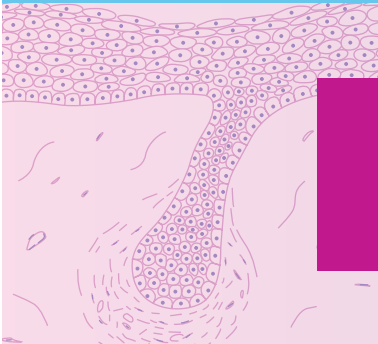




1

Introduction to Oral Anatomy

OVERVIEW

Oral anatomy is the study of the structures related to the oral cavity (which is commonly referred to as the mouth) and/or the face. The oral cavity is composed of various structures which play a vital role in essential physiological activities such as speech, mastication and deglutition. The hard tissue unit of the oral cavity includes the maxilla, mandible, other facial bones and most importantly the tooth and its supporting alveolar process. The soft-tissue unit of the oral cavity includes the tongue, palate, lips, gingiva, cheek and salivary glands.

■ Must Know

- Organization of the oral cavity
- Boundaries of the oral cavity
- Division of the oral cavity
- Components of the oral cavity

■ Desirable to Know

- Approaches to studying the oral cavity

■ Nice to Know

- Implications of oral anatomy in dentistry

associated with oral anatomy. Detailed descriptions of all the anatomical structures are dealt with in Chapters 2–7.

INTRODUCTION TO ORAL ANATOMY

The oral cavity, commonly referred to as mouth, is also called the buccal cavity. It is the most frequently used part of the human body and performs many functions which are vital and essential for the existence of the body. Being the origin of the alimentary canal that receives food, its primary function is related to the processing and digestion of food, and the secondary functions are those associated with speech, respiration, aesthetics and facial expressions.

A dentist's field of work is the oral cavity, which necessitates a thorough understanding of the oral structures for effective care of patients.

DEFINITION OF ORAL ANATOMY

Anatomy (Greek word *anatome*—*ana*, apart/separate; *tome*, to cut open/to cut apart) is a branch of biology and medicine that deals with the structure of living things. Knowledge of anatomy is the basis for understanding the other basic sciences such as physiology, microbiology and pathology as well as applied sciences such as medicine and surgery.

Oral anatomy is the study of the structures related to the oral cavity (which is commonly referred to as the mouth) and/or the face. It is the foundation for sound dental education and practice. This chapter aims at providing the necessary explanation to help understand the fundamental terminology and structural units

Significance of Oral Anatomy

With the ever-expanding frontiers of medicine, the necessity of superspecialization has attained paramount priority. Gone are the days when a single physician took care of all the problems of a patient.

Today, there is a remarkable improvement in the quality of patient care and treatment, with a more focused management of disease processes. With the growth of subspecialties and superspecialization, there has arisen a definitive need for target-oriented and focused literature which emphasize the regional management of disease processes. Dentistry on its own can be considered as a specialized branch of health sciences focusing on the management of diseases of the teeth, oral cavity and perioral (around the mouth) structures. A very important component in the fundamentals of dental education is oral anatomy, which forms the basis of understanding the structure and function of components constituting the oral cavity, face, head and neck. In-depth knowledge of the oral and perioral structures, their relationship with the adjacent structures and relevant nomenclature is essential for the following reasons:

1. To identify/study normal structure and form
2. To recognize abnormalities
3. To understand disease processes by correlating abnormalities with normal structures
4. To lay a foundation for the study and practice of pathology
5. To aid in diagnosis and treatment of disease processes
6. To plan and perform surgical procedures

The study of the oral cavity can never be complete without the knowledge of the perioral

structures, as the functioning of one anatomical unit depends on its interaction with the neighbouring units and in turn the body as a whole. The oral cavity has a direct structural as well as a direct and indirect functional relationship with the surrounding structures including the brain which mandates learning about the surrounding structures too.

Thus, oral anatomy broadly encompasses two major components:

1. Oral cavity (Fig. 1.1)
2. Perioral structures, which include the face, head and neck (Figs 1.2–1.4)

ORGANIZATION OF THE ORAL CAVITY

The human body in totality or in parts (e.g. oral cavity) essentially consists of an outer integumentary system of skin or mucous membrane which contains/envelopes the inner structures. These inner components may be divided into the following:

1. **Viscera:** These are the internal organs that perform specific functions.
2. **Skeletal system:** It is composed of bones and joints which provide the structural framework for the form and function of the human body.

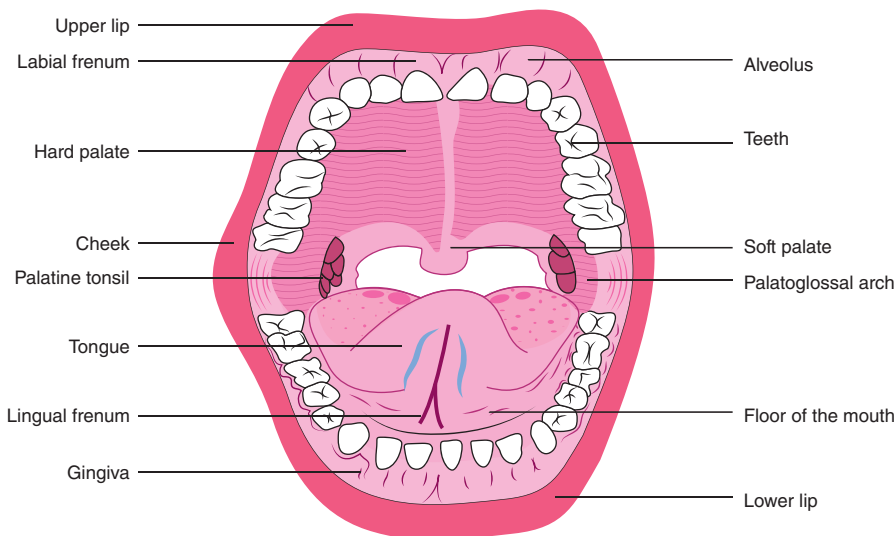


Figure 1.1 Components of the oral cavity.

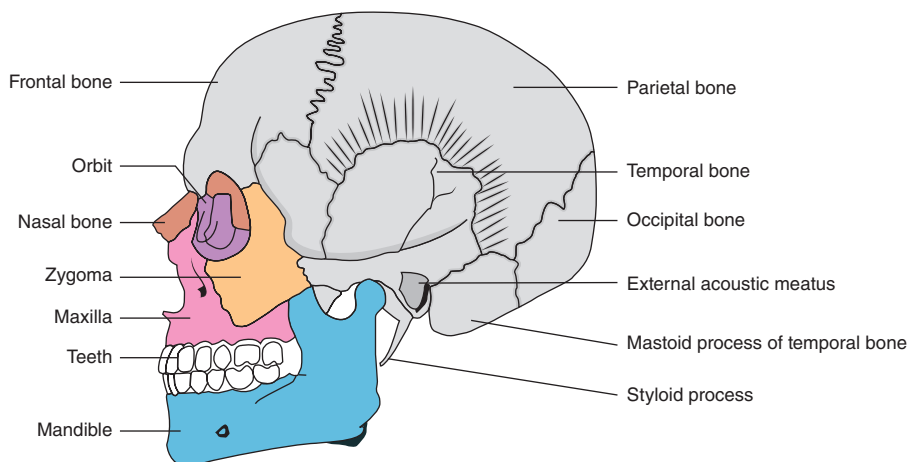


Figure 1.2 Skeletal components of the head.

