Received: 24 September 2023 | Revised: 16 January 2024 | Accepted: 19 January 2024

DOI: 10.1002/ccr3.8505

CASE REPORT

Clinical Case Reports Open Access WILEY

Endodontic treatment of a C-shaped mandibular second molar with narrow dentinal thickness: A case report

Mina Mehrjouei[1] | Hamid Jafarzadeh[1,2] | Pourya Esmaeelpour[1] | Maryam Khorasanchi[1]

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

[2]Faculty of Dentistry, University of Toronto, Toronto, Ontario, Canada

Correspondence
Maryam Khorasanchi, Department of Endodontics, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran.
Email: khorasanchim4011@mums.ac.ir

Key Clinical Message

Formulating an effective root canal treatment plan necessitates clinician awareness of the complexities of the root canal system and possible anatomic challenges. The C-shaped canal variation accompanying the radicular lingual groove makes the lingual dentinal wall so thin that cleaning and shaping of canals require accurate management. This report presents endodontic treatment of a C-shaped mandibular second molar diagnosed with pulpal necrosis and asymptomatic apical periodontitis, that initial radiographic assessment revealed extremely thin (0.3 mm) width of the lingual wall of the canals prone to perforation. Mechanical preparation was performed through the anti-curvature technique and basically by chemical irrigation rather than mechanical instrumentation. The C-shaped isthmus was prepared up to 25/02 rotary system without dentinal defect while maintaining adequate dentin thickness so as to not significantly reduce the strength of the root. Follow-up radiographs showed normal periodontal ligament and lamina dura indicating significant healing of the periapical lesion.

KEYWORDS

anatomic variation, C-shaped canal, dentin thickness, endodontic treatment

1 | INTRODUCTION

The variations in root canal system morphology in molars involve clinicians facing ceaseless challenges in endodontic treatments. For instance the C-shaped root canal configuration, an anatomical canal variation usually found in root-fused teeth, characterized by the existence of isthmus or webs connecting the canals, seen at the three dimensional transverse cross-sections.[1]

The C-shaped configuration can either continue through the root length being present at any arbitrary cross-section or divide within two/three separate canals along the way to the apex in the C-shaped groove. These teeth may have conical or square form roots due to fusing at the buccal or lingual side.[2–4] Root fusion is highly frequent in the mandibular second molars, therefore C-shaped canals are mostly seen in these teeth[5]; however, it has also been reported in other teeth like premolars, mandibular first molars, and maxillary molars.[6–8]

The diagnosis of C-shaped root canals based on two dimensional radiographs is challenging. However, observing the following in periapical radiographs may raise a suspicion of the presence of an unusual canal anatomy: fused root, poorly distinguished floor of the pulp chamber, working length radiograph with inserted instruments that gives the impression of a perforation in the furcation area, or instruments that tend to converge at the root apex.

CBCT can clearly display C-shaped root canal morphology through 3D reconstruction technology, providing accurate image data for diagnosis and treatment without overlap, amplification, or deformation. It is currently an ideal examination technology.

The definitive diagnosis is determined after accessing to the pulp chamber and detecting the ribbon shape of the orifice under magnification.

Cleaning, shaping, and obturation of C-shaped canals seem to be challenging, requiring modified endodontic treatment regimens compared with normal anatomy,[9,10] that is due to their complex root canal system and several inaccessible fins between canals. As described, like the letter C, the orifice of this ribbon-shaped canal imitates an arc of 180° that initiates at the mesiolingual aspect of the pulp chamber, curves in the buccal aspect and ends toward the distal of the tooth.[1] This creates unreachable regions difficult to disinfect.[10]

Thin dentinal walls or in other words, the narrow distance between the canal and the exterior root surface which is due to the deep groove of the root, can increase the risk of a strip perforation. This is a great concern in the concept of root canal preparation in teeth with such anatomy.[11–13] Other causes of failures with a high rate of probability include a leaky canal, missing canal, overfilling, isthmus, and iatrogenic accidents.[11]

No consensus on the matter of critical dentinal wall thickness has been reached that can guide the clinicians when the canal wall may break down at this level. Lim and Stock[14] found that 0.2–0.3 mm thickness is required for the dentinal wall to prevent fracture while placing and compacting root canal filling. Moreover, it is found that the thinner lingual walls of the C-shaped canal are more prone to root perforation during post preparation.[10]

This case report aims to address endodontic treatment of a C-shaped mandibular second molar with a narrow lingual danger zone prone to perforation.

