Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

Endodontic Management of Dilacerated Roots: A Case Series and Review of Literature

Ali Chamani[1], Maryam Forghani[1], Iman Shiezadeh[1], and Amirmohammad Moradpour[1]

[1]Mashhad University of Medical Sciences

December 27, 2024

Endodontic Management of Dilacerated Roots: A Case Series and Review of Literature

Ali Chamani[1], Maryam Forghani[3], Iman Shiezadeh[2], Amirmohammad Moradpour[2]

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

[2] Student Research Committee, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

[3] Associate Professor of Endodontics, Faculty of Dentistry, Mashhad University of Medical Science

***Corresponding author:**

Amirmohammad Moradpour[1]

Am.moradpour@yahoo.com

1 Student Research Committee, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

Key Clinical Message:

Endodontic management of dilacerated teeth requires precise diagnosis and careful technique. Advanced imaging for accurate diagnosis, flexible NiTi files to ensure safety regarding canal negotiation, thorough irrigation, and thermoplastic obturation methods are preferred to achieve a reliable seal. Continuous follow-up is essential to monitor treatment success and address any complications.

Keywords\RL: Endodontic treatment, Double curved root canal, Root Canal Treatment (RCT), Second \RL premolars RCT, S-shaped root canal

Introduction

In 1848, Tomes introduced the term ”dilacerations” to describe an angular or sharply curved section in a tooth’s root or crown, as well as a misalignment between the crown and its root. This deformity often arises from disturbances during odontogenesis, such as traumatic injuries or ectopic development of the tooth germ (1). Dilaceration shows different geographic, age, and tooth-type distribution (2). The root dilacerations are most commonly present in the apical third of the root in incisors, canines, and premolars, the middle third of the root in first and second molars, and the radicular cervical third of the root in third molars (3).Both permanent and primary teeth can have Dilaceration, but the latter has a far lower prevalence; coronal dilaceration is more prevalent than radical dilaceration (4). The reported prevalence of radicular dilaceration depends on its exact definition. Reports range from 1.8% to 98%, which is a wide range (5). dilacerations may result from differing criteria for definition. Using a criterion of a 20-degree angle or greater

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

deviation from the long axis of the tooth, the prevalence of root dilacerations in maxillary lateral incisors was reported at 98% (6).

This article describes the successful treatment of three dilacerated root canals of the premolars (maxillary and mandibular) and a maxillary canine in an attempt to demonstrate how effective combined morphological knowledge and practical apparatus can be used in treatments of various root variations.

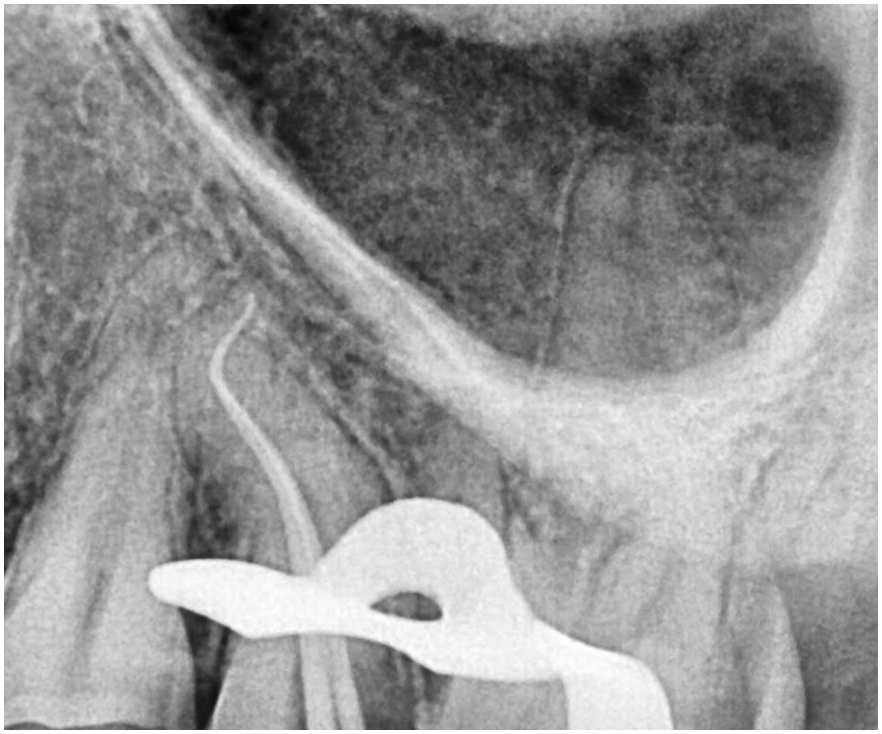
Case presentation

Case1

Case history/examination

A 28-year-old man with no history of systemic disease, allergies, or regular medication use was referred to the endodontic department for the treatment of a maxillary second premolar. The patient reported experiencing occasional pain in the upper left posterior region, describing it as moderate and intermittent. No facial swelling or lymphadenopathy was observed during the extraoral examination. The intraoral examination showed severe cold hypersensitivity, indicating pulp irritation. The response from the electric pulp testing procedure confirmed that the vitality of the pulp remains intact while also indicating an increased level of sensitivity in the affected tooth. percussion and palpation tests were normal with no periapical or periodontal issues. The patient was diagnosed with symptomatic irreversible pulpitis and required immediate endodontic treatment to address the inflammation and maintain periapical tissue health. The pericapical radiograph revealed extensive disto-occlusal caries and PDL widening without radiolucency (Figure 1. A). Also, the first and second curvatures of the tooth were calculated at 40° and 72°respectively by the Southard approach in radiograph (Figure1. E)(7).

