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# Conservative Endodontic Management of Dens Invaginatus Type III: Report of Two Cases

**SUMMARY**

*Dens Invaginatus is a developmental dental malformation characterized by complex internal anatomy. According to the classification of Oehlers, Type III is the most severe form and is characterized by extension of the invagination structure along the root, with possible communication with the periodontal tissues. Its management is challenging due to the complex morphology and the increased likelihood of periapical pathology. The aim of this report is to present and analyze two clinical cases of Type III Dens Invaginatus in maxillary lateral incisors, associated with periapical lesions, including one tooth with an immature apex, which were managed with conservative endodontic treatment. Diagnosis and treatment planning were based on clinical and radiographic findings. In both cases, successful infection control and satisfactory healing, as well as the formation of an apical barrier in the tooth with the immature apex, were obsessed at follow-up at least after 6 months. A thorough understanding of the complex anatomy and appropriate selection of techniques and materials are critical factors for prognosis.*

**Keywords:** dens in dente, dens invaginatus, endodontic treatment, clinical management, Type III.

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**CASE REPORT (CR)**
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## Introduction

Dens in dente or dens invaginatus is a dental developmental anomaly that arises from the invagination of the enamel organ into the dental papilla before the process of calcification begins[1,2]. The prevalence of dens invaginatus ranges from 0.04% to 10%[1,3,4]. The teeth most commonly affected are the maxillary lateral incisors[1-4], followed by the maxillary central incisors, premolars, and canines[5,6]. Teeth of the lower jaw, as well as primary teeth, are less commonly affected[5,6]. In approximately 50% of cases, invagination occurs bilaterally, affecting the corresponding tooth on the opposite side of the jaw[5-8]. The exact etiology of the occurrence of dens invaginatus remains unknown. Many theories have been proposed, such as infection or trauma to the dental bud, increased pressure on the dental arches during odontogenesis leading to the "folding" of the enamel, the fusion of two dental buds, distortion of the enamel organ, and rapid proliferation of the internal epithelium of the enamel within the underlying dental papilla, genetic factors and heredity[2,6,7,9]. The clinical presentation can vary from a normal tooth to a more conical or barrel-shaped tooth, with increased buccolingual dimension or even with an exaggerated talon cusp[3,5,6].

Over time, several attempts have been made to classify dental invagination. The most prevalent classification, which is still used today due to its simplicity and ease of application, is the one proposed by Oehlers[3,10]. According to this system, cases of invagination are categorized into three types (Type I, Type II, Type IIIA-IIIB), depending on the depth of the invagination and its communication with the periodontal ligament and periapical tissues[2]. In Type I, the invagination is confined to the crown of the tooth. It extends into the enamel and dentin[2,4,6]. This is the most common type (70-94%)[3]. In Type II, the invagination extends beyond the crown, surpassing the enamel-dentin junction and ending in a blind sac, without communication with the periodontal ligament[4,6]. In Type III, the invagination extends throughout the entire root length and communicates with the periodontal ligament, via a pseudo-foramen on the lateral root surface in Type IIIA and via an apical foramen in Type IIIB[1,4,6].

The complexity of the root canal–invagination system, together with the anatomical variability of teeth affected by dens invaginatus, consist of significant challenges for diagnosis, treatment planning, and clinical management[8,11]. Type III dens invaginatus is particularly challenging due to the communication of the invagination with the periodontal tissues, the increased risk of pulpal necrosis and periapical disease, and the difficulties associated with achieving adequate disinfection and sealing of the complex anatomy[6,8,11]. In addition, the presence of an immature apex may further complicate endodontic treatment and influence the choice of therapeutic approach[8,11].

Management strategies for Type III dens invaginatus vary according to the anatomical characteristics and pulpal status of the affected tooth and may include preventive approaches, nonsurgical endodontic treatment, surgical intervention, or extraction in cases with an unfavorable prognosis[5,6,11]. Although advances in three-dimensional imaging, magnification, instrumentation techniques, and bioactive materials have expanded the possibilities for conservative treatment, the optimal management of these complex cases remains controversial and highly individualized[3,11].

