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Case Report

Maxillary second molar with four roots and five canals

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Abstract In this case report, we present a maxillary second molar variant, which had two palatal roots with two canals and two buccal roots with three canals, including a second mesiobuccal canal. A 44-year-old female patient complained about a tooth crown fracture and severe pain in her right maxillary second molar. A clinical intraoral inspection and radiography were carried out on the tooth, and a diagnosis of chronic apical periodontitis was made. Four roots (two buccal and two palatal) and five canals (three buccal and two palatal) were found. The anatomical variation of the tooth was further confirmed by cone-beam computed tomography, a cone-fit procedure, and a radiograph with a shifted projection angle. Root-canal treatment was performed under an endodontic microscope.

Introduction

In endodontic therapy, a comprehensive awareness of the root-canal anatomy is of great importance, and clinicians' failure to recognize an unusual canal morphology may lead to unsuccessful treatment. Although variations in the maxillary second molar may occur, it generally has three roots and three canals, while a second mesiobuccal canal (MB2) is found in 56.9–79.6% of cases.[1] However, rare

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variations other than one or two roots can also be found in the maxillary second molar.

The present case report describes the diagnosis and treatment of such a case. This tooth had two palatal roots with two canals, and two buccal roots with three canals, including an MB2. This case report indicates the possible complexity of maxillary second molar variations, and is intended to reinforce clinicians' knowledge of the rare morphology of root canals.

Case report

A 44-year-old female patient was referred to our department by a local dentist. There was something wrong with her maxillary right second molar. She complained of tooth crown fracture and severe pain when chewing relatively hard food. The local dentist had opened the pulp chamber, provided medication, and asked her to go to our hospital because of the complexity of the tooth canal system.

A detailed examination was done after taking a preoperative radiograph. The patient's medical history was noncontributory. The distal part of the crown, including the distobuccal cuspid, of her right maxillary second molar was defective. The tooth was not sensitive to a cold test, but was tender to percussion and palpation. The periodontal condition was good, and no periodontal pocket or tooth mobility was detected. A radiographic examination disclosed a possible unusual anatomical configuration, showing that two buccal roots were respectively superimposed on two palatal roots; a periapical lesion with low density around the distopalatal root was also found (Fig. 1).

To ascertain the unusual anatomical configuration preoperatively, cone-beam computed tomography (CBCT; Galileos, Sirona Dental Systems, Bensheim, Germany) of the maxillary arch was performed. CBCT scans were made with an exposure volume of 15 cm × 15 cm × 15 cm at a 0.3/0.5-mm three-dimensional (3D) resolution of isotropic voxel size, and with the unit operated at 85 kV and 5/7 mA. The scanned information was saved as DICOM files, and the files were introduced to Galileos Implant 1.7 software (SICAT, Bonn, Germany) for analysis and 3D reconstruction. The images confirmed that the palatal roots of the tooth were completely separated (Figs. 2–4). This unusual anatomical configuration was confirmed by a radiograph taken with a varied horizontal projection angle during the operation (Fig. 5).

A diagnosis of chronic apical periodontitis was determined for Tooth 17, and root-canal treatment was recommended. The original opening access was modified so that the pulp chamber could clearly be exposed. The chamber floor was examined with an endodontic explorer DG-16 (Dentsply Maillefer, Ballaigues, Switzerland) under an endodontic microscope (Carl Zeiss, Oberkochen, Germany). Five root-canal orifices were revealed: three buccal and two palatal. The orifice of MB2 was at the palatal side of that of the first mesiobuccal canal (MB1), and an unusual second palatal canal was found located at the palatal side of MB2, which was subsequently referred to as mesiopalatal.

All canals were easily negotiated, and after determining the working length of each canal using an electronic apex locator Root ZX (J. Morita, Kyoto, Japan) and X-ray, the root canals were cleaned and shaped by manual instrumentation using Protaper NiTi rotary instruments (Dentsply Maillefer), with copious irrigation with a 2.5% sodium hypochlorite solution and 17% EDTA. The canals were enlarged to a master file size of F2 or F3 (Fig. 6), and intracanal medication was given using calcium hydroxide/distilled water paste. At the second appointment 1 week later, the tooth was asymptomatic, so the root canal space was obturated using cold lateral compaction, with gutta percha and a sealer called Cortisomol (Pierre Rolland, Merignac Cedex, France) (Fig. 7), and the access cavity was provisionally sealed with glass ionomer.

