


REVIEW

Clinical Guideline for Diagnosis and Treatment of Dens Invaginatus

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ABSTRACT

The invaginated tooth, also called dens invaginatus or dens in dente, is a rare anomaly affecting human dentition, resulting from invagination of enamel organ into the dental papilla.

Maxillary lateral incisors are the most commonly affected teeth. The accentuated pit within the DI accumulates debris causing prompt initiation and progression of dental caries with subsequent involvement of the pulp, resulting in periapical pathology. Invagination depth varies from a slight enlargement of the cingulum to an extended invagination into the apex. This anatomic variation means a true clinical challenge because of its complex anatomy. Early diagnosis is then essential to avoid any periodontal complications.

This study aims to review: etiopathogenics, classification, elements of the diagnosis and provides guidelines for the management of dens invaginatus cases in clinic that provide hope for teeth that could not be saved before.

KEYWORDS: Dens Invaginatus, Etiopathogenics, Classification, Diagnosis, Therapeutic.

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INTRODUCTION

Dens invaginatus (DI) is a developmental anomaly resulting from the invaginations of the enamel organ into the dental papilla before calcification of the dental tissues [1-10]. This creates a pocket of organic material underneath the enamel surface [6]. The invagination may be confined to the crown, and sometimes extended into the root. Therefore, root canal treatment may present a severe problem because of the complex anatomy of teeth. [8]

The invagination creates a portal of entry for bacteria in the oral cavity, being the most cause of early dental caries and periodontal diseases... [1, 6, 8]

Ploquet was the first to describe this anomaly in 1794, which he discovered in whale's tooth. Later a dentist called 'Socrates' described it in 1856 in human teeth: he spoke at that time of a «tooth within a tooth». Muhldreiter (1873), Baume (1874) and Busch (1897) call this malformation dens in dente because of the radiographic appearance of 'a tooth in a tooth' [5, 9, 10].

This anomaly has been described in the literature under several names including dentoid in dente, invaginated odontome, dilated gestant odontome, dilated composite

odontome, tooth inclusion, teeth telescopes ... This can only reflect the lack of consensus about the etiology of the invaginated tooth [5,9,10]. However, it is the term dental invagination or dens invaginatus, introduced by Hallet in 1953, which is most commonly used nowadays. [2]

ETIOLOGY

The exact etiology of dens invaginatus remains unknown; several theories have been proposed [2-6]:

External factors: Atkinson (1943) suggested that dental invagination is the result of external forces exerting an effect on the dental germ during development, trauma, infections... [2, 3, 5-7]

Developmental anomalies:

Twin theory: suggested the fusion of two tooth germs. [2]

Delay theory: it reports a failure of the internal adamantin epithelium growth, while the cells of the external adamantin epithelium continue to proliferate. [2, 5]

Active proliferation theory: it proposes that invagination is due to a rapid and aggressive proliferation of a part of the

internal enamel epithelium invading the dental papilla. [2, 5, 6]

Vascular theory: insufficient vascularization of the dental papilla may result in a reduction of ameloblast activity and lead to the formation of gaps in the internal adamantin epithelium. [2]

Genetic factor : The genetic origin of the invagination seems entirely reasonable, because of its high prevalence in individuals of the same family, and also by the possibility of association with other malformations. [2, 3, 5- 7]

PREVALENCE

The prevalence of invaginated teeth on permanent dentition ranges from 0.4% to 10%. This large disparity in results can be explained by the heterogeneity of the inclusion and exclusion criteria, the populations studied and the methods of diagnosis. Of the affected teeth, 90% are maxillary lateral incisors [2, 11, 12]. This anomaly may also be observed on canines, premolars, molars and also mandibular teeth but rarely. [2] In exceptional cases, temporary teeth may also have this anomaly, but only four cases have been reported in the literature. Dental invagination is often bilateral. [2]

