IEJ
Iranian Endodontic Journal

Root Canal Treatment of a Geminated Maxillary Second Molar with C-shaped Canal System: A Case Report

Mina Mehrjouei [a], **Maryam Khorasanchi** [a*]

[a] Department of Endodontics, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

Article Type: Case Report

Received: 13 May 2023
Revised: 19 Jun 2023
Accepted: 07 Jun 2023
Doi: *10.22037/iej.v18i3.41384*

***Corresponding author**: Maryam Khorasanchi, Vakilabad Blvd, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

E-mail: KhorasanchiM4011@mums.ac.ir

Gemination is a rare phenomenon in the maxillary posterior teeth. Endodontic treatment of these teeth requires special care due to the bizarre anatomy particularly when it is accompanied by a C-shaped canal system. This report illustrates a patient with a rare geminated C-shaped maxillary second molar comprised of two sections in its crown, including a geminated section attached to a normal coronal of a second maxillary molar diagnosed with the pulpal status "necrosis" and "irreversible pulpitis" in geminated section and the molar respectively. Thus, endodontic treatment was performed on both parts of the tooth. Two months follow-up revealed well-functioning teeth with normal status of periapical tissue with no mobility or abnormality. Successful treatment of unusual anatomical teeth requires adherence to biomechanical principles of canal preparation and coronal restoration.

Keywords: Abnormalities; Gemination; Root Canal Treatment

Introduction

Variation in the shape of teeth is a common finding. The developmental anomaly of conjoined teeth has been defined in different terms such as gemination, concrescence, fusion, twining, and double teeth [1]. Gemination may develop in the morpho-differentiation stage, due to aberration of the ectoderm and the mesoderm [2].

In the gemination process, an unsuccessful attempt of the tooth bud division occurs which is halted before tooth formation is completed. Therefore a single tooth comprising a bifid crown with connected pulp chambers is developed, mostly seen in the permanent maxillary incisors [3]. However, this anomaly occurs extremely rare in molars [4, 5]. Despite the miscellaneous prevalence rate in discrete reports, the overall prevalence in the primary and the permanent dentition appears to be approximately 0.5% and 0.1% respectively [6]. Moreover, gemination is more commonly found among Mongolians (5%) than in Caucasians (0.5%) [7]. Studies conducted on the Iranian population using cone beam computed tomography showed that the greatest variation in canal anatomy of maxillary first and second molars was discovered in the mesiobuccal canals [8-10].

C-shaped teeth encompass morphological diversity in the canal system, nevertheless, the canal, presenting like the letter "c", can be seen at any cross-section of the involved root canal [11]. The occurrence of web type connection or fin between root canals leads to identifying a root canal bearing C shape [12]. One study reported the global prevalence of C-shaped canal system in maxillary first and second molars was 3.8% and 1.1% respectively [13]. Hence it is more uncommon in second maxillary molars [14]. This variation contributes to considerable challenges not only in comprehensive debridement but also during obturation and filling [12].

Normally, geminated teeth are asymptomatic in pulp and periapical and therefore not require root canal treatment [1]. Nevertheless, due to poor aesthetics, caries deterioration, and pulp necrosis as well as periodontal reasons, root canal treatment might be prescribed [2].

In this article, we present a case of successful endodontic treatment in the maxillary second molar with gemination anomaly and C-shaped canal system.

