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Combined Endodontic and Surgical Therapy for Resolution of Type III Dens Invaginatus

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ABSTRACT

Dens invaginatus is an abnormal dental developmental, probably resulting of the invagination of mineralized tissues from the tooth crown surface before its calcification. The teeth that are most affected by this abnormality are the maxillary lateral incisors. This dental developmental anomaly has various types and the rarest is type III which has the worst prognosis, because of its complex anatomy. Conventional root canal therapy may not sufficiently resolve the case itself and in some circumstances the surgical intervention is also necessary. This report addresses a complex combined endodontic treatment of a type III dens invaginatus in a maxillary lateral incisor in an 18 years-old female patient, with an extensive periapical lesion affecting the buccal and palatine cortical bone, diagnosed by cone-beam computed tomography (CBCT). The case was conducted with the combination of endodontic and surgical treatment, under the use of the surgical operating microscope. The association of CBCT, visual magnification, XP-endo Finisher, bioceramic sealer, MTA Repair HP and bone graft were important to ensure predictable success.

Keywords: Bioceramic Sealer; Dens Invaginatus; Endodontic Surgery; Endodontic Therapy; Periapical Lesion

Introduction

Dens invaginatus (DI), is a developmental anomaly resulting from the invagination of the tooth crown surface before calcification has occurred [1]. The etiology of DI is still as yet not entirely known; interestingly its incidence reports varies from 0.3% to 10% [2, 3]. The most commonly affected teeth are maxillary lateral incisors [4].

The Oehlers' classification [5] is the most used by authors. It is based on the extent of the invaginated dental tissue. In type I, the invagination is confined within the crown, extending only to the cemento-enamel junction; this type is likely to have better prognosis. Type II, is characterized by the invagination extending apically beyond the cemento-enamel junction, the pulp and the invagination can be connected; and type III has two sub-divisions. The invagination extends beyond the cemento-enamel junction and a second foramen is formed apically (IIIA) or into laterally in periodontal ligament (IIIB) [5]. DI type I and II, according to Oehlers' classification, are more frequently encountered, and the type III is the rarest, severe form and has the worst prognosis [6].

The most common clinical finding associated to DI is the early pulpal involvement [7], because the invagination forms a space which may be susceptible to dental caries. Bacteria and their products gain access to the dental pulp via canals, resulting in pulp pathology [3].

Several treatment options have been suggested in the literature, including preventive sealing of the invagination, root canal treatment either with/without endodontic apical surgery, intentional replantation and extraction [7-11].

