

**ENDODONTIC
MANAGEMENT OF
OEHLERS TYPE III DENS
INVAGINATUS FEATURING A
RARE TRIPARTITE
INVAGINATION
CONFIGURATION: A CASE
REPORT**

**TRATAMENTO ENDODÔNTICO DE DENS INVAGINATUS TIPO III DE
OEHLERS COM RARA CONFIGURAÇÃO DE INVAGINAÇÃO TRIPARTIDA:
RELATO DE CASO**

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ABSTRACT

Dens invaginatus, or *dens in dente*, is a congenital malformation characterized by the invagination of the enamel organ into the dental papilla, resulting in a highly complex internal anatomy. This report presents the diagnosis and treatment of a maxillary lateral incisor presenting an Oehlers Type III variant, featuring a rarely reported tripartite invagination configuration associated with an odontogenic cystic lesion. Following confirmation of pulp vitality in the main canal by sensibility testing and three-dimensional Cone-Beam Computed Tomography (CBCT) planning, a conservative approach was adopted, focusing strictly on the infected invaginated tract. Under operative magnification, ultrasonic tips were used for selective enamel removal and access, followed by biomechanical preparation using a regressive taper file system (TruNatomy™, Dentsply Sirona) and chemical disinfection with 2.5% NaOCl and 17% EDTA under sonic agitation. The protocol included intracanal calcium hydroxide medication and final obturation of all three branches of the invagination with a bioceramic sealer (BioC Sealer, Angelus, Londrina, Brazil). The results demonstrated regression of the periapical lesion and absence of symptomatology over a 24-month follow-up period. CBCT-guided diagnosis combined with minimally invasive endodontic techniques enabled conservative management and preservation of pulp vitality in a severe anatomical anomaly.

Keywords: Dens invaginatus; Cone-Beam Computed Tomography; Endodontics; Root Canal Therapy; Periapical Periodontitis.

RESUMO

O *dens invaginatus*, ou *dens in dente*, é uma malformação congênita caracterizada pela invaginação do órgão do esmalte em direção à papila dentária, resultando em uma anatomia interna

altamente complexa. Este relato apresenta o diagnóstico e o tratamento de um incisivo lateral superior com a variante Tipo III de Oehlers, exibindo uma configuração de invaginação tripartida raramente descrita, associada a uma lesão cística odontogênica. Após a confirmação da vitalidade pulpar no canal principal por meio de testes de sensibilidade e planejamento com tomografia computadorizada de feixe cônico (TCFC) tridimensional, adotou-se uma abordagem conservadora, focada estritamente no trajeto invaginado infectado. Sob magnificação operatória, pontas ultrassônicas foram utilizadas para a remoção seletiva de esmalte e acesso, seguidas pelo preparo biomecânico com um sistema de limas de conicidade regressiva (TruNatomy™, Dentsply Sirona) e desinfecção química com NaOCl a 2,5% e EDTA a 17% sob agitação sônica. O protocolo incluiu medicação intracanal com hidróxido de cálcio e obturação final de todos os três ramos da invaginação com um cimento biocerâmico (BioC Sealer, Angelus, Londrina, Brasil). Os resultados demonstraram a regressão da lesão periapical e a ausência de sintomatologia durante um período de acompanhamento de 24 meses. O diagnóstico guiado por TCFC, combinado a técnicas endodônticas minimamente invasivas, permitiu um manejo conservador e a preservação da vitalidade pulpar diante de uma anomalia anatômica severa.

Palavras-chave: *Dens invaginatus*; Tomografia Computadorizada de Feixe Cônico; Endodontia; Tratamento de Canal Radicular; Periodontite Periapical.

INTRODUCTION

Dens invaginatus is a rare developmental malformation originating from the invagination of the enamel organ into the dental papilla during odontogenesis. This congenital anomaly can affect

deciduous, permanent, or supernumerary teeth, resulting in an intricate pulpal architecture that challenges endodontic practice. Frequently, its clinical detection is hindered by its asymptomatic nature and the presence of a crown with an apparently intact morphology, making early diagnosis crucial for therapeutic success (Agarwal, 2024; Boaz et al., 2022).

