



Endodontic Management of Two-rooted Mandibular Premolars using Spiral Computed Tomography: A Report of Two Cases

S Jayaprada Reddy, PV Ravi Chandra, Lakshmi Santoshi, G Vikram Reddy

ABSTRACT

Aim: To present a unique case of mandibular first and second premolars with two roots and two root canals with the aid of spiral computed tomography (SCT).

Background: Confirmation of morphology of mandibular first and second premolars with the aid of SCT.

Case description: Mandibular premolars usually have a single root and a single canal. The occurrence of two roots with two separate root canals is extremely rare. The use of SCT in this rare case greatly contributed toward making a confirmatory diagnosis and successful endodontic management.

Conclusion: Successful nonsurgical endodontic management of mandibular first and second premolars with two separate roots and root canals has been presented. In this case, exact root canal anatomy could not be confirmed by using radiographs alone. Hence, the use of SCT helped us in making a confirmatory diagnosis.

Clinical significance: Developmental anomalies can occur in any tooth and two rooted premolars are no exception. The complexity of such teeth has to be considered for planning endodontic treatment using latest diagnostic equipment to increase the chances of success.

Keywords: Mandibular premolars, Mandibular first and second premolars with two roots and two root canals, Spiral computed tomography scan, Spiral computed tomography, Root canal morphologic variations.

How to cite this article: Reddy SJ, Chandra PVR, Santoshi L, Reddy GV. Endodontic Management of Two-rooted Mandibular Premolars using Spiral Computed Tomography: A Report of Two Cases. *J Contemp Dent Pract* 2012;13(6):908-913.

Source of support: Nil

Conflict of interest: None declared

BACKGROUND

Complete knowledge of the root canal anatomy is mandatory for successive endodontic therapy.¹⁻³ Mandibular premolars have gained popularity for having the most atypical anatomy.^{4,5} Literature showed a fair percentage of teeth to

have more than one canal.⁶⁻⁸ A series of studies conducted on extracted teeth reported 2.5% incidence of a second canal.^{9,10} Conventional intraoral periapical (IOPA) radiographs are an important diagnostic tool in endodontics for assessing the canal configuration but not completely reliable owing to its inherent limitations.¹¹ Mandibular second premolars have been reported with four roots and four root canals with the aid of spiral computed tomography (SCT).¹²

CASE REPORTS

Case 1

A 38-year-old South Indian male patient reported to our postgraduate endodontic department with a chief complaint of pain in the lower right back tooth since 3 months. History revealed that patient had first experienced sensitivity to cold drinks and then pain started after some time. Pain was spontaneous in nature and aggravated on chewing and lying down. On intraoral clinical examination, there was a carious exposure of the pulp and the tooth was tender to percussion. A provisional diagnosis of acute irreversible pulpitis with apical periodontitis was made.

Radiographic evaluation of the involved tooth (# 45) revealed an unusual, complex root canal anatomy and vague outlines of two roots identified with two (mesial, distal) canals. Since the anatomic makeup of the root canal system of the involved tooth was quite unusual, numerous doubts existed about the presence of extra canals. Additional radiographs taken at different angulations revealed the presence of at least two distinct roots, but the confirmation of the number of roots or root canals could not be made with the help of IOPA radiographs as it produces only a two-dimensional image. Hence, to ascertain this rare and complex root canal anatomy of the tooth in a three-dimensional manner, dental imaging with the help of a SCT

was planned. Informed consent from the patient was obtained and the mandible was scanned by using SCT (Siemens Emotion 6 slice CT scanner, SIEMENS AG, Germany). The computed tomography (CT) scans were done using the inner ear protocol supplied by the CT scanner, at 130 KV and 130 mA, 512 × 512 pixels matrix 1 mm-thick transverse sections, 32 cm display field of view and beam incidence at the central portion on the device used to fix the specimens. A three-dimensional reconstruction image of the mandible was obtained using DICOM CD viewer (Sienet Sky, Siemens Corporation, Germany). The involved tooth was focused, and the morphology was obtained in axial sections of 0.63 mm thickness at the coronal, middle and the apical third of the roots, along with three-dimensional reconstructed image (Figs 1 A to D). The SCT images revealed that tooth 45 had two separate roots bifurcating mesially and distally and two distinct root canals, with no evidence of fusion of the root canals at any level.