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

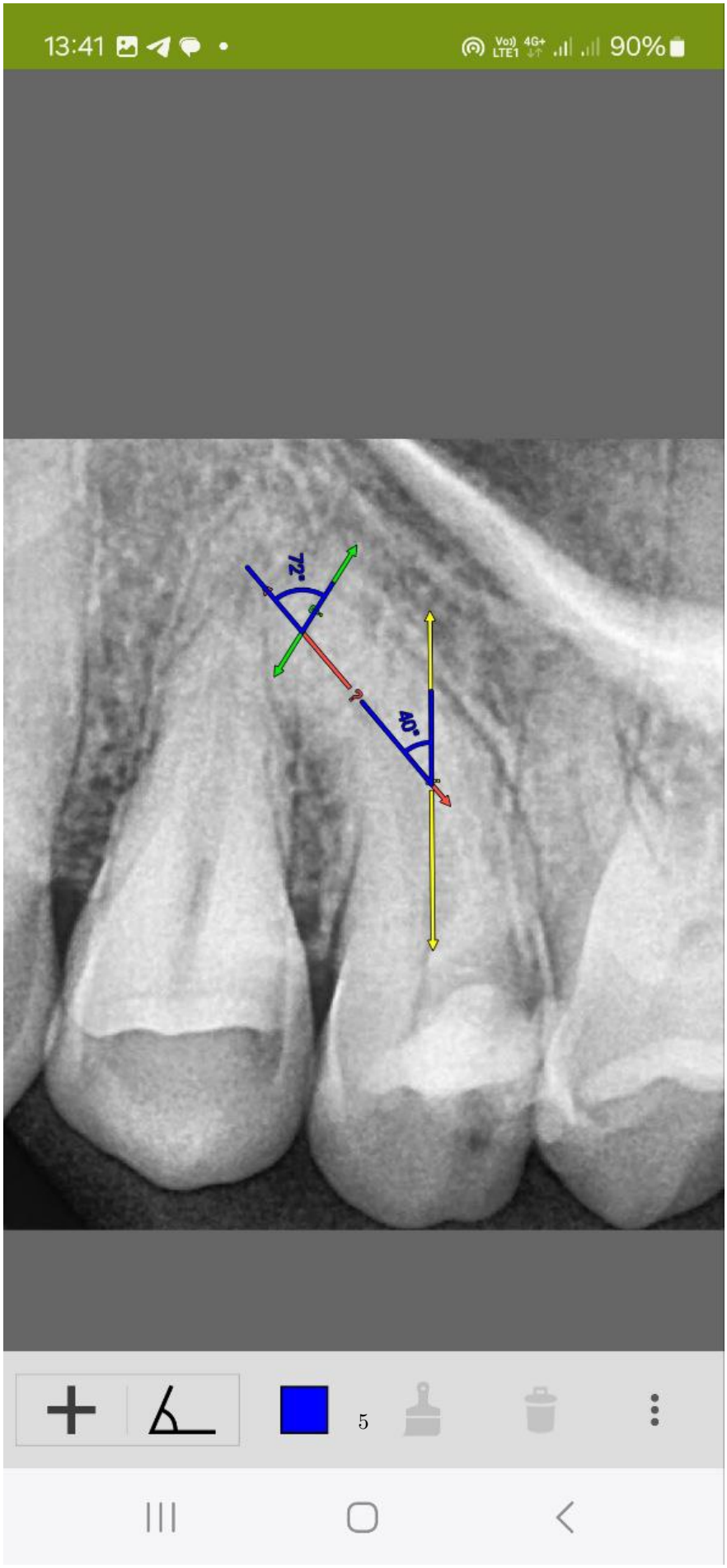


Figure . A) Initial periapical radiograph of the premolar, B) Master cone fit in the prepared canal, C) post-op periapical radiography, D) Follow-up after 15 months showing treatment outcomes, E)Curvature angle calculation by Southard approach.

Methods (differential diagnosis, investigations, and treatment method)

Upon obtaining informed consent, the treatment plan started with the administration of local anesthesia using a buccal infiltration of 1.8 ml of 2% lidocaine with 1:100000 epinephrine (Daroupakhsh, Tehran, Iran). A rubber dam was placed to ensure an aseptic environment. The access cavity was prepared using a high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) under continuous water spray, aided by a dental operating microscope (Carl Zeiss, Meditec Inc., Dublin, CA, USA). The access cavity was refined with a diamond fissure bur No. 2 (Jota AG, Rüthi, Switzerland). Frequent irrigation with sodium hypochlorite and saline enlarged the pulp chamber .Two canal orifices were identified and explored with a #15 C-file (VDW, Munich, Germany). Coronal preflaring was achieved using an SX instrument (M3, Changzhou, China). The working length was determined using an apex locator (Root ZX, J. Morita, Japan) and confirmed radiographically.The glide path was manually obtained using C-pilot (VDW, Munich, Germany) numbers 6, 8, and 10, followed by the use of rotary path files numbers 13, 16, and 19 with a 2% taper (M3, Changzhou, China) throughout the working length.The SP1 gold rotary system was utilized, with the S1 rotary file (UDG, Changzhou, China) reaching the working length through a picking motion. Subsequently, the canals were shaped using the M3 rotary system up to size 25/04. The canals were irrigated with 20ml of 5.25% NaOCl and normal saline throughout the instrumentation process.the activation of sodium hypochlorite in the root canal was performed using sonic activation (SI) with Endoactivator system (Dentsply Tulsa Dental Specialties) for 30 seconds per canal. The final irrigation of the root canal system was performed using 17% EDTA. Master cone of size 25/04% for the buccal canal and 30/04% for the palatal canal were selected (Figure 1. B).The canals were thoroughly dried with sterile paper points (META, Chungbuk, South Korea), and obturation was completed using Gutta-percha (META, Chungbuk, South Korea) and AH-plus sealer (Dentsply DeTrey, Konstanz, Germany) using the warm vertical technique by FastPackand and FastFill (Eighteeth, china) warm obturator. Finally, Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (Figure 1. C).

Outcome and \RL Follow-up

The patient was referred to the restorative department and restored with the PFM crown. Follow-up at 15 months revealed healing with no signs or symptoms (Figure 1. D).

Case 2

Case history/examination

The second case was a 44-year-old male with an edentulous area in the upper left quadrant due to a significant bone defect, which caused prevention in implant placement and he underwent prosthetic and endodontic management. Rehabilitation of the edentulous span with a three-unit fixed partial denture (bridge) was planned, with root canal therapy on the upper left canine as a stable abutment. Clinical and radiographic examinations revealed a diagnosis of normal pulp and periapical tissues, while the percussion and palpation tests were negative (Figure 2. A). The left maxillary canine displayed first and second curvatures of 45° and 53° respectively, which were calculated by the Southard approach (Figure 2.F)(7).

Methods (differential diagnosis, investigations, and treatment method)

the treatment started with the administration of local anesthesia using a buccal infiltration of 1.8 ml of 2% lidocaine with 1:100000 epinephrine (Daroupakhsh, Tehran, Iran). A rubber dam was placed to ensure an aseptic environment. The access cavity was prepared using a high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) under continuous water spray.

The orifices were negotiated with #8 and #10 K-files (Mani Inc., Utsunomiya, Japan). Working length was determined as 25mm by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England), which was confirmed radiographically (Figure 2.B).Root canal were chemomechanically prepared by crown-down

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

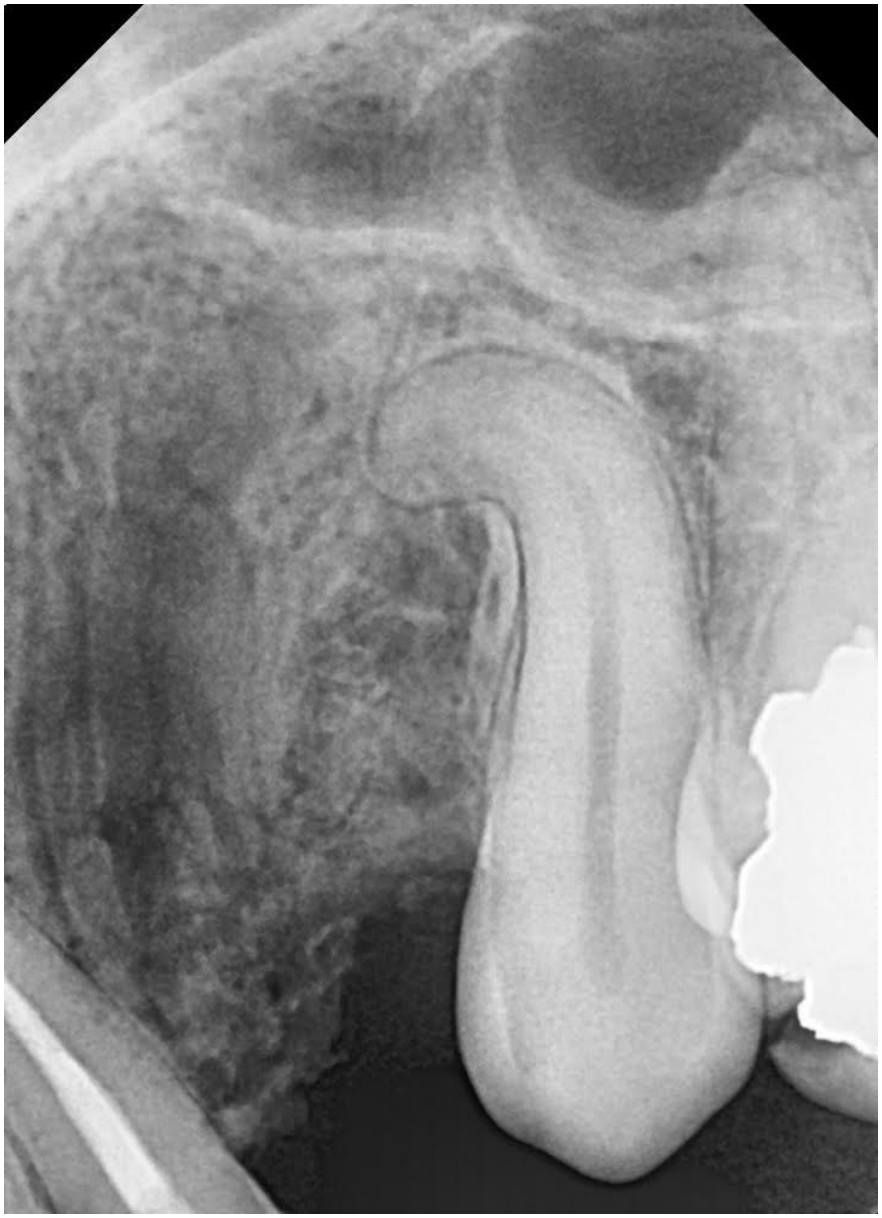
technique with M3 rotary files (UDG, Changzhou, China) up to size 25/04 under copious irrigation with 5.25% sodium hypochlorite and normal saline, alternately. After taking cone-fitting confirmation radiograph (Figure 2.C), all canals were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china).The irrigation of root canal system process followed the protocol described in Case 1. Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (Figure 2D) and the patient was referred to the department of prosthetics for permanent restoration.

