sory ducts as compared to 40% of adults. Failure of the ventral pancreatic diverticulum to migrate will result in an annular pancreas which may constrict the duodenum locally. Initially the body of the pancreas extends into the dorsal mesoduodenum and then cranially into the dorsal mesogastrium. As the stomach rotates, this portion of the dorsal mesogastrium is directed to the left forming the posterior wall of the lesser sac. The posterior layer of this portion of dorsal mesogastrium fuses with the parietal layer of the coelom wall (peritoneum), and the pancreas becomes mainly retroperitoneal.

The mouth

Oral fissure

The ***oral fissure***, or ***oral opening*** (*rima oris*) is surrounded by two fleshy folds, the *lips* (*labia oris*). The size and curvature of the exposed vermilion surfaces is subject to considerable individual, gender-related, and ethnic variation. The line of contact between the lips lies just above the incisal edges of the anterior maxillary teeth.

On each side a *labial commissure* (*commissura labiorum oris*) forms the *angle of the mouth* (*angulus oris*), usually near the first premolar tooth. The length of the oral fissure is 6–8 cm. The labial epithelia and internal tissues radiate over the boundaries of the commissure to become continuous with those of the cheek.

On each side, the ***upper lip*** (*labium superius*) is separated from the cheek laterally by the *nasolabial groove* (*sulcus nasolabialis*) and is continuous above the nasal ala with the circumalar groove (*sulcus*). Externally, the central region of the upper lip presents a shallow vertical groove, the *philtrum* (*philtrum*), which is limited above by its attachment to the columella of the nose, and ends below in a slight *tubercle* (*tuberculum labii superioris*) limited by lateral ridges (Fig. 4). The philtrum divides the upper lip into 3 portions (one middle and two lateral ones).

The ***lower lip*** (*labium inferius*) is on a more posterior plane than the upper lip. The lower lip is separated from the chin by the *mentolabial groove* (*sulcus mentolabialis*). The lower lip shows a small depression in the midline that corresponds to the tubercle. With age, buccolabial or *labiomarginal grooves* (*sulci labiomarginales*) appear at the corners of the mouth as a border between the lower lip and cheek.

The shape and size of the lips are individual. The upper lip usually protrudes and covers the lower one.

Enlargement of the lips is named macrochelia; significant reduction in their size is termed microchelia; protrusion of the lips is known as prochelia. Straight lips form *orthochelia*; the sunken lips compose *epistochelia*. A short upper lip exposes the gingiva in an opening mouth.

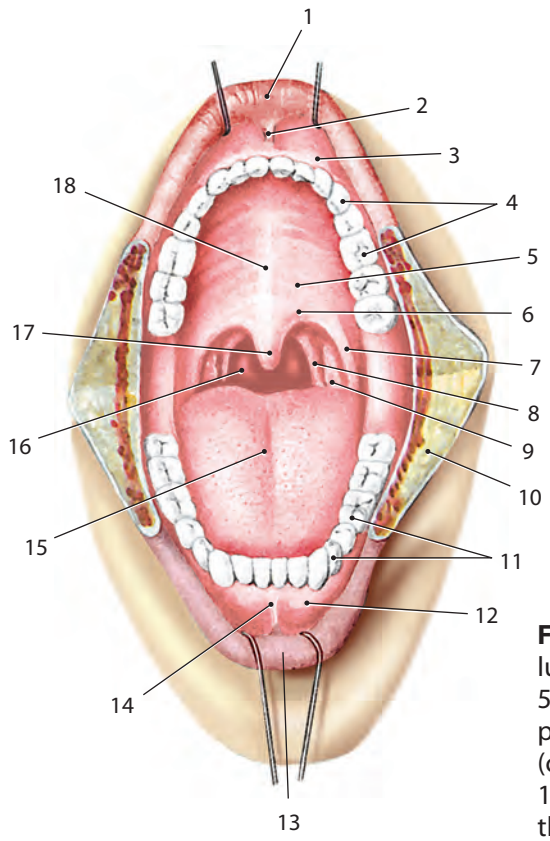

Fig. 4. Oral cavity (anterior view): 1 — upper lip; 2 — frenulum of the upper lip; 3 — gum; 4 — maxillary dental arcade; 5 — hard palate; 6 — soft palate; 7 — palatoglossal arch; 8 — palatopharyngeal arch; 9 — palate tonsil; 10 — buccal fat pad (crossing section); 11 — mandibular dental arcade; 12 — gum; 13 — lower lip; 14 — frenulum of the lower lip; 15 — dorsum of the tongue; 16 — fauces; 17 — uvula; 18 — palatine raphe

In newborns and infant children lips are relatively thick, their muscle tissue is well developed; the lower lip protrudes forward. The papillae of the posterior mucosa are strongly developed, which is important to sucking.

Each lip contains a thick strand of parallel bundles of skeletal muscle fibres, skin coating the lips outside, and mucous membrane lining them inside. The skin becomes mucosa on the clamping line of the lips.

The muscular layer of the lips is represented by the orbicularis oris muscle and the muscles of the buccolabial muscle group extending in the radial direction (elevators and depressors of the lips, elevators and depressors of the angle of the mouth, risorius). Due to the muscles with various functions the lips are very mobile and can significantly change the shape and size of the mouth opening.

The skin of the lips is thin and adherent to the underlying muscle layer. The hypoderm is found in small quantities only in the angle of the mouth.

The lips are divided into the external (skin) region, the vermilion zone, and the internal (mucosal) region.

The *cutaneous part* (*pars cutanea*) shares the structure of the skin. It is covered by thin keratinized stratified squamous epithelium. The dermis is well vascularized and contains numerous hair follicles (many of them large in the male), sebaceous glands and sweat glands.

The *transition*, or *vermilion part* (*pars intermedia*) contains stratified squamous epithelium which is thick and either lacks a superficial layer of keratin or is lightly keratinized. Under the epithelium there are tall connective tissue papillae that are close to the surface. The vermilion border is pinkishred because of the relatively translucent epithelium and the blood in capillaries in the papillae. This border lacks hair follicles and, because it has no glands, is dry. This mucocutaneous junction is named the red border of the lips. In newborns the intermediate part is covered with numerous papillae.

The *mucosal part* (*pars mucosa*) is lined by an oral mucous membrane consisting of thick nonkeratinized stratified squamous epithelium and underlying lamina propria of loose, richly vascularized connective tissue that indents the epithelium with papillae. These papillae resemble those under the epidermis but are thinner and more delicate. The highly corrugated interface between epithelium and lamina propria firmly anchors these tissues against mechanical forces such as friction. The lamina propria contains collagen and elastic fibers, which permit distensibility over underlying tissues. It also harbors capillaries and lymphatics plus many lymphocytes and other cells, which aid in immunologic defense against pathogens and irritants in the external environment. Small groups of minor salivary glands, the labial glands, are deep to the lamina propria in the submucosa. Secretions of these mainly mucussecreting exocrine glands drain onto the oral surface via small ducts, thereby providing moisture and lubrication. In infants the mucous membrane of the lips is very thin, composed of 2–3 layers of cells and is very floating. Frenula and lateral folds of mucous membrane are expressed more clearly.

The oral cavity

The ***oral cavity*** (*cavitas oris*) is limited by the *lips* and *cheeks* in front and on the sides; the superior wall of the cavity is the *palate*, the inferior wall is the *floor of the oral cavity* (Fig. 5). At the back the oral cavity is connected to the cavity of the pharynx through the fauces. *Teeth* and *gums* divide the oral cavity into 2 sections: the outer portion is the *oral vestibule* (*vestibulum oris*), and the internal portion is the *oral cavity proper* (*cavitas oris propria*).

Oral vestibule

The ***oral vestibule*** (*vestibulum oris*) is a slit-like space between the lips or cheeks on one side and the teeth and gingiva on the other. When the teeth occlude, the vestibule is a closed space that only communicates with the oral cavity proper in the retromolar regions behind the last molar tooth on each side (*spatia retrodentalia*) and *interdental spaces* (*spatia interdentalia*), that are limited by teeth at the front, by gums upward and downward and by the pterygomandibular fold of mucosa. This fold is formed because the mucous membrane covers the pterygomandibularis raphe, where bundles of the buccal muscle and superior pharyngeal constrictor muscle originate from.

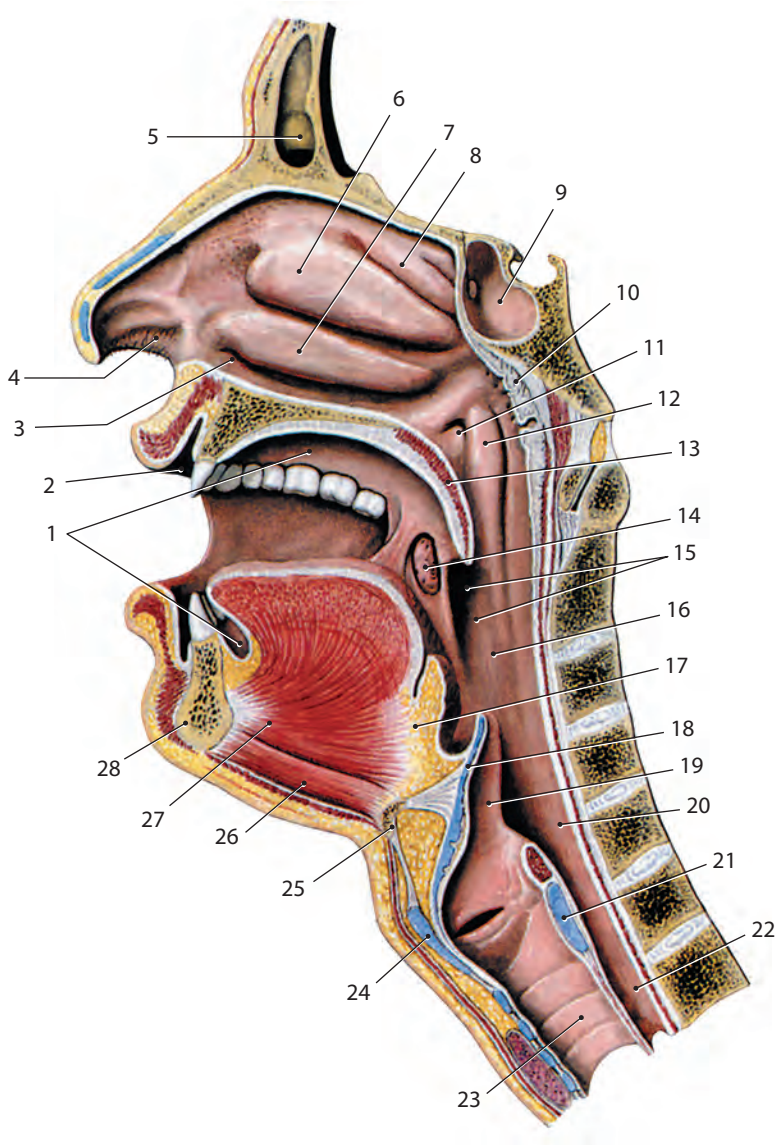

Fig. 5. The oral cavity and pharynx, sagittal section (medial aspect): 1 — oral cavity proper; 2 — oral vestibule; 3 — inferior nasal meatus; 4 — nasal vestibule; 5 — frontal sinus; 6 — middle nasal concha; 7 — inferior nasal concha; 8 — superior nasal concha; 9 — sphenoidal sinus; 10 — pharyngeal tonsil; 11 — pharyngeal opening of the auditory tube; 12 — torus tubarius; 13 — soft palate; 14 — palatine tonsil; 15 — nasopharynx; 16 — oropharynx; 17 — lingual tonsil; 18 — epiglottis; 19 — ary-epiglottic fold; 20 — laryngopharynx; 21 — cricoid cartilage; 22 — oesophagus; 23 — trachea; 24 — thyroid cartilage; 25 — hyoid bone; 26 — mylohyoid muscle; 27 — geniohyoid muscle; 28 — mandible

Where the mucosa that covers the alveolus of the jaw (gingival) is reflected onto the lips and cheeks, the fornix of the vestibule is formed (*fornices superior et inferior*). In the midline the folds of the mucosa are named *frenula of the upper and lower lips* (*frenulum labii superioris* et *frenulum labii inferioris*). Frenulum of the upper lip is larger than that of the lower one.

