Endodontic Management of a Maxillary First Molar with a Single Root and a Single Canal Diagnosed with the Aid of Spiral CT: A Case Report

Velayutham Gopikrishna, MDS, Narayanan Bhargavi, BDS, and Deivanayagam Kandaswamy, MDS

Abstract

The aim of this article is to present an endodontically managed maxillary first molar with an unusual morphology of a single root and a single canal, which has not been reported in the literature so far. An accurate assessment of this unusual morphology was made with the help of a Spiral computed tomography. This report extends the range of known possible anatomical variations to include teeth with lesser number of roots and canals. This report also highlights the role of Spiral computed tomography as an objective method to confirm the three-dimensional anatomy of teeth. *(J Endod 2006;32:687–691)*

Key Words

Maxillary first molar, single canal, single root, Spiral CT

From the Department of Conservative Dentistry and Endodontics, Meenakshi Ammal Dental College, Alapakkam Main Road, Maduravoyal, Chennai, India.

Address requests for reprints to Dr. V. Gopikrishna, Department of Conservative Dentistry and Endodontics, Meenakshi Ammal Dental College, Alapakkam Main Road, Maduravoyal, Chennai 600 095, India. E-mail address: hi_gopikrishna@hotmail.com.

0099-2399/$0 - see front matter

doi:10.1016/j.joen.2005.10.057

The variation of root canal morphology, especially in multirooted teeth, is a constant challenge for diagnosis and successful endodontic therapy (1). Complete knowledge of the root canal anatomy is mandatory because the nontreatment of one canal can lead to endodontic failure (2). Variations in canal morphology such as extra canals, apical ramifications, apical deltas, or lateral canals are commonly encountered and their incidence and significance have been well documented (3, 4). Vertucci's classification is a standardized method for categorizing known root canal anatomical variations (5). However, the clinician should also be aware of the possibility of the existence of fewer numbers of roots or canals than the normal root canal anatomy.

Conventional intra-oral periapical radiographs are an important diagnostic tool in Endodontics for assessing the canal configuration. Nevertheless, it is not completely reliable owing to its inherent limitation (6). Recently, newer diagnostic methods such as computed tomography (CT) and Spiral (SCT) or Helical CT overcome the disadvantages of radiographs by producing a three-dimensional image. These imaging techniques have emerged as a powerful tool for evaluation of root canal morphology (7).

This case report presents a maxillary first molar with an unusual morphology of a single root and a single canal, which has not been reported in the literature so far and highlights the use of SCT as a diagnostic tool to confirm the same.

Case Report

A 48-year-old female patient reported to our department with a complaint of pain in the left upper back tooth region for the past week. She gave a history of intermittent pain for the past 3 months, which had increased in intensity for the past 2 days. Examination revealed the left maxillary first molar with a sinus opening present palatally (Fig. 1*A*). The tooth was tender on percussion. Thermal and electrical pulp testing elicited a negative response in the left maxillary first molar. The preoperative radiograph (Fig. 1*B*) showed widening of the periodontal ligament space with periapical radiolucency and apical root resorption in relation to the left maxillary first molar. Crestal bone loss was also noted. The radiograph also revealed an unusual anatomy of the involved tooth with a single root and a single canal. A diagnosis of a nonvital left maxillary first molar with acute apical periodontitis was made and endodontic treatment was planned.

Access opening was done in the left maxillary first molar under rubber dam isolation. On examination, clinical presence of a single wide canal orifice was found in the center of the pulpal floor (Fig. 1*C*). Further inspection of the pulpal floor revealed the lack of any other canal orifices. To ascertain this unusual morphology, multiple X-rays in variable horizontal angulations were taken. These X-rays revealed a broader single canal bucco-lingually. On instrumentation, all the scouting files converged into a single broad canal (Fig. 1*D*). A literature search was performed to ascertain the existence of such an unusual morphology, but none could be found.