Outcome and Follow-up

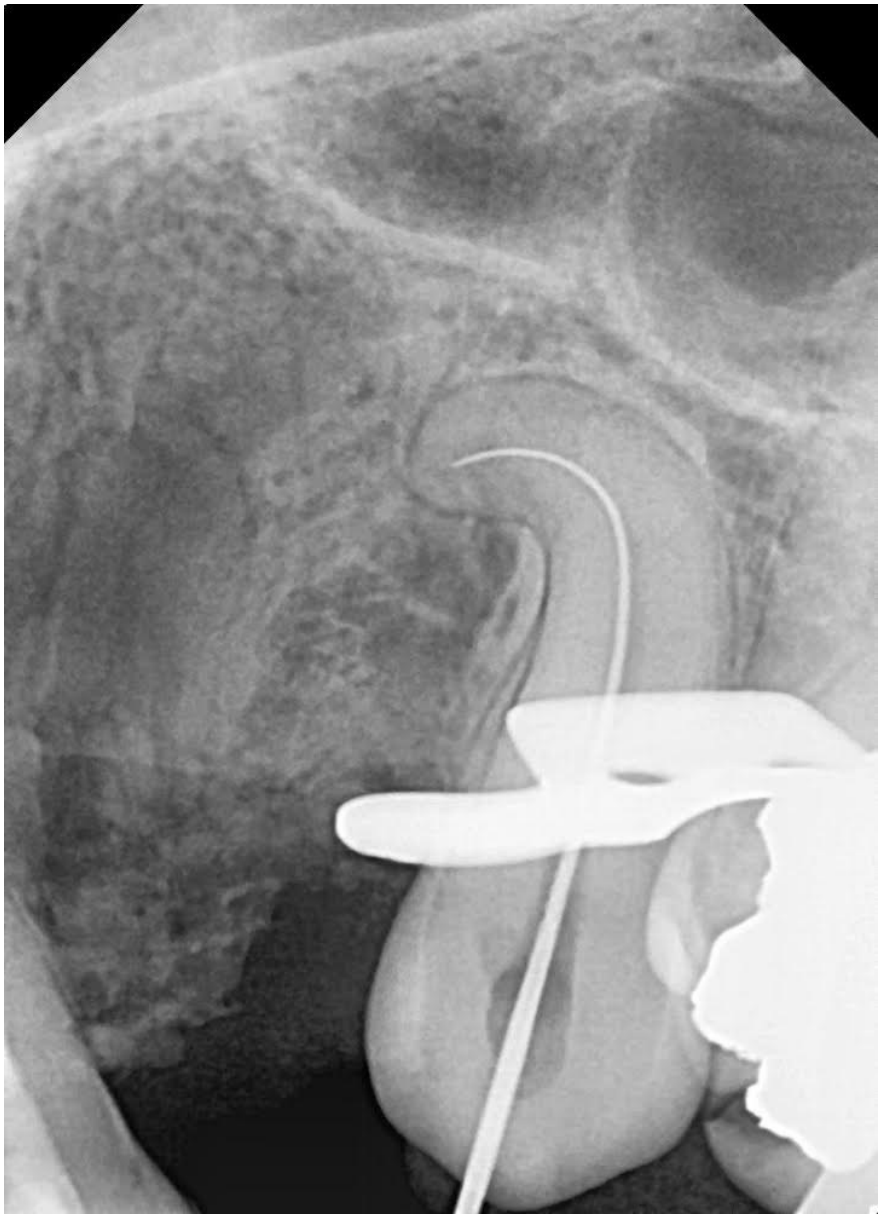
After the accomplishment of the procedure, the prosthodontics department manufactured and placed the bridge for the planned treatment. The patient's 13-month follow-up showed the success of the treatment (Figure 2.E).

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

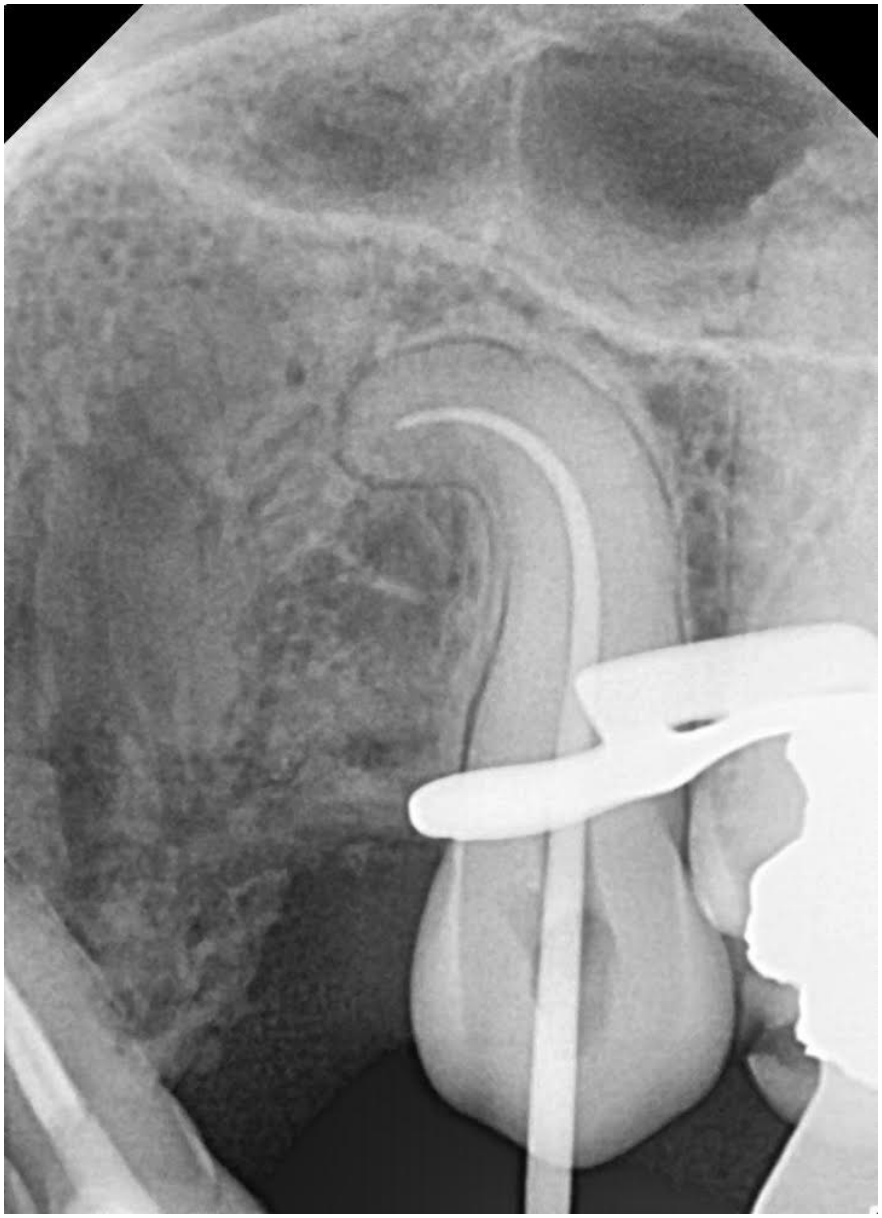
Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