The parotid duct and numerous minor salivary glands open into the oral vestibule.

In children the oral vestibule has a lesser volume (depth), frenula and accessory folds (frenula) of mucous membrane separate superior and superior fornices of the vestibule into several sections.

The *cheek* (*bucca*) is a paired area of the face limited by nasolabial grooves at the front and anterior edges of the masticatory muscles at the back, by the inferior edges of the zygomatic bone at the top, and the base of the body of the mandible at the bottom. The cheek consists of the skin, muscles and mucosa. The skin of the cheeks is thicker than the skin of the lips; subcutaneous adipose tissue is well expressed. The cheek contains the buccinator muscle. In addition, muscles of the buccolabial group are in the cheeks. A variable, but usually considerable, amount of adipose tissue is often encapsulated to form a biconcave mass, the *buccal fat pad of Bichat* (*corpus adiposum buccae*) particularly evident in infants. Processes of the fat body of cheek spread between the buccinator and masseter muscles in the deep facial space.

The mucous membrane of the cheek is smooth with an open mouth and forms a series of folds when it is closed. There is an eminence on the level of the second upper molar, it is the *papilla of the parotid duct* (*papilla ductus parotidei*). The walls of the cheek also contain fibrous connective tissue, vessels, nerves and numerous small buccal mucous (salivary) glands.

The ***gum***, or *gingiva* (*gingiva*) is a part of the mucous membrane that covers the alveolar process of the maxilla and the alveolar part of the mandible near dental alveoli on the vestibular and lingual surfaces (Fig. 6).

The gingivae can be subdivided into attached gingivae and free gingivae. Attached gingivae are firmly bound to the periosteum of the alveolus and to the teeth, whereas free gingivae, which constitute approximately 1 mm of the *gingival margin* (*margo gingivalis*), lie unattached around the cervical region of each tooth. The free gingival groove between the free and attached gingivae corresponds roughly to the floor of the gingival sulcus which separates the inner surface of the attached gingivae from the enamel. The *gingival* or *interdental papilla* (*papilla gingivalis* seu *interdentalis*) is that part of the gingivae which fills the space between adjacent teeth. A mucogingival line delineates the attached gingivae on the lingual surface of the lower jaw from the alveolar mucosa towards the floor of the mouth. There is no corresponding obvious division between the attached gingivae and the remainder

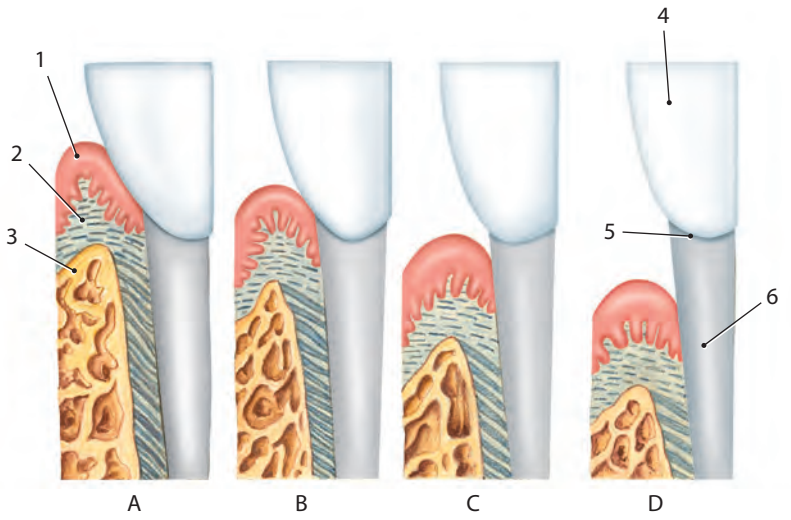

Fig. 6. Age relations of the gum with the tooth (scheme): A, B — childhood, C — mature age, D — senile age: 1 — epithelium of the gum; 2 — lamina propria of the mucosa; 3 — bone; 4 — crown; 5 — neck; 6 — root

of the palatal mucosa because this whole surface is orthokeratinized masticatory mucosa, which is pink. Gingival mucosa is keratinized or parakeratinized.

At the base of the alveoli mucosa becomes a lining of the jaw body.

The gingiva in children is relatively thicker than in adults. 5 gingival tooth tubercles are formed in the area of contact edge on each half of upper and lower jaws in children with unerupted teeth. They correspond to deciduous teeth and are separated by grooves. In dental tubercles mucosa has a whitish color, the rest is red due to a large number of vessels. Dental tubercles are better developed in the area of molar rudiments of the lower jaw. The tubercles of the upper jaw are slightly wider than those of the inferior one.

The oral cavity proper

The ***oral cavity proper*** (*cavitas oris propria*) is bounded by the hard and soft palate from above and by the tongue and mucosa, which covers the muscles of the floor of the oral cavity, from below; and by dental arches and gums from the outside. The oral cavity proper opens via the fauces to the oropharynx backward. It is limited by palatine velum at the top, by the palatolingual and palatopharyngeal arches on the sides, and by the root of the tongue at the bottom.

In occluded teeth the oral cavity proper looks like a slit; when the mouth is open, it has an ovoid irregular shape.

In newborns, infants and children under 3 months the oral cavity is very small. It is short and low due to the poorly developed alveolar part and body of the mandible. As the alveoli develop and the teeth erupt, the mouth increases and takes the form of an adult oral cavity by the age of 17–18.

The ***hard palate*** (*palatum durum*) consists of the *bony palate* (*palatum osseum*), including the palatine process of the maxilla, horizontal plate of the palatine bone and of covering soft tissue. It is a septum that separates the oral cavity from the nasal cavity. Accordingly, the hard palate has two surfaces: the oral surface converted into the mouth and the nasal one, which is the bottom of the nasal cavity.

The neonate's hard palate is usually flat. The old people's palate is close to the flat again due to loss of teeth and alveolar bone atrophy.

The oral surface of the hard palate contains a number of channels, grooves, and protuberances. Some greater and lesser palatine and incisive foramens open into it. In the middle the *palatine raphe* (*raphe palati*) is formed at the junction of the palatine processes.

The mucous membrane of the hard palate is covered by non-keratinized stratified squamous epithelium, and along its almost entire length it is intimately connected with the periosteum. In the area of the palatine raphe and palate division adjacent to the teeth, there is no submucosa, and mucosa directly adheres to the periosteum. In the anterior part of the hard palate there is adipose tissue in the submucosa between connective fibres. In the posterior part of the palate there are collections of minor mucous salivary glands. From the outside submucosa is expressed particularly well at the junction of the mucosa from the hard palate into the alveolar processes; here large neurovascular bundles are located.

The mucous membrane of the hard palate has a pale pink color, and the soft palate is pinkish-red. In the mucosa of the hard palate a range of eminences is visible. At the anterior end of the palate raphe the *incisive papilla* (*papilla incisiva*) is situated near the central incisors. It corresponds to the position of the *incisive fossa* (*fossa incisiva*) of the bony palate. *Incisive canals* (*canales incisivi*) with nasopalatine nerves open in this pit. Anesthetic solutions for local anesthesia of the anterior palate are injected in this area.

In the anterior third of the hard palate *transverse palatine folds*, or *palatine rugae* (*plicae palatinae transversae* seu *rugae palatinae*) radiate outwards from the palate raphe (2 to 6). Each contains a core of dense connective tissue. There are projections of the greater palatine foramens at 1.0–1.5 cm medially from the gingival margin at the level of the third molar on each side. Posteriorly to them there are projections of the lesser palatine foramens, through which palatine blood vessels and nerves go to the palate.

The ***soft palate*** (*palatum molle*) forms a part of the posterior wall of the oral cavity. Only a small division of the anterior portion of the soft palate belongs to the superior wall. A bigger posterior part of the soft palate hangs freely downward and backward and received the name the velum of the soft palate (*velum palatinum*). The position and shape of the soft palate depend on its functional state. Thus, in a relaxed state (e.g. during quiet breathing) the soft palate hangs vertically downwards. In this case, there is an almost complete separation of the oral cavity from the oropharynx. At the moment of swallowing the soft palate is elevated and located horizontally isolating the oral cavity and oropharynx from the nasal part of the pharynx. In newborns and infants the soft palate lies horizontally due to small height of the mouth.

The soft palate is a thick fold of mucosa enclosing a *palatine aponeurosis* (*aponeurosis palatina*), muscular tissue, vessels, nerves, lymphoid tissue and mucous glands; almost half its thickness is represented by numerous mucous glands which lie between the muscles and the oral surface of the soft palate. The latter is covered by stratified squamous epithelium, while the nasal surface is covered with ciliated columnar epithelium. The fovea palatini may be seen on each side of the midline: they represent the orifices of ducts from the minor mucous glands of the palate. In its usual relaxed and pendant position, the anterior (oral) surface of the soft palate is concave, and has a median raphe. The posterior aspect is convex and continuous with the nasal floor; the anterosuperior border is attached to the posterior margin of the hard palate. The inferior border is free.

A median conical process, the *uvula* (*uvula*), projects downwards from its posterior border. Both surfaces of the uvula in adults are covered by stratified squamous epithelium. The anterior third of the soft palate contains little muscle and consists mainly of the palatine aponeurosis. This region is less mobile and more horizontal than the rest of the soft palate. A thin, fibrous, palatine aponeurosis is composed of expanded tendons of the tensor veli palatini muscles which strengthens the soft palate.

The lateral wall of the oropharynx presents two prominent folds, the palatoglossal and palatopharyngeal folds. The *palatoglossal arch*, or *anterior pillar of the fauces* (*arcus palatoglossus* seu *plica anterior faucium*), runs from the soft palate to the side of the tongue and contains the palatoglossus. The *palatopharyngeal arch*, or *posterior pillar of the fauces* (*arcus palatopharyngeus* seu *plica posterior faucium*), projects more medially and passes from the soft palate to merge with the lateral wall of the pharynx; it contains the palatopharyngeus. A triangular *tonsillar fossa*, or *tonsillar sinus*, or *tonsillar bed* (*fossa tonsillaris* seu *sinus tonsillaris*) lies on each side of the oropharynx between the diverging palatopharyngeal and palatoglossal arches, and contains the *palatine tonsil* (*tonsilla palatina*). Over the tonsil there is a small *supratonsillar fossa* (*fossa supratonsillaris*).

