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Dental Anomalies
Part 2

Dr Jilen Patel *BDSc (Hons) WA, DClinDent, MRACDS, FADI, FICD, FPFA, SFHEA*

Specialist Paediatric Dentist

Consultant, Perth Children's Hospital

Senior Lecturer, UWA Dental School

Stages of tooth development

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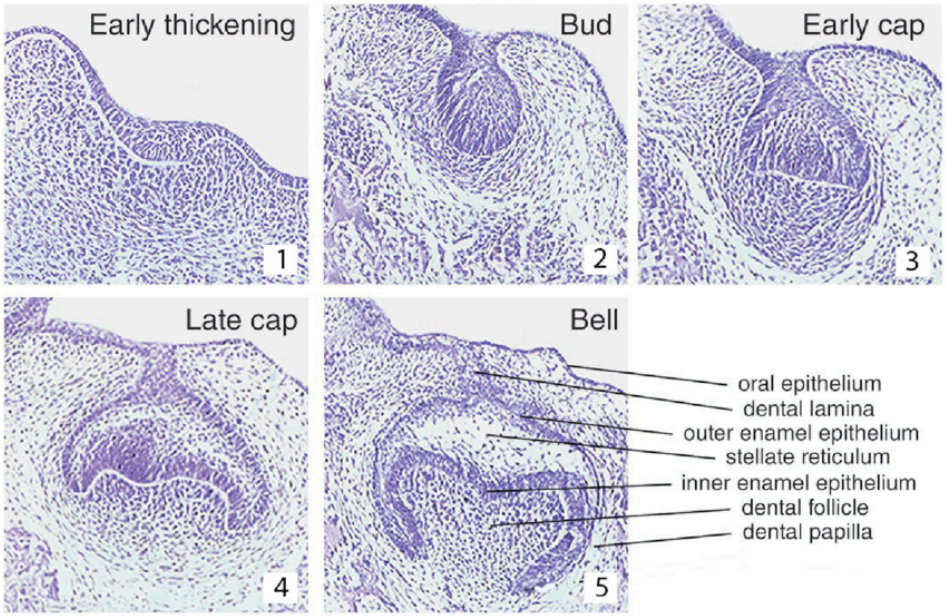
Paediatric Dentistry

Dental Anomaly	Stage of Tooth Development
Anodontia	Initiation stage
Hypodontia	Bud stage
Supernumerary teeth	Bud stage
Fusion	Bud to cap stage
Gemination	Bud to cap stage
Evaginatus	Cap to bell stage
Taurodontism	Bell stage
Dens invaginatus	Bell stage
Talon cusp	Bell stage
Concrescence	Eruption stage
Dilaceration	Root formation stage
Hypercementosis	Root formation stage



Cobourne & Sharpe 2003

Anomalies of Shape

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- Double tooth
  - **Fusion**
  - **Gemination**
- Accessory cusps
  - **Talon cusp**
  - **Evaginated odontome (dens evaginatus)**
- **Invaginated odontome** (dens invaginatus)
- Taurodontism

Double Tooth

Definition: Double teeth are formed of two or more elements diagnosed clinically by evidence of incisal notching with labial grooving and radiographically by pulpal bifurcation

(Winter, 1969)

Alternative terminology

- Connate (Tomes, 1859)
- Linking tooth (Sprinz, 1953)
- Schizodontia (DeJonge, 1955)
- Fusion (Levitas, 1965)
- Gemination (Levitas, 1965)
- Connation (Hitchin and Morris, 1966)
- Dichotomy (Schulze, 1970)
- Others
  - conjoined teeth
  - double formations

Double Tooth

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Etiology

- Inherited

- Local factors
  - the union may be the result of fusion of two adjacent tooth buds
  - the partial splitting of one into two
  - tooth germ move together because of crowding or trauma

(Milano et al. 1999)

Double Tooth

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Prevalence

- M = F
- Primary dentition: 0.1 – 3.0%

  (Brook, 1974; Buenviaje, 1984; Cheng, 2003; Sekerci et al. 2011)

- Permanent dentition: 0.1-0.8%

  (Chung et al. 1972; Brook, 1974; Tsai, 1996)

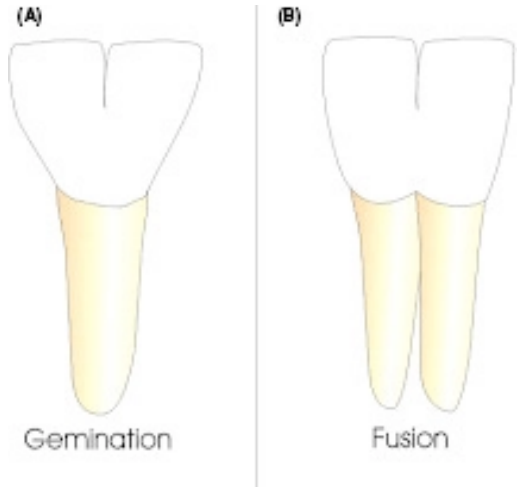
- The occurrence can be **unilateral** or **bilateral**
- Predominantly in the **incisor and canine region**
- More common in the maxilla
- ***Bilateral in primary dentition:*** greater likelihood of the subject having anomalies in the permanent dentition

Double Tooth

Clinical Presentation

- It varies considerably from a minor notch in the incisal edge of an abnormally wide incisor to the appearance of almost two separate crowns

- If the 'double tooth' is present together with a normal complement of teeth in the same quadrant : **gemination**
- If the number of teeth is reduced in the same quadrant : **fusion**



Ramezani et al 2021

Radiographs

- Necessary to determine if there is a union of the pulp chambers

Double Tooth - Fusion

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Definition

- It is a result of the embryological persistence of the dental lamina between the two tooth buds (Hitchen and Morris, 1966)
- It is the result of an unsuccessful attempt of two tooth buds to fuse into one (Kelly, 1978)

