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Dental science

Maxillary Second Molars with C-shaped Configuration

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Abstract:

The prevalence of fused roots and consequent merged and C-shaped canals in maxillary second molars can be unpredictable. Thus, pose a clinical challenge. The purpose of this article was to present 2 cases with a C- shaped configuration diagnosed during root canal treatment. Both Cases reflect the fusion into a C-shaped configuration and the configuration classified as Type B subtype 2. Clinicians should be aware of possible anatomic variation of the root canal system and anticipate such complexities when formulating an effective root canal treatment plan. Moreover, when a preoperative periapical radiograph shows signs of a fused-rooted maxillary second molar, utilization of operative dental microscopes coupled with Cone-beam computed tomography (CBCT) images is essential for localization and identification of all canals.

Introduction:

Endodontic therapy relies on several factors that collectively contribute to its success.[1,2] However, pretreatment identification of morphological variations can facilitate accurate cleaning, shaping, and complete filling of the root canal system.[1,2] In addition, prevent irreparable damages to teeth and subsequent treatment failure.[1,2] The "C-shaped" configuration is among the various anatomical configurations of the root canal system.[3,4] Cooke & Cox were the first to report C-shaped canal in 1979, as an important anatomical variation in three case reports.[3,4] Whereas C-shaped configuration in maxillary molars was first reported by Newton and McDonald in 1984, similar reports have since been published (Wells & Bernier 1984, Rabie 1985, Barnett 1986).[4-9] Racial background accounts for some variabilities.[9] According to some studies, C-shaped are predominantly observed in East Asian countries (31.5% to 44.5%) but are also present in Caucasian populations (2.7%).[9,3] Although C-shaped root canals are commonly observed in mandibular permanent second molars at a frequency of 39%, they also occur in permanent maxillary second molars with an incidence of 5.1%–22%.2.[2,10,11]

In general, managing maxillary second molars can be challenging due to limited accessibility as well as complexity of their root canal systems.[12] The most common configuration in Saudi Arabian population is the presence of three roots (92%), which agrees with the findings of studies done on other populations.[11,13] 88.5% in Caucasian population (Plotino et al., 2013).[14] 74.79% in Korean population (Lee at al., 2011).[15] 66.1% in Chinese population (Tian et al., 2016).[16] Nevertheless, variations in the number of roots ranging from one to four roots have been reported, as well as the number of root canals, ranging from one to four.[11,13] One of the clinically relevant

anatomic variations present in maxillary molars is root fusion.[14] The prevalence of fused rooted maxillary molars has been widely investigated and varies among different populations in which the percentage ranged from 5.9% to 52.9%.[14] Moreover, the presence of merged canals within root fusion is 10.6%–62.3%.[11,16,17]

Although there was no agreement on the definition and classification of "C-shaped" in maxillary molars, cases with a large semilunar root canal shape that may represent a complete or partial root canal merging between two or more root canals were usually described as C-shaped canals.[4,5,18-20] Whereas previous studies were only case reports, the study by Martins et al was the first on prevalence; also the first to propose a detailed classification, which was modified from Fan et al to fit maxillary molar cases.[17,21] A tooth is qualified as having a C-shaped root canal if it has the following features: fused roots, a longitudinal groove on the lingual or buccal surfaces of the root, and at least one cross-section of the canal that belongs to the C1, C2, or C3 configuration.[21]

C-shaped canals in maxillary molars represent a clinical challenge because canal configurations can be irregular and unpredictable. Despite these difficulties, limited knowledge is currently available regarding their prevalence in a Saudi Arabian population. We present successful endodontic treatment of two maxillary second molars with this uncommon anatomy.

Case Report 1:

A 34-year-old Saudi female was referred by her restorative dentist to the Endodontics residents' clinic, King Fahad National Guard Hospital for a root canal treatment of the left maxillary second molar (#27). The patient's medical history was noncontributory. Clinical examination of tooth #27 did not reveal tenderness with neither palpation or percussion. The tooth was not mobile and periodontal probing was within normal limits. A preoperative radiograph revealed radiolucency around the root apex (figure 1). From the clinical and radiographic findings, a diagnosis of previously initiated with asymptomatic apical periodontitis was made, and a nonsurgical root canal treatment was proposed and accepted.

