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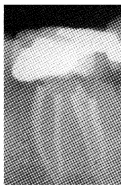

CASE REPORT

Conventional and surgical endodontic treatment of a maxillary first molar with unusual anatomy – a case report

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Abstract

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Aim To describe conventional and surgical endodontic treatment of a maxillary left first molar with two canals on the distobuccal root and to discuss the treatment outcome.

Summary According to the literature, the presence of a second canal on the distobuccal root of a maxillary first molar is rare. This anatomical anomaly might lead to an unfavourable outcome if clinicians fail to identify and treat it properly. The following case report describes conventional and surgical endodontic treatment of a maxillary left first molar with two canals on the distobuccal root.

Key learning points

- Anatomical variations of the root canal system are a challenge for clinicians during root canal retreatment.
- The principles and techniques of endodontic microsurgery are of utmost importance in clinical practice, and clinicians should be aware of them.

Keywords: root canal retreatment, second distobuccal canal, surgical endodontics, unusual anatomy.

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Introduction

Healing following root canal treatment is accomplished by removing microorganisms from the canal system and preventing reinfection. Walter Hess, in his landmark anatomical studies in the early 1920s, reported the anatomical complexities that occur throughout the root canal system and depicted a multitude of branches connecting all main and accessory canals (Hess & Zurcher 1925). For this reason, a comprehensive knowledge of canal anatomy and its variations is crucial.

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A number of studies have been published on the anatomy and morphology of the maxillary first molar, depicting a great variety of anatomical configurations on this tooth (Carlsen 1987). However, most reports on the maxillary first molar have focused on the incidence and variations of the second mesiobuccal canal, whose presence ranges from 33.1% to 95.2% (Weine *et al.* 1969, Kulild & Peters 1990, Stropko 1999, Sempira & Hartwell 2000), or on the number of palatal canals (Harris 1980, Stone & Stroner 1981, Cecic *et al.* 1982, Wong 1991). Further reports include anatomical variations such as five (Beatty 1984, Christie *et al.* 1991, Jacobsen & Nil 1994), six separate root canals (Martines-Berna & Ruiz-Badanelli 1983, Bond *et al.* 1988, Maggiore *et al.* 2002) or even seven separate root canals (Kottoor *et al.* 2010).

Concerning the distobuccal root, Vertucci (1984) and Kerekes & Tronstad (1977) reported that distobuccal roots of maxillary first molars had one canal with one apical foramen in 100% of the cases. However, Pineda & Kuttler (1972) radiographically analysed 262 maxillary first molars and concluded that two separate canals exist in 3.6% of distobuccal roots.

The following case report describes conventional and surgical root canal treatment of tooth 26 with a second distobuccal canal.

Case report

A 58-year-old white woman was referred to the endodontic clinic at University of Pennsylvania School of Dental Medicine for evaluation and treatment of tooth 26. She complained of an intermittent pain when biting on the tooth. The patient's medical history was non-contributory. A dental history indicated tooth 26 had been root filled. Clinical examination revealed moderate percussion pain on the left maxillary first molar and no sensitivity on palpation. Periodontal examination revealed probing depths 4 mm or less without mobility. Radiographic examination revealed a root filling and an apparent radiolucency around the apex of the mesiobuccal root (Fig. 1a). The tooth was restored with a composite resin build-up. Based on the history, clinical tests and radiographs, a diagnosis of a root filled tooth with symptomatic periapical periodontitis was established. The patient was informed that conventional root canal retreatment followed by possible endodontic surgery upon future evaluation was the best option. The patient consented to the treatment plan.

After local anaesthesia (two carpules of 4% septocaine with 1 : 1 000 000 adrenaline) and rubber dam isolation, the coronal restoration and all root canal filling materials were removed. The working length was established with a Root ZX (J. Morita, Irvine, CA, USA); the root canals were cleaned and shaped with stainless steel hand files (Dentsply Maillefer), using a step-back technique, using copious irrigation with 2.5% sodium hypochlorite and 17% EDTA. The palatal canal was prepared to a master apical file size 80, and the mesiobuccal and distobuccal canals to size 45. Upon microscope inspection, no additional canals could be detected. Calcium hydroxide powder (calcium hydroxide powder, USP; Henry Schein Inc., Melville, NY, USA) was mixed with saline and placed in the root canals with a lentulo spiral, and the tooth was sealed with ZOE. The patient returned 3 weeks after the initial visit for completion of the treatment. The tooth had a slight tenderness on percussion, and the patient reported pain in between visits which had been reduced however in frequency and intensity. After removal of the calcium hydroxide by copious irrigation with 3% sodium hypochlorite and circumferential hand filling with Hedström files (Dentsply Maillefer, Ballaigues, Switzerland), irrigation of the root canals with 15% EDTA for the removal of smear layer followed and all canals were filled with gutta-percha and Grossman sealer (Roth International, Chicago, IL, USA) using lateral