- If it occurs **early in odontogenesis**:
  - the two developing teeth will unite to form a single tooth of almost normal size
- If it occurs **late in odontogenesis**:
  - one tooth (which can be as much as twice the size of the normal tooth)
  - or a tooth with a bifid crown can result

Double Tooth - Fusion

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Clinical manifestations

- Fused teeth might have one or two pulp chambers
- Fused teeth commonly exhibit labial and lingual vertical grooves on the crown surface
- If the affected tooth is counted as one, there is usually one tooth less than normal for a given dental age

Double Tooth - Gemination

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Gemination

- Gemination is the formation of two teeth from the same follicle (Ravn, 1971)
- There is one common pulp chamber (Kelly, 1978)
- Gemination is more common in maxilla
- In permanent dentition these teeth are usually macrodonts
- Diagnosis of root canal morphology may be aided by use of CBCT as plain films are difficult to interpret

Bilateral Gemination

Double Tooth - Gemination

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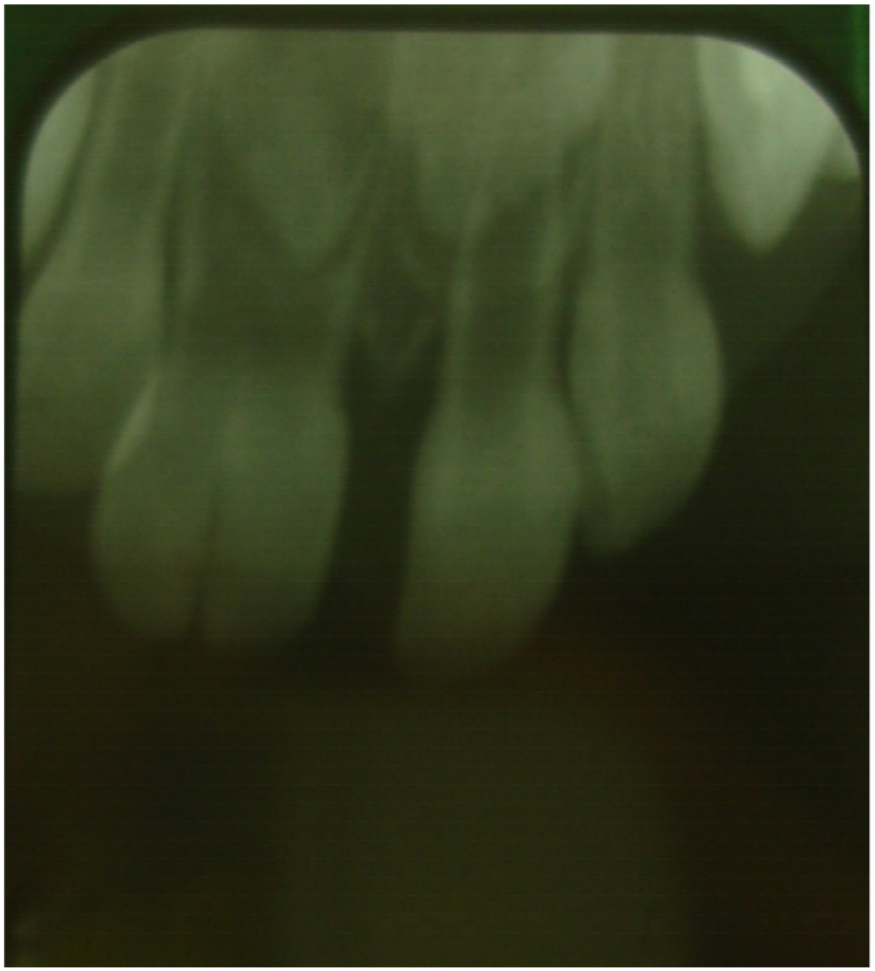
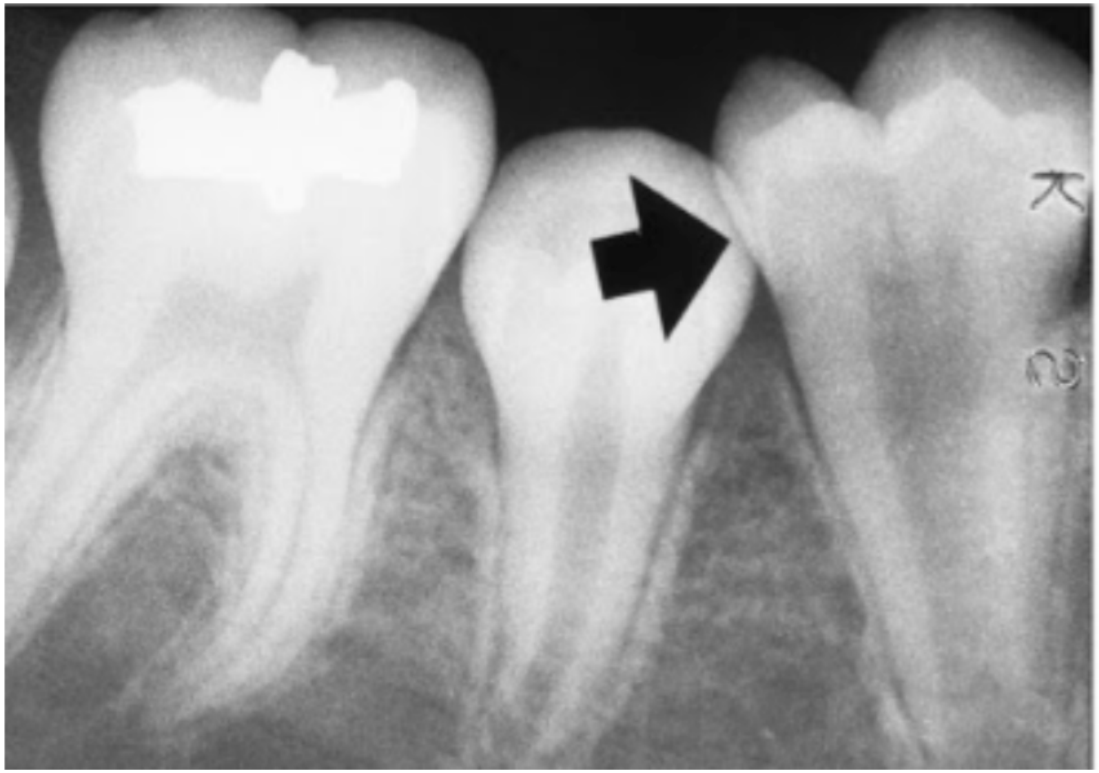


