Root Canal Treatment of the Maxillary Second Molar with an Unusual Morphology: A Case Report

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CASE REPORT

Root Canal Treatment of the Maxillary Second Molar with an Unusual Morphology: A Case Report

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ABSTRACT

Four rooted maxillary second molar is a rare condition. A research of 1,200 maxillary second molars found only 0.4% of the sample with this condition. In a tooth with two palatal roots, one of them is the normal palatal root, while the other is a supernumerary structure which can be found mesiolingually (radix mesiolingualis) or distolingually (radix distolingualis). Objective: to describes a successful root canal treatment of a maxillary second molar with radix mesiolingualis. Final restoration using a short fiber-reinforced composite as the bottom structure under the onlay composite direct restoration. Case report: A 39-year old female patient complained of pain continuously for the past two weeks in her right maxillary second molar (tooth #17). Clinical examination revealed a deep mesio-occlusal caries lesion and presence of extra cusps on the palatal surface of the crown. Conclusion: Crown with extra cusps relatively larger compared to a normal crown. It could be indicated the additional palatal roots. Those variations could be identified by clinical and radiographic examination, while more accurate assessment with CBCT imaging. The right material was required to support function and strengthen the tooth after root canal treatment.

Key words: extra cusps, four roots, maxillary second molar, radix mesiolingualis

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INTRODUCTION

The success of root canal treatment depends on many factors, and its failure can be caused by an operator’s lack of knowledge and unclear anatomy of the complex teeth involved. The key to the success of this treatment is the complete debridement of the root canal system of an infected pulp tissue. This procedure prevents the persistence of infection and reinfection in the root canal space. However, the risk of a missing anatomy is enhanced due to the involution of the root canal system. All dentition may be found with extra roots or canals.

The maxillary second molars sometimes have different internal and external anatomic variations. They are usually found in three roots with three or four root canals. However, the maxillary second molar can have an accessory palatal, buccal, or mesial root. The fourth canal is commonly found in the mesiobuccal root. Variations in literature ranged to five roots and up to eight root canals. Root variations can be caused by exogenous and endogenous factors. The failure to separate the Hertwig epithelial sheath is one eventuality.

The maxillary second molar is found in the posterior position. Zygomatic arches may cause superimposition during radiographic examination. Hard to identify the presence of additional root canals. The clarity in the presence of additional roots helps avoid missing the untreated root canals, which can lead to complications and treatment failures. If separation in the coronal bulge is visible, the opening of a wider crown access can be modified. This article discusses a successful endodontic treatment on a unique maxillary second molar with additional radix mesiolingualis variation. This anatomical anomaly was identified through a clinical examination and with the help of a radiograph obtained via cone-beam computed tomography (CBCT) imaging and under an operating microscope (Zumax Medical Co., Ltd.). Accurate designs and restorative materials should be selected to increase the tooth strength after the root canal treatment.

CASE REPORT

A 39-year-old female was referred to the Department of Conservative Dentistry Universitas Gadjah Mada
Figure 1. (a) Intraoral examination found tooth #17 with the variation in crown morphology. This variation was found bilaterally on the left side of tooth #17. (b) Two additional palatal root cusps are located on the mesial side of tooth #17 (radix mesiolingualis). (c) Variation in the radix mesiolingualis happened bilaterally on tooth #27.

Figure 2. (a) Radiology imaging showed three main root canals, namely, mesiobuccal root, distobuccal root, distopalatal root, and another root canal in the additional mesiopalatal root cusps. (b) Three-dimensional imaging of tooth #17 showed two buccal roots and two palatal roots.

Figure 3. (a) The mesiobuccal root is 16.21 mm in length, lacerated to the distal, with the sinus maxillaris wall not visible. (b) The distobuccal root is 16.90 mm, lacerated to the buccal. (c) The distopalatal root is 17.68 mm in length, straight, approximation toward the sinus maxillaris. (d) The additional palatal root (mesiopalatal) is 17.44 mm in length, lacerated to the distal, and the periodontal ligament appeared to be widened.
Dental Hospital for the root canal treatment of her maxillary right second molar. The tooth had been pulsating in pain for 2 weeks, particularly when it was being used to chew food up to a point that the pain reached the head and interfered with her activities. The patient had to take medication to relieve the pain. Clinical examination revealed a deep mesio-occlusal caries lesion. Preoperative radiographs described the condition of carious lesions approaching the pulp with a widening periodontal ligament space. Variations in the crown morphology presented on tooth #17. Two well-developed lobulated cusps separated by a groove were also detected on the palatal surface. The variation in crown morphology was found bilaterally on the left side (Figure 1a). Both of the maxillary second molars are pictured as any second molars with four cusps (two buccal and two palatal) but with two extra cusps on the mesiopalatal side (Figures 1b and 1c).

