Root canal treatment of maxillary second premolar with three roots and three canals: clinical cases

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Abstract
An accurate diagnosis of the anatomy of the root canal system is a prerequisite for successful root canal treatment. According to the endodontic literature, maxillary second premolars usually have one root and one canal. The possibility of three roots and three canals in maxillary second premolars is quite small. Diagnostic means such as preoperative radiographs and examination of the pulp chamber floor aid the location of root canal orifices. The aim of this clinical article is to describe the unusual anatomy that was detected in two maxillary second premolars during routine endodontic treatment.

Key Words:
anatomical variations, endodontic treatment, maxillary second premolar

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Introduction

A thorough knowledge of the anatomy of root canal systems is required to achieve successful root canal treatment. However, in everyday endodontic practice, clinicians have to treat teeth with atypical configurations. Extra roots or root canals if not detected are a major reason for failure[1].

The maxillary second premolar usually has one root and one canal in 75% of cases, and one root and two canals in 25% of cases[2]. Studies[2-7] have demonstrated a lower incidence of three root canals between 0.3 and 2%. Bellizzi and Hartwell[7] found only 1.1% of teeth with three canals in 630 maxillary premolars, and did not report any with three roots. Velmurugan et al.[6] have reported that out of 220 maxillary second premolar teeth that were endodontically treated, only three of these had three roots and three canals. In additionally, there are several case reports of maxillary second premolar with three canals and three independent roots[6,8-10].

The following case reports describe the root canal treatment of two patients with three-rooted and three-canalled maxillary second premolars.

Clinical Case 1

A 23-year old male patient with a noncontributory medical history was referred by his general dental practitioner for root canal treatment of his maxillary left second premolar. The pulp of the tooth had become irreversibly inflamed, and the general practitioner performed root canal treatment, but could only locate and fill one of the three root canals (Fig. 1). Clinical examination at presentation revealed an amalgam restoration in the maxillary left second premolar. The tooth was still symptomatic and tender to percussion, but there was no mobility. No swelling or fistula was present. The oral hygiene was good. Besides, maxillary left first premolar was missing. A periapical radiograph (Fig. 1) showed a failed root canal treatment in maxillary left second premolar. There was no evidence of periapical radiolucency. Based on these findings, we decided to perform root canal retreatment of maxillary left second premolar.

At the same appointment, root canal treatment was initiated on maxillary left second premolar. The tooth was anaesthetized, isolated with rubber dam and the amalgam restoration removed. The access cavity was prepared to a triangular outline and with the aid of an operating microscope (OPMI Pico Dental Microscope, Zeiss, Oberkochen, Germany), three separate root canal orifices were found on the same level of the pulp chamber floor: one mesiobuccal, one distobuccal and one palatal. Poorly condensed gutta-percha filling in the previously treated palatal canal was removed with files. Pulp tissue (mesiobuccal and distobuccal canal) was extirpated and the working length was estimated as being 1 mm short of the radiographic apex (Fig. 2). The canals were instrumented in a crown down method using rotary System GT (Dentsply Maillefer, Ballaigues, Switzerland) nickel-titanium instruments with a Tri Auto ZX (Morita, Kyoto, Japan) endodontic handpiece at low speed (300 rpm). During the instrumentation, the canals were irrigated copiously with 3 mL of 2.5% sodium hypochlorite solution (NaOCl) using a 27-gauge endodontic needle after the use of each instrument. Following the instrumentation, the canals were irrigated with 3 mL of 15% EDTA (Pulpdent, Water-town, USA) solution for 30 s to remove smear layer. Final canal irrigation was accomplished with 5 mL of 2.5% NaOCl solution.

After cleaning and shaping, the canals were dried with sterile paper points, dressed with calcium hydroxide paste (Pulpdent, Watertown, MA, USA) and coronally sealed with a temporary filling material (Cavit, Espe, Seefeld, Germany). Two weeks later, the canals were irrigated with NaOCl solution, dried and obturated with gutta percha (Sure-Endo, Seoul, Korea) and AH 26 (Dentsply/DeTrey, Konstanz, Germany) root canal sealer using a lateral condensation technique. A periapical

Fig. 1 - *Preoperative diagnostic radiogarph of the maxillary left second premolar.*

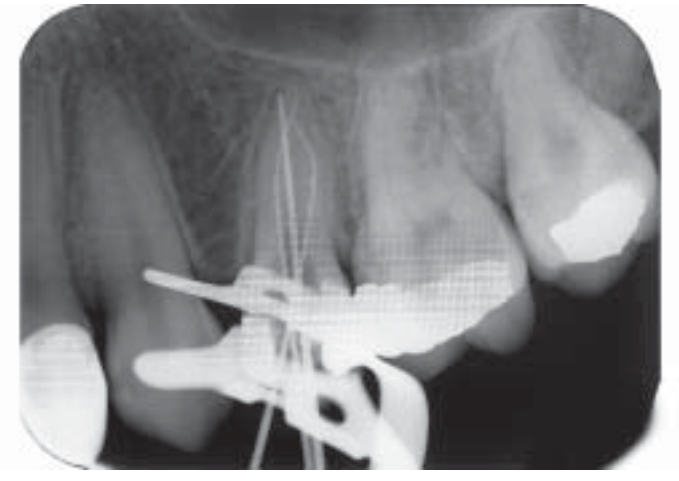

Fig. 2 - *Working-length determination radiograph with three endodontic instruments.*

