Endodontic Treatment of a Mandibular Second Premolar with Four Canals Using Operating Microscope

Giorgos N. Tzanetakis, DDS, Theodoros A. Lagoudakos, DDS, MSc, and Evangelos G. Kontakiotis, DDS, PhD

Abstract

This clinical article presents and describes the endodontic treatment of a mandibular second premolar exhibiting a total of four separate root canals. This incidence in mandibular second premolars is particularly rare in the international endodontic literature. Only some infrequent cases of mandibular second premolars with four canals have been presented; however, this was done without the use of the operating microscope. The use of magnification is a prerequisite to locate and to confirm the exact number and position of canal orifices and to complete successfully the endodontic treatment. The endodontic treatment of the mandibular second premolar presented in this article was conducted with the aid of the operating microscope and photos of the pulp chamber floor that were taken under different steps of magnification (8×, 12.8×, and 19.1×). *(J Endod 2007;33:318–321)*

Key Words

Additional root canals, endodontic treatment, mandibular second premolar, surgical operating microscope

From the Department of Endodontics, Dental School, University of Athens, Athens, Greece.

Address requests for reprints to Dr. Evangelos G. Kontakiotis, Antheon 2, Patisia, 11143 Athens, Greece. E-mail address: ekontak@dent.uoa.gr.

0099-2399/$0 - see front matter

doi:10.1016/j.joen.2006.08.006

The thorough knowledge of root canal space anatomy is a basic prerequisite for the successful completion of endodontic treatment (1, 2), especially in cases where extra root canals are expected (3). Additional root canals must be detected in all cases; otherwise treatment failure is extremely possible (4–6).

It has been shown from previous in vitro studies that a wide morphological variation does exist as regards the root canal system of mandibular premolars. These studies have reported that the incidence of two or more canals in the second mandibular premolars can vary between 1.2% and 34% (7–9). In a relatively large sample, Zillich and Dowson (10) have reported an incidence of 0.4% of mandibular second premolars with three root canals. However, Vertucci (11) does not report any case of mandibular second premolar with three or four canals at the apex.

Recent clinical reports have described some infrequent cases of mandibular second premolars with four canals (12–16) or five canals (17). These reports have indicated that aberrations in pulp space morphology with the presence of multiple canals in mandibular pemolars are quite possible. However, all these cases were mainly radiographic, documented without the use of the operating microscope. It is very important for the clinician to be familiarized with the internal morphology and to ensure through a microscope camera that no other canals exist.

It was the aim of this study to present and describe the endodontic treatment of a mandibular second premolar with four separate root canals with the aid of the operating microscope.

Case Report

A 30-year-old male patient with a noncontributory medical history was referred to the private office of one of the authors with pain at the left mandibular region. The patient reported that he felt a strong spontaneous pain and could not detect the responsible tooth and that he had undergone endodontic treatment on tooth #19 by his general practitioner 2 weeks previously.

Clinical examination revealed a deep carious lesion at the second mandibular premolar. A preoperative radiograph of the involved tooth was taken (Fig. 1*A*), demonstrating that there was no radiographic evidence of apical periodontitis. Tooth #19 was presented endodontically treated with periapical radiolucency but was symptom free (no tenderness to percussion). However, the patient was sensitive to percussion on tooth #20. There was no mobility, and probing with a periodontal probe did not reveal any periodontal pocket. Vitality tests (cold, electric pulp test [EPT]) on the involved tooth (#20) showed abnormal responses (lingering pain to cold, increased reaction at 10 EPT) indicating that irreversible pulpitis had occurred. Clinical examination of the surrounding teeth did not reveal any clinical signs or symptoms.

The radiograph revealed a complex root canal system, evidenced by apical separation of the root and a sudden change in radiographic density of the root canal space at the middle and apical portion. Partial pulp extirpation was performed at the first appointment to alleviate the patient's symptoms, and the patient was recalled for the completion of the treatment.

At the second appointment, 5 days later, the patient was pain free but the tooth was still slightly sensitive to percussion. After administering mental nerve anesthesia (1.7 ml Ubistesin forte, articaine, 1:100,000 epinephrine), the tooth was isolated with a rubber dam and the temporary filling was removed. Initial investigation of the root canal system was performed with a size 10 K-file (Dentsply, Maillefer, Baillaigues, Switzerland).

