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Case Report

Use of Highly Accurate Devices for a First Lower Premolar Endodontic Treatment with Multiple Root Canals

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This case report highlights the importance of using a dental operating microscope (DOM) and ultrasonic endodontic tips (UETs) to locate all root canals in the lower first premolar. A 53-year-old woman presented to our clinic with pain in the lower right first premolar. After a detailed search using a DOM and UETs, three root canals were found, prepared with rotary HyFlex endodontic files, and obturated using the lateral condensation technique. At the five-year follow-up after treatment, the tooth was completely restored and fulfilling its function, with no signs or symptoms of any post-treatment flare-up.

Key words: dental operating microscope, lower first premolar, multiple canals, ultrasonic endodontic tips

There are many challenging steps in treating root canals; locating all root canals might be the most significant one. In 1979, Slowey stated that the lower first premolars are among the most complex teeth to treat endodontically because of their heterogenic internal anatomy [1]. In the complicated lower premolar internal anatomy, the searchable space within the canals is very small, making the task of finding and three-dimensionally obturating all root canals very challenging. Success in a root canal treatment depends primarily on how well the internal space is disinfected. Because endodontics is a microscopic field, the use of highly accurate equipment, such as a dental operating microscope (DOM) and ultrasonic devices (UDs), provides a higher success rate for non-surgical endodontic treatment. The most common way of analyzing the number of canals in a tooth is by radiologic examination. However, this yields a two-dimensional view, and narrow canals or canals that run parallel to each other often cannot be seen on conventional dental radiographs. The "fast break guideline" referred to by Vertucci might serve as a guide to help clinicians determine whether a tooth has more than one root canal [2]. Following this rule, if the root canal disappears or becomes narrow, it means that it divides into multiple canals. The problem is that, although the method is relatively easy, one-third of radiographic analysis could fail to discern the real number of canals due to the use of a single radiographic view. Charles Clark presented his "buccal object rule" in 1910, which relates to a change in horizontal angulation to observe the presence of root canals that run parallel to each other on a dental radiograph [3]. The use of ultrasonic endodontic tips (UETs) while visualizing with a DOM makes the task of finding thin root canals easier and less invasive because

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these devices help identify and remove tertiary dentin that covers the entrance of the canals. The main advantage of UETs is that they vibrate but do not rotate, making it possible to control the degree of cut to the dentin that covers the very thin canals [4]. The present study aimed to highlight the importance of discovering all existing root canals in a single narrow space such as the lower first premolar, using a DOM and UETs.

Ethical statement. The patient provided her written consent giving permission for the publication of this case presentation.

Case Presentation

In August 2014, a 53-year-old Bolivian woman presented to the private dental clinic EMER-DENT in La Paz, Bolivia with acute continuous pain in the lower right first premolar. She reported that she had experienced a similar pain almost a year earlier and had undergone emergency dental treatment. After that appointment, she did not return to continue the therapy. A percussion test indicated acute pain with no edema. The diagnosis was a previously initiated endodontic therapy with symptomatic apical periodontitis [5]. Since this tooth had previously received emergency treatment, it was assumed that the root canals were infected. We observed a sudden disappearance of the canal at the beginning of the middle third of the tooth on the preoperative radiograph (Fig. 1), suggesting the presence of more than one root canal. Local anesthesia was applied, and rubber dam isolation was performed. Using a DOM (ALL2; Alliance, Sao Paulo, Brazil) and UD (Newtron P5 ultrasonic scaler; Satelec, Acteon, Mérignac, France) with a UET (E2D; Helse Dental Technology, Santa Rosa de Viterbo, Brazil), access cavity rectification was performed, and a 0.10 file was inserted into the distobuccal root canal. Subsequently, a working length of 23 mm was identified using a Root ZX II (Morita, Kyoto, Japan) and a radiograph was taken (Fig. 2). A second root canal was found in the mesiobuccal wall after tertiary dentin was removed using the DOM and UET E2D, and a working length radiograph with both the distobuccal and mesiobuccal root canals was taken (Fig. 3). The two root canals were prepared to create an apical glide path to a 02/20 hand file (Dentsply Maillefer, Ballaigues, Switzerland). Using rotary HyFlex CM NiTi files (Coltène/Whaledent, Altstätten, Switzerland), the canals were enlarged to 04/30. Sodium hypochlorite (5.25%) was used as a

Fig. 2 Radiograph of the distobuccal root canal working length.

