

**Case report**

# Endodontic management of developmental anomalies: conservation of invaginated tissues in Type II *dens invaginatus* – case series



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## ABSTRACT

*Dens invaginatus* is an uncommon occurrence in the permanent dentition. However, practitioners must be aware of this anatomical variation, as an early diagnosis may prevent the need for endodontic treatment. Clinically, root canal treatment of Oehler's Type II *dens invaginatus* may present a complex challenge. This paper reports two cases of non-surgical endodontic treatment and one case of non-surgical endodontic retreatment of upper lateral incisors diagnosed with Oehler's Type II *dens invaginatus*. All procedures were done maintaining the original anatomy of both the invagination and the root canal space to minimize dentin elimination. At follow-up appointments, resolution of apical pathosis was noted in all three cases, with no sign of structural strain. With the help of dedicated instruments, such as ultrasonic tips, and under magnification, the conservation of the invagination in Oehler's Type II *dens invaginatus* is a valid and successful treatment option. (Rev Port Estomatol Med Dent Cir Maxilofac. 2019;60(1):18-26)

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## Abordagem endodôntica de anomalias de desenvolvimento: conservação dos tecidos invaginados de dens invaginatus Tipo II – série de casos

### R E S U M O

#### Palavras-chave:

Caso clínico  
Dens in dente  
Dens invaginatus  
Endodontia  
Tratamento endodôntico

Apesar do *dens invaginatus* ser uma ocorrência pouco comum na dentição permanente, o clínico deve considerar esta variação anatômica, uma vez que o diagnóstico atempado pode evitar a necessidade de tratamento endodôntico. Clinicamente, o tratamento endodôntico do *dens invaginatus* tipo II de Oehlers pode constituir um desafio complexo. Neste artigo apresentamos dois casos de tratamento endodôntico e um de retratamento endodôntico de incisivos laterais superiores diagnosticados com *dens invaginatus* tipo II de Oehlers. Todos os tratamentos foram realizados com a manutenção da anatomia, tanto dos tecidos invaginados como do sistema canal, para minimizar a perda de estrutura dentinária sã. Nas consultas de controle, foi observada resolução da patologia periapical nos três casos, sem comprometimento da estrutura dentária remanescente. Com a ajuda de material específico, como pontas ultrassônicas, e sob ampliação, a conservação do tecido invaginado no tratamento de *dens invaginatus* tipo II de Oehlers constitui uma opção de tratamento válida e com resultados previsíveis. (Rev Port Estomatol Med Dent Cir Maxilofac. 2019;60(1):18-26)

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### Introduction

*Dens invaginatus* consists of an infolding of a tooth's outer portion (enamel) into the inner portion (dentine) during the soft tissue stage of development, with the formation of a pocket-like space.<sup>1,2</sup> Several classification systems have been proposed for this condition, and the most commonly accepted was published by Oehlers<sup>3</sup> in 1957. This system differentiates three types according to how far the invagination extends radiographically into the root: in Type I, the invagination is limited to the crown; in Type II, it invades part of the root and ends as a blind sac; and in Type III, it invades the entire root ending with a communication with the lateral periodontal tissues (Type IIIa) or periapical tissues (Type IIIb).<sup>1,2,4,5</sup>

The prevalence of *dens invaginatus* varies depending on the invagination type. Type I is the most common, and it may reach a prevalence of 11.3%, while Types II and III are uncommon and may reach 0.7% and 0.8% of cases, respectively.<sup>6</sup> Nevertheless, some studies report much lower ratios.<sup>7,8</sup> The most affected teeth are the maxillary lateral incisors, and bilateral occurrence is not uncommon.<sup>4,6,9</sup>

The affected tooth may show no clinical symptoms, and, in most cases, the *dens invaginatus* is detected by chance on a radiograph.<sup>8,10</sup> The invagination allows the entry of irritant agents, such as microorganisms, into the invaginated lumen. This inner space presents an atypical morphological tissue arrangement and might be extremely close to the pulp space, or even communicate with it. This situation creates a predisposition for the development of dental caries, or even pulp necrosis, which often occurs rather early, within a few years of eruption, and sometimes even before root end closure, and may eventually lead to the development of periapical pathosis in an intact and healthy-looking tooth.<sup>4,5,8,11</sup>

Periapical pathosis is more prone to occur in *dens invaginatus* Types II and III.<sup>6,7</sup> According to Gunduz et al.,<sup>7</sup> at the time of treatment referral, 8.1% and 87.5% of the patients with *dens invaginatus* Types II and III, respectively, had periapical pathosis. Kirzioglu & Ceyhan<sup>6</sup> reported similar findings.

