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Endodontic Treatment of an Upper Lateral Incisor with Oehlers' Type II Dens Invaginatus: A Case Report

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Dens invaginatus is a developmental malformation that is caused by the invagination of the enamel organ into the internal region of the dental papilla before tissue calcification. The aim of the present report is to discuss a clinical case of endodontic treatment of tooth #12, using bioceramic sealer. The extraoral examination revealed atypical anatomy, while vitality and percussion tests were negative, palpation test was positive. Edema was observed in the adjacent gingival mucosa. Based on clinical and tomographic findings, the diagnosis was pulp necrosis with chronic periapical abscess and Oehlers' type II dens invaginatus. In the first session, access surgery was performed with spherical drills with the aid of an operating microscope (OM) and an ultrasonic diamond tip. Four canals were located, and they were partially debrided and medicated. In the second session, odontometry and chemical-mechanical preparation with nickel-titanium instruments were performed. The irrigation solution was 2.5% sodium hypochlorite. The root canals were filled with calcium hydroxide paste and the chamber was temporarily sealed. During the third session, ultrasonic irrigation was applied for final washing and the root canals were filled with Bio-C sealer using the classic single-cone technique. At 6-month follow-up, the tooth was asymptomatic and the radiography revealed significant bone repair. It was concluded that tomography, operating microscope, ultrasonic irrigation, and materials with greater flow, such as bioceramic sealers, enhanced the clinical success of the clinical case.

Keywords: Case Report; Dens Invaginatus; Endodontics; Upper Lateral Incisor

Introduction

Dens invaginatus, or dens in dente, is a dental anomaly that results from developmental malformation, originating through an invagination of the enamel organ into the internal region of the dental papilla before tissue calcification, creating invaginations described by some authors as "tooth within another tooth", due to its radiographic appearance [1]. It was first described by Ploquet in 1794. The hypothesis to explain the etiology of this dental anomaly is the retardation or acceleration of the growth of the internal enamel epithelium and distortion of the enamel organ during tooth development [2]. The prevalence rate of this anomaly ranges from 0.4% to 10% and the upper lateral incisors are the most affected, followed by upper central incisors, and more rarely, canines, premolars, and molars [3].

Several classifications have been proposed to identify dental invaginations. The most accepted and widely used is Oehlers' classification, which includes 3 types based on the vertical extension of the invagination [1]. In Oehlers' type I, the most prevalent type, invagination is limited to the crown of the tooth and does not go beyond the cementoenamel junction (CEJ) [4]. In Oehlers' type II, invagination extends into the root beyond the CEJ and ends in a "blind sac" [1]. Type III is subdivided into IIIa and IIIb. In type IIIa, invagination extends into the root and communicates laterally through a pseudo-foramen with the periodontal ligament. In type IIIb, invagination extends into the root and

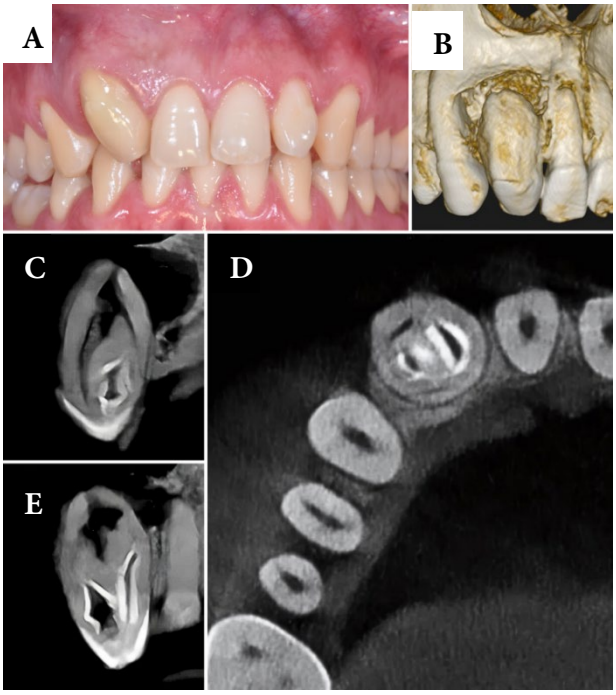

Figure 1. *A*) Intraoral photograph revealing an atypical shape of tooth #12 and presence of a fistula; *B*) 3D reconstruction of the maxillary lateral incisor from CBCT images; *C*) Sagittal section showing periapical lesion and dens invaginatus in tooth #12; *D and E)* Axial and coronal sections showing dens invaginatus in tooth #12

communicates apically through a pseudo-foramen with the periodontal ligament [5].