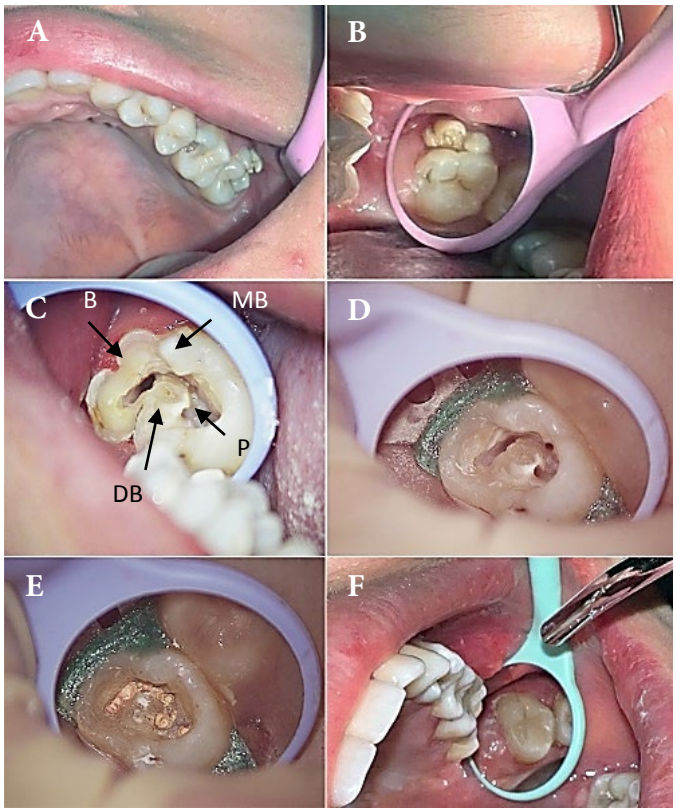

Figure 1. Intraoral photographic views, *A*) Lateral view; *B*) Occlusal view of initial clinical examination, observing a geminated maxillary left second molar with caries; *C)* Caries removal, completed access cavity preparation, the four orifices are shown, B: Buccal canal, MB: Mesiobuccal canal, DB: Distobuccal canal, P: Palatal canal; *D)* Patient referred to restorative dentist for rebuilding the buccal wall and enhancing rubber dam isolation; *E)* Final compaction of gutta-percha; *F)* Well-functioning teeth with composite restoration at two months follow-up

Case Presentation

A 19-year-old female in good normal health and with no systemic disease (ASA 1) with a chief complaint of pain in the upper left quadrant was referred to Mashhad dental school for endodontic treatment of an anomalous maxillary second molar. The initial clinical examination revealed a geminated maxillary left second molar with severe decay on the occlusobuccal aspect (Figures 1A and 1B). The crown of the tooth consisted of two parts, a geminated section attached to a normal coronal of a second maxillary molar. Pulp sensibility tests including electronic pulpal test (EPT), heat, and cold were conducted for each part. The pulpal status of geminated section and the molar was concluded as "necrosis" and "irreversible pulpitis" respectively. The periapical diagnosis was set to normal as no response to palpation and percussion test was observed; in addition to the normal periapical area of all roots demonstrated in the radiographic examination (Figure 2A).

To corroborate the anomalous morphology, and regarding the limitations of the 2D conventional radiography, a cone-beam computed tomography (CBCT) examination was performed using a Promax 3D unit (Planmeca, Helsinki, Finland). CBCT analysis shed light on the root canal system morphology: four orifices including buccal, mesiobuccal, distobuccal, and palatal were detected (Figure 3). The three buccal orifices in one fused buccal root were later merged into one canal and one apical foramen, namely the XVIII type of Vertucci's classification and forming a C-shaped canal system through the root length. Separately palatal root had one orifice leading to one foramen (Figure 1C).

Conclusively, the designed treatment plan was root canal therapy, restoring the tooth, and following up on the tooth. The prognosis was assessed as "Good". All procedures were performed under an endodontic microscope (OMS2350; Zumax, Jiangsu, China) at 5× magnification.

The patient was enlightened about the treatment process during the first visit and an informed consent form was signed by the patient. The procedure began with local anesthesia using the infiltration technique with 2% lidocaine with 1:100000 epinephrine (Daroupakhsh, Tehran, Iran). After removing caries, rubber dam isolation was compromised due to a lack of buccal wall (Figure 1C). At this point, the patient was referred to the restorative dentist to build a composite wall at the buccal side in order to facilitate the clamp placement of the rubber dam and isolation (Figure 1D).

Afterward, an access cavity was prepared and four canal orifices were found as described earlier (Figure 1C). Working length was measured with an electronic apex locator (Minipex, Woodpecker, Guilin, Guangxi, China) and confirmed by radiograph (Figure 2B). Root canal preparation was initiated manually using K-files. Irrigation activated by Sonic Irrigator activator (Easydo Activator system, EasyinSmile, USA) exerted with sodium hypochlorite solution, saline, and final irrigation with 17% EDTA and saline respectively. Shaping in buccal canals was finished with size 25/04 M3 Rotary file and M3 Pro Gold files (M3, United Dental, Shanghai, China) driven by an NSK rotary motor (Endo-Mate DT, NSK Dental, Japan), however, the palatal root prepared with 35/04 M3 Rotary file.