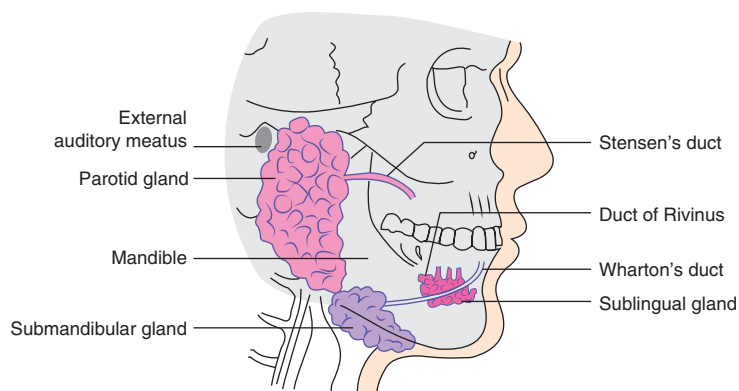


Figure 1.3 Major salivary glands.

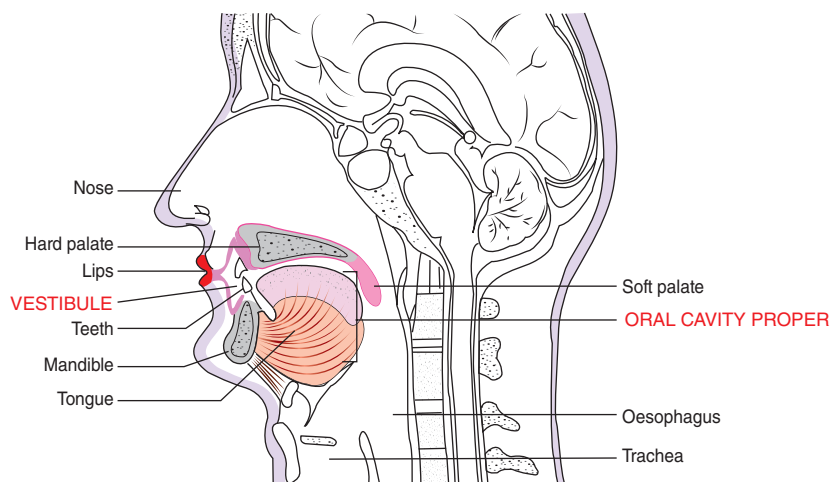


Figure 1.4 Boundaries of the oral cavity.

3. **Muscular system:** It consists of components which position and coordinate movements of the skeletal system and the viscera.
4. **Nervous system:** It consists of a network of nerves which help in the integration, coordination and functioning of all other systems by transmission of electrical impulses from the brain and the spinal cord.
5. **Vascular system:** It consists of arteries and veins which help in the supply and drainage of blood, respectively, to and from the tissues and the viscera.
6. **Lymphatic system:** These are structures that play a role in the locoregional defence of the human body through a network of lymphatic channels and collection centres called lymph nodes.

The descriptions of the above-mentioned components pertaining to the head and neck are discussed elaborately in individual chapters.

BOUNDARIES OF THE ORAL CAVITY

The extent of the oral cavity is demarcated by the following landmarks: hard and soft palates superiorly and the tongue and floor of the mouth inferiorly (Fig. 1.4). The anterior and lateral boundaries are formed by the lips, upper teeth and lower teeth while the palatoglossal folds on either side mark the posterior limiting point. The oral cavity is unique in the fact that it has a totally moist environment and is lined by the mucous membrane.

Divisions of the Oral Cavity

The oral cavity is an almost oval-shaped cavity with two basic components (Fig. 1.4):

1. Vestibule
2. Oral cavity proper

Vestibule/vestibulum oris (Fig. 1.4) is the space bounded by the lips and cheeks on the exterior and the gums and teeth within. It is lined by the mucous membrane, which is kept moist by the secretions received from the salivary glands. This mucous membrane is continuous with the mucous lining of the lips, cheeks and alveolus of the upper and lower jaws. The vestibule communicates with the exterior of the body through the orifice of the

mouth or the oral sphincter (also called the rima) and with the oral cavity proper on either side through a narrow space behind the wisdom teeth when the mouth is closed.

Oral cavity proper/cavum oris proprium (Fig. 1.4) is the area confined within the upper and lower dental arches. When the mouth is closed, the oral cavity proper is surrounded on all sides by the alveoli carrying the teeth. It communicates with the pharynx through a narrow inlet called the isthmus of the fauces or oropharyngeal isthmus. Its roof is formed by the hard and soft palates and the floor by the tongue and the mucous membrane lining the floor of the mouth.

BASIC TERMINOLOGY

The following terminology is important to understand and simplify the description of individual anatomical structures of the oral cavity as well as their relationship with the adjacent organs. The terminology is clinically useful in describing the extent of any lesion in case sheets, surgical procedures or communicating with professionals.

1. **Superficial, intermediate and deep**
 - (a) *Superficial*: Structures closer to the surface, that is skin or oral mucous membrane
 - (b) *Intermediate*: Structures in between superficial and deep
 - (c) *Deep*: Structures located much below the surface, at greater depths
2. **Medial and lateral** (Fig. 1.5)
 - (a) *Medial*: Means 'towards the midline' or 'towards the middle' of the dental arch
 - (b) *Lateral*: Means 'towards the sides' or 'towards the cheek'
3. **Internal and external**
 - (a) *Internal*: Denotes the inner aspect
 - (b) *External*: Denotes the outer aspect
4. **Anterior and posterior** (Fig. 1.5)
 - (a) *Anterior*: Means towards the front of the mouth
 - (b) *Posterior*: Means towards the back of the mouth
5. **Proximal/mesial and distal** (Fig. 1.5): These terms are commonly used in relation to the

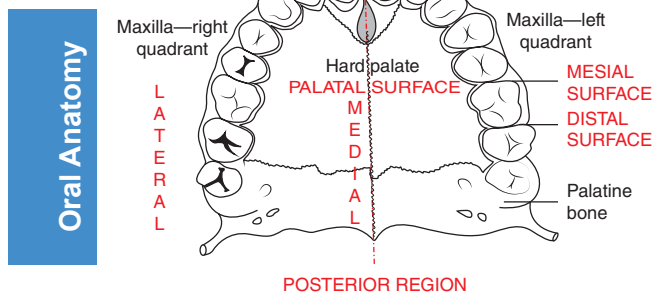


Figure 1.5 Maxilla—quadrants and surfaces.

dentition. The proximal surfaces of the teeth may be either mesial or distal.

- (a) *Proximal/mesial*: Means towards the midline of the dental arch
- (b) *Proximal/distal*: Means away from the midline of the dental arch

When used in a context not related to the dentition, proximal refers to the regions closer to the trunk while distal refers to the part which is away from the trunk. For example, the condyle of the mandible is the proximal part of the mandible while the symphyseal region is the distal part.

6. Dorsal and ventral (Fig. 1.6)

- (a) *Dorsal*: It refers to the surface on the back or the upper surface of an organ. It also indicates the surface facing away from the ground.
- (b) *Ventral*: It refers to the surface on the front or the lower surface of an organ. It also indicates the surface facing towards the ground.