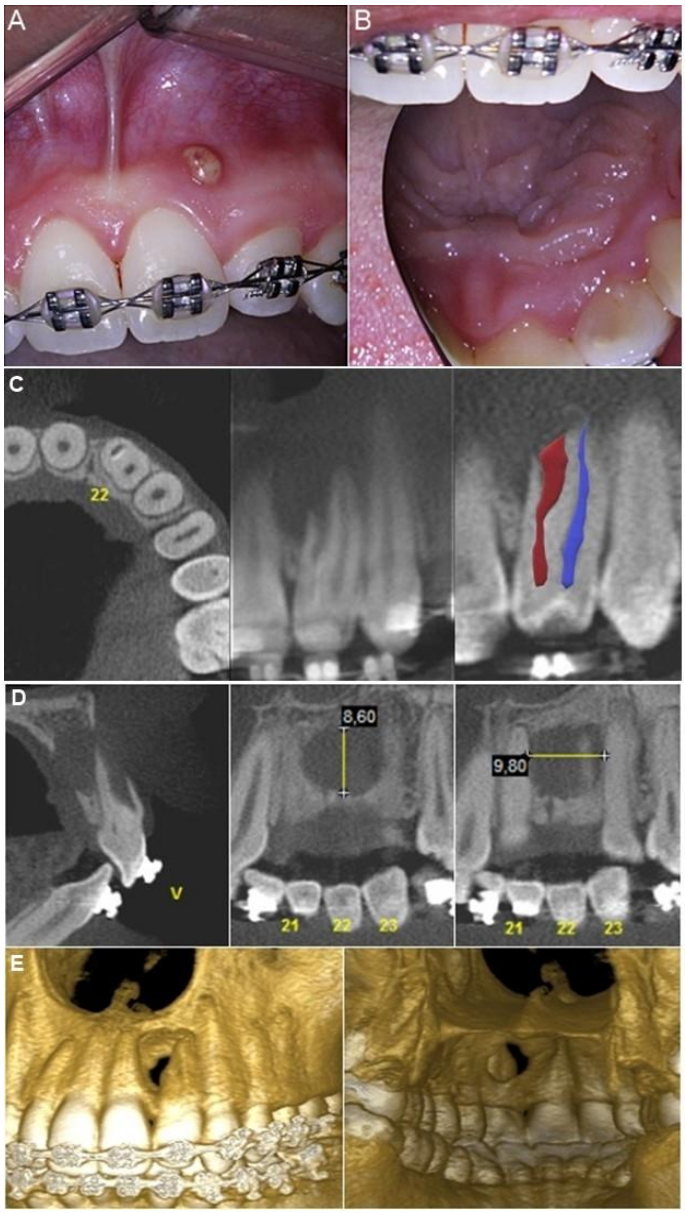

Figure1. *A,B)* Clinical view of the tooth displaying the sinus tract; *C)* The axial and coronal views of CBCT confirm the diagnosis of type III dens invaginatus. In red it can be identified the invagination and in blue, the main canal; *D)* The extension of the peri-radicular lesion can be demonstrated in the sagital and coronal views of the CBCT; *E)* A 3D reconstruction demonstrates the discontinuity of buccal and palatal cortical bobe affected.

The purpose of this article is to describe the combined use of the conventional non-surgical and surgical endodontic treatment for the resolution of a type III DI in a maxillary lateral incisor with an extensive peri-radicular lesion and apico-marginal defect affecting the buccal and palatine cortical bone. The DI was diagnosed by cone-beam computed tomography (CBCT) and treated using a surgical operating microscope and contemporary instruments and biomaterials.

Case Report

An 18-years-old female, in final maintenance phase of orthodontic treatment, was referred for endodontic treatment of her maxillary left lateral incisor, presenting dens invaginatus type III with an extensive peri-radicular lesion, affecting the buccal and palatine cortical bone.

Clinical intraoral examination revealed absence of carious lesion, normal crown morphology and the presence of a sinus tract (Figure 1A and B). The tooth had no history of orofacial trauma and its coloration was normal. It was sensitive to percussion and palpation. In pulp sensibility test with ethyl chloride frost spray (Endo-Frost; Roeko, Langenau, Germany) negative response was revealed. The case was diagnosed with pulp necrosis and acute apical periodontitis. The axial and coronal view of the CBCT confirmed the diagnosis of class III dens invaginatus (Figure 1C). The extension of the peri-radicular lesion was demonstrated in the sagital and coronal views of the CBCT (Figure 1D), and the 3D reconstruction revealed discontinuity of buccal and palatal cortical bobe affected (Figure 1E). The patient was informed about the possibilities of treatment and it was planned to perform first the non-surgical endodontic therapy. If this failed, surgical treatment would then be performed. An informed consent was assigned by the patient after careful explanation of the procedures. The patient was anesthetized using 2% lidocaine with 1:100.000 epinephrine (Nova DFL; Taquara, Rio de Janeiro, Brazil) and the root canal treatment was performed with the aid of a surgical operating microscope (D.F. Vasconcellos; Valença, Rio de Janeiro, Brazil). The access cavity was performed in high-speed rotation and after isolating the tooth with rubber dam, the canal orifices were located and the access was completed and refined using a diamond ultrasonic tip (Helse Dental Technology, São Paulo, Brazil) (Figure 2 A and 2B). A radiograph was obtained with files inserted in the root canals to establish working lengths (Figures 2C and 2D). On the radiograph, there appeared to be no connection between the primary root canal and the invagination. The mechanical chemical preparation of the canals started with an irrigation using 2.5% sodium hypochlorite (NaOCl), being careful to avoid the extravasation of the solution to the periapical tissues. The root canal shaping was performed using the rotary NiTi Logic System (Easy Equipamentos Odontológicos, Belo Horizonte, MG, Brazil) 30.01 (350 RPM; 0.5 N), 30.04 and 30.05 (650 RPM; 3 N) in the main canal and 40.05 (650 RPM; 3 N) in the canal invagination, coupled with an endodontic motor (X-Smart, Dentsply, Rio de Janeiro, Brazil) and copiously irrigated with 2.5% NaOCl during instrumentation. In order to ensure an efficient disinfection, the XP-Endo Finisher (FKG Dentaire, La Chaux-de-Fonds, Switzerland) was used after rinsing (Figure 2E and F). This is a file that when inserted in the root canal assumes