Due to the narrow lining of the dens invaginatus, the development of carious lesions is common, which can lead to an infection in the pulp or periapical tissue [6]. These teeth are often described as presenting a barrel-shaped anatomy or an atypical shape [7].

Endodontic treatment of teeth with dens invaginatus requires precise diagnosis, as well as adequate treatment planning. Thus, it is essential to use imaging tests, such as conventional X-rays or computed tomography [2].

If the dental element presents with necrotic pulp and a periapical lesion, both the invagination and the root canal must be treated, paying attention to access cavity preparation and chemical-mechanical preparation, as the irregular anatomy of these teeth represents a challenge for cleaning, disinfecting, and filling of the root canal system [1].

Nickel-titanium instruments have been used to treat this anomaly as they help the prognosis of the case. Due to their superelasticity and shape memory effect, these instruments have been indispensable for efficient cleaning and modeling of complex root canals as they are resistant to fatigue and torsion [8]. The use of ultrasound devices also play an important supporting role, as they enhance the action of irrigating substances through the shear flow caused by acoustic microstreaming along the root canal wall and cavitations [9]. Another supplementary equipment is the surgical microscope, which is an effective instrument to manage complex root canal treatments by providing illumination and magnification [10].

Dens invaginatus anomaly is a challenge to endodontics due to the complex anatomy of the tooth. As the tooth with dens invaginatus is susceptible to carious lesions and pulp infection, it is essential to study its particularities to provide the best clinical treatment. Therefore, the aim of this study is to report the planning and management of endodontic treatment of a tooth with dens invaginatus using bioceramic filling material.

Case Report

This is an observational, descriptive, case report study. The study project was conducted at the Advanced Integrated Clinic of the Postgraduate Program in Dentistry at UFAM. The study was approved by the Research Ethics Committee under registration CAAE 75110823.5.0000.5020. The authors obtained written informed consent from the patient. This study was conducted in accordance with the CARE guidelines (The CAse REport guidelines) [11].

The 29-year-old male patient, H.V.M. sought the graduate Dental Clinic of the Federal University of Amazonas complaining of the esthetics of the upper lateral incisors (Figure 1). The patient reported that he did not have any hereditary or systemic diseases or hypersensitivity to medications. On clinical examination, the presence of a fistula was observed in the vestibular region of tooth #12 (Figure 1A).

The tooth also presented with an atypical shape, similar to the one described in the literature as a “barrel-shaped” anatomy. To confirm the endodontic diagnosis, pulp vitality/sensibility tests were performed. Percussion, mobility, and cold tests were negative. The palpation test yielded a positive response. The panoramic radiographic examination revealed periapical bone rarefaction as well as complex internal root anatomy, suggestive of dens invaginatus anomaly. The axial, sagittal, and coronal sections of the cone-beam tomography (CBCT) confirmed the presence of dens invaginatus in the upper right lateral incisor (Figures 1C-1E).

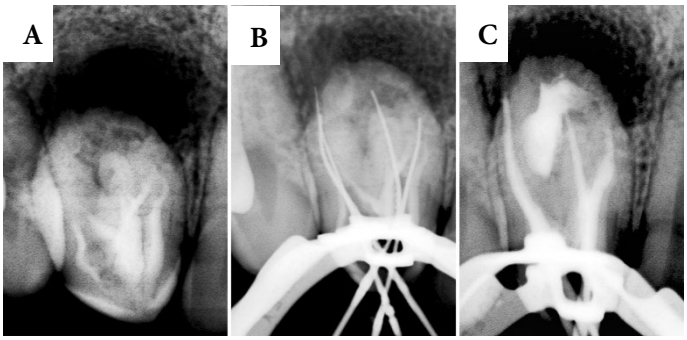

Figure 2. *A*) Initial radiograph of treatment; *B*) Periapical radiograph confirming the path of the four root canals; *C*) Periapical radiograph confirming the quality of the filling

The final diagnosis was pulp necrosis with chronic apical periodontitis and the presence of Oehlers' type II dens invaginatus anomaly.

