



Minimally Invasive Management of Two Separated Dens Invaginatus Oehler's Type I and II: A Case Report

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Abstract

Treating coronal dens invaginatus (CDI) with pulp infection typically involves the removal of the invagination, which increases the risk of fracture and perforation, compromising tooth structure. Minimally invasive endodontic management of coronal dens invaginatus is highly recommended. This case report presents the management of a 19-year-old female patient with a permanent maxillary lateral incisor exhibiting two distinct dens invaginatus anomalies. Cone-beam computed tomography (CBCT) was used to assist in the diagnosis of tooth morphology and canal location. CBCT confirmed that the buccally positioned orifice was classified as Oehlers Type II, while the one with a palatally positioned orifice corresponded to Oehlers Type I. The pulp and periapical diagnosis of this tooth was pulpless and an infected root canal system with chronic apical periodontitis according to Abbott classification. The pulp chamber was carefully accessed with minimal intervention, and the root canals were explored under magnification. All root canals were prepared using EDMax rotary files, followed by irrigation with sodium hypochlorite (NaOCl). Calcium hydroxide medication was also applied. Root canal obturation was performed using the warm vertical compaction, employing AH-Plus sealer in combination with thermosplasticized gutta-percha. After 6 and 12 months, the patient showed healing of the periapical region, with the absence of symptoms and normal dental function. Favorable radiographic and clinical findings were observed during both follow-up sessions. At the 18-month follow-up, the lesion was completely healed.

Keywords: Dens Invaginatus; CBCT; Cone-beam Computed Tomography; Minimally Invasive Endodontic Accesses

Introduction

The anatomical complexity of the tooth plays a crucial role in the success of endodontic treatment, as accessing and disinfecting the root canal system can be challenging [1]. Dens invaginatus is a developmental anomaly resulting from the invagination of the enamel organ into the dental papilla during odontogenesis, leading to significant alterations in root canal morphology [2]. Several classifications for dens invaginatus exist, with Oehlers' classification being the most widely used. In this system, Type I involves invagination limited to the dental crown, Type II extends into the root beyond the cemento-enamel junction, and Type IIIa involves invagination reaching the apical region and forming multiple foramina.

Type IIb is similar to Type IIIa but communicates with the periodontal ligament via the apical foramen [3].

The prevalence of dens invaginatus is 7.45% with the majority of cases affecting permanent upper lateral incisors [4]. Teeth with dens invaginatus are susceptible to infection due to communication with the oral cavity, which may require endodontic treatment or extraction [5]. Endodontic treatment in dens invaginatus cases presents challenges due to the complex and often irregular root canal system [6].

Cone-beam computed tomography (CBCT) has become an invaluable tool for mapping root canal morphology, enabling a 3D assessment of both external and internal anatomy. This feature is particularly useful for studying the configuration of dens invaginatus [7]. Studies have shown that CBCT consistently



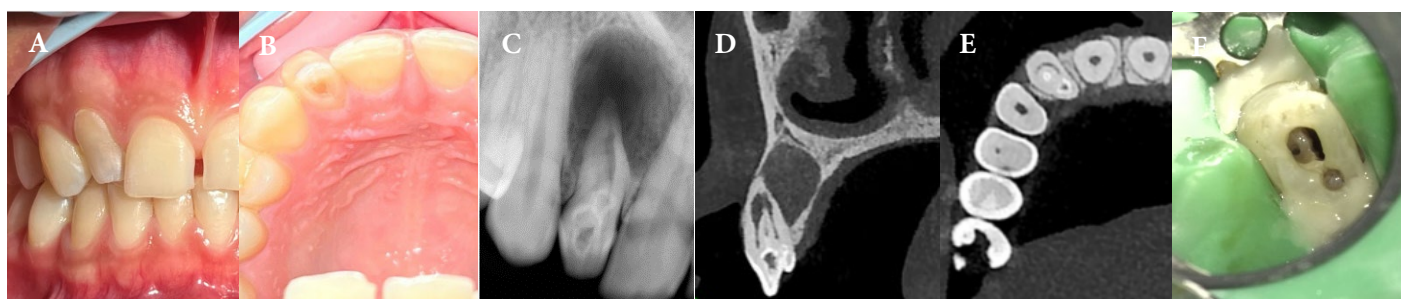


Figure 1. A) Preoperative photograph; B) Intraoral examination; C) Preoperative periapical radiography; D) Sagittal plane of CBCT; E) axial plane of CBCT showing separate orifices of the main canal, a dens invaginatus located in a more buccal position, and another dens invaginatus located in a more palatal position; F) Intraoperative photograph showing minimally invasive dual access cavities designed to preserve pericervical dentin

provides greater details compared to traditional 2D radiographs, making it crucial for identifying root canal systems [7]. Recent advancements in CBCT, dental microscopes, and ultrasonic instrumentation allow for the preservation of teeth that would otherwise have required extraction, even in cases involving pulp necrosis and periapical lesions [7].