This case series aims to present the successful nonsurgical endodontic management of two cases of Oehlers Type III dens invaginatus in maxillary lateral incisors, associated with a large periapical lesion and one of them with an immature apex in which apical barrier formation was achieved. These cases highlight the importance of individualized treatment planning and demonstrate the potential of conservative approaches for preserving teeth with complex developmental anomalies.

## Case 1

A 14-year-old female patient came to the office with pain in the area of the upper lateral incisor. No history of trauma to the area reported. During intraoral examination the crown of the tooth was noted asymmetric (barrel-like shape) and discoloured. On the palatal surface, a blind foramen and a talon cusp were detected. The tooth did not respond to any sensitivity test. It was painful on percussion and palpation. It did not show mobility or deep pockets. Radiographic examination revealed, except for root canal, an invagination canal, which communicated with periodontal ligament through a foramen on lateral side of the root (dens invaginatus Type III). The tooth associated with an extended radiolucent periapical lesion (Fig.1). Conventional root canal treatment was indicated.

*Figure 1. Pre-op radiograph of maxillary lateral incisor with dens invaginatus Type III. (Mr. Molyvdas" case).*

The patient received local anesthesia (Septanest N 4%, Septodont, France) and isolation with rubber dam. An access cavity was performed by using a diamond bur and both root canal and the invagination canal were identified. The working length was measured with X-ray and a K-file No25 (Micro-mega, France) for root canal and a H-file No20 (Micro-mega, France) for the invagination canal. No communication between root canal and invaginatoin was detected. The root canal was prepared with K-files (Micro-mega, France) to a master apical file No40 by hand and with using step-back technique to No60 by hand. The coronal third was widened with Gates-Glidden burs. During preparation, abundant irrigations with 2% sodium hypochlorite NaOCl (Chloraxid 2%, Cerkamed, Poland) and EDTA 17% (Largal L, Septodont, France) took place. The invagination canal also prepared using step-back technique to No60 by hand, Gates-Glidden burs and irrigations with 2% NaOCl (Chloraxid 2%, Cerkamed, Poland) and EDTA 17% (Largal L, Septodont, France). Paper points (Roeko, Coltene, Switzerland) used to dry the canals, calcium hydroxide $Ca(OH)_2$ paste (Calcipast, Cerkamed, Poland) used for intracanal medication and sealed with Cavit G(3M ESPE, Germany) for 10 days.

The patient returned for a second visit and the tooth was asymptomatic. $Ca(OH)_2$ was removed with H-files (Micro-mega, France) and NaOCl 2% (Chloraxid 2%, Cerkamed, Poland) irrigations. The hermetic obturation of the canals was performed using Grossman Type Root Canal Cement (Type 801, ROTH Int. LTD, Chicago IL, USA), which was placed inside them with a Lentulo spiral, and injection of thermoplastic gutta-percha. The access cavity was restored with a light-cured composite resin (Charisma, Kulzer, Germany). (Fig.2)

*Figure 2. Post-op radiograph of maxillary lateral incisor with dens invaginatus Type III (Mr. Molyvdas" case).*

Follow-up visits were conducted at 3, 15 and 24 months after treatment. No signs and symptoms were reported and bone healing was observed in the periapical area. (Fig.3,4,5).

*Figure 3. 3 months follow-up radiograph of maxillary lateral incisor with dens invaginatus Type III. ( Mr. Molyvdas" case).*

*Figure 4. 15 months follow-up radiograph of maxillary lateral incisor with dens invaginatus Type III. ( Mr. Molyvdas" case).*

*Figure 5. 24 months follow-up radiograph of maxillary lateral incisor with dens invaginatus Type III. ( Mr. Molyvdas" case).*

## Case 2

A 16-year-old male patient referred to the office by an orthodontist, as an extended, radiolucent periapical lesion in the region of the lateral incisor was preventing the eruption of the canine. During intraoral examination, the crown of the tooth was asymmetrical and presented a blind foramen on the palatal surface. The presence of a sinus tract was also noted on the buccal side, the path of which originated from an abscess around the apex of lateral incisor, as confirmed by an X-ray using a gutta-percha cone (Fig.6). From the same X-ray, a dens invaginatus Type III with immature apex was revealed (Fig.6). The tooth had negative response to any sensitivity pulp test. Conventional root canal treatment was indicated.

