Dens invaginatus type III A: case report

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ABSTRACT

Introduction: Dens invaginatus is a rare dental anomaly characterized by invagination of dental tissues, which may be from a slight increase in the pit of the cingulum to a deep groove that may extend to the tooth apex. This report describes clinical and radiographic findings and the morphology of a completely atypical and unique anomaly, and discusses the difficulties in the diagnosis and endodontic treatment of the root canal of teeth with this complex anatomy. **Clinical case:** Patient seen in the outpatient clinic of the Endodontic Service with a complaint of pain and mild edema. Clinical and radiographic examinations were suggestive of invagination in tooth #22, and conservative endodontic treatment and CT scans were indicated. **Results:** Patient was asymptomatic and had no functional disorders at 18 months of follow-up. Repair and new bone formation were satisfactory, despite cone overextension. **Conclusion:** Cone-beam CT seems to be an important method of diagnosis and treatment planning in cases of dens invaginatus, especially because it increases the chances of treatment success and prevents the early loss of teeth.

Keywords: Dens invaginatus. Dental anomalies. Cone beam computed tomography.

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Introduction

Endodontists are constantly challenged by atypical clinical cases of teeth with complex root morphology. Clinical dentists should understand and be familiar with changes in normal root canal morphology and its various treatment options.[1,2] Dens invaginatus, a rare developmental anomaly of calcified dental tissues, presents with a range of anatomical abnormalities, such as the invagination of enamel and dentin into the pulp. This in-folding may be limited to the pulp chamber, or extend to the tooth apex.[3,4,5] These teeth tend to develop early pulp necrosis and subsequent periapical changes.[6,7]

The etiology of this anomaly is controversial, and some causes have been suggested, such as changes in tissue pressure, trauma and infections.[1,2,3] According to some studies, it may have a familiar or hereditary etiological component.[8] Compression during formation and eruption of permanent teeth may lead to dental crowns that have peaks of invaginated enamel inside the root canals.[1,7] Histologically, dens invaginatus is defined as the invagination of the enamel organ into the dental papilla during dentinogenesis.[7,9,10]

The prevalence of dens invaginatus ranges from 0.3% to 10%. It may affect both deciduous and permanent dentition, and the teeth most often affected, in decreasing order of frequency, are: lateral incisors, central incisors, premolars, canines and molars. There is a predominance in the maxillary arch.[7,9,11] According to the classification prepared by Ohlers, based on depth of invagination into the root, there are three types of dentes invaginati: type I – blind-ended invagination is confined to the crown; type II – invagination extends beyond the cementoenamel junction and is confined to the main canal; type III – invagination extends along all root canal and reaches tooth apex forming one or two foramina.[9]

The complex anatomy of a dens invaginatus makes its conservative treatment difficult and unpredictable. Some authors indicate nonsurgical treatments, but some cases do not respond to conventional interventions and require endodontic surgery or removal of the invaginated portion.[7,12] Type III is the invagination that poses the greatest difficulty to endodontists.[6,13]

Early clinical and radiograph management of dens invaginatus is fundamental. The attempt to prevent loss of vitality by sealing or by anatomical reconstruction of the invaginated area is indicated to avoid more complex interventions in the future. If the tooth is no longer vital, conventional endodontic treatment may be an option. However, the removal of the affected tooth in elective or emergency surgery may be necessary in some cases.[2,4,6]

Conventional periapical radiographs, which are two-dimensional, do not provide enough information for the endodontist to evaluate the true anatomy of a dens invaginatus, which complicates diagnosis and limits clinical management. CT helps dentists to overcome these limitations as it offers a 3D visualization of all the complex root canal system and, at the same time, eliminates overlaps. In addition, it exposes patients to lower radiation doses.[11,13]

Advances in imaging studies improved CT resolution, and qualitative and quantitative analyses of the complex anatomy of the root canal are now possible. In this case, it was fundamental to visualize the anatomic details of the tooth to support the indication of a more specific and immediate treatment.[12]

This report describes a typical case of type III A dens invaginatus and provides an overview of the possible use of CT scans to establish diagnosis and treatment indications, as well as of operative microscopy and ultrasound for the individualized clinical management for each type of dens invaginatus.