Figure 1 Preoperative radiograph of the right maxillary second molar.

Figure 2 Three-dimensional reconstruction of the maxillary arch (lateral view).

Figure 3 Three-dimensional reconstruction of the maxillary arch (upper view).

Three months after obturation, the right maxillary second molar was asymptomatic, and the volume of the periapical lesion had decreased; therefore, a fiber post was fixed into the distopalatal root canal, and the defect and the access cavity were restored with composite resin (Fig. 8). The patient was then advised to restore the tooth permanently with a crown.

A radiograph was taken with a shifted horizontal projection angle at the 32-month recall, in which no obvious periapical lesion was found, and the obturation in the coronal two-thirds of the mesiobuccal root had an abnormally large diameter (Fig. 9).

Discussion

Generally, maxillary second molars have three roots: a palatal and two buccal. However, sometimes fusion of two or three roots may occur, leading to one- or two-rooted maxillary molars. The incidences of such variations seem to be partly related to racial differences, because different results have been reported for different populations. Peikoff et al reported that the incidence of one- and two-rooted (a palatal and a buccal) maxillary second molars was 3.1% and 6.9%, respectively,[1] while Rwenyonyi et al found that the mesiobuccal root was fused with the palatal root in 6.3% of specimens and with the distobuccal root in 6.8% of teeth in a Ugandan population.[2] Maxillary second molars with two palatal roots are rarely seen; as Libfield et al reported, the incidence of this variation was 0.4%.[3] Peikoff et al studied the prevalence of variations in maxillary second molars, and found that the percentage of variation with two palatal roots was only 1.4%, when they investigated 520 teeth radiographically.[1]

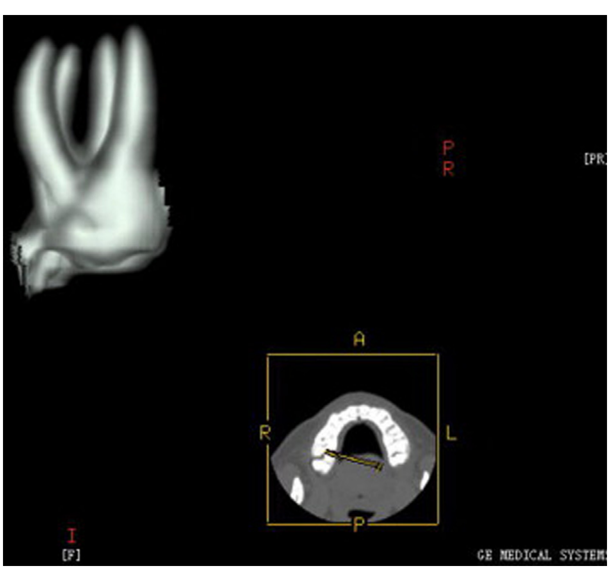

Figure 4 Three-dimensional reconstruction of Tooth 17.

Figure 5 Four roots confirmed by varying the horizontal projection angle during the operation.

It has been reported that MB2 occurs at a high incidence in maxillary first molars. More than half of the surveyed maxillary first molars had MB2,[4–6] while its incidence in maxillary second molars is relatively low, usually <50%.[1,5–7]

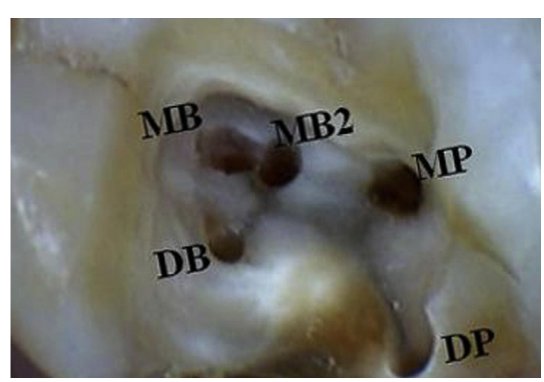

Figure 6 Five canal orifices after manual instrumentation.

