In dental practice, and for successful endodontic treatment, it is necessary to have a thorough knowledge of the root canal system anatomy. The incomplete instrumentation, cleaning, and defective obturation of the root canal system are the main causes of endodontic failure (Leonardo, 1998).

Mandibular first molars erupt earlier than all other teeth, which is why they are more often damaged by caries. Consequently, caries complications can lead to endodontic treatment.

Different anatomical variations of the mandibular first molar root canal system can be challenging for a dentist, since only one missed and untreated root canal can result in endodontic failure. For the best clinical results, the dentist should be aware of normal and abnormal variability of the root canal system anatomy (Zattar, Al-Busairy, Behbehani, 1990).

The purpose of this study is to justify the importance of knowledge about basic root canal morphology and its possible variations for successful endodontic outcomes. The authors also wanted to consider the possible treatment options of the mandibular first molar with five root canals and to analyze the frequency of occurrence of such number of canals in the literature.

Materials and methods

The authors performed a literature review and presented two case reports of mandibular first molars with the five root canals. In the majority of cases, the mandibular first molar has two roots. According to de Pablo, et al.’s (2010) systematic review on root anatomy and canal configuration of the permanent mandibular first molars (with reference to 41 studies and a total of 18,781 teeth), the third root was present in 13% of cases, and it was ethnically dependent.

The researchers analysed 4,745 teeth, which had three or more canals, and found that three root canals were found present in 61.3% of cases, four canals in 35.7% and five canals in only 0.8%. In the mesial root (4,535 roots), two canals were present in 94.4% and three canals in 2.3%. The most common canal system configurations were type IV (52.3%) and type II (35%), according to the Vertucci classification (Table 1). In the distal root (2,992 roots), type I was most often found (62.7%), followed by type II (14.5%) and then type IV (12.4%).

Fabra-Campos (1985) researched 145 mandibular first molars and detected five root canals in molars in 2.75% of all the cases, whereas Martinez-Berna, et al. (1983) found 29 molars with five canals from 2,362 teeth (1.2%) in the clinical research.

Hess (1925) examined 512 mandibular first molars and found that:
- 0.3% had one canal
- 17.7% had two canals
- 78% had three canals
- 4% had four canals.

Navarro, et al. (2007), examined 25 mandibular molars using an electron microscope and found three canals in the mesial root in three cases (12%).

Middle mesial (MM) canal is found between the mesiobuccal (MB) and mesiolingual (ML) canals. The diameter of the MM canal is smaller compared to ML and MB canals in mandibular first molars with five root canals in 2.75% of all the cases, whereas Martinez-Berna, et al. (1983) found 29 molars with five canals from 2,362 teeth (1.2%) in the clinical research.

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(Martinez-Berna, Badanelli, 1985). Mortman (2003) suggests that the third mesial canal is not an extra canal but rather the sequelae of instrumenting the isthmus between the mesiobuccal and mesiolingual canals.

According to the literature analysis, the authors found that the anatomy of the root canal system of mandibular first molar needs a high level of attention, because the number of roots and canals often varies.

Clinical case one

A 23-year-old female patient presented with persistent acute pain in the mandibular left first molar, increasing on biting. Her medical history was found to be non-contributory. Percussion test of tooth LL6 revealed intense and continuous pain, and the tooth was tender to palpation test. The tooth did not respond to the pulp thermal (cold) test or to the EPT. The adjacent teeth responded normally to pulp testing. Periodontal probing and mobility were within physiological limits.

The periapical radiograph of tooth LL6 showed a periradicular lesion (Figure 1). Radiographic evaluation of the involved tooth indicated a normal canal configuration.

It is difficult to evaluate the mandibular molars morphological structure due to the fact that radiographs provide a two-dimensional image, hiding the complexity of the root canal system (Figure 1).

The preliminary diagnosis was pulp necrosis — symptomatic apical periodontitis of tooth LL6. Based on the examination results, the patient was recommended to undertake conservative endodontic treatment.

First visit

Anesthesia of a 4% solution Ubistesin with adrenalin 1:200000 (3M™ ESPE™) was performed before placement of the rubber dam so that the tooth could be cleaned with antiseptic solution.

While preparing the straight-line access to the root canal orifices, care was taken to save as much healthy tissue as possible, especially in coronal pre-cervical dentin area. Access was made using the long neck-round-shaped drills, cone-shaped drills with non-aggressive tips, and ultrasonic tips (Figure 2). After removal of the pulp chamber roof, a continuous serous purulent exudate was observed.

Examination of the pulp chamber floor was performed with a DG16 endodontic probe under optical magnification. After access preparation, two root canals were located — both in the mesial and distal roots — and the orifice of the MM was found after isthmus preparation with ultrasonic tips in the mesial root between the previously identified mesiolingual and mesiobuccal canals.

The pulp chamber was rinsed with 5.25% sodium hypochlorite. The canals were negotiated with a slightly bent 08 K-file (Dentsply Maillefer) coated with Glyde™ (Dentsply Maillefer) lubricant using a watch-winding motion and slow pushing movements toward the apical constriction. Patency was established at working length using iPex apex locator (NSK) and confirmed radiographically.

