Development of teeth

Under construction

Do not edit, change or move this article, please. If you have some comments or suggestions, use the . You can also contact the author of this page - you will find their name in history (https://www.wikilectures.eu/index.php?title=Development_of_teeth&action=history) of this page.

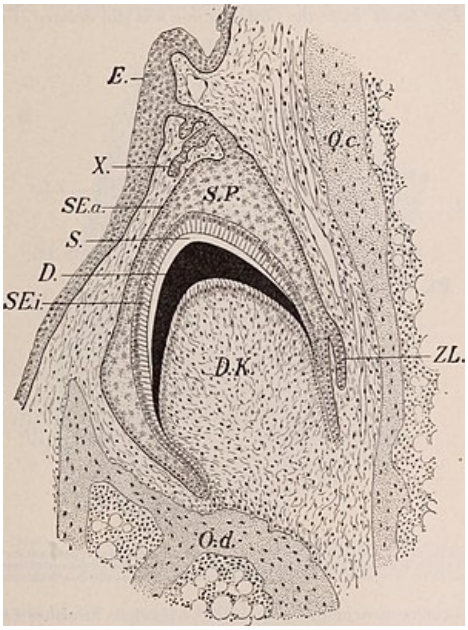
Last update: Sunday, 19 Nov 2023 at 9:37 pm.

This article has been translated from WikiSkripta; ready for the **editor's review**.

Teeth are one of the elements indicating the external shape of the face, together with the degree of development of the paranasal sinuses and the growth of the jaw. They arise as a result of the interaction between the epithelium of the oral cavity and the ectomesenchyme. They develop from the [[ectoderm]]of the oral cavity, the mesodermand the neural crest cells.

Teeth Development

Cotyledon proliferation



Dental germ

Tooth development is the interplay of proliferation of two germ sheets – **ectoderm'** and **mesenchyme**. At the same time, these two leaves stimulate each other to activate the ripening abilities. First, a primitive oral cavity is formed - *[[stomodeum]]*. Over time, the protrusions participating in the formation of the *face* coalesce, and the stomodeum thus changes its shape from the original pentagon to the shape of a transverse slit. The *Rima oris*, the oral cleft, thus acquires its definitive shape mainly through the fusion of the upper and lower primitive lip parts. The **ectoderm** epithelium that is on the surface of the lips begins to move further into the lip. A furrow is defined, which grows into the bases of the lips from the mesenchyme and the labiogingival ridge is formed. The *labiogingival strip* doubles along its entire length, and the outer part provides the foundation for the upper and lower lips, the inner part for the gums. In the gingival part, the dentogingival ridge is formed, when its dental part sinks into the mesenchyme. The *Lamina dentalis* is fully formed around the 6th week of intrauterine development. Its shape corresponds to the shape of the upper and lower lip.

Development of tooth germ

File:Histology of important stages of tooth development.. jpg
Stages of dental development

'*Epithelial cells of the dental lamina* begin to change their shape and cluster into primitive formations - **dental buds**. The tooth buds continue to be connected to the gingival epithelium by an epithelial band. The tooth buds sink more into the mesenchyme and change their shape. This is followed by a change in shape in several stages. Dental **bud'**, **cup**, **bell** stage. The cup stage is conditioned by the ingrowth of mesenchyme into the part of the tooth bud that is away from the dental bar. The bell stage is conditioned by the development of enamel nodules according to the number of tooth cusps. This **grown mesenchyme** is called the *dental papilla*.

Ameloblasts and odontoblasts

File:Enamelmineralization11-17-05.jpg
Histology of a developing tooth

The dental papilla is lined with ectoderm epithelium, which divides into two layers of cells – **an outer and an inner strip of ameloblasts'*. The ameloblasts of the outer and inner layers are connected by a thin tissue, also of epithelial origin, which we call* reticular epithelium*.** Ameloblasts and reticular epithelium together form the **enamel organ**, from which the [[Enamel|**enamel**] will gradually develop. Inner ameloblasts are tall cylindrical cells, outer ameloblasts are cubic in shape. **Contact of the dental papilla with the surface of the internal ameloblasts** leads to the differentiation of special cells - **odontoblasts**. The mesenchymal papilla is very well supplied with blood by a network of capillaries, so it is able to nourish both the odontoblasts and the enamel organ that is in contact with the odontoblasts. The single membrane that separates the enamel organ from the odontoblasts is called the *membrana praeformativa*. Around these formations, a so-called sac , **dental follicle** arises from the surrounding mesenchyme, from which cement and the periodontium proper develop later.