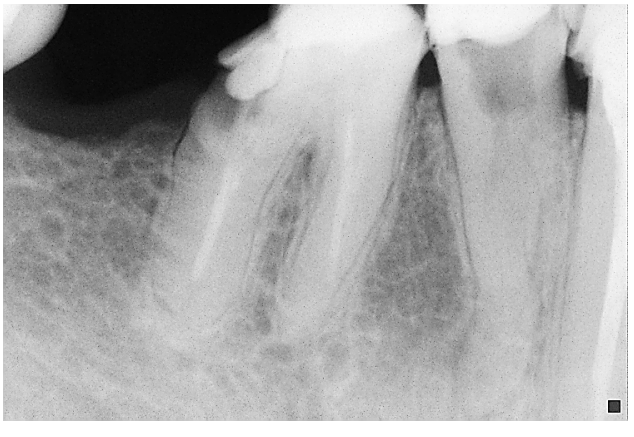

Fig. 1 Pre-operative radiograph. The canal suddenly disappears at the beginning of the middle third of the tooth.

Fig. 3 Working length radiograph of both the distobuccal and mesiobuccal root canals.

chemical disinfectant and this solution was activated by inserting an ultrasonic tip (Irrisonic E1; Helse Dental Technology) into the Newtron P5 ultrasonic scaler. After shaping both root canals, we medicated them with Metapaste (Meta Biomed, Ossong, Republic of Korea) and made a temporary crown filling using Vitremer (3M ESPE; Sumaré, SP, Brazil). Seven days later, the tooth was asymptomatic. The mesiobuccal and distobuccal root canals were sealed using an endodontic sealer (Adseal; Meta Biomed). A lateral condensation technique was used with a 04/30 master cone and 02/30 accessory gutta-percha points (Meta Biomed). After a control radiograph (Fig. 4) was taken, another unfilled canal was discovered near the mesial wall. Using the ED2 ultrasonic tip and ALL2 DOM, the dentin covering the entrance to this root canal was removed, and a K-file 0.08 was inserted, establishing a working length of 22.5 mm. The root canal was shaped using the HyFlex CM rotary system up to file 04/30. Finally, the mesiolingual root canal was medicated with Metapaste and sealed with Vitremer. One week later, since the tooth had no symptoms, the mesiolingual root canal was filled using the lateral condensation technique with a 04/30 master cone and 02/30 gutta-percha points as accessory points (Fig. 5). After the root canal treatment was completed, the patient was referred to an oral rehabilitation specialist for crown restoration. A follow-up examination 5 years later included a dental radiograph (Fig. 6) and cone-beam computed tomography (CBCT) (Fig. 7). We noted a pin inserted into the distobuccal root canal and found no signs or symptoms of periapical lesions.

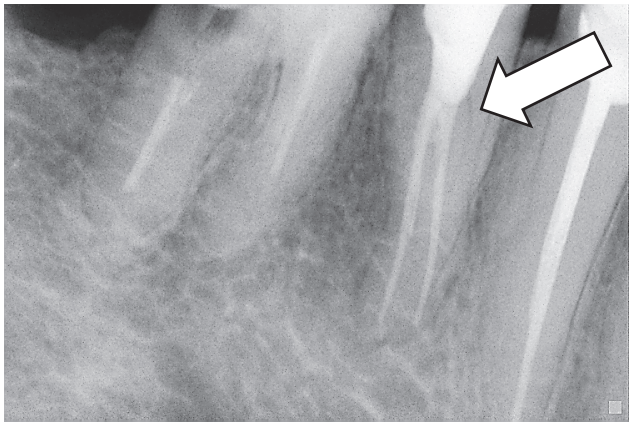

Fig. 4 Control radiograph. A third canal was observed (white arrow) after the distobuccal and mesiobuccal root canals were obturated.