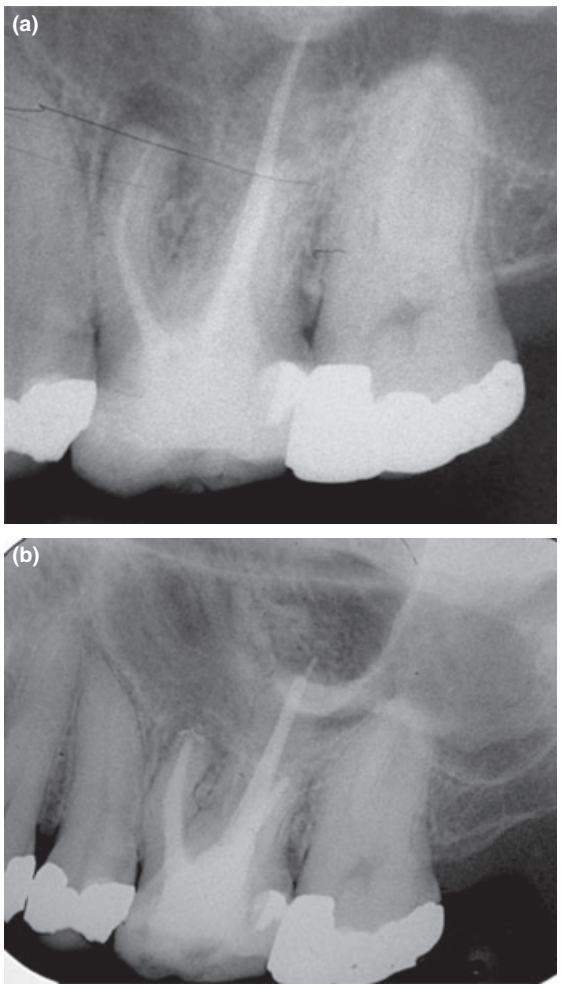

Figure 1 (a) Preoperative periapical radiograph showing tooth 26 with previous root canal treatment and core build-up. (b) Postoperative radiograph taken after root canal retreatment.

compaction (Fig. 1b). The tooth was then temporarily restored with ZOE and Ketac Molar (3M ESPE Dental Products, St. Paul, MN, USA).

The patient returned 6 months later for a recall evaluation with a permanent coronal restoration in place on tooth 26 (Fig. 2). She still complained of an intermittent sensitivity on biting, and for this reason, a diagnosis of a root filled tooth with symptomatic periapical periodontitis was established and endodontic surgery was planned. A written informed consent was given by the patient prior to surgery. During the preoperative radiographic evaluation, the proximity of the mesiobuccal apex to the sinus membrane was noted. After local anaesthesia (two carpules of 2% lidocaine with 1 : 50 000 adrenaline), a mucoperiosteal flap extending from the mesial side of tooth 25 to the distal side of tooth 27 was raised. Both mesiobuccal and distobuccal roots had fenestrated the cortical bone, and periapical pathosis was noted at the apex of the distobuccal root (Fig. 3). The granulation tissue was curetted, an osteotomy was prepared, and 3 mm of root apex was resected. Examination of the resected root surfaces was conducted at high magnification (16×). During the granulation tissue removal at the mesiobuccal root, the Schneiderian membrane was revealed, and care was taken to avoid penetration at the following surgical

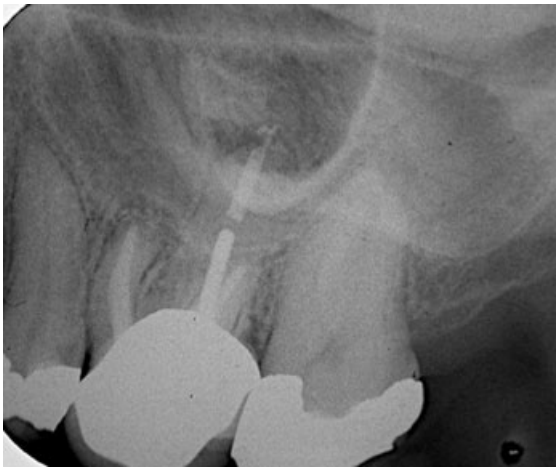

Figure 2 Periapical radiograph showing tooth 26 at the 6-month recall evaluation after the retreatment.