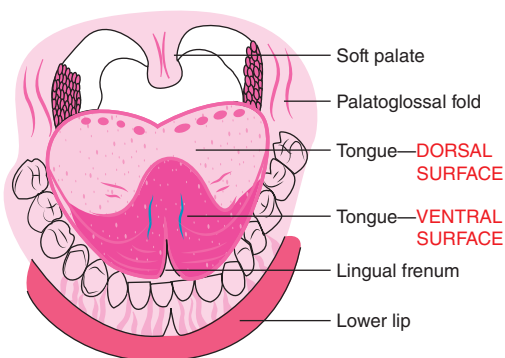


Figure 1.6 Dorsal and ventral surfaces.

7. Ipsilateral and contralateral (Fig. 1.7)

- (a) *Ipsilateral*: It denotes 'on/related to' the same side. For example, the right arm is ipsilateral to the right leg.
- (b) *Contralateral*: It denotes the 'opposite side'. For example, the right arm is contralateral to the left leg.

8. Inferior and superior

- (a) *Inferior*: Denotes 'lower'
- (b) *Superior*: Denotes 'upper'

9. Quadrants: A quadrant is an anatomical segment formed by the division of the maxillary or mandibular arch by an imaginary midline. It divides each arch into a left half and a right half. The resulting four quadrants are named as follows (Figs 1.5 and 1.8):

- (a) Maxillary right quadrant
- (b) Maxillary left quadrant
- (c) Mandibular right quadrant
- (d) Mandibular left quadrant

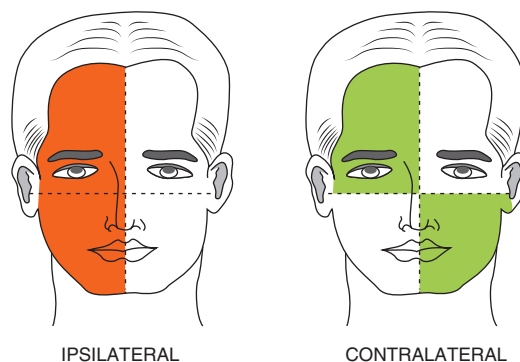


Figure 1.7 Ipsilateral and contralateral.

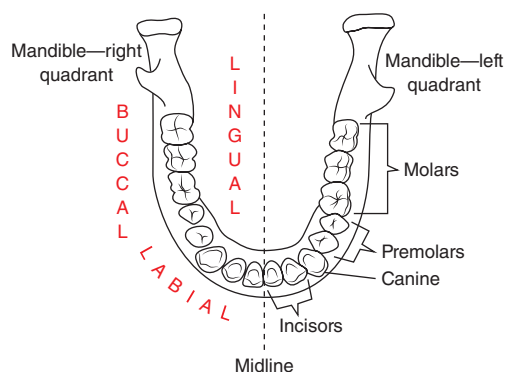


Figure 1.8 Mandible—quadrants and surfaces.

10. **Occlusion:** It is the relationship of the teeth of the mandibular (lower jaw) and maxillary (upper jaw) arches at rest or during various movements of the mandible.
11. **Surfaces (Figs 1.5 and 1.8):** The surfaces of the various structures in the oral cavity are named based on the anatomical units nearby.
 - (a) *Buccal*: Surface that faces the cheek
 - (b) *Labial*: Surface that faces the lips
 - (c) *Lingual*: Surface that faces/lies closer to the tongue
 - (d) *Palatal*: Surface that faces/lies closer to the palate
12. **Anatomical planes (Fig. 1.9):** These are reference planes used to study deeper structures and their relationship with the adjacent anatomical units. They are two-dimensional representations of three-dimensional structures and are obtained by dissections in cadavers and imaging techniques in living subjects. The various planes are as follows:
 - (a) *Median*: Plane that divides the body into right and left halves
 - (b) *Sagittal*: Plane that divides the body/parts of the body into right and left unequal parts (Fig. 1.10a)
 - (c) *Coronal*: Plane that divides the body/parts of the body into anterior and posterior parts (this plane is at right angles to the sagittal plane [Fig. 1.10b]).
 - (d) *Transverse/horizontal*: Plane that divides the body/parts of the body into upper and lower parts
 - (e) *Axial*: Any cut/plane at right angles to the body or long axis of the body (Fig. 1.10c)

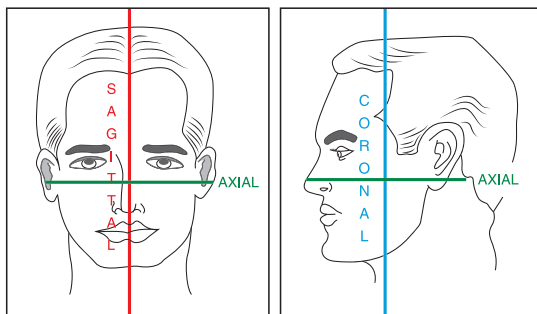


Figure 1.9 Anatomical planes.

COMPONENTS OF THE ORAL CAVITY

The oral cavity and the perioral structures can be grouped into two major components:

1. **Hard tissues:** Skeletal unit (bones) and the dental unit (teeth)
2. **Soft tissues:** Tongue, cheeks, soft palate, lips, salivary glands and various other organs

Hard Tissues

The hard tissues constituting the oral cavity and the perioral structures fall under the following two categories: perioral bones and dentition.

1. **Perioral bones:** These include the maxilla, the mandible and the other bones of the skull.
 - (a) *Mandible* (Fig. 1.2) refers to the lower jaw. It is a movable sturdy bone that articulates with the rest of the skull by a joint on either side called the temporomandibular joint.
 - (b) *Maxilla* (Fig. 1.2) refers to the upper jaw. Unlike the mandible, it is immovable. It acts like a cushion to shield the cranium from stress due to sudden trauma.
 - (c) *Skull bones* (Fig. 1.2) include bones of the facial skeleton and the cranium (refer to Chapter 2 for a detailed description).
 - (d) *Alveolus/alveolar process* (Fig. 1.1) is the part of the maxilla and mandible that supports the teeth.
2. **Dentition (Figs 1.2, 1.5 and 1.8):** The term *dentition* refers to the natural teeth in the jaw bones whose function is to aid in digestion by breaking down ingested food into smaller fragments which can be acted upon by digestive enzymes in the stomach. It is of three types:
 - (a) *Primary dentition* is the first set of teeth that erupt into the oral cavity. They are 20 in number and are also referred to as 'baby teeth' or 'deciduous teeth'.
 - (b) *Permanent dentition* refers to the second set of succedaneous teeth that erupt after shedding of the primary dentition. They are 32 in number and are also called secondary or 'adult' teeth.