Conventional film based dental radiography is the de facto standard for clinical and research examination of the oral hard tissues. The transmitted X-ray beam interacts with the film emulsion producing a latent image. The film is chemically

Figure 1. (*A*) Sinus opening in relation to the left maxillary first molar. (*B*) Preoperative Radiograph of the left maxillary first molar. (*C*) Single canal orifice. (*D*) Radiograph with scouting files in position. (*E*) Postobturation radiograph. (*F*) Healing of the sinus opening in relation to the left maxillary first molar. (*G*) Six month follow-up radiograph.

processed to provide a visible image (8). However, the main disadvantage with such radiographs is that it is only a two-dimensional image of a three-dimensional object resulting in superimposition of images.

Existing diagnostic methods such as the computerized transverse axial scanning (CT) greatly facilitates access to the internal morphology of soft tissue and skeletal structures. Recently, a new CT technique, SCT or volume acquisition CT, has been developed that has its inherent advantage (9). By employing simultaneous patient translation through the X-ray source with continuous rotation of the source-detector assembly, SCT acquires raw projection data with a spiral-sampling locus in a relatively short period (10). Without any additional scanning time, these data can be viewed as conventional transaxial images, such as multiplanar reconstructions, or as three-dimensional reconstructions. With SCT, it is possible to reconstruct overlapping structures at arbitrary intervals and thus the ability to resolve small objects is increased.

To ascertain the three-dimensional morphology of this tooth, dental imaging with the help of spiral CT was therefore planned. Informed consent from the patient was obtained. A multi slice helical or SCT imaging was performed in the maxilla using the dental software; Dentascan (GE Healthcare, USA). A three-dimensional image of the maxilla was obtained. The tooth in question was focused and its morphology was obtained in both longitudinal and cross-sections of 0.5 mm thickness (Fig. 2 *A–F*). The images revealed that the left maxillary first molar had a single root with a single canal. The canal was uniformly oval in shape. It was of interest to note that the contralateral first molar also had a similar configuration.

Working length was determined using radiographs (Ingle's method) and an apex locator. Cleaning and shaping was done using crown-down technique with hand and RaCe Ni-Ti rotary instrumentation (FKG Dentaire). Irrigation between each instrument was done using 2.5% Sodium Hypochlorite solution. Final irrigation with 17% EDTA was done and the root canal space was sealed using cold lateral compaction of gutta-percha and TopSeal sealer (Dentsply Maillefer) (Fig. 1*E*). The tooth was then subsequently restored. Subsequent follow-up revealed healing of the sinus tract (Fig. 1*F*) with the patient being clinically asymptomatic. Figure 1*G* shows the recall radiograph taken after 6 months.

Discussion

Some of the common iatrogenic access opening errors are caused during the search for the missing or extra canals. These errors include perforations and excessive tooth removal. Such iatrogenic errors can be minimized if the clinician has the knowledge of the general location and dimensions of the pulp chamber. These dimensions have been analyzed and documented by Deutsch and Musikant (11). Krasner and Rankow made a rational approach to study the relationships of the pulp chamber to the clinical crown and pulp chamber floor (12). Their observations put forth in the form of laws are valuable aids to the clinician searching for elusive canals. Although extra canals are more of a rule rather than an exception, the clinician should also be aware of the fact that in certain cases, there is a possibility of fused if not fewer canals than the normally presumed canal morphology. The varying morphology of the root canals is normally ascertained with radiographs of different angulations or careful examination of the floor of the pulp chamber. This gives us a clue to the type of canal configuration present. This case report is one such case wherein we suspected missed canals initially but ended finding only one single canal. In such doubtful cases, a radiograph cannot be considered to be foolproof because of its inherent limitations. This paper highlights the role a SCT as an objective analytical tool to ascertain root canal morphology.

Various studies have been performed in vivo and on extracted teeth to study the morphology of the maxillary first molars. They have been summarized in Tables 1 and 2.

Based on these studies, there has been no report of a maxillary molar with a single canal and a single root so far.