An invaginated tooth may pose technical difficulties to its clinical management.<sup>8</sup> Clinically, *dens invaginatus* Types II and III with pulp necrosis often represent the most challenging cases, since the pulp pathosis usually requires treatment of both the invagination and the main root canal system, and, in extreme cases, the total elimination of the invaginated tissues, which might lead to structural fragility.<sup>12</sup>

The objective of this article is to show three cases of endodontic treatment of Type II *dens invaginatus*. In all three cases, the invagination was preserved separately from the pulp canal space in an effort to spare healthy dentine and, thus, keep the original structural strength.

### CASE REPORTS

#### General clinical procedures

Three patients were referred for endodontic evaluation of a maxillary lateral incisor. In all cases, the medical and dental history was reviewed and considered non-contributory, and intra-oral and radiographic examinations were performed. Diagnosis of pulpal and periapical pathosis was made based on pulpal tests and periapical radiographs. In all teeth, a deep radiopaque enamel infolding could be noted surrounding a radiolucent lumen ending inside the root canal space. These features allowed a radiographic diagnosis of Oehler's Type II *dens invaginatus* in all teeth, which were also associated with apical periodontitis. Root canal therapy was

recommended, accepted by all the patients, who filled and signed a general informed consent, and performed under a dental operating microscope. In all cases, an effort was made to preserve tooth structure by managing the invagination independently, without its incorporation into the adjacent pulp space. After proper local anesthesia and rubber dam placement, access was obtained, using round burs (Komet Medical, Lemgo, Germany; R&S, France), Start X ultrasonic tips (Dentsply Maillefer, Switzerland) or both, and a full debridement was performed under copious irrigation with 5.25% of sodium hypochlorite. Working length was performed by using electronic apex locators (Root ZX II, Morita, USA). In all cases, the final irrigation procedure also included irrigation for one minute with 10% citric acid or 17% EDTA prior to a final sodium hypochlorite rinse under sonic or manual dynamic agitation. All teeth were filled with a resin-based sealer and warm gutta-percha, although, in one case, an apical barrier of MTA was also required. A posterior follow-up appointment showed an improvement of the clinical condition in all cases, without any sign of structural failure.

#### Case report #1

After clinical observation, a 34-year-old Caucasian male was diagnosed with asymptomatic apical periodontitis on tooth 12 after previous endodontic treatment (Figure 1). After accessing the pulp chamber, two canal orifices were evident with the invagination and *foramen coecum* in between



Figure 1. Pre-operative radiograph of tooth 12

(Figure 2). In an attempt to avoid excessive root structure damage, both root canals were treated independently, leaving the invaginated tissues in between to be included in the final root canal filling (Figure 3). Root canal instrumentation was performed with ProTaper nickel-titanium rotary instruments (ProTaper Universal, Dentsply Maillefer, Switzerland). Due to an excessively large apical size, an apical barrier of 6 mm in thickness was created with MTA (ProRoot MTA, Dentsply Tulsa Dental, USA) in the first appointment (Figure 4). In a second visit, the rest of the canal was back-filled with gutta-percha and sealer (Top Seal, Dentsply Maillefer, Swit-

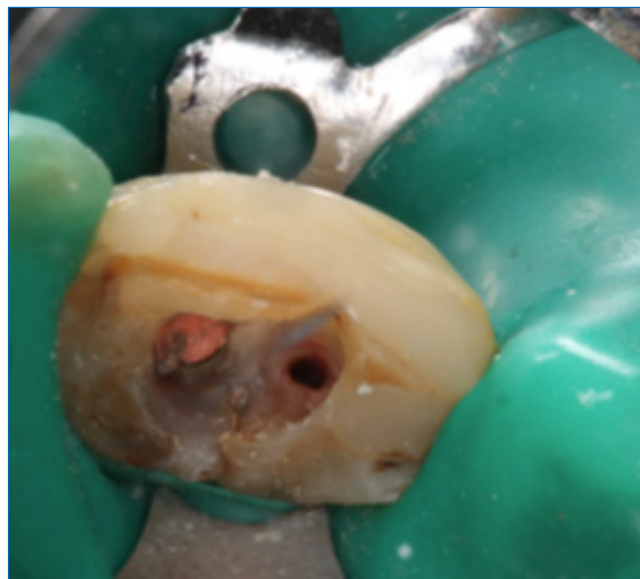


Figure 2. After endodontic access, two canals were identified, with the invagination and *foramen coecum* in between

