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Root canal treatment of a maxillary first premolar with three root canals – a case report*

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ABSTRACT

Introduction: The basis of endodontic therapy comprises the identification, proper preparation and filling of root canals. Particular attention should be paid when treating teeth with an atypical anatomy, i.e., with more canals than the average for a given tooth group. For example, the first premolars of the maxilla are typically two-canal teeth, but three-canal forms can also be observed.

The aim of the study is to describe a case of root canal treatment of tooth 14 with 3 canals and the use of volumetric imaging at the diagnostic stage.

Materials and methods: Root canal treatment of tooth 14 with 3 root canals was performed. Therapy was preceded with a tomographic scan, which revealed the presence of 3 canals. The canals were prepared and filled using the magnification of the operating microscope.

Results: Controls taken immediately after treatment and 8 years later showed correct root canal filling and no pathological symptoms.

Conclusions: The knowledge of the atypical anatomy of the teeth and the possibility of implementing modern diagnostic and therapeutic methods significantly contributes to the success of the treatment.

Keywords: canal configuration; cone-beam computed tomography; endodontics; maxillary premolars; root morphology.

INTRODUCTION

The success of endodontic treatment largely depends on a thorough knowledge of the complex anatomy of the teeth, including knowledge of possible anomalies or less common configurations of the root canal system [1]. One of the most anatomically-diverse tooth groups are the upper first premolars, which can contain all possible types of canals according to the Vertucci classification [2, 3]. The most commonly found form includes 2 canals, but single-root and single-canal forms are also observed [4, 5]. The maxillary three-canal premolars are exceptionally recognized. If an atypical, less common tooth anatomy is suspected, tomographic scans can be performed, which show the internal morphology of the teeth in a much more accurate way than radiographs. Currently, the most common imaging method in dentistry is cone beam computed tomography (CBCT), also known as volumetric imaging [6, 7].

The aim of the study is to describe a case of root canal treatment of tooth 14 with 3 root canals of atypical anatomy with the use of volumetric imaging at the diagnostic stage.

MATERIALS AND METHODS

A case report

The patient (36 year old male, Caucasian) was referred for specialized endodontic treatment of tooth 14. The dental practitioner suspected a complicated anatomy of tooth 14 (with diagnosed pulp necrosis and the need for root canal treatment) and referred the patient for a CBCT examination. Having analyzed the tomogram, the dentist found that the configuration of the canals in this tooth was so difficult that he would not be able to undertake the treatment of this case and referred the patient to the Endodontic Clinic for specialist treatment with the use of a surgical microscope. A physical examination performed in a specialist endodontic office confirmed that tooth 14 did not react to ethyl chloride, and no discomfort/pain was reported on tapping parallel and perpendicular to the crown. The relevant lymph nodes were not enlarged or tender to the touch.

Based on the analysis of CBCT scans, it was found that tooth 14 had 3 canals: 1 palatal and 2 buccal canals (Fig. 1, 2, 3). There was a single canal in the palatal root having 1 orifice and 1 foramen. In the buccal root: there was 1 canal in the coronal part of the root, which then split into 2 canals – mesiobuccal canal (MB) and distobuccal canal (DB). It was a root canal which had 1 orifice and 1 canal initially but then bifurcated into 2 independent canals with apical foramina (Fig. 1, 2, 3). After obtaining the patient's written consent, a rubber dam was placed and endodontic access was prepared. The working lengths were then determined and the chemo-mechanical preparation of the canals was commenced. The step-back method was performed using hand files, to the following sizes: MB – initial apical file (IAF) #10, master apical file (MAF) #35, finale file (FF) #50; DB –

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IAF #8, MAF #30, FF #50; palatal canal – IAF #15, MAF #40, FF #55. During the preparation, 2 mL of 2% sodium hypochlorite was used for each instrument. For the final rinsing, 2% sodium hypochlorite and 15% ethylenediaminetetraacetic acid were used; these were enriched with the activation of rinsing agents with ultrasound. After drying the canal and selecting the main guta-percha cones, the canals were filled with cold lateral condensation of gutta-percha with an epoxy resin sealer (AH Plus®, Dentsply). All treatment steps were performed under the magnification of the operating microscope (PICO®, Seliga Microscopes). After the treatment was completed, a control X-ray was taken, which showed homogeneous filling of the canals (Fig. 4). The tooth was provided with a temporary filling and the patient was referred to his dentist for the final filling of the cavity. A control visit 8 years after the end of treatment revealed no pathological symptoms (Fig. 5).

