Development of taste buds

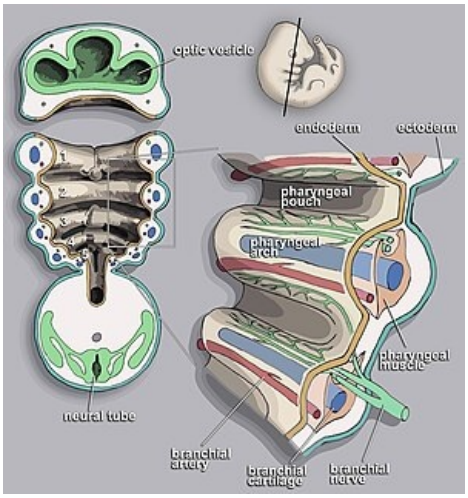
The head and neck landscape of a four-week-old embryo is similar to the gill region of a fish embryo, which is why the term gill arches (branchial) was previously used. These gill-like structures either rebuild and adapt to new functions, or disappear completely.

The **pharyngeal** (gill) **apparatus** consists of:

- pharyngeal arches,
- pharyngeal nodules,
- pharyngeal slits,
- pharyngeal membranes.

Pharyngeal arches

Their development begins at the beginning of the 4th week with the migration of neural ridge cells to the future neck and head region. By the end of the 4th week, four well-defined pairs of arches can be discerned on the sides of the embryo (the 5th and 6th arches are rudimentary and not visible). The arches are clearly separated from each other by grooves - pharyngeal depressions (slots).



Contents and distribution of the pharyngeal arches.

First pharyngeal arch

It creates two processes - the smaller maxillary process (*processus maxillaris*) → gives rise to the upper jaw, the zygomatic bone and the temporal bone scales. The greater mandibular process (*processus mandibularis*) forms the lower jaw. The first pharyngeal arch therefore plays a crucial role in the development of the jaws.

Second pharyngeal arch - hyoid'

It contributes the most to the formation of tongue.

Other arcs are indicated only by numbers. Arches reinforce the lateral walls of the primordial pharynx. The **Stomodeum** forms the base of the mouth. It initially looks like an indentation of the surface ectoderm, it is separated from the pharynx cavity by a two-layer partition - the oropharyngeal membrane (one layer of bb. ectoderm and one layer of endodermu cells). The oropharyngeal membrane disappears around day 26 (from this time the primitive intestine acquires communication with the amnium).

Parts of pharyngeal arches

Initially, the arch consists only of a mesenchymal nucleus bounded on the outside by the ectoderm and on the inside by the endoderm. During the 4th week, neural ridge cells travel to the arches, which differentiate into mesenchyme in the arches and accompany the formation of the maxillary and mandibular processes. Neural crest cells are unique in that, despite their neuroectoderm origin, they represent the major source of head and neck mesenchyme. However, skeletal musculature and endothelium vessels arise from original mesenchyme.

The fate of the pharyngeal arches

During the 5th week, the second arch enlarges and outgrows the third and fourth arches, creating an ectoderm slit - the *sinus cervicalis*. At the end of the seventh week, the 2nd to 4th arch (including the *sinus cervicalis*) disappears and the contour of the neck becomes smooth.

A typical pharyngeal arch includes:

- aortic arch – an artery from the truncus arteriosus of the primitive heart, wraps around the pharynx and opens into the dorsal aorta;
- cartilage – forms the skeleton of the arch;
- muscular component;
- nerve – supplies the mucous membrane and muscles, which are derived from the arch.

Pharyngeal cartilage derivatives

Cartilage of the first arch, **Meckel's cartilage**':

- the dorsal part gives rise to two ossicles of the middle ear – hammer and anvil;
- the middle part disappears, but its perichondrium persists as a lig. mallei anterius and lig. sphenomandibular;

- the ventral part forms the horseshoe-shaped base of the mandible;
- cartilage disappears when bone is formed around it by intramembranous ossification.