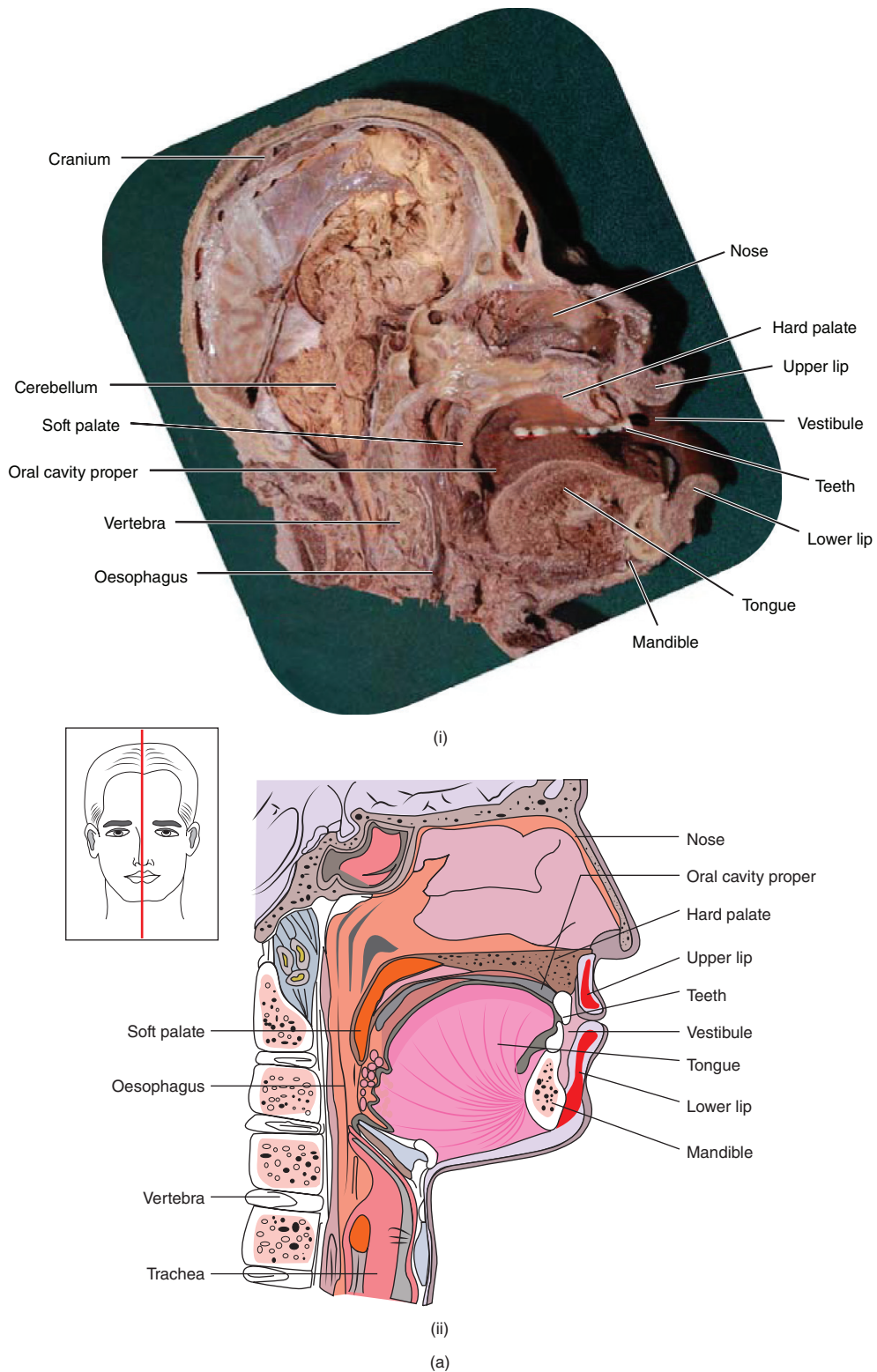
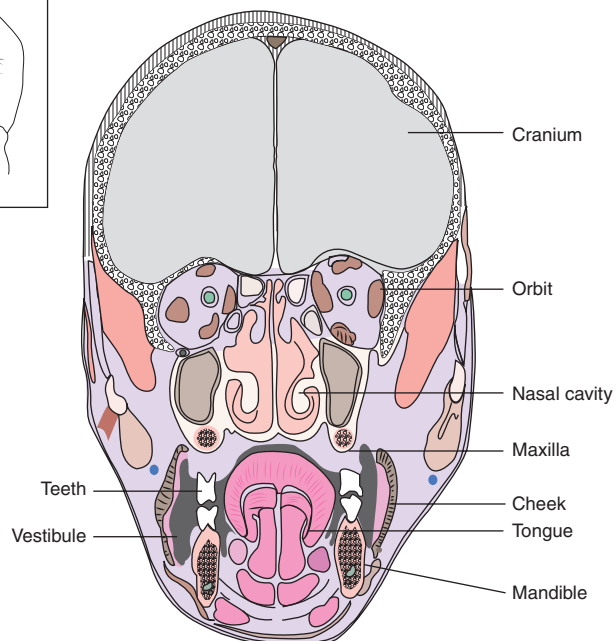
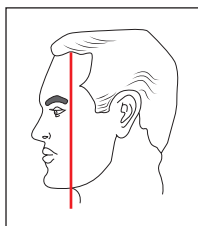


Figure 1.10 (a) Sagittal section: (i) dissected specimen and (ii) schematic diagram. (Continued)



(i)



(ii)

(b)

Figure 1.10 (Continued) (b) Coronal section: (i) dissected specimen and (ii) schematic diagram. (Continued)

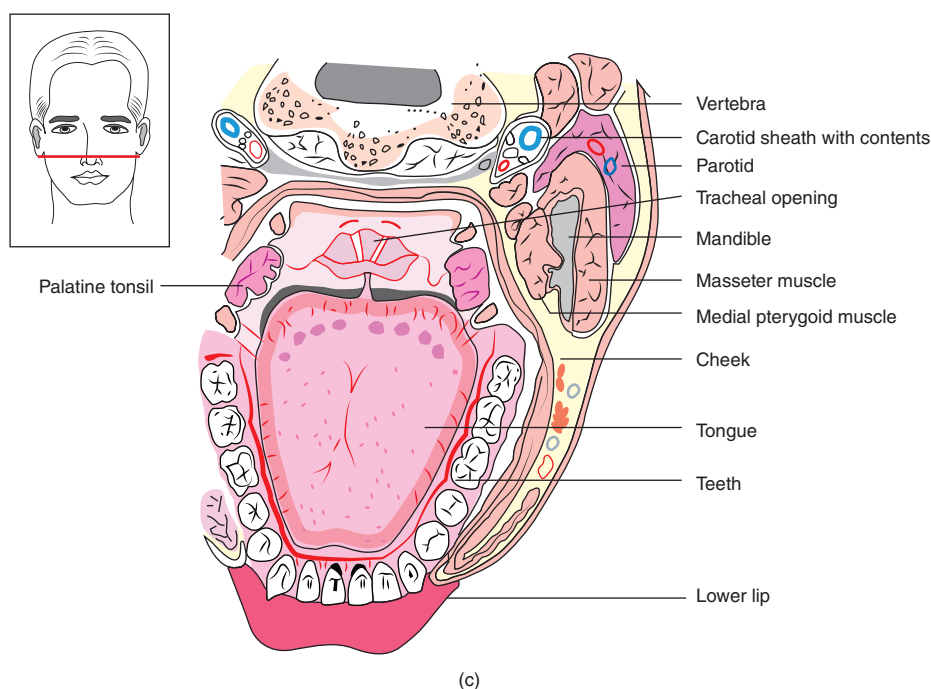


Figure 1.10 (Continued) (c) Axial section.

(c) *Mixed dentition* occurs when both primary and permanent teeth are present, usually between the ages of 6 and 12 years.

The teeth vary in their shape, size and location in the jaws. The functions of the teeth vary according to their morphology:

1. **Incisors** are front, single-rooted teeth with a relatively sharp, thin edge designed to cut food. They are four in number in each arch—two centrals (front teeth) and two laterals (distal to the centrals).
2. **Canines** are corner teeth. They are also known as cuspids and are two in number, designed for cutting and tearing foods.
 - (a) *Premolars* are also called bicuspid. They have cusps that hold and grind food. In every arch, there are four premolars in the permanent dentition. There are no premolars in the primary dentition.
 - (b) *Molars* are larger teeth with more cusps than other teeth and are used to chew or grind food. In each arch, there are four molars in the primary dentition and six molars in the permanent dentition.