Figure 3 The buccal bone is fenestrated, and granulation tissue is located at the apical part of the distobuccal root (magnification 8×).

steps (Fig. 4). Methylene blue staining on the mesiobuccal root revealed the periodontal ligament, an unfilled second mesiobuccal canal, as well as incomplete filling of the MB1 canal. In addition, there was an isthmus connecting the two canals (Fig. 5a). Moreover, on the distobuccal root, a previously unidentified and unfilled canal was detected after staining (Fig. 5b). The root end preparation of all four canals in the two buccal roots was carried out with KIS tips (Obtura Spartan, Fenton MO, USA) using the microscope, and the prepared cavities were root end filled with (Dentsply Tulsa Dental, Tulsa, OK, USA) (Fig. 6). The flap was repositioned and sutured with 5-0 nylon sutures. A postoperative radiograph was taken (Fig. 7a). The patient returned 6 days later for suture removal with no postoperative pain; healing was uneventful. The patient was examined clinically and radiographically at a 7-month and 24-month recall visit. (Fig. 7b,c). The tooth was asymptomatic at both time-points. Periapical healing around both roots with periodontal ligament reformation was observed radiographically at the 24-month recall (Fig. 7c).

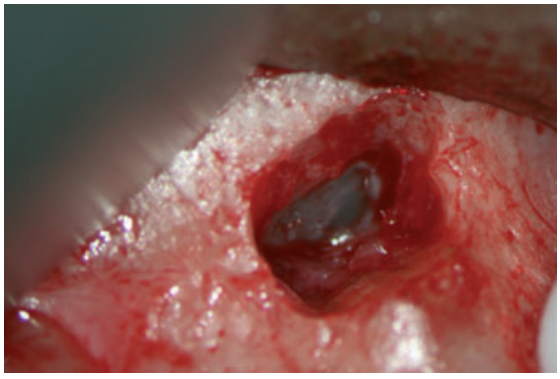

Figure 4 The Schneiderian membrane was revealed after root resection and granulation tissue removal at the mesiobuccal root (magnification 16×).

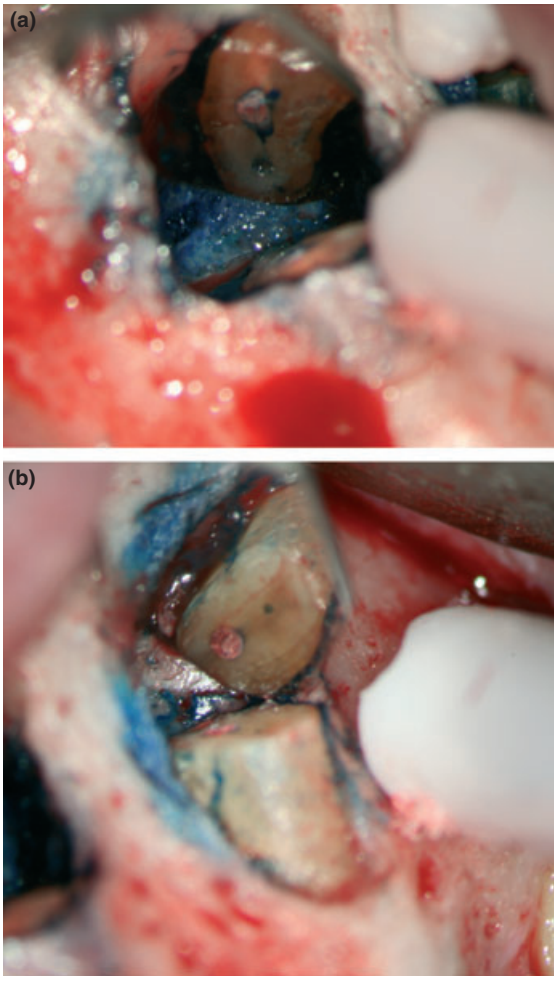

Figure 5 (a) Methylene blue staining of the resected mesiobuccal root surface showing a missed MB_2 canal. (b) Resected distobuccal root showing previously unidentified DB_2 canal (magnification 16×).