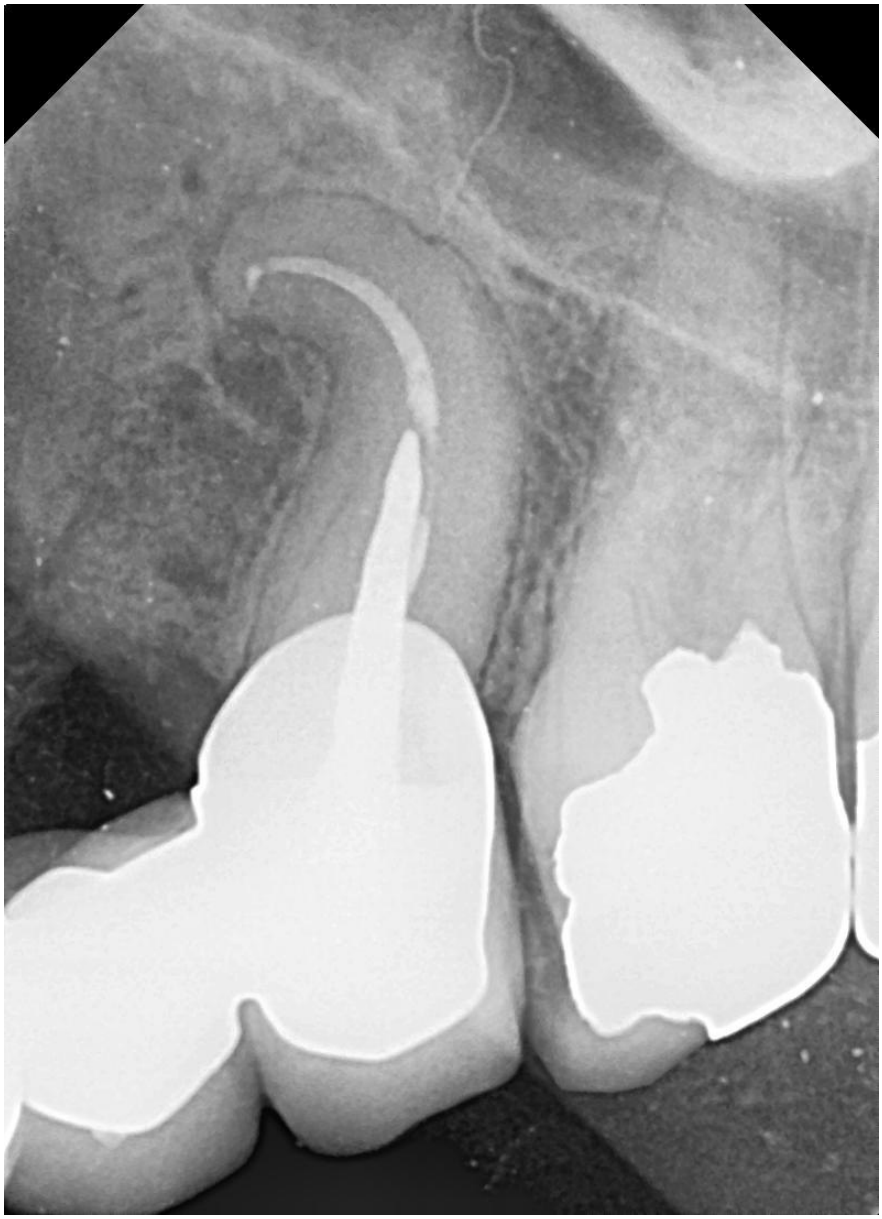


Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

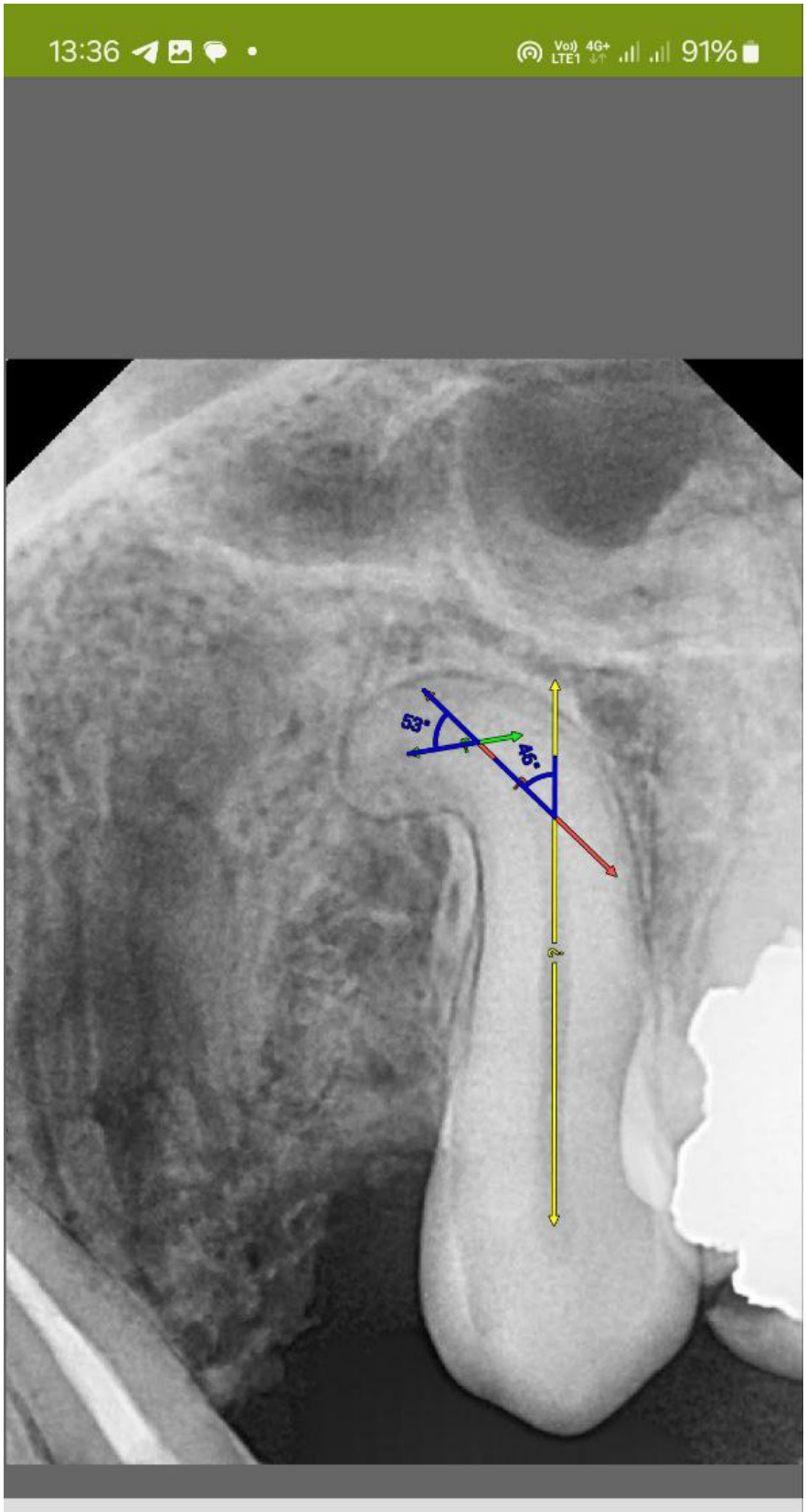


Figure . A) Initial periapical radiograph of the canine, B) Working length determination C) Master cone fit in the prepared canal, D) post-op periapical radiography E) Follow-up after 13 months showing treatment outcomes, F) Curvature angle calculation by Southard approach.

Case 3

Case history/examination

A 37-year-old male patient presented with necrotic pulp and chronic apical periodontitis in the right mandibular first premolar. The diagnosis of pulp necrosis was supported by negative responses to cold, heat, and EPT, with radiographic evidence of a periapical radiolucency, indicative of chronic apical periodontitis. All the percussion and palpation tests were negative. (Figure 3.A). Tooth number #44 displayed first and second curvatures of 37° and 23° by using the Southard method (Figure 3. F)(7).

