In vivo appearance of the oral cavity

The oral cavity (Fig. 1.1) extends from the lips and cheeks externally to the pillars of the fauces internally, where it continues into the oropharynx. It is subdivided into the vestibule external to the teeth and the oral cavity proper internal to the teeth. The palate forms the roof of the mouth and separates the oral and nasal cavities. The floor of the oral cavity consists of mucous membrane covering the mylohyoid muscle and is occupied mainly by the tongue. The lateral walls of the oral cavity are defined by the cheeks and retromolar regions. The primary functions of the mouth are concerned with the ingestion (and selection) of food, and with mastication and swallowing. Secondary functions include speech and ventilation (breathing).

**LIPS**

The lips (Fig. 1.2) are composed of a muscular skeleton (the orbicularis oris muscle) and connective tissue, and are covered externally by skin and internally by mucous membrane. The red portion of the lip (the vermillion) is a feature characteristic of humans. The sharp junction of the vermilion and the skin is termed the vermilion border. In the upper lip the vermilion protrudes in the midline to form the tubercle. The lower lip shows a slight depression in the midline corresponding to the tubercle. From the midline to the corners of the mouth the lips widen and then narrow. Laterally, the upper lip is separated from the cheeks by nasolabial grooves. Similar grooves appear with age at the corners of the mouth to delineate the lower lip from the cheeks (the labiomarginal sulci). The labiomental groove separates the lower lip from the chin. In the midline of the upper lip runs the philtrum. The corners of the lips (the labial commissures) are usually located adjacent to the maxillary canine and mandibular first premolar teeth. The lips exhibit sexual dimorphism; as a general rule, the skin of the male is thicker, firmer, less mobile and hirsute. The lips illustrated are lightly closed at rest and are described as being ‘competent’.

Incompetent lips (Fig. 1.3) describe a situation where, at rest and with the facial muscles relaxed, a lip seal is not produced. It is of some importance that this is distinguished from conditions where the lips are merely held apart habitually (as often occurs with ‘mouth breathers’). The lip posture illustrated in Figure 1.3 can be described as being ‘potentially competent’, as the lips would be capable of producing a seal at rest if there were no interference caused by the protruding incisors. Where the lips are incompetent, the pattern of swallowing is often modified to produce an...
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Fig. 1.4 (a) Competent lips maintaining normal inclination of the incisors. (b) Incompetent lips resulting in proclination of the upper incisors.

The position and activity of the lips are important in controlling the degree of protrusion of the incisors. With competent lips (Fig. 1.4a) the tips of the maxillary incisors lie below the upper border of the lower lip, this arrangement helping to maintain the ‘normal’ inclination of the incisors. With incompetent lips (Fig. 1.4b) the maxillary incisors may not be so controlled and the lower lip may even lie behind them, thus producing an exaggerated proclination of these teeth. If there is tongue thrusting to provide an anterior oral seal, further forces that tend to protrude the incisors are generated. A tight, or overactive, lip musculature may be associated with retroclined incisors.

ORAL VESTIBULE

The oral vestibule (Fig. 1.5) is a slit-like space between the lips and cheeks, and the teeth and alveolus. At rest, or with the mouth open, the vestibule and oral cavity proper directly communicate between the anterior oral seal. Accordingly, an oral seal may be formed by contact between the lower lip (or the tongue) and the palatal mucosa, and there may even be a forcible tongue thrust. It has been estimated that in the UK and the USA about 50% of children at the age of 11 years have some degree of lip incompetence.

The mucosa covering the alveolus is reflected on to the lips and cheeks, forming a trough or sulcus called the vestibular fornix. In some regions of the sulcus, the mucosa may show distinct sickle-shaped folds running from the cheeks and lips to the alveolus. The upper and lower labial frenula are such folds in the midline. Other folds of variable dimensions may traverse the sulcus in the region of the canines or premolars. Such frenula are said to be more pronounced in the lower sulcus. All folds contain loose connective tissue and are neither muscle attachments nor sites of large blood vessels.

Fig. 1.5 The oral vestibule. A = vestibular fornix; B = upper labial frenum; C = frenum in the region of the upper premolar teeth.