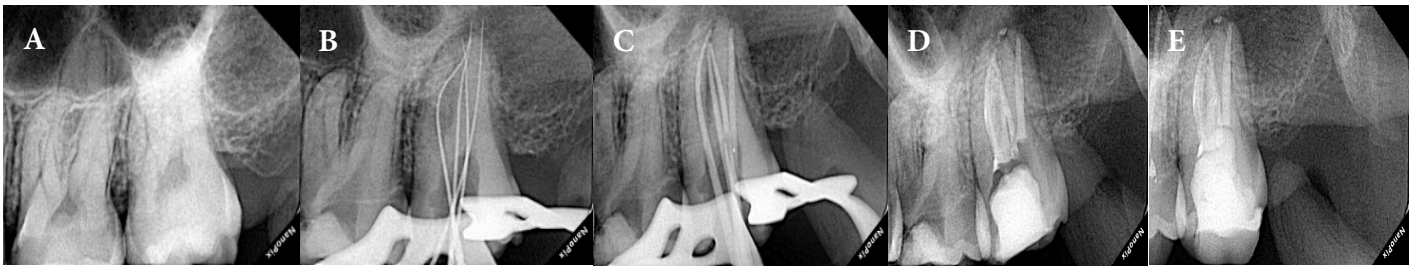

Figure 2. Periapical radiographic images, *A)* Initial periapical radiography; *B)* Confirmation of working length; *C)* Insertion of the master apical cones; *D)* Final radiograph demonstrating densely condensed root canal fillings in all canals; *E)* Periapical radiograph at two months follow-up, demonstrating normal periapical tissues

Figure 3. CBCT images of the maxillary second molar, axial views with slice intervals at 1 mm

Canals were dried with paper points. Obturation consisted of warm vertical condensation technique by inserting the master cones (Figure 2C) and utilizing Fast Pack (Eighteeth Medical, Chang-Zhou, China), then filling the remaining coronal portion with the thermos-plasticized gutta-percha using Fast Fill (Eighteeth Medical, ChangZhou, China). Also, the PDL exposure between the two sections of the tooth was disinfected and sealed with MTA (ProRoot MTA; Dentsply, Tulsa Dental, Tulsa, OK, USA). AH-26 sealer (Dentsply, Konstanz, Germany) was used. Then the coronal access was sealed with Cavit (3M ESPE, Seefeld, Germany) temporary restoration. The final radiograph demonstrated densely condensed root canal fillings in all canals (Figure 1E, 2D).

Then the patient was referred to continue the next step of the treatment plan by restoring the crown through composite restoration. Two months follow-up revealed well-functioning teeth with normal status of periapical tissue with no mobility or abnormality (Figure 1F, 2E). During this time the first maxillary left molar underwent root canal treatment.

Discussion

The anatomy of the maxillary second molar tooth has been extensively studied [15, 16], with a few case reports highlighting anomalous variations [17-19]. Nevertheless, some cases of gemination and C-shaped molars have been reported [20, 21]. Thus, a maxillary second molar with gemination and a C-shaped canal system is categorized as a rare anatomical variation.

Fusion is a union of two teeth due to pressure or force. This may either have only one pulp chamber with a convergence of enamel and dentine as occur in gemination or can have two separate pulp chambers attached only with dentin [22-24]. Distinguishing gemination from fusion can be confusing, but counting the number of teeth during clinical and radiological examinations can usually resolve the issue [25].

Moreover, Kim *et al.* [26] reported that a geminated second molar might be seen with agenesis of the third molar, which in this case, the patient's dental history indicated the absence of the wisdom teeth and not previous extraction.

Additionally, root configuration plays a pivotal role in differentiating between fusion and gemination radiographically, as in the case of gemination there is usually one large root canal, while in fusion usually two separate root canals are observed [27].

Hence, concerning the counting of the dentition, absence of the third molar, and large C-shaped root canal in the buccal portion of this tooth; the diagnosis was set to gemination.