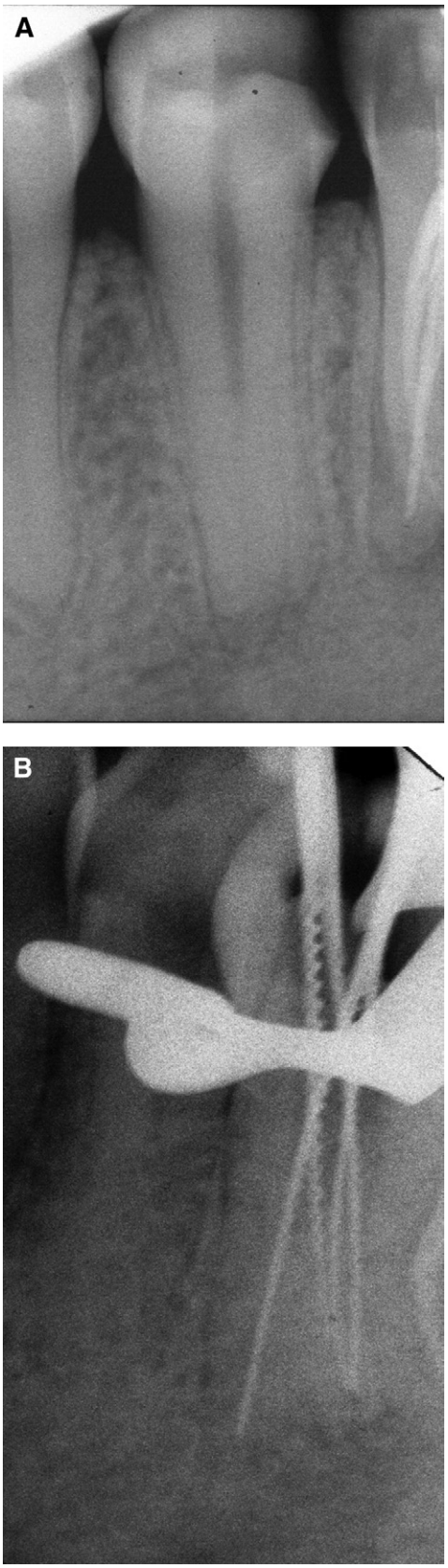

Figure 1. (*A*) Preoperative radiograph of the involved tooth. (*B*) Working length radiograph with four files in position demonstrating four canals.

Three root canals were initially detected, and an operative radiograph was taken to estimate working length. From radiographic control, it was evident that the apical third of the root was separated into buccal and lingual branches. Coronal flaring was carried out with Gates Glidden drills of ISO sizes 70 and 90 to enhance access and visualization of the root canal orifices. Observation of the pulp chamber under magnification 12.8× with the aid of an operating microscope (Global, Protégé plus) revealed an additional fourth canal.

An apex locator (Bingo 1020, Forum Technologies, Rishon Lezion, Israel) was used to verify working lengths. A second operative radiograph was taken with four files in place after the canals had been instrumented to an apical size 20 to confirm radiographically the four separate root canals (Fig. 1*B*). All four canals were instrumented to a master apical size 30 by hand. Individual canal flaring was performed with HERO 642 (Micro-Mega, Rue du Tunnel, France) rotary Ni-Ti file #30 and 6% taper. During instrumentation, copious irrigation was performed with 2.5% sodium hypochlorite. After completion of the chemomechanical preparation, root canals were dried with sterile paper points. The pulp chamber was examined again under the microscope for any additional canals, and photographs were taken under magnification 8×, 12.8×, and 19.1× from different observation angles. Four root canal orifices were totally illustrated in an almost square formation (Fig. 2).

Obturation was performed with the System B heat source using Fine nonconventional gutta-percha cones and AH-26 root canal sealer (Dentsply, De Trey, GmbH, Germany). Each canal was obturated separately, and additional vertical condensation was performed with finger pluggers of ISO size 40. The backfilling was performed with thermoplasticized gutta-percha from Obtura II. A temporary filling was placed and a postoperative radiograph was taken to assess the quality of obturation in all four canals (Fig. 3*A*). The patient was recalled 1 year postoperatively for clinical and radiographic control (Fig. 3*B*). The patient was symptom free and the tooth had been restored permanently.

Discussion

The variability in root canal morphology is a usual phenomenon. In this age of microscope-assisted and -documented endodontics, this morphology is not only something that can be imagined but also something that can be approached visually. The use of magnification and

Figure 2. Clinical view of the furcation area with the aid of the operating microscope. Four separate root canal orifices were observed, two buccal and two lingual under magnification 19.1×.