GINGIVA

The gums or gingivae, the oral mucosa covering the alveolar bone (which supports the roots of the teeth) and the necks (cervical region) of the teeth, are divided into two main components (Fig. 1.7). The portion lining the lower part of the alveolus is loosely attached to the periosteum via a diffuse submucosa and is termed the alveolar mucosa. It is delineated from the gingiva (which covers the upper part of the alveolar bone and the necks of the teeth) by a well defined junction, the mucogingival junction. The alveolar mucosa appears red, the gingiva pale pink. These colour differences relate to differences in the type of keratinization and the proximity to the surface of underlying blood vessels. Indeed, small blood vessels may readily be seen coursing beneath the alveolar mucosa (Fig. 1.7b). The gingiva may be further subdivided into the attached gingiva and the free gingiva. The attached gingiva is firmly bound to the periosteum of the alveolus and to the teeth, and the free gingiva lies unattached around the cervical region of the tooth. A groove (the free gingival groove) may be seen between the free and attached gingiva. This groove corresponds roughly to the floor of the gingival sulcus that separates the inner surface of the attached gingiva from the enamel itself (see Fig. 14.36). The interdental papilla is that part of the gingiva that fills the space between adjacent teeth. A feature of the attached gingiva is its surface stippling. The degree of stippling varies from individual to individual and according to age, sex and the health of the gingiva. Unlike the attached gingiva, the free gingiva is not stippled. On the lingual surface of the lower teeth. When the teeth occlude, the vestibule is a closed space that communicates with the oral cavity proper only behind the last molars (the retromolar regions). This provides a pathway for the administration of nutrients in a patient whose jaws have been wired together following a fracture.

Fig. 1.6 Midline diastema between upper central incisor teeth, produced by an enlarged labial frenum.
jaw the attached gingiva is sharply differentiated from the alveolar mucosa towards the floor of the mouth by a mucogingival line. On the palate, however, there is no obvious division between the attached gingiva and the rest of the palatal mucosa as this whole surface is keratinized masticatory mucosa.

**CHEEKS**

The cheeks extend intra-orally from the labial commissures anteriorly to the ridge of mucosa overlying the ascending ramus of the mandible posteriorly. They are bounded superiorly and inferiorly by the upper and lower vestibular fornices (Fig. 1.5). The mucosa is non-keratinized and, being tightly adherent to the buccinator muscle, is stretched when the mouth is opened and wrinkled when closed. Ectopic sebaceous glands without any associated hair follicles may be evident in the mucosa and are called Fordyce spots (Fig. 1.8). They are seen as small, yellowish-white spots, occurring singly or in clusters on the margin of the lips or the mucosa of the cheeks (and other sites such as genital skin). They can be seen in the majority of patients and are said to increase with age.

Few structural landmarks are visible in the cheeks. The parotid duct drains into the cheek opposite the maxillary second molar tooth and its opening may be covered by a small fold of mucosa termed the parotid papilla (see Fig. 1.25). In the retromolar region, in front of the pillars of the fauces, a fold of mucosa containing the pterygomandibular raphe extends from the upper to the lower alveolus (Fig. 1.9). The pterygomandibular space, in which the lingual and inferior alveolar nerves run, lies lateral to this fold and medial to a ridge produced by the mandibular ramus. The groove lying between the ridges produced by the raphe and the ramus of the mandible is an important landmark for insertion of a needle for local anaesthesia of the lingual and inferior alveolar nerves (see page 88).

**PALATE**

The palate forms the roof of the mouth and separates the oral and nasal cavities. It is divided into the immovable hard palate anteriorly and the movable soft palate posteriorly. As their names imply, the skeleton of the hard palate is bony while that of the soft palate is fibrous.

The hard palate is covered by a masticatory, keratinized mucosa that is firmly bound down to underlying bone and also contains some taste buds. It shows a distinct prominence immediately behind the maxillary central incisors, the incisive papilla (Fig. 1.10). This papilla overlies the incisive fossa through which the nasopalatine nerves enter on to the palate. Extending posteriorly in the midline from the papilla runs a ridge termed the palatine raphe. Here, the oral mucosa is attached directly to bone without the presence of a submucous layer of tissue. Palatine rugae are elevated ridges in the anterior part of the hard palate that radiate somewhat transversely from the incisive papilla and the anterior part of the palatine raphe. Their pattern is unique to the individual and, like fingerprints, can be used for forensic purposes to help identify individuals. At the junction of the
palate and the alveolus lies a mass of soft tissue (submucosa) in which run the greater palatine nerves and vessels. The shape and size of the dome of the palate varies considerably, being relatively shallow in some cases and having considerable depth in others.

