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Covering all Recent Updates & Qs up to June 2022 Exams

Most Comprehensive and Thoroughly Revised Fully-Colored Book on Anatomy with Many Unique Features, like Clinical Aspects, Numerous Histology Slides and Cadaveric Images for Correlation

Revise

New SARP Series for NEET/INI-CET

Anatomy

in 15 Days

5th
EDITION

As per the New Pattern Exams (NEXT) with many Clinical Case-Based Questions

References and updates from BDC 8/e, Gray's 41/e, Snell's Neuroanatomy 8/e, Last's Anatomy 12/e, Harrison's 21/e, Bailey & Love's 27/e, Langman's 14/e, Guyton & Hall's 13/e, ENT Dhingra 8/e, William's Obstetrics 25/e

Papers/Questions Covered

INI-CET 2022 - 2020

Recent Qs (Jan) 2022 - 2012

AIIMS June 2020 - 2010

Expected Clinical Case-Based Qs

CBME-Based Subjective Qs with Chapter References



- Written and Compiled by a Leading Faculty and Subject Expert of Anatomy
- Enriched with Recent/Latest Updates

1500+
MCQs of
Recent Exams

100+
CBQs

200+
Cadaveric Spotters
& IBQs

1200+
Illustrations/Images

Includes



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Fifth Edition

K Raviraj MBBS MD (Anatomy)

CBSPD

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Preface

The world is becoming increasingly competitive in almost all the fields, and the field of medicine is no exception. Almost every budding medico dreams of becoming a specialist or a super specialist as soon as possible, for which he or she has to prepare for various entrance examinations. The time available is very short, yet the young doctors are expected to master all the major clinical and nonclinical subjects in order to survive the competition and come out with flying colors.

Of all the subjects, aspirants generally find difficult to study nonclinical subjects, like anatomy, physiology, etc. as these subjects are taught in the first year of MBBS curriculum. However, without mastering these subjects, scoring high marks in competitive entrance examinations is almost impossible.

In this fifth edition, content has been modified as per the requirements of competitive examinations. Throughout the book anatomy is integrated with all other clinical subjects, like Surgery, Obstetrics and Gynecology, Medicine, Pediatrics, etc. so that aspirants can have solid foundation on anatomy in relation to the other subjects. For the first time, real-time Cadaveric images have been added. The question bank has been updated up to June 2022. As usual, book has been kept simple and easy to follow to help readers save a lot of time so that they can concentrate on other subjects as well. Hope those who are preparing for PG entrance examinations will find this book easy, relevant and concise.

As the saying goes, to err is human, therefore possibility of missing out few errors can't be ignored; and comments, suggestions and corrections are always welcome so that such errors could be rectified in the next edition.

Wish you all the very best!

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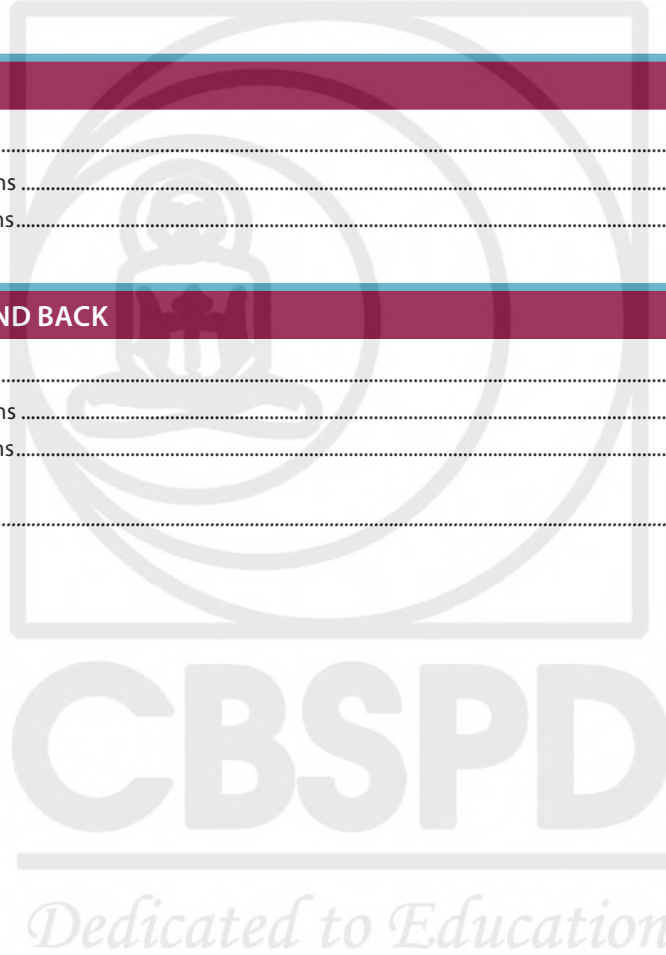
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CBME-Based Subjective Questions with Chapter References*

Competencies	Subjective Questions	For Answer Refer to Chapter
Human Anatomy		
Topic: Anatomical Terminology		
AN1.1	Demonstrate normal anatomical position, various planes, relation, comparison, laterality and movement in our body	Chapter 1
AN1.2	Describe composition of bone and bone marrow	Chapter 1
Topic: General Features of Bones and Joints		
AN2.1	Describe parts, blood and nerve supply of a long bone	Chapter 1
AN2.2	Enumerate laws of ossification	Chapter 1
AN2.3	Enumerate special features of a sesamoid bone	Chapter 1
AN2.4	Describe various types of cartilage with its structure and distribution in body	Chapter 1
AN2.5	Describe various joints with subtypes and examples	Chapter 1
AN2.6	Explain the concept of nerve supply of joints and Hilton's law	Chapter 1
Topic: General Features of Muscle		
AN3.1	Classify muscle tissue according to structure and action	Chapter 1
AN3.2	Enumerate parts of skeletal muscle and differentiate between tendons and aponeuroses with examples	Chapter 1
AN3.3	Explain Shunt and spurt muscles	Chapter 1
Topic: General Features of Skin and Fascia		
AN4.1	Describe different types of skin and dermatomes in body	Chapter 2 – histology topic
AN4.2	Describe structure and function of skin with its appendages	Chapter 2 – histology topic
AN4.3	Describe superficial fascia along with fat distribution in body	Chapter 2 – histology topic
AN4.4	Describe modifications of deep fascia with its functions	Chapter 2 – histology topic
AN4.5	Explain principles of skin incisions	Chapter 2 – histology topic
Topic: General Features of the Cardiovascular System		
AN5.1	Differentiate between blood vascular and lymphatic system	Chapter 2 – histology topic
AN5.2	Differentiate between pulmonary and systemic circulation	Chapter 2 – histology topic
AN5.3	List general differences between arteries and veins	Chapter 2 – histology topic
AN5.4	Explain functional difference between elastic, muscular arteries and arterioles	Chapter 2 – histology topic
AN5.5	Describe portal system giving examples	Chapter 2 – histology topic
AN5.6	Describe the concept of anastomoses and collateral circulation with significance of end-arteries	Chapter 2 – histology topic
AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio-venous anastomoses	Chapter 2 – histology topic
AN5.8	Define thrombosis, infarction and aneurysm	Chapter 2 – histology topic
Topic: General Features of Lymphatic System		
AN6.1	List the components and functions of the lymphatic system	Chapter 2 – histology topic
AN6.2	Describe structure of lymph capillaries and mechanism of lymph circulation	Chapter 2 – histology topic
AN6.3	Explain the concept of lymphoedema and spread of tumors via lymphatics and venous system	Chapter 2 – histology topic

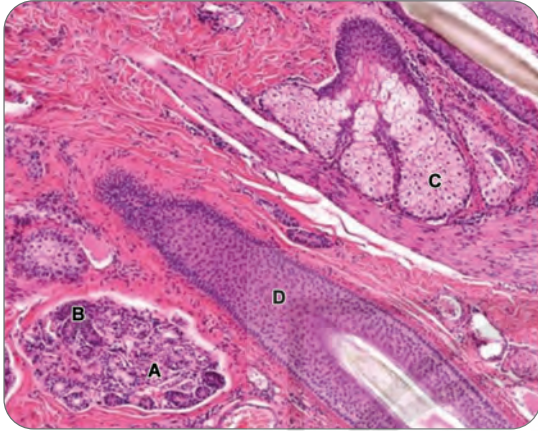
*Important competency-based topics covered

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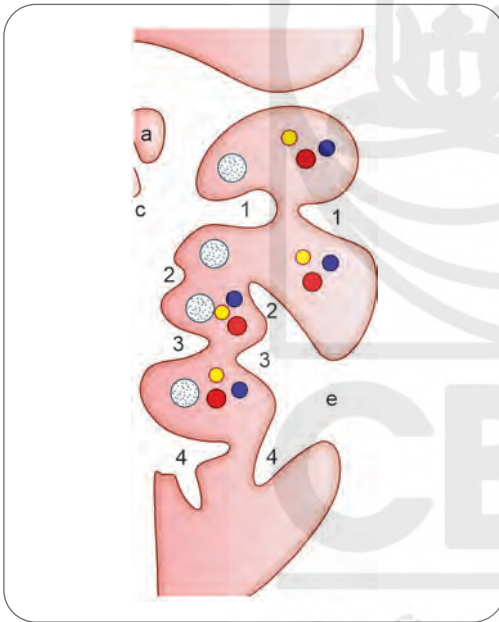
INI-CET MAY 2022 (RECALL QUESTIONS)

1. Identify the holocrine gland in the given diagram:



- a. A
- b. B
- c. C
- d. D

2. H/O Absent thymus and hypoparathyroidism. Which of the following marked structures is affected?

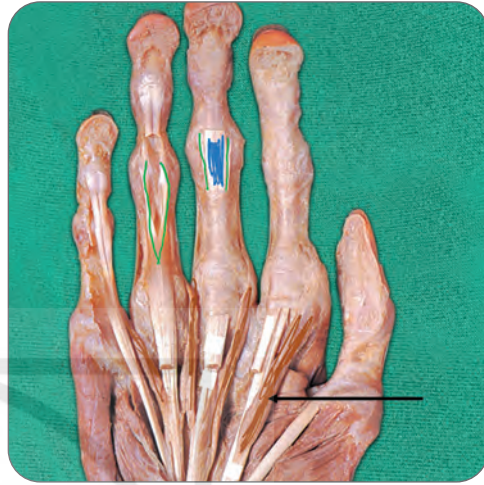


- a. 1
- b. 2
- c. 3
- d. 4

3. Which of the following foramen is located between three bones?

- a. Foramen magnum
- b. Foramen lacerum
- c. Foramen spinosum
- d. Jugular foramen

4. Nerve supply of the marked muscle:



- a. Median nerve
- b. Anterior interosseous nerve
- c. Ulnar
- d. Radial nerve

5. Which of the following structure passing through jugular foramen has separate canal?

- a. 9
- b. 10
- c. 11
- d. 12

6. Damage to marked structure results in paralysis of which of the following muscle?



- a. Lateral rectus
- b. Superior oblique
- c. Risorius
- d. LPS

7. Arrange the structures medial to lateral in cubital fossa:

- a. Median nerve, brachial artery, biceps tendon, radial nerve
- b. Brachial artery, median nerve, biceps tendon, radial nerve
- c. Median nerve, biceps tendon, brachial artery, radial nerve
- d. Median nerve, biceps tendon, radial nerve, brachial artery

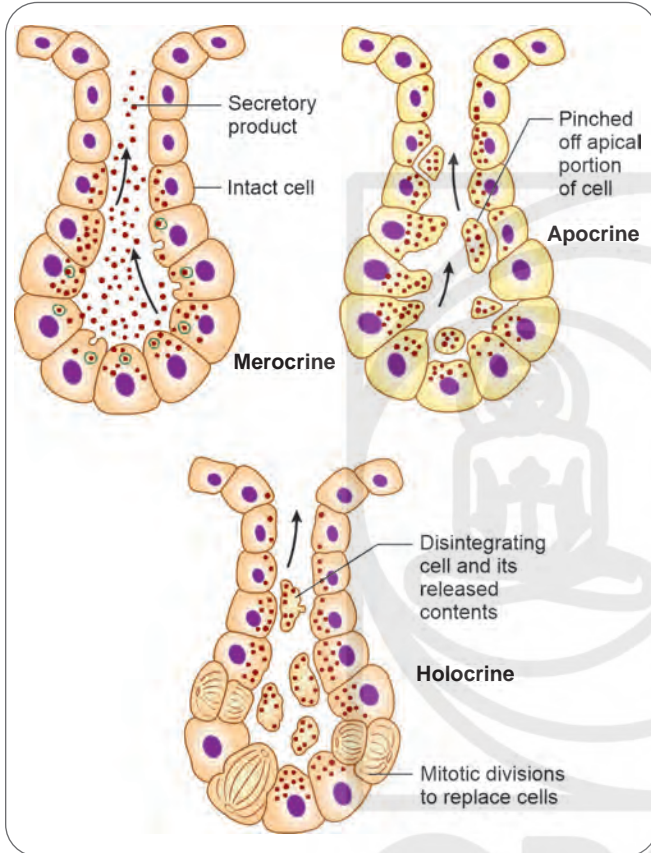
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Answers with Explanations

INI-CET MAY 2022 (RECALL QUESTIONS)

1. **Ans. c. C**



2. **Ans. c. 3**

3-endodermal pouch forms thymus and inferior parathyroid
3-pouch fails to differentiate – results in DiGeorge syndrome

3. **Ans. b. Foramen lacerum**

Foramen lacerum – located between sphenoid, temporal and occipital bone.

