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Oral and Dental Anatomy

The oral cavity consists of soft and hard tissues. The lips, cheeks, tongue, gingivae, palate, and tonsils are the former, while the teeth are the latter. The oral cavity is bounded by the lips anteriorly, the nasopharynx posteriorly, the cheeks laterally, the tongue and sublingual tissues inferiorly, and the soft and hard palate superiorly. Various muscles, nerves, and vascular systems contribute to these surrounding structures. The muscles of the oral cavity include mylohyoid, geniohyoid, stylohyoid, hyoglossus, glossopharyngeal, thyroglossus, buccinator, masseter, medial and lateral pterygoid, orbicularis oris, and temporalis. These muscles, together with their tendons, nerves, and blood vessels, keep the oral cavity functional.

1.1 The Lips: Macro Anatomy

The lips are composed of the muscular layer of orbicularis oris, connective tissue, dermis, and mucosa (Figure 1.1). The red vermilion border and its junction with the skin and mucosa at its outer and inner borders may vary in width between races and genders. Lips may have a different posture at rest, including: (i) sealed or competent, and (ii) not sealed or incompetent. Lip position may affect the alignment and profile view of teeth and occlusion (Figures 1.2–1.4). In certain circumstances, the lips appear shorter than normal, or the jaws are not in normal skeletal

relationship, with a large part of the maxillary labial gingiva being visible during speech and smile. This condition is often referred to as “gummy” smile (Figure 1.5). Alternatively, there are cases where a longer-than-normal lip length or lost vertical height is noted due to lost or missing teeth – for example, ectodermal dysplasia. This in turn could cause the lips to overlap heavily, producing the appearance of an edentulous individual (Figure 1.4).

1.2 The Palate

The palate is divided into two major parts – *soft* and *hard* palate, with each of them having specific characteristics related directly to the role they play in different oral functions. The hard palate is supported by a hard, bony structure in the roof of the mouth, while the soft palate is mainly supported by fibrous tissue. The hard palate is covered with keratinized membrane, with a prominent eminence at the anterior mid-line located on top of the incisive foramen of maxillary bone, called the “incisive papilla.” The nasopalatine nerve and blood supply pass through this foramen. “Rugae” are the anterior rough mucosal folds of the palate located on either side of the incisive papilla and midline raphe (Figures 1.6 and 1.7).

The soft palate, in contrast, consists of muscles, salivary glands, and neurovascular components. The uvula is a soft, small,



Figure 1.1 Normal intraoral tissue and teeth.



Figure 1.2 Lips of a newborn.



Figure 1.3 Lips of an 8-year-old.



Figure 1.4 Lateral lip pattern in ectodermal dysplasia.

Figure 1.5 High upper lip resulting in a “gummy” smile.



Figure 1.6 Normal palatal appearance, 11-year-old.

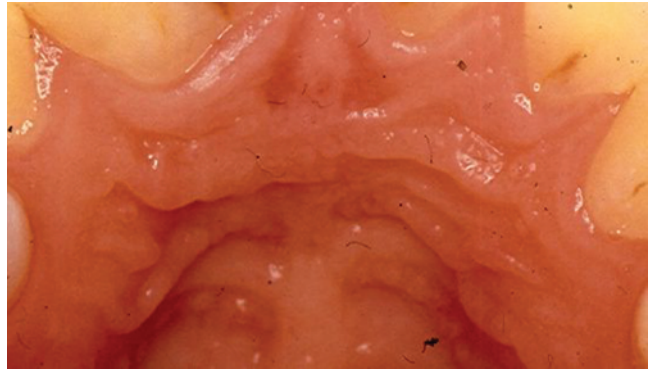
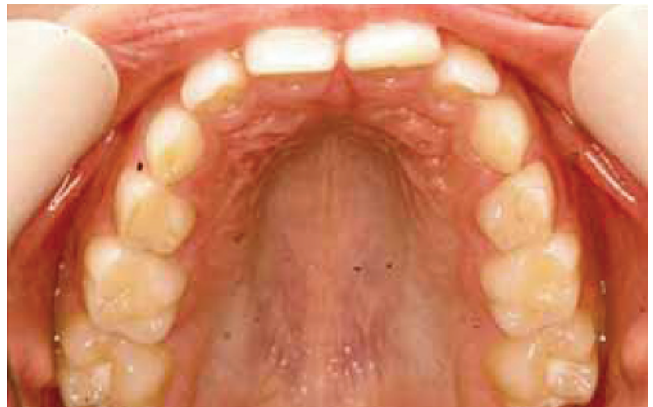


Figure 1.7 Normal palatal appearance, 8-year-old.



double-sided eminence of soft tissue located at the postero-inferior aspect of the soft palate. During swallowing, the soft palate and the uvula move together to close off the nasopharynx, preventing food from entering the nasal cavity.

