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Concomitant occurrence of bilateral dens evaginatus and dens invaginatus in maxillary lateral incisors: A case report and literature review

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Abstract
The dens evaginatus (DE), an extra enamel structure, is most frequently found on the lingual surface of anterior teeth and occlusal surface of premolars, while dens invaginatus (DI) is a developmental defect characterized by an invagination or "tooth inside a tooth." Although these conditions are uncommon when they occur alone, they are rarely observed together. This report presents a rare case of bilateral DI associated with DE in a maxillary lateral incisor. An 11-year-old male patient with both an articulated talon cusp and a deep invagination in the maxillary lateral incisors, which was challenging to diagnose and then plan the treatment. Complex morphology was solved by clinical examination, radiographic analysis, and CBCT. This case underlines the significance of early detection and meticulous management of these developmental anomalies, as they may render the tooth more susceptible to caries, pulp exposure, and subsequent endodontic sequelae. The report highlights the importance of a holistic strategy, both preventive and restorative, in dealing with rare dental diseases.

Keywords: Dens evaginatus, dens invaginatus, talon cusp, permanent dentition, developmental dental anomalies, cone-beam computed tomography

Introduction

Dental anomalies due to developmental problems are an imperative type of dental morphogenic variations.[1] Researchers have linked disturbances during the morpho-differentiation stage of tooth development to anomalies in a tooth's size and shape.[2] Two developmental variants of a tooth's form are dens evaginatus and dens invaginatus. The most frequently encountered developmental anomaly of the permanent dentition is seen in the maxillary lateral incisor. This tooth occupies an unfavorable position during its formative stages and is the last of the anterior teeth to calcify; hence, it is the one most likely to be affected by various developmental disturbances.[3]

Dens evaginatus (DE) is a dental abnormality that manifests as an enamel globule and is referred to as a talon cusp in the anterior teeth. It is believed to be an evagination of an area of the adjoining odontogenic mesenchyme and inner enamel epithelium into the dental organ.[4] Since most authors agree that the etiology of DE occurs during the morphodifferentiation stage of tooth development, the term DE is preferred in current concepts to describe this developmental aberration. Originally, the term "talon cusp" was used to describe DE because it resembled an eagle's talon.[5] According to radiographic evaluation of DE, pulp tissue was found in 42% of patients.[6] Therefore, a clinical and radiographic evaluation is required to ascertain whether a pulp horn is present in the cusp. This would not always be possible with 2D imaging, though, because of structural overlap. Cone beam computed tomography (CBCT) and other 3D imaging technologies have made it possible to witness and report these abnormalities more frequently.[4]

Mitchell [7] identified talon cusp, an uncommon tooth developmental abnormality, for the first time in 1892. Later on, Mellor and Ripa,[8] in 1979, gave it the name 'talon' because of its shape, which appeared similar to that of an eagle's talon. It is an extra cusp that emerges mostly from the lingual surface of anterior teeth, but it can also occasionally emerge from the labial surface.[9] Since then, numerous case reports have been published in English literature, and they are usually reported to be found in both primary and permanent dentitions.[10] It is more common in the permanent dentition compared to the primary dentition. It is more common in Asians, Native Americans, the Inuit, and Arabs. The prevalence of talon cusps is highest among the permanent maxillary central incisors (55%), and they may present unilaterally or bilaterally. However, it occurs rarely on mandibular incisors (6%) and maxillary canines (4%).[11] It has been reported that the prevalence ranges from less than 1% to approximately 8% in males compared to females. There are different levels of pulp tissue, enamel, and dentine in this accessory crown structure. There are usually grooves or fissures where the additional cusp and the lingual tooth surface meet.[12] Talon cusp has been linked to a number of developmental dental abnormalities, including impacted teeth, odontomes, double teeth, and supernumerary teeth, in addition to several syndromes, including Mohr syndrome, Rubinstein-Taybi syndrome, and Sturge-Weber syndrome.[13] Clinical issues related to the presence of a talon cusp include food stagnation, caries, periapical lesions, tongue irritation during speech and mastication, other soft-tissue irritation, compromised aesthetics, occlusal interference that can result in an unintentional cusp fracture, displacement of the affected tooth, temporomandibular joint pain, and periodontal issues caused by excessive occlusal force.[14]