Once the confirmatory diagnosis was made, treatment of the involved tooth was planned. After administration of local anesthesia (2% lignocaine with 1:1,00,000 epinephrine), under rubber dam isolation both 45 and 46 were accessed. To gain sufficient access to the canals, the

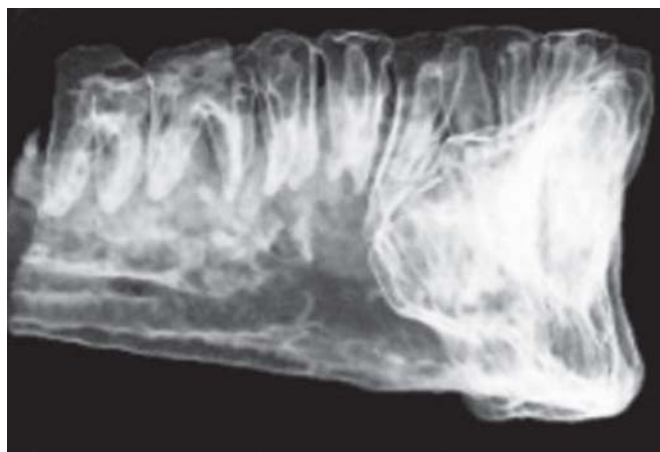


Fig. 1A: Three-dimensional reconstruction image of the mandible



Fig. 1B: Coronal third sections of the root # 45

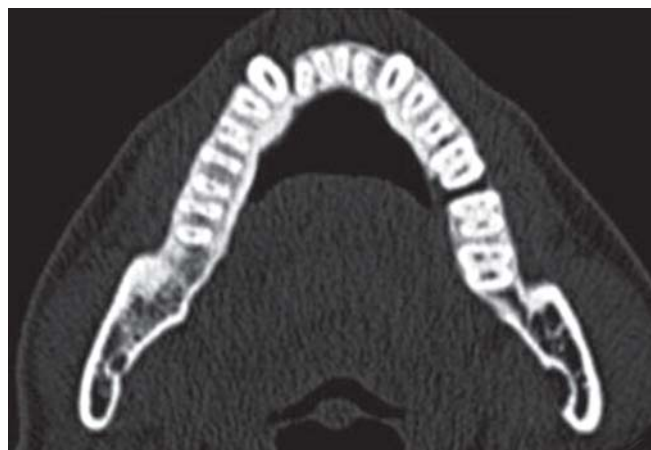


Fig. 1C: Middle third sections of the root # 45



Fig. 1D: Apical third sections of the root # 45

conventional access opening was modified into one that was wider and buccolingually oriented. On careful exploration of the pulp chamber floor with an endodontic explorer DG-16 [Dentsply Maillefer, Ballaigues (VD), Switzerland], it was seen that separation of the root started at the middle third of the root. After careful inspection, two canal orifices one from the mesial side and the other from the distal side were located and patency was obtained using a size 10 k-file. Then working length was determined by using radiographs (Fig. 2) with the same files inserted into the two root canals.

Gates Glidden drills (sizes larger to smaller) with a brushing motion were used in a crown down fashion to enlarge the main orifice to the level of the bifurcation to obtain straight line access to both the canals. Then the two canals were cleaned and shaped initially with hand K-files and then with nickel titanium rotary files (Easyrace, SybronEndo, Orange, California, USA) up to 25 (0.04 taper) under copious irrigation with 3% sodium hypochlorite and 17% ethylenediaminetetraacetic acid (EDTA). Calcium hydroxide intracanal medicament was placed inside the canals and sealed with IRM (Caulk/Dentsply Milford, Delaware, USA).