In the first session, the infiltrative anesthetic technique was performed in the lower vestibular area of tooth #12 using 4% articaine with 1:100,000 epinephrine (DFL, Rio de Janeiro, Brazil), followed by isolation of the operative field using a rubber dam sheet and clamp number 210. A 1014HL spherical diamond drill bit and a 2135 conical diamond drill with an inactive bit were used for access and shaping of the tooth, respectively. Both instruments were used at high speed with cooling. Access was improved by using an ultrasonic device (Advance View II-Microdont, São Paulo, Brazil) and an E6D ultrasonic diamond tip (Helse, São Paulo, Brazil) with the aid of an operating microscope (Alliance, São Paulo, Brazil).

An initial exploration was carried out using #10 and #15 C-Pilot files (VDW, Munich, Germany), followed by pre-widening of the root canals with 25-mm ProDesign R (25/0.06) reciprocating files (Easy Bassi, Belo Horizonte, Brazil). Four root canals were located: mesio-buccal, mesio-lingual, disto-lingual and disto-buccal. Irrigation was performed with 2.5% sodium hypochlorite and aspiration with a purple capillary tip (Ultradent, São Paulo, Brazil). Odontometry was obtained electronically with the aid of an E-Pex Pro electronic apex locator (Mk Life, Rio Grande do Sul, Brazil) coupled to a #25 K-file (Kendo-VDW, Munich, Germany). The working lengths for the mesio-buccal, mesio-lingual, disto-lingual and disto-buccal root canals were 18 mm, 18.5 mm, 17 mm, and 18 mm, respectively, confirmed by periapical radiograph using a T2 digital sensor (Microimagem, Santa Catarina, Brazil) (Figure 2B).

The first session was completed with the placement of a intracanal medication (Tricresol Formalina, Biodinamic, Paraná, Brazil) and temporary sealing with glass ionomer cement (Ionglass Maquira, Paraná, Brazil).

Anesthesia and isolation were performed in the second session, as previously described. A 1014HL spherical diamond drill bit was used to remove the temporary sealing and the cotton ball.

The glide path was created with ProGlider rotary files size 25 (Dentsply Sirona, Maillefer, Ballaigues, Switzerland) to ensure the path of the root canals. The root canals were shaped with ProDesign R (25/0.06) reciprocating files size 25 (Easy Bassi, Belo Horizonte, Brazil) at the working length.

Irrigation was carried out constantly between instrument changes with 2.5% sodium hypochlorite (Asfer, São Paulo, Brazil). Passive ultrasonic irrigation was performed using an Irrisonic ultrasonic tip (Helse, São Paulo, Brazil). Calcium hydroxide paste (UltraCalXS Ultradent, São Paulo, Brazil) was applied on the tooth on the second session and temporary restoration was performed using resin-modified glass ionomer cement (Ionglass; Maquira, Paraná, Brazil).

Anesthesia, isolation and access, as previously described, were performed on the third session, followed by the selection of M gutta-percha cones (Dentsply Sirona, Maillefer, Ballaigues, Switzerland). Final irrigation was performed with 2.5% sodium hypochlorite (Asfer, São Paulo, Brazil) and 17% EDTA (Biomicina, Paraná, Brazil) using the passive ultrasonic irrigation technique with the Irrisonic tip (Helse, São Paulo, Brazil). The root canals were dried with sterile paper cones (Dentsply Sirona, Maillefer, Ballaigues, Switzerland).

The root canals were obturated with Bio-C sealer sealer using the single cone technique (Angelus, Paraná, Brazil) and Schilder's vertical condensation technique (Odous de Deus, Belo Horizonte, Brazil). A new periapical radiograph was performed to confirm the quality of the filling (Figure 2C).

The pulp chamber was cleaned with 70% alcohol and cotton and new temporary sealing was performed with resin-modified glass-ionomer cement (Ionglass; Maquira, Paraná, Brazil). The patient was referred to a different sector of the dental clinic for definitive composite resin restoration and re-anatomization of tooth #12 (Figure 3A). The case was followed up for six months and one year. The patient remained asymptomatic during this period. A new periapical X-ray was performed to monitor the dental element (Figures 3C and 3D). Significant regression of the periapical lesion and apical bone repair was observed.