Historically, the initial record of this anomaly dates back to Ploquet (1794), who described it in whale teeth. However, the first documented report in humans was made by Socrates in 1856. The widely disseminated nomenclature, "*dens in dente*", was later introduced by Busch (1897), due to the characteristic radiographic appearance of a dental structure contained within another (Alenazy et al., 2017; Hallet, 1953).

The etiology of *dens invaginatus* remains a subject of extensive discussion. Authors such as Kronfeld (1934) and Oehlers (1957) suggested that focal growth retardation of an epithelial segment would lead to the formation of an enamel-lined blind sac. From a developmental biology perspective, Dassule et al. (2000) and Cobourne et al. (2001) highlight the essential role of the Shh (Sonic Hedgehog) signalling factor in regulating epithelial proliferation. Complementarily, the Mechanical Pressure Theory advocated by Al-Ani & Bishop (2008) suggests that external forces exerted by adjacent tooth germs could collapse the enamel organ. More recent perspectives synthesized by Subbiya et al. (2013) propose that the anomaly stems from anomalous growth of the inner enamel epithelium or from the fusion of two dental germs.

The classification proposed by Oehlers (1957) is the most widely used to categorize this malformation according to its anatomical extent.

Type I is a minimal invagination restricted to the dental crown, not extending beyond the cemento-enamel junction. Type II extends into the root, ending in a blind sac that may communicate with the pulp chamber without connecting with the periodontal ligament. Type III is characterized by an invagination traversing the entire root length, subdivided into III-A, with lateral communication with the periodontal ligament, and III-B, where the invagination passes through the apical foramen communicating directly with periapical tissues.

Although the prevalence of *dens invaginatus* in the general population varies widely between 0.3% and 10%, the Type III variant is significantly rarer, representing only approximately 3% to 5% of diagnosed cases (González-Mancilla et al., 2022; Gündüz et al., 2013). The maxillary lateral incisor is the most commonly affected tooth, although the anomaly has been documented in virtually any tooth type, including premolars and mandibular incisors (Alves Santos et al., 2023). The bilateral occurrence of *dens invaginatus* has also been reported, reinforcing the importance of systematic bilateral radiographic screening when the anomaly is identified on one side of the arch (Boaz et al., 2022).

From a clinical standpoint, the significance of *dens invaginatus* lies in its pathophysiological consequences. The invaginated enamel-lined space communicates with the oral environment through a foramen caecum, which may be extremely narrow or even imperceptible clinically. This communication provides a direct pathway for microorganisms to penetrate the invagination without initially involving the main pulp tissue. As a consequence, pulp necrosis within the invaginated tract can occur independently and often precedes the involvement of the main radicular pulp, creating

a paradoxical clinical scenario in which the tooth presents a positive vitality response despite exhibiting an extensive periapical lesion (Lee et al., 2020). This dissociation between clinical signs and the radiographic appearance constitutes one of the most challenging diagnostic traps in endodontic practice, and failure to recognize it frequently leads to unnecessary or incomplete treatment decisions (González-Mancilla et al., 2022).

Furthermore, the presence of an invaginated canal system creates profound mechanical and microbiological challenges during treatment. The irregular geometry of the invagination resists conventional rotary instrumentation, the enamel lining of the invaginated walls is highly mineralized and resistant to chemical dissolution by sodium hypochlorite, and the spatial relationship between the invaginated canal and the main root canal demands meticulous three-dimensional assessment prior to any therapeutic intervention (Alani & Bishop, 2008). These combined factors explain why Type III *dens invaginatus* is associated with some of the highest rates of treatment complexity and, historically, with premature extraction of the affected tooth (Agarwal, 2024).