In 1856, a dentist by the name of "Socrates" was the first to describe dens invaginatus (dens in dente).[15] It arises as a result of infolding in the surface of the crown/root.[12] It is found in 0.25–41% of the population, and the prevalence of this defect is lower in Western countries when compared with other parts of the world. According to earlier research, it appears to be more common in Chinese or Malaysian populations. The majority of these abnormalities were discovered in the permanent maxillary lateral incisors, and the most prevalent type of invagination is coronal type II. Nearly 40% of the cases occurred bilaterally,[16,17] and the morphology varies from a short pit confined to the crown of the tooth to a deep invagination into the root. Radiographically, it presents with an infolding of enamel and dentin (enamel located in the center, which is covered by dentin peripherally due to the invagination), which may extend into the pulp cavity, the root, and sometimes even to the root apex.[6,18] Several authors have proposed classification systems for DI, also known as dens in dente, dentoid in dente, invaginated odontome, or dilated composite odontome, but the most commonly used is the one proposed by Oehlers.[19] Over the past decades, several theories have been proposed to explain the etiology of dental coronal invaginations. Kronfeld (1934) [20] suggested that the invagination results from a focal failure of growth of the internal enamel epithelium and external forces exerted on the tooth germ. Ruston (1937) [21] suggested that the rapid and aggressive proliferation of a part of the internal enamel epithelium, whereas, according to Atkinson (1943),[22] the issue resulted from external factors influencing the tooth germ. It has been suggested that the invagination may be caused by a part of the internal enamel epithelium rapidly and aggressively proliferating and entering the dental papilla. Other potential causes, such as damage or infection, have also been postulated. The exact etiology of dens invaginatus is still up for debate, though.

These developmental disturbances are also frequently encountered in the lateral incisor; however, their simultaneous occurrence along with other dental anomalies is uncommon. Therefore, this case report aims to describe the clinical, radiographic and CBCT findings of bilateral dens evaginatus associated with dens invaginatus in maxillary lateral incisors and discuss its diagnosis and management.

Case Description

An 11-year-old male patient reported to the department of pediatric and preventive dentistry with the chief complaint of forwardly placed teeth in the upper front region of the mouth. Medical and dental history was non-contributory. Clinical examination revealed that the patient was in the mixed dentition stage with an over-retained canine and root stump in the upper left quadrant. There was also a deep mesio-proximal caries in the upper right back region. He had a class II molar relation bilaterally. An accidental finding revealed prominent tubercles in the lingual aspect of the upper right and left lateral incisors. (Figure 1) In tooth 12 the projection extended from the cingulum area to the incisal edge, while in 22 the projection extended less than halfway from the cemento-enamel junction to the incisal edge. This was diagnosed as a Type 1 talon's cusp in 12 and a Type 2 talon's cusp in 22. The patient did not have any issues with occlusion, speech, and mastication. The teeth responded well during the cold test and electric pulp test. The involved teeth did not exhibit any pain on either horizontal or vertical percussion.

Intraoral periapical radiographic examination of teeth 12 and 22 revealed some abnormal morphology, with invagination that seemed narrow and was lined by enamel limited to the crown, not extending beyond the cementoenamel junction (CEJ). As it shows 2-D image so for better understanding and correct diagnosis a CBCT was also advised. The apical closure of the tooth was completed, and no sign of periapical pathology was witnessed. (Figure 2a and b) Intraoral periapical radiographic examination of tooth 55 revealed complete root resorption and eruption of the premolar, so it was indicated for extraction.

Fig 1: Clinical picture showing the palatal aspect of maxillary right and left lateral incisor with a talon cusp

(a) (b)

Fig 2: Periapical radiograph of maxillary (a) right lateral incisor (b) left lateral incisor showing dens invaginatus

Later, a cone-beam computed tomography (CBCT) examination was carried out, which showed talon cusp (Figure 3) and dens invaginatus (Figure 4a and b), and a diagnosis of type I dens invaginatus along with talon cusp was formulated for both the teeth.