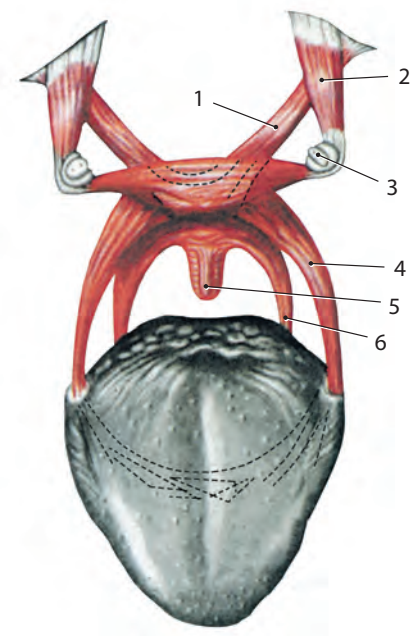

Fig. 7. Muscles of the soft palate (anterior view): 1 — levator veli palatini; 2 — tensor veli palatini; 3 — pterygoid hamulus of the pterygoid process; 4 — palatoglossus; 5 — musculus uvulae; 6 — palatopharyngeus

The soft palate is composed by the following muscles (Fig. 7).

The ***tensor veli palatini*** (*musculus tensor veli palatini*) is thin and triangular; it lies lateral to the medial pterygoid plate, pharyngotympanic tube and levator veli palatini. Its lateral surface contacts the upper and anterior part of the medial pterygoid.

The muscle arises from the scaphoid fossa of the pterygoid process and posteriorly from the medial aspect of the spine of the sphenoid bone. It is attached to the anterolateral membranous wall of the pharyngotympanic tube. Inferiorly, the fibres converge on a tendon that turns medially around the pterygoid hamulus to pass to the palatine aponeurosis and the osseous surface behind the palatine crest on the horizontal plate of the palatine bone. There is a small bursa between the tendon and the pterygoid hamulus.

Function. Together the tensor veli palatini muscles tauten the soft palate, principally its anterior part, and depress it by flattening its arch. It opens the auditory tube. Acting unilaterally, the muscle pulls the soft palate to one side.

The ***levator veli palatini*** (*musculus levator veli palatini*) arises by a small tendon from an area on the medial end of the inferior surface of the petrous part of the temporal bone, in front of the lower opening of the carotid canal. Additional fibres arise from the inferior aspect of the cartilaginous part of the pharyngotympanic tube and from the vaginal process of the sphenoid bone. It passes medial to the upper margin of the superior constrictor and anterior to salpingopharyngeus. Its fibres spread in the medial third of the soft palate between two strands of palatopharyngeus to attach to the upper surface of the palatine aponeurosis.

Function. The levator veli palatini muscles are to elevate the almost vertical posterior part of the soft palate and pull it slightly backwards during swallowing.

The ***palatopharyngeus*** (*musculus palatopharyngeus*) is composed of two fasciculi that are attached to the upper surface of the palatine aponeurosis; they lie in the same plane but are separated from each other by the levator veli palatini. The thicker, anterior fasciculus arises from the posterior border of the hard palate. The posterior fasciculus is in contact with the mucosa of the pharyngeal aspect of the palate, and joins the posterior band of the contralateral muscle in the midline. Passing laterally and downwards behind the tonsil, the palatopharyngeus descends posteromedial to and in close contact with the stylopharyngeus, to be attached with it to the posterior border of the thyroid cartilage and on the side of the pharynx. It composes the arch. It is possible to refer this muscle to the muscles of the pharynx.

Function. Acting together, the palatopharyngei pull the pharynx up, forwards and medially, and thus shorten it during swallowing. They also approximate the palatopharyngeal arches and draw them forwards. They widen the orifice of the auditory tube and strain the arch.

The ***palatoglossus*** (*musculus palatoglossus*) forms the palatoglossal arch or fold. It arises from the oral surface of the palatine aponeurosis where it is continuous with its contralateral fellow. It extends forwards, downwards and laterally in front of the palatine tonsil to the side of the tongue. Some of its fibres spread over the dorsum of the tongue into its substance to intermingle with fibres of the transverse muscle (it is referred to the muscles of the tongue).

Function. The palatoglossus elevates the root of the tongue and approximates the palatoglossal arch to its contralateral fellow, thus shutting off the oral cavity from the oropharynx.

The ***musculus uvulae*** (*musculus uvulae*) arises from the posterior nasal spine of the palatine bone and the superior surface of the palatine aponeurosis, and lies between two laminae of the aponeurosis. It runs posteriorly above the sling formed by the levator veli palatini and inserts beneath the mucosa of the uvula. Two sides of the muscle are united along most of its length. Two muscles run at right angles to each other.

Function. The contraction raises a “levator eminence” which helps seals off the nasopharynx. Two muscles shorten the uvula and lift it.

The ***fauces*** (*fauces*) is an opening that connects the oral cavity with the oropharynx. It is limited by the posterior edge of the soft palate and palatine uvula above, by palatolingual and palatopharyngeal arches laterally and by the upper surface of the tongue at the bottom. The size and shape of the fauces depend on the degree of contraction of the muscles of the soft palate and tongue. With a significant increase of the tonsils (in people with chronic tonsillitis) lateral walls of the fauces are formed by the inner surfaces of the tonsils. Fauces is narrowed in that case. The *pharyngeal lymphoid*

ring, or *Waldeyer's ring* is a circumpharyngeal ring of mucosa-associated lymphoid tissue which surrounds the openings into the digestive and respiratory tracts. It is made up anteroinferiorly by the lingual tonsil, laterally by the palatine and tubal tonsils, and posterosuperiorly by the nasopharyngeal tonsil and smaller masses of lymphoid tissue in the intertonsillar intervals.

The floor of the oral cavity, or inferior wall is formed by a mass of soft tissue located between the tongue and the hyoid bone. The basis of the floor of the mouth is *diaphragma oris* (*diaphragma oris*), which consists of a paired mylohyoid muscle. The geniohyoid, genioglossus and hyoglossus muscles are above it on either side of the median line. The anterior belly of the digastric muscle lies below the mylohyoid (mylohyoid) muscle. Together, they form the base of the muscular floor of the mouth.

The mucous membrane of the mouth covers the floor, the lateral aspect of the oral cavity aside of the tongue, and the inner part of the mandibular gingiva.

The ***frenulum of the tongue*** (*frenulum linguae*) is a vertical fold of the mucous membrane, which goes from the lower surface of the tongue to the bottom of the oral cavity. At the front the fold reaches the lingual surface of the gums.

Sublingual folds (*plicae sublinguales*) lie on either side of the frenulum of the tongue along the eminences formed by sublingual glands. Small ducts of these glands open here. At the medial ends of the eminences *sublingual caruncles* (*carunculae sublinguales*) are located. The submandibular duct and major sublingual duct open into them.

The tongue

The ***tongue*** (*lingua*; Gk. *glossus*) is a highly muscular organ composed of striated muscles (Figg. 8–9). It is covered with mucosa of particular structure. The tongue is the organ of deglutition, taste and speech, mastication, salivation, and sucking. These activities include biting, chewing, drinking, sucking, swallowing.

The tongue has the *tip*, or *apex* (*apex linguae*), *body* (*corpus linguae*) and *root* (*radix linguae*). The upper, convex surface is the *dorsum of the tongue* (*dorsum linguae*). The *inferior surface* (*facies inferior linguae*) is smaller than the superior one, since most of it is covered by the root of the tongue. Both surfaces are joined together to form the *margin of the tongue* (*margo linguae*). The margin is in contact with the gums and teeth. Its mucosa is normally pink and moist, and is attached closely to the underlying muscles. At rest the dorsum (posterosuperior surface) is generally convex in all directions. It is divided by a V-shaped *terminalis sulcus* (*sulcus terminalis*) into an anterior, oral part which faces upwards, and a posterior, pharyngeal part which faces posteriorly. The *anterior part* or *presulcar part* (*pars anterior* seu *presulcalis*) takes up about two-

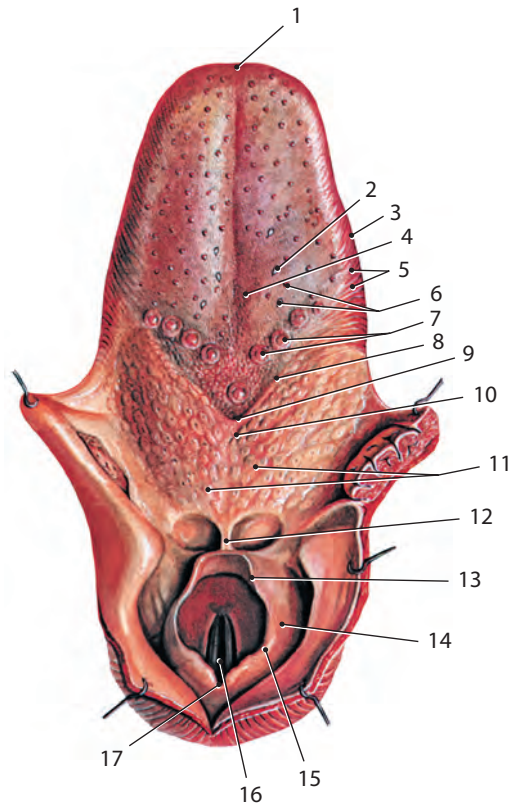

Fig. 8. The tongue (superior aspect): 1 — apex of the tongue; 2 — body of the tongue; 3 — margin of the tongue; 4 — midline groove of the tongue; 5 — foliate papillae; 6 — fungiform papillae; 7 — vallate papillae; 8 — terminal sulcus of the tongue; 9 — foramen caecum of the tongue; 10 — root of the tongue; 11 — lingual tonsil; 12 — median glosso-epiglottic fold; 13 — epiglottis; 14 — piriform fossa; 15 — ary-epiglottic fold; 16 — rima glottidis; 17 — interarytenoid notch