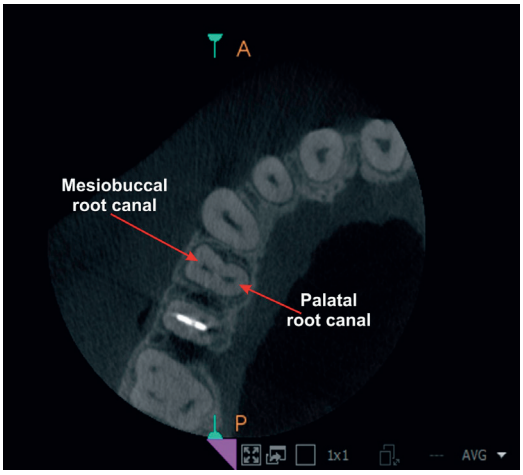

FIGURE 1. Cone beam computed tomography scanning in the horizontal plane of the coronal third of the root-tooth 14

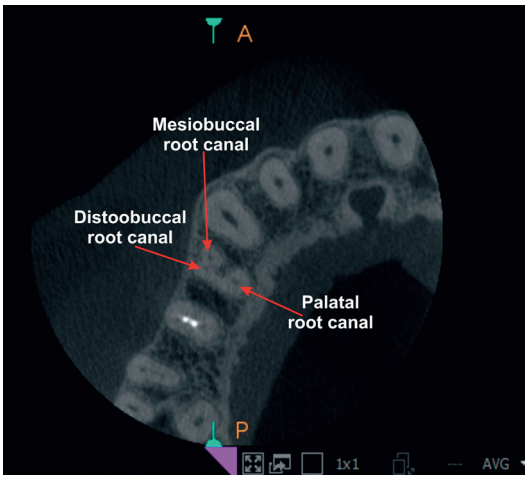

FIGURE 2. Cone beam computed tomography scanning in the horizontal plane of the middle third of the root-tooth 14

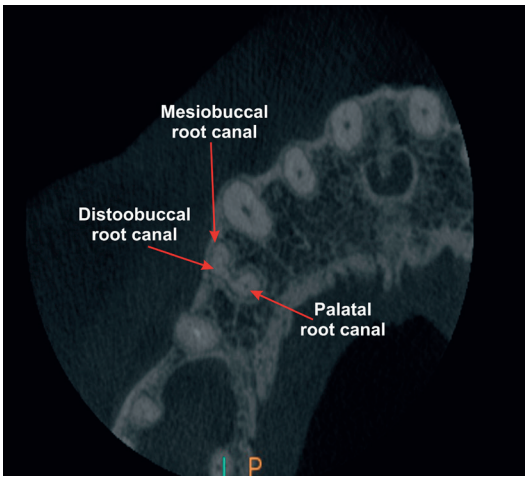

FIGURE 3. Cone beam computed tomography scanning in the horizontal plane of the apical third of the root-tooth 14

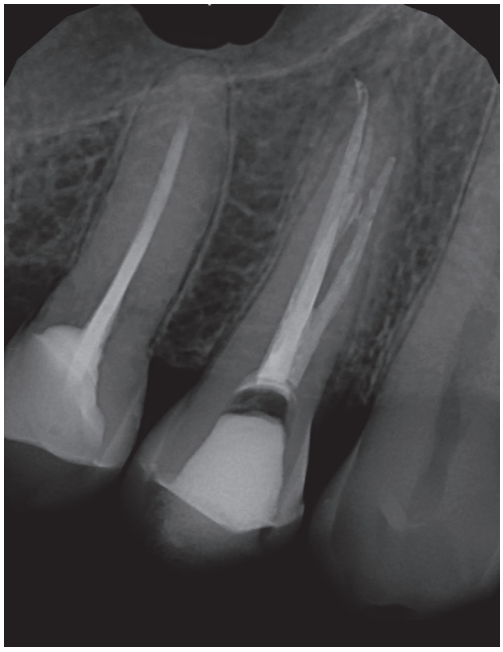

FIGURE 4. X-ray immediately after root canal filling

FIGURE 5. X-ray eight years after root canal treatment

DISCUSSION

The first upper premolars of the maxilla usually have 2 roots and 2 canals. The frequency of 2 canals (type IV root canals according to Vertucci) is approx. 80%, depending on the studied population: this figure was found to be 82.4% of 142 examined teeth in the Polish population [7]. Some studies indicate a slightly lower prevalence of 2 canals, ranging from 50–69%, depending on the study [8, 9, 10, 11, 12, 13]. In contrast, type IV was found to be present in 33–36% maxillary premolars in Chinese [14] and Indian populations [15].

