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Nonsurgical Treatment of Unusual Dens Invaginatus with MTA Based Filler in Immature Maxillary Lateral Incisor: A Case Report

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ABSTRACT

Dens invaginatus (DI) is a dental anomaly associated with complex internal anatomy. Our article discusses an unusual maxillary lateral incisor with two DI. The treatment was planned and performed using cone-beam computed tomographic (CBCT) imaging. During clinical and radiographic evaluations, tooth #7 was diagnosed with DI and pulp necrosis with asymptomatic apical abscess. Periapical radiographs of the tooth showed 2 roots and complex internal anatomy. CBCT evaluation revealed tooth #7 had 2 separate cul-de-sacs (that separate the main canal into four portions). Root canal treatment was completed in 2 visits. The tooth was obturated with EndoSeal MTA. At the 6-month re-evaluation, the patient remained asymptomatic and his tooth had remained functional. Clinical and radiographic examination showed tooth #7 had no sensitivity to percussion or palpation, probe depths within normal limits (#3 mm), no mobility and continued improvement of periapical lesion, despite the commencement of orthodontic Rx 3months previous. Radiographic assessment at the one-year follow up showed significant osseous healing of the preoperative lesion even after the orthodontic forces.

Keywords: Cone-Beam Computed Tomography; Dens Invaginatus; Dental Operating Microscope; Root Canal Anatomy

Introduction

Dens invaginatus (DI) is a well-known developmental anomaly resulting in invagination of the enamel organ into dental papilla before mineralization has occurred [1]. This entity has most commonly occurred in the maxillary lateral incisors [2]. Several studies have been evaluated the prevalence of DI in different populations and reported the prevalence of 0.04-10% [3].

According to Oehlers classification [4], three subtypes of DI has been introduced based on the extent of apical migration of an enamel lined invagination. Type I which is confined to the crown and does not extend beyond the cementoenamel junction (CEJ). Type II: the invasion of invagination into the root but remains confined within it as a blind sac with or without communication with the pulp, and type III with a second foramen located laterally (IIIa) or apically (IIIb) to the periodontal ligament. In type III, usually there is no communication with the pulp [5].

Amongst the three types of DI, type I and II corresponds for 79% and 15% of all cases while type III is the most rare one [6, 7]. Clinicians are often challenged by these teeth with anomalous and complex anatomies; although incorporation of cone-beam computed tomography (CBCT) and dental operating microscope into clinical practice could enhance the knowledge and capability of clinicians to improve treatments. various Studies have been reported the benefits of CBCT in management of complexities [8, 9]. Others showed that magnification with dental microscope could increase the number of canals negotiated [10-12]

Obturation of DI due to its complexity is another challenge that a clinician may confront. Different obturation materials has been used recently to maximize the quality of obturation in these cases. Biodentine, mineral trioxide aggregate (MTA), gutta-percha with different sealers are among these [13-18]. But all these materials have their own deficits. However, use of MTA and other calcium silicate cements as an orthograde root canal filling material is controversial due to their difficulty in

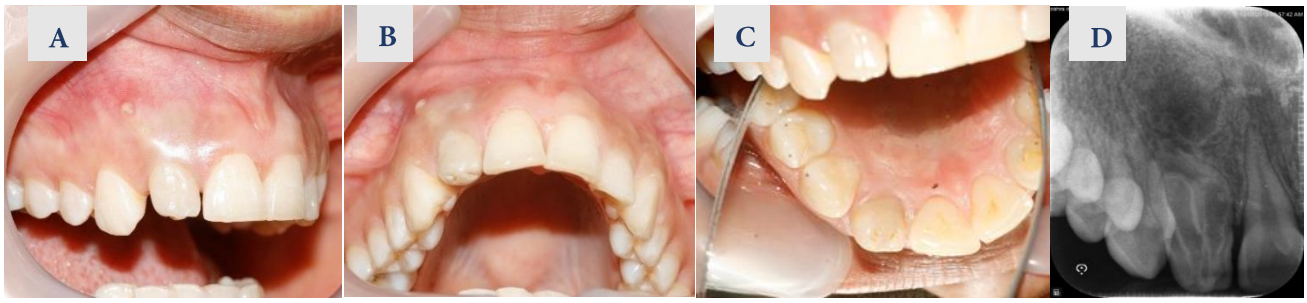

Figure 1. Preoperative images, *A,B* & *C)* Clinical view of maxilla showing an active sinus tract on the right side and the wide labiopalatal dimension of the crown #7; *D)* Radiograph showing presence of dens invaginatus associated with large periapical lesion