The morphology of every tooth in both the jaws is unique and numbered. This is discussed in detail in the section on Tooth Morphology.

Soft Tissues

The soft tissues of the oral cavity drape the skeletal components. They are composed of the lips, cheeks, gums, tongue, salivary glands and soft palate.

1. **Lips** (*labia oris*) (Fig. 1.1) are the two fleshy linear structures (upper and lower) which encircle the orifice of the mouth and control the opening and closing of the oral cavity. They are composed of the orbicularis oris muscle, blood vessels, nerves, areolar tissue, fat and numerous minor salivary glands. They are covered externally by the skin and internally by the mucous membrane. The inner surface of each lip is connected to the corresponding gum by a fold of mucous membrane in the midline called the frenum (Fig. 1.1). Lips play an important role in deglutition and speech.
2. **Salivary glands** (Fig. 1.3) are organs that secrete saliva, which has a major role

in various vital physiological functions (discussed in Chapter 7). Three large pairs of salivary glands communicate with the mouth, pour their secretion into it and are responsible for maintaining the oral cavity moist. They are the parotid, submandibular and sublingual salivary glands. In addition, there are numerous minor salivary glands.

3. **Tongue** (*lingua*) (Figs 1.1 and 1.6) is a special sensory organ situated in the floor of the mouth, within the body of the mandible, containing many small papillae that hold the taste buds. It is firmly anchored to the floor of the mouth by a fold of mucous membrane called the lingual frenum. It is the primary organ that helps in perceiving taste sensation and is also important for speech, mastication and deglutition of food.
4. **Cheeks** (*buccae*) (Figs 1.1 and 1.10b) are sheet-like structures that form the sides of the face and merge with the lips anteriorly. They are composed of muscle fibres, fat, areolar tissue, blood vessels and nerves and are lined by the skin externally and the mucous membrane internally.
5. **Gums** (*gingiva*) (Fig. 1.1) are tissues that cover the alveolar processes and encircle the necks of the teeth. They are composed of dense fibrous tissue and are adherent to the periosteum of the alveolar processes. They are covered by a firm mucous membrane. Gingivae extend as fine papillae into the interdental regions forming a healthy collar for the teeth and help in supporting them.
6. **Palate** (*palatum*) (Figs 1.1 and 1.5) is the anatomical unit that forms the roof of the mouth. It consists of two subunits: hard palate anteriorly and soft palate posteriorly.
 - The **hard palate** (*palatum durum*) (Figs 1.4 and 1.5) is the bony vault of the oral cavity bounded in front and the sides by the alveolar arches. It is continuous with the soft palate located behind it. It is covered by a firm lining formed by the adherence of the mucous membrane to the palatal periosteum and contains a few corrugations called rugae. It helps in the physical separation of the mouth from the nasal cavity and provides separate passages for the intake of air and food.

- The **soft palate** (*palatum molle*) (Figs 1.1 and 1.4) is a movable soft tissue suspended from the posterior border of the hard palate and forms an incomplete barrier between the mouth and the pharynx. It is composed of mucous membrane overlying muscle fibres, palatine aponeurosis, blood vessels and nerves. It also contains mucous glands within its substance. The soft palate has a concave ventral surface and a convex dorsal surface which merges with the lining of the nasal cavities. Its anterior border is attached to the posterior aspect of the hard palate while the lower border is free. The sides of the soft palate blend with the pharyngeal wall. Along the posterior free end is a small midline conical process called the palatine uvula. Two curved folds of mucous membranes originate bilaterally from the base of the uvula and they are called the faucial pillars or arches.

SUBDIVISIONS OF ANATOMY (Fig. 1.11)

Anatomy can be broadly classified into macroscopic anatomy and microscopic anatomy. Macroscopic anatomy can further be subdivided into gross anatomy and surface anatomy while microscopic anatomy can be divided into cytology and histology.

Macroscopic Anatomy

Macroscopic anatomy is the study of structures that can be seen by the naked eye. It encompasses the following:

1. **Gross anatomy:** It is the study of the form/structure of the body parts as seen by the naked eye/unaided vision. This can be done system-wise (e.g. vascular anatomy, neuro-anatomy, osteology) or region-wise (e.g. head and neck, upper limb).
2. **Surface anatomy (superficial anatomy):** It is the study of the external surface of the body without dissection. It helps in identifying the inner configuration of anatomical structures with the aid of visible external landmarks.

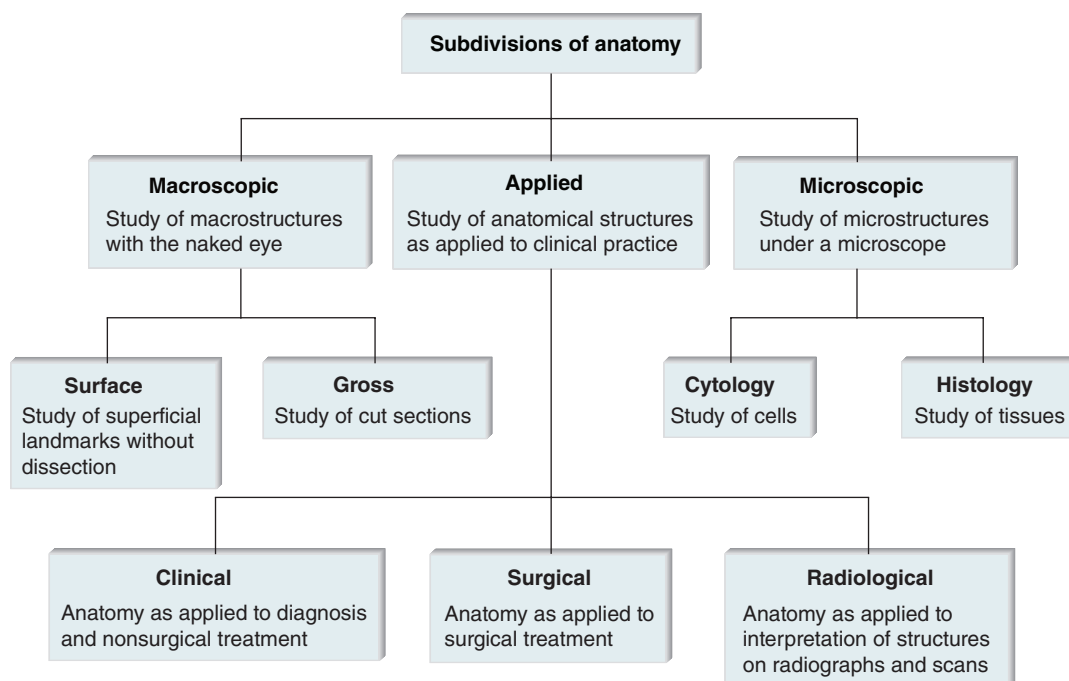


Figure 1.11 Subdivisions of anatomy.

Microscopic Anatomy

Microscopic anatomy is the study of structures in minute detail with microscopy. It consists of the following:

1. **Cytology:** Study of cells
2. **Histology:** Study of tissues

This also includes more specialized methods such as histochemistry and immunocytochemistry in which biochemical techniques are combined with histology.