2 | CASE PRESENTATION

A 42-year-old female in normal general health condition was referred to the Department of Endodontics of Mashhad Faculty of Dentistry, Mashhad, Iran. Her chief complaint was a history of severe pain in the mandibular right quadrant. The primary intra-oral examination revealed a mandibular second molar with recurrent caries and a sinus tract exiting through the lingual surface of the gingiva (Figure 1A). Furcal lesions were demonstrated in periapical radiograph (Figure 1B). Moreover, the tooth was not responsive to pulpal sensitivity tests including cold spray (Pishrosabzfidar, Tehran, Iran) or electric pulp test (Perkell, New York, USA). Therefore, the initial diagnosis of the pulpal and periapical status was set to pulpal necrosis and asymptomatic apical periodontitis respectively, and root canal therapy was arranged as the treatment plan with good prognosis and an informed consent form was signed by the patient.

As the first measure of treatment, anesthesia was achieved by inferior alveolar nerve block technique using 1.8 mL of 2% lidocaine with 1:80,000 epinephrine (Darupakhsh, Tehran, Iran). After rubber dam isolation, the restoration, as well as caries, were removed and the access cavity was prepared to the extent where the C-shaped orifices were apparent (Figure 2A). The configuration of the orifices exhibited a separate mesiolingual canal adjacent to a main C-shaped canal at distal which was categorized as C2 type according the Fan et al. (2) classification.

Root canal preparation was initiated through the negotiation of canals with #10K-file (MANI, Utsunomiya, Japan).

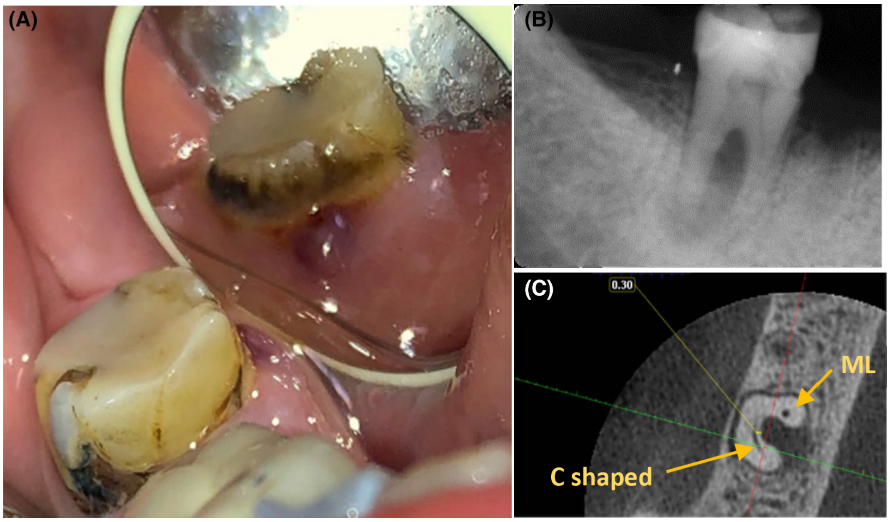

FIGURE 1 (A) Sinus tract observed in primary intra-oral examination, (B) Initial periapical radiography shows the periradicular lesion, (C) CBCT evaluation illustarting extremely thin width of 0.3 mm at danger zone, ML: Mesiolingal canal.

