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Successful management of a type II Dens invaginatus with an open apex and a large periapical lesion. A case report of a permanent maxillary canine

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Introduction

Dens invaginatus is a relatively frequent dental anomaly. It is a morphogenesis anomaly resulting from a deepening or invagination of the enamel organ into the dental papilla prior to calcification of the dental tissues It was first described in human tooth by a dentist, Socrates in 1856. Multiple names have been also used to describe this anomaly. Dens in dente was suggested by Busch in1897 implying the radiographic appearance of a tooth within a tooth. The term dens invaginatus, currently used, was introduced by Hallet 1953. It highlighted the inversion of the usual morphology of the tooth, as the enamel was positionned centrally and the dentine peripherally [1,2].

Dens invaginatus is known to be associated with other dental anomalies such as gemination, microdontia, macrodontia, absence of permanent tooth germs, taurodontism, supernumerary tooth, and dentinogenesis imperfecta [3].

Clinically, the crown of the affected teeth can have normal morphology or it can also show unusual forms such as a greater bucco lingual dimension, peg shaped form, barrel shaped form, conical shapes and talon cusps. A deep foramen coecum might be the most associated coronal alteration indicating the suspicion of dens invaginatus [4].

The most widely accepted classification of dens invaginatus was proposed by Oehlers 1957. IT's a simple and easily applicable nomenclature, that categorized the invaginations into three types based on the radiographic corono radicular extension and the presence or not of communication with the periodontal ligament. Type I, describes an enamel lined invagination confined to the coronal part of the tooth, Type II represents extension of the invagination beyond the cemento enamel junction ending as a blind sac with posible connection to the dental pulp but there is no communication with periapical tissues. Type III includes invagination penetrating the root and perforating the apical or the lateral surface of the rootwithout any communication with the pulp [1,5] (Figure 1). Type I and II are considered as incomplete invagination and their incidence is respectively 79% and 15%. Type III is considered a complete invagination with the lowest incidence at 5% [6,7].

The maxillary lateral incisors are the most commonly affected teeth. High Bilateral occurrence has been reported by Hülsmann (43%) [1,8].

In a decreasing order of frequency, the maxillary central incisor, Premolars, canines and molar can also be involved [9,10].

The present report presents a case of a type II Dens invaginatus involving a maxillary left canine associated a large chronic periapical lesion treated with conventional endodontic treatment after ultrasonic removal of the invaginated tissue.

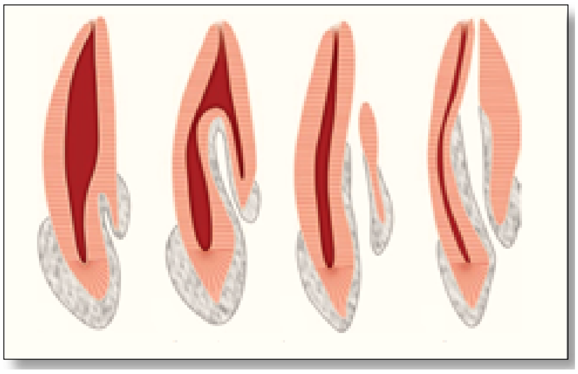

Figure 1. Oehlers' classification of dens invaginatus[23]

Case report

A twenty-four aged female patient attended at Monastir Dental Clinic for a fistula in the left maxilla. The patient had non contributory medical history. Intra oral examination revealed the presence of an intraoral sinus tract in the free mucosa next to the left maxillary canine. The tooth did not respond to cold thermal testing (Ethyl chloride spray, Walter Ritter GmbH, & co hamburg, Germany) although all of the adjacent teeth responded within normal limits. Likewise, the percussion test showed no sensitiviy on this tooth.

A thorough clinical investigation revealed no morphologic alterations of the buccal aspect of the left upper canine, except for a large crown (Figure 2). However, the affected tooth shows a cusp-like proeminent cingulum with a deep and slightly colored pit on the palatal aspect (Figure 3). There was no visible decay or restorations.