4. **Ans. a. Median nerve**

Marked muscle – lumbrical 1 – supplied by median nerve

5. **Ans. a. 9**

Jugular foramen transmits 9, 10, 11 nerve
9th nerve has separate canal.
10th and 11th nerve passing together in another canal

6. **Ans. c. Risorius**

Marked structure – facial colliculus – formed by axons of facial nerve
Damage to facial colliculus results in paralysis of facial muscles

7. **Ans. a. Median nerve, brachial artery, biceps tendon, radial nerve**

Contents of cubital fossa – from medial to lateral – median nerve, brachial artery, biceps tendon, radial nerve

8. **Ans. b. 5-1-3-4-2**

From basal to luminal – myofibroblast – then spermatogonia – primary spermatocyte – spermatid – spermatozoa

9. **Ans. c. Anterior cerebral and anterior communicating artery**

Rostrum of corpus callosum marked –
Blood supply of the corpus callosum –
Main arteries supplying corpus callosum
Anterior cerebral artery – pericallosal artery
Anterior communicating artery – gives subcallosal artery
Corpus callosum lateral part also supplied by middle cerebral artery
So, best answer is anterior cerebral and anterior communicating artery

10. **Ans. a. Pulmonary vein, pulmonary artery, bronchus, bronchial artery**

Arrangement of structures from anterior to posterior in hilum of lung
Pulmonary vein – then artery – then bronchus – bronchial artery (bronchial artery is posterior to bronchus)

11. **Ans. b. Mental**

Facial artery in cervical region gives ascending palatine artery, tonsillar branch of facial artery, submental artery.
In face – facial artery gives inferior labial, superior labial, lateral nasal, and angular artery
Mental artery – branch of inferior alveolar artery.

12. **Ans. b. Genitofemoral nerve**

Root of penis is supplied by ilioinguinal nerve > genitofemoral nerve
Most common nerve to get affected in laparoscopic hernial repair is lateral femoral cutaneous nerve > genitofemoral nerve

13. **Ans. d. Lisfranc ligament**

Lisfranc – cuneometatarsal ligament
Chopart ligament – ligament in calcaneocuboid joint
Spring ligament – plantar calcaneonavicular ligament

RECENT QUESTIONS MAY 2022

14. **Ans. d. Fibrous cartilage**

The given slide is white fibrous cartilage. Chondrocytes are arranged in rows not in groups. Between chondrocytes – bundles of collagen fiber seen.
Fibrous cartilage found in meniscus, articular disk, glenoidal labrum, intervertebral disk.



Clinical Questions

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Clinical Questions

1. A 21-year-old man receives a penetrating knife wound in the abdomen and is injured in both the INFERIOR mesenteric artery and the PELVIC SPLANCHNIC nerve. Which portion of the colon would most likely be impaired by this injury?
 - a. Ascending and descending colons
 - b. Transverse and sigmoid colons
 - c. Descending and sigmoid colons
 - d. Ascending and transverse colons
2. A 6-year-old boy comes to his pediatrician with lump in the groin near the thigh and pain in the groin. On examination, the physician makes a diagnosis of a direct inguinal hernia because the herniated tissue:
 - a. Enters the deep inguinal ring
 - b. Lies lateral to the inferior epigastric artery
 - c. Descends into the scrotum
 - d. Acquired after birth
3. A 21-year-old man developed a hernia after lifting heavy boxes while moving into his new house. During the repair of his resulting hernia, the urologist recalls that the genitofemoral nerve:
 - a. Root value L1,2,3
 - b. Is a branch of the femoral nerve
 - c. Supplies the testis and ovary
 - d. Gives rise to an anterior scrotal branch
4. While examining radiograph and angiogram of a 52-year-old patient, a physician is trying to distinguish the jejunum from the ileum. He has observed that the jejunum has:
 - a. Fewer pilcaecirculares
 - b. More mesenteric arterial arcades
 - c. Long vasa recta
 - d. More fat in its mesentery
5. A patient with diverticulosis of the colon presents for follow-up to his primary care physician with ongoing complaints of left lower quadrant pain and occasionally bloody stools. His physician begins workup with appropriating test by recalling that the sigmoid colon:
 - a. Is drained by systemic veins
 - b. Is a covered with peritoneum
 - c. Receives parasympathetic fibers from the vagus nerve
 - d. Receives its blood from the inferior mesenteric artery
6. A patient with cirrhosis is scheduled for liver transplant surgery. During the operation rounds, the transplant physician explains to his resident that one of the reasons a surgeon must pay close attention to the anatomic location of the liver is that this organ:
 - a. Receives blood only from the hepatic arteries
 - b. Manufactures red blood cells in an adult
 - c. Drains bile from the quadrate lobe into the right hepatic duct
 - d. Drains venous blood into the hepatic veins
7. Examination of a 54-year-old man reveals an isolated tumor located at the porta hepatis. This tumor most likely compresses which of the following structures?
 - a. Cystic duct
 - b. Hepatic veins
 - c. Common hepatic artery
 - d. Branches of the portal vein
8. During surgical treatment of portal hypertension in a 59-year-old man with liver cirrhosis, a surgeon inadvertently lacerates the dilated paraumbilical veins. The veins must be repaired to allow collateral flow. Which of the following ligaments is most likely severed?
 - a. Lienorenal ligament
 - b. Lienogastric ligament
 - c. Gastrophrenic ligament
 - d. Ligamentum teres hepatis
9. A 42-year-old obese woman with seven children is brought to a local hospital by her daughter. Physical examination and her radiograph reveal that large gallstones have ulcerated through the posterior wall of the fundus of the gallbladder into the intestine. Which of the following parts of the intestine is most likely to initially contains gallstones?
 - a. Cecum
 - b. Ascending colon
 - c. Transverse colon
 - d. Descending colon
10. A 36-year-old woman with yellow pigmentation of the skin and sclera presents at the outpatient clinic. Which of the following condition most likely is the cause of her obstructive jaundice?
 - a. Aneurysm of the splenic artery
 - b. Perforated ulcer of the stomach
 - c. Cancer in the body of pancreas
 - d. Cancer in the head of the pancreas
11. The general surgeon has opened the lienogastric (gastrosplenic) ligament to reach the lesser sac and notes erosion of the ulcer into an artery. Which of the following vessels is most likely involved?
 - a. Splenic artery
 - b. Gastroduodenal artery
 - c. Left gastric artery
 - d. Left gastroepiploic artery
12. A 43-year-old woman is admitted to the hospital because of deep abdominal pain in the epigastric region. On examination, it is observed that a retroperitoneal infection erodes an artery that runs along the superior border of the pancreas. Which of the following arteries is likely injured?
 - a. Right gastric artery
 - b. Left gastroepiploic artery
 - c. Splenic artery
 - d. Gastroduodenal artery
13. A 59-year-old male had tumor in the uncinat process of the pancreas. Which of the following structures is most likely compressed by this tumor?
 - a. Main pancreatic duct
 - b. Splenic artery
 - c. Portal vein
 - d. Superior mesenteric artery
14. A 27-year-old woman has suffered a gunshot wound to her mid-abdomen. After examination, the patient's angiogram, a trauma surgeon locates the source of bleeding from pairs of veins that typically terminate in the same vein. Which of the following veins are damaged?
 - a. Left and right ovarian veins
 - b. Left and right colic veins
 - c. Left and right suprarenal veins
 - d. Left and right hepatic veins



Answers with Explanations

1. Ans. c. Descending and sigmoid colons

[Ref: BD Chaurasia 7th edition volume 2 pg 306-307]

Choice	Explanation and elimination reason
a	Not correct
b	Not correct
c	Correct. Descending and sigmoid colons belong to hindgut
d	Not correct option

Other Important Notes and Recent Questions based on the Chapter and Highly Probable Questions

- Foregut artery – celiac trunk
- Midgut artery – superior mesenteric artery
- Hindgut – inferior mesenteric artery

2. Ans. d. Acquired after birth

[Ref: BD Chaurasia 7th edition volume 2 pg 234]

Deep inguinal ring – gap in fascia transversalis
1.25 cm above the midinguinal point
Inlet for inguinal canal
Acquired after birth

Choice	Explanation and elimination reason
a	Indirect inguinal hernia. Enters through Hesselbach's triangle
b	Indirect inguinal hernia medial to inferior mesenteric artery
c	Indirect inguinal hernia
d	Correct statement about direct inguinal hernia

3. Ans. d. Gives rise to an anterior scrotal branch

[Ref: BD Chaurasia 7th edition volume 2 pg 277-228]

Branch of lumbar plexus
Iliofemoral nerve
Ilioinguinal nerve
Genitofemoral nerve
Lateral femoral cutaneous nerve
Femoral nerve
Obturator nerve

Choice	Explanation and elimination reason
1	Root value L1-L2
2	Is a branch of the lumbar plexus
3	Supplies the scrotum
4	Gives rise to an anterior scrotal branch

4. Ans. c. Long vasa recta

[Ref: BD Chaurasia 7th edition volume 2 pg 290]

Choice	Explanation and elimination reason
a	More circular folds
b	Less arterial arcades
c	Long vasa recta
d	Less fat

5. Ans. d. Receives its blood from the inferior mesenteric artery

[Ref: BD Chaurasia 7th edition volume 2 pg 229]

Choice	Explanation and elimination reason
a	Drained by portal veins
b	Not true statement retroperitoneal organ
c	Parasympathetic from Nervi erigentes
d	Blood supply from inferior mesenteric artery

6. Ans. d. Drains venous blood into the hepatic veins

[Ref: BD Chaurasia 7th edition volume 2 pg 332-335]

- Left lobe of liver contains II, III, IV segments
- Right lobe of liver contains V, VI, VII, VIII

Choice	Explanation and elimination reason
a	Blood supply from portal vein
b	Not true. Only during fetal life
c	Drain into left hepatic duct
d	True statement

7. Ans. d. Branches of the portal vein

[Ref: BD Chaurasia 7th edition volume 2 pg 332-335]

Portal triad contains:
Portal vein
Proper hepatic artery
Common bile duct

Choice	Explanation and elimination reason
a	Not portal triad structures
b	Not portal triad structures
c	Not portal triad structures
d	Portal triad structures

8. Ans. d. Ligamentum teres hepatis

[Ref: BD Chaurasia 7th edition volume 2 pg 332-335]

Choice	Explanation and elimination reason
a	Not correct
b	Not correct
c	Not correct
d	Ligamentum teres hepatis and paraumbilical veins contained in falciform ligament



1

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General Anatomy



General Anatomy

BONES

Skeleton is divided into axial skeleton and appendicular skeleton.

- **Axial Skeleton:** Forms central axis of body. It includes skull, hyoid bone, vertebral bones and thoracic cage (Ribs and sternum)—80 bones in axial skeleton
- **Appendicular Skeleton:** Bones of upper limb and lower limb—126 bones appendicular skeleton.

CLASSIFICATION OF BONES

Based on Types of Development

Based on types of development, bones are classified into the following:

- **Cartilaginous bones:** Bones are formed by cartilage, which later ossify into bones, e.g., long bones, skull base and vertebra.
- **Membranous bones:** Bones are formed by membranes. These membranes are then transformed into bone, e.g., clavicle, facial skeleton, skull vault and mandible.

Based on Shape

Based on shape, bones are classified into the following:

- Long bones
- Short bones
- Flat bones
- Irregular bones

Long Bones

- Consists of two ends-epiphysis and intervening shaft- diaphysis
- Presence of medullary cavity
- Vertically placed
- Ossify by means of cartilage
- Typical long bones with two epiphysis, e.g., Humerus, radius, ulna, femur, tibia and fibula
- Miniature long bones with one epiphysis—metacarpals and phalanges
- Modified long bones with no medullary cavity—clavicle.