The patient was advised to undergo a CBCT examination. The CBCT interpretation offers additional opportunities to evaluate the morphological characteristics of tooth #17. Radiography examination by using CBCT imaging showed the radiolucent area on the crown with a depth reaching the pulp. Three main roots were shown: mesiobuccal, distobuccal, and palatal. The additional palatal root on the mesial side of the palatal is shown in Figures 2a and 2b. The mesiobuccal root was 16.21 mm, lacerated to the distal with the maxillary sinus wall not visible (Figure 3a). The distobuccal root was 16.90 mm, lacerated to the buccal (Figure 3b). The distopalatal root was 17.68 mm, straight with an approximation to the maxillary sinus (Figure 3c). The mesiopalatal root was 17.44 mm, lacerated to the distal with a widened periodontal ligament (Figure 3d).

Pulp necrosis with symptomatic apical periodontitis was diagnosed on the basis of sensitivity tests and radiographic findings. The existing condition of the patient was explained, and the treatment plan procedure and endodontic treatment were initiated. The patient’s consent was given by signing the informed consent. A conventional and modified trapezoidal-shaped endodontic access cavity was prepared to gain access to both palatal canals. An orifice was explored using a Miller needle, and four root canals were found.

The procedure was continuously performed by removing the necrotic pulp tissue with 2.5% NaOCl and saline irrigation. The pulp chamber floor of tooth #17 revealed four canal openings corresponding to the two buccal and two palatal roots under an operating microscope (Zumax Medical Co., Ltd.). The pulp chamber floor was quadrangular with four separate ones located at each corner, but the orifices of the buccal roots are close to one another compared with the palatal roots (Figure 6). The working length of all the canals was determined with CBCT radiography and electronic apex locator (E Pex, Eighteeth). Exploration and negotiation were conducted using the K-file #8, #10, and #15 with a watch winding motion.

The K-file was inserted up to 2/3 of the working length of each working length. The root canals were biomechanically prepared using Protaper Gold (Dentsply) rotary NiTi files. Mesiobuccal, distobuccal, and mesiopalatal canals were prepared up to F2 with 16 mm working length, and the distopalatal was prepared up to F3 with 16 mm working length. The canals were irrigated with 2 ml of 2.5% sodium hypochlorite solution and saline between subsequent files during instrumentation. The smear layer was removed before the intracanal dressing was applied using 17% EDTA (Smear Clear, Sybron Endo) for 1 min, irrigated with 2.5% sodium hypochlorite for 1 min, and disinfected with 2% chlorhexidine digluconate (Cavity Cleanser, Bisco). Root canals were dried with multiple paper points, dressed with calcium hydroxide, and closed with a temporary filling (Caviton, GC). The patient was asked to visit after 1 week.

On the second appointment 1 week later, the tooth was asymptomatic. Treatment was continued with obturation. All the root canals were cleaned using the previous files as indicated by the working length before. The smear layer was removed before obturation by using 17% EDTA (Smear Clear, Sybron Endo) for 1 min and then irrigated with 2.5% sodium hypochlorite for 1 min. Root canals were dried with multiple paper points and obturated by the cold lateral condensation technique with a gutta-percha cone and a resin sealer (Top Seal, Dentsply). Gutta percha was sterilized using 2.5% NaOCl and washed with alcohol. Gutta percha was fitted on root canals based on the working length. Gutta percha F2 was fitted on the mesiobuccal, distobuccal, and mesiopalatal root canals, while gutta percha F3 was fitted on the distopalatal root canal (Figure 4c). Gutta percha was cut 2 mm under the orifice with a heated plugger (Heat Carrier Plugger, Dentsply) and lightly condensed. Then, the resin-modified glass ionomer cement base material was applied before covered with a temporary filling (Caviton, GC; Figure 4d). The patient was asked to have a follow-up visit after 1 week.

The plan was to conduct direct composite resin onlay preparation design restoration with fiber reinforced on the third visit. The walls were prepared and the floor of the cavity was leveled. The occlusal reduction followed the buccal and palatal cusp sides of up to 2 mm. A short bevel was made on the cavosurface margin by using the diamond tapered micropreparation bur forming a 45° toward the cavity. A counter bevel was then made on the cavosurface margin by using a diamond flame micropreparation bur with an angle of 45° toward the outer surface of the tooth. The surface of the cavity was cleaned, and a sectional matrix (Palodent V3, Dentsply) was placed on the mesial side. The prepared
Figure 4. (a) Preoperative radiograph of tooth #17; (b) working length radiograph of tooth #17; (c) radiograph of tooth #17 master cone with gutta percha sized F2 in the mesiobuccal root, the distobuccal, and the mesiopalatal root canal, whereas gutta percha sized F3 was utilized in the distopalatal root canal; and (d) radiograph figure after four root canals were obturated.