CLASSIFICATION

Several classifications have been proposed. Oehlers' classification in 1957 is the most widely used. It suggests the existence of 4 types of DI:

- Type I is the most common. The invagination is confined in the crown (79% of cases according to Ridell et al), without extending beyond the cemento-enamel junction.
- Type II, the invagination extends into the root, but remains confined like a cul-de-sac, with or without communication with the dental pulp (15% of cases according to Ridell et al)

- Type III, the invagination extends into the root and exit laterally (type A) or apically (type B), without immediate communication with the pulp (5% of cases according to Ridell et al) [2, 11, 12, 13]. Any communication between the oral cavity and the apical area via the foramen of invagination can lead to an inflammatory response within the periodontal tissues. The disease is called "peri-invagination periodontitis". [14]

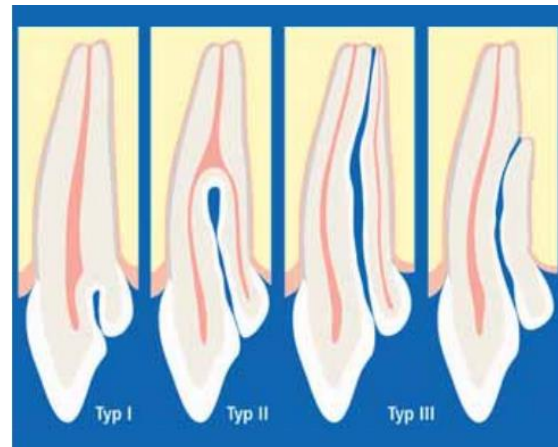


Figure 1: Oehler's classification of dens invaginatus (1957) [2]

DIAGNOSIS

Clinical examination

DI may not show any clinical signs of malformations. Although, some clinical morphological changes serve as useful hints in the detection of the lesion [8] such as: bifid cingulum, deep lingual pit (Fig. 2a) and palatal groove (Fig. 2b). In some cases, the deformation may be exaggerated and the tooth may take the form of a barrel-shaped (Fig. 2c), a cone (Fig. 2d) or a dilated crown (Fig. 2e). [2, 4, 15]

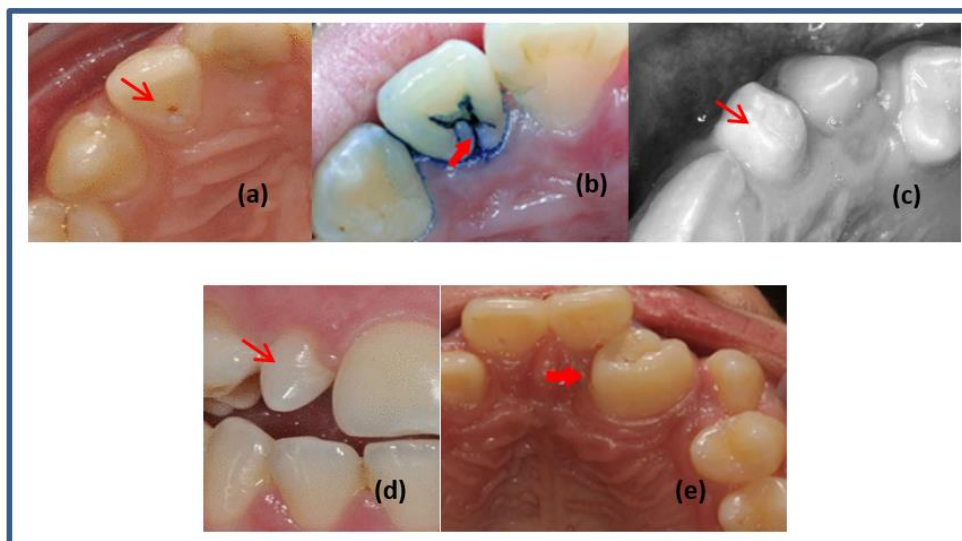


Figure 2: (a) Maxillary lateral incisor with a deep lingual pit [12] ; (b) Maxillary lateral incisor with a palatal groove [4] ; (c) Barrel-shaped clinical crown [15] ; (d) Maxillary lateral incisor with a conical, peg-shaped [12] ; (e) Maxillary lateral incisor with a dilated crown [4]