Case report

A white 11-year-old boy accompanied by his guardian sought dental care in a private office because of pain, light edema and change in the color of the mucosa in the left anterior maxillary region. The dentist referred the patient to the outpatient clinic of the Graduate Specialization of the Brazilian Dental Association (BDA), Bahia Chapter, in Ilhéus, Brazil. The patient was seen in the outpatient clinic one week later, without any edema at this time. His medical history did not reveal any pertinent abnormality.

In this first evaluation, the patient was uneasy and feeling pain, which might have confused some of his answers. His guardian said that he had some light trauma in the left maxillary anterior region when he was eight years old and, in consequence, there was some slight extrusion of tooth #21. Initially, endodontic treatment of this tooth was indicated if pulp sensitivity tests remained negative.

Intraoral examination revealed an abscess (parulis) in the mucosa of the apical third between teeth #21 and #22. Baseline radiograph and fistulography revealed the site of the lesion of tooth #22, which had a palatal anatomy suggestive of dens invaginatus and a brownish stain on the enamel of the middle third of the crown, with no changes in color on the tooth crown, nor edema in the maxillary buccal area. The clinical examination of tooth #22 revealed slight tooth mobility. Percussion and palpation confirmed tooth sensitivity both in vertical and in horizontal testing. Response to cold test using a refrigerant spray (EndoFrost, Wilcos do Brasil, São Paulo, Brazil) was negative. Periodontal probing depth was normal.

Periapical radiographs confirmed dens invaginatus type III associated with periapical bone rarefaction of tooth #22. The suggested clinical diagnosis was periapical abscess with fistula. The same tests were performed in tooth #21 as a control, and responses to percussion and palpation were normal, and to cold test, negative. Periodontal probing depth was normal, but there was some slight mobility.

CT scans of tooth #22 were indicated before completing the diagnosis and the treatment plans. The Dental Slice software (Bioparts, Brasília, Brazil) was used to show the details of the atypical internal tooth anatomy.

This case was classified as type III, according to Ohlers[9], and invagination entered the root canal, extended all along it and reached the tooth apex, where it formed two separate foramina. When the patient returned, he had no pain, and total facial edema was reduced. The tests were repeated, with different responses. The pulp test of tooth #21 was positive, and the horizontal and vertical percussion tests were negative.

These results indicated that a complementary imaging method with a small FOV should be used: cone beam CT. The study of the CT slices obtained using the Dental Slice software provided the information to plan a detailed treatment for the case. The inner side of the root canals was thoroughly scanned to establish a single step-by-step clinical technique using several technological resources, such as: engine-driven rotary files, apical locator, ultrasonic instruments, gutta-percha application systems and operative microscope.

After careful analysis of the dental CT scans, the clinical management indicated was endodontic treatment in multiple visits to negotiate the anatomic variations of the dens invaginatus gradually. The communication of the dens invaginatus with the lesion was confirmed.

In the first visit, after anesthesia was injected, access was opened only to what was identified as the main root canal, and spontaneous flow of bright red blood was visualized, confirming tooth vitality. The tooth was isolated, and #10 and #15 C-Pilot files (VDW, Munich, Germany) were used for initial canal negotiation. Lingual dentin projection was removed with a Protaper SX file (Easy, Belo Horizonte, Brazil) and Gates-Glidden #V, #VI and #III burs (Kavo Kerr, Germany). Tooth length was 23 mm, measured using a K-Flex #30/02 handfile (SybronEndo, Orange, CA) and confirmed with a Root ZX apical locator (J. Morita USA Inc., Irvine, CA). The Protaper system (Easy, Belo Horizonte, Brazil) was used for instrumentation, and the working length was set at 22.5 mm. A #45/02 file (SybronEndo, Orange, CA) was used to prepare

Figure 1. A) Extra oral clinical view. **B**) Intraoral clinical view.

Figure 2. Diagnostic periapical radiograph of tooth #22.

Figure 3. Periapical radiograph to visualize fistula.

Figure 4. Clinical aspect of palatal surface of dens invaginatus.

