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Non-surgical root canal treatment of Dens invaginatus: reports of three cases

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Dens invaginatus is a rare developmental malformation of teeth showing a deep infolding of enamel and dentine which may extend deep into the root. To date, conventional root canal therapy, endodontic surgery and extraction have been reported as treatment modalities, when the pulpo-dentinal complex of such teeth is affected. In the present report, non-surgical endodontic treatment of three maxillary lateral incisors with invaginatus (DI) is discussed. The Tri Auto ZX rotary system was used for shaping the root canals of two affected teeth and the Profile system was used in the third. Teeth with periradicular lesions received calcium hydroxide as an interim therapy. Two teeth were obturated with gutta percha points and AH Plus sealer using cold lateral compaction. In the third case, obturation was accomplished using a coated carrier system (Thermafil) due to the specific shape of the root canal system. Twelve months postoperatively all teeth were asymptomatic with resolution of the periapical radiolucency on two affected teeth, as confirmed radiographically. Healing was achieved without any need for further surgical intervention.

Key words: Tooth abnormalities, dens in dente, dens invaginatus, root canal preparation

Dens invaginatus (DI) is a developmental malformation resulting from invagination of the crown or root before calcification has occurred. The condition has been alternatively called dens in dente, invaginated odontome, dens telescopes, dilated gestant odontome, tooth inclusion and dentoid dente[1].

The aetiology of DI is controversial and remains unclear. The condition is attributed to an alteration in the normal growth pattern of the dental papilla during tooth development[2]. The presumed aetiology has been related to focal growth retardation, focal growth stimulation, localised external pressure on certain areas of the tooth bud and relative retardation of ameloblastic activity[1]. Trauma or infection have also been stated as being among possible predisposing factors which play a role in the uncoordinated growth of part of the inner enamel epithelium, invading the dental papilla[1]. Besides these, a genetic determination cannot be excluded[3,4].

The reported incidence of DI ranges from 0.04% to 10% [5]. The condition may occur in any tooth including supernumerary and deciduous teeth. Maxillary permanent lateral incisors are the most commonly affected teeth (42% of the presented cases)[1]. Cases of bilateral and multiple occurrence of DI have also been reported[1,6]. In addition, DI may appear together with other abnormalities comprising taurodontism, microdontia, gemination and dentinogenesis imperfecta[4].

Teeth with dens invaginatus are often recognised clinically because of their unusual crown form or extremely marked foramen caecum[7]. Contrarily, affected teeth may show no clinical signs of the malformation[8]. Thus, a thorough clinical and radiological examination is of utmost importance. Radiographically, DI is characterised by a radiopaque invagination, extending from the cingulum into the root canal. The invagination may vary in size and shape from a loop-like, pear-shaped or slightly radiolucent structure, resembling a "tooth within a tooth"[1]. Depending on the depth of invagination, various classifications have been proposed for DI. Oehler's classification proposes the existence of three types of invaginations:

Type 1: The invagination is confined only in the crown of the tooth.

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Type 2: The invagination extends apically beyond the cementoenamel junction and remains confined within the root as a blind sac which may communicate with the pulp, but does not reach the periodontal membrane or the periapical tissues.

Type 3: The invagination extends beyond the cemento enamel junction revealing a second foramen either into the periodontal membrane or into the periapical tissues. Usually, there is no communication between the root canal and the invagination.

Whenever endodontic treatment of a tooth with dens invaginatus becomes necessary, it is often complicated by the unusual forms and location of invagination leading to complex root canal morphology. The present paper reports and discusses nonsurgical endodontic treatment in three cases of dens invaginatus.

Cases 1 and 2

A 13 year-old female attended the clinic for orthodontic treatment. During routine radiographic examinations, dens invaginatus was detected in teeth 12 and 21. Tooth 12 was found to be profoundly carious (*Figure 1*). Delayed response to electrical and thermal pulp tests suggested questionable vitality of the tooth. Clinically, there was no tenderness to percussion. Radiographs failed to show any sign of periapical involvement. Conversely, tooth 21 was associated with periapical radiolucency (*Figure 2*) and did not respond to electrical and thermal pulp tests.