Early diagnosis of this abnormality is crucial [2,6,7]. The invagination area is a site of microbial entry that can be the starting point for carious lesions [11]. Indeed, the invagination is covered by a thin layer on enamel and may

be connected to the pulpal tissue via channels [8]. This might cause some pulpal pathologies which occur often at an early age and in some cases even before root end closure [2, 5].

Radiographic features

The retroalveolar radiography provides an idea about the form of the crown and /or the root, the periapical lesion, the size of the pulp, and the apex. However, it only provides 2D representation of 3D structure [2, 7]. The reported radiographic presentations of DI are summarized as follows.

- Dens invaginatus type I (Fig. 3a): A linear radiolucent image of the fissure confined to the crown. [4]
- Dens invaginatus type II (Fig. 3b): the invagination may appear as a loop-like, pear-shaped, a slightly radiolucent body or it might be as severe as it shows the appearance of a tooth within a tooth. [8]
- Dens invaginatus type III (Fig. 3c): the invagination may appear as a radiolucent area (the invaginated canal) surrounded by a radiopaque border. The relative position of the invagination and the main canal might be different; it can be located laterally or centrally within the main canal. [4]

The use of cone beam computed tomography (CBCT) has been described in assessing dens invaginatus lesions prior to treatment. CBCT can provide a more detailed 3D view of the complex anatomical variations seen in dens invaginatus malformations. [6]

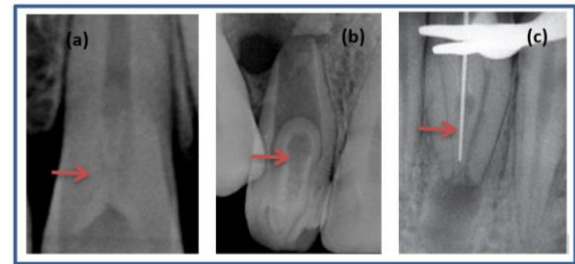


Figure 3: (a) Dens invaginatus type I [12]; (b) Dens invaginatus type II [12]; (c) Dens invaginatus type III [2].

MANAGEMENT STRATEGIES

Until the 1970’s, extraction was the preferred method for treating DI cases [8]. Currently, extraction is indicated only in the following situations: presence of mesiodens, non-restorable tooth, very wide open apex, inaccessibility of conservative or surgical endodontic treatment [2]. Extraction is also indicated for primary teeth if the periapical lesion from the teeth influences the permanent tooth germ [8].

The diagram above (Fig. 4) shows the different therapeutic possibilities depending on the restorability of the tooth and also in relation to the type of invagination.