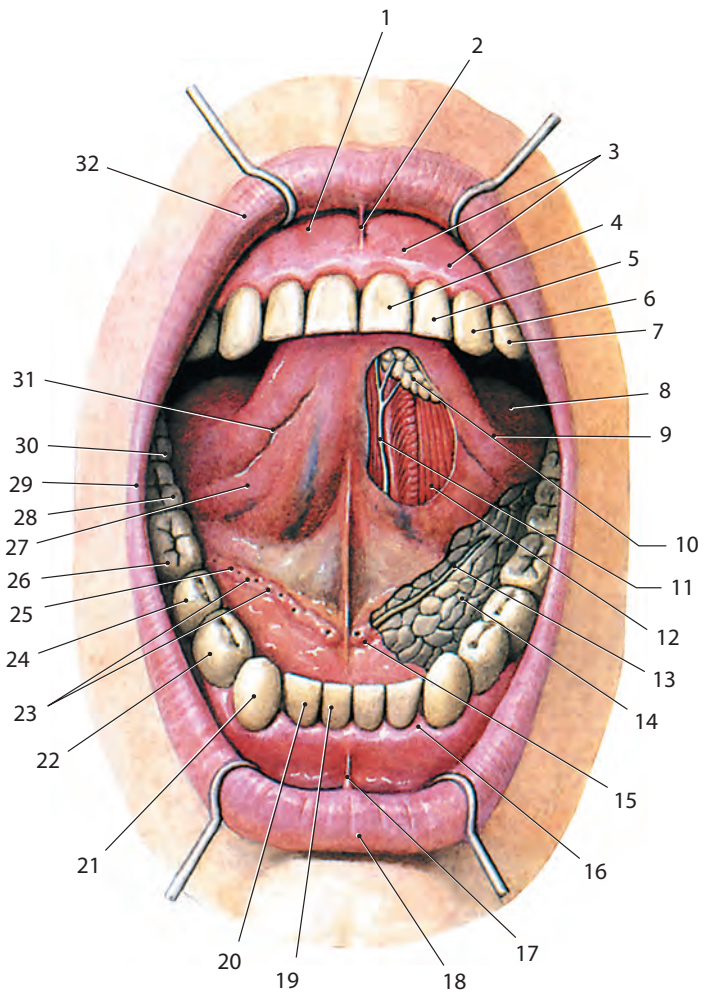

Fig. 9. Inferior surface and frenulum of the tongue: 1 — oral vestibule; 2 — frenulum of the upper lip; 3 — gum; 4 — maxillary medial incisor; 5 — maxillary lateral incisor; 6 — maxillary canine; 7 — maxillary first premolar; 8 — oral cavity proper; 9 — margin of the tongue; 10 — anterior lingual glands; 11 — lingual nerve; 12 — inferior longitudinal muscles; 13 — submandibular duct; 14 — sublingual gland; 15 — sublingual caruncle; 16 — gingival papillae; 17 — frenulum of the lower lip; 18 — lower lip; 19 — mandibular medial incisor; 20 — mandibular lateral incisor; 21 — mandibular canine; 22 — mandibular first premolar; 23 — minor sublingual ducts; 24 — mandibular second premolar; 25 — sublingual fold; 26 — mandibular first molar; 27 — inferior surface of the tongue; 28 — mandibular second molar; 29 — labial commissure; 30 — mandibular third molar; 31 — fimbriated fold; 32 — upper lip

thirds of the length of the tongue. The *posterior part* or *postsulcar part* (*pars posterior* seu *postsulcalis*) composes about one third of the tongue. Two limbs of the terminal sulcus run anterolaterally to the palatoglossal arches from a median depression, the *foramen caecum of the tongue* (*foramen caecum linguae*), which marks the site of the upper end of the embryonic thyroid diverticulum, *thyroglossal duct* (*ductus thyroglossalis*). In some people, the embryonic duct is not completely reduced, which causes formation of median cysts and fistulas of the neck.

The tongue develops from 3 sources. Traces of its adherence remain in the form of two furrows. The *median sulcus*, or *midline groove of the tongue* (*sulcus medianus linguae*) is located longitudinally on the dorsum of the tongue in the midline of the tongue from the tip to the foramen caecum. The presulcal part of the tongue develops from the lingual swellings of the mandibular arch and from the tuberculum impar, and this embryological derivation explains its sensory innervation. The postsulcal part of the tongue develops from the hypobranchial eminence. On rare occasions the thyroid gland fails to migrate away from the tongue in the process of development.

Together with their connective apparatus muscles constitute the main part of the tongue (Fig. 10). The *lingual septum* (*septum linguae*) is located in the middle line of the tongue in the vertical direction. The septum projects to the dorsum of the tongue on the median sulcus and passes into a tendinous suture of the mylohyoid muscle below. The septum divides the musculature into more or less symmetrical halves. In addition, the muscles are covered

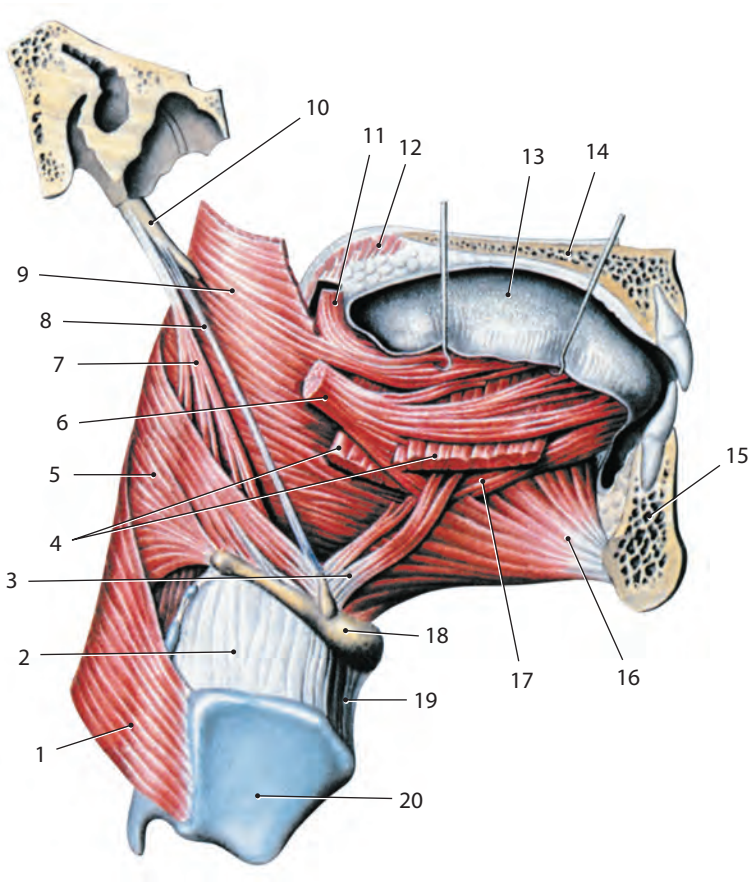

Fig. 10. Muscles of the tongue (right aspect, right side of the mandible removed): 1 — inferior constrictor; 2 — thyrohyoid membrane; 3 — chondropharyngeal part of the middle constrictor; 4 — hyoglossus (dissected); 5 — middle constrictor; 6 — styloglossus (dissected); 7 — stylopharyngeus; 8 — stylohyoid ligament; 9 — superior constrictor; 10 — styloid process; 11 — palatoglossus; 12 — soft palate; 13 — tongue; 14 — hard palate; 15 — mandible; 16 — genioglossus; 17 — inferior longitudinal muscle; 18 — hyoid bone; 19 — median thyrohyoid ligament; 20 — thyroid cartilage

by the *lingual aponeurosis* (*aponeurosis linguae*) as a complex of interlacing bundles of collagen and elastin fibers.

Striated muscles of the tongue are made up of muscle bundles extending in three mutually perpendicular directions: longitudinal, lateral and vertical. Depending on the position two groups of muscles of the tongue can be distinguished: inner and outer. Intrinsic or proper muscles lie only in the depth of the tongue and do not go beyond it. They change the form of the tongue. Extrinsic (skeletal) muscles begin at nearby bones. They go into the depth of the tongue and change its position during contraction.

The intrinsic muscles are bilateral superior and inferior longitudinal, transverse and vertical. They can change the shape of the tongue.

The ***superior longitudinal muscle*** (*musculus longitudinalis superior linguae*) constitutes a thin stratum of oblique and longitudinal fibres lying beneath the mucosa of the dorsum of the tongue. It extends forwards from the submucous fibrous tissue near the epiglottis and from the median lingual septum to the lingual margins. Some fibres are inserted into the mucous membrane.

The ***inferior longitudinal muscle*** (*musculus longitudinalis inferior linguae*) is the only one muscle, which can be separated anatomically. It is a narrow band of muscle close to the inferior lingual surface between the genioglossus and hyoglossus. It extends from the root of the tongue to the apex. Some of its posterior fibres are connected to the body of the hyoid bone. Anteriorly it blends with styloglossus.

The ***transverse muscles*** (*musculi transversi linguae*) pass laterally from the median fibrous septum, blending with palatopharyngeus, go in the transverse direction and terminate in the mucosa at the edge and dorsum of the tongue. These bundles are crossed with bundles of the genioglossus.

The ***vertical muscles*** (*musculi verticales linguae*) extend from the dorsal to the ventral aspects of the tongue in the anterior lateral aspects. They are not so strong as the previous ones.

The extrinsic musculature consists of four pairs of muscles, namely genioglossus, hyoglossus, styloglossus and palatoglossus.

The ***genioglossus*** (*musculus genioglossus*) is triangular in sagittal section. It arises from a short tendon attached to the superior genial tubercle behind the mandibular symphysis, above the origin of geniohyoid. From this point it fans out backwards and upwards. The inferior fibres of the genioglossus are attached by a thin aponeurosis to the body of the hyoid. Intermediate fibres pass backwards into the posterior part of the tongue, and superior fibres ascend forwards to enter the whole length of the ventral surface of the tongue from the root to the apex.

Function. The genioglossus brings about the forward traction of the tongue to protrude its apex from the mouth. Acting bilaterally, muscles depress the central part of the tongue, making it concave from side to side. Acting unilaterally, the tongue diverges to the opposite side.

The ***hyoglossus*** (*musculus hyoglossus*) is thin and quadrilateral, and arises from the whole length of the greater horn and the body of the hyoid bone. It passes vertically up to enter the side of the tongue between styloglossus laterally and the inferior longitudinal muscle medially. The *chondroglossus* and *ceratoglossus* are parts of the hyoglossus.

Function. The hyoglossus depresses the tongue.

The ***styloglossus*** (*musculus styloglossus*) arises from the styloid process near its apex, and from the stylomandibular ligament. Passing downwards and forwards, it divides at the side of the tongue into a longitudinal part, which enters the tongue dorsolaterally to blend with the inferior longitudinal muscle in front of hyoglossus, and an oblique part, overlapping hyoglossus and decussating with it.

Function. Two styloglossus muscles draw the tongue up and backwards. With the contraction of one side it pulls the tongue aside.

The ***palatoglossus*** (*musculus palatoglossus*) starts from the palatine aponeurosis, passes in the arch of the same name and mixes with the transverse muscles of the tongue. The muscle is able to pull up the root of the tongue, lower the soft palate, and narrow the fauces of the pharynx.

These internal and external muscles of the tongue form a complex of intermingled bundles, which explains the exceptional mobility of the tongue and the variability of its shape.