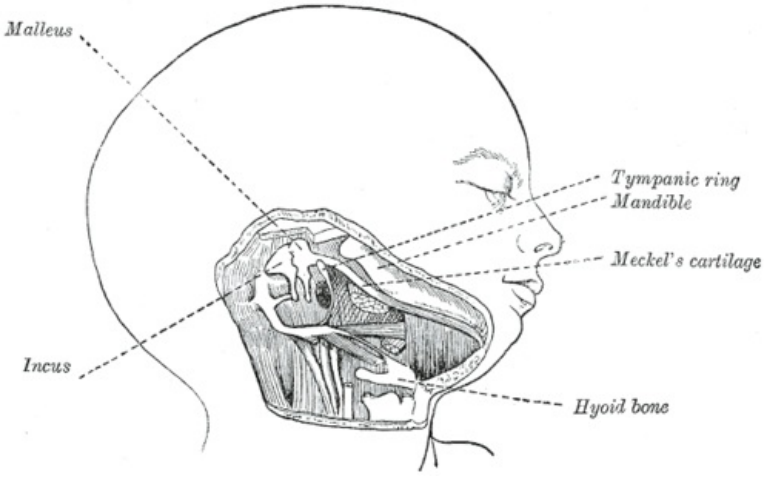
Cartilage of the second arch, '*Reicher's cartilage*:

- dorsal part gives rise to stirrup and proc. styloid ossis temporalis;
- the middle part disappears and the rest is formed by the lig. stylohyoid;
- the ventral end of the cartilage ossifies and forms the cornua minora and the corpus ossis hyoidei.

Cartilage of the third arch:

- ossifies in the big horns and the lower part of the body of the tongue.

The fourth and sixth cartilages fuse into the cartilages of the larynx (except for the epiglottis, which develops from the mesenchyme of the hypobranchial eminence).



Head and neck of human embryo at week 18 - Meckel's cartilage.

Derivatives of the muscles of the pharyngeal arches

The First Arc

Derivatives of the first arch include masticatory muscles, m. mylohyoideus, digastric anterior belly; then m. tensor tympani and m. tensor veli palatini.

The Second Arc

Derivatives of the second arch are mimic muscles, m. stapedius, m. stylohyoideus, posterior belly of the digastric.

Third Arc

The derivatives of the third arch include the stylopharyngeus m

Fourth Arch

The muscles of the larynx, m. levator veli palatini, mm. constrictores pharyngis, the striated muscle of the esophagus originate from the fourth arch.

Derivatives of the nerves of the pharyngeal arches

Each arch has its own cranial nerve.

- The first arch – contains the 2nd and 3rd branches of the trigemin;
- second arch – n. facialis;
- third arch – n. glossopharyngeus;
- fourth arch – n. vagus;
  - or The 4th arch has n. laryngeus superior, the 6th arch has n. laryngeus recurrens.

Pharyngeal nodules

The endoderm of the pharynx lines the inner surface of the pharyngeal arches, where it forms balloon diverticula - pharyngeal protrusions. The first pair of notches are located between the first and second arches. A total of 4 defined pairs of protrusions are formed (the 5th pair is rudimentary). The endoderm comes into contact with the ectoderm of the pharyngeal slits and together they form the pharyngeal membranes.

Derivatives of the first pharyngeal notch

It extends laterally as recessus tubotympanicus. The distal part communicates with the first pharyngeal slit and later contributes to the formation of the membrana tympani. The cavity of the recessus tubotympanicus gives rise to the cavum tympani and the antrum mastoideum. The connection with the pharynx gradually lengthens until the auditory tube is formed.

Derivatives of the second pharyngeal notch

The second pharyngeal notch turns into a palatine tonsil. It is usually obliterated or partially persists as sinus tonsillaris. The entoderm proliferates and grows into the surrounding mesenchyme, the central parts of the entoderm pins disintegrate and pit-like depressions - crypts - are formed. Around the 20th week, the mesenchyme around the crypts differentiates into lymphoid tissue.

Derivatives of the third pharyngeal notch

The bulb expands to form a solid bulbar part and an elongated hollow ventral part. The connection with the pharynx narrows until it disappears. At the end of the 6th week, the epithelium of both dorsal bulbar parts begins to differentiate and forms the **inferior parathyroid gland'**. The epithelium of the ventral lobe proliferates until it obliterates the lumen, the bases from both sides merge to form the base of the thymus, which then descends into the anterior mediastinum. The thymus remains at all times divided into two lobes, which have their own vascular and nerve supply.