The tooth was anesthetized with 1.8 ml 2% lidocaine containing 1:80,000 epinephrine. Temporary restoration was removed and access cavity was refined under rubber dam isolation. After completing the access opening, an anatomic variation could be seen on the pulp chamber floor. The internal anatomy was evaluated using a surgical operating microscope (Carl Zeiss AG) with the aid of DG-16 endodontic explorer. At this point, the approach was made as the tooth had 3 canals, a mesiobuccal, a distobuccal, and a palatal canal. Moreover, the diagnosis of a C-shaped maxillary second molar was made. Working length was determined using electronic apex locator (Root ZX; Morita) and confirmed with periapical radiographs. The cleaning and shaping were performed using ProTaperNext nickel-titanium rotary instruments with copious irrigation with 5.25% sodium hypochlorite (NaOCl) solution. The isthmus was cleaned using an ultrasonic tip. After completing the biomechanical instrumentation, the canals were dried and filled with calcium hydroxide paste. The access was sealed with cotton pellet, cavit, and Glass Ionomer (GIC) as a temporary restoration.

At the second appointment and under rubber dam isolation irrigation using 5.25% NaOCl was performed, coupled with ultrasonic activation. The canals were dried with paper points and obturation was performed using continuous wave compaction with Gutta percha (GP), SealApex sealer, and backfill with an Obtura II unit. A paper point was placed in the palatal canal for post-space, as the referring dentist requested. The access was restored with intermediate restorative material. The patient was then referred back to the restorative dentist to proceed with the permanent restoration.

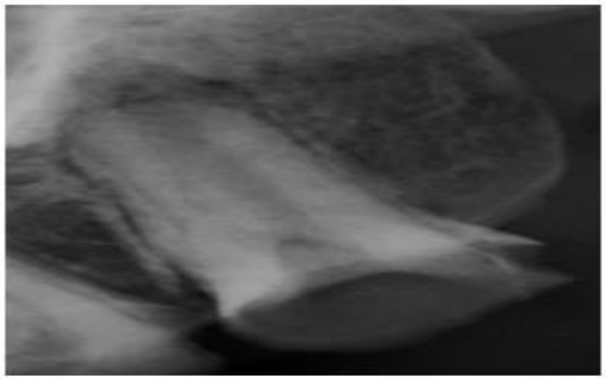

Figure 1: Pre-operative radiograph.

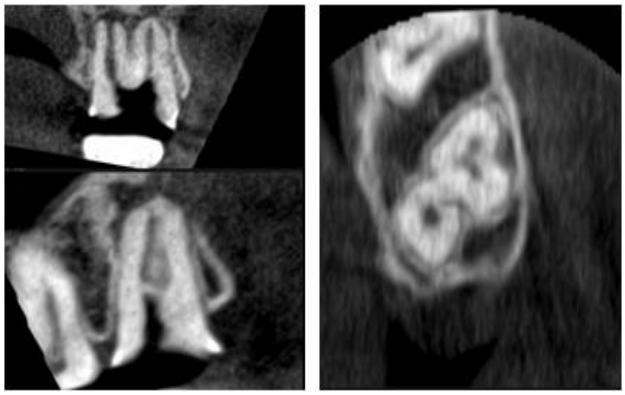

Figure 2: Sagittal and axial cone-beam computed tomography section: Maxillary right second molar with c-shaped configuration (Type B subtype 2).

Figure 3: Post-operative radiographs.

Case Report 2:

A 32-year-old Saudi female was referred by her restorative dentist to the Endodontics residents' clinic, King Fahad National Guard Hospital for a root canal treatment of the right maxillary second molar (#17). The patient's medical history was noncontributory. Clinical examination of tooth #17 did not reveal tenderness with neither palpation or percussion. The tooth was not mobile and periodontal probing was within normal limits. A preoperative radiograph revealed radiolucency around the root apex (Figure 1). From the clinical and radiographic findings, a diagnosis of previously initiated with asymptomatic apical periodontitis was made, and a nonsurgical root canal treatment was proposed and accepted.

The clinical procedures were similar to the previous presented case except for the obturation technique. In this case, after the canals were dried with paper points, Mineral Trioxide Aggregate (MTA) was placed in the apical 3mm of the root canals, obturation was performed using Hydraulic condensation of Gutta percha (GP) and Bioceramic sealer. The access was restored with intermediate restorative material temporary filling. The patient was then referred back to the restorative dentist to proceed with the permanent restoration.

Figure 1: Pre-operative radiograph and coronal and axial cone-beam computed tomography sections.