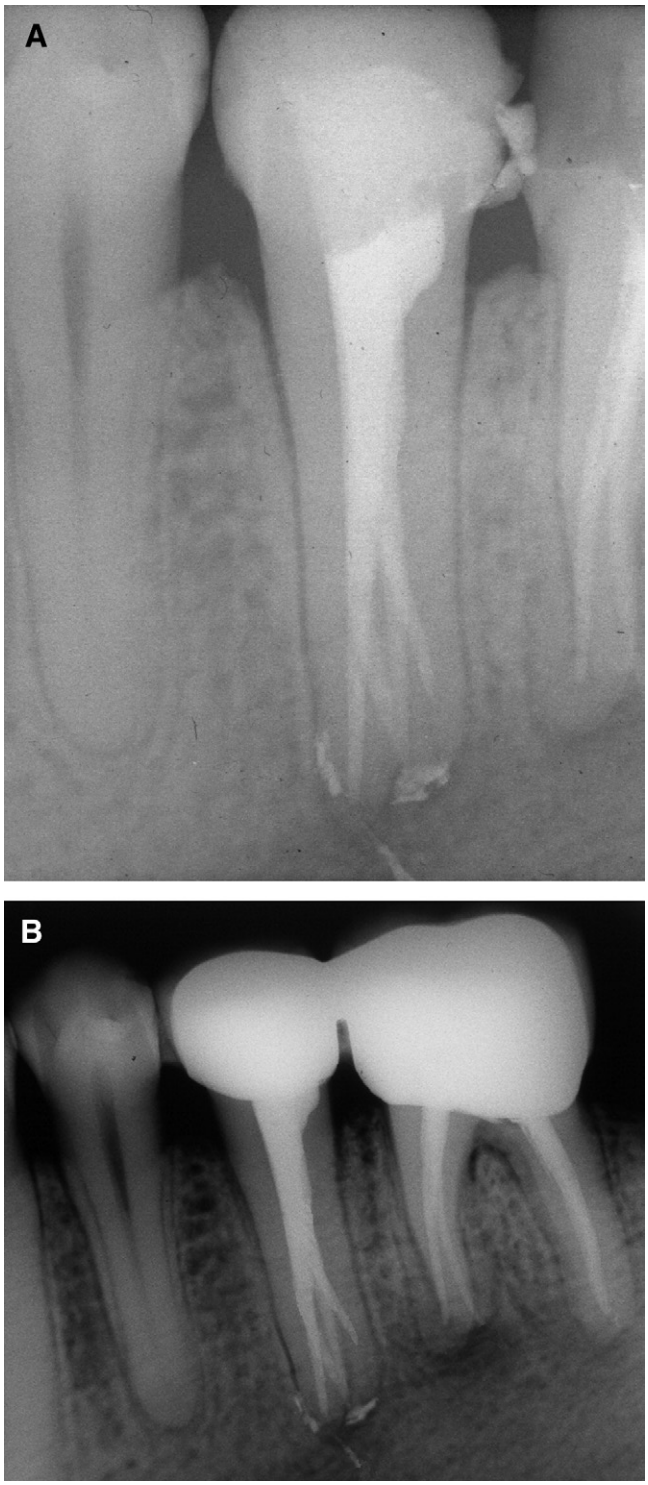

Figure 3. (*A*) Final radiograph. (*B*) Recall radiograph 1 year postoperatively.

fiberoptic illumination offers a major advantage in locating and negotiating extra root canals (18). The surgical operating microscope has been found to be particularly useful because it gives the clinician the opportunity to improve the optical field and to distinguish microstructures that are not distinct with the naked eye (19).

In the present case, the symmetry of root canal orifice positions was evident under the operating microscope. This finding is in agreement with the results of Krasner and Rankow (1). These results propose the use of symmetry laws to any tooth, especially when unexpected or unusual anatomy is present.

In endodontics, the possible existence of extra canals must be considered before endodontic treatment takes place. The clinician should have always in mind that failure to identify a second, third, or fourth canal might result in insufficient treatment and endodontic failure. Failure of endodontic treatment as a result of the inability to negotiate and instrumentate one of the additional canals is an important factor that may be encountered with mandibular premolars.

