ABSTRACT

Background: Successful endodontic treatment requires effective biomechanical preparation of the root canals and three-dimensional obturation of the root canal system. This can be achieved only by knowing and identifying the variations in the root canal system of the endodontically treated teeth.

The Aim: The aim of this article is to present cases of endodontic treatment of maxillary first premolar with three root canals – different types.

Material and Methods: Five clinical cases of successful endodontic treatment of patients with maxillary first premolar and three root canals are described.

Result and Discussion: It is noted that good endodontic practice requires good knowledge of dental anatomy and possible variations, accurate X-ray images, as well as use of magnifying equipment.

Conclusion: Knowledge of dental anatomy is fundamental for good endodontic practice.

Key words: Root canal anatomy, three roots, three canals, maxillary first premolar,

Successful endodontic treatment requires effective biomechanical preparation of the root canals and three-dimensional obturation of the root canal system. This can be achieved only by knowing and identifying the variations in the root canal system of the endodontically treated teeth. As one of the main reasons for unsuccessful endodontic treatment is identified the failure to find additional root canals due to anatomical variations [1, 2, 3].

The maxillary first premolars are described as having two roots and two root canals (56%) and one root and two root canals (40%) [4]. Although rarely, these teeth can also have three roots and three root canals and are identified in the literature as small molars, as the tooth structure and the positioning of the roots in these cases resemble those in molar teeth [4, 5]. The term “ridiculous” is also used.

Maxillary first premolars were first studied by Vertucci et al. in 1979 [4]. According to this study, 5% of 400 maxillary first premolars have three canals: 0.5% of them are teeth with three canals in a single root, 0.5% have three canals in two roots and 4% have three canals in three roots. Carns et al. discovered three separate canals in 6% of the upper fourth teeth. [6]

The visualization of three root canals of the maxillary first molars with preoperative radiography is not always possible. This makes the cases requiring endodontic treatment of maxillary first premolars with three canals particularly difficult for successful treatment.

The aim of this article is to present cases of endodontic treatment of maxillary first premolar with three root canals – different types.
Clinical Case 1:
The right maxillary first premolar with a large radicular carious lesion and diagnosis – chronic granulomatous diffuse periodontitis has three roots with three canals. Two of the root canals are buccal (mediobuccal and distobuccal) and one canal is palatal. The tooth’s buccal radicular defect made it possible to demonstrate the buccal root canals by placing markers in them (Figure 2a and 2b).

Fig. 2. Buccal canals of maxillary first premolar: a – definition of working lengths; b – drying.

Passages are created in the canals by means of hand instruments. They are prepared using the crown-down method and mechanical nickel-titanium canal instruments. After drug treatment, ozone treatment and intracanal medication with calcium-hydroxide paste, they are filled with Thermafil obturators and sealer.

Clinical Case 2:
Following irreversible pulpitis of the left maxillary first premolar with three root canals, endodontic treatment was performed (Figure 4). Under a microscope were seen two vestibular orifices and a palatal orifice (Figure 1 a, b).

Fig. 4. Left maxillary first premolar with three root canals: a-pulp chamber; b- X-ray after filling.

The mesiobuccal root has a very curved root canal with an angle of 50°, as the curve starts from the middle and continues up to the tip of the root (Fig. 3 a, b).

Fig. 3. Maxillary first premolar with three canals: a – X-ray before treatment; b – X-ray after obturation of canals.
The root canals are prepared using the step-back technique and are obturated through the cold lateral condensation method.

Maxillary first premolar with three roots, three root canals and a separate orifice and a common orifice.

A possible variation of maxillary first premolar with three roots and three independent root canals is the presence of a common buccal orifice, which subsequently splits into two separate canals (see Figure 5 a, b).

Fig. 5. Maxillary first premolar with three canals: a– pulp chamber; b- pulp chamber with magnification.

Right maxillary first premolar with diagnosis: Periodontitis chronica granulomatosa exacerbatâ sum fistulae. The patient comes for treatment following a trepanation and subsiding of the swelling. Besides periapical lesions PAI 5 [7], the original X-ray shows tooth 14 with root anatomy that does not suggest the presence of three separate root canals. The X-ray could possibly lead to assuming apical separation of root canals from the floor of the pulp chamber and unusual root morphology (Figure 6a).

The clinical investigation performed under a microscope showed that the vestibular orifice is significantly larger and almost immediately after the common beginning two separate orifices are formed (Figure 5b). The canal instruments placed in the open vestibular root canals are directed medially and distally (Figure 6b). The control X-ray, through gutta-percha points, shows two roots of the tooth – one vestibular and one palatal (Figure 6c). Similarly to the initial X-ray, the one with the points also leads to the conclusion that the centering of the x-ray is not in relation to tooth 14, but more probably in relation to 15 or even 16. Only after changing the radiography laboratory for the purpose of controlling the filling, three independent roots with two vestibular and one palatal root canal (Figure 6c) are displayed. Both vestibular root canals have a very narrow lumen (K file 008), which combined with their large length of 22 mm and the great curvature of the curve (45°) of the mesio-vestibular root makes this endodontic treatment one of the most difficult clinical cases (Figure 6c).