In the present study, we report the management of two distinct dens invaginatus. A minimally invasive endodontic approach was implemented, involving the creation of two separate access cavities. This technique was chosen to preserve as much of the natural tooth structure as possible while ensuring adequate debridement and sealing of the root canal system, with particular emphasis on chemo-mechanical debridement to enhance disinfection efficacy.

Case Presentation

A 19-year-old healthy female presented to the Department of Endodontics at Shahid Beheshti University of Medical Sciences, seeking treatment for her upper right lateral incisor. Although the patient did not report any pain or discomfort, she expressed concern about the appearance of the tooth (Fig. 1A). Upon clinical examination, only a single deep pit was observed in the gingulum area (Fig. 1B).

There were negative responses to pulp sensibility testings, including cold testing by Prodox Cool Spray (Mehrgan Teb Razi, Tehran, Iran). Additionally, pulp testing was carried out with the digital pulp tester (Parkell Pulp Vitality Tester, Parkell, Edgewood, NY, USA), which confirmed the pulp necrosis. The periodontal probing depth was within normal limits, and tooth mobility was also within the normal range. No clinical symptoms were observed in response to the percussion and palpation tests. Radiographic examination with a periapical radiograph revealed periapical bone rarefaction consistent with apical periodontitis, while CBCT imaging demonstrated the characteristic features of Oehlers' type I and II dens invaginatus (Fig. 1C & 1D). The pulp and periapical

diagnosis of this tooth was pulpless and an infected root canal system with chronic apical periodontitis according to Abbott classification [8]. To enhance the diagnostic accuracy and treatment plan, a CBCT scan was performed. The 3D imaging confirmed the presence of a C-shaped canal system located more buccally in the tooth, with the dens invaginatus positioned distopalatally within it. The CBCT revealed that the buccally positioned dens invaginatus did not have a direct connection to the main canal at the apex and was blocked at one-third of the apical root. In addition, another dens invaginatus was identified in a more palatal position, extending to the coronal third of the root. This invaginatus showed no apparent communication with the main canal or with the previously noted dens invaginatus (Fig. 1D & 1E).

Given the delicate anatomical structure of the tooth and the complexity of the root canal system, a minimally invasive treatment approach was selected. This approach involved two separate access cavities: one of the access openings is positioned more buccally to access the main canal and the buccally located dens invaginatus, while the other is placed more palatally to access another dens invaginatus (Fig. 1F). The goal was to minimize structural damage while ensuring thorough debridement and disinfection of the root canal system. Tooth extraction with prosthetic or implant replacement was presented as an alternative, but the patient chose nonsurgical root canal treatment with follow-up. All aspects of the diagnosis and procedure were explained, and written informed consent was obtained.

Local anesthetic was administered through infiltration using 1.8 mL of a 2% lidocaine solution combined with epinephrine at a concentration of 1:80,000 (DarouPakhsh, Tehran, Iran), to ensure effective anesthesia and hemostasis, and a rubber dam with a clamp was placed to ensure isolation and a dry working field.

A conservative access cavity was prepared using a round diamond bur with a high-speed handpiece, followed by refinement with a round carbide bur using a low-speed handpiece under magnification with a dental microscope (Zeiss, Jena, Germany). To preserve more tooth structure, two separate

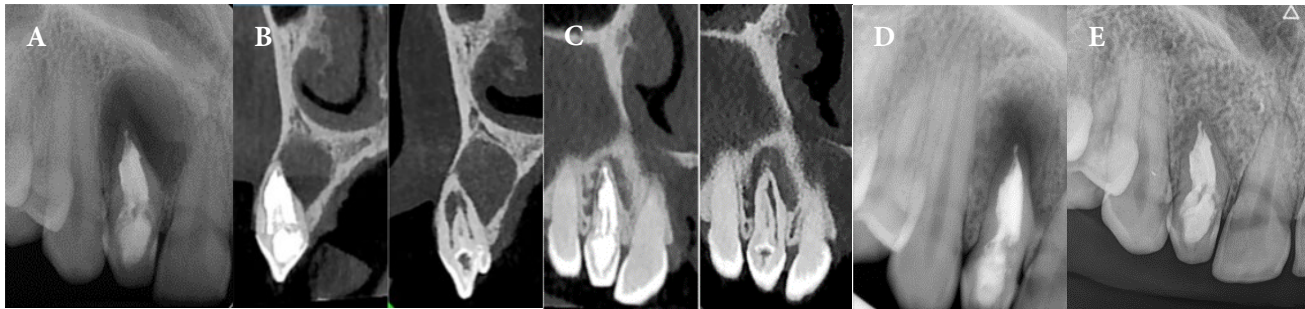


Figure 2. A) Immediate postoperative radiography; B) CBCT at six-month follow-up in comparison with pre-treatment CBCT, sagittal views; C) CBCT at six-month follow-up in comparison with pre-treatment CBCT, Coronal views; D) 12-month follow-up; E) 18-month follow-up