Fig. 3 - *Radiograph of the obturated canal system.*

radiograph was taken to access the quality of obturation (Fig. 3). One week later, the tooth was free of symptoms.

Clinical Case 2

A 20-year-old female was referred for root canal treatment in her maxillary right second premolar. The past medical history of the patient was noncontributory. Clinically, the pulp was exposed by a carious lesion in maxillary right second premolar. The tooth was tender to percussion with probing and exhibited normal mobility. Electronic pulp testing (Electric pulp tester, Parkell, Farmingdale, NY, USA) and cold application (ice stick) were positive for the tooth. A preoperative periapical radiograph (Fig. 4) confirmed the presence of a profound carious lesion on the distal surface of the tooth. The periapical region appeared radiographically normal. Based on these findings, the patient was diagnosed as having a irreversible pulp damage of the maxillary right second premolar.

At the same appointment, root canal treatment was initiated on maxillary right second premolar. The tooth anaesthetized and isolated with rubber dam. The access cavity was prepared to a triangular outline and with the aid of an operating microscope (OPMI Pico Dental Microscope, Zeiss, Oberkochen, Germany), three separate root canal orifices were found on the same level of the pulp chamber floor: one mesiobuccal, one distobuccal and one palatal. Pulp tissue was extirpated and the working length was estimated as being 1 mm short of the radiographic apex (Fig. 5). The canals were instrumented with size 15-30 K-files using a step-back technique. During the instrumentation, the canals were irrigated copiously with 2.5% NaOCl and 15% EDTA solutions.

After cleaning and shaping, the canals were dried with sterile paper points and obturated with gutta percha (Sure-Endo, Seoul, Korea) and AH 26 (Dentsply/DeTrey, Konstanz, Germany) root canal sealer using a lateral condensation technique. A periapical radiograph was taken to access the quality of obturation (Fig. 6). Two weeks later, the tooth was free of symptoms.

Fig. 5 - *Working-length determination radiograph with three endodontic instruments.*

Fig. 4 - *Preoperative diagnostic radiogarph of the maxillary right second premolar.*

Fig. 6 - *Radiograph of the obturated canal system.*

Discussion

The possible anatomical variations of maxillary premolars are well documented in the literature, except for the small incidence of maxillary premolars with three roots and canals. Usually, these premolars can be treated successfully using a non-surgical endodontic approach. Whenever there is an indication of different anatomy, additional periapical X-rays should be exposed at a mesial or distal horizontal angle. This should be followed by detailed examination of the radiographs.

The access cavity for maxillary second premolars is usually oval in the bucco-palatal direction. In these cases, the access cavity was modified. The crowns of all these teeth were broader mesio-distally. The access cavities were slightly widened in the mesio-distal direction to uncover the second buccal canal[11]. The completed access cavity preparation was triangular in outline, resembling the access cavity for a maxillary first molar, but smaller in size[6].

The root canal system of premolars with the three root canals is characterized by one large palatal or lingual canal and two smaller canals in the mesiobuccal and the distobuccal root. If only one eccentric orifice can be found, at least one more canal is present and should be searched for on the opposite side[12]. Means of magnification (ocular loops, microscope) and additional lighting (fibre optic illumination) are recommended. A third canal should be suspected clinically when the pulp chamber does not appear to be aligned in its expected buccal-palatal relationship. Additionally, lines on the floor of the pulp chamber connecting the root canal orifices give some clues about locating the root canals.

Root canal treatment is based primarily on the removal of microbial infection from the complex root canal system. NaOCl has been shown to be an effective antimicrobial irrigant for root canal treatment[13-14]. Alternating its use with EDTA, a chelating agent has been suggested to synergistically enhance the overall antimicrobial effect[14-15]. Abbott et al.[15] showed that alternate use of NaOCl and EDTA as root canal irrigation is effective in removing both organic and inorganic necrotic remnants from the root canal. The smear layer is completely removed from the canal walls, leaving the dentinal tubules open. Subsequently, this may facilitate the diffusion of antimicrobial agents[16], resulting in a more effective disinfection of the root canal system.

Clinicians should be aware of unusual root canal anatomy in maxillary premolars. Besides, the use of magnification and additional lighting are recommended for the clinical examination of the pulpal floor.

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