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Case Report

The unusual anatomy of the maxillary and mandibular molars diagnosed by cone-beam computed tomography

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Abstract: Background: Knowledge of variations in dental anatomy and canal morphology plays a key role in the success of endodontic therapy. Case presentation: This report presents a patient who had unusual tooth morphology, including the bilateral existence of 11 maxillary and mandibular first, second and third molars with a single root and a single canal. The patient was diagnosed using cone-beam computed tomography (CBCT). To our knowledge, this is the first report of such case in the literature. Endodontic treatment of the left maxillary second molar was performed. CBCT images confirmed our diagnosis and the unusual morphology of the 11 molars. Conclusions: This report highlights that CBCT has a significant role in confirming the anatomy of teeth, which provided an opportunity to precisely describe the anatomy of 11 maxillary and mandibular molars with single roots and single canals.

Keywords: Cone-beam computed tomography, maxillary molar, mandibular molar, permanent teeth, single canal and single root

Introduction

The variation of root canal morphology has been considered to be associated with the endodontic diagnosis and therapy [1]. Variations in canal morphology are commonly encountered in maxillary and mandibular molars [2-4]. Although the identification of less frequently occurring morphologic variations has been described, the existence of all of the maxillary and mandibular molars is not reported in one person. In this case report, a patient who presented for endodontic treatment with 11 single-rooted molars and single root canals is described. Cone-Beam Computed Tomography (CBCT) examinations confirmed the bilateral existence of first, second and third maxillary and mandibular molars with single roots and single canals.

Materials and methods

A 50-year-old female patient was admitted because of intermittent pain in region of the left upper back tooth. Clinical examination revealed a grossly decayed left maxillary second molar. Neither fistulae nor edema was observed in the soft tissues. There was no pain or tenderness to palpation. Vitality testing with cold ice of the left maxillary second molar led to an intense pain, whereas electric pulp testing showed an exaggerated response. The preoperative radiograph revealed the anatomy of the left maxillary second molar, as well as the unanatomy of both the left maxillary first molar and third molar with a single root and canal. The radiograph images of the right maxillary and mandibular molars also showed single root and canal. Acute pulpitis in left maxillary second molar was diagnosed and endodontic treatment was recommended.

To ascertain this rare morphology, a multi-slice CBCT (V1010, Galileos, Sinona, Germany) in the maxilla and mandible was carried out (tube voltage, 90 kV and tube current, 12 mA). The morphology of the involved teeth was obtained in transverse, sagittal and axial sections of 5-mm thickness each.

Figure 1. The cone-beam computed tomography image of the right maxillary molars in the transverse (A) and sagittal section (B), as well as the left maxillary molars in the transverse (C) and sagittal section (D).

Results

The CBCT images showed the single root and canal in transverse, sagittal and axial sections of all maxillary and mandibular first molars. In the transverse section, the canal of right (**Figure 1A**) and left (**Figure 1C**) maxillary molars was a small mesiodistal diameter. However, in the sagittal section, the image displayed a single, wide but gradually decreasing, oval-shaped root canal systems with a large buccolingual diameter (**Figure 1B**, **1D**). The morphology in the transverse section of the right mandibular first molar was uniform with a single, wide large canal from the pulp chamber to the root tip (**Figure 2A**). However, the image showed a single, conical shaped root canal in sagittal section (**Figure 2B**). The morphology of the left mandibular first molar showed an obturated image with a wide, large shape both in the transverse and sagittal sections (**Figure 2C**, **2D**). The images of the right (**Figure 3A**, **3B**) and left (**Figure 3C**, **3D**) mandibular second molar displayed a single, wide canal both in the transverse and sagittal section. In the axial section, the maxillary molars displayed single, wide but gradually decreasing, oval-shaped root canal systems with a large buccolingual diameter and a small mesiodistal diameter (**Figure 4A**, **4B**). In comparison with the maxillary molars, the single root canal systems of all mandibular molars were more circular to trapezoidal (**Figure 4C**, **4D**). The right mandibular third molar had been extracted, therefore, the morphology could not be determined.