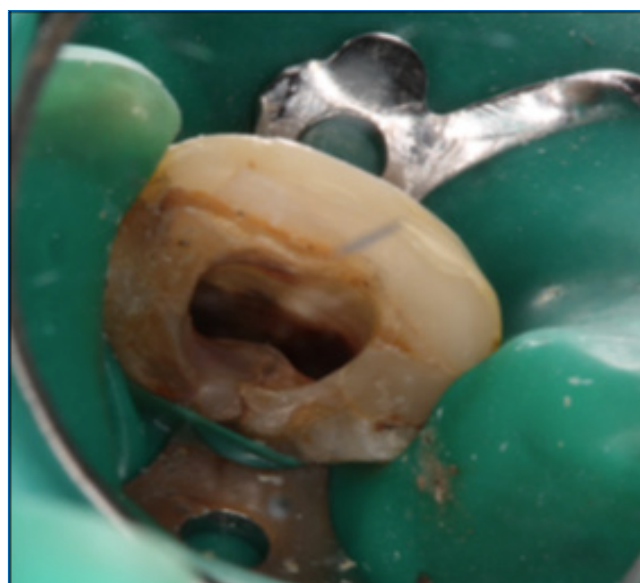


Figure 3. In a conservative approach, the root canals were treated independently, leaving the invaginated tissues in between



Figure 4. MTA apical barrier

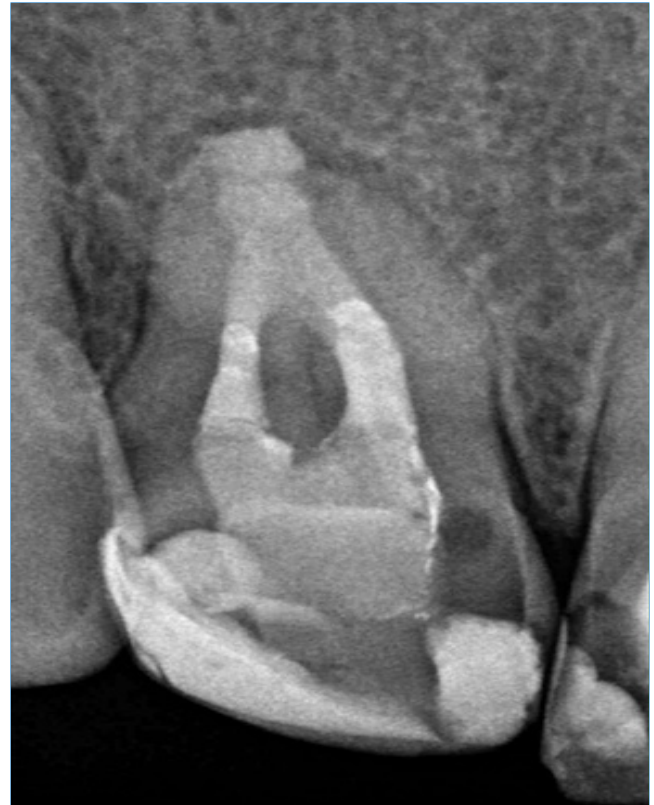


Figure 6. Two-year follow-up radiograph showed healing of periapical tissues (Case managed by SQ)



Figure 5. Post-operative radiograph

zerland) using the continuous wave of condensation technique (Figure 5). A 2-year follow-up revealed satisfactory healing of the inflammatory process associated with the tooth (Figure 6).

#### Case report #2

A 31-year-old Caucasian female patient was referred by a general practitioner after diagnosis of necrotic pulp and asymptomatic apical periodontitis on tooth 12. Radiographic exams revealed the presence of periapical pathology. An atypical pulpal anatomy could be observed with an enamel-lined invagination running parallel to the pulp system in the entire root but ending inside the root canal space (Figure 7). Endodontic therapy was performed under magnification, over three visits. After endodontic access, three canals were located and identified with START-X 3 ultrasonic tips and Endo Sonore files (Dentsply Maillefer, Switzerland). The central canal was the lumen of the invaginated tissues, while both peripheral root canals belonged to the pulp space, which was divided and compressed outwards by the invagination (Figure 8). The three canals were instrumented with ProTaper nickel-titanium rotary instruments (ProTaper Universal, Dentsply Maillefer, Switzerland). The invagination was managed as an independent root canal. Root canal obturation was performed with gutta-percha and sealer (Top Seal, Dentsply Maillefer, Switzerland) using the continuous wave of condensation technique (Figure 9). A 12-month follow-up radiograph showed healing of the periapical tissues (Figure 10).