Conclusion

We conclude that this case report presents an unusual case of a maxillary first molar with a single root and a single canal. Anomalies in root canal morphology need not be in the form of extra canals. It could also be in the form of fused or fewer numbers of canals. This paper highlights the role a SCT as an objective analytical tool to ascertain root canal morphology.

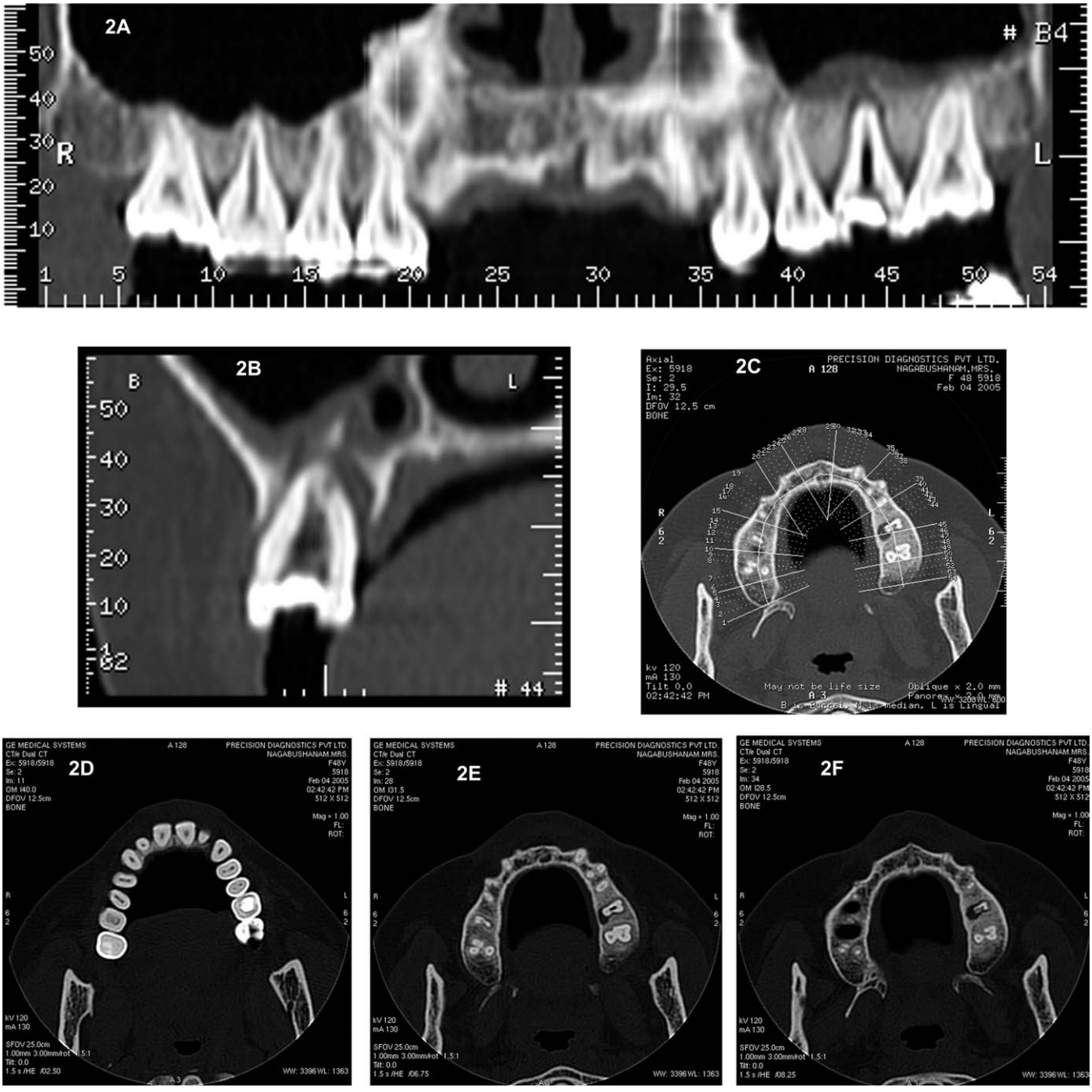

Figure 2. (*A*) Panoramic view through the posteriors. (*B*) Longitudinal section of the left maxillary first molar. (*C*) Axial view through the maxilla. (*D*) Coronal third section of the root of left maxillary first molar. (*E*) Middle third section of the root of left maxillary first molar. (*F*) Apical third section of the root of left maxillary first molar.