Methods (differential diagnosis, investigations, and treatment method)

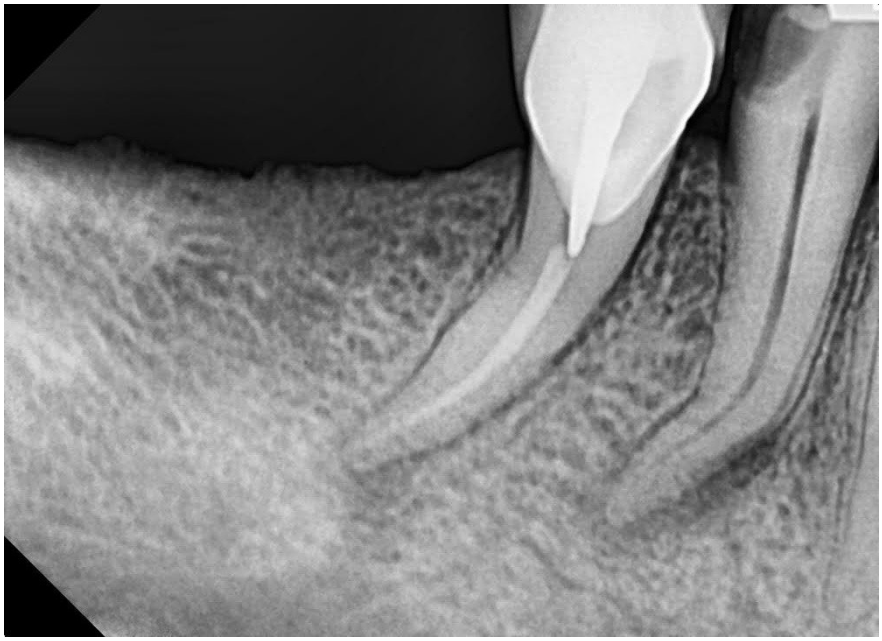
Local anesthesia was achieved by a mandibular nerve block with 2% lidocaine and epinephrine 1:100,000 (Daroupakhsh, Tehran, Iran). After isolation with rubber dam, the Caries was removed and Access Cavity was achieved with high-speed diamond round bur number 2 (Jota AG,*Ruthi* , Switzerland) and continuous water spray under a dental operating microscope (Zumax Medical Co., Suzhou New District, China). Working length was determined as 23 mm by an electronic apex locator (Dempex, DEM Ltd., Barnstaple, Devon, England), which was confirmed radiographically (Figure 3.B). The glide path was obtained using the rotary path files numbers 13, 16, and 19 with a 2% taper (M3, Changzhou, China) throughout the working length. Root canal were chemomechanically prepared by crown-down technique with M3 rotary files (UDG, Changzhou, China) up to size 25/04 under copious irrigation with 5.25% sodium hypochlorite. After taking cone-fitting confirmation radiograph (Figure 3.C), The irrigation of root canal system process followed the protocol described in Case 1. the root canal were dried with sterile paper points (META, Chugbuk, South Korea) and obturated with gutta-percha (META, Chugbuk, South Korea) and AH plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, china). Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration (Figure 3.D) and the patient was referred for permanent restoration.

Outcome and Follow-up

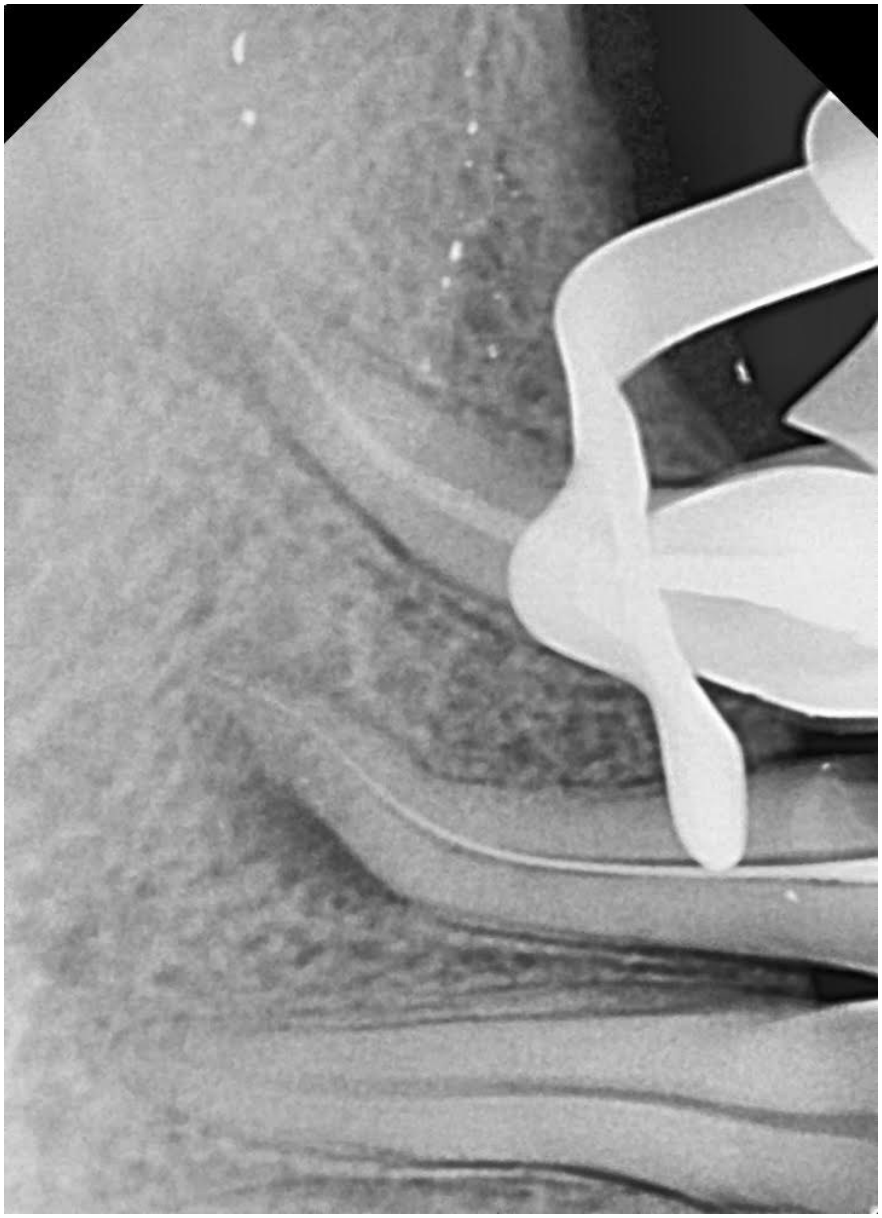
Following the completion of the treatment, the crown was fabricated and positioned for optimal occlusion. A six-month follow-up showed a proper healing process for the patient and made sure the treatment was successful (Figure 3. E).