Under local anesthesia (Septanest 4%, Septodont, France) and isolation with rubber dam, the access cavity was performed with a diamond bur. With the aid of the dental operative microscope (OMS2050, Zumax Medical Co. Ltd., Suzhou, China), which was used throughout the entire treatment, three canals were identified, two root canals (mesial-palatal and distal-palatal) and an invagination canal, which was located buccally and communicated with the oral cavity and the periradicular space. The working length to all of them was determined

*Figure 6. Pre-op radiograph of maxillary lateral incisor with dens invaginatus Type III (Gutta-percha when inserted through sinus tract). (Mr. Mikrogeorgis' case).*

using apex locator (IPEX II, NSK, Japan).

All canals were initially prepared with hand-files (Micro-mega, France) up to size 25 to the working length and subsequently with the ProTaper Gold file system (Dentsply, Maillefer). During the procedure, canals were irrigated constantly with sodium hypochlorite NaOCl 2% (Chloraxid 2%, Cerkamed, Poland) and EDTA 17% (EDTA-Solution 17%, Cerkamed, Poland). At the end, they were dried with paper points (Roeko, Coltene, Switzerland), calcium hydroxide $Ca(OH)_2$ (Calcipast, Cerkamed, Poland) was placed as intracanal medication and sealed with Cavit (3M ESPE, Germany).

After this, the patient attended a follow-up visit once per month in order to replace the $Ca(OH)_2$ paste with new one. The aim of this treatment plan was to disinfect the root canal system, promote healing of the sinus tract, and induce the formation of a hard tissue barrier to achieve closure of the immature open apex. Six months later, sinus tract and periapical lesion healing and formation of a hard tissue apical barrier were observed. At that point, since the tooth was asymptomatic, obturation of the root canals and the invagination was performed with injection of thermoplastic gutta-percha and Grossman Type Root Canal Cement (Type 801, ROTH Int. LTD, Chicago IL, USA), which was placed with a Lentulo spiral (Fig.7). The access cavity was restored with light-cured composite resin (Filtek Z250, 3M ESPE, Germany). At the follow-up visit 6 months later, the tooth was asymptomatic and bone healing was observed. A check-up appointment once a year was recommended.

*Figure 7. Post-op radiograph of maxillary lateral incisor with dens invaginatus Type III. (Mr. Mikrogeorgis' case).*

## Discussion

Dens invaginatus malformation, whose aetiology remains unclear[5,7], presents a distinct endodontic challenge due to the wide spectrum of internal morphological variations and unpredictability of the root canal anatomy. The invagination may range from a simple enamel-lined groove to a complex enamel–dentin-lined extension that communicates with the periodontal ligament or oral cavity[1,6]. The two cases presented in this report exemplify this anatomical variability, as each tooth exhibited distinct internal morphological characteristics. This altered anatomical configuration often results in aberrant canal systems, multiple accessory pathways, open apices, and atypical canal curvatures, all of which complicate accurate diagnosis, canal negotiation, debridement, and obturation[3,12]. Such complexities have long been recognized as factors that increase the risk of persistent infection and treatment failure if not addressed with advanced diagnostic and therapeutic strategies[12].

In both cases, the invagination extended throughout the root, creating a complex root canal–invagination system. This altered anatomy, together with the presence of periapical pathology, increased the technical difficulty of canal negotiation, effective disinfection, and three-dimensional obturation. In addition, the presence of an immature apex in Case 2 further complicated treatment by preventing the establishment of an apical stop before definitive root canal filling. These anatomical challenges required an individualized treatment approach aimed at preserving the affected teeth through conservative nonsurgical endodontic treatment.Given these anatomical complexities, accurate pre-operative assessment is paramount in the management of these cases. For these two cases, conventional two-dimensional periapical radiographs were used, but they often fail to reveal the true three-dimensional complexity of invaginated teeth. Cone Beam Computed Tomography (CBCT) has emerged as an indispensable diagnostic tool, provides high-resolution three-dimensional imaging, overcoming the limitations of conventional two-dimensional radiographs[3,4,5,13,14]. CBCT enables the identification of the invagination's entry point, its path along the tooth, its extent, as well as its relationship with the root canal and any potential periapical lesions[3,4,5,13,14]. This information is crucial for making treatment decisions, especially in complex cases of Type III and reducing the likelihood of procedural complications during treatment5. Regrettably, the clinical cases presented in this study were managed several years ago, during a period when imaging centers equipped with CBCT technology were remarkably scarce, thereby rendering its clinical application substantially challenging, time-consuming, and cost-prohibitive.

