

# Dens Invaginatus: Literature Review and Case Report

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## ABSTRACT

**Dens invaginatus (DI) represents a structural defect in the tooth, resulting from invagination of enamel organ into the dental papilla. This rare anomaly, which often goes unnoticed during a clinical examination, is a risk factor for the development of carious lesions and consequently pulpopathies. The knowledge of this type of lesions allows to ensure early diagnosis and thus avoid any complications.**

**This article represents a case report of dens invaginatus along with a literature review regarding etiology, classification, clinical appearance, and diagnosis. It provides also guidelines for decision-making and treatment of invaginated teeth.**

**Keywords:** Dens invaginatus, dens in dente dental malformation, invaginated teeth.

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## I. INTRODUCTION

Dens invaginatus (DI) is a developmental dental anomaly corresponding to the invagination of the enamel organ into the dental papilla before mineralization occurs. The invagination starts in the crown and may extend into the root. The first report on dens invaginatus in a human tooth was first described by Socrates in 1856 [1], [2]. Different expressions have been used to refer to this condition including dens in dente, dentoid in dente, invaginated odontoma, dilated composite odontoma and tooth inclusion [3].

The prevalence of dens invaginatus lesions ranges from 0.3 to 10% of the population. They are most commonly situated in permanent maxillary lateral incisors, followed by maxillary central incisors, then canine and premolar. These lesions have rarely been detected in temporary deciduous teeth [4].

## II. AETIOLOGY

The Aetiology of Dens invaginatus is still unclear. Diverse theories have been proposed to explain this anomaly.

- Some authors have explained the DI by a growth defect of cells of the internal epithelium into the dental papilla during development either by retardation [5] or by acceleration [6].
- The 'twin-theory' suggested a fusion of two tooth-germs [7].
- Atkinson [8] suggested that the problem is caused by external forces exerting a pressure on the tooth germ during odontogenesis causing infolding of the enamel.
- External factors such as infection [9], [10], trauma [11] been suggested as a cause.

- Other authors have studied the genetic factors that could be responsible for dens invaginatus [12]–[14]. They rely on the fact that there are molecules that regulate the morphogenesis and development of the dental organ. If they are altered or absent, the dental morphology can be affected [15], [16].

## III. CLASSIFICATION

Different classifications of invaginated teeth have been proposed by different authors. However, the most widely used classification is that of Oehlers produced in 1957. It proposes a repartition of these lesions into 3 categories according to the degree of extension of the crown inside the root, visible on radiography (Fig. 1).

Type I: It is a partial invagination confined to the tooth crown. It involves the enamel and dentin without extending beyond the amelo-cementary junction or involving the pulp.

Type II: It is an invagination that extends into the root beyond the amelo-cementary junction with or without communication with the pulp. There is no communication with the periodontal ligament.

Type III a: The enamel-lined invagination extends into the root and communicates laterally with the periodontal ligament through an apical foramen. There is usually no communication with the pulp itself, but it causes a significant anatomical malformation.

Type III b: This complete invagination extends into the root and communicates with the periodontal ligament at the apical foramen. There is usually no communication with the pulp [17], [18].

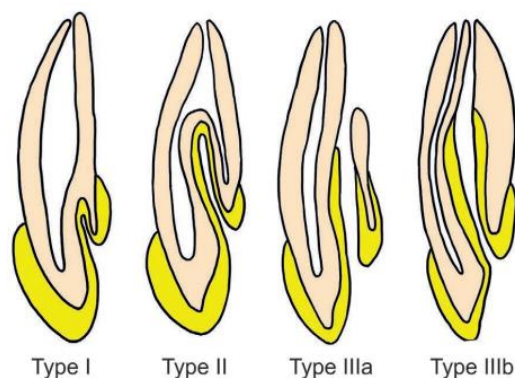


Fig. 1. Classification of invaginated teeth by Oehlers (1957) [17].

#### IV. HISTOLOGY

The morphological diversity of invaginated teeth is reflected both clinically and radiologically. This diversity is also confirmed on the histological level.