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

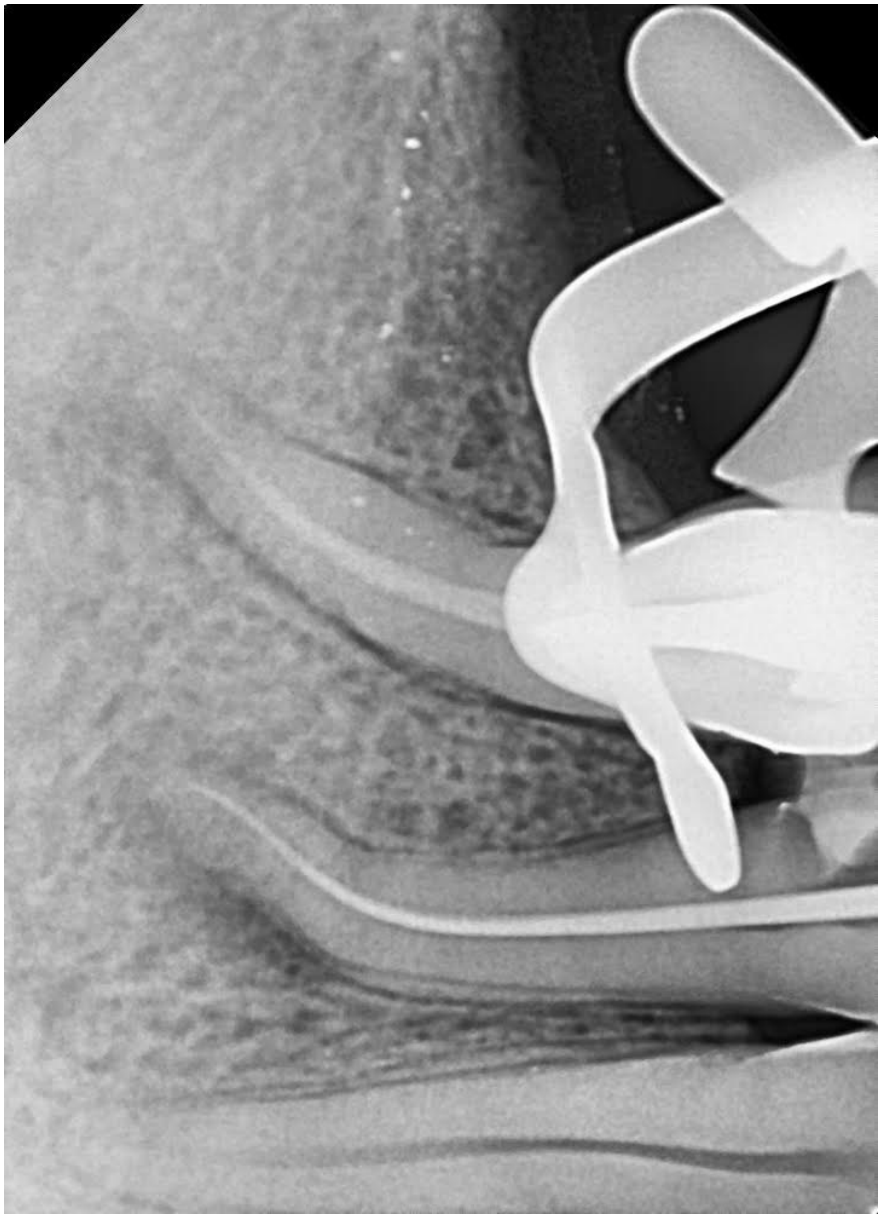
Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



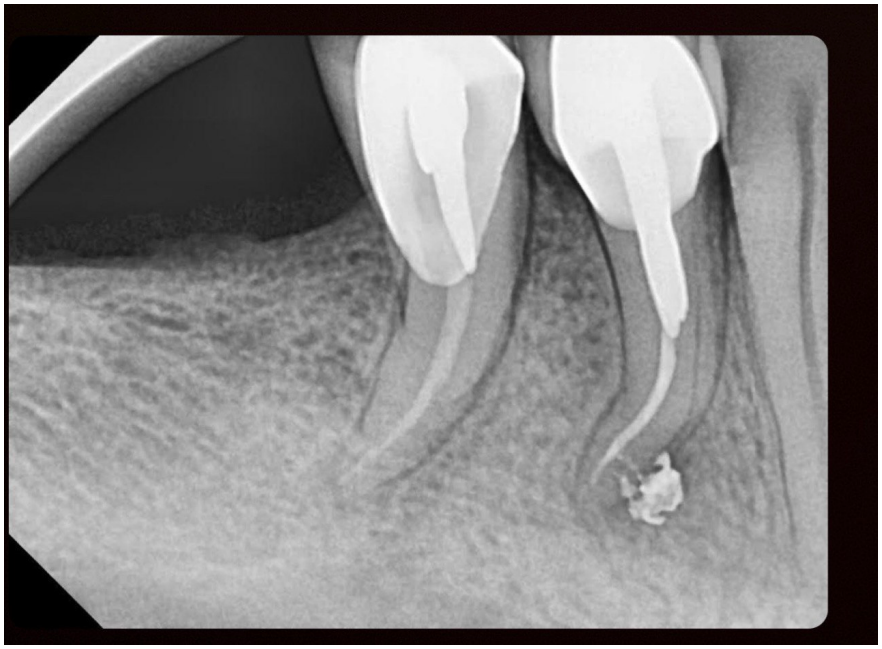
Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.



Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

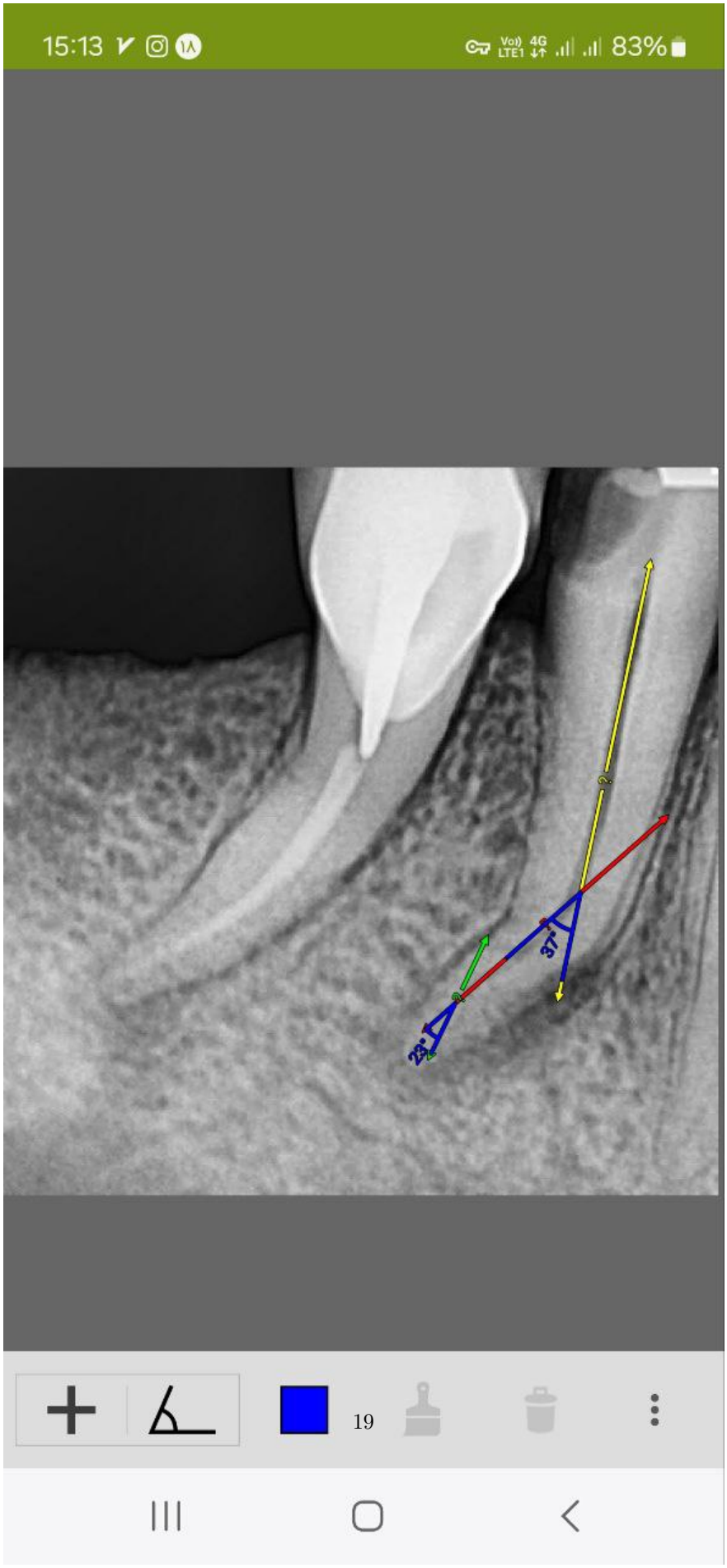


Figure . A) Initial view showing periapical pathology, B) Working length determination, C) Master cone fit, D) Obturation view, E) One-year follow-up demonstrating healing, F) Curvature angle calculation by Southard approach.