Figure 5. Axial section of the cone-beam computed tomography (CBCT) scan images of tooth #16 (a-e). (a) Two cups on the palatal surface forming the enamel overgrowth; (b) the floor of the pulp chamber is quadrangular; (c) two buccal and two palatal roots at the cervical third and the distance between the palatal root canal orifice and the buccal root canal orifices; (d) two buccal and two palatal roots at the middle; and (e) the apical third level.

Figure 6. (a) Root canal preparation along the working length identical to the last file (F2) on the the mesiobuccal and distobuccal root canal. Both of the root’s orifices are very close; (b) result of the root canal preparation along the working length identical to the last file (F2) on the mesiopalatal root canal; and (c) result of the root canal preparation along the working length identical to the last file (F3) on the distopalatal root canal. The palatal root canal has the biggest diameter with a cross section of curved triangle at the coronal area and rounded at the apical area. (d) Obturation results in the four root canals with dental microscopy enlargement (Zumax Medical Co., Ltd.).

cavity was bonded using the universal bonding (Tetric n Bond Universal, Ivoclar) and cured with a light-curing unit for 20 s. A colored packable composite resin A3 (FiltekTM P60, 3M Espe, USA) was applied to the mesial wall to form a class I cavity. A flowable composite (G-aenial Universal Flo, GC) was then applied at the floor of the cavity to fill the detailed area. The condensed fiber-reinforced composite resin (Ever-X, GC) was used to fill half into the cavity and then cured with the light-curing unit for 20 s (Figure
The colored packable composite resin A3 (*Filtek*™ *P60, 3M Espe, USA*) was applied with an incremental technique for each cusp and cured for 20 s. The composite resin was finished with a fine finishing round bur and polished with polishing disks (*Sof-Lex, 3M ESPE*) and a twister diamond polisher (Figure 8).

**DISCUSSION**

In general, dental anomalies can be divided into two groups: anomalies and anomalies obtained during development. Environmental and genetic factors likely contribute to their etiology. Five groups are categorized as anomalies: the number of teeth, size abnormalities, morphological abnormalities, tooth structure, and position. Other morphological anomaly categories include dens evaginatus and dens invaginatus, concrescence, fusion, gemination (double tooth), taurodontism, dilaceration, and supernumerary roots. The phase “supernumerary teeth” is used when additional roots are found compared with the normal anatomy of a tooth. This condition can happen to all dentitions. The most common events experienced by the maxillary and mandibular permanent molars and premolar teeth. Supernumerary roots look different and can be easily identified through a radiographic examination. Additional roots usually appear small, or they overlap with other roots, so they are difficult to identify. Identification is mandatory to diagnose before extraction or root canal therapy.

A rare anomalous event is the occurrence of double palatal roots. Only 16 maxillary molars were found with 14 maxillary second molars and 2 maxillary first molars with two palatal roots during the clinical practice of Christie et al. They tried to classify the incidence of double palatal roots by evaluating 16 arched teeth and 6 extracted teeth. Table 1 explains the classification of the three radicular configurations based on the shape and degree of separation of the palatal roots.
Table 1. Classification of maxillary molars with two palatal roots based on the separation level and divergence of the roots.7

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Maxillary molars with two widely divergent palatal roots that are often long and tortuous. Their buccal roots are often cow-horn shaped and less divergent. Four separate root apices are seen on the radiograph.</td>
</tr>
<tr>
<td>Type II</td>
<td>Maxillary molar with four separate roots, but the roots are often shorter, run parallel, have buccal and palatal root morphology, and have blunt root apices. A radiograph with a buccolingual superimposition may make this type of maxillary molar appear as having only a mesial and distal root.</td>
</tr>
<tr>
<td>Type III</td>
<td>Maxillary molar with four roots, but it is constricted in root morphology with the mesiobuccal, mesiopalatal, and distopalatal canal encaged in a web of root dentin. The distrubuccal root in these cases appears to stand alone and may even diverge to the distobuccal.</td>
</tr>
<tr>
<td>Type IV</td>
<td>Maxillary molar with four roots, but the accessory palatal root is fused with the mesiobuccal root up to the apical level.</td>
</tr>
</tbody>
</table>

Carlsen and Alexandersen (School of Dentistry in Copenhagen) provided another classification in which they observed 145 permanent maxillary molars with two palatal roots. Their classification is based on root affinity with very prominent aspects: mesiopalatal, distopalatal, or mesiopalatal and distopalatal of the crown and separate, not separate, and separate or not separate depending on the relationship of the root component (Table 2).7 The tooth described in this report is a case of radix mesiolingualis separate/nonseparate type according to the classification of Carlsen and Alexandersen and type I according to the classification of Christie et al. (Figures 1 and 2b).