It is rare to find first maxillary premolars with 3 canals and are only present in a few percent of the population typically ranging from about 0.4–1%, or are absent [3, 5, 11, 16, 17]. In the Polish population, the percentage of maxillary three-canal premolars is 9.2% [7]. Although their occurrence is relatively rare, special care should be taken when treating them. If undetected, and consequently untreated and unfilled, the 3rd canal is a potential source of infection and a cause of failure for the entire therapy [1, 18].

Any suspicion of the presence of a 3rd canal in maxillary premolars requires a slightly different and more careful procedure, even at the diagnostic stage. In three-canal teeth, an indentation can be observed in the area of furcation on the buccal side, which is palpable during probing [18]. The buccal canal, and/or the canal instrument inserted into the buccal canal opening, may also be in an eccentric position [19]. A careful analysis of radiological images is also very helpful. Some authors recommend taking 2 X-rays from different angles [19, 20]. The following signs are indicative of the presence of a 3rd canal:

— the light of the root canal suddenly "fades out" – this usually indicates that the main root canal has split into at least 2 canals,

— the width of the root in the coronal and middle part is greater (or similar in size) than the width of the crown,

— when placed in the buccal canal, the instrument is placed eccentrically,

— in the X-ray, the premolar looks like a molar (miniaturized molar-three roots can be seen, in the case of three-root premolars) [19, 20].

In extremely difficult situations or when the patient has already performed a CBCT scan, perhaps for other indications such as implantology or injuries, these scans can be analyzed. Cone beam computed tomography is increasingly used in dentistry, including endodontics. A single tomogram can give much more anatomical detail than several X-rays. X-rays, although they are a basic and necessary radiological examination in endodontics, have many limitations, most importantly, the 'overlapping' of adjacent anatomical structures [21, 22]. The literature presents a number of cases of undiagnosed X-ray images, e.g., of accessory canals or inflammatory changes in periapical tissues. These structures were visualized only on the basis of CBCT [22, 23]. Huumonen et al. report the presence of a 2nd mesiobuccal canal (MB2) in 30 out of 33 assessed upper molars. Tooth anatomy was analyzed on the basis of tomograms. It is worth noting that as many as 22 mesial roots showed the presence of periapical lesions; this was probably the consequence of failing to find and manage the accessory canal (MB2) [23].

Różyło-Kalinowska and Różyło and Patel et al. report that the presence of axial sections, "running" in a plane perpendicular to the long axis of the root of most teeth, are particularly favorable for the assessment of root canal configuration [21, 22]. The exceptions are the third molars and teeth which are incorrectly positioned in the arch. However, thanks to the use of CBCT, it is also possible to determine the atypical structure of "fused teeth", taurodontics or C-shaped canals [24, 25].

In the described case, the patient came to a specialist clinic with a previously performed CBCT scan, which significantly facilitated the treatment. It was decided that "T-trough access" should be performed. A transverse "T" beam connects both buccal canals and is "deeper" in the apical direction than the longitudinal beam located between the orifices of the buccal canals and the orifice of the palatal canal (Fig. 6). The mesial buccal canal opening is usually deeper than the distal buccal canal [19]. The surgical microscope is extremely helpful when searching for root canals, and then developing and filling them. It is particularly necessary in cases where the buccal canal is divided into 2 in the middle or at the apical part of the root [26]. The introduction of instruments into such low-lying canal orifices is practically impossible without appropriate enlargement [26, 27].

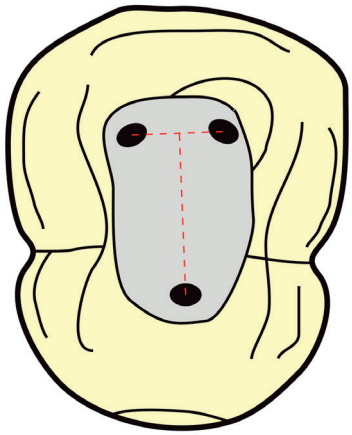

FIGURE 6. "T-trough access" in upper first premolar

CONCLUSIONS

Maxillary three-canal premolars are rare but require great attention at every stage of endodontic therapy, from diagnostics to root canal filling. Thanks to appropriate knowledge and the use of modern devices, such as microscopes and computed tomography, treatment can be successful even if the tooth presents an atypical anatomy.

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