Double Tooth - Gemination



Double Tooth - Concrescence

Double Tooth

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- **Clinical problems** associated with double tooth:
  - Caries in the groove dividing the bifid crown
  - Periodontal disease due to extension of the groove to the root surface
  - Excess arch space and diastema occurs when normal teeth are fused
  - Crowding of the dental arch, if the fusion involves one normal tooth and a supernumerary tooth
  - Aplasia of the permanent successor in case of fusion
  - Delayed exfoliation and root resorption of primary double teeth
  - Impaction of the permanent successor
  - Malocclusion
  - Esthetic problems

Hattab, 2014

Double Tooth

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Management

- Fissure sealant
- Flowable composite resin
- Hemi-section
- Reshaping or reduction of a double tooth with a single canal ?
- Orthodontic treatment and/or prosthetic replacement
- Extraction and replacement with an implant

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Talon Cusp

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- **Definition** "process of horn-like shape" curving from the base to the "cutting edge" on the palatal surfaces of the incisors (Mitchell, 1892)

- The term "talon cusp" was proposed because of the shape of the anomaly resembling an eagle's talon (Mellor and Ripa, 1970)

- A cusp-like projection from the palatal surface of an anterior tooth that extended at least half the distance from the cemento-enamel junction to the incisal edge

(Davis and Brook, 1985)

Talon Cusp

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Alternative terminology

- Cusp-like projection (Mitchell, 1892)
- Hyperplastic cingulum (Worth, 1963)
- Palatal accessory cusp (Ooshima et al. 1996)
- Projection on the facial surface of the anterior teeth (Tsutsumi 1991)
- Evaginated odontome (Lee, 1968)
- Cusped cingulum (Barnes, 1969)
- Accessory cusp (Schulze, 1970)
- Dens evaginatus (Shey and Eytel, 1983)
- Supernumerary lingual tubercle (Harris and Owsley, 1991)
- Others: T-cingulum, Y-shaped cingulum

Talon Cusp

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Frequency

- Male > Female (al-Omari et al. 1999)
- Male : Female = 1.9 : 1 (Lee et al. 2007)

- Rare in the primary dentition
- **Primary dentition**: 0.5 – 0.6%

  (Chen, 1986; Ooshima et al. 1996; Liu, 1996)
- **Permanent dentition**: 1 – 2.5%

  (Ooshima *et al.* 1996; Mavrodisz *et al.* 2003; King et al. 2010)

- It is observed only in the maxillary anterior teeth and involves the incisors and canines

Talon Cusp

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Etiology

- Unknown
- Multifactorial involving both genetic and environmental factors

  (Davis and Brook, 1986; al-Omari et al. 1999)
- May occur because of an outward folding of the inner enamel epithelial cells and a transient focal hyperplasia of the mesenchymal dental papilla

  (Hattab et al. 1996)
- Hyperactivity of the dental lamina (commonly in the anterior region)

  (Rantanen, 1971)
- Due to the fusion of a normal and a supernumerary tooth

  (Hennekam and Van Doorne, 1990)

Talon Cusp

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Classification

- **Type 1 - Talon:** A morphological well-defined additional cusp that prominently projects from the palatal surface of a primary or permanent anterior tooth and extends at least half the distance from the cemento-enamel junction to the incisal edge

Hattab et al. 1996

Talon Cusp

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Classification

- **Type 2 - Semi-talon:** An additional cusp of a millimeter or more but extending less than half the distance from the cemento-enamel junction to the incisal edge. It may blend with the palatal surface or stand away from the rest of the crown

Hattab et al. 1996

Talon Cusp

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Classification

- **Type 3 - Trace talon:** presents as an enlarged and prominent cingulum and its variations (i.e. conical, bifid, or tubercle-like)

Hattab et al. 1996

Talon Cusp

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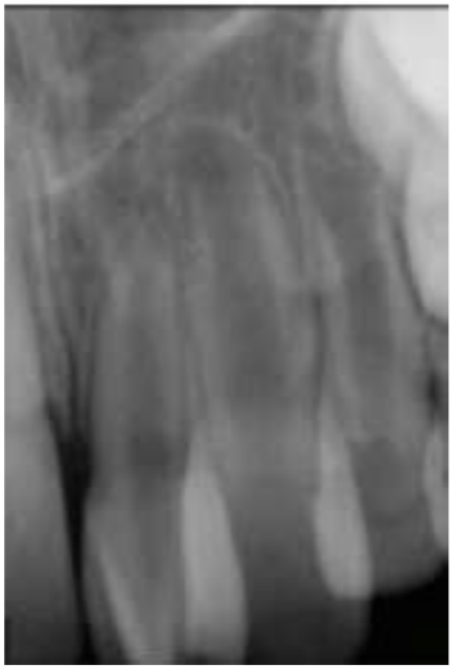
Modified classification Hsu et al. 2001

