Mandibular second molar exhibiting a unique “Y-” and “J-” “shaped” root canal anatomy diagnosed using cone-beam computed tomographic scanning: A case report

Saumya-Rajesh Parashar, R. Dinesh Kowsky, Velmurugan Natanasabapathy
Department of Endodontics, Meenakshi Ammal Dental College and Hospital, Chennai, Tamil Nadu, India

Abstract
This article aims to report a unique case with aberrant root canal anatomy exhibiting “Y-” and “J-”-shaped canal pattern in a mandibular second molar. Anatomic complexities may pose challenges for endodontic treatment. Before performing endodontic treatment, the clinician should be aware of the internal anatomy of the tooth being treated and should recognize anatomic aberrations if present. Presence of unusual anatomy may call for modifications in treatment planning. This report describes in detail about a mandibular second molar tooth associated with two paramolar tubercles having a peculiar “Y-” and “J-”-shaped canal anatomy detected with the aid of cone beam computed tomography, which has never been reported in the dental literature. The proposed treatment protocol for the endodontic management of the same has also been discussed.

Keywords: Cone-beam computed tomography; J-shaped canal; mandibular second molar; paramolar tubercle; Y-shaped canal

INTRODUCTION

Root canal anatomy is highly complex and variable. A good understanding of the basic root canal anatomy and its variations is essential to achieve success during endodontic treatment.[1] Mandibular second molars are usually similar to the first molar in terms of root canal anatomy, but variations such as two canals, single canal, C-shaped canals,[2-5] and presence of middle mesial canal[6,7] have often been reported in these teeth. Molar teeth with extra cusp or tubercles have been reported to have highly complex root canal anatomy.[8-10] “Paramolar tubercle” which was first described in the literature by Prof. Bolk as any stylar or anomalous cusp, supernumerary inclusion, or eminence occurring on the buccal surfaces of both upper and lower premolars and molars.[11] It is challenging to endodontically treat a tooth with paramolar tubercles as they can possibly contain pulp tissue and their root canals may either be independent or communicating with the canals of the associated tooth at different levels of the root.[12-14] Besides, the groove that delineates the tubercles from the associated tooth may extend to various depths along the root surfaces causing periodontal defects with respect to that region.[10] In addition, they may also pose a challenge for endodontic therapy during rubber dam isolation and postendodontic restoration.

This case report describes the anatomical and morphological characteristics of a highly complex “Y-” and “J-”-shaped root canal anatomy in a mandibular second molar tooth associated with two paramolar tubercles, diagnosed with the aid of cone-beam computed tomography (CBCT).

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Parashar SR, Kowsky RD, Natanasabapathy V. Mandibular second molar exhibiting a unique “Y-” and “J-” “shaped” root canal anatomy diagnosed using cone-beam computed tomographic scanning: A case report. J Conserv Dent 2017;20:50-3.
CASE REPORT

A 25-year-old male patient reported with a chief complaint of mild pain on his right lower back tooth region for the past 6 months. In the past 1 week, the intensity of pain increased and became continuous and spontaneous in nature. The patients familial and medical histories were noncontributory. Extraoral examination revealed no abnormalities. Intraorally, the patient had generalized gingivitis and a deep occlusal carious lesion in relation to the mandibular second molar (tooth #31). The tooth was tender to percussion. Mobility was within physiological limits, and periodontal probing around the tooth revealed a pocket depth of 4 mm on the distal aspect. Pulp testing with cold test and electric pulp tester gave a negative response in relation to tooth #31.

In addition, the crown morphology was found to be abnormal [Figure 1a]. The tooth was wider buccolingually and revealed two well-developed lobulated tubercles on the buccal surface. The tubercles appeared bulbous, conically projecting from the cervical line toward the occlusal surface. The combined mesiodistal extension of both the tubercles was almost equal to the mesiodistal width of the associated tooth. A distinct developmental occluso-gingival groove clearly delineated the tubercles from the associated tooth. The mesial tubercle was larger than the distal tubercle. Intraoral periapical radiograph revealed a periapical radioluency of about 4 mm with localized bone loss along the distal aspect of the tooth [Figure 1b]. Based on the clinical and radiographic findings, the tooth was diagnosed having pulpal necrosis with symptomatic apical periodontitis associated with paramour tubercles.