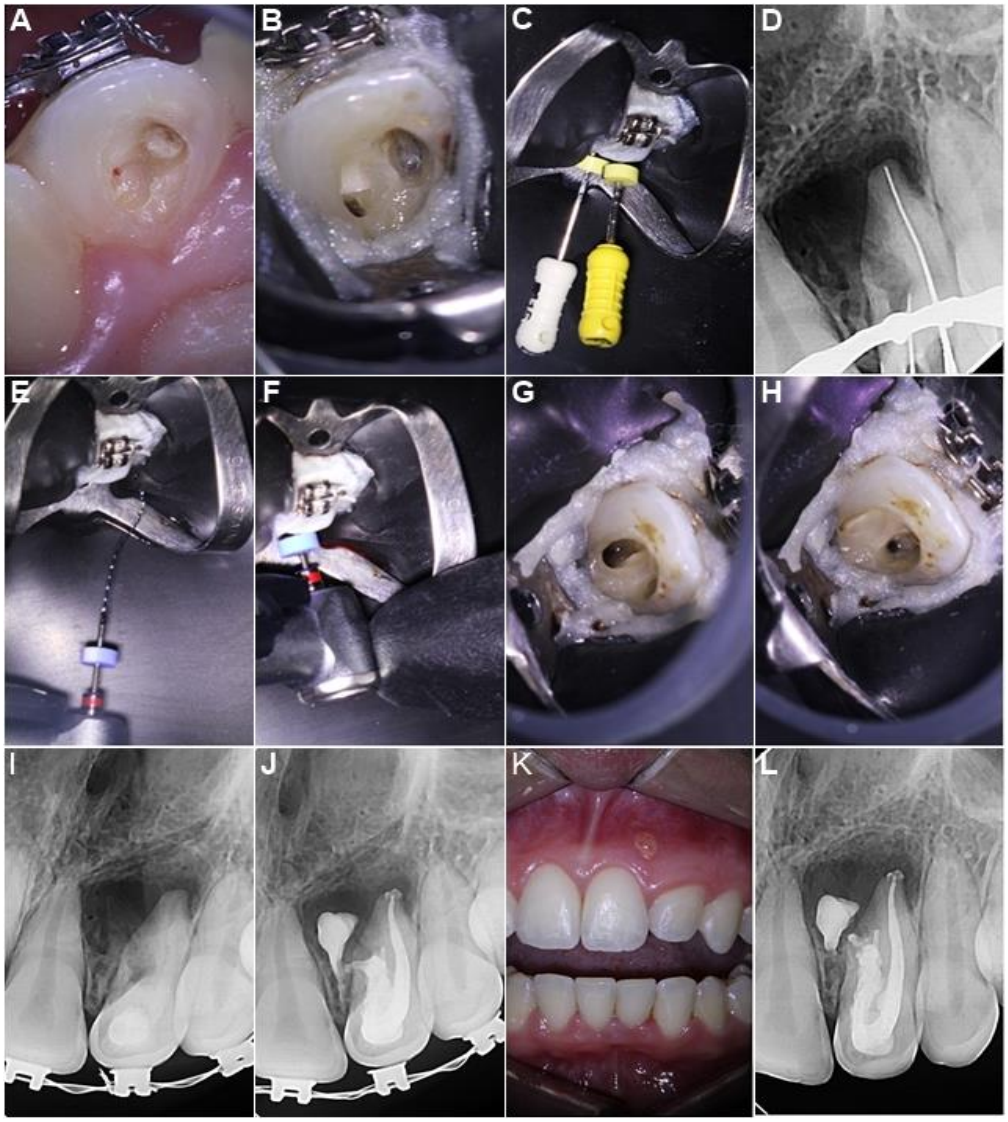

Figure .2*. A, B)* After performing the access cavity and locating the canals orifices; *C,* D) Odontometry was performed and checked radiographically *E, F)* The XP-Endo Finisher was used to agitate the irrigating solutions; *G, H)* The canals orifices can be seen after cleaning and shaping; *I)* The canals were filled with calcium hydroxide and a radiograph was taken to confirm root canals filling; *J)* In a subsequent session, after the canals were obturated, an immediate post-operative radiograph was made, which revealed a considerable extravasation of the material into the periradicular region of the pseudoforamen; *K, L)*In the clinical and radiographic follow-up, 2 months later, there was an absence of healing of the fistula and the apical lesion