The invagination is bordered by an enamel of a thickness and structure that may be irregular. This enamel may be hypoplastic and have other abnormalities. In general, the enamel layer is thinnest and least mineralised at the bottom of the invagination. It may also be missing entirely in this area (Fig. 2).

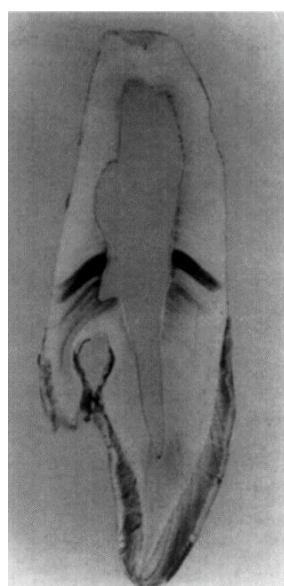


Fig. 2. Axial section showing a type 1 invagination in a barrel shaped maxillary lateral incisor. The enamel is deficient in the bottom of the invagination [17].

The invagination's dentin is mineralised with regular dentinal tubules. Occasionally, there are connective trabeculae which link the invagination and the pulp allowing the penetration of microorganisms which can cause pulp infection with subsequent necrosis. Inside the invagination, we can find some fragments of enamel, tissue calcifications in lamellae and debris.

#### V. CLINICAL AND RADIOGRAPHIC ASPECTS

##### A. Clinical Aspects

Dens invaginatus are asymptomatic lesions that are discovered incidentally during a clinical or radiological

examination. Clinically, these lesions can be represented by a 'dilated', 'peg-shaped' or 'barrel-shaped' crown. The presence of a deep foramen caecum may be also an indicator of affected teeth. In some cases, the labiolingual diameter of the crown can be greater than normal. The early diagnosis of these lesions is essential in order to avoid the development of carious lesions and the evolution towards pulpopathies. Since the lateral incisors are the teeth most affected by this malformation, they must be investigated clinically and radiologically. If one tooth is affected, the contralateral tooth must be strictly examined. Some teeth may show no clinical signs of the malformation, radiographic examination will aid and guide succinct diagnosis [19], [20].

##### B. Radiographic Aspects

Radiographically, invagination lesions usually appear as radiopaque areas, equal to enamel density, extending from the cingulum into the root canal to varying degrees. Orthopantomography and periapical radiographs are sufficient for diagnosis. Dens invaginatus may even be diagnosed radiographically before the tooth erupts. Nevertheless, there are some complex forms that require cone beam computed tomography (CBCT), to get a 3D view of their complex anatomical variations [21], [22].

On a retroalveolar radiograph and according to the type of invagination, we will find:

**Type I:** A linear radiolucent image of the fissure confined to the crown. (18)

**Type II:** The invagination may invade the root as a slightly radiolucent body, or it might be as severe as it shows the appearance of a tooth within a tooth [23].

**Type III:** The invagination penetrates through the root and bursts laterally or apically at a foramen. There is usually no communication with the pulp which lies compressed within the wall around the invagination process [24].

#### VI. TREATMENT CHOICES

The treatment of invaginated teeth is a real challenge for the practitioner, especially in complicated forms that present a complex root anatomy. It is essential as this invagination constitutes a passageway for irritants either directly into the pulp tissue or indirectly through an area which is separated from the pulp tissue by a thin layer of dentin. The choice of treatment should be based on the degree of severity of the invagination and the presence of associated clinical and radiological signs.

Type I invaginations are mild forms that usually only require prophylactic treatment as long as the invagination is early diagnosed. In the presence of a superficial invagination, a fluid resin sealant is used. If it is deep, indirect capping can be realised. Tooth monitoring should be maintained to detect any possible pulpal disease or restoration defects. If pulp necrosis is evident, endodontic treatment should be initiated. It is recommended that the invagination be incorporated into the access cavity [1].

Type II invaginations are deeper defects generally characterized by caries developed in these lesions. Indirect capping is performed. The use of materials (mineral trioxide aggregate or calcium hydroxide) promoting hard tissue formation may be indicated. If the carious lesions have

caused pulp necrosis, root canal treatment should be initiated [25], [26].