Fig 3: CBCT showing talon cusp in maxillary right and left lateral incisor

(a) (b)

Fig 4: CBCT showing dens invaginatus in (a) Tooth 12, (b) Tooth 22

Written informed consent for publication of the clinical details and images was obtained from the patient's parent. Ethical approval was not required for a single case report according to institutional policy.

Firstly, the complete oral prophylaxis was done to ensure that the patient had good oral hygiene. Since there was no pulp involvement with no occlusal interference in teeth 12 and 22, a prophylactic pit and fissure sealant was filled into the fissure. Then, extraction of teeth 55, 63, and 64 was done under local infiltration. Post-extraction instructions were given to the patient. The patient was explained the different treatment modalities and prognosis of the teeth with the anomalies. As the patient's chief complaint was forwardly placed teeth, they were asked to wait and watch for orthodontic correction until all the permanent teeth erupted. A signed consent was taken from the parent stating that they've been explained that, during orthodontic treatment, in case of any occlusal interferences, selective grinding along with the application of a desensitizing agent will be done. The patient is kept on follow-up.

Discussion

Although the exact cause is still unknown, lateral incisors frequently exhibit anomalies such as talon's cusp, dens invaginatus, palatogingival groove, etc.[23] It is uncommon for two or more abnormalities to occur in the same tooth at the same time, but in this instance, we documented the co-occurrence of a bilateral talon's cusp and dens invaginatus in the patient's maxillary lateral incisors.

According to Hattab *et al.* classification,[24] the talon's cusp in this case is a "true talon" in the maxillary right lateral incisor and a "semitalon" in the maxillary left lateral incisor. According to him, three forms of talon cusp are the following:

- **Type I (True Talon):** Distinctive additional cusp projecting from the lingual/cingulum surface of maxillary/mandibular anterior teeth to at least half the distance from the cementoenamel junction to the incisal edge.
- **Type II (semi-talon):** An additional cusp of 1mm or more that extends less than half of the distance from the cementoenamel junction to the incisal edge, and it blends well with the lingual surface of the teeth.
- **Type III (trace talon):** Prominence/variation in the cingulum; could be conical, bifid, or tubercle-like.

Hallet (1953) [25] coined the term DI, while the majority of dental surgeons prefer to use "dens in dente." A comprehensive preoperative radiographic evaluation, frequently using radiographs acquired at various angles, is necessary to determine the type of dens invagination. A three-dimensional reconstruction of the affected tooth is now possible owing to developments in radiography techniques and CBCT imaging.

According to Oehlers[26] classification, the dens invaginatus reported in this case is of type I variation. He had classified it under the following 3 categories:

- **Type I:** The invagination is a minor enamel-lined invagination confined to the crown, not extending beyond the cementoenamel junction (CEJ).
- **Type II:** The invagination extends beyond the CEJ, forming a blind sac within the root.
- **Type III:** The invagination extends through the root, potentially communicating with the periodontal ligament.
  - **Type III a:** Invagination extends into the tooth with lateral communication to the periodontal ligament.
  - **Type III b:** Invagination extends into the tooth with apical communication to the periodontal ligament. (Figure 5)