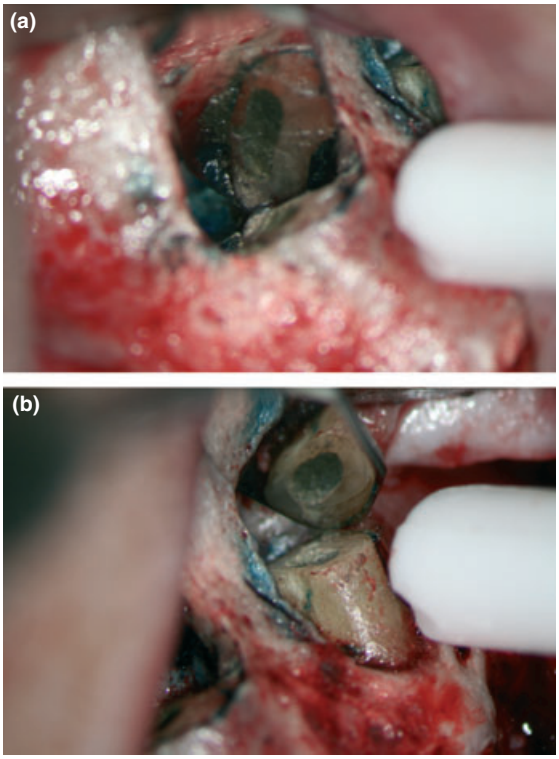

Figure 6 Root-end filling of (a) mesiobuccal and (b) distobuccal root with mineral trioxide aggregate (magnification 16×).

Discussion

The number of case reports describing two distobuccal canals in maxillary first molars is limited, revealing the rarity of this anatomical feature (Martines-Berna & Ruiz-Badanelli 1983, Hulsmann 1997, Chen & Karabucak 2006, De Almeida-Gomes *et al.* 2009). During orthograde retreatment, inspection of the pulp chamber floor using the surgical operating microscope did not reveal any indication or possible orifice of a second root canal in the distobuccal root.

In a failed root canal treatment, upon the evaluation of the preoperative radiograph, a significant and high correlation was found between an asymmetric canal filling and the presence of additional unfilled canal space (Hoen & Pink 2002). Hence, the objective evaluation of canal filling symmetry was suggested as a part of an endodontic failure evaluation (Hoen & Pink 2002). In the case described, the position of the previous filling material on the distobuccal root was symmetrical and no additional canal space was expected to be found.

Periradicular surgery might be the treatment of choice in cases with an unsuccessful outcome after primary root canal therapy or nonsurgical retreatment (Danin *et al.* 1996). Periradicular surgery aims at the removal of diseased periapical tissues and the sealing of the apical root canal system to facilitate the regeneration of hard and soft tissues, including the formation of a new attachment apparatus (Von Arx *et al.* 2001). After the introduction of microsurgical techniques in endodontics, surgical treatment outcomes have improved considerably, demonstrating a success rate as high as 92% at the 2-year evaluation (Chong *et al.* 2003) or 91.5% at the 5- to 7-year evaluation (Rubinstein & Kim