- **Type 1 - Major talon:** A morphologically well-defined additional cusp that projects from the facial or palatal / lingual surface of an anterior tooth and extends at least half the distance from the cemento-enamel junction to the incisal edge

- **Type 2 - Minor talon:** A morphologically well-defined additional cusp that projects from the facial or palatal/lingual surface of an anterior tooth and extends more than one fourth, but less than half the distance from the cemento-enamel junction to the incisal edge



- **Type 3 - Trace talon**: Enlarged or prominent cingula and their variations which occupy less than one fourth the distance from the cemento-enamel junction to the incisal edge

Facial, lingual, facial and lingual (Mallineni et al. 2014)

Talon Cusp

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Radiographically

- It resembles a radio-opaque v-shaped structure pointing towards the incisal edge of the tooth which is superimposed on the normal image of the crown

- The cusp image is outlined by two distinct white lines, representing the enamel, converging from the cervical area towards the incisal edge

Talon Cusp

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Talon cusp prevalent in the following syndromes

- Rubinstein-Taybi syndrome
- Mohr syndrome [oral-facial-digital II]
- Struge-Weber syndrome [encephalo-trigeminal angiomatosis]
- incontinentia pigmentia achromians
- Ellis-van Creveld syndrome [chondroectodermal dysplasia]
- Hyopmelanosis of Ito
- Alagille's syndrome
- Berardinelli-Seip
- Sturge-Weber angiomaans

Talon Cusp

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Complications associated with Talon cusp

- Compromised esthetics (facial talon cusp)
- Traumatic occlusion
- Displacement of the affected and opposing teeth
- Plaque retention
- Caries susceptibility in the developmental grooves delineate the cusp
- Pulpal necrosis
- Hypersensitivity
- Periodontal problems
- Attrition of the opposing teeth accidental cusp fracture
- Periapical pathosis due to excessive attrition
- Irritation of tongue during speech and mastication
- Interference with tongue space
- Speech disturbance
- Breast-feeding problems
- TMJ joint pain due to excessive occlusal forces

Hsu, 2001

Talon Cusp

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Management

- Fissure sealants or flowable composite resin: to prevent caries in the grooves between the various parts of the tooth

- If there is **no occlusal interference**: no treatment is required

- If **occlusal interference is present**:
  - gradual, periodic reduction of enamel only (to avoid pulp exposure) with fluoridation as a de-sensitising agent
  - elective pulpotomy
  - partial pulpectomy
  - or extraction followed by orthodontic treatment

(Mellor and Ripa, 1970; Pitts and Hall, 1983)

Int J Paediatr Dent. 2007 May;17(3):178-85.

The relationship between a primary maxillary incisor with a talon cusp and the permanent successor: a study of 57 cases.

Lee CK[1], King NM, Lo EC, Cho SY.

Author information

Abstract

BACKGROUND: Most reported cases of talon cusps in the primary dentition have been on the maxillary central incisors and the permanent successors have remained unaffected. Four of the five reported cases on a maxillary lateral incisor, however, have been associated with a supernumerary permanent successor.

AIM: This paper describes the relationship between the presence of talon cusps on a primary maxillary incisor, and the morphology and number of the permanent successors in a population of Chinese children.

DESIGN: The dental records of children diagnosed with a talon cusp on a primary incisor were retrieved for review. The diagnoses took place in a regional school dental clinic in Hong Kong between April 2002 and August 2005.

RESULTS: Fifty-eight primary maxillary incisors with talon cusps were found. When the central incisors were involved, 32 of the 35 (91.4%) underlying permanent successors were not found to be associated with any odontogenic abnormalities. When the lateral incisors were involved, however, 18 of the 23 cases (78.3%) showed odontogenic abnormalities, 14 of which were associated with supernumerary teeth.

CONCLUSIONS: The present study shows that, when there is a talon cusp on a primary maxillary lateral incisor, a high proportion of the underlying permanent successors can be expected to exhibit odontogenic abnormalities.

PMID: 17397461 DOI: 10.1111/j.1365-263X.2007.00823.x

[Indexed for MEDLINE]

Dens Evaginatus

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Definition: It is an **enamel-covered tubercle projecting from the occlusal surface** of a premolar and in rare instances canines and molars

(Lau, 1955, Allright, 1958)

Alternative terminology

- Interstitial cusp (Yumikura and Yoshida, 1936)
- **Leong premolar** **(Leong, 1946)**
- Occlusal enamel pearl (Pedersen, 1949)
- Dilated composite Odontome (Tratman, 1949)
- Odontome of axial core type (Lau, 1955; Allwright, 1958)
- Tuberculated premolar (Ohlers, 1956)
- Cone-shaped Supernumery cusp (Moorress, 1957)
- Dens evaginatus (Oehlers,1967)
- Evaginated Odontome (Oehlers,1967)
- Mongoloid or oriental premolar (Curzon, 1970)

Dens Evaginatus

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Etiology

- Unknown
- Multifactorial: association with racial and genetic factors
- Abnormal proliferation of the inner enamel epithelium into the stellate reticulum of the enamel caused by:
  - either an outflowing of the enamel epithelium
  - or by a transient focal hyperplasia of the primitive pulpal mesenchyme

(King et al. 2010)

Dens Evaginatus

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Prevalence

- Mostly found on permanent teeth
- Typically occurs on premolar teeth
- Demonstrate marked mandibular predominance
- Teeth with dens evaginatus usually occur bilaterally
- Prevalence between 0.1% to 4.7%
- Frequently seen in Mongoloids, Asians, the Inuit, and Native Americans and rare in Whites

(Lau, 1955; Goto et al. 1979; Ooshima et al. 1996; King et al. 2010)