Considering this atypical form of the cingulum and the absence of pulpal vitality, dental invagination was suspected. A careful three

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Figure 2. Buccal aspect of the maxillary left canine: A large crown, no morphologic alterations

Figure 3. A Cusp-like proeminent cingulum with a deep and slightly colored pit

dimensional radiographic evaluation was required in order to properly investigate the internal anatomy of the affected tooth and to establish an appropriate care plan.

A cone beam computed tomography was carried out. Sagittal and coronal sections of CBCT revealed an ubnormal crown and root canal morphology simulating the appearance of a tooth inside the affected tooth as well as a periapical radiolucency with a buccal cortex perforation apically to the left maxillary canine (Figure 4).

At the point of communication, a radio opaque infolding of enamel with a continuity between the inner enamel and the outer one through the lingual pit was discerned. The path of invagination, exceeding the cemento enamel junction was identified on the sagittal sections of CBCT investigations.

Two canals were visualized: a semi lunar shaped main canal, bucally located , continuous with pulp chamber and more bulky in apical area , and an invaginated canal adhering lingually to the main root canal. The invagination, extending in the pulp chamber and to half of the root length, showed a constriction at the apex. Axial section revealed a single root apex at the end of the main root canal [11] (Figure 5).

Treatment plan

Considering the results of clinical and radiological investigations, a diagnosis of type II Dens Invaginatus (based on Oehler's classification) associated with pulpal necrosis and a chronic periapical abcess was established and a root canal treatment was planned .

The morphological complexity of the present type II dens invaginatus case posed serious clinical challenges [12].

The current type II invagination has a separate apical foramen placed shorter to the apical foramen of the main canal. The treatment promises to be difficult because of this deep invagination. Indeed, although the invaginated tooth communicates apically with the main canal, it empedes proper and convenient instrumental access to its apical portion and thus optimal chemomechanical debridement of the root canal system. Consequently, it appeared useful and unavoidable to remove the invaginated portion for better cleaning and filling the root canal system. Anesthesia was not requisite as the tooth responded negatively to the vitality test. Access preparation was accomplished, under rubber dam isolation and using a fast hand piece round diamond bur. It revealed two openings access, one of the invagination and another of the main canal (Figure 6a, 6b and 7a). Ultrasonic instrumentation was then used, under an operating microscope, to explode the anomalous edifice and concluded with a unique and tapered large canal (Figure 6c and 7b). Next, F3 protaper universal file served alternately with a copious irrigation using a 5.25 % Sodium Chloride solution to achieve better canal debridement. At the end of this first visit, The canal was filled with Calcium Hydroxide paste (Metapaste, Meta-Biomed) for a 15 days period and the access cavity was temporary sealed with Cavit (3M ESPE AG, Seefeld, Germany).

On the second visit**,** clinical examination revealed healing of the fistula. After isolation with rubber dam and **removal** of the provisional

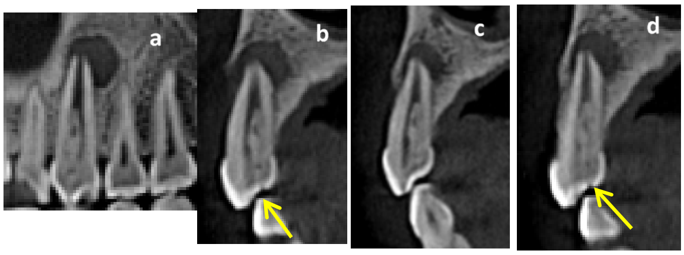

Figure 4. Preoperative cone-beam computed tomography, coronal slice (a): lingual corono radicular invagination, irregular lumen. Sagittal slices (b)(c) and (d), Penetration point (arrow), periapical radiolucency. No communication of the invagination with periodontal tissues