Given the aforementioned, the present study aims to report the diagnosis, conservative endodontic management, and 24-month follow-up of a maxillary lateral incisor (tooth 22) diagnosed with an Oehlers Type III *dens in dente* associated with an odontogenic cystic lesion, detailing the fundamental clinical steps for therapeutic success in an exceptionally rare tripartite configuration.

Case History/Examination

Written informed consent was obtained from the patient prior to treatment and for the publication of this case report and all accompanying clinical and radiographic images, in accordance with the terms outlined in the Wiley standard patient consent form.

A 19-year-old male patient presented to the dental clinic of the institution reporting a previous history of pain in tooth 26. During the anamnesis and general clinical examination of the oral cavity, an altered coronal anatomy was observed on tooth 22 (left maxillary lateral incisor). The tooth appeared clinically sound but featured an extremely deep palatal groove and fissure. Cold pulp sensibility tests yielded a normal positive response, suggesting vitality of the main pulp. However, the periapical radiographic examination (Figure 1) revealed severe anatomical complexity incompatible with standard root morphology, including a diffuse periapical radiolucency extending beyond the apex of the invaginated system.

Given the extreme limitations of conventional radiography in comprehending complex internal anatomy, a Cone-Beam Computed Tomography (CBCT) scan was deemed essential. The volumetric assessment confirmed the presence of a *dens invaginatus* classified as Oehlers Type III (Figures 2 and 3). Unusually, the tomographic scan revealed that the amelodontinal invagination presented a bifurcation, establishing a complex tripartite system extending through the middle and apical thirds of the root unit. The three distinct branches of the invagination were clearly delineated on both sagittal and axial CBCT reconstructions, with the main root canal confirmed to be anatomically separate and fully vital. The periapical bone defect associated with the invaginated system was well-defined, with cortical bone destruction consistent with a developing odontogenic cystic lesion.



Figura 1: Preoperative periapical radiograph of tooth 22 showing the complex invaginated canal system and associated periapical radiolucency.

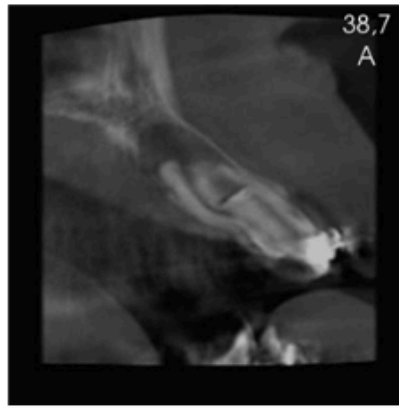


Figura 2: Preoperative CBCT sagittal view of tooth 22 revealing the bifurcated tripartite invagination system extending through the apical root thirds (Oehlers Type III).

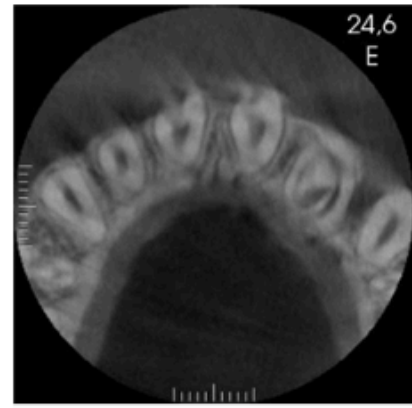


Figura 3: Preoperative CBCT axial view of tooth 22 showing the cross-sectional anatomy of the three branches of the invaginated system at the middle root third.

Differential Diagnosis, Investigations and Treatment

The differential diagnosis at presentation included severe root dilaceration with secondary periapical periodontitis, external root resorption with associated cyst formation, and *dens invaginatus* with infected invaginated canal system. The CBCT volumetric assessment was decisive in excluding dilaceration and resorptive defects, confirming the diagnosis of Oehlers Type III *dens invaginatus* with a tripartite invaginated system. The clinical and tomographic dissociation between a vital main pulp and the extensive periapical lesion was conclusive in indicating that the infectious process was confined to the invaginated tract, sparing the main radicular pulp.