Lingual mucosa. The dorsal mucosa is somewhat thicker than the ventral and lateral mucosae; it adheres directly to underlying muscular tissue with no discernible submucosa, and is covered by numerous papillae. The dorsal epithelium consists of superficial stratified squamous epithelium, which varies from non-keratinized stratified squamous epithelium posteriorly, to fully keratinized epithelium overlying the filiform papillae more anteriorly. The underlying lamina propria is a dense fibrous connective tissue, with numerous elastic fibres, and is continuous with similar tissue extending between the lingual muscle fasciculi. It contains numerous vessels and nerves from which the papillae are supplied, as well as large lymph plexuses and lingual glands. The mucosa of the postsulcal part is reflected laterally onto the palatine tonsils and pharyngeal wall, and posteriorly onto the epiglottis by the *median* and two *lateral glosso-epiglottic folds* (*plica glossoepiglottica mediana* et *plicae glossoepiglotticae laterales*) which surround two depressions or *epiglottic valleculae* (*valleculae epiglotticae*). The posterior part of the tongue is devoid of papillae, and exhibits low elevations. There are underlying lymphoid nodules which are embedded in the submucosa and collectively termed the lingual tonsil. The ducts of small seromucous glands open on the apices of these elevations. The mucosa on the inferior (ventral) surface is smooth, purplish and reflected onto the oral floor and gums: it is connected to the oral floor anteriorly by the *frenulum of the tongue* (*frenulum linguae*). The deep lingual vein, which is visible, lies lateral to the frenulum on either side. The *fimbriated fold* (*plica fimbriata*), a fringed mucosal ridge directed anteromedially towards the apex of the tongue, lies lateral to the vein. *Lingual papillae* (*papillae linguales*) are projections of the mucosa covering the dorsal surface of the tongue (Fig. 11). They are limited to the presulcal part of the tongue, produce its characteristic rough-

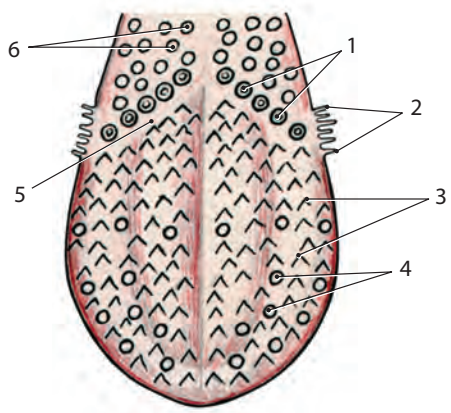

Fig. 11. Lingual papillae (scheme, superior aspect): 1 — vallate papillae; 2 — foliate papillae; 3 — filiform papillae; 4 — fungiform papillae; 5 — terminal sulcus of tongue; 6 — lingual tonsil

ness and increase the area of contact between the tongue and the contents of the mouth. There are four principal types, named filiform, fungiform, foliate and vallate papillae, and all except the filiform papillae bear taste buds. Papillae are more readily seen when the tongue is dry.

Filiform papillae (*papillae filiformes*) are minute, conical or cylindrical projections which cover most of the presulcal dorsal area, and are arranged in diagonal rows that extend anterolaterally, parallel with the sulcus terminalis, except at the lingual apex, where they are transverse. They are the most numerous. At the front they are longer than on the posterior dorsum of the tongue. The length is 0.6–2.5 mm, the thickness is 0.1–0.6 mm. They have irregular cores of connective tissue and their epithelium, which is keratinized, may split into whitish fine secondary processes. They appear to function to increase the friction between the tongue and food, and facilitate the movement of particles by the tongue within the oral cavity. They contain pain, temperature, tactile receptors (general sensation). Exfoliated horny scales have a whitish color, so that the color of the tongue can be whitish-pink. If there are digestive problems, desquamation of cornified epithelial cells is delayed, which results in appearance of a white plaque called "coated" tongue. Conical papillae are among filiform papillae and very close to them in structure and function.

Fungiform papillae (*papillae fungiformes*) are less numerous than the filiform ones (150–200), occur mainly on the lingual margin but also irregularly on the dorsal surface, where they may occasionally be numerous. They are larger (0.5–1.5 mm long and 0.5–1.0 mm thick), rounded and deep red in colour, the latter feature due to their thin, non-keratinized epithelium and highly vascular connective tissue core. Each bears one or more *taste buds* (*caliculus gustatorius*) on its apical surface. They are clearly visible to the naked eye in the form of reddish dots, as through the capillaries of papillae translucent to epithelium.

Vallate papillae (*papillae vallatae*) are large cylindrical structures, varying in number from 7 to 18 (average 7–12), which form a V-shaped row immediately in front of the sulcus terminalis on the dorsal surface of the tongue. Each papilla, 1–2 mm in diameter, 3–6 mm long, is surrounded by a slight circular mucosal elevation (vallum or wall) which is separated from the papilla by a circular sulcus. The papilla is narrower at its base than its apex and the entire structure is generally covered with non-keratinized stratified squamous epithelium. Numerous taste buds (40 to 150 per one papilla) are scattered in both walls of the sulcus.

Foliate papillae (*papillae foliatae*) lie bilaterally (15–20 on each side) in two zones at the sides of the tongue near the sulcus terminalis, each formed by a series of red, leaf-like mucosal ridges, covered by a non-keratinized epithelium. The height of the folds can be up to 7 mm and their thickness is 2–3 mm. They bear numerous taste buds.

Taste buds are microscopic structures which contain chemosensory cells. They are numerous on all types of lingual papillae (except filiform papillae), on the epiglottis, pharyngeal arches, in the epithelium of the pharynx and the soft palate. It is believed that fungiform papillae recognize the sweet taste, foliate papillae recognize the sour and salty taste, and vallata papillae are for perception of the bitter taste.

Serous, mucous and mixed glands are between the muscle bundles located under the mucous membrane. Their ducts open on the tongue.

The mucosa of the pharyngeal part of the dorsal surface of the tongue contains many lymphoid fol-

licles (*noduli lymphoidei linguales*) aggregated into dome-shaped groups, the ***lingual tonsil*** (*tonsilla lingualis*). Each group is arranged around a central deep crypt, or invagination, which opens onto the surface epithelium. The ducts of mucous glands open into the bases of the crypts. Small isolated follicles also occur beneath the lingual mucosa. The collection of paired palatine, tubal, unpaired lingual and pharyngeal tonsils located on the border of the oral cavity and pharynx is named the *pharyngeal lymphoid ring*.

Glands of the mouth

Salivary glands are compound, tubuloacinar exocrine glands whose ducts open into the oral cavity. They secrete saliva, a fluid which lubricates food to assist deglutition, moistens the buccal mucosa, which is important for speech, and provides an aqueous solvent necessary for taste and a fluid seal for sucking and suckling. They also secrete digestive enzymes, e.g. salivary amylase, and antimicrobial agents, e.g. immunoglobulin A, lysozyme and lactoferrin, into saliva. Conditions where there is a significant decrease in the production of saliva (xerostomia) may result in periodontal inflammation and dental caries. The *major salivary glands* are the paired parotid, submandibular and sublingual glands. In addition, there are numerous *minor salivary glands* scattered throughout the oral mucosa and submucosa. Approximately 0.5 L of saliva is secreted per day. Its flow rate is negligible during sleep. In the unstimulated state, the parotid gland contributes 20%, the submandibular gland 65%, and the sublingual and minor salivary glands 15% of the daily output of saliva. When stimulated, the parotid contribution rises to 50%.

The minor salivary glands of the mouth include the *labial*, *buccal*, *molar*, *palatine* and *lingual glands* (Fig. 12). The labial and buccal glands contain mucous and serous elements. The palatine glands occur in both the soft and hard palate, around the pharyngeal isthmus. The anterior and posterior lingual glands are mainly mucous. Serous glands (von Ebner's glands) occur around the circumvallate papillae, their secretion is watery, and they probably assist in gustation by spreading taste stimuli over the taste buds and then washing them away. Salivary glands have numerous lobes composed of smaller lobules separated by dense connective tissue which is continuous with the capsule of the gland, and contains excretory (collecting) ducts, blood vessels, lymph vessels, nerve fibres and small ganglia. Each lobule has a single duct.

The ***parotid gland*** (*glandula parotidea*) is a complicated alveolar gland, the largest of all the salivary glands (Fig. 13). It has the *superficial part* (*pars superficialis*) and the *deep part* (*pars profunda*).

The superficial part of the parotid gland is in the parotid-masticatory area on the ramus of the mandible and masseter muscles. It has a triangular shape. It reaches the zygomatic arch and the external auditory meatus above, the mastoid process and sternocleidomastoid muscle behind, the angle of the mandible below, and middle of the masseter muscle in front. In some cases, it forms two processes: superior, adjacent to the cartilaginous part of the external auditory meatus, and anterior, situated on the outer surface of the masseter.

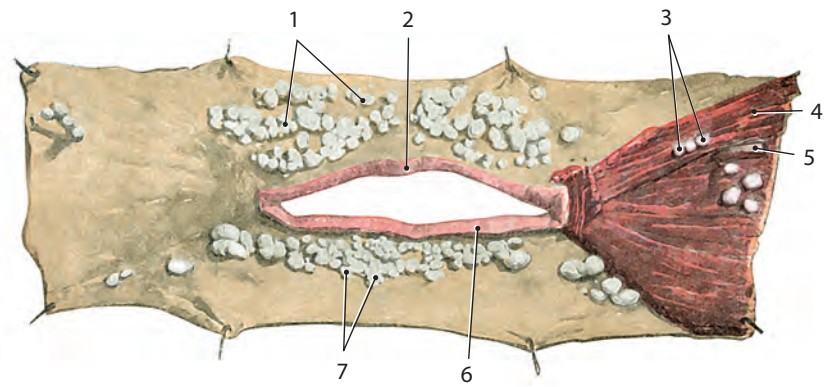

Fig. 12. Labial and buccal glands (anterior aspect, skin is removed): 1 — superior labial glands; 2 — upper lip; 3 — buccal glands; 4 — buccinator; 5 — parotid duct; 6 — lower lip; 7 — inferior labial glands

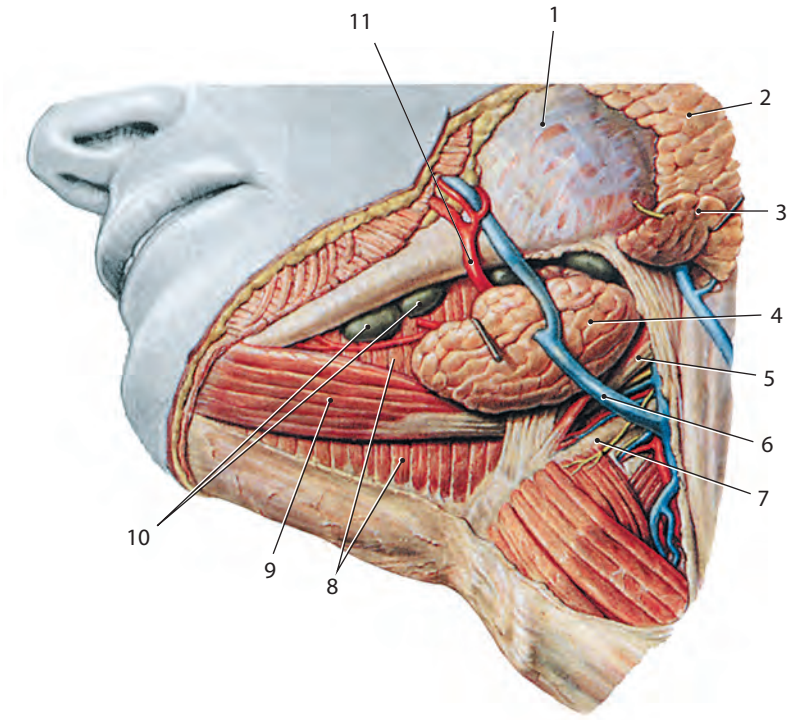

Fig. 13. Submandibular and parotid glands (inferior and left aspect): 1 — masseteric fascia; 2 — parotid gland; 3 — accessory parotid gland; 4 — submandibular gland; 5 — posterior belly of the digastric; 6 — facial vein; 7 — hyoid bone; 8 — mylohyoid; 9 — anterior belly of the digastric; 10 — submandibular lymph nodes; 11 — facial artery

The deep part of the gland is located behind the mandibular fossa filling it entirely.