Caries excavation in the distal surface of the tooth was restored with IRM (IRM; Dentsply De Trey GmbH, Konstanz, Germany). A rubber dam was placed, and a conventional endodontic access opening was established with an Endo Access bur (Dentsply Tulsa, Tulsa, OK). Local anesthesia was induced using 1.7 mL articaine with 1:100,000 epinephrine (Rolland, Meriganc, France). On access opening, a single large buccolingual canal was discovered in the center of the pulp chamber. The pulp chamber was confirmed using dental operating microscope (M525 F40, LeicaMicrosystyms, Germany).

Discussion

This clinical case report focused on three aspects. The first was the unusual anatomy of the maxillary and mandibular molars with a single root and canal in one patient. The second was that the same anatomical aberration presented in the contralateral pairs with the exception of the right mandibular third molar. The third was the confirmation of our diagnosis with the aid of CBCT.

Our case report highlighted the presence of an unusual anatomy both in maxillary and mandibular molars in one person. The comprehensive review of Cleghorn *et al.* [5] described that three roots presented in the first maxillary molars, which occurred in an overall percent-

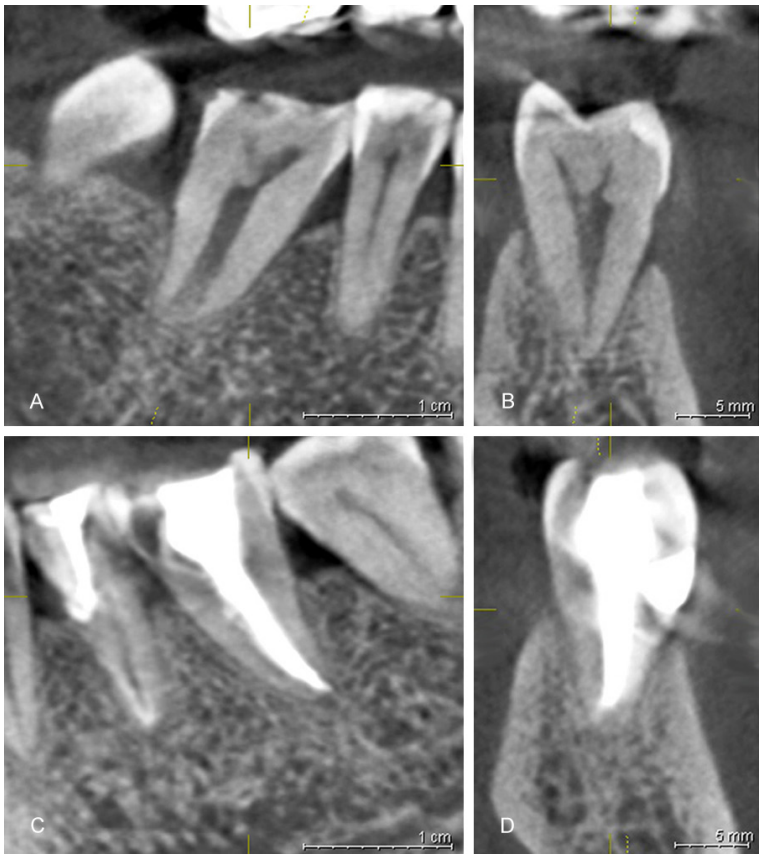

Figure 2. The cone-beam computed tomography image of the right mandibular first molar in the transverse (A) and sagittal section (B), as well as the left mandibular first molar in the transverse (C) and sagittal section (D).