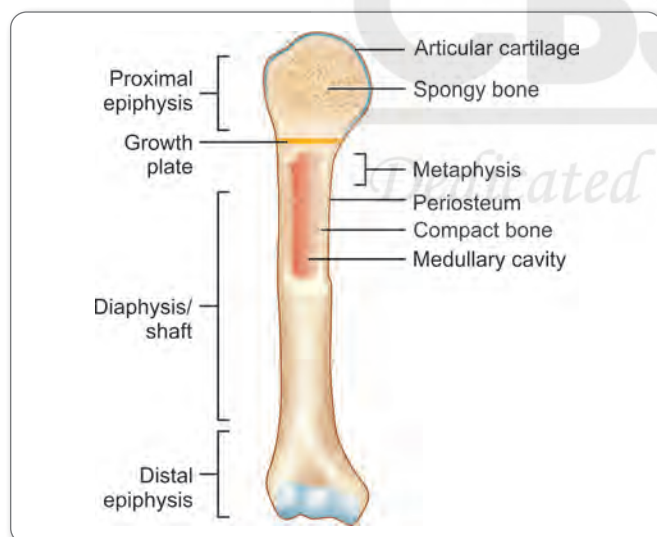


Fig. 1: Structure of long bone

Short Bones

Short in length and it can be of any shape. According to their shape, these bones are named—trapezium and cuboid.

Flat Bones

Flat in appearance and so there are two surfaces, i.e., in front and behind for these bones, e.g., Bones of thoracic cage, bones forming cranial vault.

Irregular Bones

These bones are irregular and not fit into any category of shape. For example, Hip bone.

Other Types of Bones

Pneumatic Bones

Contain large spaces lined by epithelium. For example, Maxilla, sphenoid and ethmoid.

Sesamoid Bones

- Bones formed in tendons and joint capsules
- Sesamoid bones reduce the friction
- No periosteum and ossify after birth
- No Haversian system and no medullary cavity

Sesamoid Bones in the Body

Muscle name	Sesamoid bone
Flexor carpi ulnaris	Pisiform
Quadriceps femoris	Patella
Adductor longus	Rider's bone
Lateral head of gastrocnemius	Fabella
Peroneus longus	Os perineum
Peroneus brevis	Os vesalianum

Note: Os trigonum – not sesamoid bone – it is uncommon accessory bone seen behind talus.

Macroscopic Classification of Bones

Classified into compact and cancellous bone:

- **Compact bone:** More bone tissue and less empty space. Dense in nature.
- **Spongy (cancellous) bone:** More space and less bone tissue.

Microscopic Classification of Bones

- **Lamellar bone:** Collagens are arranged in orderly manner in form of concentric sheets.
- **Woven bone:** Woven bones are arranged in random manner.

High Yield Point

Woven bones are formed during pathological conditions in adults, which are then replaced by lamellar bones.

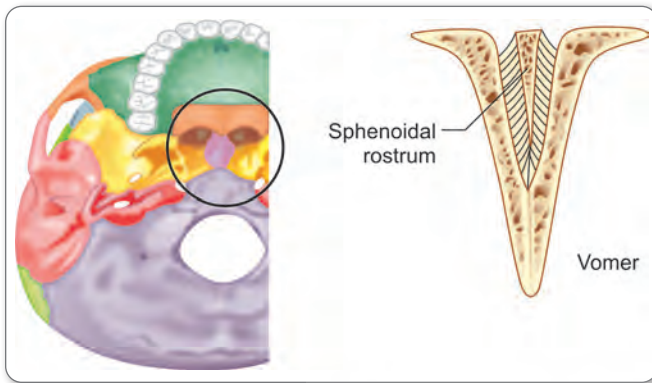


Fig. 8: Schindylesis (Ridge and groove)

Syndesmosis

Bones are connected by interosseous ligaments

Gomphosis

Otherwise known as peg and socket

Synovial Joint

- Articular surface covered by hyaline cartilage
- Synovial membrane lines entire joint except the articular surface
- Joint cavity is filled with synovial fluid
- Joint is covered by fibrous capsule.

Types

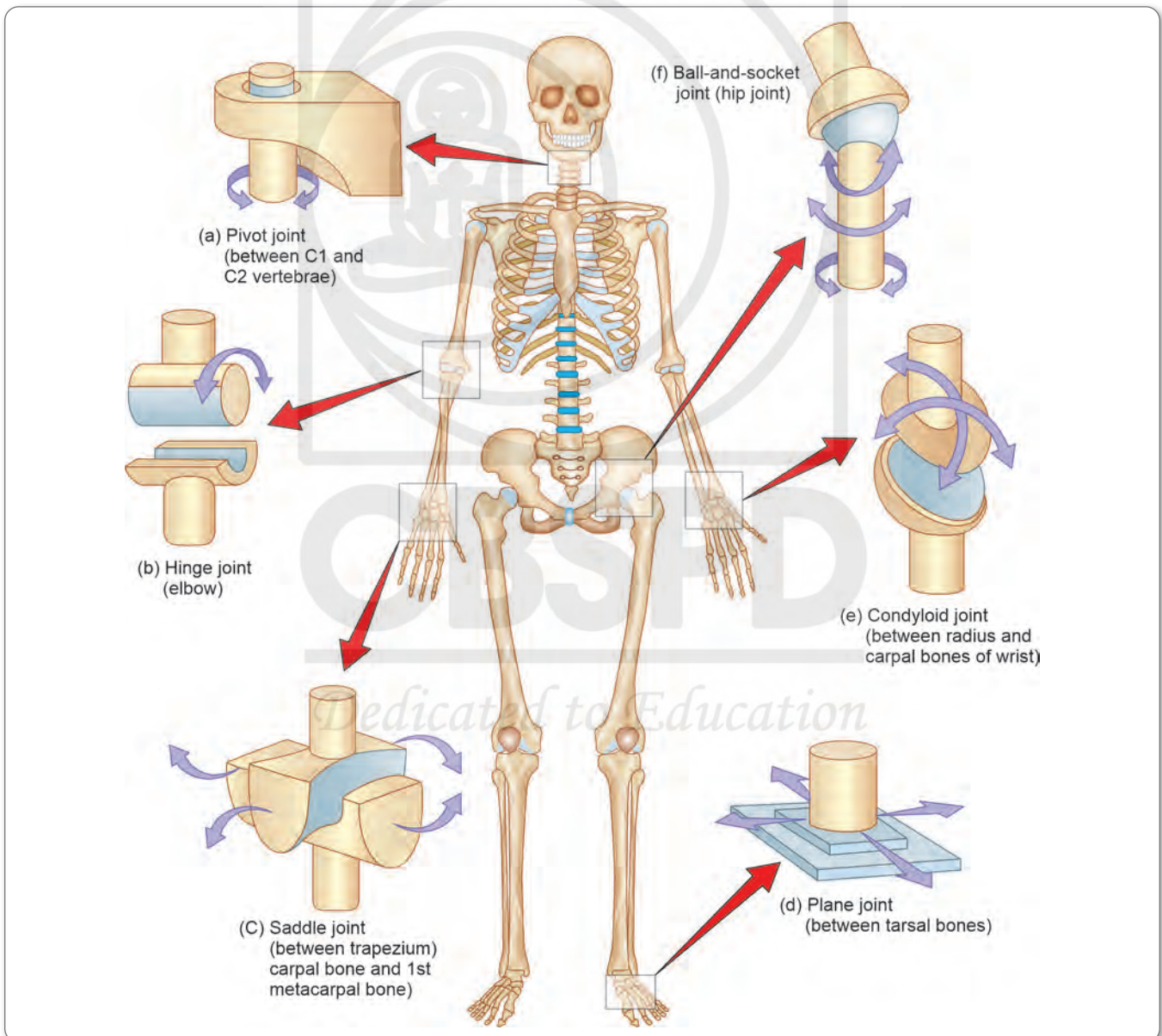


Fig. 9: Types of synovial joint



FASCICULAR ARCHITECTURE OF MUSCLES

Arrangement of muscle fibers varies according to the direction of force and range of habitual movement at particular joint. Muscles can be classified according to their arrangement of fasciculi into following groups.

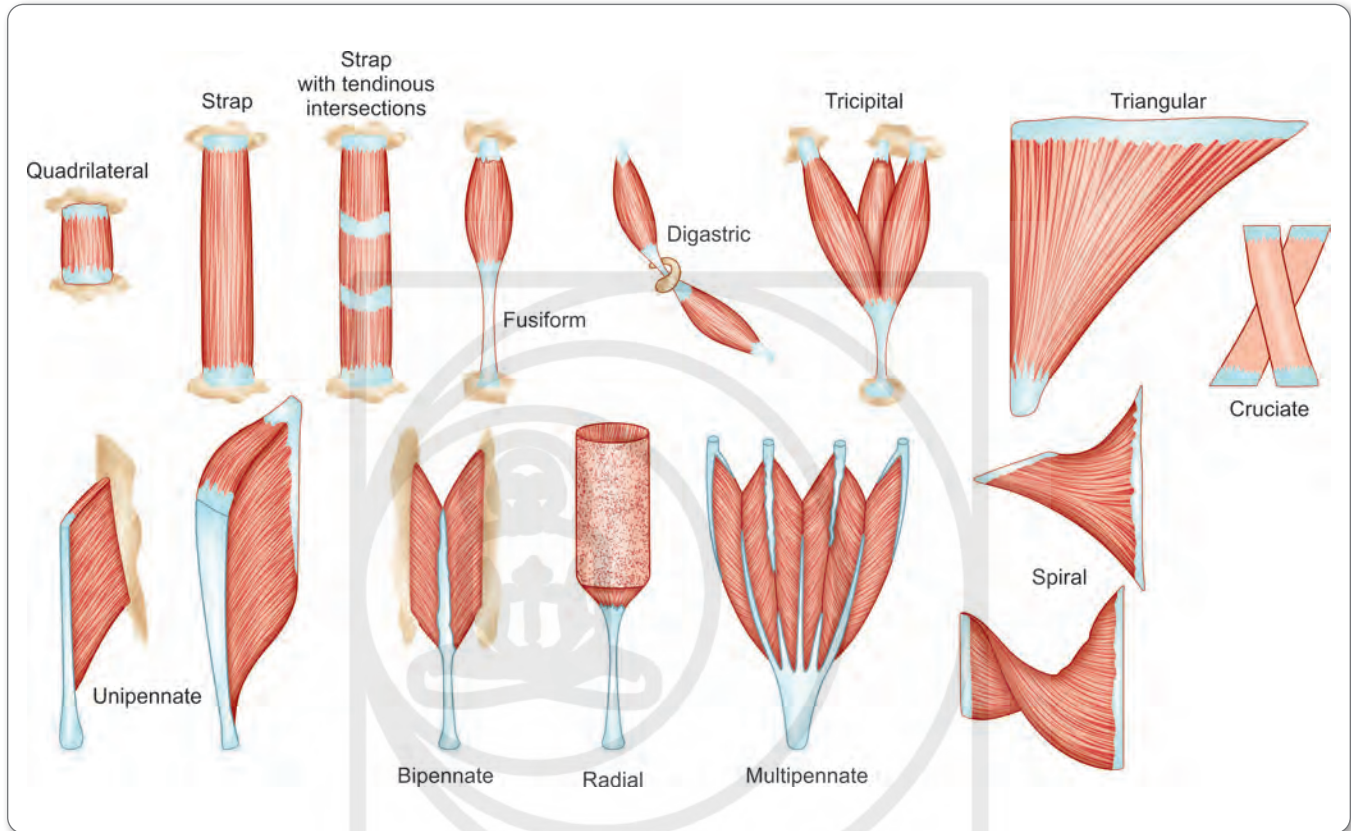


Fig. 10: Muscle shapes

- **Parallel fasciculi:** Fibers are parallel to each other
 - *Strap-like:* Infrahyoid muscles, Sartorius
 - *Strap-like with digitations:* Rectus abdominis
 - *Fusiform:* Digastric and Biceps
 - *Quadrilateral:* Thyrohyoid and Pronator quadratus.
- **Convergent muscle:** Fibers converge at insertion point
 - *Fan-shaped:* Temporalis.
- **Sphincter type:** Surrounding the orifice
 - Orbicularis oris
 - Orbicularis oculi
- **Spiral or twisted type:** Fibers are twisted
 - Pectoralis major, latissimus dorsi, trapezius.
- **Cruciate muscles:** In some muscles, fasciculi are crossed. Masseter, sternocleidomastoid, adductor magnus
- **Pennate muscle:** Feather-like
 - *Unipennate:* Extensor digitorum longus, flexor pollicis longus, peroneus tertius, palmar interossei
 - *Bipennate:* Rectus femoris, peroneus longus, dorsal interossei, flexor hallucis longus
 - *Multipennate:* Middle part of deltoid, Subscapularis, tibialis anterior (multipennate with oblique fibers)
 - Spiral or twisted fibers found in trapezius, pectoralis major, latissimus dorsi and supinator

Note: Shape of trapezius – triangular.