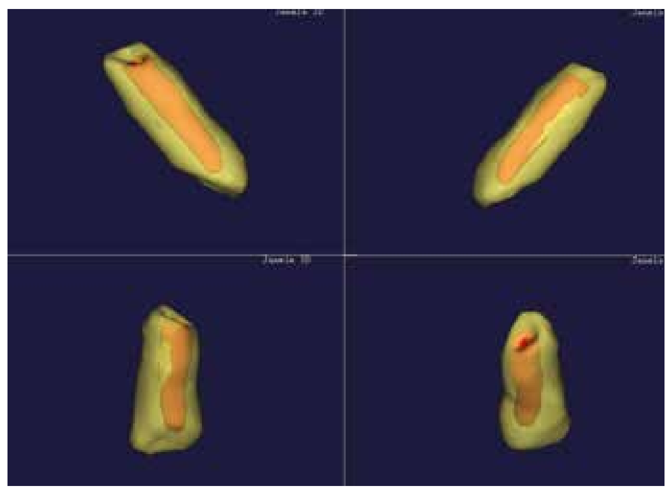

Figure 5. Cone-bean Computer Tomography scan – detailed views using Dental Slice software.

the apical stop, and a CPillot #10 file (VDW, Munich, Germany), to maintain patency at 23 mm. The procedure on that visit was concluded using passive ultrasonic irrigation (PUI) and intracanal medication with calcium hydroxide (UltraCal, Ultradent Products Inc., South Jordan, UT).

Four days later the patient and his guardian returned to the BDA outpatient clinic with a complaint of pain and facial edema. Flare-up was diagnosed, and no clinical dental intervention was indicated. The patient received 500 mg amoxicillin and 125 mg clavulanic acid every 8 h for seven days, and his clinical improvement was followed up.

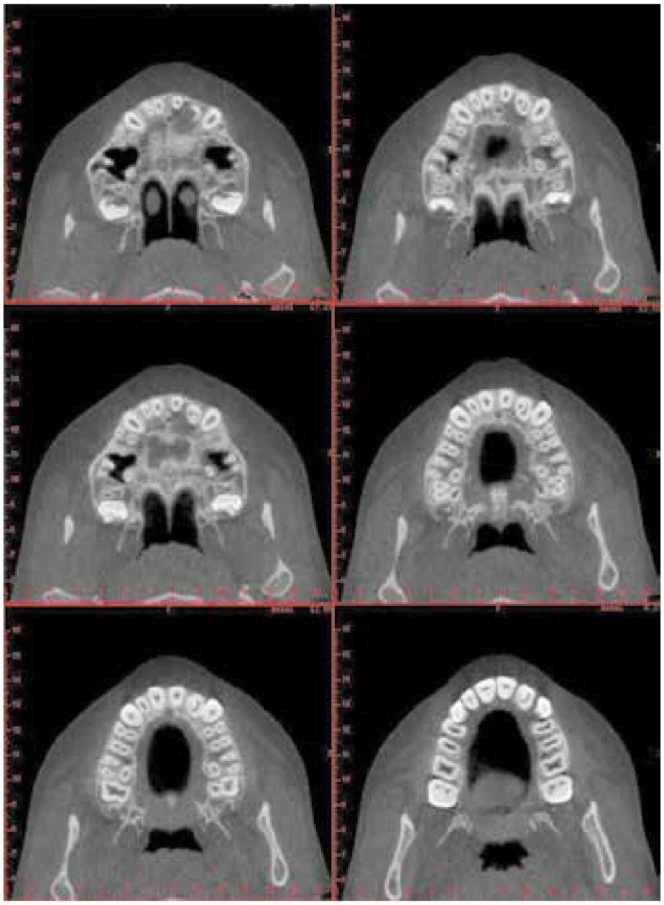

Figure 6. Cone-beam CT scan – coronal view.