a conformation that allows the instrument to work against the dentin sidewalls of the canals during the instrumentation, even when there are anatomical irregularities or abnormalities. This file was coupled in the same motor and activated (800 RPM; 1 N) in both canals for 20 sec, using slow and gentle lengthwise movements along the canals, under irrigation with 2.5% NaOCl solution. This cycle was repeated three times, totalizing one min. The smear layer was removed by rinsing the canals with 17% EDTA for 3 min, followed by a final irrigation with 2.5% NaOCl. After that, the canals were dried with sterile absorbent paper points, filled with calcium hydroxide (Ultracal; Ultradent Products Inc), and sealed with a temporary filling material (Cavit; 3M ESPE, Seefeld, Germany). A radiograph exam was taken to visualize the material in the canals (Figure 2I).

One month later, the tooth did not present symptoms or signs and was then filled. After accessed, the canals were irrigated with 2.5% NaOCl to remove the calcium hydroxide with another cycle (3×20 sec) using the XP-endo Finisher instrument (FKG Dentaire, La-Chaux-de Fonds, Switzerland). After canal cleaning and preparation, an irrigation with 17% EDTA for 3 min followed by a last irrigation with 2.5% NaOCl was made. The main canal was filled with gutta-percha and bioceramic sealer (Bio C-Sealer; Angelus, Londrina, Brazil) with