- *Cruciate* - In certain muscles fasciculi crossed – cruciate muscles – sternocleidomastoid, masseter, adductor magnus

Hybrid Muscles

- Muscles having more than one nerve supply
- Muscles in the body innervated by two or more nerves

Digastric

- Posterior belly-facial nerve
- Anterior belly-nerve to mylohyoid

Sternocleidomastoid

- Spinal root of accessory nerve
- Ventral rami of C2 and C3

Cricopharyngeal Part of Inferior Constrictor of the Pharynx

- External laryngeal nerve
- Recurrent laryngeal nerve

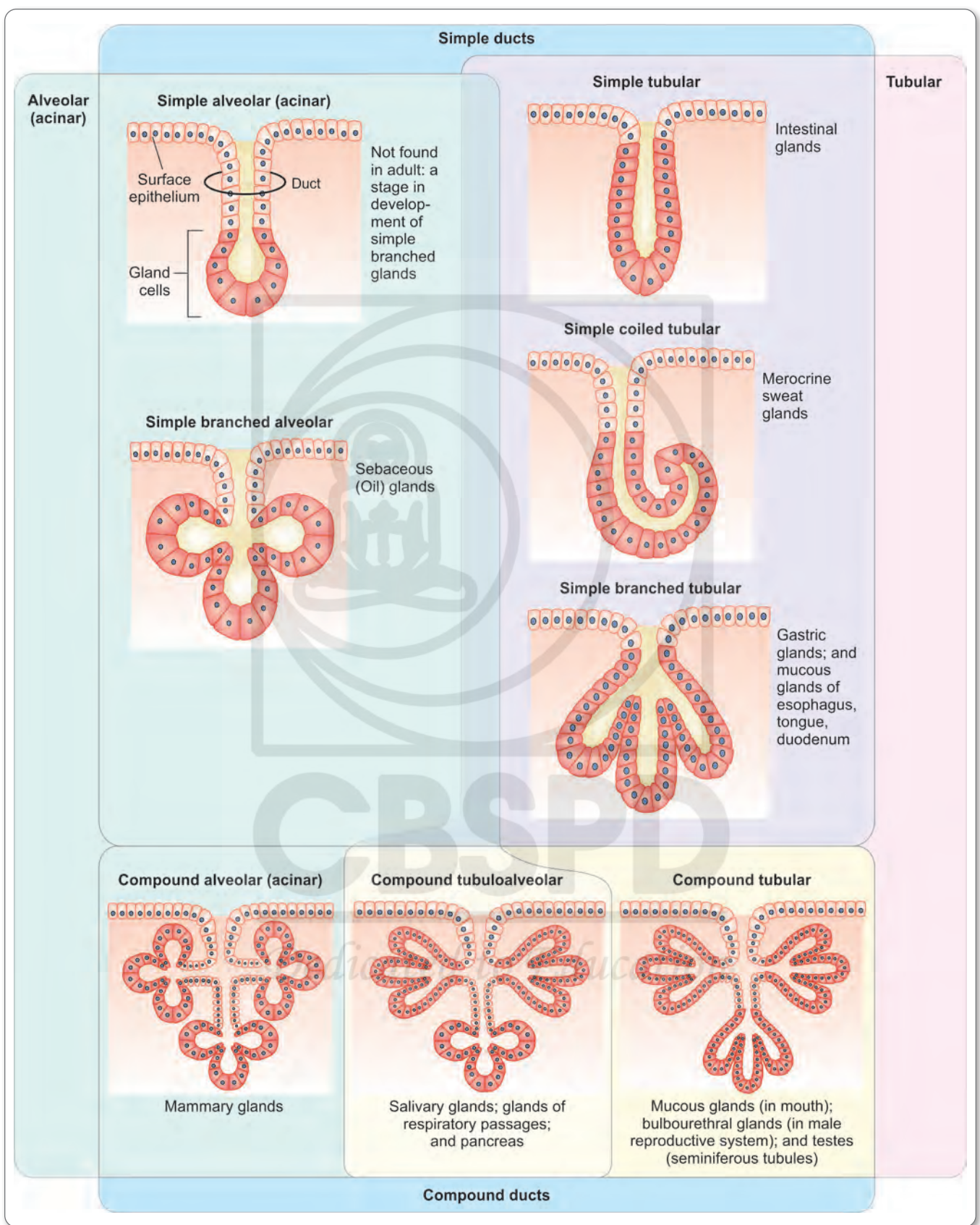


Fig. 15: Simple ducts and compound ducts



General Histology

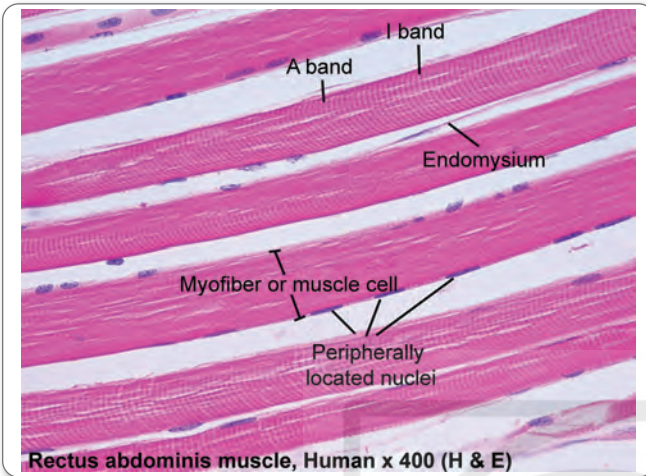


Fig. 26: Histology of skeletal muscle

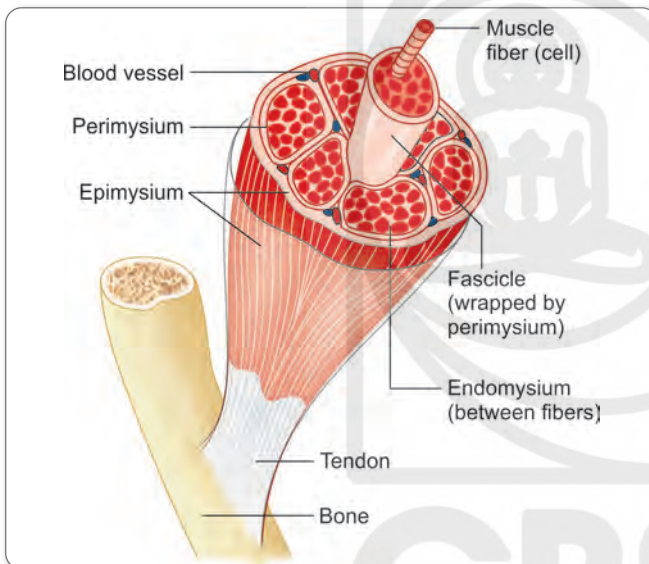


Fig. 27: Single multinucleated skeletal muscle cell

- Each fiber is surrounded by outer limiting membrane called sarcolemma
- Under high power, myofibrils depict alternate dark and light bands
- These dark and light bands produce cross striations in muscle
- Each of dark and light bands are intersected by lines
- Dark band or A band contains a light zone called H zone
- Light band or I band is similarly bisected by a dark transverse line Z line
- Functional unit of muscle fiber is known as sarcomere which is segment between two successive Z lines and therefore includes one A and half of two contiguous I bands
- During phases of contraction, length of A band remains constant while length of H and I band is shortened.

Cardiac Muscle

- Muscle fibers are joined together by surface specializations known as intercalated discs

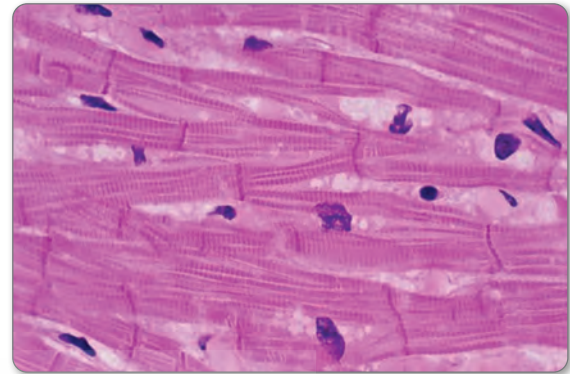


Fig. 28: Histology of cardiac muscle

- Three types of cell junctions make up an intercalated disc— fascia adherens, desmosomes and gap junctions
- Fascia adherens: Are anchoring sites for actin and connect to the closest sarcomere
- Desmosomes (macula adherens): Stop separation during contraction by binding intermediate filaments, joining the cells together
- Gap junctions: Allow action potentials to spread between cardiac cells by permitting the passage of ions between cells producing depolarization of heart muscle.

BLOOD VESSELS

Blood vessels consist of arteries, capillaries and veins. They consist of three layers from within outward.

- Tunica intima
- Tunica media
- Tunica adventitia.

LARGE SIZE ARTERY—ELASTIC ARTERY

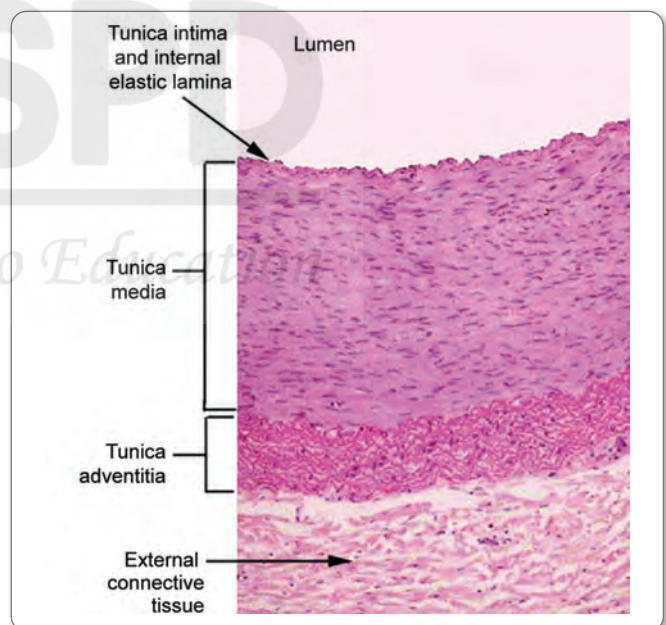


Fig. 29: Elastic artery



Tunica Intima

- Consists of single layer of endothelial cells directed toward the lumen
- Endothelium is supported by thin layer of subendothelial connective tissue consisting of both collagen and elastic fibers
- Fenestrated elastic membrane known as internal elastic lamina is made up of elastic fibers that separate tunica intima from tunica media.

Tunica Media

- Thickest layer consisting of predominantly elastic fibers
- These fibers are arranged circularly in the form of fenestrated elastic lamellae
- In between elastic lamellae, circularly arranged smooth muscle fibers are present
- The last layer of elastic lamellae is named external elastic membrane.

Tunica Adventitia

- Thin connective tissue made up of fibrous tissue with loose network of elastic fibers

Note: In internal and external elastic lamina are present but cannot be differentiated from surrounding elastic fibers present in tunica media.

MUSCULAR ARTERY—MEDIUM SIZED ARTERY

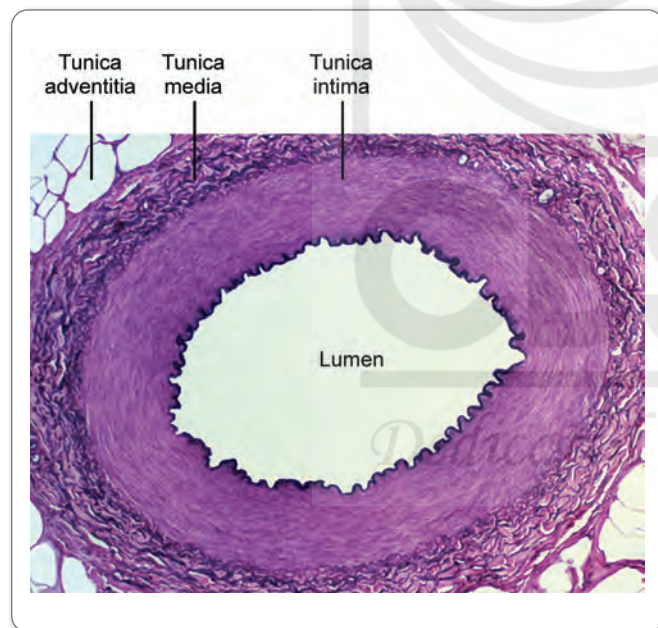


Fig. 30: Muscular artery

Tunica Intima

- Single layer of endothelium resting on basement membrane
- **Internal elastic membrane is more clearly seen.** Appears as wavy fold because of contraction of muscular media.