The boundary between the soft palate and the hard palate is readily palpable and may be distinguished by a change in colour, the soft palate having a yellowish tint. Extending laterally from the free border of the soft palate on each side are the palatoglossal and palatopharyngeal folds (pillars of the fauces), the palatoglossal fold being more anterior (Fig. 1.11). These folds cover the palatoglossus and palatopharyngeus muscles and between them lies the tonsillar fossa that, in children, houses the palatine tonsil. The palatine tonsil is a collection of lymphoid material of variable size that is likely to atrophy in the adult. It exhibits several slit-like invaginations (the tonsillar crypts), one of which is particularly deep and named the intratonsillar cleft. The free edge of the soft palate in the midline is termed the palatal uvula. The oropharyngeal isthmus is where the oral cavity and the oropharynx meet. It is delineated by the palatoglossal folds.

Knowledge of the anatomy of the palate has clinical relevance when siting the posterior border (postdam) of an upper denture. The denture needs to bed into the tissues at the anterior border of the soft palate (at a location sometimes referred to as the ‘vibrating line’ because the soft palate can be seen to move here on asking a patient to say ‘ah’). In most individuals two small pits, the fovea palatini, may be seen (Fig. 1.12) on either side of the midline; these represent the orifices of ducts from some of the minor mucous glands of the palate. The fovea palatini can also be seen on impressions of the palate and a postdam may usually be safely placed a couple of millimetres behind the pits.

The moveable floor of the mouth is a small, horseshoe-shaped region above the mylohyoid muscle and beneath the movable part of the tongue (Fig. 1.13). It is covered by a lining of non-keratinized mucosa. In the midline, near the base of the tongue, a fold of tissue called the lingual frenum extends on to the inferior surface of the tongue. The sublingual papilla, on to which the submandibular salivary ducts open into the mouth, is a large centrally positioned protuberance at the base of the tongue. On either side of this papilla are the sublingual folds, beneath which lie the submandibular ducts and sublingual salivary glands.

The tongue is a muscular organ with its base attached to the floor of the mouth. It is attached to the inner surface of the mandible near the midline and gains support below from the hyoid bone. It functions in mastication, swallowing and speech and carries out important sensory functions, particularly those of taste. The lymphoid material contained in its posterior third has a protective role.

The inferior (ventral) surface of the tongue, related to the floor of the mouth, is covered by a thin lining of non-keratinized mucosa that is tightly bound down to the underlying muscles. In the midline, extending on to the floor of the mouth, lies the lingual frenum (Fig. 1.14). Rarely, this extends across the floor of the mouth to be attached to the mandibular alveolus. Such an overdeveloped lingual frenum (ankyloglossia) may restrict movements of the tongue. Lateral to the frenum lie irregular, fringed folds: the fimbriated folds. Also visible through the mucosa are the deep lingual veins.

The upper (dorsal) surface of the tongue may be subdivided into an anterior two-thirds (palatal part) and a posterior one-third (pharyngeal part). The junction of the palatal and pharyngeal parts is marked by a
shallow V-shaped groove, the sulcus terminalis (Fig. 1.15). The angle (or ‘V’) of the sulcus terminalis is directed posteriorly. In the midline, near the angle, may be seen a small pit called the foramen caecum. This is the primordial site of development of the thyroid gland.

The mucosa of the palatal part of the dorsum of the tongue is mainly keratinized and is characterized by an abundance of projections (papillae). The most numerous are the filiform papillae appearing as whitish, conical elevations (Fig. 1.16). Interspersed between the filiform papillae and readily seen at the tip of the tongue are isolated reddish prominences, the fungiform papillae. The largest papillae on the palatal surface of the tongue are the circumvallate papillae, which lie immediately in front of the sulcus terminalis. There are about 10–15 circumvallate papillae (Fig. 1.17). They do not project beyond the surface of the tongue and are surrounded by a circular ‘trench’. Foliate papillae (Fig. 1.18) appear as a series of parallel, slit-like folds of mucosa on each lateral border of the tongue, near the attachment of the palatoglossal fold. The foliate papillae are of variable length in humans and are the vestige of large papillae found in many other mammals. Apart from the filiform papillae, the papillae are the site of taste buds.