The complexity of the root canal–invagination cavity system also raises the need for the use of magnification tools to enhance diagnostic and therapeutic precision[14]. The introduction of the dental operating microscope (DOM) has significantly enhanced clinicians' ability to manage intricate internal anatomies[15]. Magnification and coaxial illumination facilitate the identification of additional canal orifices, microscopic communications, and microanatomical details that are often invisible to the naked eye[6,13,14]. Microscopic visualization supports more conservative access cavity designs while ensuring complete negotiation of complex canal systems without unnecessary dentin removal, thereby preserving tooth structure and reducing the risk of iatrogenic damage[6,13,14].

Moreover, the development and refinement of mechanized rotary and reciprocating instruments have improved the efficiency, safety, and predictability of canal preparation in challenging anatomies, as dens invaginatus cases. Nickel–titanium (NiTi) instruments with advanced metallurgical properties and flexibility allow for controlled shaping of curved and narrow canals, decreasing the likelihood of an incident. However, during the preparation of the invagination canal, the use of Ni-Ti micro-instruments requires particular caution, as the presence of the thin enamel layer covering its walls and its irregular shape increase the likelihood of fracture of these instruments[5,11,12,13]. The use of ultrasonic files, Gates-Glidden burs, and hand files (K or H), combined with copious sodium hypochlorite irrigations, ensures adequate cleaning throughout the entire length of the canal[5,6,11,13]. For obturation of the root canal and invagination, the thermoplastic gutta-percha injection technique is recommended[6,7,16].

The integration of these technologies — CBCT, DOM, and mechanized instrumentation — supports a more conservative and biologically sound approach to dens invaginatus cases[11,13,17]. Together, they enhance the clinician's ability to achieve thorough debridement, disinfection, and hermetic obturation of both the primary root canal system and the invagination canal[11,13]. This, in turn, greatly improves the likelihood of periapical healing, resolution of associated sinus tracts, and long-term retention of the affected tooth, thereby reducing the need for extraction, which was the treatment of choice some years ago[7,11,12,13,17].

As in case 2, there are numerous reports of cases of dens invaginatus with immature apex. Case 2 was dealt with apexification with the use of $Ca(OH)_2$. The use of this material was based on its effectiveness as an intracanal medication, its ability to promote healing of the sinus tract and periapical bone, and its capacity to stimulate hard tissue formation at the root apex, making it the material of choice for the treatment plan. In recent years, with the development of revascularization techniques, it has become possible to continue root development in the teeth with dens invaginatus[18,19]. Revascularization through the formation of a blood clot, apexogenesis using PRF, and apexification with the use of $Ca(OH)_2$ or an MTA plug are techniques that have been used with very satisfactory results[5,11,12,16,18,20-23].

## Conclusion

The present cases demonstrate that Oehlers Type III dens invaginatus may exhibit considerable anatomical variability, requiring careful case-by-case evaluation and individualized treatment planning. Despite extensive periapical pathology and the presence of an immature apex in one case, conservative nonsurgical endodontic management resulted in favorable clinical and radiographic outcomes during follow-up. A thorough understanding of the internal anatomy, efficient chemo-mechanical preparation and appropriate adaptation of the treatment plan to the unique anatomical features of each case were key factors contributing to treatment success. These cases highlight that preservation of teeth with complex developmental anomalies is achievable when diagnosis and treatment are guided by the specific anatomical characteristics of each case.

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