One week later, the teeth were asymptomatic. At the second appointment, all canals were recapitulated, irrigated, dried and a radiograph was taken with master cones in all canals (Fig. 3). Upon verification of master cone length, the canals were obturated by using gutta-percha and sealer (AH-plus, Dentsply Maillifer, Ballaigues(VD), Switzerland). A postobturation radiograph was taken (Fig. 4) and the

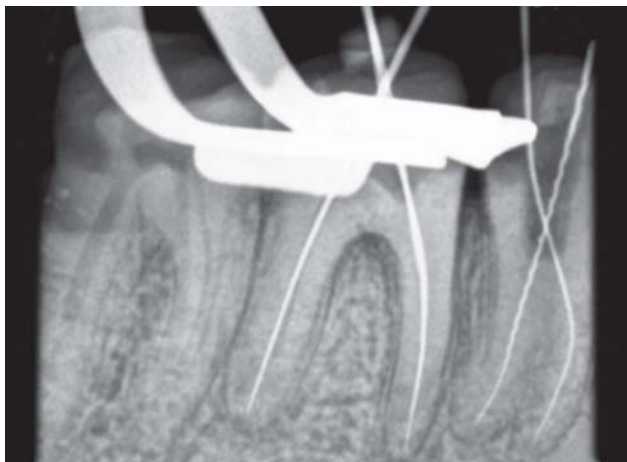


Fig. 2: Working length radiograph



Fig. 3: Master cone selection radiograph



Fig. 4: Postoperative radiograph

access was restored permanently with universal composite resin restorative material (3M ESPE Dental products, St Paul, Minnesota, USA). The patient experienced no post-treatment discomfort and subsequently porcelain fused to metal crown was placed.

Case 2

A 36-year-old male patient reported to our postgraduate endodontic department with a chief complaint of severe pain in right lower premolars for the preceding week. He gave a history of intermittent pain in the same region for the preceding 3 months. The patient's medical history seemed to be noncontributory. Clinical examination revealed carious exposure of the pulp of both the premolars. Further examination showed that teeth # 44 and 45 had no tenderness to percussion. No periodontal pockets were present. The clinical and radiographic findings led to a diagnosis of acute irreversible pulpitis.

Radiographic evaluation of the involved tooth (# 44, # 45) revealed atypical root canal anatomy with mesiodistal alignment of root bifurcation. As the confirmation of the number of roots or root canals could not be made with the help of IOPA radiographs, the mandible was scanned using SCT (Siemens Emotion 6 slice CT scanner, SIEMENS AG, Germany) in the same manner as Case 1. The morphology of the teeth was obtained in different sections of 1 mm thickness at the coronal, middle and apical thirds of the root (Figs 5A to C), along with three-dimensional reconstructed image. The SCT images revealed mesiodistal bifurcation in relation to # 44 and buccolingual bifurcation in relation to # 45 both starting at the middle third of the roots. Moreover, there was bilateral appearance of two roots in relation to both the lower premolars which is confirmed by SCT in the 0.63 mm thick axial section at the apical third level (Fig. 5C).

Preparatory measures were made as described previously (Case 1). Under rubber dam isolation, the access opening of # 44 and # 45 was done and upon careful exploration it was seen that the root canal was bifurcated at the middle third of the root. Then working length was determined by taking IOPA (Fig. 6) in relation to # 44 and # 45. Then the root canals were cleaned and shaped with initially K-files to size 20 and later with nickel titanium rotary files (Easy Race, Sybron Endo, Orange, California, USA accompanied with irrigation by using the same protocol as described earlier. Master cones confirmed for both the teeth (Fig. 7). Then the canals were obturated (Fig. 8) by using gutta-percha and sealer [(AH-plus, Dentsply-Maillifer, Ballaigues (VD), Switzerland)]. Then the teeth were restored permanently with Fuji type IX glass ionomer cement. The