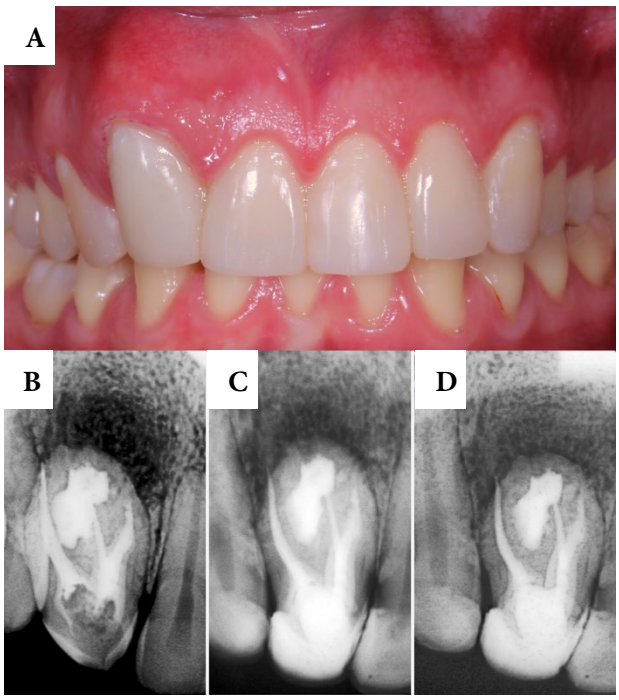

Figure 3. *A*) Intraoral photograph revealing the definitive composite resin restoration and regression of the fistula; *B*) Final radiograph of treatment; *C*) Six-month follow-up radiograph; *D*) One-year follow-up radiograph

Discussion

The etiology of dens invaginatus is not clear, but some hypotheses include external factors, trauma and aggression, or genetic factors. Nevertheless, it is widely accepted that this anomaly arises from the invagination of the enamel organ into the dental papilla before calcification [5].

Most patients are asymptomatic and dens invaginatus is diagnosed during routine clinical and radiographic examinations. During initial clinical examination, the dentist may note an atypical barrel-like shape anatomy or presence of a pit or palatal groove. The diagnosis requires additional examinations, such as periapical radiography or CBCT [7, 12].

The malformation of dens invaginatus makes the tooth susceptible to carious lesions given that the invagination often opens into the oral cavity and favors bacterial colonization and accumulation, which may lead to the need for endodontic treatment [6]. Furthermore, imaging exams are required as the type of invagination is decisive for the planning of endodontic treatment. In the present study, the diagnosis was of Oehlers' type II dens invaginatus, which is an invagination that extends into the root beyond the CEJ and ends in a "blind sac" with no communication with the periodontal ligament [5].

Due to the challenges in carrying out the chemical-mechanical preparation of these teeth, magnification and disinfection techniques are recommended, such as operative microscopy, mechanical agitation of sodium hypochlorite (NaOCl), and cleaning of root canal irregularities and of the invagination using ultrasound before obturation [1, 13]. The operating microscope is an important tool for complex endodontic therapy as it provides details of the operating field and of the location of the root canals [10], thus obtaining high success rates.

Endodontic treatment should be the first choice for teeth with dens invaginatus, before endodontic surgery [14], as several clinical studies have reported success and periapical healing [2]. Efficient cleaning and shaping of invaginations and ramifications are imperative to reduce root canal infection [15].

As reported in the literature, 2.5% sodium hypochlorite irrigant solution improves chemical-mechanical preparation for it dissolves organic tissues and eliminates microorganisms [9]. Sodium hypochlorite has shown increased effectiveness when activated ultrasonically through the passive ultrasonic irrigation technique (PUI) and studies have reported it to be indispensable for the debridement of complex roots [2]. The PUI is essential in difficult cases since other instruments cannot reach some of the areas of the root canal. The ultrasonic device converts electrical energy into ultrasonic waves and the energy is transmitted by means of ultrasonic waves from the instrument to the irrigant, thus removing debris and bacteria [9].

Choosing the filling material is also decisive for the success of endodontic treatment. In dens invaginatus, the ramifications of the invagination must be filled with materials with adequate biocompatibility and sealing potential [16]. In comparative studies, calcium silicate-based sealers have shown good flow and adaptation to dentinal tubules due to their consistency, biocompatibility and calcium nanoparticles, which provide tissue regeneration and bactericidal action [17, 18].

Conclusion

This study reported the successful endodontic treatment of an upper right lateral incisor with Oehlers' type II dens invaginatus using conventional endodontic techniques associated with contemporary instruments and materials. The patient remains asymptomatic, and the 12-month follow up showed signs of periapical repair.

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Conflict of interest
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Authors' contributions
Conceptualization: AAMJ, Methodology: MS/PS/STA, Formal analysis and investigation: AAMJ/SBS/ROR/ILMC, Writing-original draft preparation: ARAH/ECSJ, Writing-review and editing: AAMJ/SBS/ROR/ILMC, Supervision: AAMJ. All authors read and approved the final manuscript.

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