Dens Evaginatus

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Dens Evaginatus

Classification (Lau, 1955)

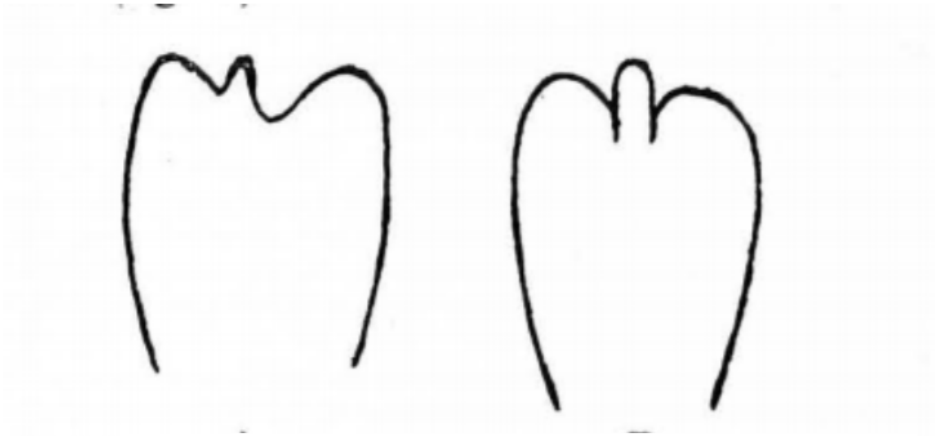
According to the location

- Tubercle can arise from **the lingual ridge of the buccal cusp**
- Tubercle is located in the **center of the occlusal surface**

According to the form of the projection

The evagination may be:

- Smooth
- Grooved
- Terraced
- Ridged



1. Smooth form

2. Grooved form

3. Terraced form

2. Ridged form

Dens Evaginatus

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Classification (Oehlers, 1967)

Oehlers identified the evagination according to the pulp contents within the tubercle:

• Wide pulp horns	34%
• Narrow pulp horns	22%
• Constricted pulp horns	14%
• Isolated pulp horn remnants	20%
• No pulp horn	10%

Dens Evaginatus

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Radiographic Examination

- The pulp tissue in the tubercle is normal unless the tubercle has been fractured, or worn down, thereby permitting bacterial invasion, with consequent pulpal necrosis (Merrill, 1964)

- Necrosis of pulp tissue can subsequently lead to:
  - an acute or chronic dentoalveolar abscess

- Other findings includes:
  - Osteomyelitis (Allwright, 1958)
  - Thickening of the periodontal membrane
  - Periapical rarefaction
  - Incomplete root formation
  - Fracture of the root
  - Cyst formation
  - Dilaceration

(Oehlers, 1967)

Dens Evaginatus

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Management

- *Composite reinforcement:* to support the sides of the tubercle with composite resin (should be performed before the tooth comes into complete occlusion)
- *Grinding of tubercle:* if tubercle is cause of occlusal interference grinding of the tubercle followed by fissure sealing in some cases
- Trauma or attrition to the tubercle results in pulp exposure: an elective (Cvek) pulpotomy can be performed in an attempt to allow normal root formation
- Revascularization
- Extraction of the tooth may be considered after orthodontic consultation

Dens Invaginatus

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Definition: An infolding of the enamel and dentin towards the pulp (Tomes, 1859)

- **Alternative terminology**
  - Warty teeth (Salter, 1855)
  - Invagination of the enamel (Hallet, 1953)
  - Dens in dente (Salter, 1855; Shepard, 1968)
  - Invaginated odontome
  - Dilated composite Odontome (Worth, 1963)
  - dents telescopes (Augsberger and Brandebura, 1978)
  - Gestant Odontome (Augsberger and Brandebura, 1978)

Dens Invaginatus

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Etiology: Theories as below:

- **Growth pressure: (**Euler, 1939; Atkinson, 1943)
  - buckling of the enamel organ might be caused by growth forces in the developing arch
  - disproportion between jaw size and the total length of the dental arch
- **Focal growth retardation:** (Kronfeld, 1934)
  - invagination results from a focal failure of growth of the internal enamel epithelium.
  - The surrounding normal epithelium continues to proliferate and engulfs the static area, eventually enclosing it
- **Focal proliferation:** (Rushton, 1937)
  - invagination is the result of an invasion of the dental papilla by a rapid and aggressively proliferating area of internal enamel epithelium
- **Local causes:** Trauma (Gustafson & Sundberg, 1950)
  - infection (Fischer 1936, Sprawson 1937)
- **Genetic**: (Grahnen et al. 1959, Casamassimo et al. 1978, Hosey & Bedi 1996)

Dens Invaginatus

Prevalence

Primary dentition: 0.1% (Brook, 1974)

- Male = Female
- Teeth: primary canine, maxillary central incisor, mandibular second molar

Permanent dentition: 0.2- 10.0%

- Male > Female
- Teeth: Maxillary lateral incisors, maxillary central incisors and canines

(Atkinson, 1943; Grahnen et al. 1959; Poyton and Morgan, 1966; Kong, 1972; Reprecht et al. 1986; King et al. 2010)

Dens Invaginatus

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Classification: (Rushton, 1937)

Coronal dens invaginatus:

- It is anomalous infolding of enamel organ into dental papilla
- It results in the folding of hard tissue within the tooth, characterized by enamel lining the fold and covering the dentin peripheral to it

Radicular dens invaginatus:

- It is a result of invagination of Hertwig's epithelial root sheath, resulting in accentuation of normal longitudinal root grooves
- It is lined by cememtum
- Root sheath may bud off sac-like invagination that results in a circumscribed cememtum defect in root