access cavities were prepared with the use of CBCT as a guide (Fig. 1E). The buccally positioned access cavity provided direct entry to both the main root canal and the buccally located invaginatus, in contrast, the palatal access facilitated the instrumentation and management of the palatally positioned invaginatus (Fig. 1F). Initial exploration of the canals was carried out using a #10 K-file (Mani, Tokyo, Japan).

The working length was determined using an electronic Root ZX apex locator (J Morita, Kyoto, Japan), and periapical radiography was used to confirm the WL. The root canals were instrumented with EDMax rotary files (Neolix, Evron, France) according to the manufacturer's recommended protocol, using the following sequence: 15/0.03, 20/0.04, 25/0.04, and 30/0.04. Throughout the procedure, a total of 10 mL of 5.25% sodium hypochlorite (NaOCl) (Nikdarman, Tehran, Iran) was used for irrigation between each instrumentation step, delivered with a 30-gauge double side-vented needle (SybronEndo, Glendora, CA, USA), then it's was passive activated within the canals by the ultrasonic device (Varios 970; NSK, Tochigi, Japan) for a duration of 20 sec [9]. Sonic irrigation using a size 15, 0.02 taper EndoActivator tip (Dentsply Sirona, Ballaigues, Switzerland) was utilized to improve contact with the canal walls, enhance cleaning efficiency, and facilitate the activation of NaOCl within the root canal system [10]. Following irrigation with sodium hypochlorite, 17% EDTA (Nikdarman, Tehran, Iran) was applied for one minute to remove the inorganic and mineralized component of the smear layer. Subsequently, a final rinse with sodium hypochlorite was performed for 30 sec to enhance its penetration into the dentinal tubules, which had been exposed by smear layer removal, thereby improving its antibacterial efficacy [11]. After the chemo-mechanical preparation (CMP), the canals were irrigated with 5 mL of sterile saline.

After thorough cleaning and shaping, in the presence of intracanal exudate upon instrumentation, calcium hydroxide (Golchai, Tehran, Iran) was placed in the root canal to achieve disinfection and enhance the healing of periapical tissues [12]. The canals were properly filled with calcium hydroxide, and the

crown was restored using temporary restoration (Cavisol; Golchai, Tehran, Iran).

The patient was recalled 10 days after the procedure. Clinical examination revealed no signs or symptoms, and the patient reported no discomfort or pain. During this appointment, the previously placed calcium hydroxide dressing was removed, and the root canal system was re-irrigated with 5.25 % NaOCl and 17% EDTA according to the protocol used in the first appointment. At the end of the CMP preparation, canals were washed with 5 mL of sterile saline, dried with paper points (Dentsply Maillefer, Ballaigues, Switzerland), and filled with gutta-percha (Meta obturator; Meta Biomed, Cheongju-so, Chungbuk, South Korea) and AH-Plus Sealer (Dentsply De Trey, Konstanz, Germany) using a warm vertical compaction technique (Fig. 2A). The patient was referred to the restorative department for permanent coronal restoration.

The patient was scheduled for follow-up visits at 6, 12, and 18 months. During the 6- and 12-month follow-up visits, the patient reported no symptoms, and clinical examination demonstrated normal tooth function, characterized by normal probing depths, absence of tenderness to palpation and percussion, and physiological mobility. For a more accurate assessment of the lesion at the 6-month follow-up, CBCT imaging with a limited field of view was utilized [13]. CBCT evaluation at the 6-month follow-up and radiographic assessment at the 12-month follow-up demonstrated a significant and progressive decrease in the size of the periapical lesion, indicating ongoing osseous healing (Fig. 2B & 2C). The periapical lesion was completely healed at the 18-month follow-up (Fig. 2D).

Discussion

Dens invaginatus (DI), also known as “dens in dente,” is a developmental anomaly characterized by infoldings of enamel and dentin into the dental papilla during tooth formation [14]. This condition predominantly affects maxillary lateral incisors, with varying degrees of severity [4]. This case report highlights the

minimally invasive management of two distinct dens invaginatus anomalies, Type I and Type II, using advanced imaging techniques and a conservative treatment approach. The primary focus is on chemo-mechanical debridement of the canals.