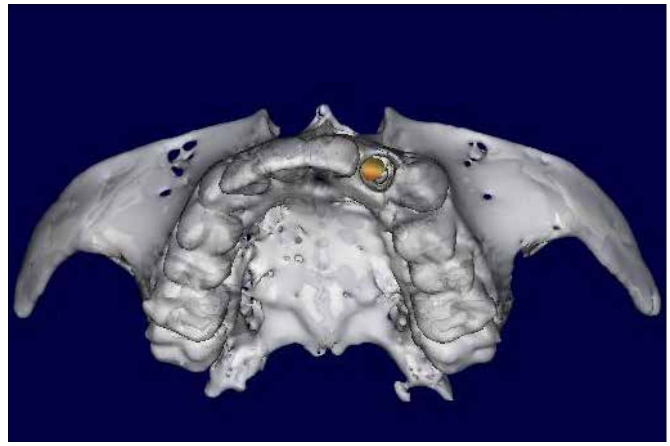

Figure 7. Maxilla's 3D Reconstruction.

On the second visit, the cavity was opened to access the dens invaginatus canal. Signs confirmed a necrotized tooth with no signs of bleeding or pulp remnants. The canal was cleaned, coronal interferences were removed, and digital and radiographic measurements determined that the length of the dens invaginatus was 21 mm. Two measuring techniques were used because the dens invaginatus fora-

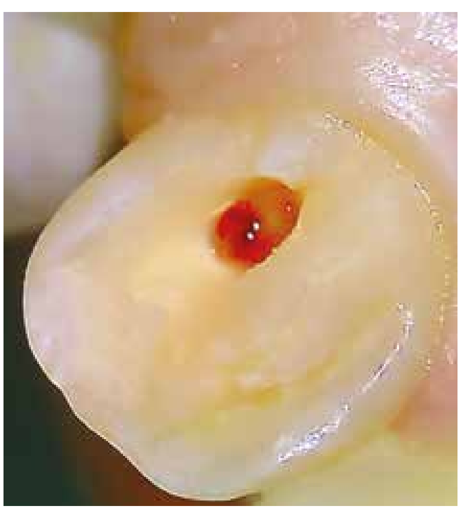

Figure 8. Lingual endodontic access to main canal.

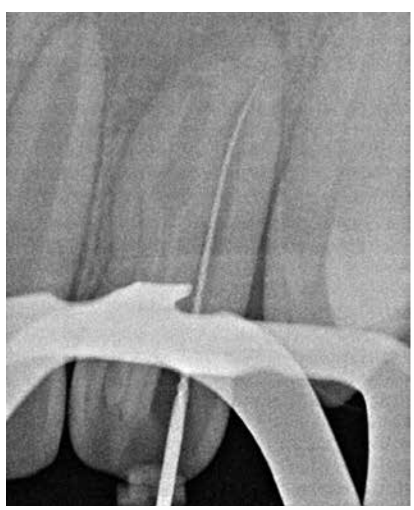

Figure 9. Periapical radiograph to determine working length.

Figure 10. Intracanal medicament: $Ca(OH)_2$ in main canal.

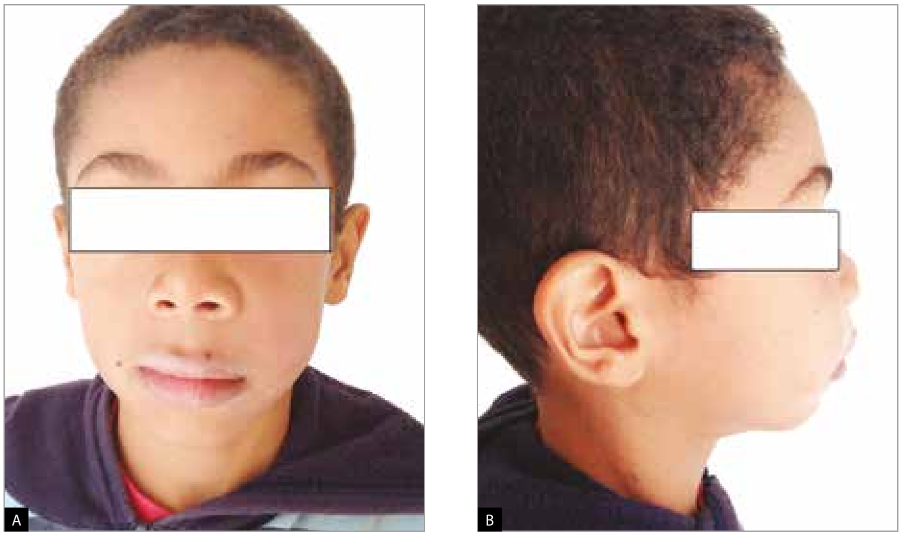

Figure 11. Extra oral frontal (**A**) and profile (**B**) view of acute exacerbation after endodontic intervention

Figure 12. Lingual endodontic access of dens invaginatus canal.

men was not within the normal range. Gates-Glidden #VI, #III and #II burs (Kavo Kerr, Germany) were used to a length of 16 mm, followed by PUI and intracanal medication with calcium hydroxide (UltraCal, Ultradent Products Inc., South Jordan, UT). The intracanal medicament of the main canal was changed.