Dens Invaginatus

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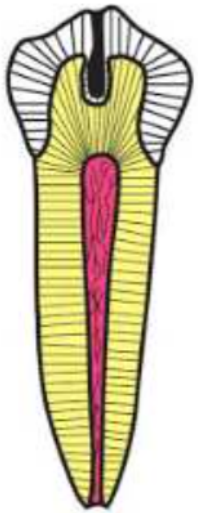
Classification: Oehlers's, 1957

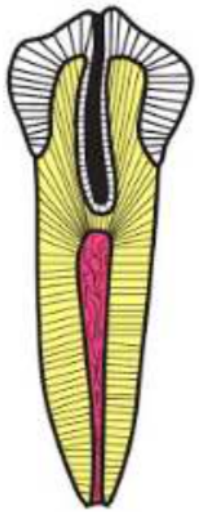
Dens Invaginatus

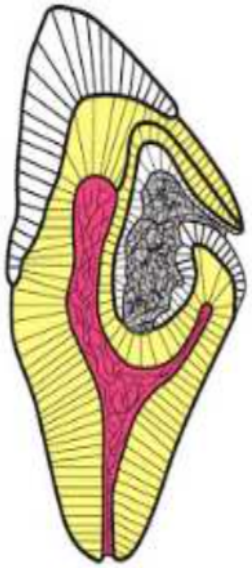
Type 1: invagination confined to the crown

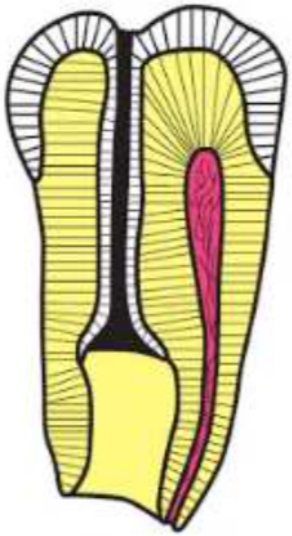
Type 2 : invagination extends beyond the CEJ but does not involve the periapical tissues

Type 3: Extends past CEJ & perforating laterally (type 3a) or apically (Type 3b) at a foramen









Dens Invaginatus

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Dens Invaginatus - Type II

Dens Invaginatus - Type III

Dens Invaginatus

Dens Invaginatus - Type III (b)

Dens Invaginatus

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Clinical features

- Tooth crowns and roots may exhibit variations in size and form
- 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 predispose tooth for dental caries
- Pulp necrosis often occurs within a few years of eruption, sometimes even before root end closure (channels may also exist between the invagination and the pulp)
- May lead to a abscess formation or cellulitis
- Retention or displacement of neighbouring teeth
- Cyst formation
- Internal resorption

Dens Invaginatus

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Management

- **Preventive treatment:** fissure sealant, flowable composite
- **Restorative treatment:** if caries is evident tooth should be restored with composite resin
- **Endodontic treatment**
  - symptomatic tooth
  - root canal morphology favourable
- **Autotransplantation**
- **Extraction**
  - if the internal anatomy is complex and the root canal is not possible
  - infection
  - endodontic failure
  - ➢ orthodontic treatment planning should be carried out prior to extraction

Accessory Cusps: Summary

1. Talon cusp: A talon cusp is an accessory cusp that occurs on the lingual surface of the anterior teeth. It is a relatively common developmental anomaly that is characterised by a prominent, dagger-like cusp that extends from the cingulum of the tooth towards the incisal edge.

2. Cusp of Carabelli: The cusp of Carabelli is a small accessory cusp that occurs on the mesiopalatal surface of the maxillary first molars. It can be considered a trait (rather than an anomaly) in many populations.

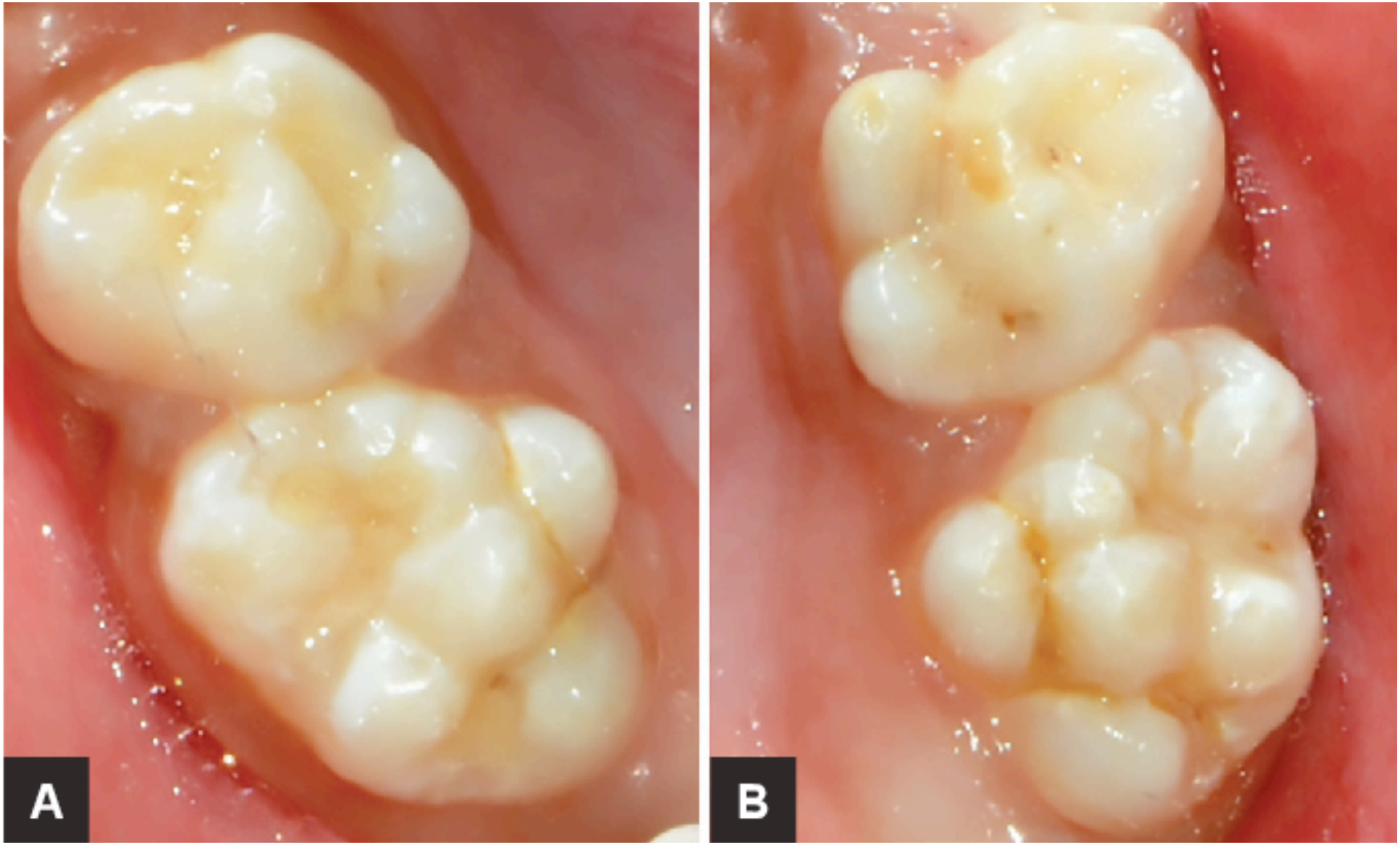
3. Dens evaginatus: Dens evaginatus is an accessory cusp that occurs on the occlusal surface of premolars or molars. It is characterised by a small, rounded or pointed projection that extends from the occlusal surface of the tooth.