Tunica Media

- Composed predominantly of circular and spirally arranged smooth muscle with few elastic and collagen fibers
- It is separated from tunica adventitia by well defined external elastic membrane.

Tunica Adventitia

- Composed of loose connective tissue with collagen and elastic fibers
- Thickness of tunica adventitia of muscular artery is almost equal to that of media.

Table 7: Features of large and medium sized artery

Features	Large artery	Medium sized artery
Tunica intima	Internal elastic lamina not clearly demarcated	Internal elastic lamina clearly seen
Tunica media	Thickest layer, consists of elastic fibers arranged in the form of fenestrated elastic lamellae with smooth muscle fiber present in between lamellae	Consists predominantly of circularly arranged smooth muscle fiber with few elastic fiber
Tunica adventitia	Thin layer separated from media by external elastic lamina which is not clearly seen	Thickness of tunica adventitia is equal to thickness of tunica media with well-defined external elastic lamina

LARGE VEIN

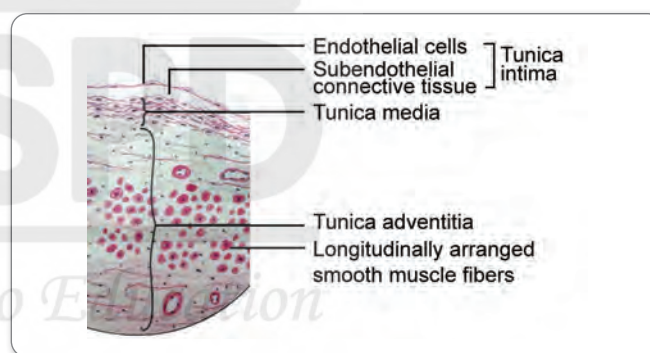


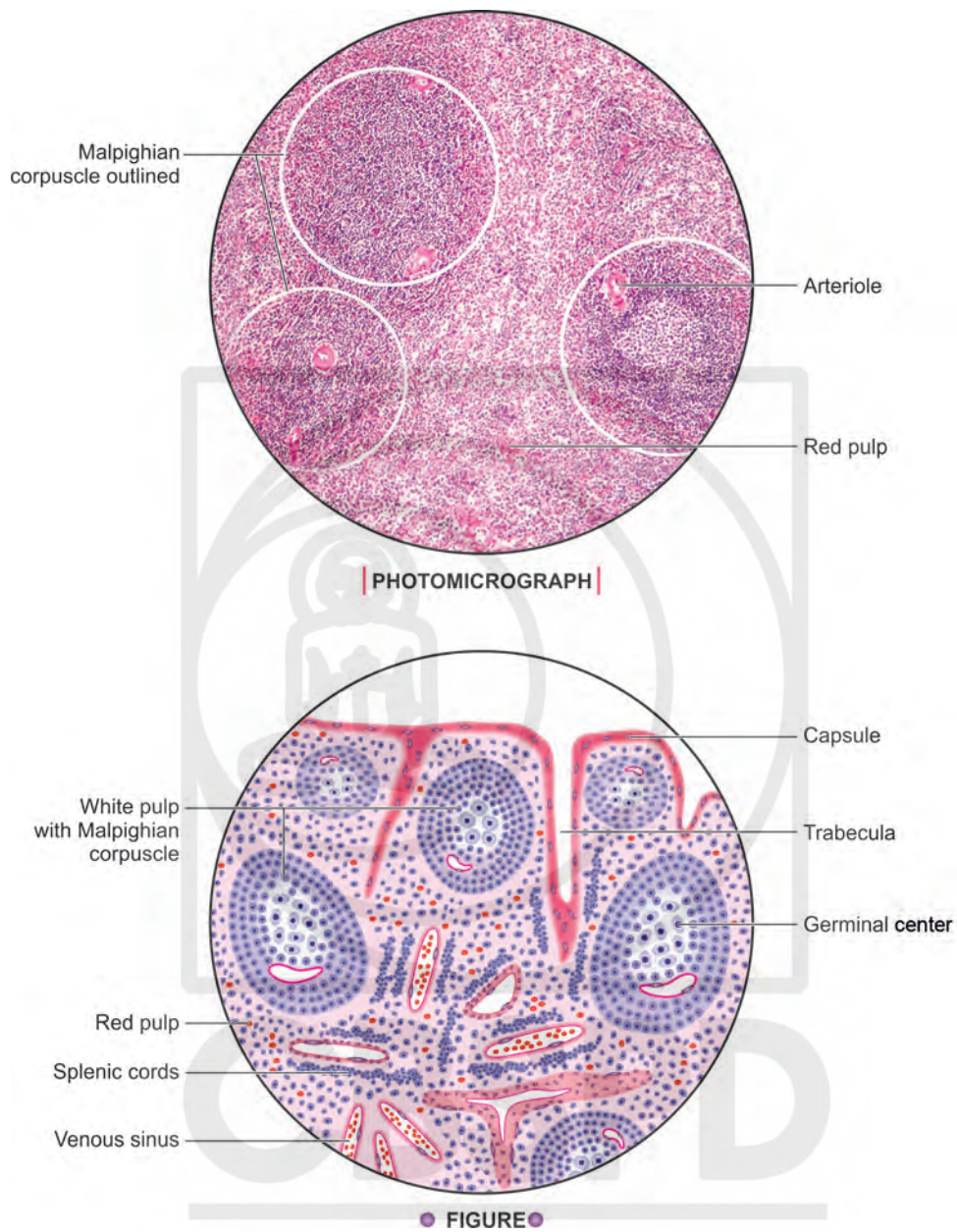
Fig. 31: Large vein

Tunica Intima

- Consists of flattened endothelial cells supported by minimal amount of subendothelial connective tissue
- Internal elastic lamina absent in large veins (wall of the vein collapsed).

Tunica Media

Made up of few layers of circularly arranged smooth muscle.



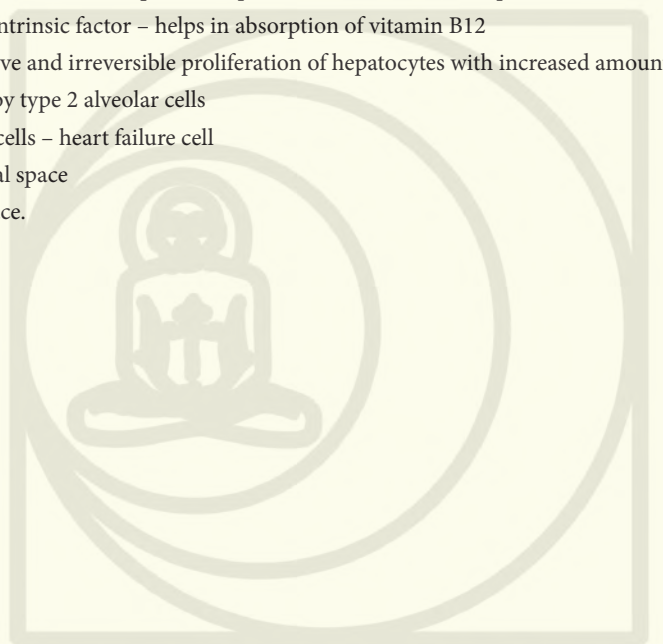
Structure of spleen. Stain: Hematoxylin-eosin, 100X

Courtesy: Krishna Garg et al. Textbook of Histology Color Atlas, 5th ed. CBS Publishers and Distributors Pvt. Ltd., 2014.



Chapter at a Glance

- Blood-Brain Barrier (BBB): Astrocyte
- Blood-Testis Barrier (BTB): Sertoli cells
- Placental barrier: Syncytiotrophoblast
- **Stave cells** are found in spleen
- Hassall's corpuscles are found in **thymus**
- Tonsil: Lined by stratified squamous epithelium and tonsillar crypts are present
- **Lymphatic nodule** is **absent in thymus** and **present in lymph node, spleen and tonsil**
- Barret's esophagus: Metaplasia – stratified squamous epithelium converted to simple columnar and caused by reflex of gastric contents
- Parietal cell: Main source of intrinsic factor – helps in absorption of vitamin B12
- In cirrhosis of liver: Progressive and irreversible proliferation of hepatocytes with increased amount of connective tissue
- Surfactant mainly produced by type 2 alveolar cells
- Alveolar macrophages: Dust cells – heart failure cell
- Space of Disse: Peri-sinusoidal space
- Space of Mall: Peri-portal space.



CBSPD

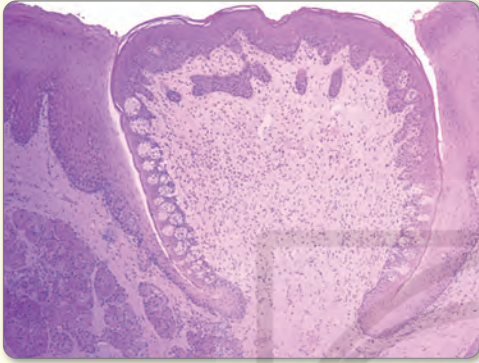
Dedicated to Education



Multiple Choice Questions

1. Identify the papillae shown in the given diagram:

(Recent Question 2021)

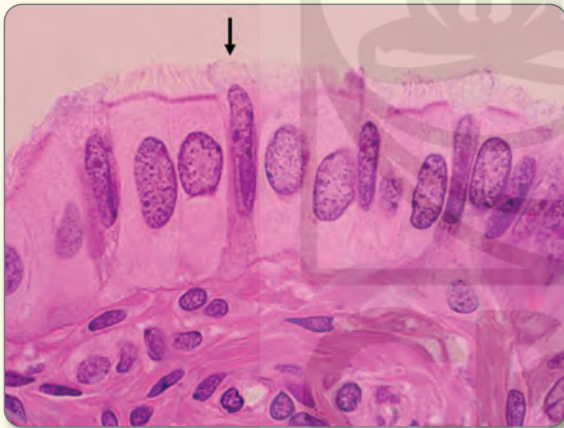


- a. Fungiform b. Filiform
c. Circumvallate d. Foliate

2. Reticular fibers are not found in: (IN-ICET Nov 2020)

- a. Thymus b. Spleen
c. Lymph node d. Bone marrow

3. The given structure is not found in: (IN-ICET Nov 2020)



- a. Oviduct (fallopian tube) b. Epididymis
c. Bronchi d. Ependyma

4. Transitional epithelium is present in all; except:

(AIIMS June 2020)

- a. Ureter b. Renal pelvis
c. Minor calyx d. Membranous urethra

5. Ito cells in liver is present in: (AIIMS June 2020)

- a. Sinusoids b. Space of Disse
c. Space of Mall d. Bile canaliculi

6. Cells lining the isthmus of gastric pits are: (AIIMS June 2020)

- a. Chief cells b. Parietal cells
c. Stem cells d. Mucous neck cell

7. Difference between exocrine pancreas and parotid:

(AIIMS June 2020)

- a. Absence of striated duct
b. Presence of acidophilic serous acini at the tip
c. Serous acini supported by basal lamina
d. Apical acinar villi

8. The cell junction allowing exchange of cytoplasmic molecules between two cells are called:

- a. Gap junctions b. Tight junctions
c. Anchoring junctions d. Focal junctions

9. The ducts of all the following consists of stratified cuboidal epithelium; except:

- a. Sweat glands b. Sebaceous gland
c. Salivary glands d. Pancreas

10. The cells belonging to the following type of epithelium are provided with extra reserve of cell membrane:

- a. Transitional b. Stratified squamous
c. Stratified cuboidal d. Stratified columnar

11. The ureter is lined by -----epithelium.

- a. Stratified squamous b. Cuboidal
c. Ciliated columnar d. Transitional

12. Which group has similar kind of epithelium?

- a. Alveoli – olfactory epithelium
b. Olfactory epithelium – skin
c. Esophagus – urinary bladder
d. Lung alveoli – Bowman's capsule

13. A patient with acute abdominal pain on clinical suspicion underwent cholecystectomy. On histopathological examination, the finding is normal. The gall bladder epithelium will be:

- a. Squamous
b. Simple Columnar
c. Simple Columnar with brush border
d. Cuboidal with stereocilia

14. Cell lining of common bile duct is:

(Recent Question July 2015)

- a. Stratified Columnar b. Stratified Squamous
c. Simple Cuboidal d. Simple Columnar

15. Ansa nephroni is lined by:

- a. Columnar b. Squamous epithelium
c. Cuboidal and columnar d. Stratified squamous

16. Which vitamin deficiency may lead to keratinization?

- a. A b. B
c. C d. D

17. Myelin sheath in CNS is synthesized by:

- a. Microglia b. Schwann cells
c. Oligodendrocytes d. All of these

18. Oligodendrocytes are important in:

- a. Blood-brain barrier b. Myelin formation
c. Phagocytosis d. Chemotaxis

19. Glitter cells are:

- a. Microglia b. Modified macrophages
c. Astrocytes d. Neutrophils

20. Pseudounipolar neurons are seen in:

- a. Olfactory b. Celiac ganglion
c. Spinal dorsal root ganglion
d. Cochlea

21. Neuro – epithelial type of sensory receptors are found in following system; except:

- a. Visual b. Olfactory
c. Gustatory d. Auditory



Answers with Explanations

1. Ans. c. **Circumvallate**

Circumvallate Papillae (Surrounded by a wall, vall-wall)

8–12 papillae located just anterior to the sulcus terminalis.