Formation of hard dental tissues

Ameloblasts are cells capable of forming **enamel'** ***and odontoblasts are*** *dentin****. The formation of enamel and dentin takes place simultaneously as*** *matrix secretion*. The enamel is formed by **enamel prisms** which are gradually piled up in the apical direction. Enamel is formed according to the dogma – 1 ameloblast = 1 prism. The inner ameloblasts therefore give way to the newly formed enamel at the expense of shrinking the zone of the reticular epithelium and approach the outer ameloblasts. When the outer and inner ameloblasts fuse, crown development is complete and the enamel is covered only by a fine **cuticle'**. The cuticle is shed as the tooth begins to cut into the oral cavity. The union of the outer and inner ameloblasts creates the **Hertwig sheath**, which is very important for the **root development*****. Unlike ameloblasts , odontoblasts do not disappear after the development of dentin. They persist throughout life and are able to form secondary, tertiary or sclerotic dentin. Their first secreted product is unmineralized dentin -*** *predentin*. Predentin is mainly composed of collagen fibrils and mucopolysaccharides. The dentin gradually *mineralizes* and the odontoblasts retreat deeper into the mesenchymal papilla in front of the newly formed dentin. Odontoblasts are never part of dentin per se. They leave only their **Tomes filaments** in the dentin, which are their cytoplasmic projections. These take place in the dentinal tubules.

Dental pulp formation

Mesenchymal dental papilla gives rise to '*dental pulp*. The dental pulp is made up of a *jelly-like* tissue with many capillaries and nerve endings. In order for the dental pulp to locate inside the future tooth, root development is required.

Root Development

The development of the root takes place ""delayed"" compared to the development of enamel and dentin. It begins to form a little before pruning the crown. The **Hertwig's sheath'** ***has a large role in shaping the shape of the root - it forms its form for the deposition of dentin. It influences nearby cells in the mesenchymal papilla to differentiate into odontoblasts and form root dentin. Again, predentin is formed first, which is gradually mineralized and thus obliterates the wide dental pulp in the form of a narrow canal. However, the narrow channel is still connected by nerves and blood vessels to the surrounding environment. When root development is complete, Hertwig's sheath disappears. However, it may persist in the form of*** *Malassez epithelial plugs*. These pins retain their proliferative properties and can be the cause of tumor growth in later life. Cement on the surface of the dentinal root is formed from the dental sac that surrounds the entire developing tooth. The contact of the dentin with the mesenchymal cells of the dental sac results in a morphological change of the cells into cementoblasts, which are able to secrete cement. At first, cement formation is slow, but it accelerates towards the apex. Due to the rate of cementum formation at the apex, the cemetoblasts cannot retreat and are therefore entrapped in the cementum. We can therefore distinguish between *acellular cement* in the upper 2/3 of the tooth and *cellular* cement in the 1/3. From the remnants of the dental pocket around the tooth, the periodontium and its ligaments and the future bone bed are differentiated. These ligaments, **Sharpey's fibers**, are important in connecting the tooth in the socket to the bone base. The developing root gradually moves the crown of the tooth up toward the gum to cut through the .< ref>MÁZANEK, George, et al. *Dentistry : propaedeutics.* 1. edition. Prague : Grada, 2014. ISBN 978-80-247-3534-4. < /ref> <ref>WEBER, Thomas – KOŤOVÁ, Magdalena. *Memorix of Dentistry.* 2. edition. Prague : Grada, 2012. ISBN 9788024735191. < /ref><ref>MOORE, Keith L. – PERSAUD, TV N. *The Birth of Man.* 1. edition. Prague : ISV, 2002. 564 pp. ISBN 80-85866-94-3. < /ref><ref>KLEPACEK, Ivo. *Dental anatomy, periodontium, tooth development* [lecture for subject Anatomy, specialization Dentistry, 1. LF UK]. Prague. November 2010. Avaliable from <https://el.lf1.cuni.cz/zub07>. < /ref>