4. Dens invaginatus: Dens invaginatus occurs when the enamel organ invaginates into the dental papilla during tooth development, resulting in a deep, enamel-lined pit or groove on the occlusal or lingual surface of the tooth.

5. Supernumerary cusps: Supernumerary cusps are additional cusps that can occur on any tooth. They are a developmental anomaly and can vary in size, shape, and location.

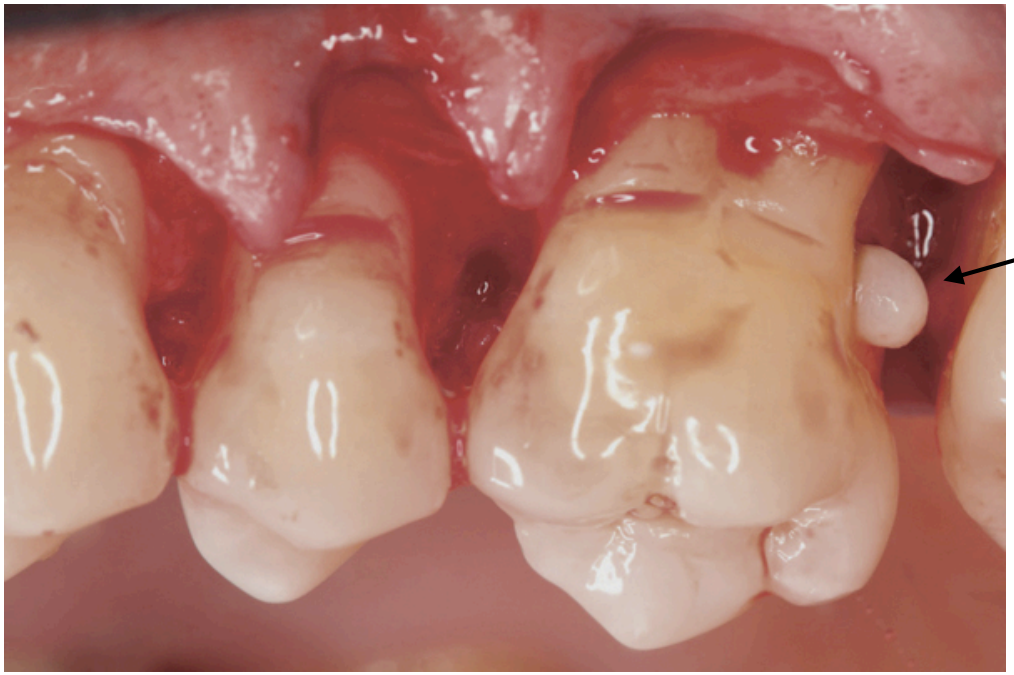
6. Enamel pearls: Enamel pearls are small, spherical structures of enamel that can occur on the root surface of teeth. They are are typically located near the furcation of the tooth.