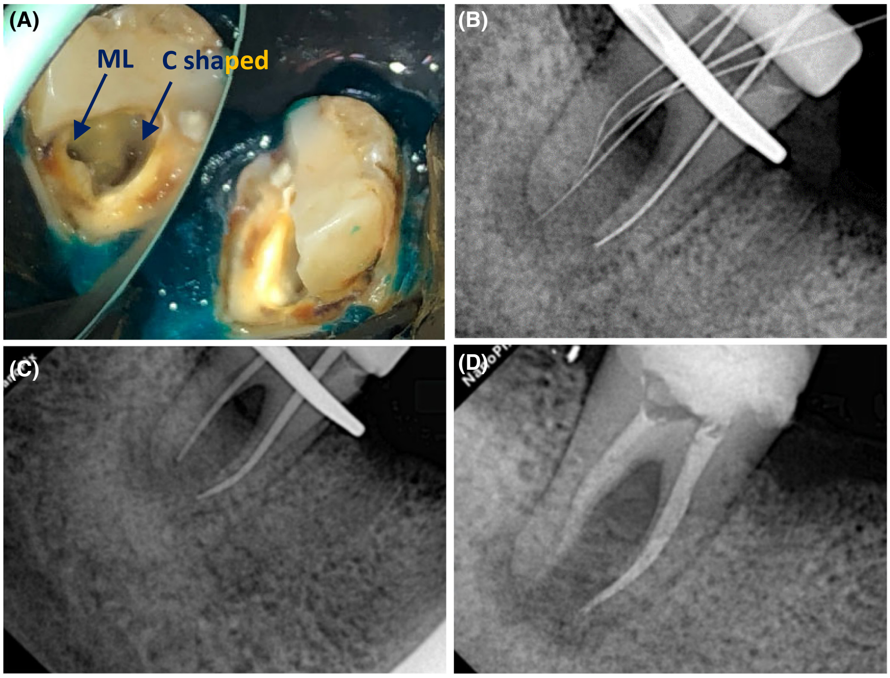

FIGURE 2 (A) Mesiolingual and C-shaped orifice after completion of access cavity preparation, ML: Mesiolingual. (B) Working length confirmation with periapical radiography in which potential perforation is suspected. (C) Master apical cone radiograph. (D) Final radiograph.

The working length was determined using an electronic apex locator (Minipex, Woodpecker, Guilin, China) and then confirmed by a periapical radiograph (Figure 2B).

In the initial radiographic assessment, the danger zone of the distal root was suspected with potential perforation (Figure 2B), however; no sign of perforation including intracanal bleeding or apex locator alarm was observed. Furthermore, cone-beam computed tomography (CBCT) contradicted the primary findings of conventional periapical radiographs. CBCT revealed the width of the lingual wall of the canals was extremely thin as 0.3 mm (Figure 1C). Thus, in this case, the approach to root canal preparation was focused on chemical irrigation rather than mechanical preparation to avoid any perforation of the lingual wall and optimal cleaning of the fins between the canals.

Mechanical preparation was performed through the anti-curvature technique. After establishing the glide path with 10/02 path files, the mesiolingual canal and the C-shaped isthmus were prepared up to 25/04 and 25/02, respectively. The root canal was irrigated after each file with 5.25% NaOCl (2 mL) using a 30G double-side vented syringes (United Dental, Shanghai, China) and activated by ultrasonic irrigation (Eighteeth, Sifary Medical Technology, Changzhou, China) for 30 seconds. Then, the canals were rinsed with a final rinse of 17% EDTA (5 mL) activated for 1 min to remove the smear layer, and finally the canals were dried with sterile paper points (AriaDent, Tehran, Iran).

At this point, the dried canals were checked with paper points for potential bleeding to ensure no perforation had occurred, as the cone being soaked with blood may indicate a strip perforation.

