DENS EVAGINATUS: ETIOLOGY, CLASSIFICATION, PREVALENCE, DIAGNOSIS, ASSOCIATIONS AND TREATMENT CONSIDERATIONS. A REVIEW

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Summary

Dens evaginatus is a developmental dental anomaly characterized by a projection of enamel and dentin that usually encloses pulp tissue. Dens evaginatus was traditionally known as talon cusp and can be very distressing for the dental practitioner. The term talon cusp is only applicable to the anterior teeth originate palatally and proposed as a subset of dens evaginatus. For this reason dens evaginatus is more generalized term and is based on developmental origin, morphological, and histological considerations and more accurate than the term talon cusp. This standard term will help in firm diagnostic criteria for reliable estimation and evaluation, prevalence and its clinical significance of this developmental anomaly. This paper reviews the etiology, classification, prevalence, diagnosis, associations and treatment considerations.
Introduction

Dens evaginatus (DE) is a developmental malformation of crown shape occur in the early stages of dental development before the mineralization of hard tissues. It is a well-established phenomenon resulting from the outward folding of the inner enamel epithelial layer into the stellate reticulum of the enamel organ and transient focal hyperplasia of the primitive pulpal mesenchyme during the morphodifferentiation stage of the tooth development.\textsuperscript{1, 2} Dens evaginatus is characterized by the presence of an extra cusp that takes the form of a tubercle projecting from the crown of the tooth. This anomalous structure is composed of an outer layer normal enamel, a core of dentin and either has varying extensions of pulp tissue into it or is devoid of a pulp horn.\textsuperscript{3} Dens evaginatus varies widely in shape (horn-like, conical or pyramidal), size (enlarged cingulum, projection of one millimeter or more or extended to the incisal edge or beyond), structure, location, and site of origin.

This accessory cusp-like structure may arise from the occlusal surface or buccal surface of the posterior teeth and from the palatal surface or labial surface of the anterior teeth.\textsuperscript{4, 5} This phenomenon affects the primary\textsuperscript{6-9} and permanent\textsuperscript{4, 5, 10-16} teeth, affects the anterior and posterior teeth, and affects the maxillary and the mandibular teeth. The reported prevalence is 0.6\% in Mexicans, 7.7\% in a northern Indian, 2.5\% in a Hungarian, 5.2\% in Malaysian and 2.4\% in Jordanian population\textsuperscript{17}. The affected permanent teeth may be maxillary central and lateral incisors, canines, mandibular central and lateral incisors and canines.\textsuperscript{4, 10, 11} The affected primary teeth may be maxillary central and lateral incisors and mandibular molars. It occurs in both sexes and may be unilateral or bilateral. Dens evaginatus was first described in a human tooth by Mitchell in 1892.\textsuperscript{12} While one article attempts to distinguish talon cusp from DE\textsuperscript{18}, most authors
agree both are the result of an exacerbation of the same phenomena during the morphodifferentiation stage of tooth development.\(^{19,20,15}\)

Talon cusp originated as a descriptive term for DE when observed on the lingual surface of anterior teeth because of a resemblance to an eagle’s talon.\(^{20,14}\)

Currently, DE is the preferred terminology utilized to describe this developmental abnormality, first recommended by Oehlers\(^{21}\) in 1967.

Radiographically, dens evaginatus is visible as radiopaque structures composed of normal enamel and dentin and occasionally pulp extension, and may be detected radiographically before tooth eruption, and cause diagnostic problems as the dens evaginatus mimic a mesiodens, or even a compound odontome and awareness of this presentation avoid unnecessary surgical intervention. It has been suggested that dens evaginatus may be associated with other odontogenic anomalies. Table 1.

**Synonyms**

Various names have been given for this malformation. These are: talon cusp,\(^{14}\) interstitial cusp,\(^{22}\) tuberculated premolar,\(^{23}\) odontome of the axial core type,\(^{24}\) evaginated odontome,\(^{21}\) occlusal enamel pearl,\(^{25}\) occlusal anomalous tubercule,\(^{16}\) supernumerary cusp,\(^{16}\) and dilated composite odontome.\(^{13}\) leong's premolar , tuberculum anomalous , odontome.\(^{26}\)
Etiology of dens evaginatus

The etiology of the condition remains unknown. The causative event leading to dens evaginatus malformation may be determined by multifactorial inheritance, i.e. combining both primary polygenetic with some environmental factors.\textsuperscript{10, 27} Similar to other defects in the tooth form, dens evaginatus originates during the morphodifferentiation stage of tooth development. The majority of cases reported in the literature indicate that dens evaginatus is an isolated anomaly rather than an integral part of any disorder.