Since the root canal anatomy of the involved tooth was complex, a limited field of view CBCT was obtained following the ALARA principle to ascertain the root canal systems in a three-dimensional (3D) manner. The axial images revealed peculiar root canal anatomy outlines, which was highly complex and varied across the length of the tooth. At the beginning of the floor of the pulp chamber, five separate canal orifices were seen; three round orifices of the mesiobuccal, mesiolingual, and distolingual canals, one oval-shaped orifice of the mesial paramolar tubercle canal, and a teardrop-shaped orifice formed by the fusion of the distal paramolar tubercle and the distobuccal canal [Figure 1c-i].

At the cementoenamel junction (CEJ), a “Y”-shaped root canal anatomy was observed [Figure 1c-ii]. However, about 1.2 mm below the CEJ, a very unique “J”-shaped canal anatomy was seen which extended till 2.8 mm apically. The curved portion of the J-shaped canal was formed by the communication between the mesiobuccal, mesiolingual, and distolingual canals, and the straight arm of the “J” was formed by the fusion of the mesial tubercle, distal tubercle, and the distobuccal canals [Figure 1c-iii]. Beyond this, the canal anatomy changed into three separate canals (mesiobuccal, mesiolingual, and a ribbon-shaped outline formed by the fusion between the mesial tubercle canal, distal tubercle canal, and the distobuccal canal) [Figure 1c-iv]. The canal anatomy further changed into four canals, 6.5 mm from the CEJ [Figure 1c-v]. Finally, at the apex, three portals of exits were seen; two from the main tooth and one from the tubercle [Figure 1c-vi]. Diagrammatic representation of the canal pattern is shown in Figure 1d-i–d-vi. Nonsurgical endodontic treatment was suggested to the patient for which he refused consent. Hence, the tooth was not treated.

DISCUSSION

The internal anatomy of the root canal system often exhibits a wide range of variations, which could be challenging to diagnose and treat endodontically. This case report describes a complex root canal anatomy of a mandibular second molar fused with two paramolar tubercles having a Y-shaped and J-shaped root canal pattern, which has never been reported earlier.

Figure 1: (a and b) Clinical photograph and intraoral periapical radiograph. (c) Cone-beam computed tomography scan axial slices, i – At the level of the pulp chamber showing five distinct canal orifices, ii – At the cementoenamel junction showing Y-shaped canal anatomy, iii – 1.2 mm apical to the cementoenamel junction showing J-shaped canal anatomy, iv – 4 mm apical to the cementoenamel junction showing four separate canals, v – 6.5 mm apical to the cementoenamel junction showing four separate canals, vi – Apical portion of the root showing three portals of exit. (d-i-vi) Diagrammatic representation of the complex root canal anatomy at different axial levels corresponding to the cone-beam computed tomography scan slices.
The etiology of paramolar tubercles is relatively unknown. Nevertheless, according to Turner and Harris, the over activity of the dental lamina during the morphogenesis of a tooth could lead to such an aberrant anatomy. Moreover, recently, it has been established that the PAX and MSX genes could also be the reason for the abnormal shape of the teeth.\cite{15} Hanihara et al.\cite{16} classified the clinical presentation of lower primary molars fused with paramolar tubercles (protostylid) into six types. However, our case report presented with two paramolar tubercles, which does not fall into any of the six types mentioned in this classification.