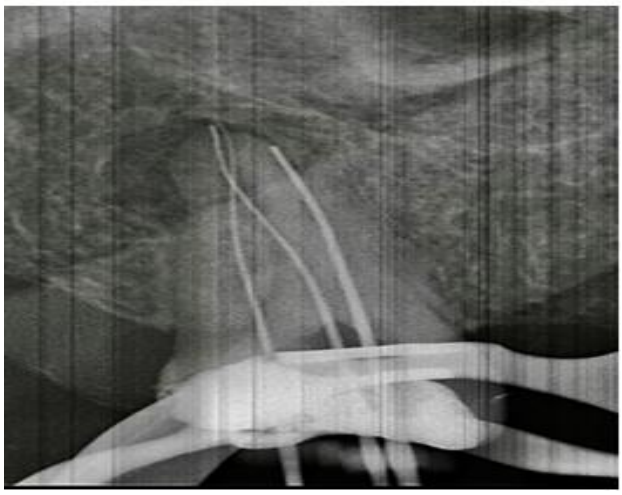

Figure 2: Working length determination.

Figure 3: Master cone radiograph.

Figure 4: Post-operative radiograph.

Figure 5: 4-month follow-up radiograph.

Discussion:

It has been established that the root with a single tapering canal and apical foramen is the exception rather than the rule (Abou-Rass et al. 1980).[22] Thus, knowledge of root canal morphology and its possible variations, particularly in multi-rooted teeth, is of utmost importance.[23-27] Moreover, recognition of unusual canal configurations facilitates cleaning, shaping, and obturation.[23-27] Back in 1925, Hess pointed out the complexity of the root canal system of maxillary molars.[28] Of particular interest is the canal configuration of the maxillary second molar as it has been known for having an intricate morphology.[28] Hence, prone to variations of its root canal system.[28] Since maxillary second molars usually have three roots with three or four root canals, a limited number of studies have demonstrated the existence of root canals with this configuration.[11] In fact, the most likely of permanent teeth to exhibit this morphological variation is the mandibular second molar.[10] Typically, the failure of Hertwig's epithelial sheath to develop or fuse in the furcation area during the developing stage of teeth results in this canal configuration, which leads to longitudinal communication between canals.[21] Additionally, Zhang et al studied and precisely defined a maxillary molar tooth to have fused roots when the ratio of the distance from the cementoenamel junction (CEJ) to the lower point of the root furcation or root fusion and from the CEJ to the apex of the root is not less than 70%.[29] In the present case, the fusion occurred between the mesiovestibular and distovestibular roots and extended to the apical third. Reported prevalence of root fusion in maxillary second molars is 42.25% in China, 25.2% in Portugal, 14% in Uganda, 10.71% in Korea, 6.7% in India, and 0% in Thailand and Burma.[17,29-34] Moreover, the prevalence of root fusion in women is 48.44%, which is significantly higher than that in men (31.91%).[12] Besides, the percentage of fused roots increased with age in both genders.[29] Such increase is likely due to age and sex-related cementum deposition, which have resulted in different forms and prevalences of root fusion.[29] The shape of the fused root classified into six categories by Yang et al. Based on the six types, Martins JN et al. added a new one—Type 7: Single conical shaped root.[9] Both cases would be classified as Type 2 according to CBCT.

One type of C-shaped configuration was reported in this article. The same precautions had to be made concerning the correct cleaning and shaping of the root canal system. The nature of such root canal configuration obliges instrumentation modification for a more effective removal of tissue from the C-shaped canal ramifications. In the reported cases, isthmus and grooves were cleaned with ultrasonic tips. Moreover, ultrasonic

activation of the irrigants was done to maximize disinfection of the root canals. Different root canal obturation techniques have also been used for a better approach to the characteristics of these anatomies.

Judicious utilization of dental operating microscopes (DOM) and CBCT significantly enhances the success of root canal treatment.[35] CBCT has emerged as a valuable tool for acquiring highly detailed information on morphology and exact topography of the root canal system.[35] It is important for the diagnosis, especially in teeth with complex root canal configuration.[35] In the present cases CBCT was used to identify the number of roots and root canals. Moreover, localization of root canal orifices was facilitated by the higher magnification and illumination of DOM.

Conclusion:

The variation of root canal system represents a challenge to both endodontic diagnosis and treatment. Although the prevalence of such variation is not common, yet the clinician should be aware of unusual root morphologies and their canal configurations. Moreover, effort should be made to locate and treat all canals to avoid incomplete root canal preparation and eventual failure of the endodontic therapy.

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