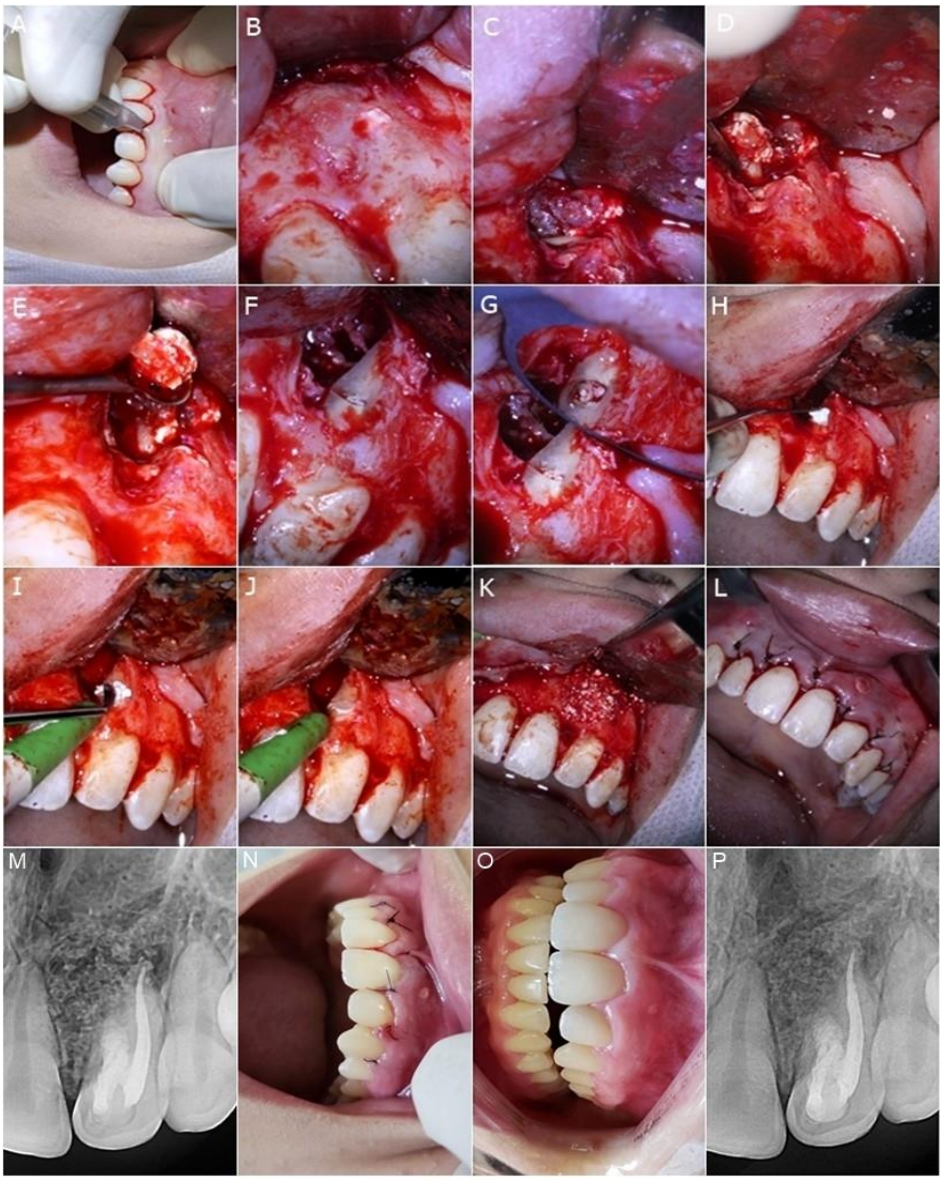

Figure 3. *A*) After the intrasulcular incision; *B*) The mucoperiosteal flap was elevated; *C-E*) The curettage of the granular tissue and of the material scattered from the canal was performed; *F, G*)The borders of the pseudoforamen was smoothed; *H-J*) Retrofilling with MTA Repair HP was performed; *K*) The bone graft material was applied to the bone defect; *L*) The flap was repositioned; *M*) Sutured and a immediate post-operative radiograph was made; *N*) One-week after the surgery the gingival repair was satisfactory; O) A new 12-months' follow-up demonstrated clinical; *P*) Radiographic signs of healing

lateral condensation technique. The canal invagination was mainly filled with the bioceramic sealer, as the gutta-percha was only the carrier for the sealer. A post-operative radiographic exam was obtained immediately following treatment and revealed a considerable extravasation of the material in the peri-radicular region of the pseudoforamen (Figure 2J). In the following week the definitive restoration was performed with composite resin. The patient returned for clinical and radiographic examinations after two months with new episodes of sinus tract (Figure 2K and L). At this appointment, it was decided to perform the surgical intervention after discussion with the patient.

In a subsequent session, after anesthesia with 2% lidocaine and 1:100.000 epinephrine, an intrasulcular incision was performed and a mucoperiosteal flap elevated exposing an area of bone defect (Figure 3A and 3B). The granular tissue and the bioceramic material that scattered were thoroughly curetted (Figure 3C-3E). The rough borders of the region of the pseudoforamen were smoothed (Figure 3F and 3G) and the canal was retro-filled with MTA Repair HP (Angelus, Londrina,

Brazil), using retro-condensers (Kit Bernabé; Thimon Odontologia, São Paulo, Brazil) (Figure 3 H-J). After adequate debridement and cleaning of the surgical site, it was filled with bone graft (Lumina Bone; Biomaterials criteria, São Paulo, Brazil) (Figure 3K), and the flap was repositioned and sutured (Figure 3L). A post-operative radiograph exam revealed the correct and satisfactory retrofilling (Figure 3M).

In the appointment for suture removal, one week later, the patient was completely asymptomatic, and the appearance of gingival tissue was healthy (Figure 3N). The 12-month clinical and radiographic follow-up showed complete healing (Figure 3O and 3P).

Discussion

In DI cases the incidence of pulp involvement associated with/without a periapical lesion is high, and needs an early diagnosis to prevent pulp necrosis and periapical inflammation [5]. However, the anomaly is commonly discovered only after the appearance of signs and symptoms, as reported in this case. Althought data was not available, the previous orthodontic treatment might have enhanced the inflammatory process and concomitant root and bone resorption.

A better diagnosis, planning and prognosis in cases of DI has been associated with the use of cone-beam computed tomography , because they provide a three-dimensional view of the tooth, which helps to recognize the type of DI, the size and depth of the invagination, as well to determine the dimensions of bone lesion [12-15].

In this report, the CBCT images clarified the Oehlers' Type III anatomy and also helped in the analyses of bones dimensions and discontinuities that were affected.

Sousa and Bramante [8] demonstrated that in cases of DI, in which a complex anatomy and periapical lesion is already established, endodontic surgery can be previously indicated because of the difficulty in obtaining an effective cleaning, disinfection and sealing of the canals in the apical third, mainly in the invagination canal, which often presents an unusual conformation with a wide apical opening.