- Large circular papillae, each is surrounded by a deep groove
- Has taste buds.

A deep trench or furrow (5, 10) surrounds the base of each circumvallate papilla.

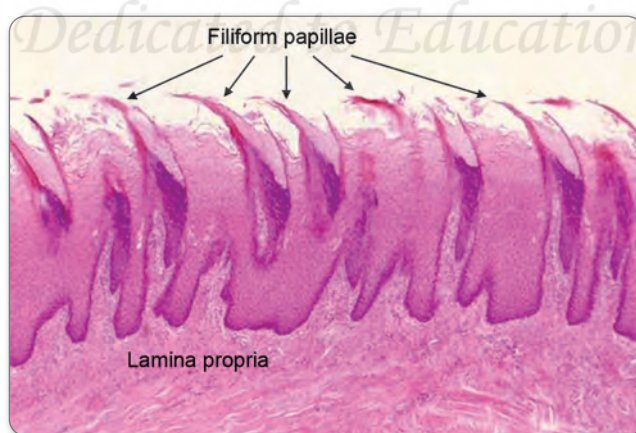
Located deep in the lamina propria and core of the tongue are numerous, tubuloacinar serous (von Ebner's) glands. The secretory product from these glands acts as a solvent for taste-inducing substances



Filiform Papillae (Cone-shaped)

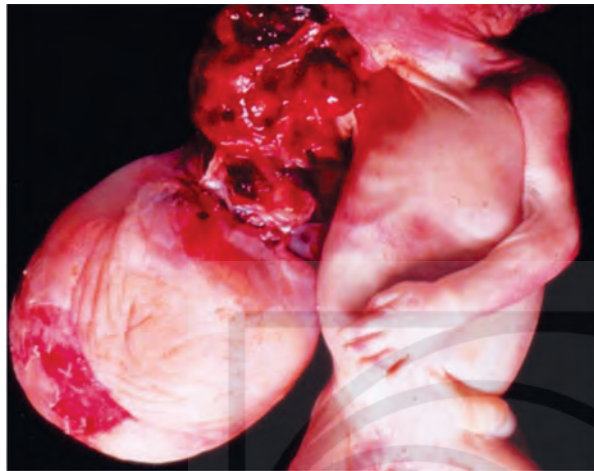
- Most numerous; all over the tongue.
- No taste buds

The epithelium at the tips of these papillae is keratinized





Clinical Aspect



Craniopharyngeal teratoma



Sacrococcygeal teratoma

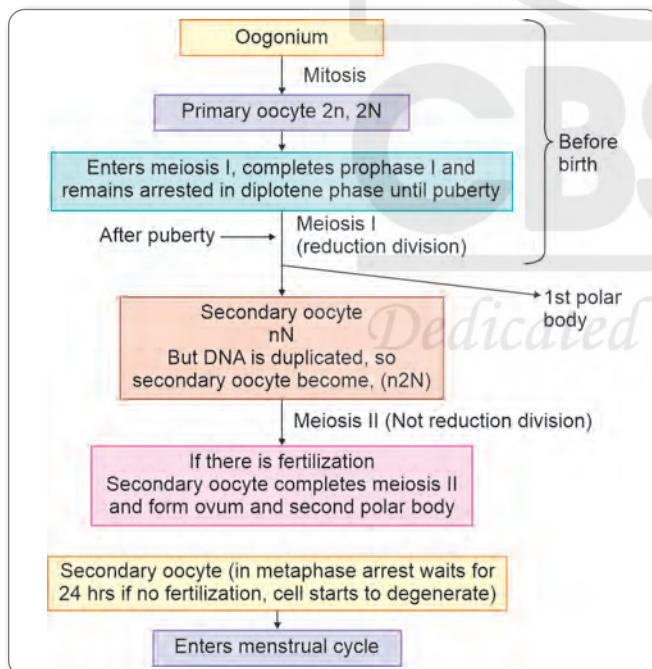
- Abnormal migration of PGC to head and neck instead of gonad cause Craniopharyngeal teratoma
- Abnormal migration of PGC to sacrum and coccyx cause sacrococcygeal teratoma

Gametogenesis

Formation of gametes is called gametogenesis. There are two types of gametogenesis:

- **Oogenesis:** Formation of female gametes, i.e., oogonium
- **Spermatogenesis:** Formation of male gametes, i.e., spermatogonium

Oogenesis



- PGC differentiates into Oogonium (46, 2N)
- Oogonium then forms primary oocyte (46, 2N)

- All oogonium converted to primary oocytes (46, 2N) by 7th month
- Primary oocyte enters meiosis I and completes prophase phase and remains arrested in diplotene phase
- Primary oocyte remains dormant in diplotene phase till puberty
- After puberty primary oocyte completes meiosis I and forms secondary oocyte (23, N) and polar body I
- Polar body is formed due to unequal division of cytoplasm. All the cytoplasm goes to secondary oocyte and polar body is the one with no cytoplasm
- DNA content of secondary oocyte duplicates. So, the chromosomal number for secondary oocyte (23, 2N – n, 2N)
- Secondary oocyte enters meiosis II and completes metaphase and remains arrested after that.
- If the fertilization occurs, secondary oocyte in metaphase arrest completes Meiosis II and forms ova and polar body II
- No fertilization – secondary oocyte disintegrates in the menstrual cycle.

Note: Secondary oocyte gets arrested in metaphase stage and waits only for 24 hours.

High Yield Points

- Meiosis II is not reduction division, because only DNA number is reduced from 2N to N.
- Polar body II (rarely formed) formed only if fertilization occurs.
- LH surge occur usually 36 hours before ovulation
- LH peak is associated with release of 1st polar body and occurs 12 hours before ovulation
- Sperms viable for 48 hours inside the female genital tract and secondary oocyte in metaphase arrest waits for 24 hours. So, viable period for fertilization is 2 days before ovulation + one day after ovulation



General Embryology

Clinical Aspect



Sacrococcygeal teratoma

- Tumors arising from remnants of primitive streak which normally degenerates and disappears
- Sacrococcygeal teratoma also due to primordial germ cell abnormal migration to sacrum and coccyx instead of gonads
- Sacrococcygeal teratoma is the most common germ cell tumor of the childhood

Septum Transversum

- Derived from visceral (splanchnic) mesoderm surrounding heart and assumes the position between primitive thoracic and abdominal cavity

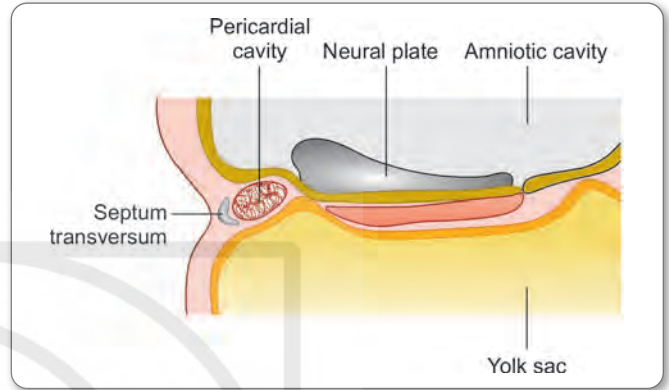
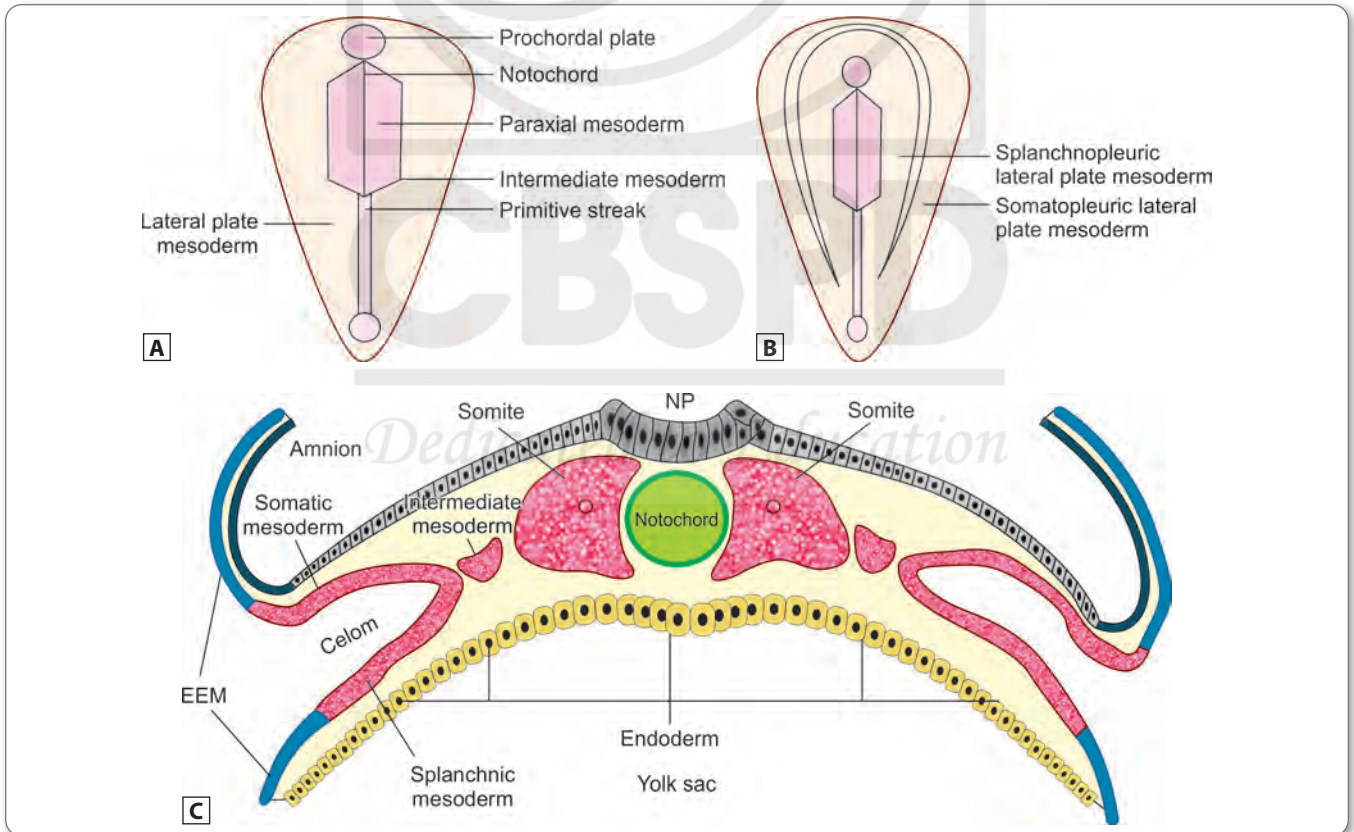


Fig. 16: Sagittal section showing the position of the septum transversum rostral to the pericardial cavity – 3 week embryo

Derivatives

- Central tendon of diaphragm
- Connective tissue of liver capsules, sinusoids, kupffer cells, etc.
- Ventral mesogastrium
- Fibrous pericardium

Subdivision of Intraembryonic Mesoderm

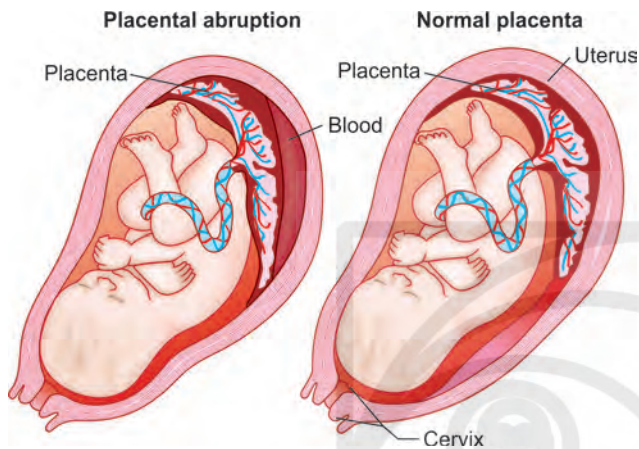


Figs 17A to C: Subdivisions of intraembryonic mesoderm



- Placenta attaches to lower part of uterus covering internal os
- Uterine blood vessels ruptures as they begin to dilate
- So, in placenta previa maternal vessels rupture and result in the death of the mother

Abruptio Placenta



- Normally implanted placenta prematurely separates from uterus before delivery.