The intervention was conducted under local anesthesia, rubber dam isolation, and with the constant aid of operative magnification (dental operating microscope). The clinical protocol was divided into sessions to ensure maximum microbiological control.

The access cavity was prepared on the palatal aspect, directed strictly toward the invagination, carefully preserving the pulp chamber of the main canal to maintain its vitality. Immediately following initial exploration with C-Pilot manual files (C-Pilot® Files, VDW GmbH, Munich, Germany), an intracanal medication consisting

of Calcium Hydroxide P.A. mixed with propylene glycol was placed, and the cavity was temporarily sealed with Glass Ionomer Cement.

During the second clinical session, the cervical opening was prepared and the middle root third was neutralized. The use of ultrasonic tips was fundamental for the selective removal of the invaginated enamel that restricted visibility within the operative field. Subsequently, canal enlargement was performed using glide path instruments (ProGlider™ File, Dentsply Sirona, Ballaigues, Switzerland), and the cavity received a fresh application of intracanal medication followed by a temporary seal.

In the subsequent session, the definitive location of the three branches of the invaginated system was established and their respective working lengths were determined using an electronic apex locator confirmed by periapical radiography: 22 mm for the distal canal, 15 mm for the medial canal, and 19 mm for the mesial canal.

Biomechanical shaping was executed using the TruNatomy™ file system (Dentsply Sirona, Ballaigues, Switzerland) to size 36.04, alternating between Prime and Large files according to the canal orifice anatomy. The rotary kinematics associated with the regressive taper allowed preparation of the root walls without causing apical transportation or excessive wear of the remaining dentin. Irrigation was copious, employing 2.5% sodium hypochlorite and 17% EDTA, both enhanced by sonic agitation to maximize cleaning of irregular areas. The system was subsequently filled with calcium hydroxide and propylene glycol-based intracanal medication.

Following the intracanal medication period, definitive obturation (Figures 4, 5, and 6) was performed using a bioceramic sealer (BioC Sealer, Angelus, Londrina, Brazil) due to its high flowability and biocompatibility, ensuring hermetic filling of the three branches of the invagination and the apical pseudo-foramen.

Conclusion and Results (Outcome and Follow-up)

The patient was reviewed at 6, 12, and 24 months following completion of treatment. At all follow-up appointments, the tooth was asymptomatic, with no pain on percussion or palpation, and no swelling or sinus tract. Cold pulp sensibility testing confirmed the continued vitality of the main root canal pulp at each review.

Radiographic assessment at 12 months demonstrated significant regression of the periapical radiolucency previously associated with the infected invagination. CBCT evaluation at 24 months (Figures 5 and 6) confirmed complete osseous repair at the periapical region, with restoration of the lamina dura and periodontal ligament space surrounding the main root. No evidence of root resorption, fracture, or periradicular pathology was observed. The tooth remained fully functional throughout the follow-up period.



Figura 4: Post-obturation periapical radiograph of tooth 22 confirming hermetic filling of all three branches of the invagination with bioceramic sealer.



Figura 5: CBCT sagittal view of tooth 22 at 24-month follow-up showing complete obturation of the tripartite system and periapical bone repair.



Figura 6: CBCT axial view of tooth 22 at 24-month follow-up confirming tridimensional sealing of the three invagination branches with no periradicular pathology.

The successful management of this case demonstrates that CBCT-guided diagnosis associated with minimally invasive endodontic treatment can effectively preserve pulp vitality while promoting complete periapical healing in complex anatomical anomalies such as Oehlers Type III *dens invaginatus*.