The use of the XP-Endo Finisher file associated with 2.5% NaOCl solution were fundamental due to its ability to access and clean areas that other instruments might not have reached, with no damages to dentin or alteration of the original root canal shape[13, 16, 17].

In order to remove the smear layer and expose the dentinal tubules, continuous irrigation with 5 mL of 17% EDTA was performed for 3 min inside the root canal [18]. This approach also permitted the exposition of dentinal tubules, which is essential for the proper contact and action of the bioactive sealer with dentin. According to previous studies, 17% EDTA is indicated and present better results when utilized between 1 to 5 min [19-21]. However, it has been demonstrated that 1-min exposure to the solution may not be sufficient for proper smear layer removal [22-24]. On the other hand, dentinal erosions were observed with 10 min of tissue exposure to 17% EDTA [20, 25-27]. The use of calcium hydroxide is frequent in cases of DI [13-15, 28-30] to assist the disinfection of root canal systems that cannot be fully accessed [16], especially in cases of necrotic teeth with periapical lesion because of its antimicrobial properties and repair action induction [8, 31]. Estrela and Holland [31] described the effectiveness of using calcium hydroxide for at least 21 days. In this case, the medication was maintained for 30 days due to the availability of the patient to return.

One of the main challenges in a case of DI endodontic treatment is to perform an excellent root filling due to its complex anatomy. Some authors describe the use of lateral condensation [15, 32] or thermoplasticized obturation [8], techniques as the most appropriate for such teeth, because they permit flow of softened gutta-percha to inaccessible areas better than others. In this case, lateral condensation associated to the bioceramic sealer (Bio C-Sealer, Angelus, PR, Brazil) contributed to a better root canal sealing due to the excellent flowing property of the cement. In the DI canal, the bioceramic sealer was the main material to fill the irregularities, and gutta-percha played the role of a carrier in this case. Bioceramics are biocompatible materials that, when in contact to tissues, integrate to them through chemical bonds, which forms hydroxyapatite, eliminating spaces between the dentine walls and the material, performing the canal sealing. Albeit these techniques are the most appropriate to root filling, there are risks of material extrusion in open apex [8] as occurred in this case. Koch *et al.* [33] reported absence of inflammation or pain in cases after bioceramic sealer extrusion to periapical tissues.

Many cases of DI type III do not present lesion repair with the non-surgical endodontic treatment. An explanation for that is the presence of irregularities, which can harbor a difficult to remove biofilm [14-16]. The surgical association approach was performed to overcome the apical irregularities and the persistent infection, once the apical anomaly does not provide a good surface for the correct debridement and root canal obturation [8]. The mineral trioxide aggregate (MTA) and bioceramic sealers remain the "gold standard" retrofilling materials [34]. These materials are indicated for their advantageous characteristics, such as sealing capacity, low

solubility, lower bacterial infiltration, biocompatibility, bioactivity and apical healing stimulation [34, 35].

In our report, the lesion was not given to the pathologist for microscopic examination because the origin of the lesion was very likely to be clear and the inflammatory tissue was removed in pieces, and not entirely in just one specimen. The specimens were small, and would be very difficult to be utilized.

Bone grafts in endodontic surgical sites can be used to achieve favorable healing and regeneration of the bone defect in the area affected by the lesion [15]. The "guided tissue regeneration" (GTR) techniques helps creating conditions that are ideal for repair of the original structures and normal functioning of the tissues that were affected, preventing the epithelial down growth along the denuded root surface after apical surgery [15, 36]. In this report, the periapical lesion affected a large area, causing a defect in buccal and palatal cortical bone. The bone graft material was applied to the bone defect to avoid infiltration by epithelial cells and gingival connective tissue, favoring the healing process. The use of the GTR was based in previous studies that demonstrated an increase in the success rate of endodontic microsurgeries with this procedure [37-39].

The use of the surgical operating microscope was paramount for the success of the case. The inability to observe details in small operative fields is a reason for surgical failure. The use of visual magnification had greatly contributed to differentiate the healthy from the pathological tissue and to provide most precision in apicoplasty, retro-preparation and retro-filling.