1.3 The Tongue

The tongue is a muscular structure attached to the floor of the mouth at its posterior. The ventral part of the tongue is covered with a thinly keratinized mucosal membrane

firmly attached to the underlying muscles. The lingual frenulum is a thin layer of membranous tissue that attaches the anterior half of the tongue at its midline to the muscular structures in the floor of the mouth. The dorsal surface of the tongue is divided into two parts; the anterior two-third, and the posterior one-third (also known as the “pharyngeal” part). The border between these two segments is a shallow “V”-shaped groove, with the apex of the “V” lying posteriorly. Occasionally, there is a pit located at this apex, known as the “foramen caecum.”

The dorsal part of the tongue contains several types of papillae that function as taste organs: filiform; fungiform; foliate (Figures 1.8–1.10); and circumvallate forms.

1.4 The Cheek and Floor of the Mouth

The mucosal structure forming the interior surface of the cheek is non-keratinized, such as the floor of the mouth. These parts of the mouth contain numerous blood vessels and



Figure 1.8 Multiple filiform papillae on dorsum of tongue.



Figure 1.9 Foliate papillae on lateral tongue border.



Figure 1.10 Larger red fungiform papillae on dorsum of tongue.

nerve bundles. The main salivary glands and their ducts are located mainly in the cheeks (parotid glands and parotid ducts) and floor of the mouth (submandibular and sublingual glands and their ducts). The parotid is the largest salivary gland, with the parotid duct exiting from the frontal portion of the gland, passing over the masseter muscle and buccal pad of fat, then penetrating the body of buccinator muscle, before opening into the oral cavity via the parotid papilla close to the second maxillary molar. The parotid glands secrete mainly serous saliva. The submandibular and sublingual are mixed serous/mucous glands located in the floor of the mouth on either side of the lingual frenum,

close to the lingual surfaces of the lower incisors. They look different in clinical view when in rest or in tension (Figure 1.11a and b).

The mylohyoid and digastric muscles help to form the floor of the mouth alongside the base of the tongue.

1.5 The Periodontium

The periodontium includes ligament tissue bundles that control the teeth within their bony alveolar sockets and attaches them to the alveolar bone in one side while attaching to the cementum of the teeth on the other side. Vascular and nerve bundles are also present within the collagenous ligament layers. The outer layer of cementum is covered by a cellular layer, while the inner layer adjacent to dentine is mainly acellular. The gradual and continuous formation of cementum is responsible for the “compensation” of tooth structure loss due to attrition throughout life, as well as for the production of new connections and bonds between the root surfaces and the periodontal ligaments (Figures 1.12 and 1.13).

1.6 The Periodontal Ligament (PL)

The PL is a relatively firm fibrotic connective tissue that is located in the space between the root surface and alveolar bone surface.

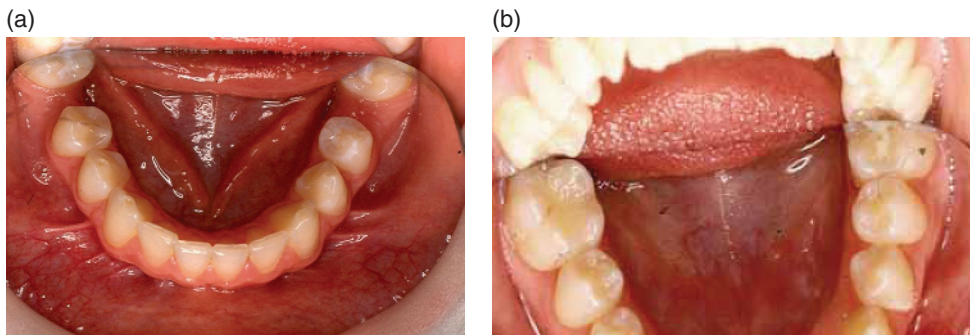


Figure 1.11 Floor of the mouth: (a) sublingual papilla in rest, (b) sublingual papilla in tension.



Figure 1.12 Relatively normal gingivae (note absent central incisors).



Figure 1.13 Alveolar bone covering both dentitions in the skull of a child.

The PL:

- a) Holds the tooth to the alveolar bone and prevents damage to the tooth.
- b) Is involved in the maintenance and repair of the alveolar bone and tooth cementum.
- c) Is actively involved in neurogenic mastication control via its mechanoreceptors.