APPLIED ANATOMY

Applied anatomy is the study of the form and structure of different anatomical units as applied to diagnosis and treatment. It includes the following:

1. **Clinical anatomy:** It is the practical application of anatomy in diagnosis and treatment planning.
2. **Surgical anatomy:** It is the anatomy that facilitates planning and performing surgical procedures.
3. **Radiological anatomy (also called imaging anatomy):** It is the study of anatomy in living subjects by interpretation of structures in radiographs and scans.

The evolution of the field of anatomy has led to creation of other specialized branches such as developmental anatomy (embryology) and comparative anatomy (comparative study of anatomy in different species).

APPROACHES TO STUDYING ANATOMY (Fig. 1.12)

The modes of studying anatomy are more than being confined to books. They have widened scope with the use of clinical material in the form of cadavers, live subjects, imaging methods and microscopy. Today, anatomy is learnt through diverse and novel approaches mentioned as follows:

1. **Dissectional:** This includes the traditional study of gross anatomy of the deeper structures with the aid of scalpel dissection of cadavers and study during surgical dissection in live subjects.
2. **Clinical:** This is the study of anatomy practically in living subjects by inspection and palpation. It correlates clinical features with anatomical structures and helps in application of anatomy to diagnosis and treatment of patients.
3. **Radiological:** This consists of a structural study in the living subjects through real-time modes, such as ultrasound, and cross-sectional modes, such as CT and MRI scans.

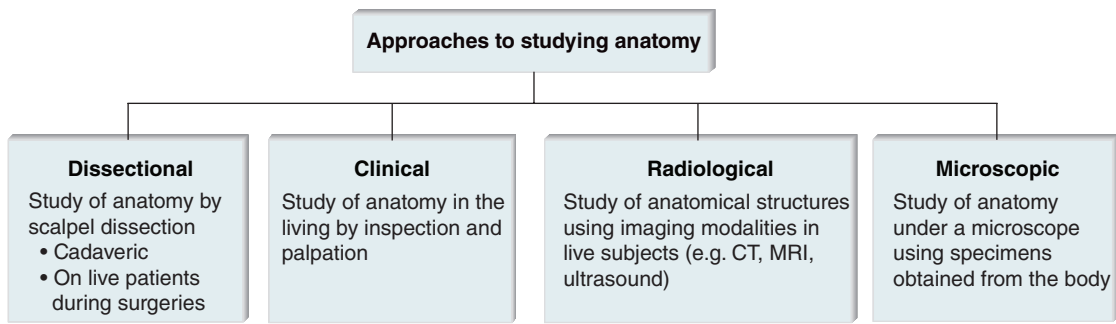


Figure 1.12 Modes of studying anatomy.

4. **Microscopic:** This is primarily an in vitro specialization which involves the study of cells and tissues of specimens obtained from the human body through microscopy.

IMPLICATIONS OF ORAL ANATOMY IN DENTISTRY

Dentistry is a specialized branch of health science dealing with the care and well-being of the teeth and the oral cavity. The study of oral anatomy has numerous implications in dentistry highlighted as follows:

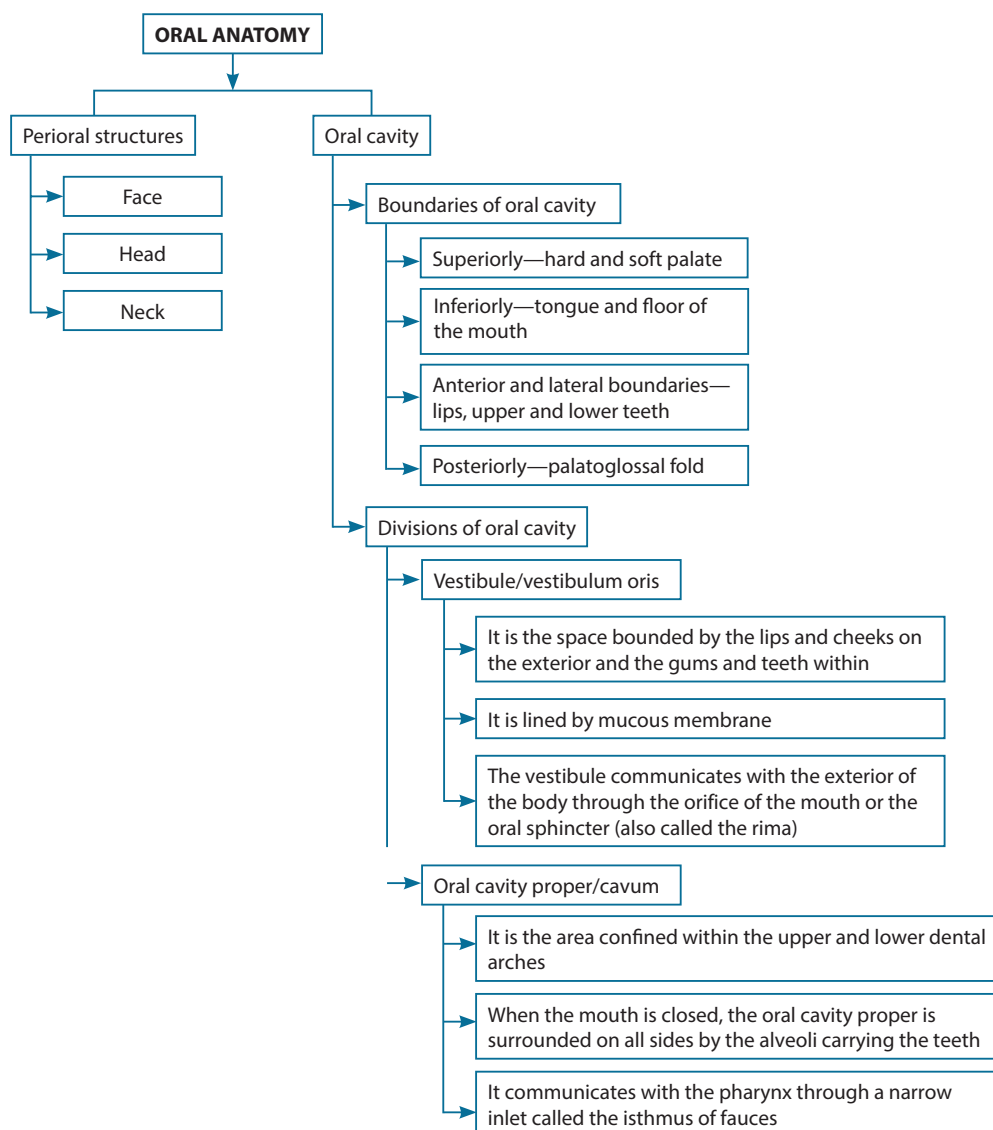
1. **Establishing harmony between anatomical parts and dentistry:** A dentist has the crucial role of restoring the form, function and aesthetics of the oral cavity and the face which are totally dependent on achieving ideal oral anatomy.
2. **Understanding the functional importance of the oral cavity:** The realm of the dentist is not only the teeth. It includes complex functions such as speech, respiration and facial expression which are influenced by the structures in his or her domain. A change in the anatomy and dynamics of the oral cavity has a direct influence on the above-mentioned functions. For example, a denture extending into the soft palate not only can affect mastication, which is the primary function for its fabrication, but may also significantly alter speech. A deficiency or abnormality in the jaws may affect a very important function such as respiration by creating an obstruction in the pharyngeal inlet.
3. **Diagnosing disease processes:** Knowledge of regional anatomy helps us to distinguish the abnormal from the normal, such as identification of a lingual thyroid or a syphilitic gumma. It provides us with an understanding of the channels and modes for the spread of disease process from the mouth to the body and vice versa, such as the occurrence of cavernous sinus thrombosis secondary to a perioral infection.
4. **Planning and performing treatment procedures:** Anatomical knowledge plays an important role in the planning and execution of surgical procedures in a precise manner.
5. **Maintaining oral care, restoration and rehabilitation:** Rehabilitation of oral structures, which is the primary role of a dentist, requires good working knowledge of the regional anatomy. Anatomy enables better application of biomechanical principles for an effective aesthetic and functional outcome.