Mandibular premolars are considered to be the most difficult teeth for endodontic treatment (4). This fact can be explained by the presence of multiple root canals (20, 21), apical deltas, and lateral canals. In addition, the access cavity in these teeth is relatively small, resulting in reduced visualization. So, because the detection and management of such root canal systems is not easy, optimum access cavity preparation is absolutely necessary.

Radiographs exposed at two different horizontal angles and their careful interpretation facilitate the search for additional root canals (22, 23). In the present case, the preoperative radiographs made us suspicious of some anatomical complexity. We initially observed a disappearing pulp space under the mid-root level; even the horizontal cone angulation was altered. However, initial radiographs alone were not sufficient to give us a complete image of the internal anatomy. For this reason, it was decided to complete the endodontic treatment under the operating microscope. Efforts were made to focus at the level where root canals were separated. This point is very significant because it seems that the case difficulty is determined directly by the location of this level. The more apically the furcation area is located, the more difficult is the case. In the present case, this area was located at the level of 16 mm. The operating microscope aided in focusing precisely at this level. In addition, a clear optical field was obtained with the aid of high illumination (xenon light).

During obturation of this type of root canal system it is highly important the canals remain patent through the apically compacted gutta-percha with a file or with a nonconventional spreader of suitable taper while each one is being obturated. This will help the clinician to complete the obturation without problems and procedural errors.

It must be underscored that it is highly important for the clinician in such cases to see and understand the topographic location of the furcation area as well as the precise position of the root canal orifices. If this cannot be achieved, the negotiation of the entire root canal system is questionable, and the long-term prognosis for the tooth may become extremely poor.

References

1. Krasner P, Rankow HJ. Anatomy of the pulp-chamber floor. J Endod 2004;30:5–16.
2. Rodig T, Hulsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three root canals. Int Endod J 2003;36:912–9.
3. Sikri VK, Sikri P. Mandibular premolars: aberrations in pulp space morphology. Indian J Dent Res 1994;5:9–14.
4. Slowey RR. Root canal anatomy: road map to successful endodontics. Dent Clin North Am 1979;23:555–73.
5. Weine FS. Non surgical re-treatment of endodontic failures. Compend Cont Educ Dent 1995;16:326–35.
6. Hoen MM, Pink FE. Contemporary endodontic retreatments: an analysis based on clinical treatment findings. J Endod 2002;28:834–6.
7. Barrett MT. The internal anatomy of teeth with special reference to the pulp and its branches. Dent Cosm 1925;67:581–92.
8. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. Oral Surg 1972;33:101–10.
9. Green D. Double canals in single roots. Oral Surg 1973;35:689–96.
10. Zillich R, Dowson J. Root canal morphology of mandibular first and second premolars. Oral Surg Oral Med Oral Pathol 1973;36:738–44.
11. Vertucci FJ. Root canal morphology of mandibular premolars. J Am Dent Assoc 1978;97:47–50.

12. Wong M. Four root canals in a mandibular second premolar. J Endod 1991;17:125–6.
13. Bram SM, Fleisher R. Endodontic therapy in a mandibular second bicuspid with four canals. J Endod 1991;17:513–5.
14. Holtzman L. Root canal treatment of mandibular second premolar with four root canals: a case report. Int Endod J 1998;31:364–6.
15. Rhodes JS. A case of unusual anatomy: a mandibular second premolar with four canals. Int Endod J 2001;34:645–8.
16. Al-Fouzan KS. The microscopic diagnosis and treatment of a mandibular second premolar with four canals. Int Endod J 2001;34:406–10.
17. Macri E, Zmener O. Five canals in a mandibular second premolar. J Endod 2000;26:304–5.
18. Saunders WP, Saunders EM. Conventional endodontics and the operating microscope. Dent Clin North Am 1997;41:415–28.
19. Koch K. The microscope: its effect on your practice. Dent Clin North Am 1997;41:619–26.
20. De Moor RJ, Calberson FL. Root canal treatment in a mandibular second premolar with three root canals. J Endod 2005;31:310–3.
21. Nallapati S. Three canal mandibular first and second premolars: a treatment approach. J Endod 2005;31:474–6.
22. Walton RE. Endodontic radiographic techniques. Dent Radiogr Photogr 1973;46:51–9.
23. Fava LR, Dummer PM. Periapical radiographic techniques during endodontic diagnosis and treatment. Int Endod J 1997;30:250–61.