Two palatal roots can occur bilaterally on both sides of the maxillary and appear asymmetrical on one side. The prevalence of additional palatal roots is not influenced by gender or topology.7 In our case, the contralateral tooth had an abnormal anatomy with two palatal roots and two palatal canals (Figure 1c).

The presence of the extra palatal roots is sometimes marked by cusps or extra cusps on the buccal or lingual surfaces of the molar crown; consequently, the crown appears relatively larger than normal. The number of cusps is not always associated with an increase in the number of roots, but an increase in the number of cusps and the number of root canals is linked to the number of additional roots (Figure 5a). The presence of a distinct and prominent mesiopalatal or distopalatal bulge being aware of the presence of extra palatal roots.8 A similar observation was made in the case reported here, considering that two prominent extra cusps were visible on the mesiopalatal (Figure 1).

Anatomic variations can be detected with the help of radiography, especially with CBCT imaging. Preoperative radiographs that show unclear root lines, root canals with sharp densities, and poorly drawn apices are suspected additional roots. With CBCT, various fields, including sagittal, coronal, axial, oblique, and curved fields, can be created. In this case, the results of CBCT scan images help confirm the addition of two palatal roots and provide important information about the morphological characteristics of the crown and roots (Figures 2 and 5).

The presence of two palatal roots can be drawn with a pulp chamber floor pattern. In type I, where two very different palatal roots are present, a rectangular pulp chamber is depicted with one canal hole located at each corner (Figure 5b). The mesial and distal palatal roots are present more peripherally than the buccal root orbitals. In the case reported here, the distances between the holes in the palatal canals and between the buccal canals were 7.88 and 2.48 mm, respectively (Figure 5c). The palatal wall of the access cavity should be extended further toward the mesiodistal to find and gain access to the canal opening (Figure 6d). The presence of additional roots is important in planning a root canal treatment to avoid the lost root canal as a cause of complications and failure of treatment.3

Teeth with deep and wide cavities, such as restorations in class II, are at a high risk of fracture events because the extent of the missing tooth structure decreases the fracture’s strength and endurance. Composite resins are most common although they have a shrinkage weakness during polymerization, thereby forming

Table 2. Classification of maxillary molars with two palatal roots based on the affinity of the palatal root to the very pronounced mesiopalatal and distopalatal parts of the maxillary molar crown and degree of separation.7

| Radix mesiolingualis | Refers to the mesiopalatal root that has direct affinity to the very pronounced mesiopalatal part of the maxillary molar crown. They can be separate, nonseparate, or separate/nonseparate. |
| Radix distolingualis | Refers to the distopalatal root that has direct affinity to the very pronounced distopalatal parts of the maxillary molar crown. They can be separate, nonseparate, or separate/nonseparated. |
| Radix mesiolingualis/distolingualis | Refers to the mesiopalatal and distopalatal roots that have direct affinity to the very pronounced mesiopalatal and distopalatal parts of the maxillary molar crown, respectively. They can be separate, nonseparate, or separate/nonseparate. |
cracks that cause secondary caries, which results in the weakening of the restoration and easier fractures. After years of follow-up of indirectly or directly made posterior composite restorations, no significant difference between the two techniques of restoration fracture is found, thus leading to restoration failure. In this case, with an anomaly on the crown morphology, the restoration treatment involved a direct composite with an onlay design preparation added with short fiber-reinforced composite resin (Figure 6).

The teeth used in high-stress-bearing areas of the dental art can be strengthened using onlay composite restorations reinforced with short fiber composite resin. A substantial increase in pressure on the load-bearing capacity combined material recorded in the data. A high fracture resistance in the composite resin with a fiber material occurs because of the transfer of stress from the matrix to the fiber. This condition is due to the presence of a bulk short fiber composite substructure based on surface particulate filler supporting layer and functioning as a cracking stop layer. Other supports also depend on the length and diameters of fibers. A randomly oriented filler fiber is absorbed partly during polymerization from polymerization losses and increases the capacity to reduce the pressure of the matrix. This condition can increase material adaptation and reduce marginal microleakage, which results in a higher fracture resistance.

Short fiber-reinforced composite materials exhibit unique fibers and polymer varieties in their composition and enhance various mechanical and physical properties. Biomimetic restoration techniques with short fiber-reinforced composite as a composite substructure with a particulate filler are alternatives to recommended direct restorations and can be used reliably for the restoration of the coronal tooth with a large cavity at the high pressure-bearing area. Correct materials must be utilized to achieve the benefits and durability.

CONCLUSION

The prognosis of radix mesiolingual was expected to be favorable. The failure to localize and treat all of the canals of root canal systems is considered one of the major causes of the failures of root canal treatments. Understanding the diversity, accurate interpretation of angular radiographs, and precise access preparation is important in identifying and managing a successful endodontic treatment of teeth with anatomical anomalies. The right design and materials of final restoration materials also need the strengthening of a tooth after a root canal treatment.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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