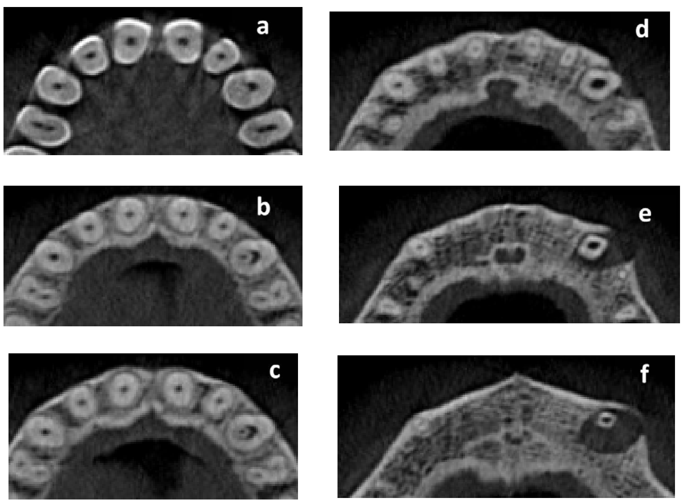

Figure 5. Preoperative cone-beam computed tomography, Axial sections(a), (b) and (c) lingual invagination adhering to the lingual wall of the main canal. (d), (e) and (f): large and single apical foramen, peri apical radiolucency, perforation the buccal bone

restoration and calcium hydroxide endodontic dressing, the canal was dried with serile paper points and small pieces of ETIK collagen (Acteon Pierre Roland) were tamped into the periapical defect and the last apical millimeters of the main canal in order to create an apical barrier, enable three dimensional compaction of the root filling and prevent apical extrusion. Biodentine cement powder and liquid were mixed according to the manufacture's instructions, progressively inserted into the dried canal using a sterile amalgam carrier and effectively condensed within the canal using pre-fitted root Machtou Hand pluggers (Densply, Maillefer Sirona) . The access cavity was then promptly sealed with Filtek Z350 resin composite.

A post operative radiographic control revealed a dense and hermetic root filling, but infortunately, an apical shortage, due to an excessive use of collagen matrix was also evident (Figure 7c). A full thikness mucoperiosteal flap was then immediately retracted exposing the apical lesion. The enucleation of the pathologic periapical tissues enabled a 3 mm root end resection thus removing the non sealed part of the canal. The quality and the sealing of the orthograde filling was then thoroughly checked and the flap sutured with Vicryl 4-0. An intra oral periapical radiograph was eventually taken and an appointment for elimination of stitches was given (Figure 8).

Clinical and radiologic follow ups at **one week** revealed no tenderness on percussion of the crown or on palpation in the apical area. The tooth presented a successful outcome. The periapical lesion was healing.

Discussion

Dens invaginatus is recognized to be rare in permanent canines. Cakici, *et al.* 2010, Assessed the prevalence and classification of DI in a sample of Turkish population. They detected DI only in Maxillary lateral incisors and no dens invaginatus was observed among 1951 maxillary canines and 1968 mandibular canines [14].

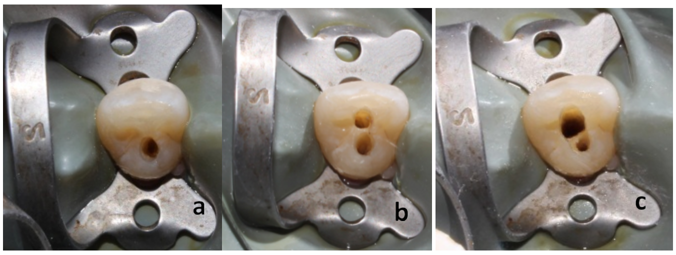

Figure 6. Per-operative photographs: (a) lingual access to the invagination was firstly performed (b): a buccal access to the main canal and a lingual one to the invagination (c): progressive destruction of the anomalous edifice through the main canal