Discussion

Some studies [6, 7] have reported a high incidence of failures of non-surgical endodontic treatment in the lower premolars. These flare-ups might be related to the wide variety of internal anatomical configurations of these teeth. In 1984, Vertucci found that the incidence of a lower first premolar having 3 canals at apex is 0.5% [8]. Another study using CBCT in a Spanish population showed a similar low incidence of 0. 8% for a lower premolar to have 3 root canals [9]; however, other studies have shown that, on average, 40.3% of lower first premolars have 2 or more root canals [10-13]. Other

Fig. 5 Post-operative radiograph. The 3 root canals were completely obturated.

Fig. 6 Five-year follow-up radiograph. A dental pin can be seen inserted into the distobuccal root canal.

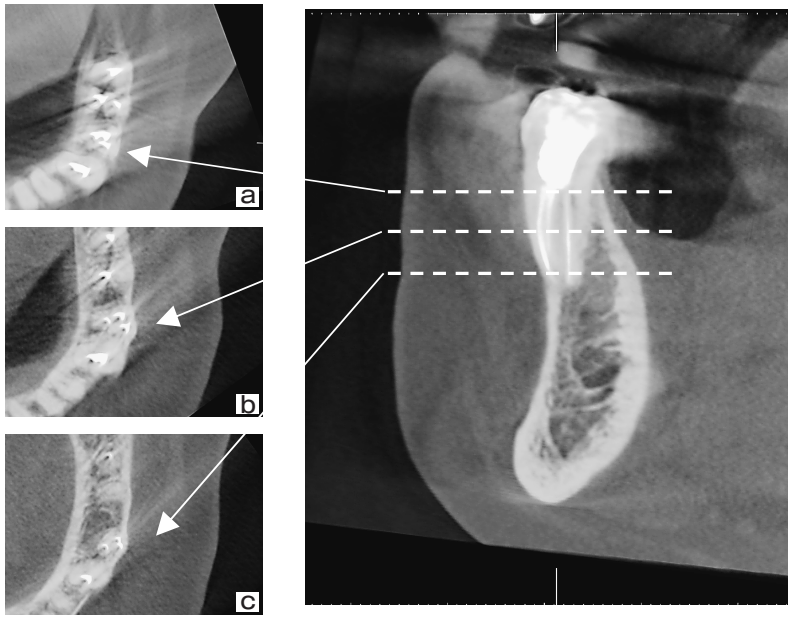

Fig. 7 Five-year follow-up cone-beam computed tomography (CBCT). Left, an axial view from the floor of the pulp chamber to the apical third of the tooth; **a**, The entrances to the 3 independent root canals can be seen around the beginning of the middle third; **b**, Three separate root canals can be seen at the middle third of the tooth; **c**, Note that the mesiobuccal and distobuccal root canals appear to approach each other at the apical third of the tooth; Right, a sagittal view of the tooth.

investigators have found a much lower incidence of between 13.8% and 19.4% [14-16]. In 1986, Trope *et al.* showed that the number of root canals is an ethnic-dependent factor, with a higher number in African American patients (32.8%) than in Caucasians (13.7%) [17]. Because this tooth is very narrow, the concept that the lower first premolar has only one canal is commonly accepted even today. However, with the development of new endodontic technologies, the probability of missing a root canal, even an accessory one, is very low. These new technologies include a variety of devices such as the DOM, UETs, and CBCT. In our particular clinical case, we did not perform CBCT before treatment because our analysis of the first preoperative radiograph showed that there was more than one root canal. We then used control radiographies, DOM, and UETs to find the additional root canals. It should also be noted that the entrances of the three independent root canals were located at the beginning of the middle third of the tooth, so it can be deduced how difficult it would have been to carry out this endodontic treatment without the assistance of the DOM (Fig. 7a). In addition, the entrances of the distobuccal and mesiobuccal root canals were covered with tertiary dentin, so without the use of the UET activated in the ultrasound scaler neither canal could have been discovered. When the first 2 root canals were filled, the patient felt no pain even though there was an extra canal, and we therefore assumed that the remaining pulp was necrotic. We applied the criteria established by Ahmed *et al.* to assess the number of root canals and classified this tooth as $^{1}44^{1\text{-}3\text{-}3}$ [18]. England *et al.* previously reported a similar case in which three canals with fused roots were identified in the lower first premolar [7]. Two of the root canals were in the buccal aspect and the other was on the lingual side, as in the present case. In our case, a follow-up assessment five years after treatment showed no apical radiolucency, and no symptoms or signs that suggested post-treatment flare-up. Thus, the main objective of therapeutic endodontics — to preserve the tooth in the oral cavity — was achieved.