Obturation was done with thermoplasticized gutta-percha (Eighteeth, Sifary Medical Technology, Changzhou, China) in the mesiolingual canal, nevertheless, the C-shaped canal was filled with mineral trioxide aggregate (MTA) (Angelus, Londrina, Brasil) in full length to prevent condensation pressure on the thin dentinal wall in this canal as well as sealing potential strip perforation (Figure 2C,D). All procedures were performed under an endodontic microscope (OMS2350; ZUMAX, Jiangsu, China).

After completing the root canal treatment, the patient was referred to the Department of Restorative Dentistry of Mashhad Faculty of Dentistry, Mashhad, Iran and the tooth was restored with a full coverage crown. A six-month follow-up clinical examination revealed a well-functioning tooth with no mobility or abnormality and recall radiograph demonstrated healing of the periapical lesion (Figure 3A). Furthermore, CBCT taken at twelfth month of follow-up showed normal periodontal ligament and lamina dura indicating significant healing of the periapical lesion (Figure 3B). The patient's treatment plan for the adjacent edentulous space involved an implant, and at the twelfth-month follow-up, the patient had undergone a CBCT of the area. Following the ALARA rule, the patient was not obligated to take additional radiographs. Moreover CBCTs are considered the most accurate for assessing the healing of periapical radiolucency.[15] Therefore the authors reported the twelfth month follow-up based on the preordered CBCT.

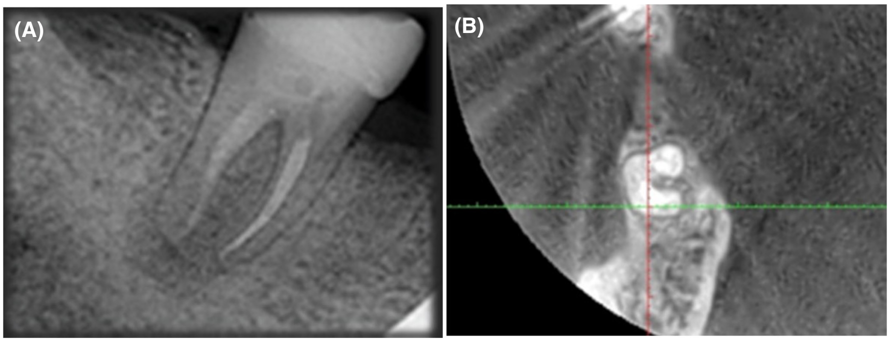

FIGURE 3 (A) Follow-up radiograph after 6 months. Healing of periradicular lesions is observed. (B) CBCT evaluation after 12 months revealed satisfactory outcome of the treatment.

3 | DISCUSSION

The endodontic treatment of a C-shaped mandibular second molar with an extremely thin lingual danger zone is demonstrated in this report. Twelve months of follow-up presented the periapical lesion healing, therefore, the treatment procedure was considered to be effective with the above-mentioned approach.

The C-shaped configuration is a significant ethnic variation. A relatively high prevalence has been reported in mandibular second molars of Chinese and Lebanese populations and is more common in Asians than in whites.[7]

Researches demonstrated that both cold lateral and warm vertical compaction techniques can be responsible for crack propagation in root structure which is not favorable.[16] In order to seal ribbon-shaped connections in a C-shaped canal system comprehensively thermoplasticized gutta-percha technique has been proven to have more favorable result.[17] In this case, the warm vertical compaction technique was used for the obturation of the mesiolingual canal which was separated from the main C-shaped configuration. However, the main C-shaped canal was filled with MTA justified by the excellent reparative property exhibited by this material and to seal any possible perforations as well as precluding crack incidence of condensation pressure in the extremely thin dentinal wall of canal.

Lim and Stock[14] found that 0.2–0.3 mm thickness is required for the dentinal wall to prevent fracture while placing and compacting root canal filling. In a study conducted by Cheung and Cheung,[18] the average dentin thickness in C-shaped molars after instrumentation to size 30/06 was investigated, authors observed that the mesiolingual canals have always the shortest mean thickness at different root levels (0.71–0.96 mm). Not much data is available regarding this controversial issue and no consensus on the matter of critical dentinal wall thickness has been reached that can guide the clinicians when the canal wall may break down at this level. Small perforations may remain undetected by the clinician even in a clinical situation as well as periapical radiograph. Several approaches have been suggested in literature to assist the operator as discussed below.