This gland is adjacent to the lateral pterygoid muscle, the posterior belly of the digastric muscle and the muscles originating on the styloid process from inside.

The parotid gland consists of acini connected into small lobules, which compose the lobes. Intralobular salivary ducts form excretory interlobular and interlobar ducts. The *parotid duct* (*ductus parotideus*) is formed by fusion of interlobar ducts. The gland is covered with fascial capsule from outside. That capsule is produced by the parotid fascia (for the superficial part) and the fascia of the muscles that limit the retromandibular fossa (for the deep part).

The ***parotid duct***, or *Stenon duct* (*ductus parotideus*) begins at the confluence of two main tributaries within the anterior part of the parotid gland: the duct appears at the anterior border of the gland and passes horizontally across masseter, approximately 1 cm below the zygomatic arch. It turns medially at its anterior border at an almost right angle, and traverses the buccal fat pad and buccinators. It opens upon a small papilla opposite the second upper molar crown. The average dimensions of the parotid duct are 5 cm long and 3 mm wide (although it is narrower at its oral orifice). Sometimes there is an *accessory parotid gland* (*glandula parotidea accessoria*) over the parotid duct, whose excretory duct empties into the main duct. A line extending from the lower edge of the external auditory opening to the nasal alae defines the projection of the parotid duct.

The external carotid artery, retromandibular vein and facial nerve, either in part or in whole, traverse the gland and branch within it.

The ***submandibular gland*** (*glandula submandibularis*) is a complicated alveolar gland lying in the submandibular space (triangle). The gland is adjacent to the submandibular fossa on the inner part of the mandible by its superior external (lateral) surface, to the posterior belly of the digastric muscle backward and to the anterior belly of the digastric muscle forward (Figg. 13–14). Its inner (medial) surface is located on the hyoglossus muscle and partly on the mylohyoid muscle. It flanks the sublingual gland, being separated from its only fascia by its posterior edge. The lower edge of the gland covers the posterior belly of the digastric muscle

and stylohyoid muscle. Above the posterior edge of the gland is very close to the parotid gland and is separated from it by the capsule. The gland has an irregular ovoid shape and consists of 10–12 lobules.

The ***submandibular duct***, or *Wharton's duct* (*ductus submandibularis*) is usually 5 cm long and has a thinner wall than the parotid duct. It begins from numerous tributaries in the superficial part of the gland and emerges from the medial surface of the gland behind the posterior border of mylohyoid. It traverses the gland, then it runs forwards between the mylohyoid and hyoglossus passing between the sublingual gland and the genioglossus to open in the floor of the mouth on the summit of the sublingual papilla at the side of the frenulum of the tongue with the major sublingual duct.

The ***sublingual gland***, or *Rivinus's gland* (*glandula sublingualis*) is the smallest of the major salivary glands: each gland is narrow, flat, shaped like an almond, and consists of 4–16 (usually 5–8) lobules. The sublingual gland lies on the mylohyoid, and is covered by the mucosa of the floor of the mouth, which is raised as a sublingual fold. The mandible above the anterior part of the mylohyoid line, the sublingual fossa, is lateral, and the genioglossus is medial, separated from the gland by the lingual nerve and submandibular duct. The gland is covered with a thin fascial capsule. The sublingual

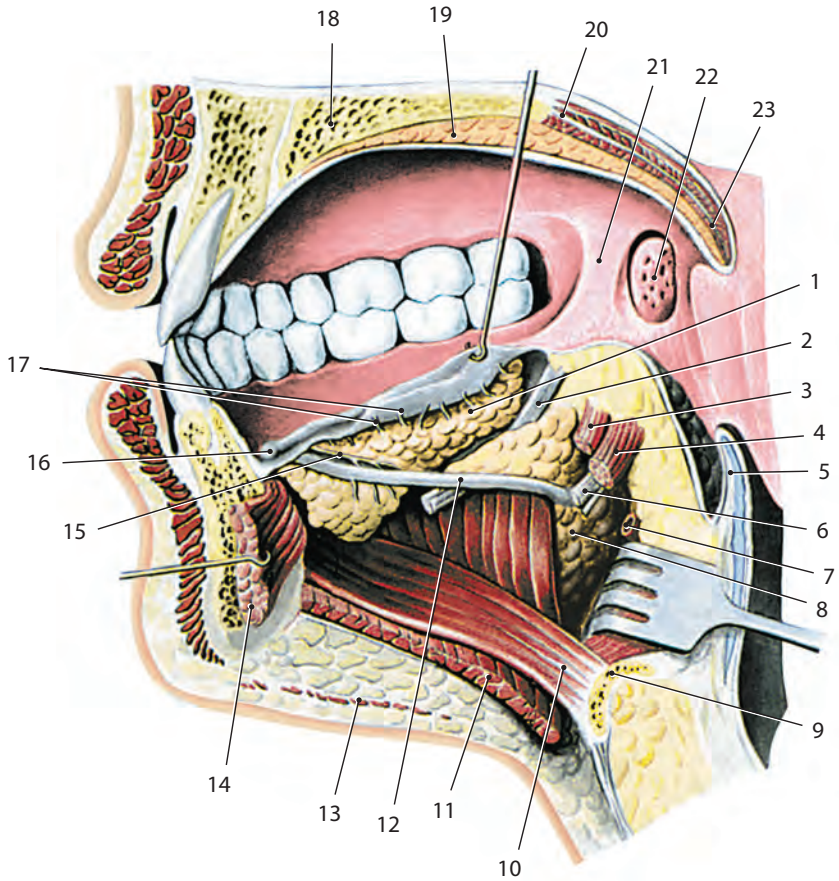

Fig. 14. Sublingual and submandibularl glands (medial aspect, sagittal section, right): 1 — sublingual gland; 2 — lingual nerve; 3 — palatoglossus; 4 — styloglossus; 5 — epiglottis; 6 — hypoglossal nerve; 7 — lingual artery; 8 — submandibular gland; 9 — body of the hyoid bone; 10 — geniohyoid; 11 — mylohyoid; 12 — submandibular duct; 13 — platysma; 14 — genioglossus; 15 — major sublingual duct; 16 — sublingual caruncle; 17 — minor sublingual ducts; 18 — hard palate; 19 — palatine glands; 20 — soft palate; 21 — palatoglossal arch; 22 — palatine tonsil; 23 — uvula

gland has 18–20 excretory ducts. The ***major sublingual duct***, or *Bartolin's duct* (*ductus sublingualis major*) is composed by small rami from the anterior part of the gland; it opens with, or near to, the orifice of the submandibular duct.

Minor sublingual ducts (*ductus sublinguales minores*) open, usually separately, from the posterior part of the gland onto the summit of the sublingual fold.

In newborns and infants the parotid gland is more developed. Submandibular and sublingual glands are less developed. Until 25–30 years of age all the major salivary glands keep growing, and after 55–60 they reduce.

Teeth

Teeth (*dentes*) are arranged in dental alveoli of the upper and lower jaws (maxilla and mandible) at the interface between the vestibule of the mouth and oral cavity proper. The teeth ensure gripping, biting and grinding (chewing) of the food.

Humans have two generations of teeth: the deciduous (primary) dentition and the permanent (secondary) dentition (*dentes permanentes*). The first *deciduous teeth* (*dentes decidui*) erupt into the mouth at about 6 months after birth, and all of the deciduous teeth have erupted by the age of 2. The first permanent molar erupts at or around 6 years. A complete permanent dentition is present at or around the age of 18–21. In the complete deciduous dentition there are 20 teeth. In the complete permanent dentition there are 32 teeth. Deciduous teeth differ by their regular smaller size and structure.

Three parts are distinguished in each tooth (Fig. 15).

The *crown* (*corona dentis*) is a thickened part protruding from the dental alveolus.

The *root* (*radix dentis*) is a part, which lies within the dental alveolus.

The *neck*, or *cervix* (*cervix dentis*) is a narrow part located between the crown and the root and surrounded by gingival mucosa.

The body of a tooth is mostly *dentine* (*dentinum*). It is a yellowish avascular tissue. It is a tough, compliant composite material, with a mineral content of 70% dry weight (largely crystalline hydroxyapatite with some calcium carbonate) and 20% organic matrix. Dentine (ivory) of a crown is covered by very hard translucent *enamel* (*enamelum*) up to about 2 mm thick. Yellowish bone-like *cement* (*cementum*) coating the root is much thinner. These meet at the neck or cervical margin.

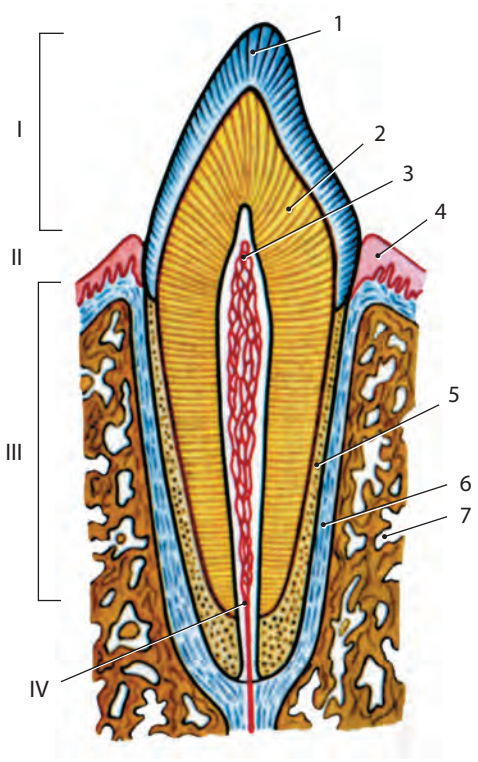

Fig. 15. The tooth (scheme): 1 — enamel; 2 — dentine; 3 — dental pulp; 4 — gum; 5 — cement; 6 — periodontium; 7 — bone; I — crown; II — neck; III — root; IV — root canal

The dentine surrounds the central *pulp cavity* (*cavitas dentis* seu *cavitas pulparis*), expanding at its coronal end into the *pulp cavity of the crown* (*cavitas coronae*) and narrowing at the root as a *pulp canal* or *root canal* (*canalis radicis dentis*) opening at or near its tip by an *apical foramen* (*foramen apicis dentis*), occasionally multiple (Fig. 16). The *dental pulp* (*pulpa dentis*) is a loose connective tissue, continuous with the periodontal ligament via the apical foramen. It contains vessels for the support of the dentine and sensory nerves. It is divided into the *crown pulp* and *root pulp* (*pulpa coronalis et pulpa radicularis*) according to the departments.