Alpha Fetoprotein

- Fetal albumin produced by fetal hepatocytes and yolk sac
- Frequently assayed in maternal serum and amniotic fluid between 14–18 weeks
- Elevated AFP levels: Neural tube defects (allow the fetal serum to leak into amniotic fluid) and in esophageal and duodenal atresia
- Reduced AFP levels: In down syndrome (yolk sac small in size – so less AFP)

DEVELOPMENT OF VARIOUS ORGAN SYSTEMS

GESTATION PERIOD

- Fertilization to birth (38 weeks)
- Prenatal period (before birth)
- Embryological development
 - First 2 months after fertilization (embryo)
 - All principal adult organs are present
- Fetal development
 - From 9 weeks until birth (fetus)
 - Placenta is functioning by end of 3rd month

NEONATAL PERIOD

- First 42 days after birth
 - Within 1 month, gross characteristics of all the organs have begun to develop
 - During the next 2–3 months, details of the organs are established
 - Beyond 4 months, organs of the fetus are grossly the same as those of the neonate.

- However, cellular development in each organ is far from complete

CIRCULATORY SYSTEM

- Beating of the heart begins (4th week)
- Contraction of the heart—65 beats/min
- Increases to 140 beats/min before birth

FORMATION OF BLOOD CELLS

- 3rd week—nucleated RBCs
In yolk sac and mesothelial layers of the placenta
- 4th to 5th weeks—nucleated RBCs

FETAL MESENCHYMAL AND ENDOTHELIUM OF FETAL BLOOD VESSELS

- 6th weeks: RBCs liver
- 3rd months: Spleen and other lymphoid tissue
- 3rd month onwards
Principle source RBCs and most of WBC—bone marrow
Lymphocytes and plasma cells—lymphoid tissue

RESPIRATORY SYSTEM

- No respiratory activity during fetal life
- No air to breath in amniotic fluid
- Lungs are completely deflated
- Inhibition: Prevents filling of the lungs with fluids and debris from meconium excreted by fetus' get into the amniotic fluid

NERVOUS SYSTEM

- 3rd to 4th months
Spinal cord and brain stem reflexes are present
- Cerebral cortex is immature
- Myelination of major tracts is completed 1 year of postnatal life

GASTROINTESTINAL SYSTEM

- By midpregnancy
- Fetus ingests and absorbs large quantities of amniotic fluid
- Last 2–3 months: Function approaches that of normal neonate
- Formation of meconium during the last 2–3 months

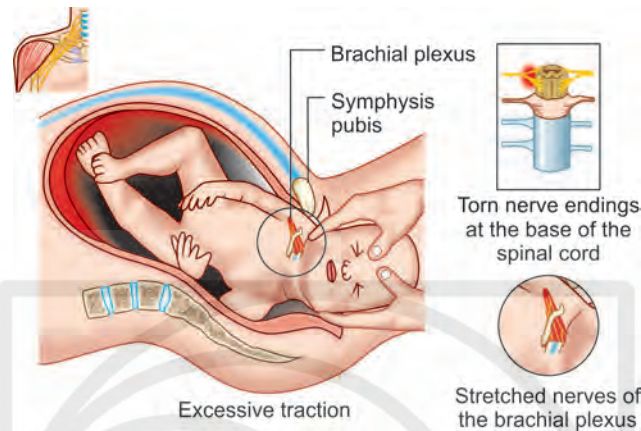
KIDNEYS

- 2nd trimester: Urine excretion. Accounts 70–80% of amniotic fluid
- Oligohydramnios: Reduced formation of amniotic fluid
 - Abnormal kidney development
 - Severe impairment of kidney function
- Renal control systems: Regulation of fetal ECF volume and electrolyte balances, especially acid base balance are almost nonexistent until late fetal life
- Do not reach full development until a few months after birth



Clinical Aspect

Brachial Plexus Injury



Brachial plexus injury

Erb's Palsy

- Upper trunk injury C5–C6,—due to fall on the shoulder, obstetric complication (birth injury)
- Lesion in the erb's point
- Erb's point is a meeting place of six nerves. C5 root, C6 root, anterior and posterior division from the upper trunk, suprascapular nerve and nerve to subclavius.

Mnemonic

- Nerves affected in ERB'S PALSY – (**SuperR MAN mnemonic**)
- **M**usculocutaneous nerve
- **A**xillary nerve
- **N**erve to subclavius
- **S**uprascapular nerve
- **R**adial nerve

Muscles Affected in Erb's Palsy

- Biceps (Flexor of elbow joint, supinator), brachialis (Flexor of elbow joint) affected due to involvement of musculocutaneous nerve. Coracobrachialis is not affected because it is supplied by nerve root C5-C7
- Deltoid (abductor of shoulder joint) and teres minor (lateral rotator of shoulder joint) are affected due to involvement of axillary nerve
- Subclavius affected due to involvement of nerve to subclavius
- Supra spinatus (initiate the abduction) and infraspinatus (lateral rotator of shoulder joint) affected due to suprascapular nerve
- Brachioradialis (Flexor of elbow joint), supinator (supinates the forearm), extensor carpi radialis longus (extends the wrist, but other extensor muscles prevent wrist drop) affected due to radial nerve.

Deformity

- **Effects:** Waiter's tip deformity/Policeman tip deformity



Deformities due to Erb's palsy



Clinical Aspect

Patient with wrist drop is Given Cock - Up Wrist Splint



- Then proceeds along the medial side of brachial artery
- Median nerve is the **most medial** structure in the cubital fossa
- Leaves the cubital fossa between superficial and deep head of **pronator teres**
- Enters the forearm under the tendinous arch of flexor digitorum superficialis



Fig. 44B: Course of the median N. in forearm

- In the forearm, it descends between superficialis and profundus
- In the forearm, it is accompanied median artery which is branch from anterior interosseous artery
- In the wrist, it lies between the tendon of flexor carpi radialis and palmaris longus and passes below the carpal tunnel

MEDIAN NERVE

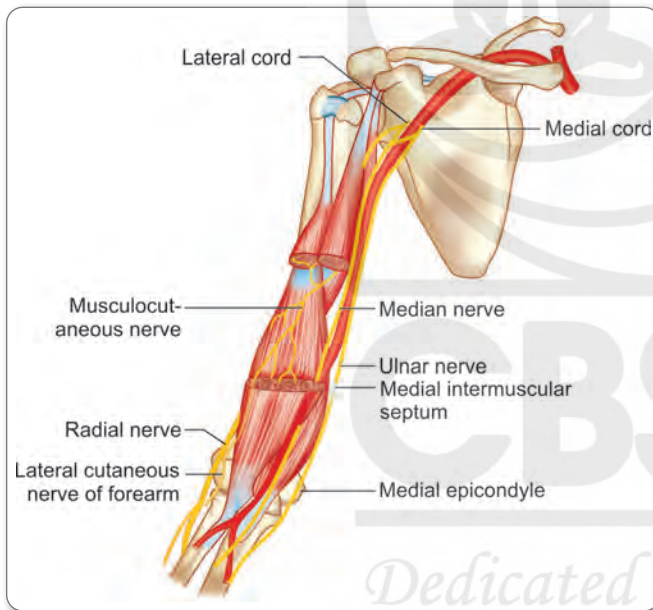


Fig. 44A: Course of median N. in arm

- Formed by **median root of median nerve** (branch of medial cord) and **lateral root of median nerve** (branch of lateral cord)
- Descends along the lateral side of axillary artery and brachial artery
- In the middle of the arm, nerve from lateral side cross to medial side

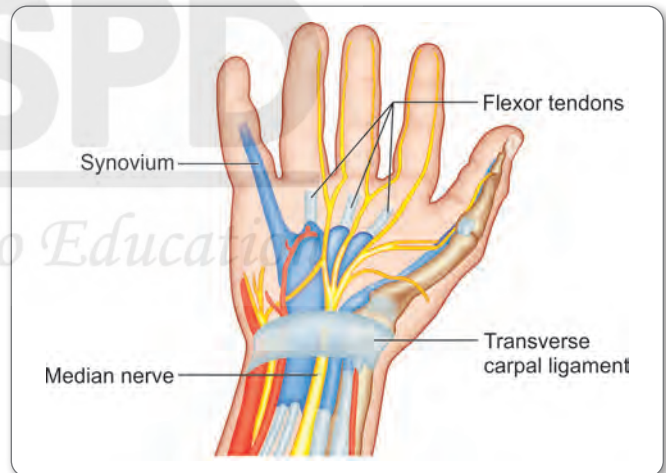


Fig. 44C: Course of the median N. in wrist

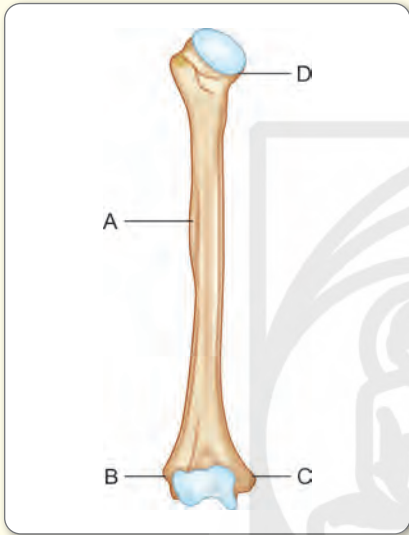


Upper Limb

Multiple Choice Questions

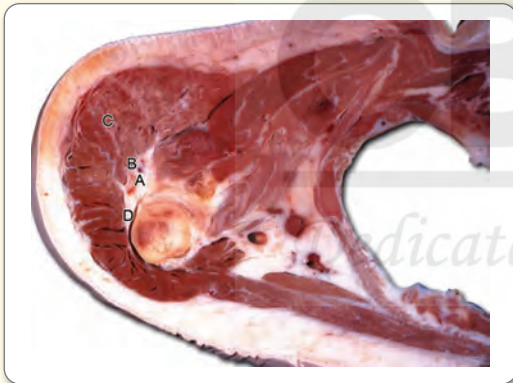
Bones of Upper Limb

1. A 25-year-old male presented with symptoms of inability to flex the distal interphalangeal joint of the 4th and 5th digits. He was also not able to hold a piece of paper between his fingers. What is the likely site of injury? (INI-CET July 2021)



- a. A
- b. B
- c. C
- d. D

2. A patient who has taken the first COVID vaccine comes for the second dose. An astute nurse noticed that the shoulder was flabby, flat, and was asymmetrical. There was an associated loss of contour of the shoulder joint. Injury to which of the structures might have resulted and was avoidable? (INI-CET July 2021)



- a. Lateral cutaneous nerve of arm
- b. Posterior circumflex artery
- c. Deltoid muscle
- d. Rotator cuff

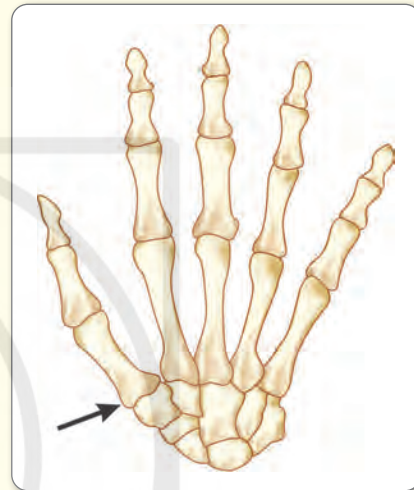
3. Muscle not used in overhead abduction: (INI-CET Nov 2020)

- a. Serratus anterior
- b. Trapezius
- c. Deltoid
- d. Pectoralis major

4. Patient unable to abduct upper limb. Which root value is involved? (INI-CET Nov 2020)

- a. C5
- b. C6
- c. C4
- d. C7

5. Muscle attached to marked area: (INI-CET Nov 2020)

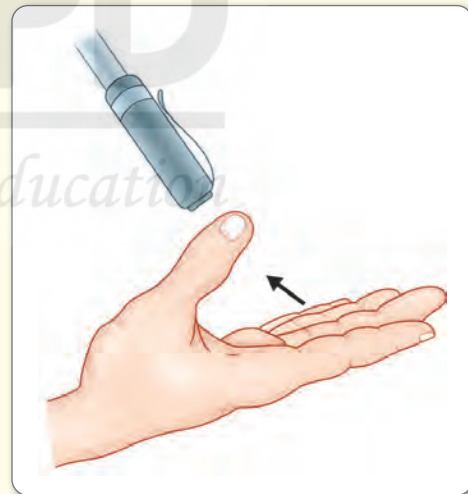


- a. Abductor pollicis longus
- b. Palmar interosseous
- c. Opponens pollicis
- d. Flexor pollicis brevis

6. A 7-year-old boy was brought to the hospital with multiple fractures of humerus secondary to a fall from height. On examination, there is difficulty in flexion of the elbow and supination of forearm with associated loss of sensation over lateral aspect of forearm. Which is the nerve MOST likely to be injured? (Recent Question 2021)

- a. Radial nerve
- b. Median
- c. Musculocutaneous nerve
- d. Ulnar nerve

7. Given test is to check, which of the following nerve: (Recent Question 2021)



- a. Median
- b. Ulnar
- c. Radial
- d. Anterior interosseous nerve



Upper Limb

Answers with Explanations

Bones of Upper Limb

1. Ans. c. C

The given clinical situation with a positive card test and an inability to flex the distal interphalangeal joint of the 4th and 5th digits, suggests an **ulnar nerve injury**.