Clinical problems

Dens evaginatus may cause significant clinical problems as it influences treatment planning. The primary dental complication of dens evaginatus is fracture or wear of the tubercle which leads to pulp exposure, pulpal necrosis and periapical infection. Pathosis of the pulp can occur before complete root formation with cessation of root development.\textsuperscript{16} Dens evaginatus in the anterior teeth can extend to the incisal edge of the crown and may be esthetically unacceptable.\textsuperscript{4, 14} The bulk of the dens evaginatus can cause occlusal disharmonies, and it may also interfere with occlusion and may cause pain in the periodontal ligament secondary to traumatic occlusion and temporomandibular joint pain.\textsuperscript{4} This anomalous may even displace the affected and opposing teeth. It may be subject to rapid and advanced attrition, leading to pulp exposure and a possible periapical pathologic condition.\textsuperscript{14} Dens evaginatus tooth are delineated by deep developmental fissures or grooves that accumulate plaque and become susceptible to caries, so fissure sealant is indicated. Grooves at the lateral aspect of the dens evaginatus are often an area of plaque retention and may become carious and require restoration.\textsuperscript{11} It is possible that prominent coronal grooves may continue onto the tooth surface and cause periodontal problems. In addition dens
evaginatus may be a source of irritation to the tongue during speech and mastication. Interference with the eruption of teeth has been reported. Early diagnosis may minimize local problems such as caries, periodontal disease and malocclusion.

Systemic anomalies associated with dens evaginatus

Dens evaginatus sometimes occurs together with a generalized syndrome. The dens evaginatus has not been reported as an integral part of any specific syndrome, although it appears to be more prevalence in patients with Rubinstein-Taybi Syndrome, Mohr Syndrome (oral-facial-digital II Syndrome), Sturge-Weber Syndrome (encephalo-trigeminal angiomatosis), and a newly paper reported in Ellis-van-Creveld Syndrome.

Classification of dens evaginatus

There are different criteria for categorization of this anomaly due to different terms had been given to dens evaginatus. Without standardization of terminology and classification the prevalence and clinical significance of this anomaly will remain unreliable for estimation and evaluation. Reviewed of the literature revealed a few classifications had been given to this anomaly.

Hattab et al suggested a classification based on the degree of formation and extension of dens evaginatus in the anterior teeth only as follows: Type 1. Talon: a morphologically well delineated additional cusp the project from the palatal surface and extends at least half the distance from the cementoenamel junction to the incisal edge. Type 2: Semitalon: an additional cusp extending less than half the distance from the cementoenamel junction to the incisal edge.
Type 3: Trace talon: prominent cingula. Because a recently report of dens evaginatus in labial surface (facial) was observed on the maxillary incisor,\(^5\) this classification is not applicable. So, I suggest this classification for the anterior and posterior teeth. This classification based on the surface of the dens evaginatus originated and applicable in posterior and anterior teeth as follows: for the posterior teeth: Occlusal dens evaginatus, buccal dens evaginatus, palatal dens evaginatus for maxillary teeth or lingual dens evaginatus for mandibular teeth and can be applied for the permanent and primary dentitions and for the maxillary and mandibular teeth. For the anterior teeth: lingual dens evaginatus for mandibular tooth or palatal dens evaginatus for maxillary teeth, and labial dens evaginatus for maxillary and mandibular teeth.

Schulge (1987) distinguishes the following five types of DE for posterior teeth by the location of the tubercles:\(^{20}\)

1. A cone-like enlargement of the lingual cusp
2. A tubercle on the inclined plane of the lingual cusp
3. A cone-like enlargement of the buccal cusp
4. A tubercle on the inclined plane of the buccal cusp
5. A tubercle arising from the occlusal surface obliterating the central groove.

Lau classified tubercle on the basis of anatomical shapes as smooth, grooved, terraced and ridge\(^{24}\).

Whereas, Oehlers\(^{21}\) identified the evagination according to the pulp content within the tubercle by examining the histological appearance of the pulp using decalcified serial sections of extracted teeth with DE. They are categorized as:

- Wide pulp horns (34%)
- Narrow pulp horns (22%)
- Constricted pulp horns (14%)
- Isolated pulp horn remnants (20%)
- No pulp horn (10%)

**Prevalence of dens evaginatus**

There are insufficient data on the prevalence of dens evaginatus and may vary according to the population examined. In a radiographic survey of 15,000 teeth, Dankner et al\textsuperscript{15} reported that the prevalence of dens evaginatus was distributed as follows: 37\% in maxillary central incisor, 60\% in maxillary lateral incisors, found in about 1\% of the anterior dentition and was more frequent in the maxilla, particularly in the incisors, 3\% in mandibular central incisor.

The overall prevalence of dens evaginatus of anterior teeth was 0.23\% of all the teeth evaluated radiographically, and 77\% in the permanent and 23\% in the primary dentition. The teeth affected in the permanent dentition are distributed as follows: 97\% in the maxilla and 3\% in the mandible and 65\% in men and 35\% in women. In children, 82\% boys and 18\% girls presented dens evaginatus in their primary anterior teeth.

The bilateral occurrence of dens evaginatus is an interesting phenomenon. In the radiographic study 65\% of the cases were bilateral. All reports on dens evaginatus in primary teeth were in the maxilla and lateral maxillary central incisor was most frequently involved, followed by lateral incisors.\textsuperscript{6-9}

**Treatment considerations**
The treatment of dens evaginatus varies with the circumstances of the individual case. Some patients require no treatment at all, if esthetic appearance is satisfactory, function is within normal limits, no caries or advanced attrition are present, and if the anomalous is not sharp.