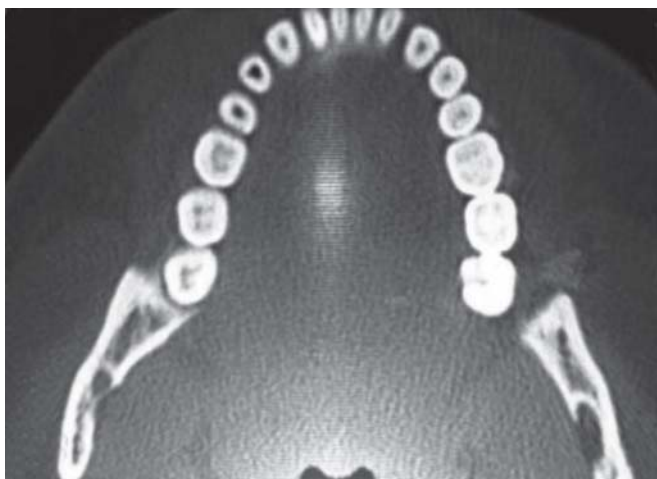


Fig. 5A: Coronal third sections of the root # 44 and 45

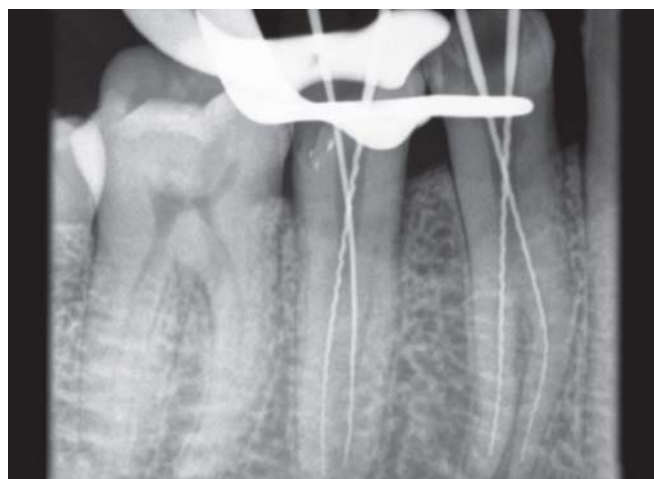


Fig. 6: Working length radiograph

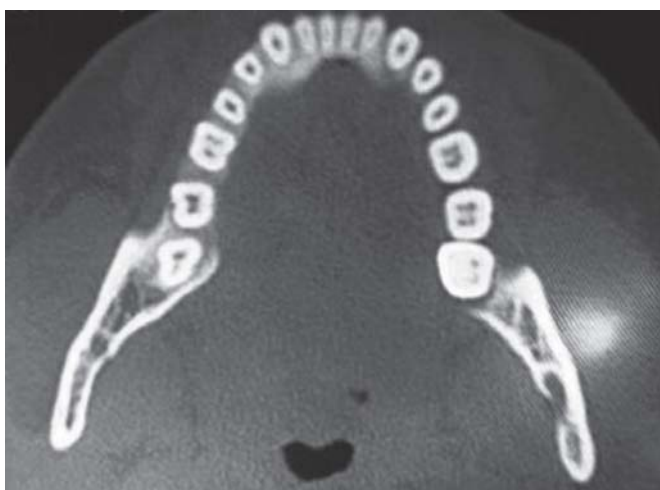


Fig. 5B: Middle third sections of the root # 44 and 45



Fig. 7: Master cone selection radiograph



Fig. 5C: Apical third sections of the root # 44 and 45



Fig. 8: Postoperative radiograph

patient experienced no postoperative discomfort and subsequently porcelain fused to metal crown was placed. One-year follow-up radiograph (Fig. 9) revealed favorable results.