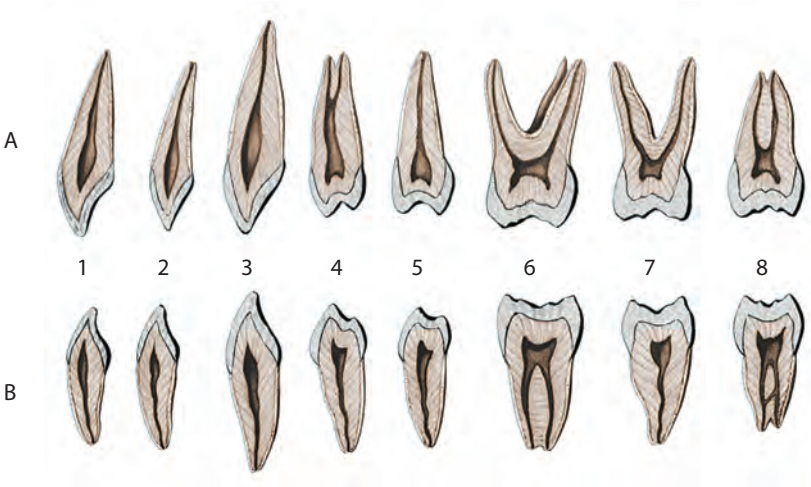

Fig. 16. Pulp cavity of the teeth. A — maxillary teeth; B — mandibular teeth. Vertical section: 1 — medial incisor; 2 — lateral incisor; 3 — canine; 4 — first premolar; 5 — second premolar; 6 — first molar; 7 — second molar; 8 — third molar

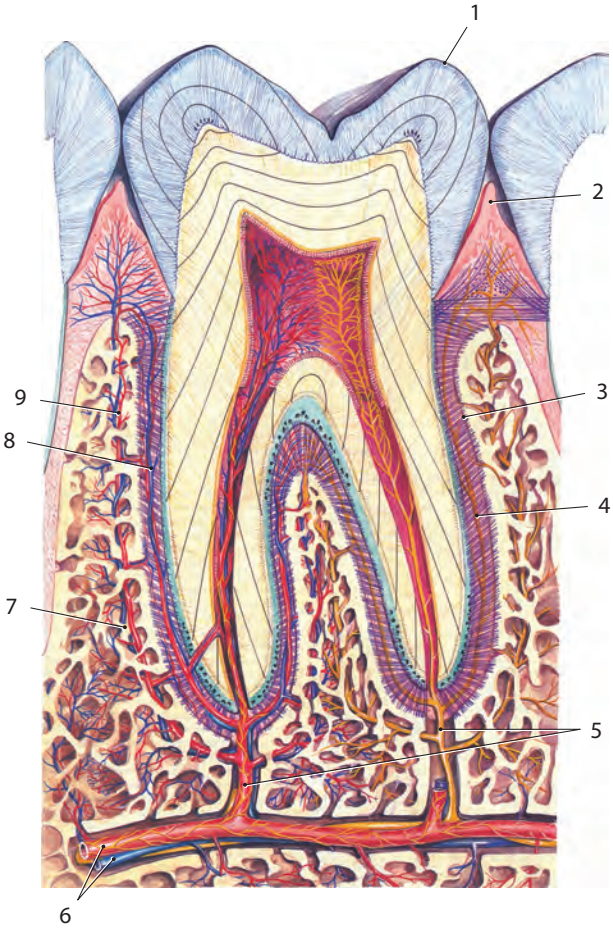

Fig. 17. The dento-alveolar segment (scheme): 1 — tooth; 2 — dental papillae; 3 — dental alveoli; 4 — periodontium; 5 — dental vessels and nerves; 6 — alveolar vessels and nerves; 7 — part of the mandible; 8 — periodontal vessels and nerves; 9 — peridental and dental vessels and nerves

The root is surrounded by alveolar bone, its cement separated from the osseous socket (alveolus) by the connective tissue of the *periodontium* (*periodontium*). Coarse bundles of collagen fibres are embedded at one end in cement and enter the osseous alveolar wall. Near the cervical margin, the tooth, periodontal fibres and adjacent bone are covered by the gingival (Fig. 17). The principal functions of the periodontium are to support the teeth, amortize, generate the force of tooth eruption and provide sensory information about tooth position and forces to facilitate the reflex jaw activity. The periodontium is a dense fibrous connective tissue 0.2 mm wide which contains cells associated with the development and maintenance of alveolar bone (osteoblasts and osteoclasts) and of cementum (cementoblasts and odontoclasts). It also contains a network of epithelial cells.

In humans, there are four basic tooth forms: incisor, canine, premolar and molar. *Incisor teeth* (incisors) are cutting teeth, and have thin, blade-like crowns. *Canine teeth* (canines) are piercing or tearing teeth, and have a single, stout, pointed, cone-shaped crown. *Molar teeth* and *premolar teeth* (molars and premolars) are grinding teeth and possess a number of cusps on an otherwise flattened biting surface.

A formula of permanent teeth in the adult (i.e. numeric designation of number and sequence of teeth on one side of the lower or upper jaw) is 2.1.2.3 (scheme 1). The first number indicates the number of incisors, the second refers to the canines,

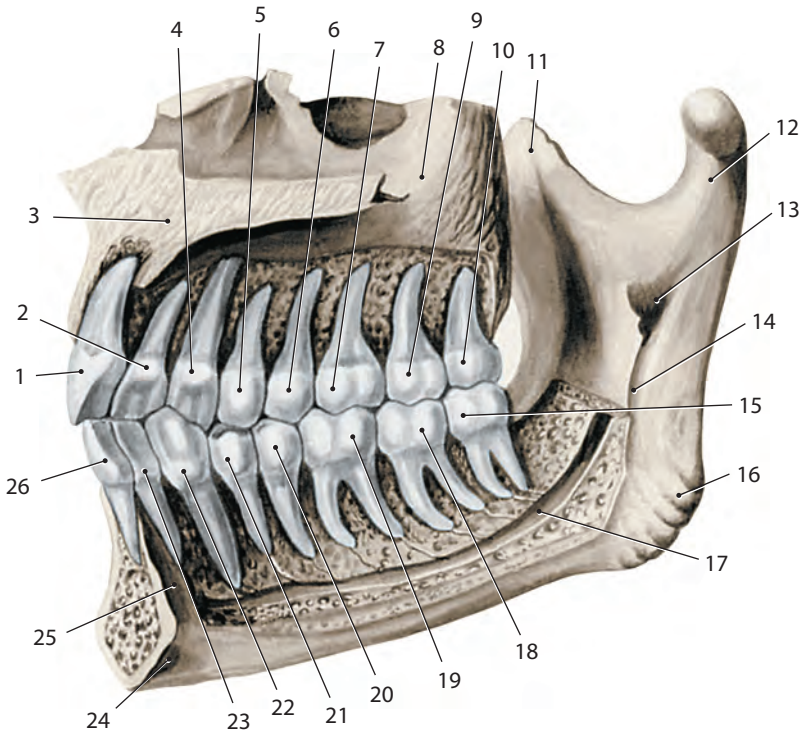

Fig. 18. Permanent teeth of the right side, lingual surface: 1 — maxillary medial incisor; 2 — maxillary lateral incisor; 3 — palatine process; 4 — maxillary canine; 5 — maxillary first premolar; 6 — maxillary second premolar; 7 — maxillary first molar; 8 — horizontal plate of the palatine bone; 9 — maxillary second molar; 10 — maxillary third molar; 11 — coronoid process of the mandible; 12 — condylar process of the mandible; 13 — mandibular foramen; 14 — mylohyoid groove; 15 — mandibular third molar; 16 — pterygoid tuberosity; 17 — mandibular canal; 18 — mandibular second molar; 19 — mandibular first molar; 20 — mandibular second premolar; 21 — mandibular first premolar; 22 — mandibular canine; 23 — mandibular lateral incisor; 24 — digastric fossa; 25 — sublingual fossa; 26 — mandibular medial incisor

the third points the premolars, the fourth shows molars. Consequently, the number of teeth on the human maxilla and mandible is the same. On each side there are 2 incisors, 1 canine, 2 premolars and 3 molars. Incisors and canines are considered the frontal group and premolars and molars comprise the distal tooth group (Fig. 18).

3.2.1.2	2.1.2.3
3.2.1.2	2.1.2.3

Scheme 1. Anatomical formula of permanent teeth

The human deciduous formula is 2.1.0.2. Zero indicates that there are no premolars (scheme 2) among the primary teeth. It should be noted that there are molar teeth (two on each side) in place of permanent premolars.

2.0.1.2	2.1.0.2
2.0.1.2	2.1.0.2

Scheme 2. Anatomical formula of deciduous teeth

The tooth-bearing region of the jaws can be divided into four quadrants, the right and left maxillary and mandibular quadrants. A tooth may thus be identified according to the quadrant in which it is located (e.g. right maxillary tooth or left mandibular tooth). In both the deciduous and permanent dentition, the incisors may be distinguished according to their relationship to the midline. Thus, the incisor nearest the midline is the central (first) incisor and the incisor that is positioned more laterally is termed the lateral (second) incisor. The permanent premolars and the permanent and deciduous molars can also be distinguished according to their mesiodistal relationships. The molar positioned most mesially is designated the first molar, and the one behind it is the second molar. In the permanent dentition, the tooth positioned most distally is the third molar. The mesial premolar is the first premolar, and the premolar behind it is the second premolar. Each tooth, from the mid-plane, has its proper serial number. Permanent incisors are denoted by numbers 1 and 2, the canine is 3, premolars are 4 and 5, and molars are termed 6, 7 and 8. Deciduous teeth have the following designation: the incisors are I and II, the canine is III, molars are V and VI.

Recently, a binary digital form of dental records has been introduced in dentistry. For the perma-

nent teeth a number is added before the serial tooth number: cipher 1 (for the teeth of the right half of the upper jaw), cipher 2 (for the left half of the upper jaw), cipher 3 (for the left half of the lower jaw) and cipher 4 (right half of the lower jaw). So, the canine of left half of the maxilla is indicated by the number 23, the last molar of the right half of the mandible is 48 (scheme 3).

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

Scheme 3. Clinical formula for permanent teeth adopted by the World Health Organization

For deciduous teeth cipher 5 is added before the serial tooth number (for the teeth of the right half of the upper jaw), cipher 6 is for the teeth of the left half of the upper jaw, cipher 7 is for the left half of the lower jaw and the cipher 8 is for the teeth of the right half of the mandible). For example, the lateral incisor of the right half of the upper jaw is denoted by number 52, and the first molar of the left half of the mandible — 74 (scheme 4).

55	54	53	52	51	61	62	63	64	65
85	84	83	82	81	71	72	73	74	75

Scheme 4. Clinical formula for deciduous teeth adopted by the World Health Organization

On each tooth crown we distinguish a number of separate surfaces or sides (Fig. 19).

The ***lingual surface*** (*facies lingualis*) is the surface of the crown of the teeth of the mandible facing into the oral cavity and touching the tongue.