In conclusion, the association of non-surgical and surgical endodontic therapy was successful in this case of DI type III, presenting a wide-open apex, extensive peri-radicular lesion and bone defect. The association of CBCT, surgical operating microscope, XP-endo Finisher, Bio C-Sealer, MTA Repair HP and GTR were important to ensure a success predictable outcome.

Conflict of Interest: 'None declared'.

References

1. Ruschel HC, da Rocha S, Birlem PHZ, Rodrigues PH, Kramer PF. Dens in dente bilateral: relato de caso e considerações de tratamento. Stomatos. 2011;17(32):91-6.
2. Thakur S, Thakur NS, Bramta M, Gupta M. Dens invagination: A review of literature and report of two cases. J Nat Sci Biol Med. 2014;5(1):218-21.
3. Crincoli V, Di Bisceglie MB, Scivetti M, Favia A, Di Comite M. Dens invaginatus: a qualitative-quantitative analysis. Case report of an upper second molar. Ultrastruct Pathol. 2010;34(1):7-15.
4. Grahnen H. Dens invaginatus. I. A clinical, roentgenological and genetical study of permanent upper lateral incisors. Odontologisk Revy. 1959;10:115-37.
5. Oehlers FA. Dens invaginatus (dilated composite odontome). I. Variations of the invagination process and associated anterior crown forms. Oral Surg Oral Med Oral Pathol. 1957;10(11):1204-18 contd.
6. Kirzioglu Z, Ceyhan D. The prevalence of anterior teeth with dens invaginatus in the western Mediterranean region of Turkey. Int Endod J. 2009;42(8):727-34.
7. Rotstein I, Stabholz A, Heling I, Friedman S. Clinical considerations in the treatment of dens invaginatus. Endod Dent Traumatol. 1987;3(5):249-54.
8. de Sousa SM, Bramante CM. Dens invaginatus: treatment choices. Endod Dent Traumatol. 1998;14(4):152-8.
9. Afkar M, Gholamshahi M, Mohammadi M. Nonsurgical Treatment of Type II Dens Invaginatus in a Maxillary Lateral Incisor Using Cone-Beam Computed Tomography. Iran Endod J. 2018;13(1):132-4.
10. Norouzi N, Kazem M, Gohari A. Nonsurgical Management of an Immature Maxillary Central Incisor with Type III Dens Invaginatus Using MTA Plug: A Case Report. Iran Endod J. 2017;12(4):521-6.
11. Caliskan MK, Asgary S, Tekin U, Guneri P. Amputation of an Extra-root with an Endodontic Lesion in an Invaginated Vital Maxillary Lateral Incisor: A Rare Case with Seven-year Follow-up. Iran Endod J. 2016;11(2):138-41.
12. Ranganathan J, Rangarajan Sundaresan MK, Ramasamy S. Management of Oehler's Type III Dens Invaginatus Using Cone Beam Computed Tomography. Case Rep Dent. 2016;2016:3573612.
13. Rodrigues EA, Belladonna FG, De-Deus G, Silva EJ. Endodontic management of type II dens invaginatus with open apex and large periradicular lesion using the XP-endo Finisher: A case report. J Clin Exp Dent. 2018;10(10):e1040-e4.
14. Zhang P, Wei X. Combined Therapy for a Rare Case of Type III Dens Invaginatus in a Mandibular Central Incisor with a Periapical Lesion: A Case Report. J Endod. 2017;43(8):1378-82.
15. Sharma S, Wadhawan A, Rajan K. Combined endodontic therapy and peri-radicular regenerative surgery in the treatment of dens invaginatus type III associated with apicomarginal defect. J Conserv Dent. 2018;21(6):696-700.
16. Silva E, Belladonna FG, Zuolo AS, Rodrigues E, Ehrhardt IC, Souza EM, et al. Effectiveness of XP-endo Finisher and XP-endo Finisher R in removing root filling remnants: a micro-CT study. Int Endod J. 2018;51(1):86-91.
17. Bao P, Shen Y, Lin J, Haapasalo M. In Vitro Efficacy of XP-endo Finisher with 2 Different Protocols on Biofilm Removal from Apical Root Canals. J Endod. 2017;43(2):321-5.
18. Mello I, Kammerer BA, Yoshimoto D, Macedo MC, Antoniazzi JH. Influence of final rinse technique on ability of ethylenediaminetetraacetic acid of removing smear layer. J Endod. 2010;36(3):512-4.