The connective tissue fibers of the PL are mostly type 1 collagen; however, a small portion of fibers are oxytalan and reticulin, and elastin has been found in some parts. Fibroblasts are the most frequent cells found in the connective tissues of the PL. They cover the surface of the cementum and alveolar bone, and are considered to be part of the periodontal ligament. They include: cementoblasts, cementoclasts, osteoblasts, and osteoclasts. In addition, there are also

undifferentiated mesenchymal cells, defense cells, and remnants of the epithelial cells of Malassez.

1.7 The Alveolar Bone

The bony part protecting the teeth is called the “alveolar bone” of the maxilla and mandible. The alveolar bone is dependent on the presence of teeth to remain. In cases of congenital absence of all teeth (anodontia), the alveolar bone is negligible or absent. After individual tooth extraction, the alveolar bone that used to encase the root of the tooth will atrophy. Bone is a mineralized connective tissue with almost 60% mineral content, together with 25% organic materials and 15% water. By volume, bone is 36% mineral, 36% organic,

and 28% water. The mineral phase consists of hydroxyapatite, and 90% of the organic part is type I collagen. In addition, it has a small amount of other proteins, such as osteocalcin, osteonectin, osteopontin, and proteoglycan.

1.8 The Teeth: Dental Anatomy

Human dental systems consist of two dentitions: a *primary* (deciduous, milk) dentition and a *permanent* (secondary) dentition. The eruption process of the primary dentition starts at and around 6 months of age, and is usually complete by 24–30 months. The eruption process for the permanent dentition starts at 6 years of age (± 6 months), and continues into the late teens until the third

molar (if present) erupts. The number of primary teeth is 20 (10 in each jaw), and the number of permanent teeth is 32 (16 in each jaw) (Figures 1.14 and 1.15).

The correct terminology of the parts of the tooth is essential:

- a) *Crown*: The *clinical crown* is the part of the tooth that is visible on oral examination. The *anatomical crown*, on the other hand, is the part covered with enamel (Figure 1.16).
- b) *Root*: The *clinical root* is the part of the tooth covered by alveolar bone. The *anatomical root* is the part covered with cementum. The *furcation area* (bifurcation or trifurcation) is the area of the root in multi-rooted teeth where the roots start to develop away from the crown (Figure 1.16).

Figure 1.14 Normal primary dentition.



Figure 1.15 Normal permanent dentition.





Figure 1.16 A human maxillary molar with typical landmarks.



Figure 1.18 Pulp in a traumatically separated crown with the remaining radicular pulp tissue intact.

- c) *Cervical area*: The part of the tooth where the root and crown join; also known as the *tooth neck* (Figure 1.16).
- d) *Dental pulp*: The central space in the teeth occupied by blood vessels, lymph vessels, and connective tissue (Figures 1.17 and 1.18). Odontoblasts are located at the outer surface of the pulp adjacent to the dentine.
- e) *Anatomic landmarks of the tooth crown* (Figures 1.19 and 1.20):
Occlusal: the biting surface on posterior teeth (molars and premolars).
Incisal: the cutting edge on the anterior teeth (incisors and canines).

Cusp: eminences on the occlusal surface of the posterior teeth.

Tubercle: small projection on some coronal tooth parts due to excess enamel formation at the developmental stage that could be considered as a deviation from normal structure and shape.

Cingulum: a bulbous convexity close to the cervical part of the lingual surface of anterior teeth.

Ridge: a linear eminence on the occlusal surface of the crown seen in three parts and shapes: marginal, oblique, and triangular. The first two are mainly seen

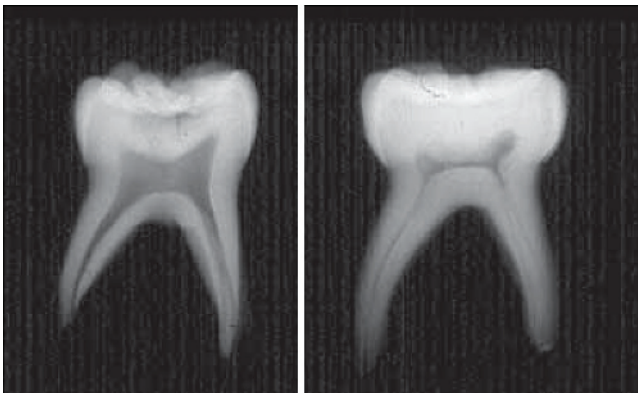


Figure 1.17 Radiographic view of primary (left) and permanent (right) molar pulp outlines.

Figure 1.19 Maxillary primary and permanent molars with cusps and fissures.



Figure 1.20 Maxillary central and lateral incisors.



on maxillary molars, while the latter is seen in both maxillary and mandibular molars and premolars.

Fissures: the groove between cusps and ridges.

Fossa: irregular intrusions and concavities on the tooth surface, examples of which include the lingual fossa on the lingual surface of incisors and the central fossa on the occlusal surface of molars.