A rational and conservative approach to the management of dens evaginatus in vital teeth includes early preventive treatment to diminish the chances of inadvertent fracture of tubercle of dens evaginatus tooth is recommended to avoid abscess formation before complete root closure. The tubercle is reinforced by bonding composite around the base to the occlusal surface. Occlusal interference opposing projection is reduced, so that in all excursive movements there was no contact with the tubercle.\(^{32}\)

Other patients may require some form of definitive care. Some patients need only simple reduction as gradual, periodic reduction with fluoride as a desensitizing agent to relieve pain and to improve esthetic appearance or eliminate occlusal interference, sharpness or attrition.\(^{28,33-35}\)

The fissures associated with the lateral aspects of those anomalous should be frequently checked for caries and restored if indicated, and should fissure sealed if it is highly susceptible to caries.\(^{28,36,37}\)

Extraction may be considered, if the apexification procedure is unsuccessful or contraindicated, or if the tooth is to be removed for orthodontic purposes.\(^{38}\) Complete elimination of the anomalous, endodontic therapy, and restoration of the teeth with a crown may be required to achieve satisfactory esthetic appearance and function in other instances.\(^{14,39}\) Orthodontic correction and realignment also may be required for the displaced teeth.\(^{40}\)

The disadvantages of selective grinding the dens evaginatus are sensitivity of the tooth and many visits required, which could prove very in convenient. Uyeno and Lugo concluded that this treatment option may only be indicated in cases where there is no pulpal extension into the
tubercle of the dens evaginatus of the tooth. Prophylactic pulp capping is indicated in cases with pulpal extension. When teeth with dens evaginatus become pulpally involved before root closure, apexification followed by conventional endodontic therapy is recommended. Due to the possibility of early pulpal necrosis, endodontic therapy can be complicated further by an incomplete root formation with an open apex. Emphasis should be placed on early detection of this anomaly and on prophylactic treatment.

**Treatment Regimen for Dens Evaginatus**

<table>
<thead>
<tr>
<th>Prophylaxis Tubercle Intact or Without Enamel</th>
<th></th>
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<tbody>
<tr>
<td><strong>Normal pulp</strong></td>
<td></td>
</tr>
<tr>
<td>Type I Mature Apex</td>
<td>Type II Immature Apex</td>
</tr>
<tr>
<td>Reduce opposing occluding tooth</td>
<td>Same as Type I except:</td>
</tr>
<tr>
<td>Apply acid-etched flowable lightcured resin to tubercle</td>
<td>Reevaluation every 3–4 months until development of mature apex</td>
</tr>
<tr>
<td>Yearly reevaluation to assess occlusion, resin, pulp and periapex</td>
<td></td>
</tr>
<tr>
<td>When reevaluation demonstrates adequate pulp recession, remove tubercle and apply resin</td>
<td></td>
</tr>
<tr>
<td>Intervention tubercle with pulp exposure</td>
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<tr>
<td>-----------------------------------------</td>
<td></td>
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<tr>
<td><strong>Inflamed Pulp</strong></td>
<td><strong>Necrotic Pulp</strong></td>
</tr>
<tr>
<td><strong>Type III Mature Apex</strong></td>
<td><strong>Type IV Immature Apex</strong></td>
</tr>
<tr>
<td><strong>Type V Mature Apex</strong></td>
<td><strong>Type VI Immature Apex</strong></td>
</tr>
<tr>
<td>Conventional root canal therapy</td>
<td>Conventional root canal therapy</td>
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<tr>
<td>Shallow MTA pulpotomy</td>
<td>MTA root-end barrier</td>
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<tr>
<td>Restoration</td>
<td>Restoration</td>
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<tr>
<td>Glass ionomer layer</td>
<td>Glass ionomer layer</td>
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<tr>
<td>Acid-etched light-cured resin</td>
<td>Acid-etched light-cured resin</td>
</tr>
</tbody>
</table>

Levitan and Himel Dens Evaginatus: Review (J Endod 2006;32:1–9)
Table 1: Odontogenic anomalies associated with dens evaginatus.

- Shovel-shaped incisor.\(^{10}\)
- Bifid cingula.\(^{10}\)
- Additional tubercles.\(^{10}\)
- Peg-shaped lateral incisor.\(^{11}\)
- Impaction.\(^{11,27,46}\)
- Odontomes.\(^{27,46}\)
- Supernumerary.\(^{6,27}\)
- Shallow groove in the lateral incisor.\(^{10}\)
- Megadont.\(^{27}\)
- Labial groove.\(^{10}\)
- Agenesis.\(^{10}\)
- Labial drifting.\(^{10}\)
- Prominent marginal ridge.\(^{10}\)
- Exaggerated cusp of carabelli.\(^{10}\)
- Dens evaginatus.\(^{10}\)
- Aesthetic problems.\(^{10,27}\)
- Occlusal problems.\(^{10,27}\)
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22) Yumikura S, Yoshida K: Abnormal cusp on the occlusal surface of the human premolar. Kokubyo Gakkai Zasshi, 10: 73, 1936