DISCUSSION

The diagnosis and management of extra roots or root canals in mandibular premolars is undoubtedly an endodontic challenge. In order to achieve this, the clinician must have



Fig. 9: One-year follow-up radiograph

a thorough understanding of the normal root canal anatomy and of its common variations. A wide range of opinions are reported in the literature regarding the number of root canals, but there are very few reports on the variations in the number of roots that occur in the mandibular second premolars.^{13,14}

Previous anatomic studies that included 4019 teeth report on data for the number of roots in the mandibular second premolar (Table 1).^{9,10,15-19} The majority of the teeth in these studies (99.6%) had a single root. Two roots were found in only 0.3% and three roots in 0.1% of the teeth studied.

Considering the fact that so many aberrations exist in these teeth, it becomes mandatory that when a patient comes with pain or sensitivity to hot and cold after root canal treatment the clinician must suspect the presence of missed canals. Judicious use of high-end diagnostic aids should also be considered in such complex situations.

Radiographs produce only a two-dimensional image of a three-dimensional object resulting in superimposition of images. Hence, they are of rather limited value in cases with complex root canal anatomy. Tachibana and Matsumoto²⁰ studied the applicability of computerized tomography to endodontics. Based on previous studies performed by Ballal et al,²¹ Gopikrishna et al,²² Robinson et al²³ and Sponchiado et al,²⁴ wherein SCT was used for the confirmatory diagnosis of morphological aberrations in the root canal anatomy, SCT of the involved tooth was planned.

Table 1: Number of roots in the mandibular second premolar (incidence by number of teeth)

Reference (chronologic order)	1 root (%)	2 roots (%)	3 roots (%)
Sert and Bayirli (2004) ¹⁵	100	-	-
Zaatar et al (1997) ¹⁶	95.6	4.7	-
Caliskan et al (1995) ¹⁷	100	-	-
Geider et al (1989) ¹⁸	97.6	0.4	-
Vertucci (1978) ⁹	100	-	-
Zilich and Dowson (1973) ¹⁰	96.6	-	0.4
Barrett (1925) ¹⁹	100	-	-

The SCT images revealed that the teeth in the two above-reported cases had two separate roots with two distinct root canals. Both the root canals had separate portals of exit. Although the vague lines of the two roots could be observed on the radiograph, the confirmatory diagnosis of the exact number of roots and root canals could only be made with the help of SCT.

Clearly, these findings are clinically important as in a study by Ingle JI in 2003 at the University of Washington assessing the results of endodontic therapy, the mandibular first and second premolars showed a failure rate of 11.45 and 4.54% of all types of the teeth. Conceivably, these findings could be due to the complex root canal anatomy of a large number of these teeth. Failure to recognize the presence of extra root or canals can often lead to acute flare-ups during treatment and subsequent failure of endodontic therapy.

CONCLUSION

Successful nonsurgical endodontic management of mandibular first and second premolars with two separate roots and root canals has been presented. It is a well-established fact that the presence of extra roots and root canals in these teeth may be far more than one can expect. In this case, exact root canal anatomy could not be confirmed by using radiographs alone. Hence, the use of SCT helped us in making a confirmatory diagnosis.

CLINICAL SIGNIFICANCE

The endodontic management of two-rooted mandibular premolars in conjunction with SCT, in the present case restored function, comfort and oral health of the patient.

REFERENCES

1. Krasner P, Rankow HJ. Anatomy of the pulp-chamber floor. *J Endod* 2004 Jan; 30(1):5-16.
2. Rodig T, Hulsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three canals. *Int Endod J* 2003 Dec;36(12):912-19.
3. Hoen MM, Pink FE. Contemporary endodontic retreatments: An analysis based on clinical treatment findings. *J Endod* 2002 Dec;28(12):834-36.
4. Vertucci FJ. Root canal anatomy of the human permanent teeth. *Oral Surg Oral Med Oral Pathol* 1984 Nov;58(5):589-99.
5. Slowey RR. Root canal anatomy. Road map to successful endodontics. *Dent Clin North Am* 1979 Oct;23(4):555-73.
6. Amos ER. Incidence of bifurcated root canals in mandibular bicuspid. *J Am Dent Assoc* 1955 Jan;50(1):70-71.
7. Baisden MF, Kulild JC, Weller RN. Root canal configuration of the mandibular first premolar. *J Endod* 1992 Oct; 18(10):505-08.
8. England MC Jr, Hartwell GR, Lance JR. Detection and treatment of multiple canals in mandibular premolars. *J Endod* 1991 Apr; 17(4):174-78.