The pharyngeal surface of the dorsum of the tongue is non-keratinized and is covered with large rounded nodules termed the lingual follicles. These follicles are composed of lymphatic tissue, collectively forming the lingual tonsil. The posterior part of the tongue slopes towards the epiglottis, where three folds of mucous membrane are seen: the median and lateral glossoepiglottic folds. The anterior pillars of the fauces (the palatoglossal arches) extend from the soft palate to the sides of the tongue near the circumvallate papillae.

CLINICAL CONSIDERATIONS

There are a number of conditions in the mouth that can be inspected in the non-clinical environment. They provide examples of 1) normal variation, 2) common benign disorders and 3) disorders that may highlight normal features, which may be otherwise inconspicuous.

As examples of normal variation, we can consider pigmentation, Fordyce spots and black hairy tongue. In dark-skinned patients, patches of melanin pigment may be seen in the mouth, particularly in the gingiva (Fig. 1.19). This pigmentation is due to the extra melanosome granules present within the oral epithelium (see Fig. 14.22). Such pigmentation needs to be distinguished from other forms of mucosal pigmentation and from increased melanin pigmentation associated with a range of inflammatory conditions, such as lichen planus where melanin pigment is held within macrophages in the lamina propria (Figs 1.20, 1.21). Fordyce spots are seen in varying degrees as small, yellowish-white spots, occurring singly or in clusters on the margin of the lips (Fig. 1.22) or in the mucosa of the cheeks (Fig. 1.8) (and other sites such as genital skin). They can be seen in the majority of patients and are said to increase with age. They represent collections of sebaceous glands (Fig. 1.23) without any associated hair follicles. The range of variation in the filiform papillae on the dorsum of the tongue is
well illustrated by black hairy tongue (lingua villosa nigra), a benign condition in which there is hypertrophy of these papillae (Fig. 1.24). Instead of being about 1 mm in length, the filiform papillae may reach up to 15 mm, giving the dorsum an appearance of being covered in fine hairs. This provides a suitable environment for bacteria (and sometimes fungi) to accumulate and, together with retained pigments of dietary or microbial origin, may colour the surface of the tongue black. The condition may be associated with the administration of antibiotics or mouthwashes that may alter the normal bacterial population. It has a frequency of about 5% of the population.

Examples of common benign disorders are linea alba and tori. On the inside of the cheek and level with the occlusal plane, a linear, slightly raised whitish ridge may be seen, the linea alba (Fig. 1.25). It is commonly the result of low-grade, intermittent trauma due to folds of cheek mucosa being trapped between the teeth. More active trauma associated with cheek chewing produces a much larger, irregular white patch (Fig. 1.25). The
constant irritation converts the surface epithelium from its normal non-keratinized state into a parakeratinized layer (Fig. 1.26).

Individual variation in the shape of the jaws is recognized by anatomists and pathologists. Such variations blend with benign conditions. As an example, tori are benign localized overgrowths of bone found in both the upper (torus palatinus) and lower (torus mandibularis) jaws, resulting in an increased radiopacity in the region. In the upper jaw, the enlargement is typically seen in the midline (Figs 1.27–1.29), while in the lower jaw it is usually on the lingual aspect in the canine/premolar region and may be unilateral (Fig. 1.30) or bilateral (Fig. 1.31). However, a torus mandibularis may also affect the buccal surface of the mandible (Fig. 1.32). Torus palatinus is more common in females, while torus mandibularis is slightly more common in males. Tori vary in size from small to very large and there is a tendency for them to increase in size with age. Tori may be related to functional adaptations, as there is some evidence that their incidence is decreased in association with fewer teeth being present in the jaws. They require no treatment unless they interfere with the construction of satisfactory removable dentures. Their incidence varies from about 0.5% to over 65%, being less frequent in Caucasians and more frequent in Eskimos, Mongoloids and other Asian groups.

As an example of a disorder that highlights normal features that may be otherwise inconspicuous, one can inspect the palate of a patient who smokes heavily, revealing a whitish appearance that highlights numerous reddish spots (Fig. 1.33). The white appearance is the result of a pronounced orthokeratinized layer being present due to chronic irritation and this highlights the orifices of the ducts (as red spots) associated with the numerous mucous salivary glands present.