Dens invaginatus - A review & case report

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ABSTRACT
Root canal treatment of teeth with complex root canal anatomy such as Dens Invaginatus can be problematic because infected pulpal tissues may remain in inaccessible areas of the canal system. The cleaning and debridement of such root canal systems are therefore challenging. An immature apical root end development is another challenge in Root Canal Treatment (RCT) especially in controlling the apical extent of the filling material and achieving an apical seal. This case report presents the endodontic treatment, apicocurettage and retrofilling using MTA in a case of an open apex and class II Dens invaginatus.

INTRODUCTION
Dens invaginatus is a developmental anomaly resulting from the invaginations of the enamel organ into the dental papilla during the soft tissue stage of development. As the hard tissues are formed, the invaginated enamel organ produces a small tooth within the future pulp chamber. The affected teeth radiographically shows an in folding of enamel and dentine which may extend deep into the pulp cavity and into the root and sometimes even reach the root apex. Tooth crowns as well as roots may exhibit variation in size and form. This kind of tooth malformation was first described by Ploquet in 1794 (Schaefer 1955), who discovered this anomaly in a whale's tooth (Westphal 1965). Dens invaginatus in a human tooth was first described by a dentist named Socrates in 1856 (Schulze 1970).

Synonyms for this malformation are: Dens in dente, invaginated odontome, dilated composite odontome, deep foramen caecum, tooth inclusion, dentoid in dente. (Since invagination is the common denominator of these lesions).

Aetiology of dens invaginatus
The aetiology of dens invaginatus malformation is controversial and remains unclear. Over the last decades several theories have been proposed to explain the aetiology of dental coronal invaginations:

1. Kronfeld (1934) suggested that the invagination results from a focal failure of growth of the internal enamel epithelium while the surrounding normal epithelium continues to proliferate and engulfs the static area.

2. Infection was considered to be responsible for the malformation by Fischer (1936) and Sprawson (1937).
3. Rushton (1937) proposed that the invagination is a result of rapid and aggressive proliferation of a part of the Internal enamel epithelium invading the dental papilla. He regarded this a benign neoplasma of limited growth.

Oehlers (1957) considered that distortion of the enamel organ during tooth development and subsequent protrusion of a part of the enamel organ will lead to the formation of an enamel-lined channel ending at the cingulum or occasionally at the incisal tip. The latter might be associated with irregular crown form.

4. Growth Pressure of the dental arch results in buckling of the enamel organ (Euler 1939, Atkinson 1943).

5. The “twin-theorie” (Bruszt 1950) suggested a fusion of two tooth-germs.

Gustafson & Sundberg (1950) discussed trauma as a causative factor, but could not sufficiently explain why just maxillary lateral incisors were affected and not central incisors.

Most authors, meanwhile consider dens invaginatus as a deep folding of the foramen coecum during tooth development which in some cases even may result in a second apical foramen (Schulze 1970). On the other hand the invagination also may start from the incisal edge of the tooth. Generic factors cannot be excluded. (Grahnen 1962, Casamassimo et al. 1975. Ireland et al 1987. Hosey & Bedi 1996).2,7.

Classification of Dens Invaginatus

The first classification of invaginated teeth was published by Hallet (1953). The most commonly used classification proposed by Oehlers (1957) is shown below.

He described the anomaly occurring in three forms:

**Type I**: An enamel-lined minor form occurring within the confines of the crown not extending beyond the amelocemental junction (Fig.1)

**Type II**: An enamel-lined form which invades the root but remains confined as a blind sac. It may or may not communicate with the dental pulp (Fig.2, Fig.3)

**Type III**: A form which penetrates through the root perforating at the apical area showing a second foramen in the apical or in the periodontal area. There is no immediate communication with the pulp. The invagination may be completely lined by enamel, but frequently cementum will be found lining the invagination2 (Fig.4)

Bhaskar describes two variations of Dens Invaginatus— a Coronal type and a Radicular type.

The coronal type is caused by an invagination of all layers of the enamel organ into the dental papilla. The pulp is usually exposed and becomes necrotic or inflamed. Not infrequently, periapical lesions are associated with this type, necessitating endodontic therapy.