In summary, we argue that clinical operators should focus on the idea that "every case is unique," meaning that there are no fixed rules about the number of possible root canals present. We conclude that detailed radiographic analysis together with the use of a DOM and UETs should be compulsory in complex cases. Together, these tools could assist in the search, complete disinfection, and subsequent obturation of the root canal system. Such management would decrease

the risk of non-surgical endodontic treatment flare-ups and help achieve the main goal of endodontics: preservation of the tooth in the oral cavity. Before considering which tools to use, we need to analyze the cost and radiation dose for each patient. In extreme cases in which missed canals cannot be found even after searching for them with a DOM and UETs, CBCT should be performed.

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References

1. Slowey RR: Root canal anatomy. Road map to successful endodontics. Dent Clin North Am (1979) 23: 555–573.
2. Vertucci FJ: Root canal morphology and its relationship to endodontic procedures. Endod Topics (2005) 10: 3–29.
3. Clark CA: A method of ascertaining the relative position of unerupted teeth by means of film radiographs. Proc R Soc Med (1910) 3: 87–90.
4. Plotino G, Pameijer CH, Maria Grande N and Somma Francesco: Ultrasonics in endodontics: A review of the literature. J Endod (2007) 33: 81–95.
5. AAE: Consensus conference recommended diagnostic terminology. J Endod (2009) 35: 1634.
6. Cleghorn BM, Christie WH and Dong CC: The root and the root canal morphology of human mandibular first premolar: A literature review. J Endod (2007) 33: 509–516.
7. England MC Jr, Hartwell GR and Lance JR: Detection and treatment of multiple canals in mandibular premolars. J Endod (1991) 17: 174–178.
8. Vertucci FJ: Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol (1984) 58: 589–599.
9. Llena C, Fernandez J, Ortolani PS and Forner L: Cone-beam computed tomography analysis of root and canal morphology of mandibular premolars in a Spanish population. Imaging Sci Dent (2014) 44: 221–227.
10. Lu TY, Yang SF and Pai SF: Complicated root canal morphology of mandibular first premolar in a Chinese population using the cross-section method. J Endod (2006) 32: 932–936.
11. Sert S and Bayirli GS: Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod (2004) 30: 391–398.
12. Zaatar EI, Al-Kandari AM, Alhomaidah S and Al-Yasin IM: Frequency of endodontic treatment in Kuwait: radiographic evaluation of 846 endodontically treated teeth. J Endod (1997) 23: 453–456.
13. Caliskan MK, Pehlivan Y, Sepetcioglu F and Turkun M: Root canal morphology of human permanent teeth in a Turkish population. J Endod (1995) 21: 200–204.
14. Yoshioka T, Villegas JC, Kobayashi C and Suda H: Radiographic evaluation of root canal multiplicity in mandibular first premolars. J Endod (2004) 30: 73–74.
15. Sabala CL, Benenati FW and Neas BR: Bilateral root canal aberrations in a dental school patient population. J Endod (1994) 20: 38–42.
16. Miyoshi S, Fujiwara J, Tsuji T, Nakata Y and Yamamoto K: Bifurcated root canals and crown diameter. J Dent Res (1977) 56: 1425.
17. Trope M, Elfenbein L and Tronstad L: Mandibular premolars with more than one root canal in different race groups. J Endod (1986) 12: 343–345.
18. Ahmed HMA, Versiani MA, De-Deus G and Dummer PMH: A new system for classifying root and root canal morphology. Int Endod J (2017) 50: 761–770.