Key Points

- Oral anatomy is the study of structures related to the oral cavity (which is commonly referred to as the mouth) and/or the face.
- The basic components of any anatomical unit are as follows: viscera (internal organs), skeleton (bone and joints), muscles, nerves, blood vessels and lymphatic system.
- The major parts of the oral cavity include the vestibule and oral cavity proper.

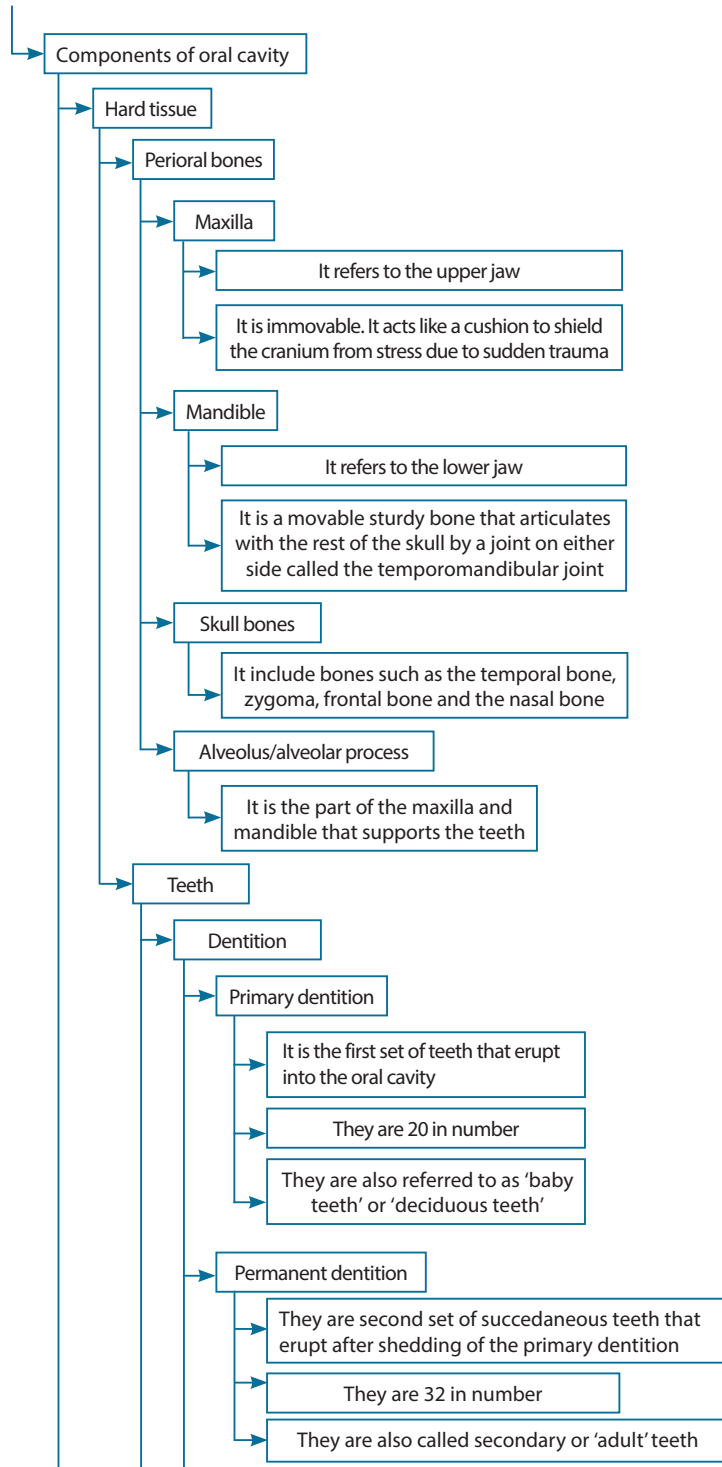
- *Anatomical planes* are reference planes used to study deeper structures and their relationship with the adjacent anatomical units. The various planes are *sagittal*, *coronal*, *transverse/horizontal* and *axial*.
- Anatomy can be broadly classified into macroscopic anatomy and microscopic anatomy. Macroscopic anatomy can further be subdivided into gross anatomy and surface anatomy while microscopic anatomy includes cytology and histology.
- Applied anatomy is the study of the form and structure of different anatomical units as applied to diagnosis and treatment. It may be surgical, clinical or radiological.
- Alteration in anatomy leads to abnormalities in the form and function of organs which clinically present as diseases. The study of such diseases is called pathology.