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

Discussion

A dilacerated tooth has been described as one tooth in which the root is curved 90° or more to the long axis of the tooth, or one tooth in which the apical portion of the root is more than 20° from the axis (8, 9). A study of 3150 teeth from 800 patients in Iran found a 1.65% prevalence of tooth dilacerations: 7.5% in males and 5% in females. Mandibular third molars exhibited the highest occurrence of dilacerations at 14%. (2). A dilaceration in root canal significantly increases the risk of procedural accidents, including loss of apical patency, canal transportation, perforation, ledge formation, and instrument fracture, which could compromise infection control and the treatment outcome (10). To enhance the effectiveness of root canal treatments and minimize complications, a comprehensive understanding of the complex anatomy of tooth canals is essential (11). Detailed information on root canal curvature and complexity of dilacerated tooth aids in the proper planning of treatment, and selection of appropriate materials and techniques (12, 13). Studies have stated the importance of 3D imaging modalities such as CBCT for the proper visualization of canal morphology, which is of paramount importance to avoid mishaps like perforation or transportation during instrumentation (13). The implication of this thorough understanding is not only in the enhancement of procedural efficiency but also in guaranteeing the long-term success of endodontic treatments (13). Also, modern NiTi rotary instruments and dynamic irrigation improve speed, safety, and outcomes in complex root cases (6, 7). The single-cone, warm vertical compaction, and lateral condensation techniques are common methods for obturation in curved canals, each varying in effectiveness (8). A strong seal using appropriate filling materials is key to preventing infections and enhancing longevity post-procedure (9, 10, 11).

In dilacerated teeth, prior to starting root canal treatment, the radiograph should be used to determine the degree of canal curvature. The junction of a straight line from the orifice through the coronal portion of the root and another straight line from the apex through the apical portion of the canal forms the interior angle (12, 13). The Schneider approach categorizes the canals into three groups: I) straight (0–5°), II) moderate (5–20°), and III) severe (>20°); thus, moderate and severe were classified as curved canals (14, 15). But, in measuring double-curved root curvature, the method of Southard et al. is more effective as it utilizes three lines in differentiating curve angles compared to Schneider's method, which was concerned with only a single curvature angle by measuring the deviation between the coronal and apical path of the canal (16, 17). This technique quantifies curvatures by calculating two angles: the first is between the long axis of the file's coronal shaft and a "best fit" line representing the canal's initial curvature, while the second is between this line and the apical segment (16).

Diagnosis

Root canal systems are typically curved or irregular, complicating thorough cleaning and shaping. Maxillary premolars have a 30% likelihood of exhibiting bifurcated or severely curved canals (14). The diagnosis and treatment planning of modern-day root canal therapy has greatly changed with the use of new diagnostic tools like cone-beam computed tomography (CBCT). La Rosa et al. recently discussed guided surgical endodontics, focusing on preoperative CBCT to predict curvatures and describe access paths. The possibility of viewing the root canal path and the anomalies associated with it enhances procedural accuracy significantly (15).

Challenges

Curved root canals present several significant difficulties, including challenges in instrumentation, insufficient cleaning, and complications during the filling process (16). According to Călin et al.'s systematic review, continuous rotary systems appear to be preferable to reciprocating systems in managing the extracted teeth root canal instrumentation with moderate and severe curvatures (17). Ultrasonic activation of irrigation has been proven to enhance the effectiveness of disinfection in the apical third, which is usually unreachable due to canal curvature (16, 17). The single-cone, warm vertical compaction, and lateral condensation techniques, which are common obturation methods, have significantly different efficacy and suitability for curved root

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

canals (18). The single-cone method, although simple and time-efficient, often fails to achieve the desired level of canal adaptation and has a high tendency to form voids, especially in irregularly shaped and curved canals (19, 20). Lateral condensation enhances obturation quality through mechanical compaction but has less ability to fill complex anatomical spaces well due to its reliance on lateral pressure (21). on the other hand, the warm vertical compaction technique demonstrates superior adaptability and sealing ability in curved canals by using thermoplasticized gutta-percha, which flows to conform to the canal's intricate morphology, including isthmuses and lateral canals. This not only significantly reduces microleakage and voids but also enhances long-term results (21). While much of the previous studies utilized single-cone and lateral condensation techniques, the authors propose warm vertical compaction as a more favorable option in complicated cases and consider the application of other methods limited to simpler cases (22, 23).

S-shaped root canals present even greater difficulties due to their double curvatures in opposite directions, which makes it harder to navigate the instruments (9, 24). In this case report, we demonstrated precise instrumentation to treat three double-curved root canals with severe curve angles based on the Schneider approach (25). Previous cases have not highlighted severe S-shaped teeth as seen in our study.

Techniques and Innovations

Advanced techniques for managing curved root canals have transformed the approach to treatment by improving our understanding of anatomy and minimizing risks during procedures. Heat-treated NiTi instruments have enhanced flexibility and resistance to cyclic fatigue, thus reducing canal transportation and preserving natural anatomy (16). Finite Element Analysis (FEA) application has improved instrument design and development through the assessment of biomechanical stress associated with the use of an instrument, hence making more durable rotary files possible (26). Ultrasonic irrigation activation systems are effective in cleaning and disinfecting the apical third of curved canals, which is impossible with traditional methods (27). Thermoplasticized obturation techniques improve sealing in irregular canals by adapting to their natural morphology (16). Further, navigation systems assisted by artificial intelligence have also proven to be a game-changer in precise canal mapping and reducing operator errors (16). These collectively enhance the success and predictability of treating curved canals. In these cases, we used NiTi rotary files to instrument teeth followed by NaOCl, saline, and EDTA with ultrasonic activation irrigation while the warm obturation technique was used with AH Plus sealer.

Comparative Analysis and Review

Table 1 presents a summary of recent case reports and reviews concerning approaches in the management of curved root canals. These articles present major challenges, but they also demonstrate specified solutions to improve results and efficiency. Other studies followed up with their patients for periods ranging from one week to 12 months to assess the effectiveness and safety of their treatments. Consistent with our findings, these studies reported no complications or pain among their patients during the follow-up period which suggests a favorable outcome in terms of treatment tolerability and safety.

Table . Recent Case Reports on Curved Root Canals.

Author/year	Number of Cases Presented	Challenges
Liu et al. (11)/2024	1 (maxillary second premolar)	severely "S-shaped" root(6
Alhwieti et al. (28)/2024	1 (mandibular second molar)	narrow and curved canal
Rizky et al. (22)/2024	1 (maxillary premolar)	secondary caries and curva
Arora and Seth (29)/2024	1	curved root canal
Rosselle et al. (24)/2024	3 (maxillary first and second molar and mandibular first molar)	Severely curved root canal
Umale and Gade (1)/2023	2 (first and second maxillary premolar)	dilacerated root canals
Matta and Kaur (30)/2021	1 (maxillary lateral incisor)	thin and S-shaped root
Deshmukh et al. (31)/2020	1 (maxillary second premolar)	S-shaped root canal
Elkholy and Ha (32)/2020	1 (maxillary lateral incisor)	S-shaped double-curved ro
Patnana et al. (9)/ 2018	3 (mandibular first and second molar)	Severe root canal curvatur

Author/year	Number of Cases Presented	Challenges
Sakkir et al. (33)/2014	1 (maxillary first and second premolar)	doubly curved or S-shape
Ansari and Maria (23)/2012	3 (maxillary first molar and second premolar)	sharp mesiobuccal and dis

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

Conclusion

Treatment of dilacerated root canals, especially teeth with difficult anatomy requires an integration of an accurate diagnostic armamentarium, novel techniques, and modern instrumentation. Furthermore, complementary achievements in the area of activation of ultrasonic irrigation and thermoplasticized warm vertical obturation have enabled better cleaning and obturation of curved canals by minimal residual infection, which leads to long-term clinical outcomes. This paper reports on three complex endodontic cases that encourage the dental profession to treat even the most challenging anatomical situations. These variations can affect technique effectiveness, so future studies with larger and more diverse samples, including various tooth types and canal configurations, and with longer follow-ups, can demonstrate long-term outcomes of treatment efficacy. Future investigations and new technologies will assist clinicians in refining existing and developing new methods to better care for patients and effectively treat challenging cases, such as those with dilacerated roots.