TABLE 1. Studies on root canal morphology of maxillary first molar

Author (year)	No. of teeth	Type I	Type II	Type III	Total with 1 canal at apex	Type IV	Type V	Type VI	Type VII	Total with 2 canals at apex	Type VIII	Total with 3 canals at apex
Frank J. Vertucci	MB 100	45	37	0	82	18	0	0	0	18	0	0
(1984) (5)	DB 100	100	0	0	100	0	0	0	0	0	0	0
	P 100	100	0	0	100	0	0	0	0	0	0	0
Caliskan et al. (1995)	MB 100	34.43	40.98	-	75.41	11.48	1.64	11.48	-	24.60	-	-
(In percentages)	DB 100	98.36	-	-	98.36	-	-	1.64	-	1.64	-	-
(13)	P 100	93.44	3.28	-	96.72	-	3.28	-	-	3.28	-	-
Wasti et al. (2001)	MB 30	33.3	23.3	-		23.3	13.3	6.8	-		-	
(In percentages)	DB 30	83.3	-	-		-	16.7	-	-		-	
(14)	P 30	66.7	-	-		-	33.3	-	-		-	
Ng et al. (2001)	MB 90	30	25.6	1.1		33.3	6.7	-	-		-	
(In percentages)	DB 90	94.5	2.2	1.1		1.1	-	-	-		-	
(15)	P 90	100	-	-		-	-	-	-		-	
Alavi et al. (2002)	MB 52	32.7	17.3	1.9		44.2	1.9	-	-		-	
(In percentages)	DB 52	98.1	1.9	-		-	-	-	-		-	
(16)	P 52	100	-	-		-	-	-	-		-	
Sert & Bayirli (2004) (17)												
Men	MB 100	3	42	19		29	2	2	1		-	New type
	DB 100	92	1	5		1	1	-	-		-	2
	P 100	94	-	3		3	-	-	-		-	
Women	MB 100	10	37	10		27	2	4	10		-	
	DB 100	89	5	2		4	-	-	-		-	New type
	P 100	95	-	-		-	2	-	-		-	3

MB = Mesiobuccal; DB = Distobuccal; P = Palatal.

TABLE 2. Case reports of maxillary first molar with unusual canal morphology

Author (year)	Unusual morphology of the maxillary first molar
Arturo Martinez-Berna (1983) (2 cases) (18)	6 canals with 3 mesiobuccal, 2 distobuccal & 1 palatal
Lior Holtzman (1997) (2 cases) (19)	5 canals with 2 mesiobuccal, 1 distobuccal & 2 palatal
Michael Hulsmann (1997) (20)	4 canals with 2 distobuccal, 1 mesiobuccal & 1 palatal
Peter M. Di Fiore (1999) (21)	4 roots - distobuccal, distopalatal, mesiobuccal & mesiopalatal
L. R. G. Fava (2001) (22)	2 roots - buccal & palatal, with Weine's type IV configuration in the buccal root
R. J. G. De Moor (2002) (4 cases) (23)	C-shaped canal configuration
F. Baratto-Filho et al. (2002) (24)	2 palatal roots, each with separate canal i.e., 2 palatal canals & 1 mesiobuccal & distobuccal canal
F. Maggiore, Y. T. Jou & S. Kim (2002) (25)	6 canals with 2 mesiobuccal, 3 palatal & 1 distobuccal
Barbizam JV, Ribeiro RG, Filho MT (2004) (26)	2 cases with 4 roots and an extracted molar with 5 roots