In the Radicular type of dens invaginatus there is a folding of Hertwig’s sheath into the developing root, much like the coronal type, and pulpal necrosis and apical lesions are often associated3,9.

**Prevalence of Dens Invaginatus**

Dens invaginatus is a relatively common condition ranging in reported incidence from 0.25 percent to 5.10 percent, with an average incidence of approximately 2 percent. Studies on the prevalence of dens in dente have previously been
reported by Shafer, Polyton and Morgan Pindborg, Ulmansky and Hermel, Amos and Grahnen, Lindahl, and Omnell. The permanent maxillary lateral incisors are the most frequently involved teeth, with the maxillary central incisors following as the second most common area of involvement. Bilateral occurrence of the condition is frequently seen. Multiple dens invaginatus involving all four maxillary incisors has been reported by Conklin.

Ulmansky and Hermel described a case of double dens in dente of the maxillary central incisors, and Archer and Silverman reported a case of double dens in dente in bilateral supernumerary incisors. The double form of dens invaginatus of the maxillary incisor region has been reported by one author. Dens invaginatus of the mandibular teeth has been less commonly noted, but two recent reports have shown involvement of four mandibular premolars and bilateral involvement of the mandibular incisor region associated with apparent congenital absence of two mandibular incisors. There has been reported one case of a radicular cyst with dens invaginatus as an etiologic factor in the mandibular premolar area.

Histological Findings

The dentine below the invagination may be intact without irregularities (Brabant & Kleas 1956) but also may contain strains of vital connective tissue (Omnell et al 1960) or even fine canals with communication to the dental pulp (Kenfeld 1934, Fischer 1936, Rushton 1958). Some authors reported hypomineralized or irregularly shortened dentine (Vincent - Townend 1974, Baynon 1952).

The structure and thickness of the enamel lining the invagination may vary widely. The enamel was described as irregularly structured by Atkinson 1943, Piatelli & Trusi 1993. Baynon 1982 reported hypomineralized enamel at the base of the invagination where as Morfis (1992) in a chemical analysis, detected upto eight times more phosphate and calcium compared with the outer enamel, but in his analysis magnesium was missing completely. Bloca - Zupan et al 1995 found differences in structure and composition between the external and internal enamel.

The internal enamel exhibited a typical and more complex rod shapes and its surface presented the typical honey comb pattern but no perikymata which however was observed on the outer surface of tooth 2.6.

Diagnosis of Dens Invaginatus

In most cases a dens invaginatus is detected by chance on the radiograph.

Clinically, an unusual crown morphology (dilated, peg-shaped, barrel-shaped) or a deep foramen coecum may be important hints, but affected teeth also may show no clinical signs of the malformation.

As maxillary lateral incisors are the teeth most susceptible to coronal invaginations these teeth should be investigated thoroughly clinically and radiographically, at least in all cases with a deep pit at the foramen coecum.

If one tooth is affected in a patient the contra lateral tooth should also be investigated.

As pulpal involvement of teeth with coronal invaginations may occur a short time after tooth eruption, early diagnosis is mandatory to instigate preventive treatment2.
Clinical Features
The invagination allows entry of irritants into an area which is separated from pulpal tissue by only a thin layer of enamel and dentine and presents a predisposition for the development of dental caries. In some cases the enamel-lining is incomplete. Channels may also exist between the invagination and the pulp (Kronfeld 1934, Hitchin and McHugh 1954). Therefore, pulp necrosis often occurs rather early, within a few years of eruption, sometimes even before root end closure (Swanson and McCarthy 1947, Ulmansky and Hermel 1964, Stepanik 1968, Nik-Hussein 1994, Hulsmann and Radianski 1994).


The dental literature on dens invaginatus malformations contains several case reports presenting invaginated teeth coincident with other dental anomalies, malformations and even dental or medical syndromes.² ⁵

CASE REPORT
A 25 year old male patient reported to Post Graduate Endodontic clinic at Modern Dental College with the chief complaint of pain & localized swelling in the gingival above the maxillary left central incisor.