During the third visit, the main canal was obturated with AHplus cement (Dentsply, Ballaigues, Switzerland) using the continuous wave compaction technique. The cavity was sealed with a zinc oxide-zinc sulfate-based cement (Coltosol, Vigodent, Rio de Janeiro, Brazil) and a glass ionomer cement (Maxxion, FGM, Joinville, Brazil). On the fourth visit, the dens invaginatus canal was obturated, and the cone was overextended. The patient has been under observation and, if necessary, will undergo endodontic surgery in the future.

Nine months after the treatment was completed, the first control radiograph revealed that the lesion was beginning to heal (Figure 15). The second control radiograph was obtained 18 months after obturation, and repair was practically complete, despite the overextended cone.

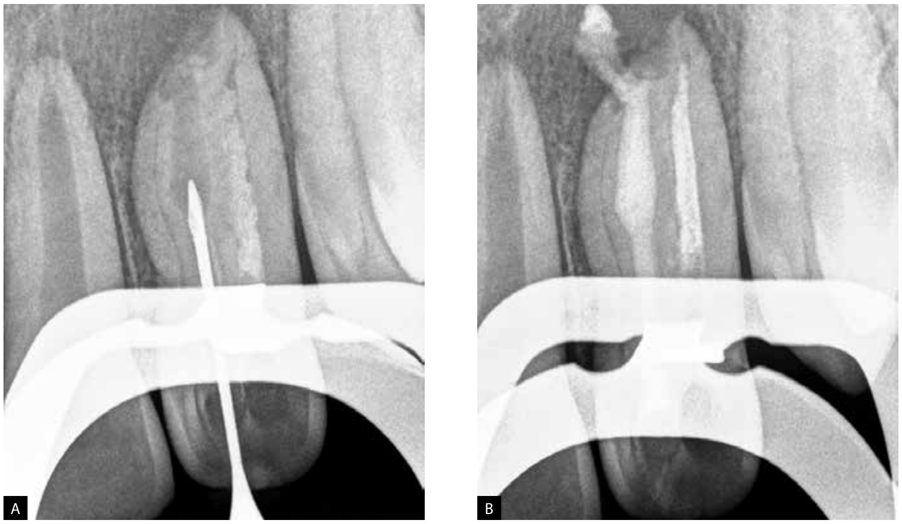

Figure 13. A) Periapical radiograph for teaching purposes: Gattes-Gliden bur inside dens invaginatus canal **B**) Intracanal medicament: $Ca(OH)_2$ in dens invaginatus canal.

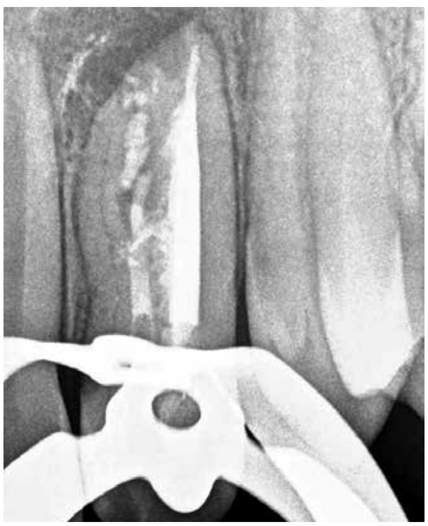

Figure 14. Periapical radiograph after main canal obturation.

Figure 15. Periapical radiograph after dens invaginatus canal obturation.

Figure 16. Periapical control radiograph at 9 months.

Figure 17. Periapical control radiograph at 18 months.