DISCUSSION

The clinical management of teeth diagnosed with Oehlers Type III *Dens Invaginatus* (DI) represents one of the major challenges in contemporary endodontics. The unpredictability of the internal anatomy, which frequently acts as a niche for bacterial proliferation isolated from the main pulp yet in direct communication with the periapical tissues, demands highly precise operative protocols. In the present report, the complexity was exacerbated by the presence of a bifurcated amelodontinal invagination resulting in a tripartite system — a structural variation with exceedingly scarce documentation in the endodontic literature. To the best of the authors' knowledge, the combination of a Type III classification with a bifurcated, tripartite invagination channel is among the rarest morphological presentations reported in the indexed literature, underscoring the idiosyncratic and unpredictable developmental nature of this anomaly.

Precise, three-dimensional diagnosis was the cornerstone for planning the conservative approach. Conventional periapical radiographs, while useful for initial screening, are fundamentally limited by the superimposition of anatomical structures and their inherent two-dimensionality, which frequently leads to underestimation of the true extent and configuration of DI. In cases of Type III DI, conventional radiography may fail entirely to

demonstrate the number of invagination branches, their individual trajectories, their relationship with the main root canal, and the precise dimensions of any associated periapical lesion. The use of CBCT was therefore mandatory in the presented case, corroborating the findings of González-Mancilla et al. (2022) and Gündüz et al. (2013), who highlight CBCT as the gold standard for morphological assessment, access planning, and delimitation of bone lesions associated with this anomaly. Furthermore, CBCT allowed confirmation that the invagination and the main canal were anatomically separate, which is the critical prerequisite for a vitality-preserving approach (Lee et al., 2020). Without this tridimensional confirmation, a conventional approach — involving full pulpectomy — would likely have been adopted, unnecessarily sacrificing a viable pulp and significantly compromising the long-term prognosis of the tooth.

A fundamental premise dictating modern minimally invasive endodontics is the preservation of the host tooth's main pulp vitality, provided sensibility tests yield a normal response. Unlike radical approaches of the past, which often culminated in premature extractions or full devitalization of the tooth, the executed therapy focused strictly on the orthograde treatment of the infected invaginated tract. This selective, anatomy-driven approach is fully aligned with current evidence-based endodontic philosophy, which recognizes the maintenance of pulp vitality as a primary objective whenever clinically feasible (Lee et al., 2020; Agarwal, 2024). To achieve this, the continuous use of operative magnification and ultrasonic tips played a critical role, allowing selective and millimetric removal of the deep invaginated enamel without sacrificing remaining healthy dentin. Operative magnification — whether provided by surgical loupes or a dental operating

microscope — is now considered an indispensable resource in complex endodontic anatomy management, enabling the clinician to distinguish the enamel-lined walls of the invagination from the surrounding dentinal structures with a level of precision unattainable under naked-eye conditions (González-Mancilla et al., 2022).

The biomechanical preparation of atypical anatomies demands extra caution. Conventional rotary instrumentation systems, designed for regular root canal morphologies, are frequently insufficient when applied to the irregular geometry of invaginated canals, where abrupt directional changes, extreme narrowing, and the presence of residual enamel create significant mechanical obstacles. The use of regressive taper instruments, such as the TruNatomy™ system (36.04), was strategically chosen for their high flexibility and reduced cross-sectional mass, ensuring shaping of canals with aberrant paths without promoting apical transportation or structural weakening of the root — a common and catastrophic complication in teeth already compromised by the congenital invagination. The irrigation protocol utilizing NaOCl and EDTA under sonic agitation, combined with successive changes of calcium hydroxide paste [Ca(OH)₂], proved indispensable for chemical disinfection of anatomical recesses inaccessible to the purely mechanical action of the files. Sodium hypochlorite at 2.5% concentration, potentiated by sonic agitation, has demonstrated significantly superior antimicrobial penetration and organic tissue dissolution in irregular canal spaces compared to passive irrigation alone (Alani & Bishop, 2008). The use of EDTA served the dual purpose of removing the smear layer and facilitating bioceramic sealer penetration into dentinal tubules, maximizing the hermetic quality of the final obturation.