Pit: pinpoint inversions of the surface enamel at the junction of grooves or at their ends. An example would be the occlusal pit on the occlusal central fossa of molars where the fissures meet.

Buccal: the crown surface touching /adjacent to the cheek (posterior teeth).

Labial: the crown surface touching/adjacent to the lips (anterior teeth).

Palatal: crown surface adjacent to the palate (maxillary teeth).

Lingual: the crown surface touching/adjacent to the tongue (mandibular teeth).

Mesial: the crown surface facing the midline.

Distal: the crown surface facing away from the midline.

1.9 Normal Occlusion

The skeletal jaw relationship dictates the inter-cuspal position of the teeth (occlusion). *Occlusion* can be defined as the relationship of the teeth in both jaws when

they are in contact. A normal occlusion (Class I) is the commonest occlusion in the population:

- a) The maximum number of teeth are in contact, and the mastication forces are at the physiological limit and along the long axis of the crowns.
- b) Lateral movements of the jaws are carried out without interferences.
- c) The space between teeth at rest is known as the *freeway space*.
- d) Teeth alignment is acceptable esthetically.

1.10 Classification of the Occlusion

Normal occlusion: All teeth are in appropriate occlusion, with correct molar and incisor relationships (Figure 1.21a and b).

- a) *Class I malocclusion:* One or more teeth are not in the normal position (malposition), while the molar relationship is normal (Figure 1.22a and b)
- b) *Class II malocclusion:* The maxillary first molar is located mesially by a minimum of half a cusp from its normal Class I position. There are two sub-groups of Class II: Division I (maxillary anterior teeth are proclined, as shown in Figure 1.23) and Division II (maxillary anterior teeth are retroclined, as shown in Figure 1.24). In certain cases, only the centrals are retroclined, and laterals are proclined.
- c) *Class III malocclusion:* The maxillary first molar is at least a half cusp more distal than a Class I. The incisor relationship changes from a normal maxillary over-jet to a reverse over-jet (Figure 1.25a and b).

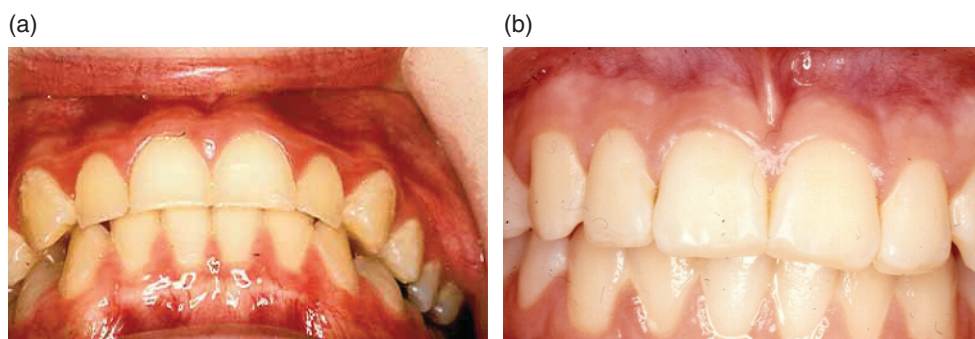


Figure 1.21 Normal occlusion, bite relationship: (a) over-jet, (b) over-bite.

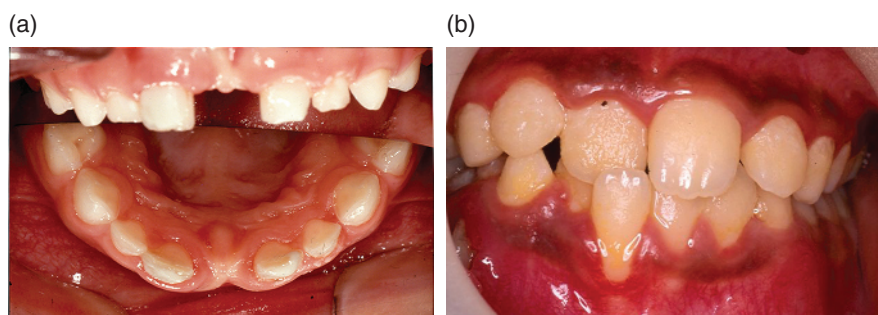


Figure 1.22 Class I malocclusion: (a) wide diastema, (b) severe crowding and cross-bite.



Figure 1.23 Class II Division I: anterior open bite.

(a)



(b)



Figure 1.24 Class II Division II: (a) deep over-bite, (b) increased anterior over-jet and over-bite (occlusal view).

(a)



(b)



Figure 1.25 Class III malocclusion: (a) reverse over-jet, (b) edge-to-edge and posterior cross-bite.

