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Photodynamic Therapy in a Lateral Maxillary Incisor with Dens in Dente Type Ⅱ and Primary Endodontic Lesion: Case Report

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Endodontic treatment in dens invaginatus anomaly is associated with challenges in all stages. This case report outlines the therapy provided for tooth #10 with occasional pain. In examinations, tenderness to percussion and touch and non-response to sensibility tests were observed, and pulp necrosis and symptomatic periapical periodontitis were diagnosed. Radiographic evaluation showed a structural anomaly related to the dens invaginatus and the associated periapical lesion. Cone-beam computed tomography confirmed the presence of DI type II. Endodontic treatment combined with photodynamic therapy and active irrigation using a dental operating microscope was successful and radiographic examinations showed periapical healing along with bone formation in 6-month and 1-year follow-ups.

Keywords: Dens Invaginatus; Disinfection; Photodynamic Therapy; Root Canal Therapy

Introductin

Dens invagination (DI) is a dental abnormality that occurs during development and can lead to pulp necrosis or pre-radicular pathology. The central and lateral teeth of the maxilla are the most commonly affected by this anomaly [1]. DI occurs when the enamel organ in the dental papilla invaginates during the process of tooth development. This can be observed on a radiograph as a radiolucent invagination enveloped by a radiopaque perimeter, with the potential to be localized within the coronal portion of the tooth or extends into the root [2].

One of the most widely recognized classifications of DI was developed by Oehlers [3]. It categorized them according to the depth of the invagination in relation to the cementoenamel junction and its interaction with the periodontal ligament:

Type I: The invagination stays limited to the crown and doesn't extend beyond the point where the enamel and cement meet.

Type II: The infolding extends into the root but remains enclosed, with the possibility of it either connecting or not connecting with the dental pulp.

Type III: The invagination reaches into the root, forming an additional opening in the apical or periodontal region, but it lacks a direct link to the dental pulp.

The malformation known as DI can present in various clinical forms, with different sizes and shapes such as grooves, slots, conical shapes, barrel shapes, or even talon cusp shapes [4]. Research suggests that cone-beam computed tomography (CBCT) can provide practitioners with a precise three-dimensional (3D) image of the internal anatomy in different planes [5, 6].

Several clinical methodologies have been delineated for the management of dense invaginatus, encompassing restorative interventions, non-surgical endodontic therapy, endodontic surgical procedures, intentional tooth replantation, and in some cases, the extraction of the affected tooth anatomical configurations with the utilization of CBCT and dental operating microscopes in endodontic surgery [7, 8]. This case report outlines the approach taken to manage an extensive periapical lesion linked to a maxillary lateral incisor exhibiting dense invaginatus (DI) deformity. Our methodology involved

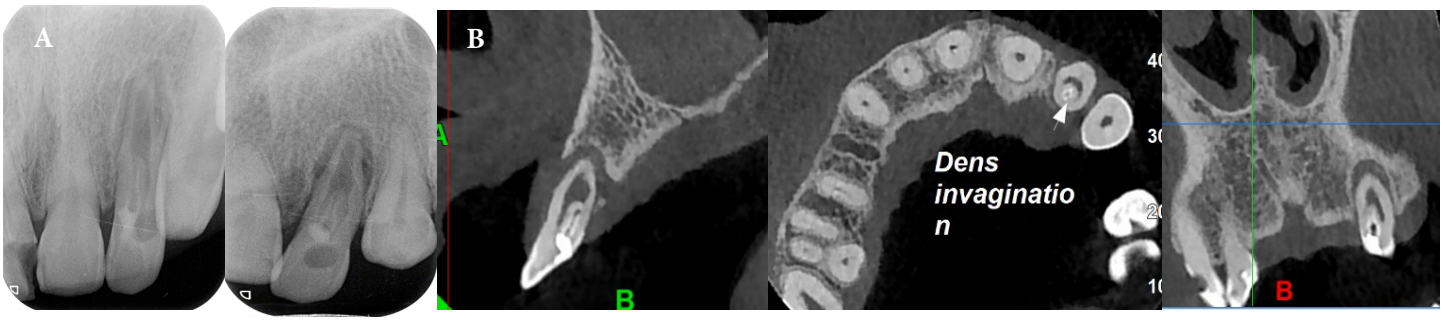

Figure 1. *A*) A large lesion with dens in dente appearance was observed; *B*) CBCT views (axial, sagital and frontal)), there was no connection between the main and pseudo canal and no secondary apical foramen

employing CBCT for diagnostic and treatment planning purposes, in conjunction with the application of the DOM and ultrasonics techniques in the execution of non-surgical endodontics treatment.

Case presentation

A 38-year-old male patient with no significant medical history was referred to the endodontic department complaining of tooth decay and occasional pain. In the clinical examination, poor oral hygiene and decay of tooth #10 were observed, but there were no signs of swelling. Tooth #10 displayed no response during sensibility tests and demonstrated tenderness upon palpation and percussion. The buccal probing depth was measured at 5 mm and the mobility level of grade 2 was detected.

A large lesion with dens in dente appearance was observed on the periapical radiograph (Figure 1A). In CBCT, there was no connection between the main and pseudo canal and no secondary apical foramen (Figure 1B).