MIND MAP



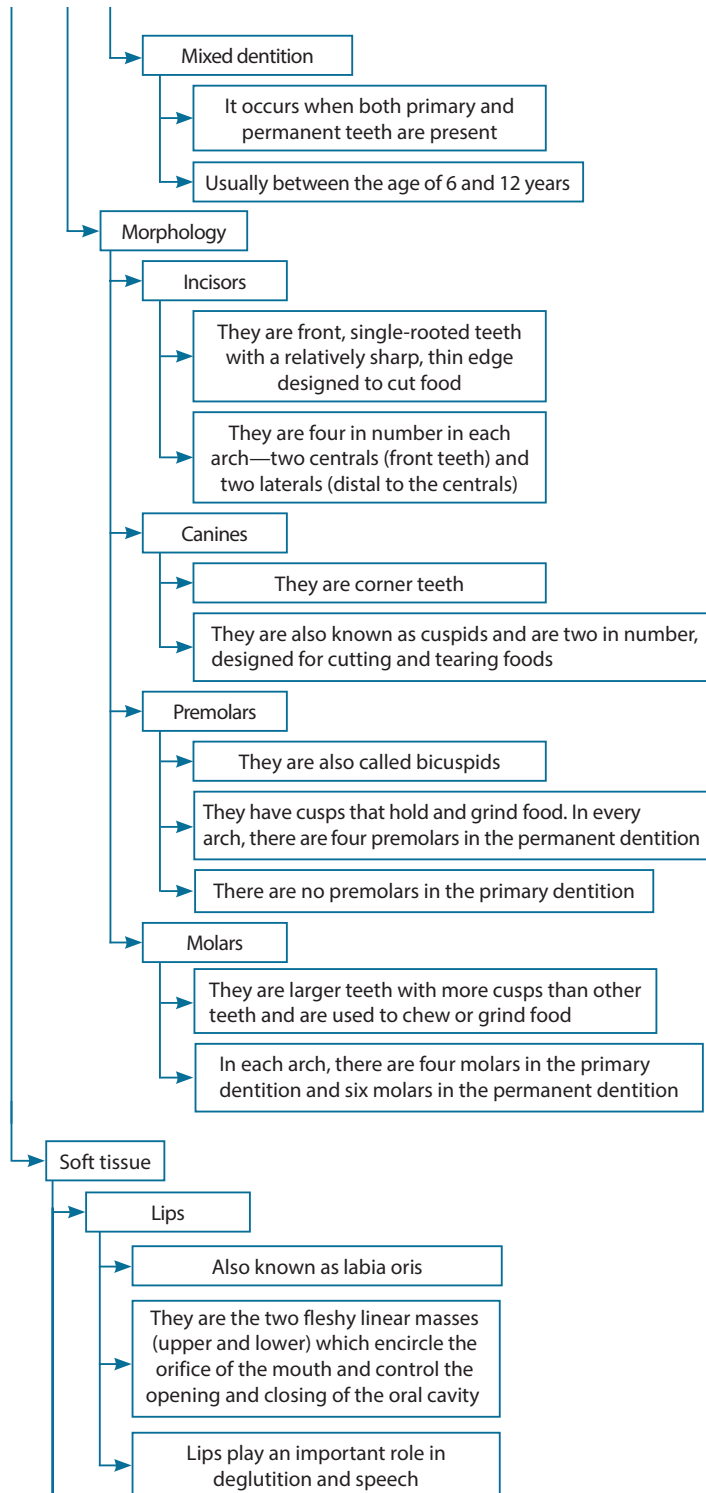
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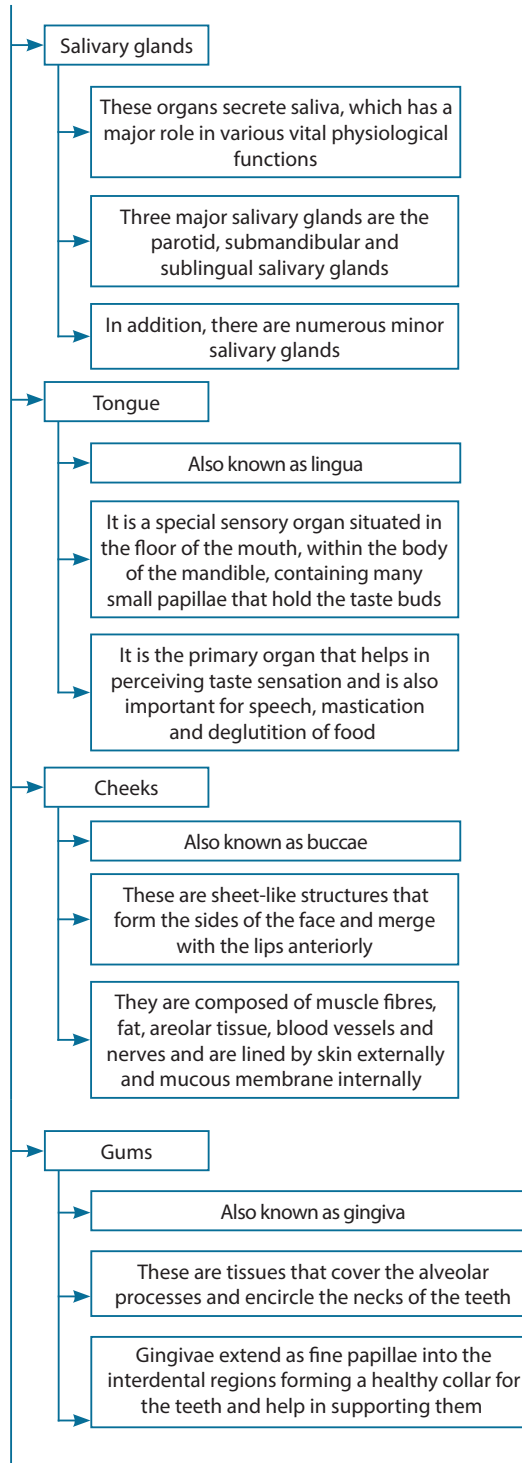
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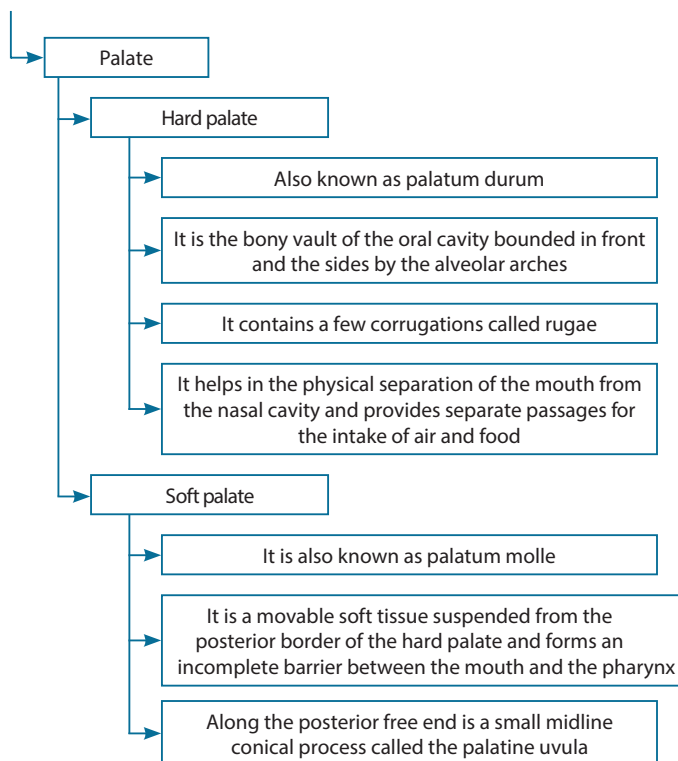
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Self-Assessment

Multiple Choice Questions

- Buccal cavity refers to the
 - Oral cavity
 - Nasal cavity
 - Auditory cavity
 - Pituitary cavity
- The term viscera refers to
 - Cheek
 - Internal organs
 - Soft palate
 - Mandible
- The role of the lymphatic system is in
 - Maintaining body temperature
 - Respiration
 - Locoregional defence
 - Digestion
- The posterior limit of the oral cavity is formed by the
 - Lips
 - Tongue
 - Palate
 - Palatoglossal fold
- The term medial denotes
 - Towards midline
 - Towards cheek
 - Towards the sides
 - On the muscle
- The term that refers to the surface on the back or the upper surface of an organ is
 - Ventral
 - Dorsal
 - Medial
 - Lateral
- The relationship of the teeth of the mandibular and maxillary arches at rest or during various movements of the mandible is called
 - Articulation
 - Quadrant
 - Occlusion
 - Intercuspation
- The sagittal plane divides the body into
 - Upper and lower parts
 - Superficial and deep parts
 - Front and back parts
 - Right and left parts

9. The maxilla is the
 - (a) Upper jaw
 - (b) Lower jaw
 - (c) Lower joint
 - (d) Lower tooth
10. The organ that helps in digestion is the
 - (a) Lacrimal gland
 - (b) Salivary gland
 - (c) Pituitary gland
 - (d) Lymph node

Game-Based Learning

Unscramble

1. AIBAL
2. SECUAF
3. ELUBITSEV

Word Finder

1. 9-Letter word that starts with S and ends with S

2. 8-Letter word that starts with S and ends with L
3. 7-Letter word that starts with P and ends with M
4. 6-Letter word that starts with L and ends with A

Answers

Multiple Choice Questions

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (a) | 2. (b) | 3. (c) | 4. (d) | 5. (a) |
| 6. (b) | 7. (c) | 8. (d) | 9. (a) | 10. (b) |

Unscramble

1. Labia
2. Fauces
3. Vestibule

Word Finder

1. Symphysis
2. Sagittal
3. Palatum
4. Lingua