Fig. 6. Maxillary first premolar with three canals: a – pre-operative X-ray; b – definition of working lengths; c – X-ray after obturation.

Passage is made in the canals by means of hand tools; after that the canals are shaped with mechanical nickel-titan canal instruments using the crown-down technique. After antibacterial treatment of the endodontic space (irrigation with sodium hypochlorite and chelator, ozone treatment and intracanal application of calcium hydroxide paste), the three main canals are filled with Termafil (Maillefer) obturators and Seal Apex (Kerr) sealer [5, 8].

Maxillary first premolar with two roots and three root canals

According to Vertucci in 0.5 % of the cases, the maxillary first premolar has two roots and three root canals.

Clinical Case 1

Irreversible pulpitis is the diagnosis of a 21-year-old patient with spontaneous pain in the left maxillary first premolar and a carious lesion covering the medial surface and part of the central fissure of the tooth. The X-ray inspection shows two roots, but due to the overlapping of
shades, their apical configuration is not clear enough and the presence of a third root canal has not been assumed.

Treatment follows the vital extirpation method. After the excochleation of the contents of the pulp chamber two orifices are discovered – a vestibular one and a palatal one. The drilling of the canals reveals that the vestibular orifice is an entrance to two independent root canals with respective lengths – mediobuccal 19.5 mm and distobuccal 19 mm with the buccal cusp as a reference point. The separation of the two independent canals is about halfway of the root length or at reference point 12-13 mm. The palatal canal is 20 mm long with the palatal cusp as a reference point. The preparation of the root canals is performed by step-back technique, while the obturation is performed using the cold lateral condensation method, with master gutta-percha points for mediobuccal 02.35, for the distobuccal 02.35 and for the palatal canal 02:30 and sealer of VDW, Germany. Radiography of the filled canals is performed with a slight displacement of the X-rays from the distal side (Figure 7).

![Fig. 7. Maxillary first premolar with two roots and three root canals after obturation of canals](image)

The treatment in this case is particularly difficult, because one canal in the vestibular root leaves the pulp chamber and about 7 mm from the apex separates into two canals, which end with separate foramen – type V according to Vertucci. As a favorable circumstance, the canals are not very curved, but nevertheless are difficult to be instrumentally processed and filled.

The preparation of the root canals is performed by step-back technique, while the obturation is performed using the cold lateral condensation method.

**Clinical Case 2**

Tooth 24, diagnosed with irreversible pulpitis, has one merged root and three root canals. The preoperative X-ray shows root canals that are not clearly defined (Figure 8a). This necessitates the use of an endodontic microscope when shaping the pulp chamber. The microscope revealed three root canal orifices, but of special interest is their positioning in a straight line (Figure 8b). The X-ray picture performed with gutta-percha points (Figure 8c) shows vestibular root canals that cross each other but remain independent.

![Fig. 8. Maxillary first premolar with one merged root and three root canals a – preoperative X-ray; b – preoperative X-ray; c – definition of working lengths; d – X-ray after obturation.](image)

From the respective center-point, the control X-ray after filling shows three canals, but does not take into account their autonomy. The filling is performed through Termafil (Maillefer) obturators and Seal Apex (Kerr) sealer [5, 7].

**RESULTS AND DISCUSSION**

One of the major challenges in endodontic therapy is to treat teeth with variable anatomic configurations. The careful examination of pre-operative radiographs is essential. In case of a doubt regarding possible variations in dental anatomy, two diagnostic X-ray images are recommended [1, 2, 3, 5]. If suddenly the X-ray image of a wide and well-shaped root canal narrows or disappears, it is assumed that there is a special root anatomy and probably a split of the root canal [5, 8, 9].

Of primary importance in such cases is the clinical study of the root canals with a surgical microscope or a magnifying glass. The careful inspection of the shape of the pulp chamber might be a signal for a greater number of root canals [3, 5, 10, 11]. The buccal pulp horn is larger than the palatal pulp horn. The mean distance between the most cervical region of the pulp chamber roof and the canal bifurcation and trifurcation is 3.13 and 5.08 mm [12].
Establishing the presence of three root canals in the presented endodontic treatments of maxillary first premolars is a prerequisite for successful endodontic practice.

The study of the anatomy of the maxillary first premolar reveals significant anatomical variations. The establishment of three canals in maxillary first premolars ranges from 1.2% to 6% according to various authors [2, 6, 10]. Definitely much rarely three canals of maxillary first premolar can be observed in Asian population [3, 10, 13, 15].

An interesting anatomical feature has been reported by Sieraski et al. When the mesio-distal width of the middle part of the root in the X-ray is equal to or greater than the width of the tooth’s crown, it is possible that we have three roots in the maxillary first premolar [14].

CONCLUSION

Knowledge of dental anatomy is fundamental for good endodontic practice. Although the frequency of maxillary second premolars with three root canals is rare, each case should be investigated carefully and radiographically, to detect the anatomical anatomy.

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