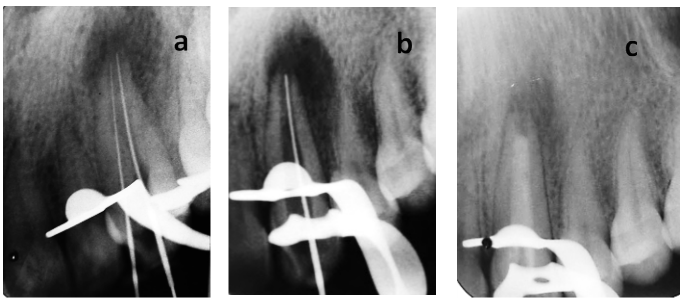

Figure 7. (a) Periapical radio with two files in place, a lingual one in the invaginated canal and a buccal in the main canal (b): length determination radio, (c) post operative radiographic control of the root filling

Figure 8. (a) and (b) clinical view showing the healing of the fistula 15 days after Calcium hydroxide dressing (c) a full thikness mucoperiosteal flap rising, exposing the apical lesion and a narrow root denudation (d) periapical pathologic tissues curetage and root end resection removing of the non sealed part of the canal (e) perfect apical sealing of biodentine orthograde obturation (f) post apical resection periapical radiograph

Only few cases of dens invaginatus involving maxillary canine have been reported in the littérature [15-20].

According to Kronfeld (1934) [21] hypothesis, the presence of invagination increases pulpal and peri-apical pathosis risk. Pulpal infection of DI commonly occurs soon after dental eruption which promotes communication with the oral environment. Indeed, remnants of the dental papilla or periodontal connective tissue, contained in the invagination, become necrotic. Furthermore, the invagination presents a predisposition for the development of dental caries [22].

For these reasons, and whenever DI are diagnosed, an early prophylactic approach is recommanded to prevent pulpal and periapical complications of Dens Invaginatus. Restaurative procedures using adhesive materials such as resin composite and conventional glass ionomer must be used to seal the penetration point. Walzade PS, *et al.* (2017) [23], used a preventive fissure sealing restoration to manage conservatively Type II DI. The invagination was lined with Calcium Hydroxide to stimulate formation of secondary dentin and Conventional glass ionomer cement was used to provide secondary caries inhibition. Lucas, *et al.* (2003) [24] showed that regular follow-up and periodic evaluation are necessary after an early prophylactic sealing of type II invagination since it appears not to be always favorable.

In cases of reversible pulp inflammation some authors indicate only endodontic treatment of the invagination, leaving the main pulp canal intact [25].

Late identification of the invagination may lead to the invaginated pulp necrosis and periapical lesions, at early ages after invaginated tooth eruption, subsequent to main pulp contamination through the invagination space. These conditions are reported to be the main circumstance of dens Invaginatus discovery [12,25-30].

In the current case, the CBCT showed an invagination which extented into the root of the left maxillary canine which was categorized as Oehler's type II dens invaginatus. CBCT sagittal and axial sections exhibited a break of the lingual enamel, the presence of a thin layer of enamel limited to the coronal part of the invagination whereas, the radicular part is lined by a thin layer of dentin and the lumen of the invagination opened apically in the main canal. According to Crincoli, *et al.* (2010) [31]**,** these findings justify the penetration of irritants in the main pulp and its infection [11].

A chronic periapical lesion on a type II invagination with evident apical perforation of the sac was diagnosed in the current case. The main pulp and the invagination content were necrotic. Necrosis in the main canal might have occured due to the passage of bacterial products from the infected lumen to the main pulp through the dentinal tubules and the apical communication. Therefore complete desinfection of the main and the invaginated canals is mandatory to promote healing of the affected periadicular tissues [32].

The various and unpredictable internal anatomy makes endodontic treatment of DI type II complicated. In fact, in this case, Invagination generally occurs inside the pulp cavity and it is totally surrounded by pulp tissue. Thus, adequate cleaning of the main root canal is always challenging. The invagination is usually removed during treatment to facilitate desinfection , apexification and filling of the canal system [25,29,33,34].