1. Tactile sense
2. Persistent bleeding during preparation
3. Paper point soaked with blood
4. The apex locator alarm
5. Radiolucency associated with a communication between the root canal walls and the periodontal space

Tactile sense as described by Mamoun et al.[19] is an aid for clinician to suspect to perforations when accompanying other signs. A file in a perforation may provide a kink feeling, from the file rubbing against the coronal aspect of the perforation, and also advanced apically. Despite the fact that a file in a canal normally provides a consistent, smoother tactile feeling, a file in a perforation may give a tactile sense of a “bottomless pit,” as if no boundary exists when the file is moved laterally.[19]

During root canal preparation of vital teeth, the radicular pulp may be excised. After removal of pulp tissue, persistent bleeding during preparation of coronal access or root canal may be indicative of a perforation.[20] A file in a necrotic canal may induce unexpected orifice bleeding when the file is negotiated past the apex due to severance of blood vessels located beyond the apex. In this case the pulpal status was necrosis and no bleeding occurred after access cavity and root canal preparation. Thus, no perforation had occurred at this stage.[19]

An additional approach for detection of perforation is a paper point soaked with blood could be suggestive of perforation which in this case was not observed after cleaning and drying the root canals. However, medications, systemic conditions, open apex or internal resorbed teeth as well as symptomatic apical periodontitis may be associated with excessive bleeding, and be mistaken with root perforation.[21]

To eliminate this challenge of detecting root perforation, the apex locator as a technological resource may help clinically to conquer this issue; however, it may show some false results. Although small perforation may remain unnoticed until extrusion of sealer illustrated in final periapical radiograph.[21]

In periapical radiographs, a pivotal vestige of root canal perforation are demonstrated as a radiolucency associated with a communication between the root canal walls and the periodontal space. Nevertheless in the periapical radiograph of this case was perforation suspected.

Two features, notable in the radiographs of this case, has been corroborated by literature for c-shaped canal[7,22] including: (a) instruments may exit at the furcation and (b) instruments tend to converge at the apex.[2] The former may appear as a perforation of the furcation, however, the mentioned approaches are available to rule out the possibility.

The incorporation of CBCT in endodontic procedures enables clinicians with new parameters helping to diagnose the pathologic and iatrogenic conditions.[23] Shemesh et al. concluded that CBCT scans possess a significantly higher sensitivity than periapical radiographs. However no significant difference was observed between the methods for detection of root perforations in their study. They argued that the inability of 2 dimensional periapical radiograph and CBCT to detect strip perforations may be due to the location of the perforation, which could be camouflaged by the concavity of the root and absence of filling material penetrating inside the perforation, respectively.[24]

Takahashi et al.[25] discovered the lingual dentinal width of the C-shaped anatomy to be narrower than the buccal side, which is due to the impeded dentin formation in this region. This phenomenon is explained through the broadening of the odontoblasts on lingual side of the canal. Hence, there is always a risk of strip perforation at the lingual wall of the C-shaped canal. Moreover Abou-Rass et al.[26] concluded that the anti-curvature technique for the preparation of c-shaped anatomy is useful. Although copious data are missing on this issue, it may be obvious that perforation or fracture is probable when dentin is thin. Using large instruments in the process of preparation and not avoiding the danger zone may lead to strip perforation.[27] Additionally the oversight might even remain undetected until after sealer extrusion of the defect, which in this case was not observed.