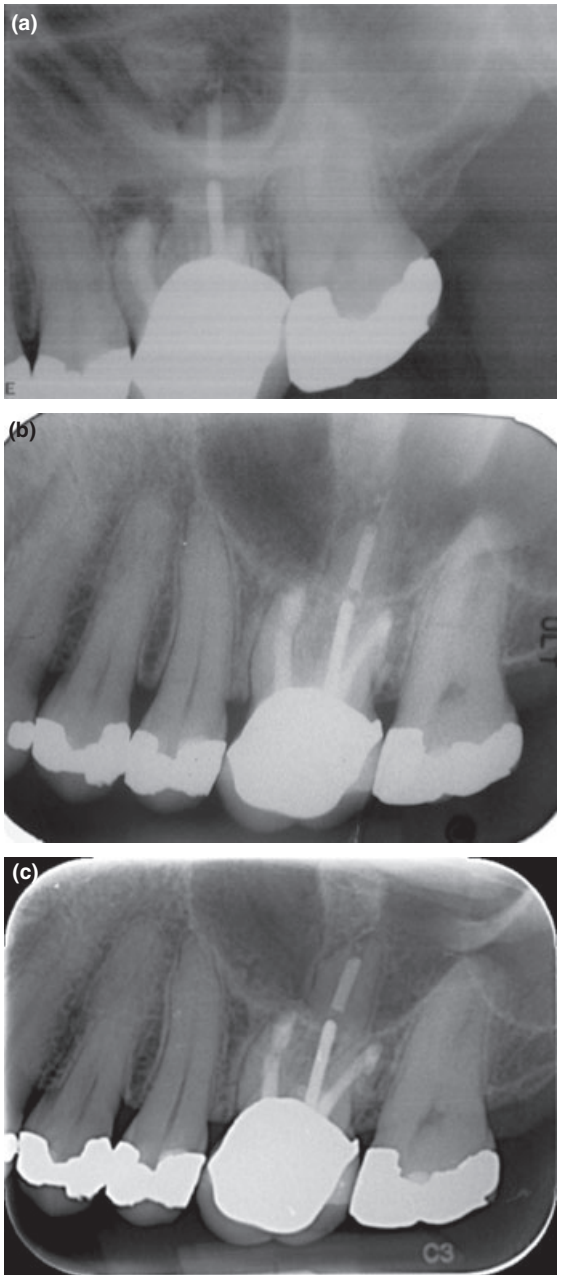

Figure 7 (a) Postoperative radiograph taken after endodontic surgery. (b) 7-month recall radiograph. (c) 2-year recall radiograph.

2002). The modern surgical techniques apply the use of a dental operating microscope, microsurgical instruments and ultrasonic preparation of the root end cavity, as well as a biocompatible root end filling material (Kim & Kratchman 2006). Several studies have reported significantly higher success rates of microsurgery in comparison with traditional surgical techniques, ranging from 87% to 97%, on the basis of short-term (Rubinstein & Kim 1999) and long-term (Rubinstein & Kim 2002, Gagliani *et al*. 2005) follow-ups. These higher success rates were attributed to a superior inspection of the surgical site and to

precise preparation of root ends with microinstruments using high magnification and enhanced illumination (Zuolo *et al*. 2000, Chong *et al*. 2003, Maddalone & Gagliani 2003).

An endodontic microsurgical approach can produce predictable outcomes in the healing of lesions of endodontic origin; hence, it is essential to evaluate surgical cases on the basis of preoperative clinical and radiographic findings to obtain a predictably high success rate (Kim & Kratchman 2006).

Conclusion

Knowledge of the anatomical and morphological complexities can help clinicians recognize anatomical variations and improve treatment quality. To this end, high magnification can allow clinicians to thoroughly inspect and find anatomical irregularities and treat all canals optimally. Endodontic surgery cannot replace nonsurgical root canal retreatment; however, when indicated, it is a treatment modality that can enhance the outcome.

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References

Beatty RG (1984) A five-canal maxillary first molar. *Journal of Endodontics* **10**, 156–7.

Bond JL, Hartwell G, Portrell FR (1988) Maxillary first molar with six canals. *Journal of Endodontics* **14**, 258–60.

Carlsen O (1987) *Dental Morphology. Copenhagen: Munksgaard.*

Cecic P, Hartwell G, Bellizzi R (1982) The multiple root canal system in the maxillary first molar: a case report. *Journal of Endodontics* **8**, 113–5.

Chen IP, Karabucak B (2006) Conventional and surgical endodontic retreatment of a maxillary first molar: unusual anatomy. *Journal of Endodontics* **32**, 228–30.

Chong BS, PittFord TR, Hudson MB (2003) A prospective clinical study of mineral trioxide aggregate and IRM when used as root-end filling materials in endodontic surgery. *International Endodontic Journal* **36**, 520–6.

Christie WH, Peikoff MD, Fogel HM (1991) Maxillary molars with two palatal roots: a retrospective clinical study. *Journal of Endodontics* **17**, 80–4.

Danin J, Stromberg T, Forsgren H, Linder L, Ramskold LO (1996) Clinical management of nonhealing periradicular pathosis-surgery versus endodontic retreatment. *Oral Surgery Oral Medicine Oral Pathology* **82**, 213–7.