Declaration of Patient Consent

All forms of consent from the patients have been obtained in written form, and these consents include permission to report their cases with the publication of photos and any medical details concerning their cases. Patients are also well-informed that an attempt will be made to conceal their identity completely, although anonymity cannot be fully assured; thus, patient names and initials will not appear in publications.

Financial Support and Sponsorship

None

Author Contributions

Ali Chamani : conceptualization, data curation, investigation, resources, supervision, writing - review & editing. **Maryam Forghani** : supervision, writing - review & editing. **Iman Shiezadeh** : visualization, writing - original draft, writing - review & editing. **Amirmohammad Moradpour** : project administration, writing - original draft, writing - review & editing.

Acknowledgment The authors gratefully acknowledge the assistance and financial support of Mashhad University of Medical Sciences and the Student Research Committee of Mashhad University of Medical Sciences.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Umale K, Gade V. Management of dilacerated root canals — A challenge to endodontist. Archives of Dental Research. 2023;12:115-8.2. Kuzekanani M, Sadeghi M. Prevalence and distribution of dilaceration in the permanent dentition of an Iranian population. European Journal of Anatomy. 2019;23:273-7.3. Malcić A, Jukić S, Brzović V, Miletić I, Pelivan I, Anić I. Prevalence of root dilaceration in adult dental patients in Croatia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;102(1):104-9.4. Jafarzadeh H, Abbott PV. Dilaceration: Review of an Endodontic Challenge. Journal of Endodontics. 2007;33(9):1025-30.5. Kilpatrick NM, Hardman PJ, Welbury RR. Dilaceration of a primary tooth. Int J Paediatr Dent. 1991;1(3):151-3.6. Chohayeb AA. Dilaceration of permanent upper lateral incisors: frequency, direction, and endodontic treatment implications. Oral Surg Oral Med Oral Pathol. 1983;55(5):519-20.7. Southard DW, Oswald RJ, Natkin E. Instrumentation of curved molar root canals with the Roane technique. J Endod.

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.

1987;13(10):479-89.8. Jafarzadeh H, Abbott PV. Dilaceration: review of an endodontic challenge. J Endod. 2007;33(9):1025-30.9. Patnana AK, Chugh A. Endodontic Management of Curved Canals with ProTaper Next: A Case Series. Contemp Clin Dent. 2018;9(Suppl 1):S168-s72.10. Chaniotis A, Ordinola-Zapata R. Present status and future directions: Management of curved and calcified root canals. International Endodontic Journal. 2022;55(S3):656-84.11. Liu H, Hao J, Shen Y. Endodontic Treatment of a Dilacerated Maxillary Second Premolar With a Severely Curved Root Canal: A Case Report and Literature Review. Cureus. 2024;16(5):e59590.12. Peters OA. Current Challenges and Concepts in the Preparation of Root Canal Systems: A Review. Journal of Endodontics. 2004;30(8):559-67.13. Versiani MA, Pereira MR, Pécora JD, Sousa-Neto MD. Root Canal Anatomy of Maxillary and Mandibular Teeth. In: Versiani MA, Basrani B, Sousa-Neto MD, editors. The Root Canal Anatomy in Permanent Dentition. Cham: Springer International Publishing; 2019. p. 181-239.14. Ahmad IA, Alenezi MA. Root and Root Canal Morphology of Maxillary First Premolars: A Literature Review and Clinical Considerations. Journal of Endodontics. 2016;42(6):861-72.15. La Rosa GRM, Peditto M, Venticinque A, Marcianò A, Bianchi A, Pedullà E. Advancements in guided surgical endodontics: A scoping review of case report and case series and research implications. Australian Endodontic Journal. 2024;50(2):397-408.16. Silva E, Martins J, Versiani M. Advancing insights in contemporary endodontics: Proposing a multimethod approach for comprehensive evaluation of NiTi instruments. International Endodontic Journal. 2023;57.17. Călin C, Focșăneanu A-M, Paulsen F, Didilescu AC, Niță T. Shaping Efficiency of Rotary and Reciprocating Kinematics of Engine-driven Nickel-Titanium Instruments in Moderate and Severely curved Root Canals Using Microcomputed Tomography: A Systematic Review of Ex Vivo Studies. Journal of Endodontics. 2024;50(7):907-24.18. Bhandi S, Mashyakhy M, Abumelha AS, Alkahtany MF, Jamal M, Chohan H, et al. Complete Obturation—Cold Lateral Condensation vs. Thermoplastic Techniques: A Systematic Review of Micro-CT Studies. Materials [Internet]. 2021; 14(14).19. Kalantar Motamedi MR, Gilbert BE, Ha WN. Enhancing Coronal Adaptation of Root Canal Fillings with a Modified Single-Cone Obturation Technique: Two Case Reports. Iran Endod J. 2024;19(1):50-5.20. He P, Bao X. [Sealing effect of GuttaFlow2 in curved root canals]. Beijing Da Xue Xue Bao Yi Xue Ban. 2024;56(1):99-105.21. Gilhooly RMP, Hayes SJ, Bryant ST, Dummer PMH. Comparison of cold lateral condensation and a warm multiphase gutta-percha technique for obturating curved root canals. International Endodontic Journal. 2000;33(5):415-20.22. Rizky M, Farahany W, Yanti N. Endodontic broken file retrieval in curvature premolar tooth: A case report. Editorial Board Bali Medical Journal.7.23. Ansari I, Maria R. Managing curved canals. Contemp Clin Dent. 2012;3(2):237-41.24. Rosselle V, Ongkowijoyo C, Setyabudi. Endodontic treatment of severely curved root canals – A case series. Dental Journal. 2024;57:145-51.25. Schneider SW. A comparison of canal preparations in straight and curved root canals. Oral Surg Oral Med Oral Pathol. 1971;32(2):271-5.26. Keerthi M, Sridevi E, Sankar AJS, Nagesh B, Pranitha K, Sankar KS. Evaluation of the stress generated during biomechanical preparation with nickel–titanium rotary endodontic file using finite element analysis. Saudi Endodontic Journal. 2024;14(1).27. Chamani A, Gharechahi M, Shakiba R, Alipour F. Management of radix entomolaris of mandibular first molar with complex root canal curvatures; A case report and mini review. Management. 2024;5:1.28. Alhwieti AA, Bahammam LA. The use of modified nickel–titanium rotary file for preparing staging platform to retrieve instrument fragments from narrow and curved canal. Saudi Endodontic Journal. 2024;14(3).29. Arora S, Seth M. MANAGEMENT OF CURVED ROOT CANALS: A CASE REPORT.30. Matta MS, Kaur M. Endodontic management of thin and double-curved root of maxillary lateral incisor. Saudi Endodontic Journal. 2021;11(2).31. Deshmukh S, Shenoy V, Margasahayam S, Patil A, Shah J. Endodontic Management of S-Shaped Root Canal in a Maxillary Premolar Using Controlled Memory Nickel Titanium Rotary Files – A Case Report. Journal of Evolution of Medical and Dental Sciences. 2020;9:3894-7.32. Elkholy M, Ha W. An Arithmetic Crown-down Dynamic Tactile Instrumentation Technique: A Case Report of an S-shaped Root Canal. Journal of Endodontics. 2020;47.33. Sakkir N, Thaha KA, Nair MG, Joseph S, Christalin R. Management of Dilacerated and S-shaped Root Canals - An Endodontist's Challenge. J Clin Diagn Res. 2014;8(6):Zd22-4.

Hosted file

`1.zip` available at https://authorea.com/users/785442/articles/1254766-endodontic-management-of-dilacerated-roots-a-case-series-and-review-of-literature

Hosted file

2.zip available at https://authorea.com/users/785442/articles/1254766-endodontic-management-of-dilacerated-roots-a-case-series-and-review-of-literature

Hosted file

3.zip available at https://authorea.com/users/785442/articles/1254766-endodontic-management-of-dilacerated-roots-a-case-series-and-review-of-literature

Posted on 27 Dec 2024 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.173532163.38619085/v1 | This is a preprint and has not been peer-reviewed. Data may be preliminary.