The treatment of type III invaginations is much more complex. The main challenge is to determine the pulp vitality of the tooth. If vital, the invagination is treated as a false canal separately from the main canal. If necrosis is evident, both canals are treated [27], [28].

## VII. CASE REPORT

A 10-year-old child consulted our department for dental care before orthodontic treatment. Endobuccal examination revealed localized invaginations of his four maxillary incisors. A radiographic examination was performed to determine the extent of the invagination within the tooth and to confirm the type of invagination.

- 12, 21, 22: The invaginations are type 1. They do not show any carious lesion. The retroalveolar radiography does not represent any sign of pulp necrosis.
- 11: Type 1 invagination. It presents a deep carious cavitation without communication with the pulp. The tooth was not sensitive to percussion and responded positively to thermal stimuli. The retroalveolar radiography shows no sign of pulp necrosis (Fig. 3).

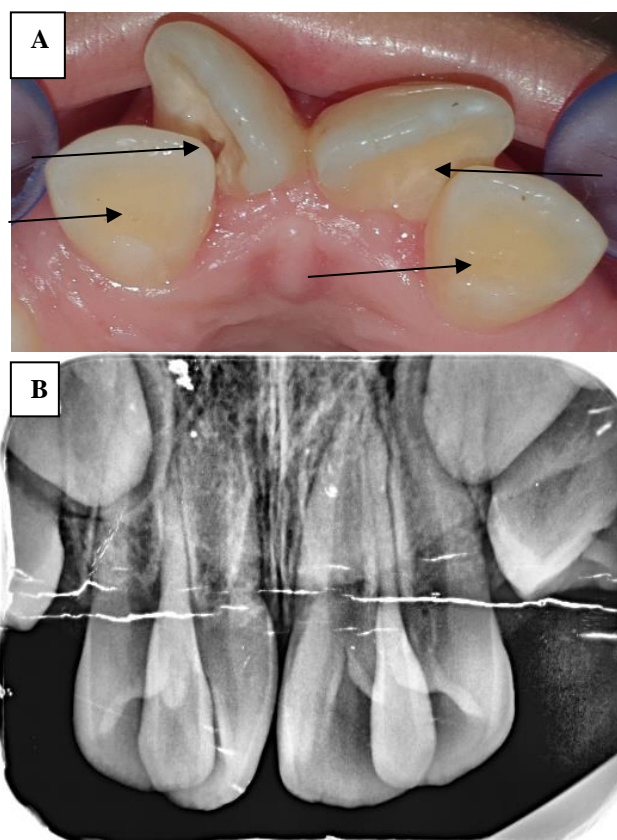


Fig. 3. A: Maxillary incisors with Type I dens invaginatus lesions B: Pre-retroalveolar radiograph of the dens invaginatus lesions.

Invaginations in the 12, 21, 22 were sealed with a fluid resin. Severe crowding in the upper incisal area made it difficult to treat the 11. We waited for the alignment of the 4 incisors before proceeding with removal of tooth decay located in the invagination of the 11. orthodontic treatment

has been initiated. In the meantime, we have carried out a good motivation and hygiene check. A restoration with composite was then performed (Fig. 4).



Fig. 4. Post-treatment: 12-21-22 were sealed with a fluid resin, 11: removal of tooth decay and restauration with composite.

## VIII. DISCUSSION

Many articles are published regarding treatment of dens invaginatus. Different treatment options are available depending on the type of invagination, vitality and restorability of the tooth. Extraction may also be the treatment of choice when the invaginated tooth causes an aesthetic or functional disturbance. Third molars and mesiodens are examples of such situations. Another situation is when the location of the tooth renders the possibility of endodontic treatment, complemented by endodontic surgery, impracticable [29].