To the best of our knowledge, the prevalence rate of protostylids has not been reported in the dental literature; however, the prevalence rate of parastyles has been reported to be 0–0.1% in upper first molars, compared with 0.4–2.8% in upper second molars or 0–4.7% in upper third molars.\cite{17,18}

A double cusp development takes place very rarely. Most of the cases in the dental literature report a single paramolar tubercle being associated with the tooth,\cite{8,10,19} excluding one case reported by Nayak et al.\cite{25} which exhibited a maxillary right second molar associated with two paramolar tubercles. On the other hand, this article reports a case of a mandibular second molar associated with two paramolar tubercles displaying a complex root canal anatomy that was varying at different levels of the root diagnosed with the aid of limited volume CBCT.

Since conventional radiographs provided limited information regarding the internal root canal anatomy and true pulpal communication between the paramolar tubercle and the associated tooth, a limited field of view CBCT was planned to delineate the structure of the paramolar tubercle and visualize this complex internal anatomy 3D.

Interestingly, in our case, the root canal of the tubercles was communicating with the main tooth at different levels across the length of the tooth, displaying a Y-shaped canal anatomy at the CEJ, further showing a unique J-shaped canal anatomy 1.2 mm from the CEJ, which has never been reported in the dental literature. In addition, the apical part of the root was further complicated with three root canals. In contrast, Nayak et al.\cite{8} reported that in his case report, the tubercles had their own pulp chamber exhibiting a round to oval-shaped canal that remained independent from the main root canals in spite of the roots being fused. In a case series by Ohishi et al.,\cite{10} the roots of the paramolar tubercle were fused to that of the distobuccal root of the main tooth. Likewise, the tubercle canal communicated with only the distobuccal canal at various levels.

Endodontic treatment of such a complex anatomy would definitely be challenging, especially when there is a communication between the tubercle and the main tooth canals. Such cases can be managed efficiently with the aid of limited volume CBCT and magnification using the surgical operating microscope. Since CBCT revealed the paramolar tubercles to have their own pulp space, access needs to be prepared separately for the main tooth and the tubercle canals. Two percent taper hand nickel–titanium files used with circumferential filling technique along with passive ultrasonic irrigation will be helpful for canal debridement.\cite{20}

Newer irrigation devices such as photo-induced photoacoustic streaming (PIPS)\cite{21,22} or the GentleWave system\cite{23,24} can be used in these cases with highly complex root canal anatomy. The GentleWave system creates multisonic waves inside the root canal using a degassed fluid to achieve disinfection, whereas the PIPS uses laser energy at subablative power settings to create photoacoustic shock waves. Nonetheless, these strategies are relatively new and expensive. Alternatively, the modified EndoVac irrigation technique suggested by Thomas et al.\cite{25} could perhaps aid in effective debridement. In this technique, the irrigant will be delivered using a conventional needle in one of the root canals while simultaneously using the macro/microcannula in the adjacent root canal, which will enable the irrigant to be pulled across the isthmus and the communications. This novel technique was clinically implemented by Jain et al.\cite{8} in his case report for the management of a maxillary second molar fused with a paramolar tubercle, which provided superior canal and isthmus debridement. The thermoplasticized gutta-percha obturation technique may be more suitable in such cases with complex root canal communications.\cite{26}

Since the patient did not report back for further visits, the treatment was not completed. Anomalous cases with such aberrant anatomy are rare but can be encountered. Being aware of the presence of such aberrations can help clinicians to detect and manage them effectively when present.

**CONCLUSION**

This case report describes a complex root canal anatomy seen in a mandibular second molar fused with two paramolar tubercles, diagnosed with the help of CBCT. The root canal anatomy was varying at different levels of the root, and it exhibited a unique “Y” and “J”-shaped root canal anatomy in the coronal third of the root which has never been reported in literature.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.
REFERENCES