Discussion

Dens invaginatus is usually detected when the patient seeks dental attention because of pain and inflammation, or during routine examinations.[4] Our patient sought dental care because of a facial edema.

This clinical case confirms the prevalence rates reported in the studies conducted by Alani & Bishop, who concluded that dens invaginatus is probably one of the most common tooth development anomalies in maxillary lateral incisors (MLI).[1] Sahoo, Mishra and Mishra described a case of type III dens invaginatus in MLI that was extracted, differently from conservative treatments adopted even for similar cases of the same subtype of dens invaginatus.[6]

Permanent MLIs seem to be the tooth that most often has this anomaly, whereas posterior teeth are less susceptible to it.[1,2,5] The prevalence of each type of invagination has also been described by Ridell et al., and Type I is the most common (79%), followed by type II (15 %) and III (5%).[10] The case reported here is in the lowest prevalence range and is, therefore, a rare case.

In type III, the invagination communicates with periapical tissues, and, therefore, may lead to invasion of the pulp by irritants, which may eventually result in pulpal necrosis and the development of apical periodontitis.[6,14] This is confirmed in our report, as the tooth was healthy and intact, which would be a coherent hypothesis for the fact that it was necrotized. In addition, this is the most difficult type to treat endodontically because of the complexity of its root canal system and the communication with the periodontium through an incomplete apex.[13,14]

Carvalho et al. described a clinical case of dentes invaginati in the four maxillary incisors, in which only tooth #11 had periapical changes. In the other teeth, which only had the malformation, the treatment was conservative.[7] As in our clinical case, the choice was conservative endodontic treatment of dens invaginatus, avoiding a more aggressive treatment, such as extraction. However, different from our case, which was a type III A according to Ohlers' classification, the clinical case described by Carvalho was a milder type I dens invaginatus, which facilitated endodontic treatment.

Carvalho et al. agreed that dentists should understand the clinical and radiographic characteristics of this anomaly to make an accurate diagnosis and define the best prognosis for such cases.[7] An operative microscope is a valuable tool in endodontics, as it supports the accurate performance of several treatment techniques.[11,13,14]

Alani & Bishop reported on findings that clarify why the clinical case described here developed without caries, traumas or periapical changes. They found that the nature of the problem itself might increase the risk of pulp infection and the high level of complexity of its endodontic treatment.[1]

The study conducted by Sahoo, Mishra and Mishra confirmed that there are limitations when only conventional radiographs are used as the main resource for the diagnosis and treatment planning of cases of dens invaginatus, and pointed out the importance of CT scans to define case prognosis.[6,13,14] In this study, CT scans were used because of the wealth of details that they provide. Treatment planning for this case was specific and individualized, which ensured greater longevity to the tooth that had the anomaly.

According to Naravana et al., the clinical management of cases of dens invaginatus should include the use of CT scans to support diagnosis and treatment planning and to guide the use of the operative microscope in the phase of endodontic and surgical treatment, when necessary.[11,13,14]

Kumar et al. chose a treatment that was more conservative than extraction. After analysis of the CT scans, they performed apexification of tooth #12 and pulpal regeneration of tooth #22.[15] Yang et al. reported on several cases and concluded that conservative endodontic treatments should be considered for type II dens invaginatus with an open apex. They suggested that pulpal regeneration might be the best choice for these cases.[16]

Arsenault et al. described a case of facial cellulitis secondary to infection associated with an unerupted type III dens invaginatus, but their clinical treatment of the case was different from the one that we conducted, as they chose to extract the tooth.[17]

Studies indicate that cases of dens invaginatus associated with extensive periapical lesions should be treated with endodontic surgery.[11,17,18] In this case, surgery was suggested because of the filling material overextension, which complicated the clinical improvement of the lesion. However, we decided to observe the case progression and follow up the process of periapical repair.

Conclusion

Dens invaginatus is an anomaly with several morphological variations described in the literature. Early clinical and radiographic diagnosis is extremely important. In the case described here, the anatomical complications of type III A dens invaginatus and the difficulties it posed to conventional endodontic treatment indicated that CT scans had to be used to establish a diagnosis and a specific treatment plan. Additional endodontic surgery was indicated, as well as observation for the next five years.

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