De Almeida-Gomes F, Maniglia-Ferreira C, Carvalho de Sousa B, Alves dos Santos R (2009) Six root canals in maxillary first molar. *Oral Surgery Oral Medicine Oral Pathology* **108**, 157–9.

Gagliani MM, Gorni FG, Strohmenger L (2005) Periapical resurgery versus periapical surgery: a 5-year longitudinal comparison. *International Endodontic Journal* **38**, 320–7.

Harris WE (1980) Unusual root canal anatomy in a maxillary molar. *Journal of Endodontics* **6**, 573–5.

Hess W, Zurcher E (1925) *The Anatomy of the Root Canals of the Permanent Dentition. New York: William Wood and Company*.

Hoen MM, Pink EF (2002) Contemporary endodontic retreatments: an analysis based on clinical treatment findings. *Journal of Endodontics* **28**, 834–6.

Hulsmann M (1997) A maxillary first molar with two distobuccal root canals. *Journal of Endodontics* **23**, 707–8.

Jacobsen EL, Nil C (1994) Unusual palatal root canal morphology in maxillary molars. *Endodontics and Dental Traumatology* **10**, 19–22.

Kerekes K, Tronstad L (1977) Morphometric observations on the root canals of human molars. *Journal of Endodontics* **3**, 114–8.

Kim S, Kratchman S (2006) Modern endodontic surgery concepts and practice: a review. *Journal of Endodontics* **32**, 601–23.

Kottoor J, Velmurugan N, Sudha R, Hemamalathi S (2010) Maxillary first molar with seven root canals diagnosed with cone-beam computed tomography scanning: a case report. *Journal of Endodontics* **36**, 915–21.

Kulild JC, Peters DD (1990) Incidence and configuration of canal systems in the mesiobuccal root of maxillary first and second molars. *Journal of Endodontics* **16**, 311–7.

Maddalone M, Gagliani M (2003) Periapical endodontic surgery: a 3-year follow-up study. *International Endodontic Journal* **36**, 193–8.

Maggiore F, Jou YT, Kim S (2002) A six-canal maxillary first molar: case report. *International Endodontic Journal* **35**, 486–91.

Martines-Berna A, Ruiz-Badanelli P (1983) Maxillary molars with six canals. *Journal of Endodontics* **9**, 375–81.

Pineda F, Kuttler Y (1972) Mesiodistal and buccolingual roentgenographic investigation of 7275 root canals. *Oral Surgery Oral Medicine Oral Pathology* **33**, 101–10.

Rubinstein RA, Kim S (1999) Short-term observation of the results of endodontic surgery with the use of a surgical operation microscope and SuperEBA as root end filling material. *Journal of Endodontics* **25**, 43–8.

Rubinstein RA, Kim S (2002) Long-term follow-up of cases considered healed one year after apical microsurgery. *Journal of Endodontics* **28**, 378–83.

Sempira HN, Hartwell GR (2000) Frequency of second mesiobuccal canals in maxillary molars as determined by use of an operating microscope: a clinical study. *Journal of Endodontics* **26**, 673–4.

Stone LH, Stroner WF (1981) Maxillary molars demonstrating more than one palatal root canal. *Oral Surgery Oral Medicine Oral Pathology* **51**, 649–52.

Stropko JJ (1999) Canal morphology of maxillary molars: clinical observations of canal configurations. *Journal of Endodontics* **25**, 446–50.

Vertucci FJ (1984) Root canal anatomy of the human permanent teeth. *Oral Surgery Oral Medicine Oral Pathology* **58**, 589–99.

Von Arx T, Gerber C, Hardt N (2001) Periradicular surgery of molars: a prospective clinical study with a one-year follow-up. *International Endodontic Journal* **34**, 520–5.

Weine FS, Healey HJ, Gerstein H, Evanson L (1969) Canal configuration in the mesiobuccal root of the maxillary first molar and its endodontic significance. *Oral Surgery Oral Medicine Oral Pathology* **28**, 419–25.

Wong M (1991) Maxillary first molar with three palatal canals. *Journal of Endodontics* **17**, 298–9.

Zuolo ML, Ferreira MO, Gutmann JL (2000) Prognosis in periradicular surgery: a clinical prospective study. *International Endodontic Journal* **33**, 91–8.