On one hand, mechanical root canal preparation generates high forces leading to dentinal defects[28] and rotary nickel–titanium instruments seems to be the major reason for the higher occurrence of dentinal defects when compared to manual preparation.[29] On the other hand, a systematic review investigated remaining dentine thickness (RDT) after pulpectomy in primary molars and compared the hand and rotary instrumentation. Authors concluded that in rotary instrumentation more RDT remains than manual root canal preparation systems according to the majority of studies.[30] Moreover, studies have demonstrated no differences regarding the cleaning efficacy of either system.[31–33] In this case we managed to remove infected dentin and perform cleaning with the rotary system without dentinal defect while maintaining adequate dentin thickness as to not significantly reduce the strength of the root.

As discussed comprehensively in literature, the ultimate goal of endodontic treatment is the elimination of microbial communities within the root canal system which can be achieved through mechanical instrumentation and chemical irrigation. The former aims to physically disrupt microbial biofilms as well as provide a shape that allows irrigants to infiltrate the root canal.[34] The irrigants during the endodontic treatment can act as lubricant to the dentinal walls and help to wash out loose debris as well as dissolve organic material in the canal, and eventually have an antimicrobial role.[35] Cleaning and disinfecting procedures rely on the mechanical and chemical properties of the irrigants. Mechanical effects include the flow and backflow of irrigant solution which significantly reduce the bacterial population inside the root canal system.[36]

However, the anatomical complexities encompass residue of infected pulp tissue leading to persistent intraradicular infection triggered by microorganisms hosted in these zones.[37] The presence of fins in a c-shaped canal configuration makes it challenging to do the debridement efficiently.[38] Consequently, ultrasonic irrigation plays a pivotal role in the debridement of inaccessible areas of the canal system.[18,39] Likely in the present case, the canal instrumentation was performed basically by chemical irrigation rather than mechanical instrumentation in order to prevent mishaps including strip perforation and better cleaning of the fins and webs. T-pro and Hero rotary systems with low constant tapering property were used to reduce the risk of perforation in the danger zone. Irrigation comprising NaOCl was activated by the ultrasonic for more efficient cleaning.

4 | CONCLUSION

The present case report illustrates the canal variations in the mandibular second molars. When the dentin thickness is minimum, abundant activated irrigation as well as conservative canal preparation is essential for successful outcome of the root canal treatment. Additionally, MTA might be a wise choice for obturating the canal in full length to prevent crack incidence of condensation pressure resulting from obturation techniques. The clinician must be aware of the unusual anatomic challenges necessitating adherence to biomechanical principles to achieve a successful endodontic outcome.

AUTHOR CONTRIBUTIONS

Mina Mehrjouei: Data curation; methodology. **Hamid Jafarzadeh:** Supervision. **Pourya Esmaeelpour:** Writing – original draft. **Maryam Khorasanchi:** Writing – original draft; writing – review and editing.

ACKNOWLEDGMENTS

The authors deny any conflicts of interest related to this study. We affirm that we have no financial affiliation (e.g., employment, direct payment, stock holdings, retainers, consultantships, patent licensing arrangements or honoraria), or involvement with any commercial organization with direct financial interest in the subject or materials discussed in this manuscript, nor have any such arrangements existed in the past 3 years.

FUNDING INFORMATION

None declared. There are no financial agreements, funding, or grants for this research.

CONFLICT OF INTEREST STATEMENT

None declared. We hereby declare that there is no conflict of interest regarding the publication of this paper, and we declare that the information given is true to the best of our knowledge.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analyzed.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

Mina Mehrjouei https://orcid.org/0000-0001-6201-2195
Hamid Jafarzadeh https://orcid.org/0000-0001-5318-7129
Pourya Esmaeelpour https://orcid.org/0009-0008-5649-5387
Maryam Khorasanchi https://orcid.org/0000-0002-8622-5029