The ***palatal surface*** (*facies palatinalis*) is the surface of the crown of the upper jaw teeth facing the palate.

The ***vestibular surface*** (*facies vestibularis*) is the surface facing into the vestibule of the oral cavity; it touches the lips at the frontal (anterior) teeth [*labial surface* (*facies labialis*)] and contacts cheeks at the posterior (distal) teeth [*buccal surface* (*facies buccalis*)].

Surfaces facing the neighboring crowns located on the same jaw are named *contact surfaces* (*facies contacta*). Labial and lingual surfaces of an incisor

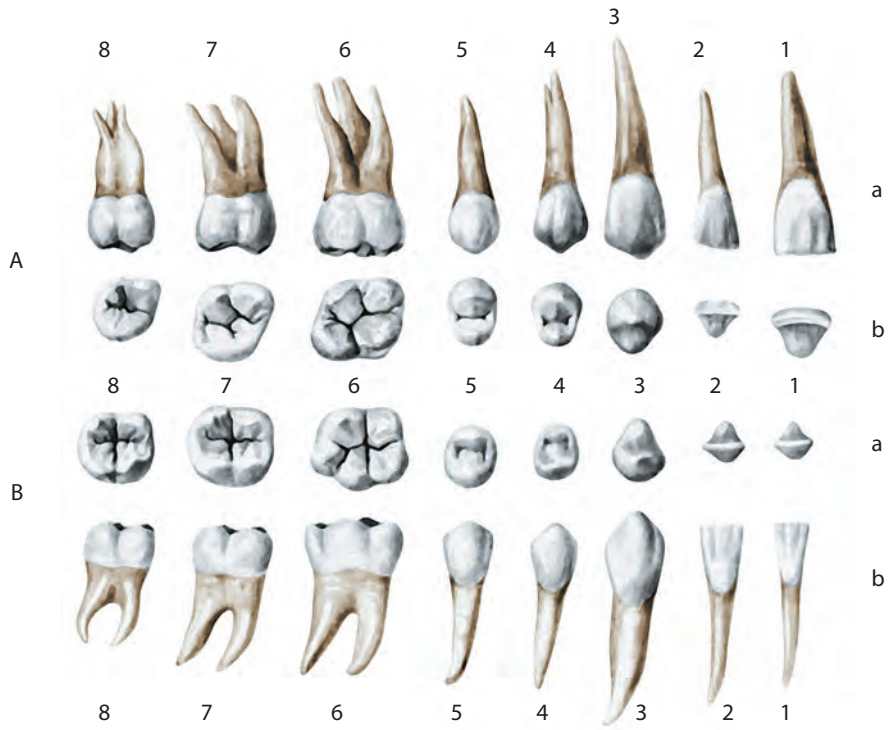

Fig. 19. The shape and structure of teeth and crowns of grownup men (right): A — maxillary teeth; B — mandibular teeth; a — vestibular surface; b — occlusal surface: 1 — medial incisor; 2 — lateral incisor; 3 — canine; 4 — first premolar; 5 — second premolar; 6 — first molar; 7 — second molar; 8 — third molar

meet medially at a *mesial surface* (*facies mesialis*) and laterally at a *distal surface* (*facies distalis*); there are terms describing the equivalent surfaces of premolar and molar (postcanine) teeth. On account of the curvature of the dental arch, mesial surfaces of postcanine teeth are directed anteriorly and distal surfaces are directed posteriorly. Thus, the point of contact between the central incisors is the datum point for mesial and distal. These surfaces are *approximal*, or *interproximal* (*facies approximalis*) in relation to each other. The biting or *occlusal surfaces* (*facies occlusalis*) of postcanine teeth are tuberculated by cusps which are separated by fissures forming a pattern characteristic of each tooth. The biting surface of an incisor is the *incisal margin* (*margo incisalis*). The occlusal surfaces of teeth in the lower jaw are directed upwards, occlusal surfaces of teeth in the upper jaw are directed downwards.

The number of roots of the teeth is different and varies from one (incisors, canines) to three (upper molars). The shape of the tooth cavity varies in accordance with that fact. The shape resembles a crown bit (at the incisors), a cone (for canines), or there is a massive body in the shape of an irregular cube with multiple tubercles (for molars).

The ***incisor teeth*** (*dentes incisivi*), four in number, are located in the front on the upper and lower jaws. Medial (central) and lateral incisors are distinguished. In labial view, the crowns are trapezoid, the maxillary incisors (particularly the central ones) are larger than the mandibular teeth. The *incisal margins* initially have three tubercles (cusps), which are rapidly ground off by wear. In mesial or distal view, their *labial surfaces* are convex while their *lingual surfaces* are concavo-convex. The roots of incisors are single. and in maxillary teeth they are rounded while mandibular teeth are flattened mesiodistally. The upper lateral incisor may be congenitally absent or may have a reduced form.

The ***canine teeth*** (*dentes canini*) are located behind the incisors, one on each side in the upper and lower jaws. A canine tooth has a single cusp instead of an incisal margin. The maxillary canine is stouter and more pointed than the mandibular canine whose cusp tip is inclined lingually. The canine root, which is the longest of all teeth, shows a bulge (canine eminence) on the alveolar bone externally, particularly in the maxilla. Although canines usually have single roots, those of the mandible can sometimes be bifid. Roots may extend to the maxillary sinus.

The ***premolar teeth*** (*dentes premolares*) are distal to the canines. Both premolars have buccal and lingual cusps. The *occlusal surfaces* of the maxillary premolars are oval, and a mesiodistal fissure separates two cusps. The maxillary first premolar can have two roots (buccal, palatal ones). The maxillary second premolar usually has one root. The occlusal surfaces of the mandibular premolars are more circular or squarer than those of the upper premolars. The buccal cusp of the mandibular first premolar towers above the lingual cusp. In the mandibular second premolar a mesiodistal fissure usually separates the buccal cusp from two smaller lingual ones. Each lower premolar has one root.

The ***molar teeth*** (*dentes molares*) are posterior to the premolars. The size of three molars decreases distally. Each has a large rhomboid (upper jaw) or rectangular (lower jaw) occlusal surface with four or five cusps and fissures which compose the letter H. The maxillary first molar has a cusp at each corner of its occlusal surface, and the *mesiopalatal cusp* is connected to the *distobuccal cusp* by an oblique ridge. A smaller cusplet or tubercle (cusplet of Carabelli) usually appears on the mesiopalatal cusp (most commonly in Caucasian races). The tooth has three widely separated roots, two buccal, and one large palatal. The first molar roots are wide apart while the second and third molar roots are converged. The smaller maxillary second molar has a reduced or occasionally absent *distopalatal cusp*. Its three roots show varying degrees of fusion. The maxillary third molar, the smallest one, is extremely variable in shape. It usually has three cusps and commonly the three roots are fused.

The mandibular first molar has three buccal and two lingual cusps on its rectangular occlusal surface, the smallest cusp being distal. The cusps of this tooth are all separated by fissures. It has two widely separated roots, one mesial and one distal. The smaller mandibular second molar is like the first, but has only four cusps, and its two roots are closer together. The mandibular third molar is smaller still and, like the upper third molar, is variable in form. Its crown may resemble that of the

lower first or second molar and its roots are frequently fused.

Eruption. The developmental stages of initial calcification and crown completion are less affected by environmental influences than is eruption, the timing of which may be modified by several factors such as early tooth loss and severe malnutrition. Usually eruption of primary teeth begins in the middle of the 1st year of life. This process is over by the beginning of the third year. First, the incisors of the mandible appear, and then maxillary incisors erupt. After that the medial molars, canines, and, finally, the lateral molars appear.

The average time and sequence of teeth eruption are individual. They may appear earlier than usual (sometimes a child is born with erupted incisors). Quite often teeth erupt at later dates or appear in the wrong order, as mentioned above.

Second dentition begins at 6–7 years and is over by 13–15 years. The deciduous teeth are exfoliated one by one to be replaced by their permanent successors. The first lower molars are the first to erupt followed by medial incisors and the first upper molars, after that the lateral incisors erupt. The first premolars erupt later followed by canines and second premolars, and finally, the second molars erupt. A complete permanent dentition is present when the third molars erupt at or around the age of 17–25 years (sometimes even later, and they are often completely absent).

The pharynx

The ***pharynx*** (*pharynx*) is a 12–14 cm long musculomembranous tube shaped like an inverted cone (Fig. 20). It extends from the cranial base to the lower border of the cricoid cartilage (the level of the sixth cervical vertebra), where it becomes continuous with the oesophagus. The width of the pharynx varies constantly because it is dependent on muscle tone, especially that of the constrictors: at rest the pharyngo-oesophageal junction is closed as a result of tonic closure of the upper oesophageal sphincter, and during sleep muscle tone is low so the dimensions of the pharynx are markedly decreased. The pharynx lies behind, and communicates with, the nasal, oral and laryngeal cavities via the nasopharynx, oropharynx and laryngopharynx respectively. Its lining mucosa is continuous with that lining the pharyngotympanic tubes, middle ear (tympanic cavity), nasal cavity, mouth and larynx. The crossing of the digestive and respiratory tracts occurs in the *pharyngeal cavity* (*cavitas pharyngis*). It is possible to distinguish the superior, lateral and posterior walls. The pharynx is composed by 3 parts, nasopharynx, oropharynx, hypopharynx. An upper part of the pharynx, adjacent to the external base of the cranium, is named the *pharyngeal vault* (*fornix pharyngis*).

The ***nasopharynx*** (*pars nasalis pharyngis*) is the upper part of the pharynx; it differs from the other parts in that its upper and lateral walls are fixed to the bone, so they do not collapse. The anterior wall of the nasopharynx is absent, due to the fact that the nasopharynx lies above the soft palate and behind the posterior nares, which allow free respiratory passage between the nasal cavities and the nasopharynx. On the lateral walls at the level of the posterior end of the inferior nasal concha there is a paired infundibular *pharyngeal opening of the auditory tube* (*ostium pharyngeum tubae auditivae*), which is limited from above and backward by the *torus tubarius* (*torus tubarius*).

The torus tubarius is formed by protrusion of cartilage of the auditory tube into the pharyngeal cavity. The short *salpingopharyngeal fold* of the mucous membrane (*plica salpingopharyngea*) descends from the torus tubarius. The mucosa composes the *torus levatorius* (*torus levatorius*) covering the levator veli palatini muscle; it is located before the salpingopharyngeal fold. Along the anterior edge of this fold the *salpingopalatine fold* (*plica salpingopalatina*) goes. Behind the torus tubarius the mucous membrane forms a large, *pharyngeal recess* (*recessus pharyngeus*) of varying shape, whose depth depends on the development of tubal tonsils. The *pharyngeal tonsil* (*tonsilla pharyngea*), a mass of lymphoid tissue, is situated in the place of transition of the upper wall into the posterior wall between the pharyngeal openings of auditory tubes. In childhood it is fully developed, but it regresses with age. The second double accumulation of lymphatic tissue lies in front of the pharyngeal openings of the auditory tube. It is a *tubal tonsil* (*tonsilla tubaria*). The *pharyngeal lymphoid ring* (*anulus lymphoideus pharyngis*) is con-