age of 96.2%, whereas the percentage of first maxillary molars with two roots was 3.8%. The existence of maxillary second molars with a single root and canal had been reported in rare occasions. Previous study reported an incidence of 0.5% after an *in vivo* evaluation of 200 radiographs of maxillary second molars [6]. Recent studies showed an incidence of 4.63% of the second maxillary molar with single root in a Korean population [7] and an incidence of 5% in a South Asian Indians population [8]. Typically, the majority of permanent mandibular first molars presented two well-defined roots, including a mesial root with two canals and a distal root with one or two canals. Systematic reviews of the literature [9, 10] on canal morphology of the mandibular first molar had not documented this rare morphology. This morphological variation had been documented only once in an *in vitro* study conducted by Reuben *et al.* [11]. He found that only one sample had a single root in 125 samples of mandibular first molars from an Indian population. In 2011, Ioannidis *et al.* [12] reported a case of the left first mandibular molar with a single root and canal and described the incidence and the endodontic management. In 2014, Sooriaprakas *et al.* [13] reported that a case had a first mandibular molar with a single root. They also identified the existence of this anatomical variation in bilateral pairs in both mandibular first and second molars. Papers of the first molar with a single root and canal are shown in **Table 1**.

The occurrence of second mandibular molars with a single root and canal also had been reported. In a clinical case, Fava *et al.* [14] identified the existence of such anatomical variations in the second maxillary and mandibular molars. Ioannidis *et al.* [12] found the same case and described this bilateral existence by using CBCT. Sooriaprakas *et al.* [13] found all of the first and second mandibular molars with a single root and canal. Papers of the second molar with a single root and canal are shown in **Table 2**.

Relatively few studies had been conducted on the root and canal morphology of the mandibular third molars. Park *et al.* [15] investigated the morphology and number of roots of Korean mandibular third molars using CBCT and the results showed that 81 third molars (37.9%) were one-rooted and 121 third molars (56.5%) had two roots. In addition, Furry [16] suggested that 80.5% of patients had similar root morphology on both sides. However, Gunst *et al.* [17] found that left-right symmetry in the root development of the mandibular third molar had a correlation coefficient of 0.93 for males and 0.95 for females. Although some studies had investigated the root morphology of the third molar, few studies provided a comprehensive morphological description of the third molar with a single root and canal.

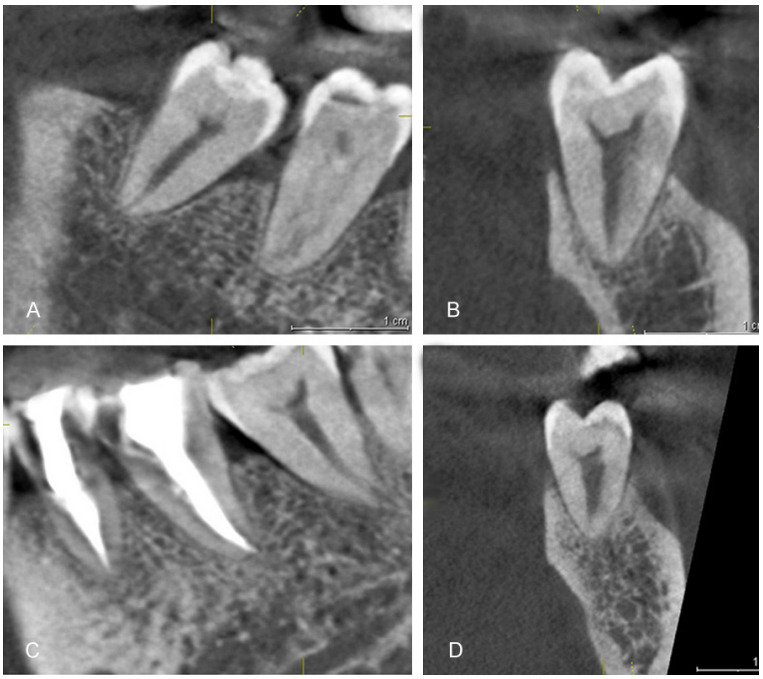

Figure 3. The cone-beam computed tomography image of the right mandibular second molar in the transverse (A) and sagittal section (B), as well as the left mandibular second molar in the transverse (C) and sagittal section (D).