In the present case, the invaginated tissues were removed to better perform disinfection and instrumentation of the necrotic root canal system. Indeed Cone Beam Computed Tomography examination showed an evident communication from the dens invaginatus with the main root canal pulp. In addition, we believed that removing the invaginated tissue does not dramatically influence tooth structure.

The removal of the invagination may facilitate the root canal desinfection but may result in compromised tooth structure. Thus, whenever the main root canal and the invaginated canal do not communicate, and when the invagination does not impede full access to the apical portion of the main canal, both canals are separately throughly desinfected and obturated [28,35].

Some authors **kept** the invaginated tissue to avoid additional weakening of invaginated teeth and performed endodontic microsurgey to achieve a perfect seal of the main canal [27,30,36].

Giuliani, *et al.* (2002) [37], emphasized that a complete pulp space disinfection of Dens Invaginatus is mandatory to promote healing of affected periradicular tissues. 5.25% sodium hypochlorite as irrigation and calcium hydroxide as intracanal medication between appointments are recognized to be the gold standard to attain this purpose.

When the foramen is open, apical closure is required to prevent over-extension the root filling material in periodontal tissues and achieve an apical seal [25,29,33,34,38]. In the current case, the affected tooth presented a favorable crown/root ratio, thick dentinal walls that are not susceptible to fracture but a lack of apical stop. An immediate closure of the wide apex through the formation of an apical buffer using collagen matrix and complete canal obturation with Biodentine was performed.

Sathorn and Parashos (2007) [38] reported a case of type II DI of maxillary canine in which the dense and infected necrotic pulp were removed and apexification with MTA was done.

Kristoffersen, *et al.* (2008) [34] and A. Gangwar, et al. (2014) [33] reported respectively an immature maxillary right lateral incisor with type II DI and an immature mandibular left lateral incisor in which dens was removed and MTA was used as an orthograde apical barrier.

In the current case, a complete root canal obturation was realized with Biodentine biomaterial to achieve apexification.

It is well documented that Biodentine used as a retrograde root end filling on teeth with apical periodontitis. It allows micromechanical adhesion in the interace betweeen the material and human dentine. Previous outcome studies on periapical surgery showed that the periapial tissue healing pattern after the use of biodentine is similar to that of MTA and that the periapical bone re-establish very close to the surface of retrograde material [39].

In more complex cases, when the treatment through the canal is not realisable, root canal treatment is associated with retrograde filling. Azambuja and al. 2002 reported a successful case where only surgical treatment was performed on a tooth with periapical radiolucency and no radiographic pulp chamber [40].

J. Yang used pulp revascularization to successfully treat a maxillary lateral incisor with necrotic pulp, type II dens invaginatus and a large periapical lesion. During this procedure, Irrigation was performed with 5.25% NaOCl, followed by sterile normal saline and a triple Antibiotic paste was used into both main and invaginated canals for a period of four weeks. The invaginated canal was then sealed with Gutta Flow (Coltène / Whaledent, Langenau, Germany). As, no bleeding was found into the main canal, it was not possible to place MTA as required by the protocol. Access cavity was sealed using Glassionomer cement covered with Composit resin. A twenty four recall showed periapical radioluscent lesion elimination and apical closure [41].

Yuemin Ch, *et al.* used patelet rich fibrin collected via Choukroun's technique as scaffolding material to overcome the difficulty in inducing bleeding and placing MTA over the blood clot in an invaginated mandibular second premolar invaginated teeth. They obtained a complete root developpment and a closure of the root apex [42,43].

Conclusion

Dens invaginatus is a rare developmental malformation. They are prone to bacterial contamination at an early age and their discovery is usually associated with necrotic pulp, periapical complications and open apex. The intricate anatomy of type II Dens invaginatus always makes endodontic management challenging especially in immature teeth. Various treatment procedures has been reported in the littérature including or not invaginated tissue removal, apexification, pulp re-vascularisation. Surgical approach was reserved to orthograde endodontic treatment failures.

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