Tooth development in brief

- Upper and lower **dental lamina'**, *lamina dentalis* - corresponds to the upper and lower jaw (6th week of embryonic development) → divides into a number of separate islands, **tooth buds'** (approx. 8th week), of which there are 10 in each jaw – the basis of the ectoderm part of the future teeth.
- By immersion of tooth buds into the [[mesenchyme]]of the jaw, '*tooth cups* are formed (cup-shaped stage of tooth development, 9th week).
- The wall of the goblet later splits and forms: outer and inner layer of cells = outer and inner enamel epithelium, between which a thin, network-organized layer - stellate reticulum is formed, the whole structure is then called the *vitreous organ*, the mesenchyme surrounds dental cup and arches into it as **dental papilla** (*papilla dentalis*).
- In further development (around the 3rd month), the dental cup forms a *bell-shaped structure* (bell stage), vessels and nerves grow into the dental papilla. The mesenchymal cells of the papilla adjacent to the inner layer of the enamel epithelium undergo differentiation into **odontoblasts'** => begin to produce **dentin**, the bodies of the odontoblasts are pushed deeper into the dental papilla by the dentin, leaving behind long projections cytoplasms – **Thomas filaments**. The odontoblast layer is maintained throughout life and is able to continuously produce dentin. The remaining mesenchymal cells of the *dental papilla* form the dental pulp (*pulpa dentis*).
- In the meantime, the cells of the enamel epithelium differentiate into **ameloblasts'*****, which begin to produce*** *enamel* (*enamel*). The enamel first accumulates at the tip and then spreads towards the neck of the tooth, as the enamel increases, the ameloblasts are pushed into the reticulum of the enamel organ and gradually disappear (a part, however, is taken into the *tooth membrane* (*cuticula dentis*) - blank covering the enamel surface).
- Differentiation of the tooth root, where the cells of both layers of the enamel epithelium come together at the edge and form an '*epithelial root sheath* (Hertwig's sheath) around the papilla. Mesenchymal cells pressing on the dentin of the root - differentiation into cementoblasts, producing dental cementum, outside of it the periodontium differentiates from the surrounding mesenchyme.

- The growth of the root causes the crown of the tooth to be pushed into the oral cavity, the eruption of temporary teeth from the 6th to the 24th. months of postnatal life.
- Buds of permanent teeth appear during the 3rd month of intrauterine development, remain in a latent stage until the 6th year of postnatal life, then begin to grow and contribute to the loss of the teeth of the temporary dentition.

Teething

- The cutting of temporary teeth takes place in the following order:
  - i_1, i_2, m_1, c, m_2.
- Eruption of permanent teeth takes place in the following order:
  - M_1, I_1, I_2, P_1, C, $P_{2< /sub>}$, M_2, M_3.

🔎 *For more information see Teething.*

Molecular regulation of tooth development

- The formation and development of teeth parallels the development of the neural crest.
- Development occurs through the interaction between epithelium and mesenchyme.
- The tooth pattern is determined by the expression of HOX genes in mesenchymal cells.
- Signaling molecules involved in tooth development - WNT, BMP, FGF, SHH and transcription factors - MSX1 and 2.

Abnormalities in tooth development

- Variations in the shape of the teeth.
  - **Enamel pearls** - spherical masses of enamel found in teeth.
- Numerical Abnormalities:
  - **supernumerary teeth** - occur in the area of the upper incisors, disturb the position and cutting of normal teeth,
  - **partial anodontia** - one or more teeth are missing,
  - **total anodontia** - teeth do not develop at all, this phenomenon is usually associated with AED (congenital anhydrotic ectodermal dysplasia).
- Abnormal size of teeth:
  - **macrodontia**' x **microdontia**.
- **Amelogenesis imperfecta** - the enamel is soft, pliable, insufficient calcification, the teeth have a yellow/brown color. Autosomal dominant affection, the teeth are covered with a layer of abnormally formed enamel, the adjacent dentin shows through (hence the yellow-brown color).
- **Dentiogenesis imperfecta** - teeth are brown to grey-blue, the cause lies in the abnormal differentiation of odontoblasts, the production of insufficiently calcified dentin.
- **Abnormally colored teeth** - due to the action of various substances, e.g. tetracyclines.

🔎 *For more information see Disorders of tooth development.*

< noinclude >

Links

Related Articles

- Teething
- Disorders of tooth development
- Orthodontic anomalies

External links

- HOT, Drahomir – NOVÁKOVÁ, Květoslav. *Morphology of the Orofacial System for Dental Students* [online] . 2. edition. Published online. 2011. Available from <https://mefanet.upol.cz/clanky.php?aid=58>. ISBN 978-80-244-2702-7.

References

- SADLER, Thomas w. *Langman's Medical Embryology.* 10. edition. Prague : Grada, 2011. 432 pp. ISBN 978-80-247-2640-3.

- MOORE, Keith L. – PERSAUD, TV N. *The Birth of Man.* 1. edition. Prague : ISV, 2002. 564 pp. ISBN 80-85866-94-3.

- ŠIHÁK, Radomír, et al. *Anotomy.* 2. edition. Prague : Grada, 2002. 488 pp. ISBN 80-247-0143-X.

- KLEPACEK, Ivo. *Dental anatomy, periodontium, tooth development* [lecture for subject Anatomy, specialization Dentistry, 1. LF UK]. Prague. November 2010. Avaliable from <https://el.lf1.cuni.cz/zub07>.