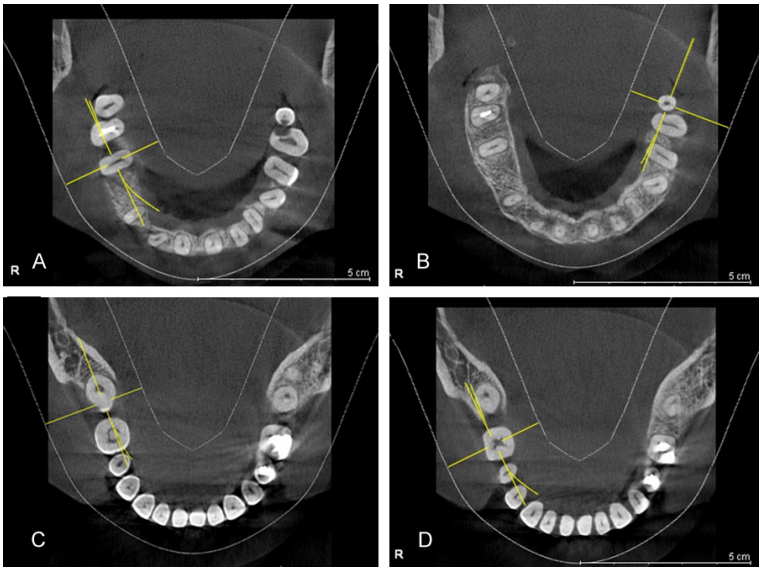

Figure 4. The cone-beam computed tomography image of the maxillary (A, B) and mandibular (C, D) molars in the axial section.

The presence of identical root and canal variations in contralateral pairs was important, because there were occasions in which a clinician had to perform endodontic treatment in the contralateral teeth and the ones that were originally affected. Few studies compared the bilateral existence of previously diagnosed unusual anatomical variations in the contralateral pairs. Fava *et al.* [14] reported the bilateral existence of four second molars in a patient. Alani [18] reported the endodontic management of bilaterally occurring four-rooted maxillary molars in a patient. Ioannidis *et al.* [12] and Sooriaprakas *et al.* [13] also reported the bilateral existence of involved molars with unusual morphology. A radiograph of the contralateral tooth was highly recommended as soon as an unusual anatomical variation was detected [14].

CBCT technology was widely used in diagnosing endodontic pathology, assessing root and alveolar fractures, analyzing resorptive lesions, identifying the pathology from non-endodontic origin, and evaluating the technical quality [19-21]. Furthermore, CBCT measurements were geometrically accurate, owing to the fact that the CBCT voxels (3D pixels containing data) were isotropic [22]. In the present case, CBCT imaging confirmed the unusual root morphology of 11 molars with a single root and canal in one patient.

We concluded that this case report presented a patient who had unusual tooth morphology, including the bilateral existence of 11 maxillary and mandibular first, second and third molars with a single root and canal. This paper also highlighted that CBCT had a significant role in confirming the anatomy of teeth.

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Table 1. Papers of the first molar with single root and single canal

Author (year)	Population	Material and Method	The Tooth	Variations reported	Diagnosed tool
Gopikrishna *et al.* (Gopikrishna, V., Bhargavi, N., et al. 2006) (2006)	Indian	Case report	The maxillary first molar	Single root and single canal	Spiral-CT
Cobankara *et al.* (Kottoor, J., Sudha, R., et al. 2010) (2008)	Turkey	Case report	The maxillary first molar	Single root and single canal	X-Radiograph/Micro-scope
De la Torre *et al.* (de la Torre, F., Cisneros-Cabello, R., et al. 2008) (2008)	Spain	Case report	The maxillary first molar	Single root and single canal	X-Radiograph/Micro-scope
Shigli *et al.* (Shigli, A. and Agrawal, A. 2010) (2010)	Indian	Case report	The maxillary first molar	Single root and single canal	Spiral-CT
Ioannidis *et al.* (Ioannidis, K., Lambrianidis, T., et al. 2011) (2010)	Greece	Case report	Seven maxillary and Mandibular Molars	Single root and single canal	CBCT
Neelakantan *et al.* (Neelakantan, P., Subbarao, C., et al. 2010) (2012)	Indian	*In vitro*	220 maxillary first molars	1/220 single root and single canal	CBCT
Kim *et al.* (Kim, Y., Lee, S.-J., et al. 2012) (2012)	Korean	*In vitro*	814 maxillary first molars	2/814 single root and single canal	CBCT
Chhabra *et al.* (Chhabra, N., Singbal, K.P., et al. 2013) (2013)	India	Case report	The maxillary first molar	Single root and single canal	CBCT
Saxena *et al.* (Saxena, A., Singh, A., et al. 2014)(2014)	India	Case report	The maxillary first molar	Single root and single canal	Spiral-CT
Sooriaprakas *et al.* (Sooriaprakas, C., Ballal, S., et al. 2014) (2014)	India	Case report	The maxillary first molar	Single root and single canal	X-Radiograph