Figure 7. Pre-operative radiograph of tooth 12, presenting an enamel infolding restricted to the pulp canal space

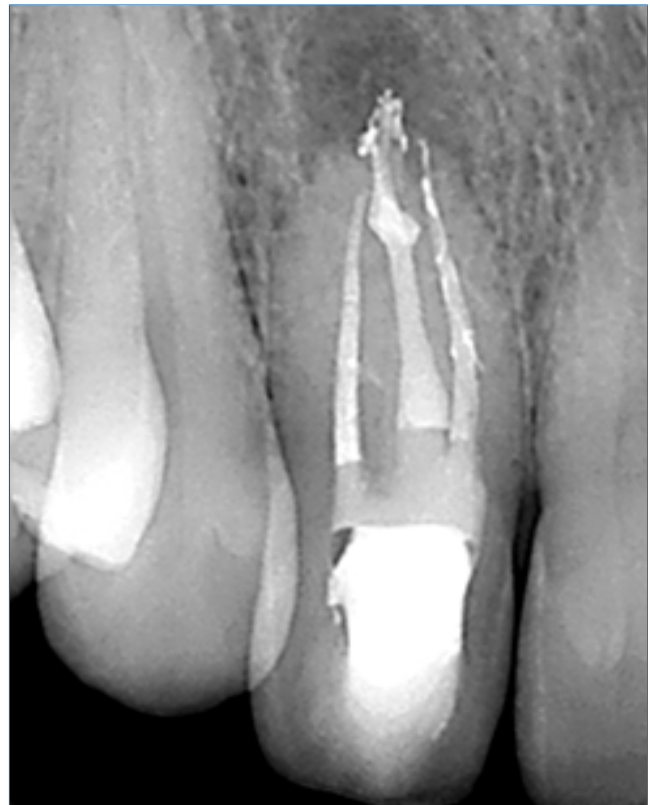


Figure 9. Post-operative radiograph

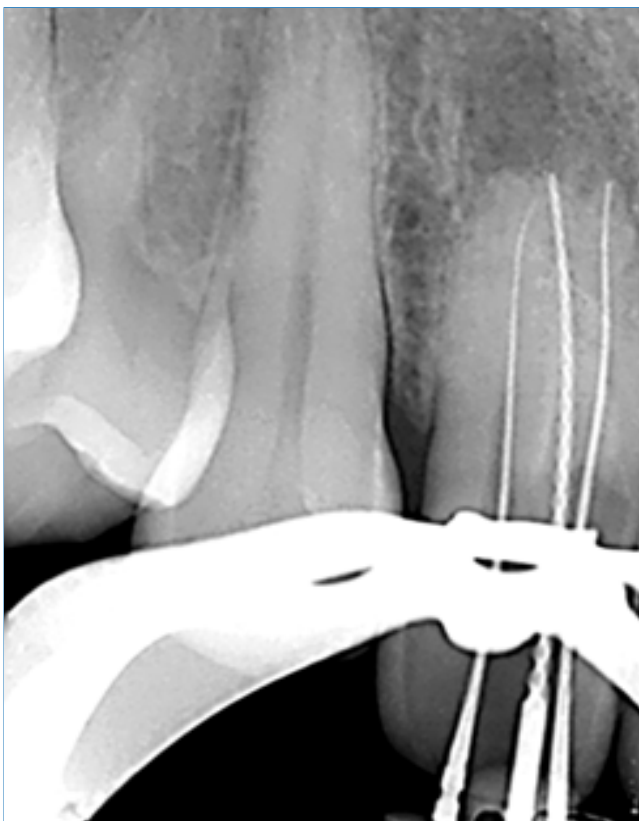


Figure 8. After access, three root canals were located



Figure 10. Twelve-month follow-up radiograph showed healing of the periapical tissue (Case managed by RPC)