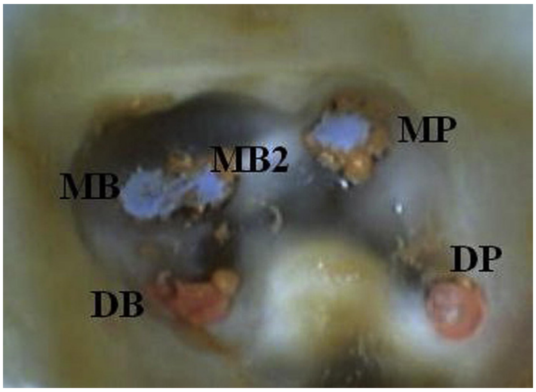

Figure 7 Five canal orifices after canal obturation.

Figure 9 Radiograph taken at the 32-month recall after canal obturation.

To date, few studies have reported on maxillary second molars with both double palatal roots and an MB2. In the present case report, we found a right maxillary second molar with two palatal roots and an MB2 classified as type II, that is, two canals merging short of the apex into a single canal at the apex. This unusual morphology was confirmed by the cone-fit procedure, in which the master cone for MB2 could not reach its full length if the one for MB1 was placed to its full working length. There was also evidence of the type II MB2 on the 32-month recall radiograph, in which a shifted horizontal projection angle indicated an abnormally large-diameter obturation in the coronal two-thirds of the mesiobuccal root of Tooth 17.

Anatomical variations can be found in all teeth, so understanding root-canal morphology is one of the most important steps in the success of endodontic therapy. Practitioners should use any possible methods to locate and treat the entire root canal system, especially when facing maxillary molars in which many kinds of aberrations may occur. Radiographs play important roles in detecting anatomical variations,[8] but they have disadvantages in that overlap sometimes may occur between the buccal and palatal roots. Under such circumstances, an additional shifted radiograph may be useful in any attempt to determine anatomical variations in posterior teeth preoperatively (Fig. 1). If an additional shifted radiograph does not work, CBCT can be an objective analytical tool to ascertain the root-canal morphology.[9–13] In recent years, the introduction of CBCT systems has greatly facilitated the imaging of hard tissues of the maxillofacial region.[14] They have short scanning times (10—70 seconds); the radiation dosage is reportedly up to 15 times lower than that of conventional CT scans; and the profile of the teeth can also be simulated by 3D reconstruction. In this case report, 3D reconstruction of the right maxillary second molar confirmed that the tooth had four roots. However, when CBCT is not available, a traditional radiograph with a shifted projection angle can still play an important role. Besides the aforementioned methods, during the operation, careful inspection of the pulp chamber floor is of great importance, so we routinely use endodontic microscopy to explore canal orifices during root-canal therapy.

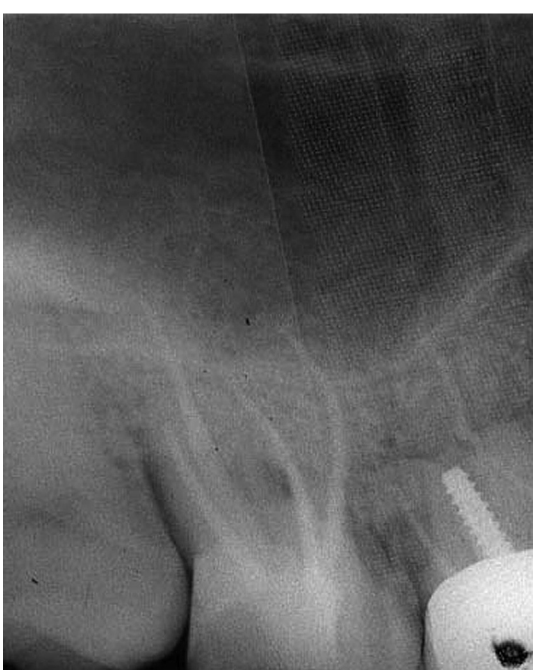

Figure 8 Radiograph taken at 3 months after canal obturation.

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