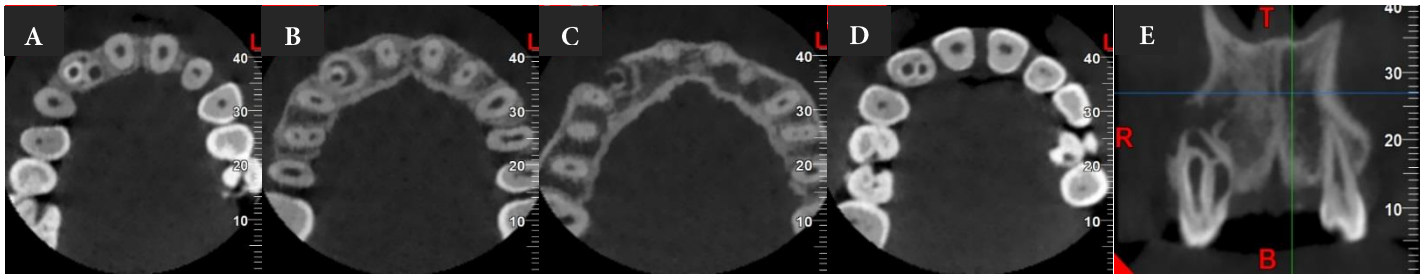

Figure 2. *A)* An axial view of the coronal third of the crown showing the 2 Dens Invaginatus canals surrounding with a complex root canal system; *B)* An axial view of the middle third of the crown showing the cul-de-sacs separated the canal into four portions; *C* & *D)* Axial views of the apical third of the crown showing the cul-de-sacs were protruded to apical part of canal but do not make any independent foramen; *E)* Coronal section of tooth #7, two cul-de-sacs were distinctly showed and periapical lesion was perforated the buccal cortex

delivering the material, the formation of voids, poor adaptation of these materials to the canal wall, and also their wash-out as the result of long setting time [19-22]. Thus, some MTA-like products have been developed to overcome these problems. Endo seal MTA is a new calcium silicate sealer (Endoseal MTA, Maruchi, Wonju, Korea) based on MTA and is derived from Pozzolan cement. Pozzolan is a siliceous material, with few cementitious properties. Pozzolan reacts with calcium hydroxide in the presence of water and forms compounds with cementing properties [23]. An extremely fine silica particle size in the pozzolan cement results in fast setting time of Endoseal MTA. Faster setting time and higher wash-out resistance of pozzolan cements is the superiority of these cements to other MTA products [24]. Low cytotoxicity, bioactivity inducing hard tissues, and minimal discoloration are among other characteristic of these cements [24-27]. The manufacturer also suggests that it can be used not only as a root canal sealer but also as a root canal filling material. Complete obturation of the entire root canal, including accessory and lateral canals, regardless of whether it is used alone or with core material is reported in a recent study [23]. These superior properties of Endoseal MTA, such as fast setting time, improved workability, and physical properties suitable for orthograde filling material [28], superior sealer distribution [29], and satisfactory bond strength performance for application in endodontic therapy [30].

This report documents the treatment of a challenging case of dense invagination of a permanent maxillary lateral incisor. Three months after obturation the patient was subjected to orthodontic treatment with the active orthodontic forces on the mentioned tooth. The outcome of endodontic treatment was successful.