### Case report #3

A 41-year-old Caucasian male was diagnosed with necrotic pulp and symptomatic apical periodontitis on tooth 22. A clinical, radiographic analysis revealed an Oehler's Type II *dens invaginatus* (Figure 11). The tooth was intact, and it was assumed that the necrosis was due to the communication between the *foramen coecum*, in the palatal surface, and the dental pulp, through the invagination (Figure 12). A routine access to the main root canal system was prepared and the access to the interior of the invaginated tissues was prepared with ultrasonic tips (ProUltra, Dentsply Maillefer, Switzerland) (Figure 13). The root canal system and invagination were instrumented and disinfected independently, not removing the entire *dens invaginatus* to preserve structure. ProTaper nickel-titanium rotary instruments (ProTaper Universal, Dentsply Maillefer, Switzerland) were used. At the second visit, the root canal and invagination were filled with gutta-percha and sealer (AH Plus, Dentsply, USA) using the continuous wave of condensation technique (Figures 14, 15 and 16). A communication was noted between the canal and the invagination in the final radiograph (Figure 17). A 7-month follow-up radiograph showed healing of the periapical tissues (Figure 18).

### Discussion

Early diagnosis of *dens invaginatus* is important to help prevent the need for endodontic treatment and to plan for it correctly when necessary. This anomaly is more commonly detected by chance in periapical radiographs, but clinicians should be aware of its prevalence and take it into consideration especially when assessing upper lateral incisors.<sup>8,10</sup> Advanced radiographic techniques with cone-beam computed tomography (CBCT) imaging may also be useful.<sup>12</sup> However, the decision to use CBCT scanning should depend on whether the benefits outweigh the risk of the relatively higher radiation dose.<sup>9</sup> Treatment options for *dens invaginatus* range from preventive measures such as sealing minimal invaginations in cases of vital pulp and absence of clinical symptoms and radiographic signs, to extraction when the invagination is severe and the tooth has a poor prognosis.<sup>13,14</sup>

Clinically, Oehler's Type II invaginations are more challenging and difficult to deal with due to the larger extension of the invagination and the complexity of the internal anatomy, which may hamper the thorough disinfection of the canal space.<sup>15</sup> Moreover, early pulp necrosis may lead to arrest of root development, and, consequently, an open apex, further complicating the management of such teeth.<sup>5,15</sup>

However, the technological advances in Endodontics, such as the operating microscope, ultrasonic tips and bioceramic cements, make conventional endodontic treatment of Type II *dens invaginatus* predictable.

When both the root canal and the invagination are infected, the root canal treatment of a *dens invaginatus* Type II anatomy may involve the inclusion of the invagination into the root canal space or maintaining the invagination separately. Two studies have recommended the elimination of the invagination and its infected dentin, and the consequent creation of a unique and larger root canal space, to simplify the root canal disinfection and obturation.<sup>14-16</sup> However, this may lead to unnecessary