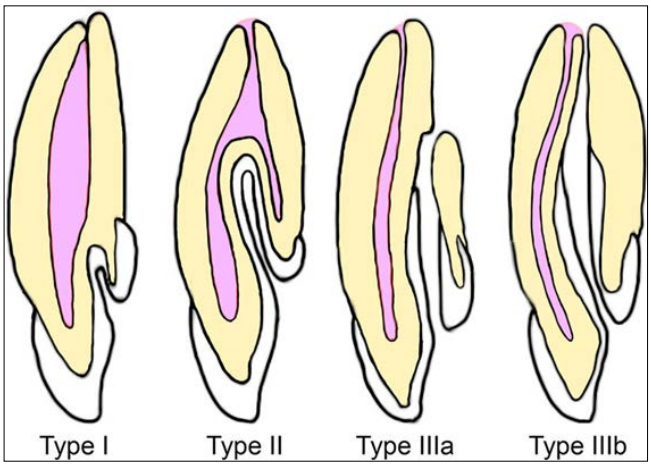

Fig 5: Oehlers classification of dens invaginatus

Each case requires a unique treatment plan tailored to the individual's specific condition, needs, and response to therapy. Vigorous oral hygiene and regular monitoring are sufficient for an asymptomatic talon's cusp with no occlusal interference, but any interference with speech or occlusion necessitates cusp reduction with the use of a desensitizing agent; occasionally, deliberate endodontic treatment and full-thickness crown coverage may be necessary to avoid dental caries and early tooth loss.[18,23] Prophylactic treatment is the preferred method of approach. If the cusp is small or presents no clinical difficulties, no therapy is performed. In order to avoid cavities in the concerned tooth, fissure sealant should be used if it has a deep developing groove. When there is occlusal disturbance, either a pulpotomy is performed along with the complete reduction of the cusp or an extra cusp is selectively reduced along with fluoride application.[27–29] After the bulk of excess cusp is gradually and periodically reduced, a desensitizing/remineralizing agent containing 0.2% sodium fluoride is applied. This lowers sensitivity, promotes the production of reparative dentin, and keeps the tooth vital, particularly in permanent teeth with open apices. Additionally, it suppresses the cariogenic microbiological process, encourages remineralization, and strengthens tooth resistance to acid dissolution.[5] If the maligned affected tooth or adjacent teeth crowd together, orthodontic treatments may be necessary.[30]

Endodontic treatment for dens invaginatus may include cautious restoration, routine monitoring, and basic oral hygiene practices, depending solely on the symptoms that are present.[18,23] Richardson (1985) [31] proposed a preventive strategy that involved acid-etching with phosphoric acid and pumice prophylaxis, followed by the application of a composite material. When pulp is not involved, flowable composite resin is the preferred substance for preventative filling. Depending on the severity and pulpal condition of DI, there are several different

treatment options. In simpler cases (Oehlers Type I & Type II DI) where the pulp is healthy, it's important to close the invagination to prevent problems and keep an eye on it regularly. When the invagination may not be able to connect with the root canal, sealing the invagination and preserving the pulp vitality may be considered. If the invagination connecting with the root canal exhibits signs of pulp pathosis, endodontic therapy is required. In recent years, the field of endodontics has been dominated by digitalization. For endodontic challenges like partial or complete calcified canals, anomalous root canal morphology, DI, conservative access cavity preparation, and microsurgical endodontic procedures, clinicians prefer the recently developed technique known as guided endodontics because it produces predictable and successful outcomes. A virtual plan for obtaining the best possible access to the DI can be accomplished with the aid of specialized design software, alignment with a CBCT, and a surface scan. Then, using a 3D printer, a surgical template is created. A minimally invasive drill is guided by this surgical stent to the DI portion, which was filled with MTA and coronally sealed with resin composite. It raises the chances of success by decreasing the probability of iatrogenic problems like perforation.[32]

DE and DI are clinically significant because they may be associated with impaired function and appearance, and since they provide a site for food particles and dental plaque to attach, they are more likely to be affected by the carious process.[6,23] It is crucial to identify any anomalies through early diagnosis and initiate prompt treatment to restore function, improve prognosis, minimize potential complications, and enhance the patient's quality of life.

The present case highlights the importance of CBCT in identifying complex developmental anomalies that may not be completely appreciated on conventional radiographs. Early diagnosis allows preventive management, thereby reducing the risk of pulpal complications and avoiding extensive endodontic procedures.

Conclusion

To conclude, dens evaginatus and dens invaginatus are uncommon dental abnormalities that might be difficult to diagnose and treat. Although both disorders involve the development of additional enamel or enamel-like structures within teeth, their specific characteristics and potential complications differ. Prompt detection and appropriate management are essential to prevent issues such as wear, decay, or pulp exposure. By understanding these conditions, dental practitioners can better meet patient needs and deliver high-quality care.

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