while at the same time eliminating superimpositions [36]. Besides radiological diagnosis, clinical inspection should also be thoroughly done and the standard triangular access should be modified in a more trapezoidal form]. Whenever, the orifice of RE canal does not present itself clearly, a careful inspection of pulp chamber and wall, more so in distolingual area is advised. Loupes or surgical operating microscope can help aiding the quicker location. Also, one should carefully locate the dark line which often marks the exact location of orifice of RE canal.

There is also variability in root canal system in mandibular molars. The presence of three root canals in the mesial and the distal roots in mandibular first molar has been reported by several authors. The third middle root canal is found centrally between the MB and ML root canals. Dentinal vertical apposition formed inside the root canal cavity due to secondary dentine apposition during tooth maturation form root canals and this third canal is formed by same process. If present the diameter of this third middle canal is smaller than that of the other two mesial canals and is age related because of apposition of dentine [37]. Three morphological variations of these canals in relation to the other main mesial root canals. The third middle mesial canal is defined as either independent or confluent depending on whether it has a distinct orifice with separate foramen or merges with either of the mesial canals and emerges having common apical foramen [38]. It has also been described as a fin when an endodontic instrument passes to the buccal or lingual canals from the third middle canal. It had been reported that the orifice of the MM canal was always located close to the ML canal. In this case report, the mandibular first molar with three mesial canals had confluent anatomy which is the usual anatomical configuration. The middle mesial canal in mandibular first molar presented here converge to ML canal to terminate at a common apical foramen.

Another variation of root canal system is C-shaped canal configuration which was first depicted by Keith & Knowles and then described in detail by Nakayama with name of 'gutter-shaped root. In 1979 Cooke and Cox described this aberrancy, and then after the terms 'C-shaped root/root canal. There is racial predilection of this variation and most commonly found in mandibular second molars but mandibular premolars, maxillary molars and mandibular third molars may also present this variation [39]. When Hertwig's epithelial sheath fails to fuse in furcation area in either buccal/lingual side it manifests as buccal/lingual groove, however, a conical or prism-shaped root is formed in case there is no fusion from either side [40]. The pulp chambers of such teeth depict low placed furcation and this manifests as greater depth of pulp chamber and an increased apico- occlusal dimensions. Also, the middle third of root close to apical third of root canal manifests with various fan-shaped communications]. In our case report of mandibular second molar with C-shaped canal system, had the pulp chamber floor of Type I and radiographic configuration of Type I having a mesial and a distal canal that merged into one before exiting at the apical foramen.

Apart from the commonly reported C-shaped canal variation in mandibular second molars, other variation do exists like two or four canals instead of the commonly occurring three canals, supernumerary roots, taurodontism, additional or lesser number of canals in one or more of the roots. The presence of one single root and one root canal in all second molars of the same patient. Manning et al. reported a high prevalence of single rooted mandibular second molars in Asians A study conducted by Weine et al. [20] reported that only one tooth (1.3%) had single canal configuration out of 75 extracted mandibular second molars.

CONCLUSION

The clinician must be aware of all the morphological variations that can be found in mandibular molars that directly affect the probability of success. The initial diagnosis should be done thoroughly. CBCT along with the operating microscope and ultrasonic tips are useful tools in the diagnosis and success of root canal therapy.

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CITATION OF THIS ARTICLE

C Arora, N Mittal Morphological Variations of Mandibular Molars: A Case Series . Bull. Env.Pharmacol. Life Sci., Spl Issue [2]: 2022: 27-32