Figure 11. Pre-operative radiograph of tooth 22



Figure 12. Clinical view of the foramen coecum in the tooth palatal surface



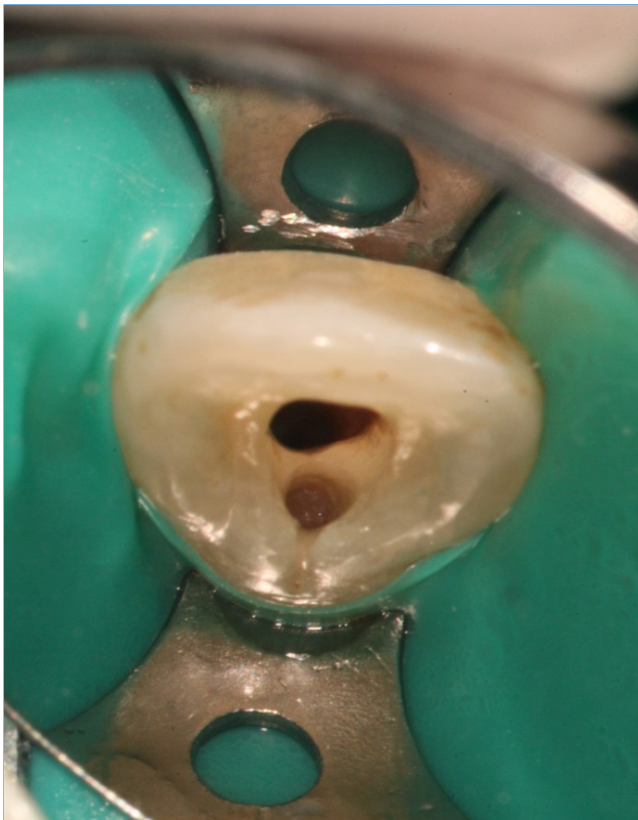


Figure 13. Both main root canal and invaginated tissues were accessed



Figure 15. Post-operative photograph

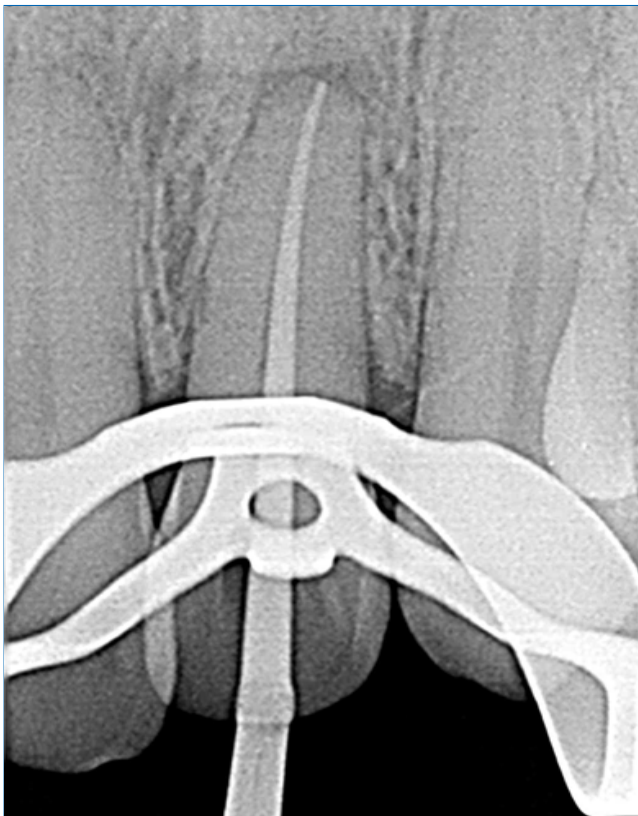


Figure 14. Both root canal and invagination were filled with gutta-percha and sealer



Figure 16. Post-operative radiograph



**Figure 17. A communication was noted between the canal and the invagination in the post-operative radiograph.**



**Figure 18. Seven-month follow-up radiograph showed healing of the periapical tissues (Case managed by JM)**

elimination of healthy dentine besides resulting in thinner root walls, which may increase the tendency for root fracture. Other techniques, such as regenerative endodontics, endodontic microsurgery or both have also been reported as successful options to treat Type II *dens invaginatus*.<sup>17-19</sup> In these morphologies, the apex is also unusually large, due to incomplete or atypical embryological development, thus rendering impossible to guarantee adequate apical seal with conventional thermoplastic obturation techniques, and apexification with an MTA apical barrier might be recommended. The results of both *in vitro* and *in vivo* studies show that MTA is not only biocompatible but also bioactive, and exerts antibacterial properties while assuring a good seal.<sup>20-24</sup> In an attempt to overcome the known drawbacks of MTA (long setting time, high cost, and potential for discoloration) other bioceramic cements, such as Biodentine (Septodont, Saint-Maur-des-Fossés, France), have been employed for apical plugs with promising results.<sup>25,26</sup>

It is important that the clinician acknowledges the complexity of this kind of teeth and its morphology and prepares himself with certain armamentarium. With the use of modern endodontic techniques such as specific ultrasonic tips and microscope magnification, the clinician is able to perform a conventional endodontic treatment with predictable outcomes, while trying to preserve the maximum structure possible.<sup>27</sup>

The three case reports described in this study are demonstrative of different *dens invaginatus* morphologies. All cases were associated with both root canal and invagination infection. The pulpal and periapical diagnoses were based on pulpal tests and intraoral digital periapical radiographs. All cases were endodontically treated while preserving the invaginated tissues separated from the main canal space. This procedure allowed the reduction of healthy dentin removal and avoiding the creation of an extremely large empty root canal space, which would reduce the root's global strength. Although a proper endodontic treatment follow-up is recommended after one year, or even earlier, these clinical cases presented resolution of symptoms and clinical improvements in the periapical lesions in all three cases, with no signs of structural fatigue.<sup>28</sup> Even though a longer follow-up would be recommended, the clinical option to perform endodontic treatment without incorporating the invaginated tissues into the canal space showed a favorable outcome.

### Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors declare that no patient data appear in this article.

### Conflict of interest

The authors have no conflicts of interest to declare.



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