19. Hulsmann M, Heckendorff M, Schafers F. Comparative in-vitro evaluation of three chelator pastes. Int Endod J. 2002;35(8):668-79.
20. Calt S, Serper A. Time-dependent effects of EDTA on dentin structures. J Endod. 2002;28(1):17-9.
21. Hulsmann M, Heckendorff M, Lennon A. Chelating agents in root canal treatment: mode of action and indications for their use. Int Endod J. 2003;36(12):810-30.
22. Machado-Silveiro LF, Gonzalez-Lopez S, Gonzalez-Rodriguez MP. Decalcification of root canal dentine by citric acid, EDTA and sodium citrate. Int Endod J. 2004;37(6):365-9.
23. Mancini M, Armellin E, Casaglia A, Cerroni L, Cianconi L. A comparative study of smear layer removal and erosion in apical intraradicular dentine with three irrigating solutions: a scanning electron microscopy evaluation. J Endod. 2009;35(6):900-3.
24. Poudyal S, Pan WH, Zhan L. Efficacy of solution form of ethylenediaminetetraacetic acid on removing smear layer of root canal at different exposure time In Vitro. J Huazhong Univ Sci Technolog Med Sci. 2014;34(3):420-4.
25. Calt S, Serper A. Time-dependent effects of EDTA on dentin structures. J Endod. 2002;28(1):17-9.
26. De-Deus G, Paciornik S, Mauricio MH. Evaluation of the effect of EDTA, EDTAC and citric acid on the microhardness of root dentine. Int Endod J. 2006;39(5):401-7.
27. Sayin TC, Cehreli ZC, Deniz D, Akcay A, Tuncel B, Dagli F, et al. Time-dependent decalcifying effects of endodontic irrigants with antibacterial properties. J Endod. 2009;35(2):280-3.
28. Ferguson FS, Friedman S, Frazzetto V. Successful apexification technique in an immature tooth with dens in dente. Oral Surg Oral Med Oral Pathol. 1980;49(4):356-9.
29. Holtzman L, Lezion R. Endodontic treatment of maxillary canine with dens invaginatus and immature root. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1996;82(4):452-5.
30. Pai SF, Yang SF, Lin LM. Nonsurgical endodontic treatment of dens invaginatus with large periradicular lesion: a case report. J Endod. 2004;30(8):597-600.
31. Estrela C, Holland R. Calcium hydroxide: study based on scientific evidences. J Appl Oral Sci. 2003;11(4):269-82.
32. Fregnani ER, Spinola LF, Sonego JR, Bueno CE, De Martin AS. Complex endodontic treatment of an immature type III dens invaginatus. A case report. Int Endod J. 2008;41(10):913-9.
33. Koch KA, Brave DG, Nasseh AA. Bioceramic technology: closing the endo-restorative circle, Part I. Dent Today. 2010;29(2):100-5.
34. Lima NFF, dos Santos PRN, da Silva Pedrosa M, Delboni MG. Cimentos biocerâmicos em endodontia: revisão de literatura. Revista da Faculdade de Odontologia-UPF. 2017;22(2).
35. Leal JM. Materiais obturadores de canais radiculares. Endodontia: tratamento de canais radiculares1991. p. 348-404.
36. Gagnon K, Morand M-A. La regeneration tissulaire guidee en endodontie (1^ r^ e pattie). Journal-Canadian Dental Association. 1999;65:394-8.
37. Britain SK, Arx T, Schenk RK, Buser D, Nummikoski P, Cochran DL. The use of guided tissue regeneration principles in endodontic surgery for induced chronic periodontic-endodontic lesions: a clinical, radiographic, and histologic evaluation. J Periodontol. 2005;76(3):450-60.
38. Tsesis I, Rosen E, Tamse A, Taschieri S, Del Fabbro M. Effect of guided tissue regeneration on the outcome of surgical endodontic treatment: a systematic review and meta-analysis. J Endod. 2011;37(8):1039-45.
39. Bernabe PF, Gomes-Filho JE, Bernabe DG, Nery MJ, Otoboni-Filho JA, Dezan E, Jr., et al. Sealing ability of MTA used as a root end filling material: effect of the sonic and ultrasonic condensation. Braz Dent J. 2013;24(2):107-10.

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