Canal preparation and obturation of C-shaped canals, regarding their complex root canal system and several inaccessible fins between canals [28], require a modified endodontic treatment approach as it appears to be challenging compared to normal anatomy [29]. The C-shaped canal system can be present at any arbitrary cross-section or remain through the root length [30].

In this case regarding the caries defect as well as the groove between the buccal cusp and the geminated portion, pulp necrosis has occurred over time. Commonly, an early connection between the tooth pulp and the oral cavity is made due to this anomalous condition, which necessitates endodontic treatment.

The root canal morphology was confirmed by CBCT examination due to the superimposition of periapical radiographs in which geometric distortion of the anatomic structures evaluated was more probable. CBCT enables clinicians to investigate the complex internal anatomy of root canal systems and perform cleaning, shaping, and obturating them more efficiently [31]. Moreover, CBCT accurately reveals the type, extension, and complex morphology of dental anomalies [32], and utilizing this technology can be considered as an obligatory tool that without its help, proper management of cases cannot be done.

Conclusions

This case report demonstrated a complicated root canal treatment with communication between two abnormal pulp chambers and root canals due to the occurrence of gemination. Thus, endodontic treatment was performed on both parts of the tooth. Successful treatment of teeth with unusual anatomy requires adherence to biomechanical principles of canal preparation and coronal restoration.

Conflict of Interest: 'None declared'.

References

1. Milos S, Maja V, Ivona B, Miroslav M, Radisa V. All We Need to Know about Normal and Abnormal Human Teeth. In: Dr. Lavinia Cosmina A, Prof. Laura-Cristina Cristina R, editors. Human Teeth - From Function to Esthetics. Rijeka: IntechOpen; 2023. p. Ch. 11.
2. Grover P, Lorton L. Gemination and twinning in the permanent dentition. Oral Surg Oral Med Oral Pathol. 1985;59(3):313-8.
3. Kremeier K, Pontius O, Klaiber B, Hülsmann M. Nonsurgical endodontic management of a double tooth: a case report. Int Endod J. 2007;40(11):908-15.
4. Fekonja A. Prevalence of dental developmental anomalies of permanent teeth in children and their influence on esthetics. J Esthet Restor Dent. 2017;29(4):276-83.
5. Salem Milani A. Endodontic management of a fused mandibular second molar and paramolar: a case report. Iran Endod J. 2010;5(3):131-4.
6. Rao P, Veena K, Chatra L, Shenai P. Twin tooth on either side: A case report of bilateral gemination. Ann Med Health Sci Res. 2013;3(2):271.
7. Agnihotri A, Marwah N, Goel M. Geminated maxillary lateral incisor with talons cusp: A rare case report. J Oral Health Comm Dent. 2007;1(2):40-2.
8. Rouhani A, Bagherpour A, Akbari M, Azizi M, Nejat A, Naghavi N. Cone-beam computed tomography evaluation of maxillary first and second molars in Iranian population: a morphological study. Iran Endod J. 2014;9(3):190-4.
9. Naseri M, Safi Y, Akbarzadeh Baghban A, Khayat A, Eftekhar L. Survey of Anatomy and Root Canal Morphology of Maxillary First Molars Regarding Age and Gender in an Iranian Population Using Cone-Beam Computed Tomography. Iran Endod J. 2016;11(4):298-303.
10. Naseri M, Ali Mozayeni M, Safi Y, Heidarnia M, Akbarzadeh Baghban A, Norouzi N. Root Canal Morphology of Maxillary Second Molars according to Age and Gender in a Selected Iranian Population: A Cone-Beam Computed Tomography Evaluation. Iran Endod J. 2018;13(3):373-80.
11. Irfan F, Ali SA, Khan H, Rehman A, Akhtar H, Younus MZ. Prevalence of C-Shaped Root Canals and Its Types in Mandibular Second Molars in Karachi Pakistan: An In-Vitro Study. Pakistan Oral & Dental Journal. 2022;42(4):184-8.
12. Al Yahya RS, Al Attas MH, Javed MQ, Khan KI, Atique S, Abulhamael AM, Bahammam HA. Root Canal Configuration and Its Relationship with Endodontic Technical Errors and Periapical Status in Premolar Teeth of a Saudi Sub-Population: A Cross-Sectional Observational CBCT Study. Int J Environ Res Public Health. 2023;20(2):1142.
13. Martins JNR, Mata A, Marques D, Anderson C, Caramês J. Prevalence and Characteristics of the Maxillary C-shaped Molar. J Endod. 2016;42(3):383-9.