CT, computed tomography; CBCT, cone-beam computed tomography.

Table 2. Papers of the second molar with single root and single canal

Author (year)	Population	Material and Method	The Tooth	Variations reported	Diagnosed tool
Hartwell and Bellizzi (Hartwell, G. and Bellizzi, R. 1982) (1982)	-	*In vivo*	Endodontically treated maxillary second molars	0.6% single root and single canal	X-radiograph
Libfeld and Rotstein (Libfeld, H. and Rotstein, I. 1989) (1989)	-	*In vitro*	200 endodontically treated maxillary second molars	0.3% single root and single canal	X-radiograph
Calsen *et al.* (Carlsen, O., Alexandersen, V., et al. 1992) (1992)	-	*In vitro*	100 single rooted maxillary second molars	30.4% single root and single canal	X-radiograph
Pansiera and Milano (Pansiera, A.F. and Milano, N.F. 1995) (1995)	-	*In vitro*	102 extractedmaxillary second molars	5.88% single root and single canal	X-radiograph
Peikoff *et al.* (Peikoff, M., Christie, W., et al. 1996) (1996)	-	*In vitro*	520 endodontically treated maxillary second molars	3.1% single root and single canal	X-radiograph
Fava *et al.* (Fava, L., Weinfeld, I., et al. 2000) (2000)		Case report	2 maxillary second molars and 2 mandibular second molars	Single root and single canal	X-radiograph
Ioannidis *et al.* (Ioannidis, K., Lambrianidis, T., et al. 2011) (2011)	Greek	Case report	2 maxillary second molars and 2 mandibular second molars	Single root and single canal	CBCT
Sooriaprakas *et al.* (Sooriaprakas, C., Ballal, S., et al. 2014) (2014)	Indian	Case report	1 maxillary second molars and 2 mandibular second molars	Single root and single canal	X-radiograph
Wang *et al.* (Wang, Y., Hui, X., et al. 2011) (2011)	Chinese	Case report	1 maxillary second molars	single root and single curved canal	CBCT
Sert *et al.* (Sert, S., Şahinkesen, G., et al. 2011) (2011)	Turkish	*In vitro*			
			252 maxillary second molar	1.9% single root and single canal	X-radiograph
			332 mandibular second molar	1.2% single root and single canal	X-radiograph
Kim *et al.* (Kim, Y., Lee, S.-J., et al. 2012) (2012)	Korean	*In vitro*	775 maxillary second molar	3.87% single root and single canal	CBCT
Roy *et al.* (Roy, A., Velmurugan, N., et al. 2013) (2013)	-	3 cases reports			
			4 second molars	Single root and single canal	SCT
			Left mandibular second molar	Single root and single canal	Microscope
			4 second molars	Single root and single canal	X-radiograph
Jahromi *et al.*(Jahromi, M.Z., Golestan, F.J., et al. 2013) (2013)	Iran	*In vitro*	100 mandibular second molar	Single root and single canal	Clearing method

CBCT, cone-beam computed tomography; SCT, scan computed tomography.

drafted the manuscript. RW, YX and DZ performed assessment of the patient and reviewed the available literature. All authors read and approved the final manuscript.

Disclosure of conflict of interest

None.

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