Derivatives of the fourth pharyngeal notch

Similar to the third, this protrusion also creates a dorsal bulbar and a ventral elongated part. The connection with the pharynx is reduced to a narrow duct, which soon degenerates. Both dorsal parts turn into **superior parathyroid glands'** (even though the lobe is lower than the 3rd), so those bodies are higher because the lower bodies from the 3rd lobe descend a bit along with the thymus, making it lower. the elongated ventral part develops into the ``ultimobranchial body *(so named because it is the last of all pharyngeal structures to develop), which eventually merges with the base of the thyroid gland and its elements are located in the parenchyma disperses as parafollicular cells (originating from neural crest cells that travel from the arches to the 4th pair of lobes).*

Pharyngeal slits

They separate the pharyngeal arches from the outside. Only the first pair, which persists as the external auditory canal, is significant. The other slits lie in the sinus cervicalis and obliterate together with it during the development of the neck.

Pharyngeal Membranes

Only the first membrane contributes to the definitive structures, which, together with the interspersed mesenchyme, forms the ear drum.

Thyroid Development

The first endocrine gland that develops in the embryo is the thyroid gland. Development begins around day 24 with endoderm thickening at the floor of the pharynx. In its place, a small lump, the so-called thyroid diverticulum, will soon appear. As the embryo and tongue grow, the gland descends into the throat in front of the uvula and laryngeal cartilages. For a short time, it remains connected to the tongue by a thin tube - ductus thyreoglossus. The diverticulum is initially hollow, but then becomes compact and divides into left and right lobes, which are joined by an isthmus. The gland has its definitive shape and placement in the 7th week, by which time the thyreoglossus duct has already disappeared. The proximal mouth of the duct persists as a small hole at the root of the tongue - the foramen caecum linguae. In 50% of cases, it departs from the isthmus of the lobus pyramidalis, which can be fixed on the tongue by a band of fibers or a bundle of smooth muscle (m. levator glandulae thyrodieae).

Language Development

At the end of the fourth week, a triangular elevation appears on the floor of the primitive pharynx (rostral to the foramen caecum), in the midline - the medial lingual protrusion (tuberculum impar). On its sides, two oval distal lingual projections (lateral lingual bumps) will soon form. They are accumulations of mesenchyme of the first gill arch. The distal processes rapidly enlarge, fuse together and outgrow the tbc. impar (they form the front two thirds of the tongue). the tuberculum impar does not form any outwardly visible part of the tongue. The formation of the back of the tongue is indicated by two projections caudal to the foramen caecum.

- copula (lat. bond, bundle) – is formed by joining the ventromedial parts of the second pharyngeal arches;
- eminentia hypobranchialis – caudal to the copula from the ventromedial part of the third and fourth arches;

The copula is gradually covered by an eminence, which is why the 3rd and 4th arches are mainly involved in the back part of the tongue. Muscular bb. they travel from the occipital myotomes and drag the nervus hypoglossus with them. After birth, the entire tongue is in the oral cavity, the back part descends into the pharynx by the fourth year of life.

Development of taste buds

- Papillae circumvalatae and foliatae appear first, near the terminal branches of n. IX;
- fungiform papillae are formed later around the branching of the n. lingualis (chorda tympani – n. VII...);
- papillae filiformes (the most common papillae of the tongue) develop at the beginning of the fetal period (10th week);
- taste buds develop 11-13 weeks.

Nerve supply of the tongue

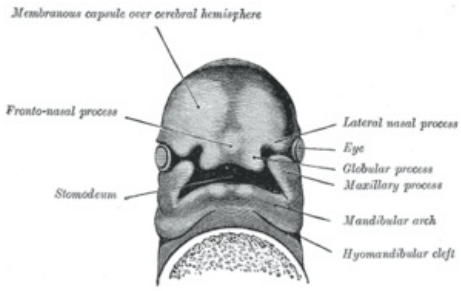
The front two thirds are derived from the first pharyngeal arch - therefore they are innervated by the third branch of n. V (n. lingualis). The derivative from the second arch (copula) has been covered, therefore the n. facialis does not innervate the tongue (except for taste on the first two thirds). The posterior region is innervated by the glossopharyngeus n., at the very back is the contribution of the fourth arch - there is also the vagus n.