1. Rubinstein RA, Kim S. Long-term follow-up of cases considered healed one year after apical microsurgery. J Endod 2002;28:378-83.
2. Manning SA. Root canal anatomy of mandibular second molars. Part I. Int Endod J 1990;23:34-9.
3. Neelakantan P, Subbarao C, Subbarao CV, Ravindranath M. Root and canal morphology of mandibular second molars in an Indian population. J Endod 2010;36:1319-22.
4. Manning SA. Root canal anatomy of mandibular second molars. Part II. C-shaped canals. Int Endod J 1990;23:40-5.
5. Barsness SA, Bowles WR, Fok A, McClanahan SB, Harris SP. An anatomical investigation of the mandibular second molar using micro-computed tomography. Surg Radiol Anat 2015;37:267-72.
6. Azim AA, Deutsch AS, Solomon CS. Prevalence of middle mesial canals in mandibular molars after guided troughing under high magnification: An in vivo investigation. J Endod 2015;41:164-8.
7. Nosrat A, Deschenes RJ, Tordik PA, Hicks ML, Fouad AF. Middle mesial canals in mandibular molars: Incidence and related factors. J Endod 2015;41:28-32.
8. Jain P, Ananthnarayan K, Ballal S, Natanasabapathy V. Endodontic management of maxillary second molars fused with paramolar tubercles diagnosed by cone beam computed tomography – Two case reports. J Dent (Tehran) 2014;11:726-32.
9. Nayak G, Shetty S, Singh I. Paramolar tubercle: A diversity in canal configuration identified with the aid of spiral computed tomography. Eur J Dent 2013;7:139-44.
10. Ohishi K, Ohishi M, Takahashi A, Kido J, Uemura S, Nagata T. Examination of the roots of paramolar tubercles with computed tomography: Report of 3 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;88:479-83.
11. Bolk L. Problems of human dentition. Am J Anat 1916;19:91-148.
12. Friedman S, Stabholz A, Rotstein I. Endodontic management of molars with developmental anomalies. Int Endod J 1986;19:267-76.
13. Zidan O, el-Deeb M. Restorative and endodontic management of an anomalous mandibular molar. Quintessence Int 1991;22:189-92.
14. Thompson BH. Endodontic therapy of an unusual maxillary second molar. J Endod 1986;14:143-6.
15. Turner RA, Harris EF. Maxillary second premolars with paramolar tubercles. Dent Anthropol 2004;17:75-8.
16. Hanihara K. Criteria for classification of crown characters of the human deciduous dentition. J Anthropol Soc Nippon 1961;69:27-45.
17. Kustaloglu OA. Paramolar structures of the upper dentition. J Dent Res 1962;41:75-83.
18. Ooshima T, Ishida R, Mishima K, Sobue S. The prevalence of developmental anomalies of teeth and their association with tooth size in the primary and permanent dentitions of 1650 Japanese children. Int J Paediatr Dent 1996;6:87-94.
19. Desai VD, Gaurav I, Das S, Kumar MS. Paramolar complex – The microdental variations: Case series with review of literature. Ann Bioanthropol 2014;2:65-73.
20. Gutarts R, Nusstein J, Reader A, Beck M. In vivo debridement efficacy of ultrasonic irrigation following hand-rotary instrumentation in human mandibular molars. J Endod 2005;31:166-70.
21. Lloyd A, Uhles JP, Clement DJ, Garcia-Godoy F. Elimination of intracanal tissue and debris through a novel laser-activated system assessed using high-resolution micro-computed tomography: A pilot study. J Endod 2014;40:584-7.
22. Arslan H, Capar ID, Saygili G, Gok T, Akcay M. Effect of photon-initiated photoacoustic streaming on removal of apically placed dentinal debris. Int Endod J 2014;47:1072-7.
23. Molina B, Glickman G, Vandrangi P, Khakpour M. Evaluation of root canal debridement of human molars using the GentleWave system. J Endod 2015;41:1701-5.
24. Haapasalo M, Wang Z, Shen Y, Curtis A, Patel P, Khakpour M. Tissue dissolution by a novel multisonic ultracleaning system and sodium hypochlorite. J Endod 2014;40:1178-81.
25. Thomas AR, Velmurugan N, Smita S, Jothilatha S. Comparative evaluation of canal isthmus debridement efficacy of modified EndoVac technique with different irrigation systems. J Endod 2014;40:1676-80.