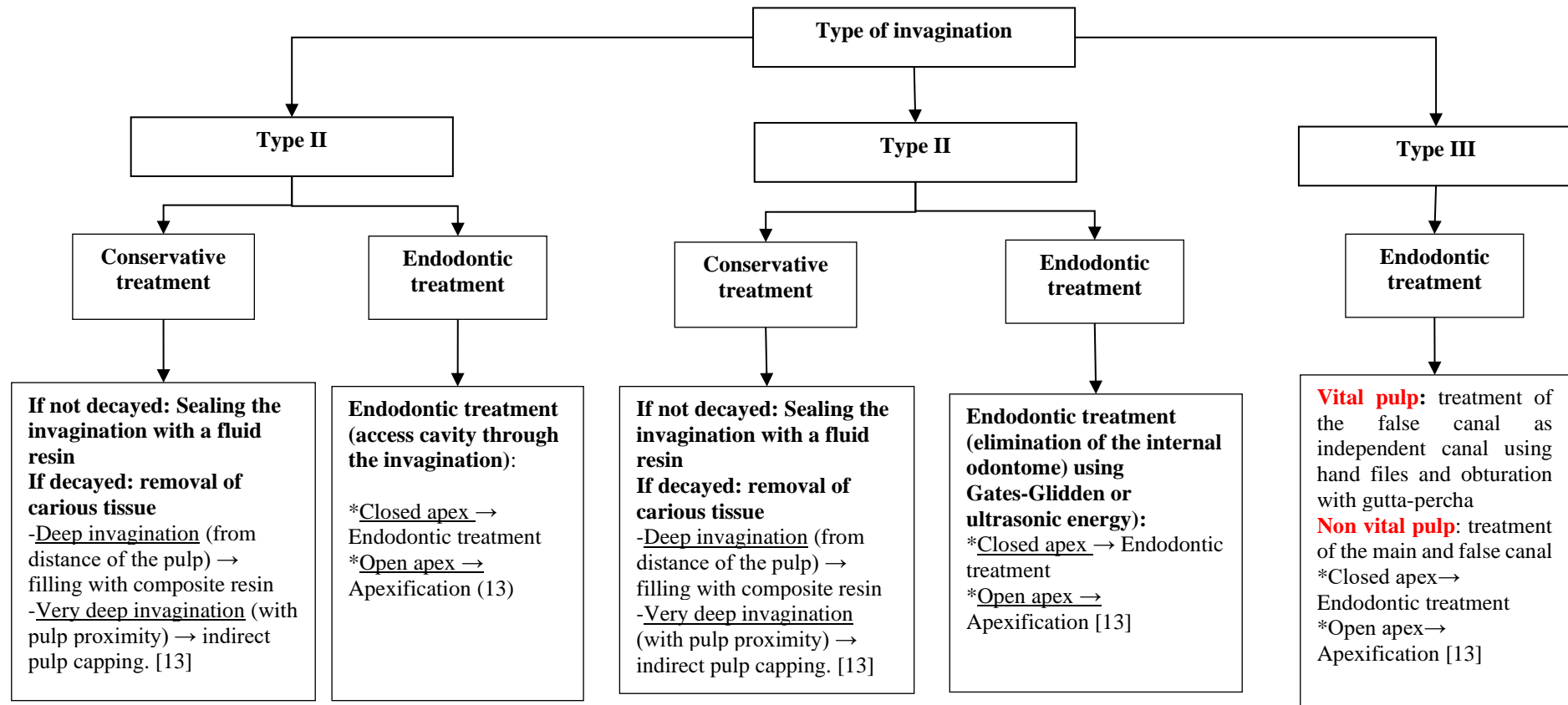
In our clinical case, radiographic examination revealed type I invaginations in the four maxillary incisors. The right central incisor presents a deep carious without periradicular implication. Pulp vitality testing showed that all four teeth are alive.

The treatment of choice is rather oriented towards preventive measures, and that in order to inhibit the passage of microorganisms through the invagination that can cause pulp infection with subsequent necrosis. It is important that the patient is aware of the need for good oral hygiene and attend regular clinical and radiological check-ups to avoid any complication.

The following diagram shows the different therapies depending on the vitality of the tooth and the type of invagination:

## IX. CONCLUSION

The variation in clinical and radiological forms of invaginated teeth makes the treatment options for these lesions very diverse. However, the preservation of the pulp vitality of the tooth is essential. This can only be ensured by an early diagnosis of these lesions in order to avoid pulpal and periapical involvement. Thus, if the treatment proves impracticable, extraction remains inevitable.





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