Through clinical and radiographic assessments, a clinical diagnosis of DI (Oehlers' Type Ⅱ), necrotic pulp, and symptomatic apical periodontitis was confirmed. Subsequently, by the patient's informed consent the treatment of tooth #10 was initiated with a fair prognosis.

In the first session, local infiltration anesthesia was administered using 2% lidocaine with 1:80000 epinephrine (Darupakhsh, Tehran, Iran), and a rubber dam with a clamp was employed. The caries were removed and access cavity preparation was performed using a high-speed turbine and diamond fissure bur (Dentsply, Maillefer, Ballaigues, Switzerland) all while utilizing 4× magnification provided by a dental operating microscope (Carl Zeiss, Oberkochen, Germany). With the help of DOM, both canals were found and patency was confirmed with file #10 (VDW, Munchen, Germany) in the main canal. The establishment of working length was accomplished through the utilization of an electronic apex locator (Root ZX; J Morita, Japan) in conjunction with periapical radiography (Figure 2A). The canals were prepared and shaped with the rotary ProTaper system using the SP1 file (Shenzhen, China). Irrigation was done with 5.25% NaOCl and the solution was stirred by utilizing a PD1 ultrasonic tip attached to an NSK ultrasonic device (Varios 970; NSK, Japan), at a power level configured to 6, for a duration of 20 sec [9]. Due to purulent and active discharge, calcium hydroxide in combination with saline with a creamy consistency was inserted into the canals, and the access cavity was sealed using Cavit as a temporary restoration during the intervals between treatment sessions.

In the second session, which was scheduled 2 weeks later, the patient's symptoms had improved but had not completely disappeared, and discharge from the canal continued. After active irrigation with NaOCl and ultrasonic, the canal was rinsed with saline. In the following steps, photodynamic therapy was performed; The canal was impregnated with methylene blue as a photosensitizer for 60 sec and the emitter was then placed in the root canal and irradiation was carried out for 30 s [10] (Figure 2B). After re-irrigation with saline, calcium hydroxide in combination with chlorhexidine, with a creamy consistency, was used as an intracanal medicament.

Next session, the patient's symptoms, including sensitivity to percussion and touch, were resolved, and the discharge from the canal was controlled. Also, the mobility of the tooth was improved. The root canal was filled using the warm vertical compaction method, employing gutta-percha cones in combination with AH-26 sealer. (Dentsply, Tulsa Dental, OK, USA). The final radiograph was obtained immediately after filling the root canal to confirm the tight seal resulting from the filling (Figure 2C).

Figure 2. *A*) Working length was confirmed; *B*) Photodynamic therapy was performed; *C*) The root canal was filled using the warm vertical compaction method; *D)* One-year follow-up

The access cavity was restored using composite resin as the final restorative material. In follow-up sessions; 6 months and 1 year later, the patient was completely asymptomatic, and dental radiographs demonstrated a decrease in the dimensions of the periapical lesion, which indicates the healing process (Figure 2D).

Discussion

DI is a dental malformation resulting from the inward folding of enamel or dentin folding into the tooth's cavity or root. Structural irregularities induced by DI serve as contributory factors for dental caries, indeed microorganisms and their products can exacerbate the infection and eventually cause pulp necrosis [11, 12].

Managing a tooth with DI can be difficult due to the intricate canal morphology and anatomical structure involved. The patient presented tooth #10 with DI (Oehler's type II) accompanied by pulp necrosis and symptomatic periapical periodontitis. To achieve comprehensive disinfection of the root canal system, we utilized a blend of irrigation and disinfection methods, which included the application of photodynamic therapy (PDT). For managing DI, it is recommended to utilize CBCT for the classification of the condition [13]. This is important in determining the most suitable treatment plan. Passive activation of NaOCl was achieved using Ultrasonic Ultra-X equipped with the blue tip, recognized for its enhancement of canal irrigation. To remove the smear layer, 17% EDTA was used as a chelator material. According to previous research, the utilization of ultrasonic activation in combination with PTD or alongside 2.5% NaOCl can lead to an improvement in disinfection and the eradication of *Enterococcus (E.) faecalis* [14, 15].

During PDT, a safe and non-toxic photosensitizing agent, called photosensitizer (PS), is used for irrigation and disinfection. This substance becomes active when exposed to light of a particular wavelength and localized in tissues, leading to the generation of singlet oxygen and free radicals, which exhibit cytotoxicity towards specific tissue cells. Cationic PS, exemplified by methylene blue, displays effectiveness against various gram-positive and gram-negative oral bacteria when subjected to red light exposure [16]. Studies have shown a substantial 97% reduction in *E. faecalis* biofilm following the application of 25 g/mL of methylene blue and subsequent illumination with light [17].

Conclusion

This case report details the effective implementation of non-surgical endodontic procedures, combining photodynamic therapy with active irrigation, to manage a challenging case of DI associated with an extensive periapical lesion in a maxillary lateral incisor.

Conflict of interest
None.

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Authors' contributions
Maryam Amiri: management of the case; Arezoo Mirzaie: management of the article

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