Case Report

An eighteen-year-old female was referred with a history of repeated swelling in the area of tooth #7. The reason for referral, as stated by his general dentist, was complex root canal anatomy. The medical history of the patient was noncontributory. Clinical evaluations revealed that tooth #7 was not sensitive to percussion and palpation. There was no intraoral or extra oral swelling at the time of evaluation but a sinus tract was revealed (Figure 1A and 1B). The periodontal condition of tooth #7 was within normal limits (probing depth #3 mm and normal mobility). Tooth #7 did not respond to cold tests using Endo Ice and the electric pulp test. The tooth showed a wide labiopalatal dimension. There were no visible caries or previous restorations in this tooth (Figure 1A-C). Radiographic evaluation of the tooth showed an open apex tooth with 2 roots (mesial and distal), and two enamel-walled space in the center of the tooth, indicating DI. Also, there was a large periapical lucency to the

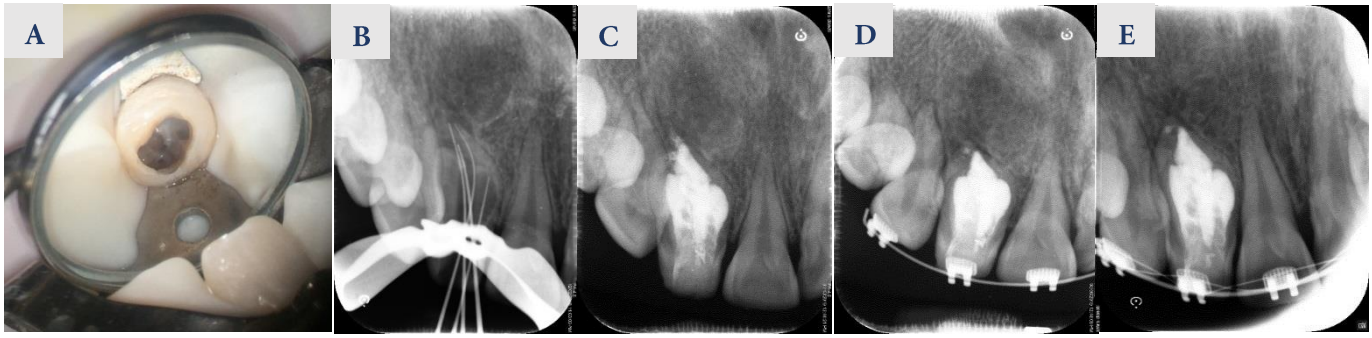

Figure 3. Intraoperative and immediate postoperative images, *A)* Prepared access cavity, note that four portions are detectable on tooth #7; *B)* Working length determination; *C)* Post-operative radiograph; *D)* Radiographic evaluation at six months follow-up showed continued improvement of periapical lesion; *E)* In one year follow up, resolution of the periapical radiolucency can be seen

DI (Figure 1D). The diagnosis for tooth #7 was DI unusual type II and pulp necrosis with asymptomatic apical abscess. Because the preoperative radiographs revealed complex anatomy, a CBCT scan was taken (Kodak 9000 3D; Kodak Dental Systems, Carestream Health, Rochester, NY, USA). Three dimentional evaluation of tooth #7 showed 2 DI canals surrounding with a complex root canal system. Axial slices showed the presence of 2 separate cul-de-sac which were not in communication with the pulp canal. These cul-de-sacs separated the canal into four portions which were protruded to apical part of canal but do not make any independent foramen. The axial cross sections did not show the presence of a possible communication between DI and the root canal system (Figure 2A-D). In coronal cross section of CBCT two cul-de-sacs were distinctly showed, one lined with enamel. The periapical lesion was also perforated the buccal cortex (Figure 2E). After clinical and radiographic examination, root canal treatment was planned for tooth #7. The patient gave oral and written informed consent. Complete local anesthesia *via* buccal infiltration was provided with 1 cartridge of 2% lidocaine with 1:80000 epinephrine (Darupakhsh, Tehran, Iran). After rubber dam isolation, the access cavity was prepared. Based on the CBCT findings, the mesial and distal canals were found. More access penetration was made under magnification (Dental Operating Microscope; Zeiss, Oberkochen, Germany), which provided straight-line access to each canal with ultrasonic tips (Figure 3A). At the first appointment, Root canal instrumentation was performed using stainless steel hand files and root canal system was irrigated with 2.5% sodium hypochlorite with ultrasonic activation (Figure 3B). Then, calcium hydroxide ($CaOH_2$) was introduced into the canals for 10 days. The medicament was removed using the #30 K-file in a circumferential filing action while irrigation with 2.5% NaOCl; ultrasonic activation of the irrigation has been used in order to maximize the removal of calcium hydroxide. According to the manufacturer's instruction, a needle tip containing Endoseal MTA was inserted to reach the apical third of tooth, and the Endoseal MTA was applied gently while pulling the syringe back passively until the needle reached the orifice, the canal and the cul de sacs were obturated totally with Endoseal MTA. Excess canal filling material was cut off and removed at the orifice level. Periapical radiograph was taken to confirm adequacy of root canal obturation (Figure 3C). The access cavities were restored with light cured composite resin (Heraeus Kulzer, Wehrheim, Germany). The patient returned asymptomatic 7 days later. Two weeks later, the patient was contacted by phone and confirmed the patient's tooth was asymptomatic. Three months later, orthodontic treatment was started for the patient. The patient returned asymptomatic at the 6-month re-evaluation (Figure 3D). Tooth #7 was functional and had no sensitivity to percussion or palpation. The probe depths were within normal limits (=3 mm). One year after first radiograph, the re-evaluation radiograph showed significant osseous healing of the prior periapical lesion (Figure 3E).