REFERENCES

1. Cooke H 3rd, Cox FL. C-shaped canal configurations in mandibular molars. *J Am Dent Assoc*. 1979;99(5):836-839.
2. 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.
3. Riazifar N, Amini K, Boushehri MZ, Sheikhi M, Karamifar K. Biometric analysis of C-shaped root canals in mandibular second molars using cone-beam computed tomography. *Iran Endod J*. 2018;13(4):486-491.
4. Janani M, Rahimi S, Jafari F, Johari M, Nikniaz S, Ghasemi N. Anatomic features of C-shaped mandibular second molars in a selected Iranian population using CBCT. *Iran Endod J*. 2018;13(1):120-125.
5. Orban B, Mueller E. The development of the bifurcation of multirooted teeth. *J Am Dent Assoc*. 1929;16(2):297-319.
6. Jo H-H, Min J-B, Hwang H-K. Analysis of C-shaped root canal configuration in maxillary molars in a Korean population using cone-beam computed tomography. *Restor Dent Endod*. 2016;41(1):55-62.
7. Jafarzadeh H, Wu Y-N. The C-shaped root canal configuration: a review. *J Endod*. 2007;33(5):517-523.
8. Khorasani M, Nabavi S, Hamedi A, Jafarzadeh H. Endodontic treatment of C-shaped mandibular premolars: a case report and review of literature. *Iran Endod J*. 2021;16(4):244-253.
9. 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):1003-1008.
10. Chai WL, Thong YL. Cross-sectional morphology and minimum canal wall widths in C-shaped roots of mandibular molars. *J Endod*. 2004;30(7):509-512.
11. Gao Y, Fan B, Cheung GS, Gutmann JL, Fan M. C-shaped canal system in mandibular second molars part IV: 3-D morphological analysis and transverse measurement. *J Endod*. 2006;32(11):1062-1065.
12. Jin G-C, Lee S-J, Roh B-D. Anatomical study of C-shaped canals in mandibular second molars by analysis of computed tomography. *J Endod*. 2006;32(1):10-13.
13. Fan B, Cheung GS, Fan M, Gutmann JL, Fan W. C-shaped canal system in mandibular second molars: part II—radiographic features. *J Endod*. 2004;30(12):904-908.
14. Lim S, Stock C. The risk of perforation in the curved canal: anticurvature filing compared with the stepback technique. *Int Endod J*. 1987;20(1):33-39.
15. Antony DP, Thomas T, Nivedhitha M. Two-dimensional periapical, panoramic radiography versus three-dimensional cone-beam computed tomography in the detection of periapical lesion after endodontic treatment: a systematic review. *Cureus*. 2020;12(4):e7736.
16. Capar ID, Saygili G, Ergun H, Gok T, Arslan H, Ertas H. Effects of root canal preparation, various filling techniques and retreatment after filling on vertical root fracture and crack formation. *Dent Traumatol*. 2015;31(4):302-307.
17. Soo W, Thong Y, Gutmann J. A comparison of four gutta-percha filling techniques in simulated C-shaped canals. *Int Endod J*. 2015;48(8):736-746.
18. Cheung LH, Cheung GS. Evaluation of a rotary instrumentation method for C-shaped canals with micro-computed tomography. *J Endod*. 2008;34(10):1233-1238.
19. Mamoun JS. The maxillary molar endodontic access opening: a microscope-based approach. *Eur J Dent*. 2016;10(03):439-446.
20. Verma Y, Tyagi S, Dwivedi V, Sahu A, Satsangi A. Root perforations: a review of diagnosis, prognosis and materials. *J Appl Dent Med Sci*. 2021;7:3.
21. Estrela C, Decurcio DA, Rossi-Fedele G, Silva JA, Guedes OA, Borges ÁH. Root perforations: a review of diagnosis, prognosis and materials. *Braz Oral Res*. 2018;32:32.
22. Raisingani D, Gupta S, Mital P, Khullar P. Anatomic and diagnostic challenges of C-shaped root canal system. *Int J Clin Pediatr Dent*. 2014;7(1):35-39. doi:10.5005/jp-journals-10,005-1230