The glide path was performed using size 08 and 10 K-files and rotary nickel-titanium PathFile™ instruments (Dentsply Maillefer). PathFile No. 1 was used to the working length with light up-and-down movements. The root canal system was irrigated with 5.25% sodium hypochlorite, and the patency was confirmed with a size 08 K-file. PathFiles No. 2 and No. 3 were used the same way. The root canals were prepared with rotary nickel-titanium ProTaper® Universal and Profile instruments (Dentsply Maillefer). The instrumentation of the coronal and the middle third of the root was performed using the ProTaper Universal instruments SX, S1, and S2, and the apical third with the ProFile® system (Dentsply Tulsa Dental Specialties) instruments. .04 taper.

The MB, MM, and ML canals of the medial root merged in the apical third. The apical third of MB, ML, DB, and DL canals were shaped up to the size 35. The canals were irrigated between file insertions with 5.25% sodium hypochlorite solution. After the instrumentation and irrigation of the root canal system, it was not possible to achieve a dry canal with absorbing paper points, so it was decided to treat the patient in two visits.

The root canals were irrigated with sterile saline, dried with absorbent paper points, and filled with calcium hydroxide paste. The glass ionomer cement Fuji IX GP® (GC) was used for the temporary restoration.

Second visit

The patient attended the clinic for obturation of the root canals 10 days later. The tooth was asymptomatic.

After the antiseptic wash, local anesthesia was given, and the rubber dam was applied. The temporary restoration was removed. The access cavity and root canals were filled with citric acid, and the solution was activated by means of ultrasonic tip 3 times for 20 seconds with regular solution replacement for residual calcium hydroxide removal.

While planning the irrigation protocol before root canal system obturation, the

Figure 2: Start-X™ (Dentsply) ultrasonic tips were used for access cavity refinement
dilution effect of disinfectant (reduction of its initial concentration while moving through the dentinal tubules, which reduces the potential disinfecting ability) was taken into account. It was concluded that any irrigant alone cannot completely remove all organic and inorganic matter from the canal walls (Basrani, et al., 2007). That is why, for the final irrigation, the combination of several solutions was used in the correct sequence reinforced by ultrasonic activation for the effective removal of the residual dentinal debris (Jensen, et al., 1999).

Irrigation protocol:
- NaOCl 5.25% activated by ultrasonic tip 3 times for 20 seconds with regular replacement of solution
- EDTA 17% activated by an ultrasonic tip 3 times for 20 seconds with regular replacement solution
- Sterile saline
- 2% solution of chlorhexidine for 3 to 5 minutes and activated by an ultrasonic tip 3 times for 20 seconds with regular replacement of solution
- Sterile saline

All master cones were cleaned with antiseptic, fitted and set to working length. Obturation was conducted by cold, lateral condensation of gutta percha and AH Plus® (Dentsply) sealer.

After examination, the post-obturation radiographs (Figures 3A and 3B) and the CBCT results (Figures 4, 5, and 6) revealed the following:
- Axial slice of CBCT of tooth LL6 confirmed three root canals in the mesial and two root canals in the distal roots (Figure 6).
- In the medial system, three separate root canals with separate orifices and two separate apices (Figure 4), which are the XII (3-1) type, according to the Gulabivala (2001) classification of the root canal morphology (Table 1), that partially overlap on the postoperative radiograph (Figure 3).
- A thin isthmus partially divides two distal root canals, which exit by two separate apices that corresponds to the type IV morphology of root canals, according to the Vertucci classification (Table 1). These canals also overlap on the postoperative radiograph (Figure 5).

Cross-sectional and tangential sections (Figures 4, 5, and 7) confirm the presence of osteolytic changes in the area of the LL6 tooth roots, which are poorly visible on radiographs.

Glass ionomer cement Fuji IX GP was used for temporary sealing. The patient was referred for the restorative treatment of tooth LL6.

The patient was recalled after 3 months (Figure 8), and radiological evidence of the periapical healing was confirmed.
Clinical case two

The patient contacted the practice complaining of aching pain in tooth LR6, which increased on biting. Temperature test was negative, while percussion test was positive. The radiograph didn’t show any evidence of periapical radioluencies (Figure 9).

The diagnosis was acute apical periodontitis of tooth LR6, and conservative endodontic treatment was recommended.

After the pulp chamber roof was removed, the root canal orifices were not visible (Figure 10). Figure 11 shows the pulp chamber view after the use of ultrasonic tips.

After cleaning the access cavity, the root canals were shaped with ProTaper® Universal instruments (Figure 12). Obturation of root canals was made by condensation of warm gutta percha using the continuous wave method (Figures 13A and 13B).

The glass ionomer cement Fuji IX GP was used for the temporary restoration. The patient was referred for the permanent restoration of tooth LR6.

Discussion

The typical morphology of mandibular molars is widely described in the literature, along with numerous case reports. Inability to locate, prepare, and obturate the entire root canal system usually leads to the failure of treatment (Leonardo, 1998).

Conclusion

According to the literature, the third canal in the mesial root of the mandibular first molar is found in 0.8-12% of cases. This canal can be separate, with separate apex, or can merge with either the mesiolingual or mesiobuccal canal. In daily practice, it is important to use methods such as preoperative periapical radiographs in three projections or, if necessary, CBCT.

Optical magnification and special tools for root canal detection can significantly improve the quality of treatment. A detailed knowledge of root canal anatomy, the correct diagnosis, and appropriate shaping and cleaning of the root canal system usually leads to successful results (Schafer, Bossmann, 2001).

REFERENCES