9. Vertucci FJ. Root morphology of mandibular premolars. *J Am Dent Assoc* 1978 Jul;97(1):47-50.
10. Zilich R, Dowson J. Root canal morphology of mandibular first and second premolars. *Oral Surg Oral Med Oral Pathol* 1973 Nov; 36(5):738-44.
11. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root 32 canals. *Oral Surg, Oral Med Oral Pathol* 1972; 33(1):101-10.
12. Sachdeva GS, Ballal S, Gopikrishna V, Kandaswamy D. Endodontic management of a mandibular second premolar with four roots and four root canals with the aid of spiral computed tomography. *J Endod* 2008 Jan;34(1):174-78.
13. Goswami M, Chandra S, Chandra S, Singh S. Mandibular premolar with two roots. *J Endod* 1997 Mar; 23(3):187.
14. Shapira Y, Delivanis P. Multiple-rooted mandibular second premolars. *J Endod* 1982 May;8(5):231-32.
15. Sert S, Bayirli GS. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. *J Endod* 2004 Jun;30(6):391-98.
16. Zaatar EI, al-Kandari AM, Alhomaidah S, al-Yasin IM. Frequency of endodontic treatment in Kuwait: Radiographic evaluation of 846 endodontically treated teeth. *J Endod* 1997 Jul;23(7):453-56.
17. Çaliskan MK, Pehlivan Y, Sepetçioğlu F, Türkün M, Tüncer SS. Root canal morphology of human permanent teeth in a Turkish population. *J Endod* 1995 Apr;21(4):200-04.
18. Geider P, Perrin C, Fontaine M. Endodontic anatomy of lower premolars—Apropos of 669 cases. *J Odontol Conserv* 1989 Winter;(10):11-15.
19. Barrett M. The internal anatomy of the teeth with special reference to the pulp and its branches. *Dent Cosmos* 1925;67: 581-92.
20. Tachibana H, Matsumoto K. Applicability of X-ray computerized tomography in endodontics. *Endod Dent Traumatol* 1990 Feb; 6(1): 16-20.
21. Ballal S, Sachdeva GS, Kandaswamy D. Endodontic management of a fused mandibular second molar and paramolar with the aid of spiral computed tomography: A case report. *J Endod* 2007 Oct; 33(10):1247-51.
22. Gopikrishna V, Bhargavi N, Kandaswamy D. 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. *J Endod* 2006 Jul;32(7):687-91.
23. Robinson S, Czerny C, Gahleitner A, Bernhart T, Kainberger FM. Dental CT evaluation of mandibular first premolar root configuration and canal variations. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002 Mar;93(3):328-32.
24. Sponchiado EC Jr, Ismail HA, Braga MR, de Carvalho FK, Simoes CA. Maxillary central incisor with two root canals: A case report. *J Endod* 2006 Oct; 32(10):1002-04.

ABOUT THE AUTHORS

S Jayaprada Reddy (Corresponding Author)

Professor, Department of Conservative Dentistry and Endodontics Kamineni Institute of Dental Sciences, Narketpally, Nalgonda-508254, Andhra Pradesh, India, Phone: 09703936020 e-mail: drsjayapradareddy@gmail.com

PV Ravi Chandra

Professor and Head, Department of Conservative Dentistry and Endodontics, Kamineni Institute of Dental Sciences, Nalgonda Andhra Pradesh, India

Lakshmi Santoshi

Senior Consultant, Department of Endodontics, Apollo WHITE Dental Clinic, Hyderabad, Andhra Pradesh, India

G Vikram Reddy

Senior Lecturer, Department of Periodontics, Kamineni Institute of Dental Sciences, Nalgonda, Andhra Pradesh, India