Swelling had been present intermittently for several years.

Clinical examination of the maxillary left central Incisor gave the appearance of being Dens Invaginatus (Fig 5). Tooth was not tender to percussion.

Radiographic Examination
Intra Oral Periapical Radiograph and occlusal radiographs were made. A periapical radiolucency with definite borders was seen associated with the involved tooth (Fig. 6).

The associated tooth (21) also had an open apex. The periapical radiolucency was seen extending to 12, Vitality test was performed on 22, which gave no response.

DIAGNOSIS
Diagnosis was made as Dens Invaginatus with necrotic pulp and a radicular cyst.

Hence endodontic treatment was recommended with 21,22 followed by apicocurettage and retrofilling with 21.

Treatment considerations
Preventive treatment
Teeth with deep palatal or incisal invaginations or foramina coeca should be treated with fissure sealing before carious destruction can occur. A composite restoration and strict periodic review is recommended (Rotstein et al 1987b, Hulsmann & Radianski 1994). If no entrance to the invagination can be detected and no signs of pathosis are visible clinically and radiographically
no treatment is indicated, but strict observation is recommended (Hulsmann 1995b, Duckmanton 1995, Hulsmann 1996)\(^2\).

The tooth was isolated with a rubber dam and two lingual access openings were made to expose the invagination (Fig. 7).

The length of both canals were established and recorded with apex locator. This case was then classified as Type II Dens Invaginatus (Fig. 8, Fig. 9). A Pre operative CT scan was made to detect the presence of extra canals (Fig. 10).

Chemo mechanical cleaning was performed on the inner cavity of the invagination and the constrictive main canal. Intracanal calcium hydroxide dressing was given for a period of one week. Cystic lining was removed (Fig. 11). Apicocurretage of the lesion was done (Fig. 12) followed by retrofilling with MTA (Fig. 13). Main canal was obturated using thermoplasticized gutta percha. The invaginated canal was obturated with GP points using lateral condensation technique.
Figure No 5
Clinical appearance of left maxillary central incisor

Figure No 6
Pre operative Occlusal radiograph

Figure No 7
Two lingual access openings

Figure No 8
Working length determination

Figure No 9
Classification as dens invaginatus : type II

Figure No 10
Pre operative C T scan

Figure No 11
Removal of stick lining

Figure No 12
Apico curettage of the lesion
DISCUSSION

Numerous articles have been published regarding treatment of dens invaginatus which lie low in the hierarchy of evidence. Generally this condition is thought to be a rare one, but incidence reports have shown occurrences to be as high as 10%. To adequately treat this condition endodontically, knowledge of the different types and approaches to treatment are essential.

These kind of cases have often been treated with non surgical Root Canal Treatment, Root Canal Treatment and surgery and even extraction\(^4,6\).

The present case demonstrates that root canal treatment of Dens Invaginatus can be successful in complicated cases characterized by an invagination, the presence of an open apex, loss of vitality with the presence of periapical inflammation and cyst formation. Root canal treatment of invaginated teeth is frequently associated with problems arising from complex
variations of root canal morphology or from difficult access to regular and invaginated canals. Two canal orifices, one regular and one invagination opening, were found without additional help. The current case of dens invaginatus was classified as Ohelers type II because the radiographic examination showed that the invagination invaded the root but remained confined as a blind sac with no communication with the main canal.

The invagination allows entry of irritants into an area which is separated from pulpal tissues by only a thin layer of enamel and dentin and presents a predisposition for the development of infection. Thus without any history of caries, or trauma, irritants and microorganisms from the oral cavity caused inflammation.

In some cases isolated endodontic treatment of the invagination canal had been sufficient and maintained the pulpal vitality, this was not possible in the case presented here as there was a presence of periapical cyst at the time of initial presentation.

**CONCLUSION**

Historically endodontic treatment of teeth with severe Dens Invaginatus was deemed impractical. Treatment options were then limited to extraction. The dramatic improvements in endodontic armamentarium have made possible the conservative treatment of such anomalies.

This case report has shown that class II dens invaginatus with an open apex and a periapical cyst can be treated successfully.

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