23. Dutra KL, Haas L, Porporatti AL, et al. Diagnostic accuracy of cone-beam computed tomography and conventional radiography on apical periodontitis: a systematic review and meta-analysis. *J Endod*. 2016;42(3):356-364.
24. Shemesh H, Cristescu RC, Wesselink PR, Wu M-K. The use of cone-beam computed tomography and digital periapical radiographs to diagnose root perforations. *J Endod*. 2011;37(4):513-516.
25. Takahashi M, Asami Y, Miyata K, Sasagawa I, Kobayashi K. On the peculiar dentin existing in the gutter-shaped root. *Shigaku*. 1989;76(7):1362-1373.
26. Abou-Rass M, Frank AL, Glick DH. The anticurvature filing method to prepare the curved root canal. *J Am Dent Assoc*. 1980;101(5):792-794.
27. Froughreyhani M, Milani AS, Barakatein B, Shiezadeh V. Treatment of strip perforation using root MTA: a case report. *Iran Endod J*. 2013;8(2):80-83.
28. Hülsmann M. Effects of mechanical instrumentation and chemical irrigation on the root canal dentin and surrounding tissues. *Endod Topics*. 2013;29(1):55-86.
29. Jovanović-Medojević M, Dragičević A, Milanović I, Matija L, Živković S. Opto-magnetic imaging spectroscopy in analyzing rotary NiTi endodontic instruments. *J Mech Behav Biomed Mater*. 2023;141:105789.
30. Nisar P, Katge F, Bhanushali P, Deshpande S, Poojari M, Shetty S. Comparative in vitro evaluation of remaining dentine thickness following instrumentation with hand and rotary endodontic files during pulpectomy in primary molars: a systematic review. *Eur Arch Paediatr Dent*. 2023;24(1):15-32.
31. Ramezanali F, Afkhami F, Soleimani A, Kharrazifard MJ, Rafiee F. Comparison of cleaning efficacy and instrumentation time in primary molars: Mtwo rotary instruments vs. hand K-Files. *Iran Endod J*. 2015;10(4):240-243. doi:10.7508/iej.2015.04.006
32. Musale P, Mujawar S. Evaluation of the efficacy of rotary vs. hand files in root canal preparation of primary teeth in vitro using CBCT. *Eur Arch Paediatr Dent*. 2014;15:113-120.
33. Moghaddam KN, Mehran M, Zadeh HF. Root canal cleaning efficacy of rotary and hand files instrumentation in primary molars. *Iran Endod J*. 2009;4(2):53.
34. Abusrewil S, Alshanta OA, Albashaireh K, et al. Detection, treatment and prevention of endodontic biofilm infections: what's new in 2020? *Crit Rev Microbiol*. 2020;46(2):194-212.
35. Campello AF, Rodrigues RC, Alves FR, et al. Enhancing the intracanal antibacterial effects of sodium hypochlorite with etidronic acid or citric acid. *J Endod*. 2022;48(9):1161-1168.
36. Siqueira JF Jr, Rôças IN, Santos SR, Lima KC, Magalhães FA, de Uzeda M. Efficacy of instrumentation techniques and irrigation regimens in reducing the bacterial population within root canals. *J Endod*. 2002;28(3):181-184.
37. Van Der Sluis L, Versluis M, Wu M, Wesselink P. Passive ultrasonic irrigation of the root canal: a review of the literature. *Int Endod J*. 2007;40(6):415-426.
38. Zhao Y, Fan W, Xu T, Tay F, Gutmann J, Fan B. Evaluation of several instrumentation techniques and irrigation methods on the percentage of untouched canal wall and accumulated dentine debris in C-shaped canals. *Int Endod J*. 2019;52(9):1354-1365.
39. Martin G, Arce Brisson G, Chen B, et al. Root dentine thickness in C-shaped lower second molars after instrumentation: a CBCT and micro-CT study. *Aust Endod J*. 2021;47(2):122-129.

How to cite this article: Mehrjouei M, Jafarzadeh H, Esmaeelpour P, Khorasanchi M. Endodontic treatment of a C-shaped mandibular second molar with narrow dentinal thickness: A case report. *Clin Case Rep*. 2024;12:e8505. doi:10.1002/ccr3.8505