At first appointment, caries removal was performed in tooth 12 under local anaesthesia and rubber dam isolation. The carious lesion extended deep toward the pulp through the invagination. Tactile and visual examination performed by the end of excavation showed that the pulp had previously been exposed by caries, indicating endodontic therapy. Further exploration with a No.15 endodontic file disclosed a communication between the invagination tract and the main root canal. Preparation of the root canal was performed with the Tri Auto ZX rotary system with the apex locator set at 0.5mm from the apex (Morita, Kyoto, Japan) and Profile 04 nickel titanium files (Dentsply, Tulsa Dental, Tulsa, USA) under 2.5% NaOCl irrigation. Following preparation, the canal was rinsed with 17% EDTA and 2.5% NaOCl solutions. The canal was subsequently dried with sterile paper points. The root canal was obturated with gutta percha points (SPI Dental Mfg Inc, Korea) and a resin-based sealer (AH Plus, Dentsply, De Trey, UK) using a cold lateral compaction technique (*Figure 3*). Composite resin (Filtek Z 250, 3M ESPE, Seefeld, Germany) was placed as a permanent restoration using a fifth-generation adhesive system (Single Bond, 3MESPE, Seefeld, Germany).

Tooth 22, following local anaesthesia, was isolated with rubber dam and a direct access to the root canal was obtained with a tapered fissure bur. Preparation of the root canal was performed with Profile 04 nickel titanium files (Dentsply, Tulsa Dental, Tulsa UK). Irrigation of the root canal system was accomplished as with tooth 12. Unlike tooth 12, tooth 22 showed periradicular involvement. Therefore, calcium hydroxide (Calasept, Nordiska Dental, Angelholm, Sweden) was placed as an interim canal dressing to promote healing in the apical region. After 4 months, a decrease in size of radiolucency was indicative as a sign of tendency toward healing. Obturation of the root canal and final restoration of the tooth was performed as with tooth 12.

Both teeth were free of symptoms on recall visits. Control radiographs showed a remarkable decrease in periapical radiolucency of tooth No.22 at twelve months post-operatively (*Figure 4*).

Case 3

A 21 year-old male attended the clinic with a chief complaint of pain around the maxillary right lateral incisor. His medical history was non-contributory and did not include any previous traumatic injury. The maxillary right lateral incisor was tender to percussion and did not respond to thermal and electrical pulp tests. A periapical radiograph of the tooth revealed a dens invaginatus in the mesial half of the crown, with a possible extension communicating with the pulp (*Figure 5*). A periradicular radiolucency was also observed as with tooth 22.

The tooth was anesthetised and isolated with rubber dam. Access was made through the lingual pit into the enamel invagination showing that the root canal appeared as a main canal and an invagination tract. After determination of working length, canal preparation was performed with the Tri Auto ZX system with the apex locator set at 0.5mm from the apex (Morita, Kyoto, Japan) and Profile 04 nickel titanium files (Dentsply, Tulsa Dental, Tulsa, USA). Irrigation of the root canal system was performed as with cases 1 and 2. The main canal and the invagination tract were filled with calcium hydroxide paste (Calasept, Nordiska Dental, Angelholm, Sweden) to promote healing of the periradicular lesion. Five months post-operatively, a marked decrease in radiolucency, suggestive of advanced healing was evident in the periapical region. Final obturation of the root canal system was performed using a coated carrier system (no. 80, Thermafil, Dentsply, Switzerland) in conjuction with Top Seal root canal sealer (Dentsply, Switzerland) and subsequent cold lateral compaction. Final coronal restoration of the tooth was accomplished using composite resin (Filtek Z 250, 3M ESPE, Seefeld, Germany) and a fifth-generation adhesive system (Single Bond, 3MESPE, Seefeld, Germany). The patient was fully satisfied with the treatment and attended 12 and 18 month recall visits without any symptoms (*Figure 6*).