Facial Development

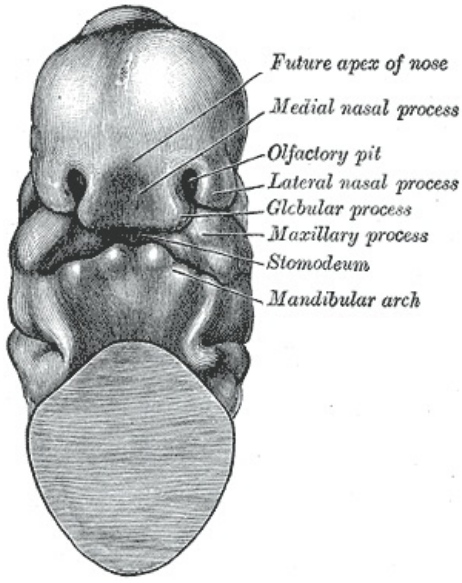
The foundations of the face begin to form at the beginning of the fourth week around the great stomodeus. Development is dependent on the inductive action of the prosencephalic and rhombencephalic organizational centers. Five facial foundations:

- one frontonasal process;
- paired maxillary processes;
- paired mandibular processes;

The facial processes are a derivative of the first pharyngeal arch and are formed mainly by the neural crest cells. The frontonasal process surrounds the ventrolateral circumference of the forebrain, from which the optic sacs emerge. Development takes place mainly between the 4th and 8th week. The mandibular processes are the first to fuse and the lower jaw and lower lip develop. At the end of the fourth week, the nasal placode (the base of the nose and sinuses) is forming in the laterocaudal region of the frontonasal process. Placodes are convex at first, later depressions and hollows form in them. Horseshoe-shaped ridges will appear - medial and lateral nasal projections. Shifting the maxillary processes to the midline will bring the medial nasal processes closer to each other. Both lateral ramparts remain separated from the maxillary processes by a slit (sulcus nasolacrimalis). At the end of the fifth week, the primordia of the auricles begin to form - three ear bumps appear on each side (around the first gill slit). Initially, they are in the neck area, but with the development of the mandible, they slide down the sides of the head to the level of the eyes. During the seventh week, the vascular supply of the face is switched from a. carotis interna to externu (reflecting the transformation of the initial pattern of the aortic arches).



Facial development - 29 day old human embryo.



Facial development - 30 to 31 day old human embryo.

Development of Nasal Cavities

Nasal placodes deepen to form nasal pits. Proliferation of the mesenchyme gives rise to a medial and lateral nasal process, which further deepens the nasal pits and gives rise to the primordia of the nasal sacs. The pouches grow in a dorsal direction. Initially, the cavity is separated from the mouth by the oronasal membrane, but it disappears and the two spaces merge into one another. The choans grow in the cavity and the olfactory epithelium differentiates in the ceiling.

Development of secondary sinuses:

- at the time of birth, the maxillary sinuses are small, their development then ends with the eruption of the permanent dentition;
- sinus frontales and sphenoidales develop only postnatally;
- the ethmoid sinuses are small before the second year of life;

From the 6th to the 8th week, the nasal epithelium above the primitive palate invaginates into the nasal septum and forms the organon vomeronasale (Jacobsoni), it is a chemosensory structure, the organ gradually disappears.


Facial development - 8 week old human embryo.

Palate Development

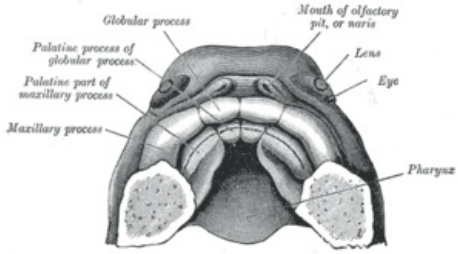
The floor develops from two foundations - from the primary floor and from the secondary floor. The critical period for palate development peaks around the sixth week.

Primary Floor

The processus palatinus medianus develops from the intermaxillary segment of the upper jaw. The median palatine process later forms the base of the premaxilla.

Secondary Floor

It forms the basis of the hard and soft palate in the area behind the foramen caecum. It is formed from two mesenchymal protrusions on the inner surface of the maxillary processes - the lateral palatal processes. The projections first go in the mediocaudal direction, then the growing jaw and the tongue horizontalize them. The projections then merge in the midline to form a floor.



Palate development - 2.5 month old embryo.

Links

Bibliography

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