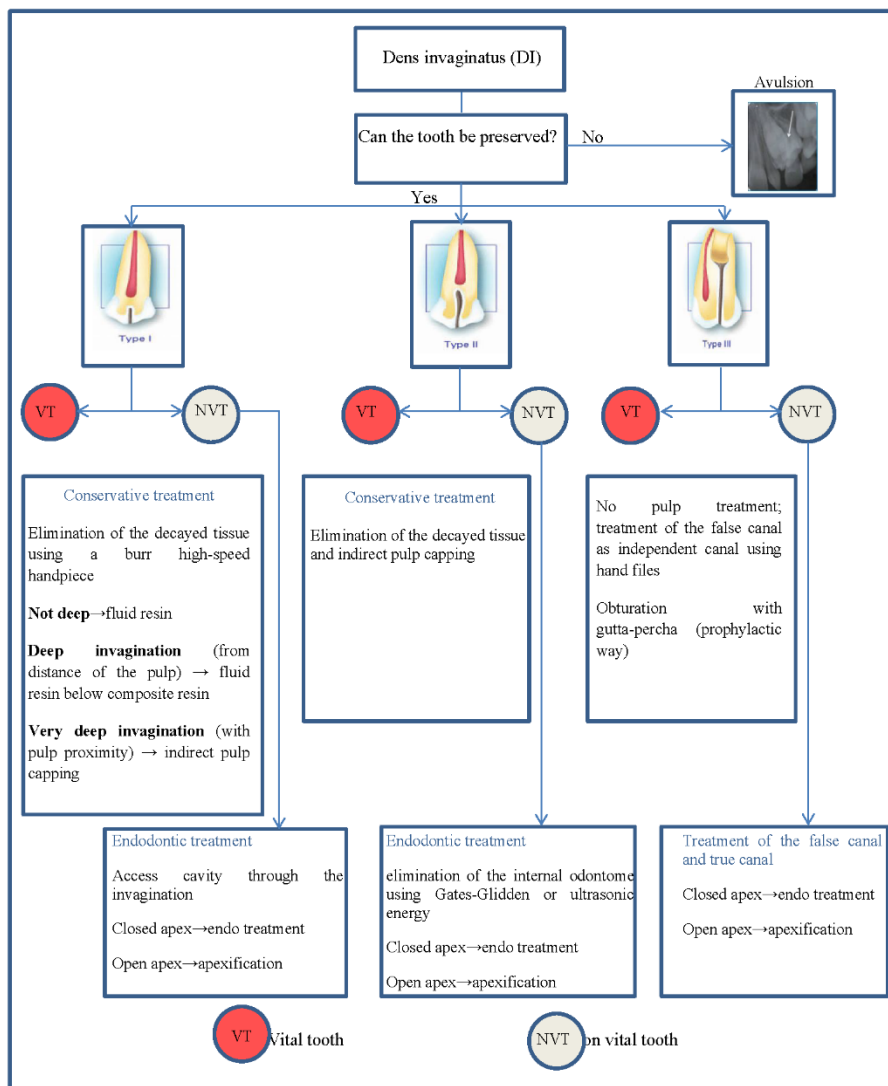


Figure 4: Different therapeutic approaches according to the invagination [2,3]

For dens invaginatus type I (limited in the crown) that does not present any particular difficulties, the treatment of choice is rather oriented towards preventive measures; sealing the invagination with composite or fissure sealing resin when the pulp is not infected. Nevertheless, endodontic treatment is mandatory in cases where the tooth presents a negative response to the pulp vitality test. [2-6]

For dens invaginatus type II, the invagination is deeper than in type I. Treatment of the invagination alone and its filling are recommended if the tooth is vital. In case of pulpal pathology and/or peri-radicular lesions, endodontic treatment is necessary. [2-6]

For dens invaginatus type III, the main challenge is to highlight the pulpal vitality which will guide our therapeutic approach towards two choices: treating the root canal as a separate entity without affecting the vitality of the tooth (prophylactic treatment). [2-6] In the other hand, the invagination and the root canal should be combined in the treatment, If the pulp was necrotic. Ultrasonic instruments or long-shanked round burs are preferably used working from the root canal side to the invagination. It is preferred to keep the invagination and the root canal separate. After preparation, obturation with gutta-percha points is acceptable. [8]

CONCLUSION

The existence of multiple possibilities of clinical and radiographic presentation of the invaginated tooth makes

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the therapeutic management of this anomaly very viable. However, the overriding objective must preserve pulp vitality as much as possible. This can be achieved by early diagnosis and prophylactic treatment [3].

If endodontic treatment is feasible, and given the complexity of the root canal system of an invaginated tooth, the practitioner should use modern cone beam sectional imaging, which has low irradiance and compensates for the shortcomings of a conventional two-dimensional imaging protocol that is too imprecise [11].

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Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

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