Supernumerary Cusps



Singh et al. 2018

Enamel Pearls

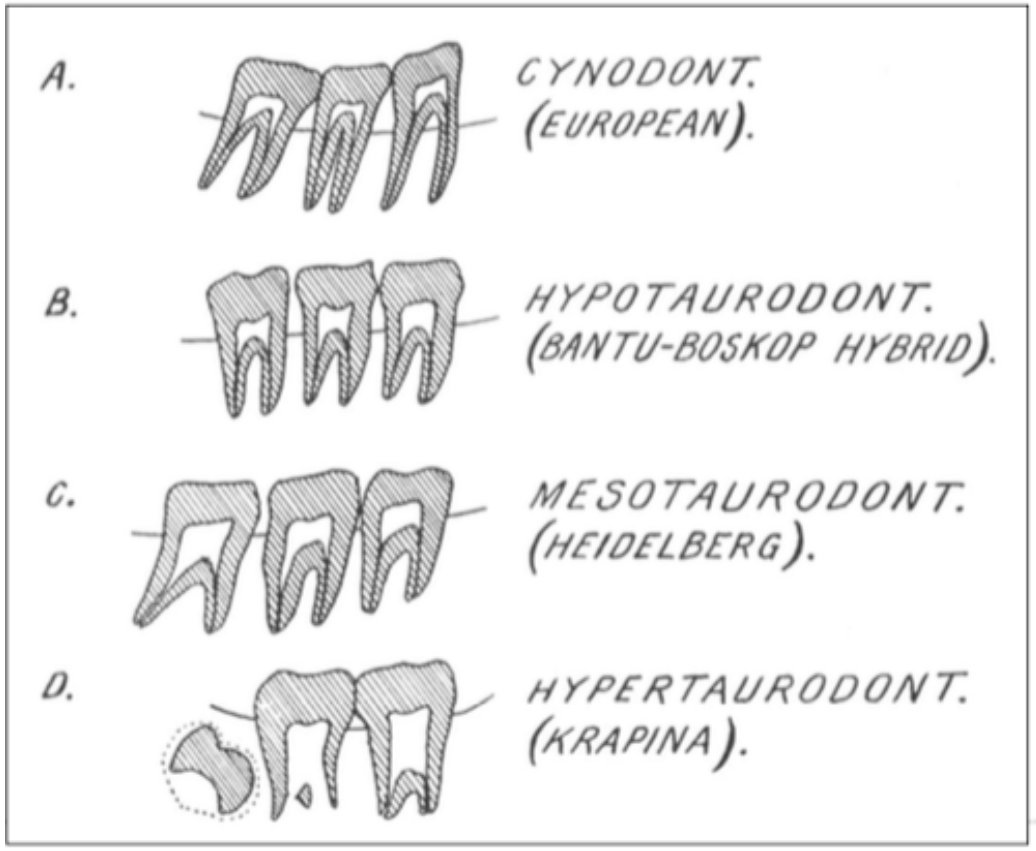


Lopez et al. 2015

Depending on their location enamel pearls can become a nidus for inflammation causing periodontal defects

Taurodontism

- pulp cavity that tends to enlarge at the expense of the roots
- first described by Sir Arthur Keith 1913
- Classification Shaw 1928



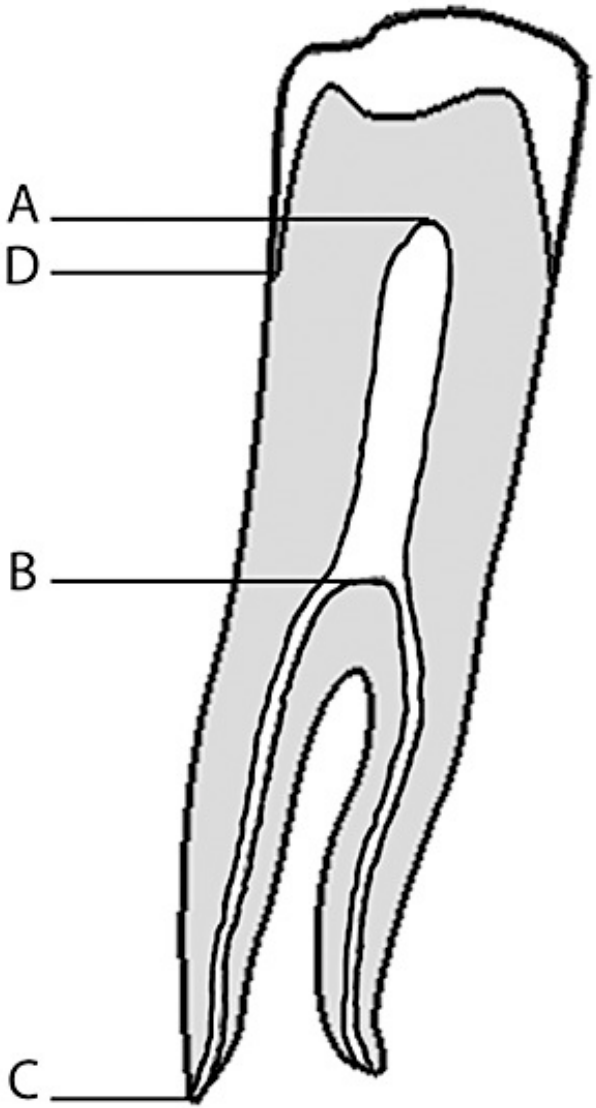
Taurodontism

- **Aetiology**
- unknown
- delay or failure of invagination of Hertwig's epithelial root sheath

- **Prevalence**
- M>F
- Wide range in reported prevalence (5-60%!)

- **Associated anomalies**
- Amelogenesis Imperfecta
- Hypodontia (35% prevalence in patients with hypodontia)
  - (Seow & Lai 1989)

Taurodontism



A - Highest point of the pulp chamber roof

B - Lowest point of the floor

AB - Vertical height of the pulp chamber

AC - Distance between the highest point of the roof of the pulp chamber to the apex of the longest root

BD - Distance between the cemento-enamel junction and the lowest point on the floor of the pulp chamber

To establish taurodontism, the following criteria are used:

(AB/AC) x 100 > 20 and BD > 2.5 mm

The Taurodontic Index (TI) was calculated as AB/AC x 100. The degrees of taurodontism were categorized as follows:

- Hypotaurodontism: TI 20-30
- Mesotaurodontism: TI 30-40
- Hypertaurodontism: 40-75

Shifman and Chanannel 1978

Taurodontism

- **Clinical Implications**
- short but very curved canals

- canals difficult to visualise due to length of pulp chamber

- thermoplasticised GP recommended

Taurodontism