References

1. Malagnino V, Gallotini L, Passsariello P. Some unusual clinical cases on root canal anatomy of permanent maxillary molars. J Endod 1997;23:127–8.
2. Christie WH, Peikoff MD, Fogel HM. Maxillary molars with two palatal roots: a retrospective clinical study. J Endod 1991;17:80–4.
3. Jung IY, Seo MA, Fouad AF, et al. Apical anatomy in mesial and mesiobuccal roots of permanent first molars. J Endod 2005;31:364–8.
4. Marroquin BB, El-Sayed MA, Willershausen-Zonnchen B. Morphology of the physiological foramen: I. maxillary and mandibular molars. J Endod 2004;30:321–8.
5. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol 1984;58:589–99.
6. Hildebolt CF, Vannier MW, Pilgram TK, Shrout MK. Quantitative evaluation of digital dental radiograph imaging systems. Oral Surg Oral Med Oral Pathol 1990;70:661–8.
7. Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. J Endod 2004;30:559–67.
8. Christensen's physics of diagnostic radiology, 4th ed. Malvem, PA: Lea and Febiger, 1990.
9. Hounsfield GN. Computerized transverse axial scanning (tomography) I. Description of system. Br J Radiology 1973;46:1016–22.
10. Kalender WA, Siessler W, Klotz E, Vock P. Spiral volumetric CT with single-breadth-hold technique, continuous transport and continuous scanner rotation. Radiology 1990;173:567–8.
11. Deutsch AS, Musikant BL. Morphological measurements of anatomical landmarks in human maxillary and mandibular molar pulp chambers. J Endod 2004;30:388–90.
12. Krasner P, Rankow HJ. Anatomy of the pulp-chamber floor. J Endod 2003;30:5–16.
13. Caliskan MK, Pehlivan Y, Sepetcioglu F, Turkun M, Tuncer SS. Root canal morpho1ogy of human permanent teeth in a Turkish Population. J Endod 1995;21:200–4.
14. Wasti F, Shearer AC, Wilson NHF. Root canal systems of the mandibular and maxillary first permanent molar teeth of South Asian Pakistanis. Int Endod J 2001;34:263–6.
15. Ng Y-L, Aung TH, Alavi A, Gulabivala K. Root and canal morphology of Burmese maxillary molars. Int Endod J 2001;34:620–30.
16. Alavi AM, Opasanon A, Ng Y-L, Gulabivala K. Root and canal morphology of Thai maxillary molars. Int Endod J 2002;35:478–85.
17. Sert S, Bayirli Gunduz S. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod 2004;30:391–8.

18. Arturo M-B, Pedro R-B. Maxillary first molars with six canals. J Endod 1983;9:375–81.
19. Holtzman L. Multiple canal morphology in the maxillary first molar: case reports. Quintessence Int 1997;28:453–5.
20. Hulsmann M. A maxillary first molar with two disto-buccal root canals. J Endod 1997;23:707–8.
21. Peter M, Di Fiore. A four rooted quadrangular maxillary molar. J Endod 1997;25:695–7.
22. Fava LRG. Root canal treatment in an unusual maxillary first molar: a case report. Int Endod J 2001;34:649–53.
23. De Moor RJG. C-shaped root canal configuration in maxillary first molars. Int Endod J 2002;35:200–8.
24. Baratto-Filho F, Fariniuk LF, Ferreira EL, Pecora JD, Cruz-Filho AM, Sousa-Neto MD. Clinical and macroscopic study of maxillary molars with two palatal roots. Int Endod J 2002;35:796–801.
25. Maggiore F, Jou YT, Kim S. A six-canal maxillary first molar: case report. Int Endod J 2002;35:486–91.
26. Barbizam JV, Ribeiro RG, Filho MT. Unusual anatomy of permanent maxillary molars. J Endod 2004;30:668–71.