The management of dens invaginatus presents significant challenges due to its complex internal anatomy, irregular canal systems, and the potential communication between the invaginated tract and periapical tissues. Traditionally, endodontic treatment of DI involved the removal of the invaginated portion and its incorporation into the main canal system to facilitate cleaning and obturation [5]. However, this approach often leads to significant dentin loss, particularly in the peri-cervical region, which is crucial for maintaining tooth integrity and resistance to fracture [15]. In contrast, the minimally invasive approach described in this case focuses on the selective management of the invaginated tracts, preserving as much natural tooth structure as possible. This approach is crucial, especially when CBCT imaging reveals spatial separation between the invaginatus and the main canal, enabling a dual access cavity strategy to treat the invaginatus independently [16].

The use of CBCT significantly improved the diagnosis and treatment planning in this case [17]. CBCT provided detailed three-dimensional imaging that revealed the complex canal system, including two distinct invaginatus located more buccally and palatally positioned, without direct communication between them. This allowed for the creation of two separate access cavities, which minimized structural compromise and maximized the preservation of peri-cervical dentin. Preserving pericervical dentin (PCD) is essential for long-term tooth survival because it maintains cervical stiffness, distributes occlusal stresses, and prevents catastrophic vertical or cervical fractures. Conservative access and shaping that preserve PCD significantly improve fracture resistance and long-term prognosis compared with traditional extensive preparations [18, 19]. Recent studies confirm that conservative access cavities and limited canal enlargement enhance structural integrity and reduce the risk of catastrophic cervical fractures compared with conventional strategies that extensively remove or incorporate the invagination. Thereby reducing iatrogenic errors and improving biomechanical survival [20-22]. Collectively, these findings highlight that preservation of PCD should be a central principle in the management of dens invaginatus and other anatomically complex cases. By accessing the buccally positioned invaginatus through the buccally placed access cavity and the palatally positioned invaginatus *via* the palatally placed access cavity, the treatment was tailored to the unique anatomy of the tooth, ensuring effective disinfection and sealing of the root canal system.

Effective CMP debridement is paramount in cases of dens invaginatus, as the irregular canal morphology can harbor persistent microbial biofilms that are difficult to remove with conventional instrumentation [23]. In this case, passive activation of sodium hypochlorite (NaOCl) was performed using ultrasonic devices, which enhanced the irrigant's ability to penetrate the irregularities and lateral canals of the invaginated system. Studies have shown that passive ultrasonic activation (PUA) is highly effective in improving the efficacy of NaOCl by enhancing its penetration into difficult-to-reach areas and promoting better microbial control [24]. Additionally, the use of 17% EDTA for one minute after NaOCl application helped to remove mineralized and inorganic components of the smear layer, ensuring thorough disinfection and promoting the optimal filling of the root canals [11].

The use of calcium hydroxide as an intracanal medicament was also essential for disinfection and promoting the healing of the periapical tissues. This was particularly relevant in this case, where the patient had chronic apical periodontitis associated with both invaginatus. Calcium hydroxide's antibacterial properties and its ability to promote tissue healing make it an ideal choice for cases involving apical periodontitis and infected root canal systems [12].

Follow-up assessments at 6 and 12 months demonstrated gradual healing of the periapical tissues, and the 18-month follow-up indicated that the lesion had completely healed. This finding demonstrates the effectiveness of the minimally invasive treatment approach, which emphasizes preserving tooth structure while ensuring effective disinfection and sealing of the root canal system [25-27].

Conclusion

The management of dens invaginatus requires careful consideration of the tooth's unique anatomy, and the use of advanced imaging techniques, such as CBCT, plays a crucial role in treatment planning. Recent evidence suggests that CBCT-guided dual minimally invasive access allows precise treatment of both the main canal and the invagination while preserving pericervical dentin. This technique represents a conservative paradigm for managing similar anatomical anomalies, providing effective disinfection with minimal structural compromise. The minimally invasive approach, which preserves the tooth structure while achieving effective disinfection, offers a favorable prognosis for teeth affected by complex root canal anomalies such as dens invaginatus. The combination of advanced irrigation protocols, passive activation techniques, and appropriate intracanal medicaments results in successful outcomes, as demonstrated in this case.

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Conflict of interest

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Authors' contributions

Conceptualization: MB; Methodology: MB/NJ; Formal Analysis and Investigation: NJ; Writing-Original draft preparation: NN; Writing-review and editing: NJ/NN; Supervision: NJ. All authors read and approved the final manuscript.

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