Discussion

DI, as a developmental abnormality, cause a structural defect (such as pits) in teeth which made them susceptible to caries and subsequently to necrosis. Thus, DI needs early diagnosis and treatment [31]. In the present case, the tooth revealed an unusual DI mostly resemble to Oehlers type II anatomy because it shows just one apex. However, it has some characteristics of type III Oehlers classification. The crown was free from any detectable caries and no history of trauma was reported. The pulpal necrosis of the tooth might have resulted from infiltration of bacteria into the pulp through microscopic channels present in the pit. The early necrosis of the pulp

interferes with the maturation of the apical foramen. The large periapical lesion of such teeth combined with the open apex make sealing of the canal space more difficult. On the other hand, in this case, cleaning, shaping and also obturating the two separated cul-de-sac, and the main canal that is obstructed with these two blind sacs, made the treatment so challenging. Two recent case reports have removed the invaginated hard tissue as it obstructed the central part of the canal and make debridement so hard [13, 18]. This technique may remove excessive tooth structure and endanger the long-term prognosis of the teeth. In the present case, this attitude was not applicable as the cul-de-sacs were extended to the apical part of the canal.

To aid in detection of complex anatomy of this case and in order to determining the extent of periapical lesion, a supplementary CBCT scan was ordered. CBCT showed that two cul-de-sacs were surrounded by pulpal space from all sides. De Rosi *et al.* [32] also showed the presence of more than one DI in a tooth. In the present case, in the coronal cross section of the CBCT the presence of the defects in the enamel lining of DI was clear, which was previously reported in another case reports [14, 33]. These defects in the enamel lining of DI is a potential pathway for bacterial contamination of the pulp tissue if DI canal becomes infected.

In complex anatomies, root canal instruments and irrigation solutions cannot remove the entire bacterial biofilms from root canal spaces, and lead the clinician to perform insufficient treatments [34]. Thus, use of ultrasonic activation during cleaning and shaping is needed to maximize the debridement. In the present case, irrigation of the root canal and also, cul de sacs were done under the activation of ultrasonic instrument.

This report is the only case of DI that obturate with Endoseal MTA and showed a promising result. In the one year follow up the patient was free of symptoms and the periapical radiolucency was completely resolved. A recent study also showed the good characteristics of this MTA sealer [23].

Another considerable fact about this case is the orthodontic forces that applied on this tooth about 3 months after obturation. de Souza *et al.* showed that the orthodontic movement delayed, but did not hinder, the periapical healing process [35]. In the present case orthodontic forces also did not inhibit the healing process of in one year follow up. Some studies showed that orthodontic forces on teeth with active periapical lesion could linger the periapical healing or even worsen it which is not in agreement with the present case [35-37].

Conclusion

Our case study demonstrated successful coronal endodontic treatment of an unusual anomaly in a maxillary lateral incisor with two dens invaginatus canals resembling type 2. The asymptomatic apical abscess was effectively treated by obturating the canals coronally with Endoseal MTA.

Conflict of interest: 'None declared'.

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