14. Martins J, Marques D, Silva E, Caramês J, Mata A, Versiani M. Prevalence of C-shaped canal morphology using cone beam computed tomography–a systematic review with meta-analysis. Int Endod J. 2019;52(11):1556-72.
15. Ghasemi N, Rahimi S, Shahi S, Samiei M, Frough Reyhani M, Ranjkesh B. A Review on Root Anatomy and Canal Configuration of the Maxillary Second Molars. Iran Endod J. 2017;12(1):1-9.
16. Khademi A, Zamani Naser A, Bahreinian Z, Mehdizadeh M, Najarian M, Khazaei S. Root Morphology and Canal Configuration of First and Second Maxillary Molars in a Selected Iranian Population: A Cone-Beam Computed Tomography Evaluation. Iran Endod J. 2017;12(3):288-92.
17. Ozcan E, Aktan AM, Arı H. A case report: unusual anatomy of maxillary second molar with 3 mesiobuccal canals. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107(1):e43-e6.
18. Asgary S. Endodontic treatment of a maxillary second molar with developmental anomaly: a case report. Iran Endod J. 2007;2(2):73-6.
19. Shakouie S, Mokhtari H, Ghasemi N, Gholizadeh S. Two-rooted maxillary first molars with two canals: a case series. Iran Endod J. 2013;8(1):29-32.
20. Pereira RP, Ravazzi R, Silva RV, Nunes E, Gusmão JMR, Campos PSF. Multidisciplinary Treatment of a Double First Mandibular Premolar. Iran Endod J. 2017;12(4):512.
21. Paksefat S, Rahimi S. Root canal treatment of a two-rooted C-shaped maxillary first molar: a case report. Iran Endod J. 2014;9(4):301.
22. Tannenbaum KA, Alling EE. Anomalous tooth development: case reports of gemination and twinning. Oral Surg Oral Med Oral Pathol. 1963;16(7):883-7.
23. Venkatesh A, Mitthra S, Prakash V, Prasad TS. Gemination or fusion?–a case report. Biomed Pharmacol J. 2016;9(3):1225-8.
24. Jarząbek A, Gońda-Domin M, Węsierska K, Aniko-Włodarczyk M, Trybek G, Nowicka A. Multidisciplinary Management of a Double Immature Permanent Tooth: A Case Report. Iran Endod J. 2020;15(4):253-8.
25. Altug-Atac AT, Erdem D. Prevalence and distribution of dental anomalies in orthodontic patients. Am J Orthod Dentofacial Orthop. 2007;131(4):510-4.
26. Kim E, Jou Y-T. A supernumerary tooth fused to the facial surface of a maxillary permanent central incisor: case report. J Endod. 2000;26(1):45-8.
27. Kelly JR. Gemination, fusion, or both? Oral Surg Oral Med Oral Pathol. 1978;45(2):326-7.
28. Chai WL, Thong YL. Cross-sectional morphology and minimum canal wall widths in C-shaped roots of mandibular molars. J Endod. 2004;30(7):509-12.
29. Fan B, Min Y, Lu G, Yang J, Cheung GS, Gutmann JL. Negotiation of C-shaped canal systems in mandibular second molars. J Endod. 2009;35(7):1003-8.
30. Fan B, Cheung GS, Fan M, Gutmann JL, Bian Z. C-shaped canal system in mandibular second molars: part I—anatomical features. J Endod. 2004;30(12):899-903.
31. James EP, Johns DA, Johnson K, Maroli RK. Management of geminated maxillary lateral incisor using cone beam computed tomography as a diagnostic tool. J Conserv Dent. 2014;17(3):293.
32. Pradeep K, Charlie M, Kuttappa M, Rao PK. Conservative management of type III dens in dente using cone beam computed tomography. J Clin Imaging Sci. 2012;2.

Please cite this paper as: Mehrjouei M, Khorasanchi M. Root Canal Treatment of a Geminated Maxillary Second Molar with C-shaped Canal System: A Case Report. Iran Endod J. 2023;18(3): 181-5. *Doi: 10.22037/iej.v18i3.41384.*