Figure 1. Radiograph of tooth 12 at first appointment

Figure 2. Radiograph of tooth 21 at first appointment

Figure 3. Radiograph of tooth 12 at 1 year recall

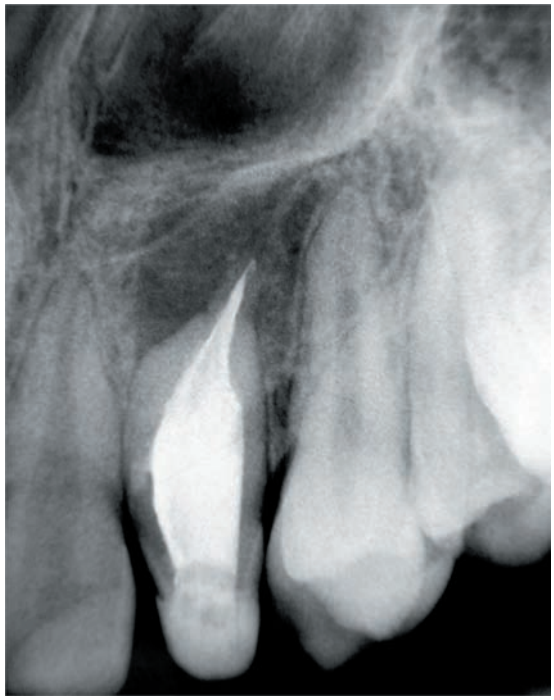

Figure 4. Radiograph of tooth 21 at 1 year recall. Note marked healing around the apical region.

Figure 5. Radiograph of tooth 12 at first appointment

Figure 6. Radiograph of tooth 12 at 18 month recall. Periapical healing has been achieved.

Discussion

Dental treatment is commonly indicated for teeth with invagination. Such teeth are susceptible to caries, since deep pits act as places of stagnation leading to the initiation of caries and structural defects exist in the depth of these pits. In these defects, the enamel is often malformed or absent and may have numerous fine canals which lead to a communication with the pulp. Thus, microorganisms and their products, desquamated epithelial cells, or other foreign material may easily obtain access through such communications. This continuous threat usually gives rise to infection and necrosis of the pulp.

With early diagnosis, fissure sealants and conservative restorative procedures can be performed effectively in cases of dens invaginatus. When pathosis exists, surgical endodontic treatment, non-surgical endodontic treatment, combination of the latter two, intentional replantation and extraction are the suggested treatment methods[9]. However, the first three methods can further be divided into cases where the pathosis involves both the pulp space and the invagination, and cases in which the pathosis is confined to the invaginated part only. When treating the latter, it is possible to preserve the vitality of the entire tooth with the so-called root invagination treatment in which root canal treatment is performed only for the invaginated part[10]. In such cases, the clinician may obtain a positive response to the electrical pulp test due to the lack of communication of the invaginatus and the main canal, while this does not necessarily mean that the entire pulp is vital[8]. This unreliability due to atypical morphology may explain the false positive response of one of the teeth presented in the first patient. In the present report, root invagination treatment was not performed in any case since all the invaginations communicated directly with the pulp space.

According to Rotstein *et al.*[11], the following should be considered in treatment planning: accessibility, complexity of the anomaly, apical morphology, age and physical condition of the patient. In two of the cases presented here, the pulp necrosis resulted in a chronic periapical abscess. After consideration of the age of patients and the complexity of the anomaly, it was decided to treat the teeth solely by means of root canal therapy, leaving apical surgery as a further treatment option. In light of previous reports, endodontic surgery should be employed when endodontic therapy fails or when endodontic treatment or retreatment is not sufficient to handle the severity of the case[1,9].

The requirement for successful endodontic therapy is the complete removal of all irritants from the root canal system, followed by its obturation with a biocompatible material. It is known that teeth with dens invaginatus demonstrate a variety of canal morphologies with dips, concavities, intracanal communications, inaccessible fins, apical ramifications, and other regions that instruments cannot reach. For these reasons, the operator should master a variety of techniques and choose the most appropriate one for the removal of necrotic tissue and bacteria[9]. In the present paper, the use of various instruments is reported, each bearing its own advantages and disadvantages. Conventionally, invaginated teeth have been endodontically prepared using hand instruments. In the present report, a rotary system was chosen for biomechanical preparation in tooth 22 due

to the complexity of the root canal system as confirmed radiographically. The other reported lateral incisors could have been prepared using conventional hand instruments. In these teeth, rotary instruments were utilised since the technique allows rapid and controlled preparation of the root canal system. Chemo-mechanical preparation using rotary instruments is encouraged in the literature. Yet, it is also stated that the clinician must be careful when using rotary instruments and coated carrier obturation techniques due to the various canal shapes of invaginated teeth. The technique and the instruments should be selected specifically for each case[11].

Because of its well-established, reliable and enduring antimicrobial action, calcium hydroxide was used as an interim canal medicament in two of the cases presented herein. Besides, calcium hydroxide can serve as an indicator of anatomic irregularities by virtue of its radiopacity, providing a more accurate visualisation of the root canal morphology before final obturation[12].

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