The tridimensional sealing of the root canal system represents the predictive factor for long-term success in the management of invaginated systems. Irregular, bifurcated, and voluminous root canal systems, characteristic of the Type III variant, present significant obturating challenges for conventional gutta-percha-based techniques. The use of a bioceramic sealer was therefore justified by its superior physicochemical properties: high flowability allowing penetration into the most intricate ramifications of the tripartite system; bioactivity and biocompatibility promoting a regenerative periradicular environment; intrinsic hydrophilicity allowing setting in the presence of tissue moisture at the apical pseudo-foramen; and a subtle setting expansion capacity that ensures adaptation to irregular dentinal walls (Alves Santos et al., 2023). Such properties collectively ensured penetration of the material into all three branches of the invagination, hermetically obliterating the apical pseudo-foramen and creating a favorable biological environment for the repair of periradicular tissues and bone neoformation — outcomes confirmed by the 24-month CBCT follow-up.

It is also worth emphasizing the broader educational and clinical implications of the present case. The incidental discovery of tooth 22 during the examination of a patient presenting for an unrelated complaint in tooth 26 illustrates a frequently overlooked aspect of dental practice: the critical importance of a systematic and complete clinical and radiographic examination of the entire oral cavity, regardless of the primary complaint. Had the clinical examination been restricted to the region of interest reported by the patient, a tooth harboring a complex invagination with an associated cystic lesion — capable of progressive expansion and significant bone destruction — would have gone undetected. This observation

reinforces the professional obligation to conduct thorough full-arch examinations and to interpret radiographic findings with a critical and anatomy-oriented perspective, particularly in young patients in whom developmental anomalies may still be in early, asymptomatic stages.

Finally, the present case contributes to the growing body of evidence supporting the feasibility and predictability of conservative, vitality-preserving endodontic management of severe Type III *dens invaginatus*, even in the most anatomically complex presentations. The 24-month clinical and tomographic outcome documented here — complete periapical bone repair, maintained main pulp vitality, and absence of symptomatology — demonstrates that, when supported by adequate three-dimensional diagnosis, operative magnification, and contemporary biomaterials, tooth preservation is an achievable and clinically meaningful objective even in cases that would historically have been considered untreatable.

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Conflict of Interest Statement

The authors declare no conflict of interest. None of the authors have any proprietary, financial, professional, or other personal interest of any nature or kind in any product, service, or company that could be construed as influencing the position presented in this manuscript.

Consent Statement

Written informed consent was obtained from the patient prior to treatment and for the publication of this case report and all accompanying clinical and radiographic images. The patient confirmed understanding that the clinical information will be published and may be freely accessed. A copy of the signed consent form is available upon request.

Data Availability Statement

Data sharing is not applicable to this article as no datasets were generated or analysed beyond those described in the manuscript.

Artificial Intelligence (AI) Declaration

Generative Artificial Intelligence tools, specifically Gemini (Notebook LLM) and Claude, were utilized to assist in the preparation of this manuscript. Their application was strictly limited to English language editing and grammatical polishing, brainstorming for logical text structuring, and web-based bibliographic data-searching. The authors have reviewed all AI-assisted outputs and take full responsibility for the clinical content, data accuracy, and final scientific concepts presented herein.

Key Clinical Message

Cone-beam computed tomography (CBCT) is essential for diagnosing and planning the treatment of complex *Dens Invaginatus*, particularly in rare configurations such as a tripartite invagination. Selective endodontic treatment of the infected tract, combined with bioceramic obturation, promoted periapical healing and resolved the associated cystic lesion over a 24-month follow-up.

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³ Investigation, Writing – Review & Editing.

⁴ Investigation, Data Curation.

⁵ Methodology, Resources.

⁶ Supervision, Conceptualization, Validation, Writing – Review &
Editing.

⁷ Supervision, Validation.

⁸ Supervision, Validation.