The most likely site of injury would thus be **medial epicondyle - site C**

- Option a: Radial groove - Radial nerve
- Option b: Neck of humerus - Axillary nerve
- Option c: Lateral epicondyle – May lead to tardy ulnar nerve palsy after fracture but the incidence is less.

2. Ans. c. Deltoid muscle

The given clinical vignette is suggestive of **deltoid muscle palsy**.

The axillary nerve supplies the deltoid muscle and teres minor. Iatrogenic injuries of the axillary nerve can occur due to incorrectly administered IM injection.

Axillary nerve is commonly injured during shoulder dislocation (most commonly anterior type) or fractures of the humeral neck.

Injury to the axillary nerve can lead to:

- Weakness of abduction and lateral rotation of the arm
- **Atrophy of the Deltoid muscle** leading to the loss of muscle contours of the shoulder
- Regimental badge anesthesia

3. Ans. d. Pectoralis major

Overhead Abduction—done by Trapezius and Serratus Anterior. Abduction is carried out by the deltoid – 15 – 90 degrees of abduction of shoulder joint **the supraspinatus in the first 15 degrees**.

From 90° to 180° it is the trapezius and the serratus anterior.

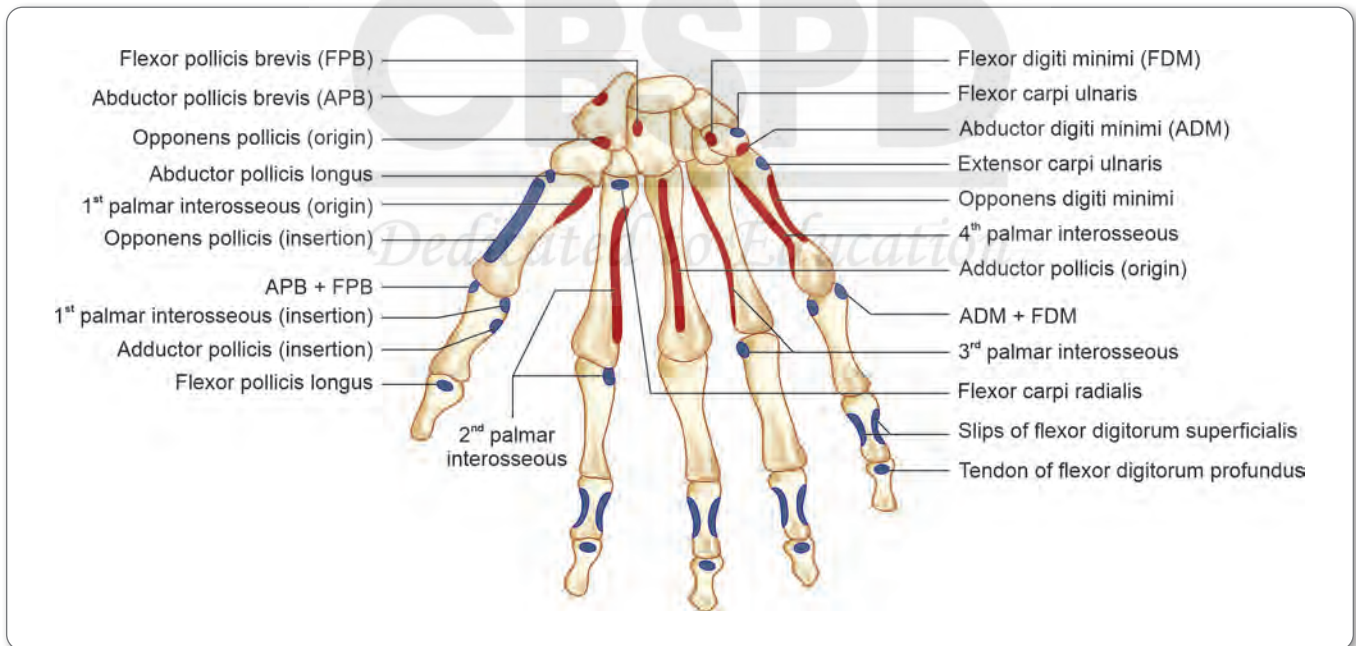
Adduction is carried out by the pectoralis major, latissimus dorsi, teres major and the subscapularis.

4. Ans. a. C5

Shoulder	
Flexion, abduction, lateral rotation	C5
Extension, adduction, medial rotation	C6,7,8
Elbow	
Flexion – biceps reflex	C5,6
Extension - triceps reflex	C6,7,8
Forearm	
Pronation	C7,8
Supination	C6
Wrist	
Flexion/extension	C7,8
Fingers/thumb – long tendons	
Flexion/extension	C7,8
Hand – small muscles	
All movements	t1

5. Ans. a. Abductor pollicis longus

Marking on the base of 1st metacarpal bone





Lower Limb

LOWER LIMB DEVELOPMENT

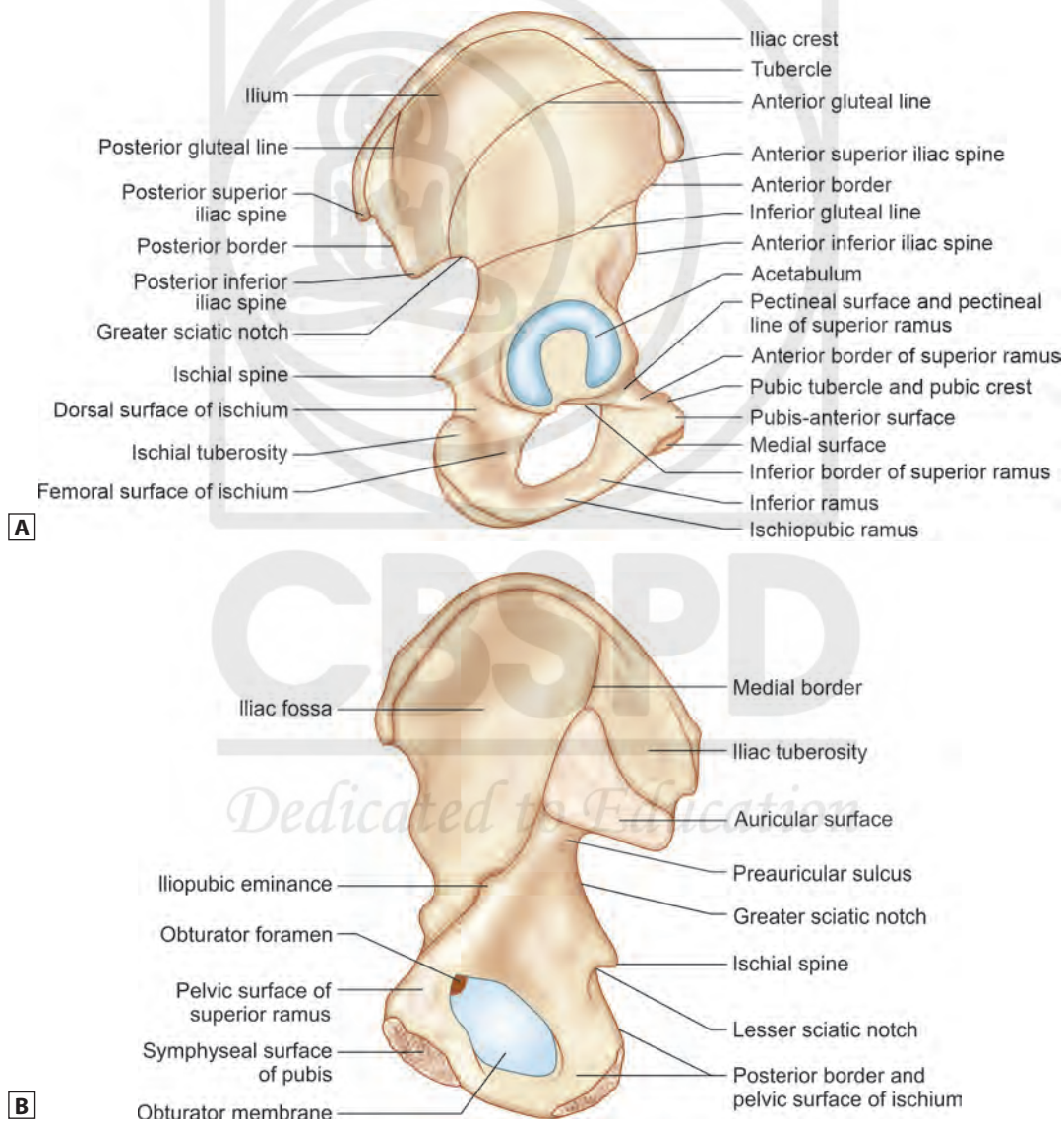
- Lower limb bud appear at the 5th week. (upper limb bud – by the end of 4th week – 2 days later lower limb bud appears)
- Bones derived somatopleuric lateral mesoderm
- Muscles derived from paraxial mesoderm – myotome of somites
- Lower limb rotates 90° medially so that extensor compartment become anterior, flexor compartment – posterior and great toe on medial side
- Preaxial vein – long saphenous vein, postaxial vein – small saphenous vein
- Blood supply is derived from 5th lumbar intersegmental artery.

OSTEOLOGY

HIP BONE

Pelvic bones are flat and are cancellous type.

It consists of venous plexus. So, any fracture in pelvic bones is of surgical emergency because patients bleeds about 1.5–2 L of blood.



Figs 1A and B: Hip bone. **(A)** Lateral view; **(B)** Medial view

It comprises one dorsal component—ilium and two ventral components—ischium and pubis.



Lower Limb

Ischium

Ischial Tuberosity

- Divided into upper quadrilateral and lower triangular area by transverse ridge.
- **Oblique ridge:** Quadrilateral area into upper and lateral area (semimembranosus origin) and lower and medial (semitendinosus and long head of biceps origin).
- Lower triangular part divided by vertical ridge into medial which transmits body weight and lateral part (origin to hamstring part of Adductor magnus).

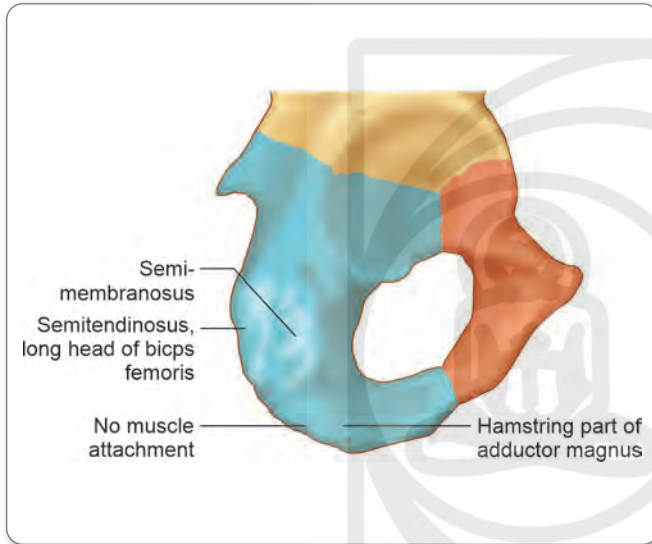


Fig. 3: Structure/division of ischial tuberosity

Jumper's Fracture

Jumper's fractures of the sacrum – **H or U-shaped fracture line in the upper sacrum**, usually involving the S1-S2 region.

The anterior segment of the pelvic ring usually not injured.

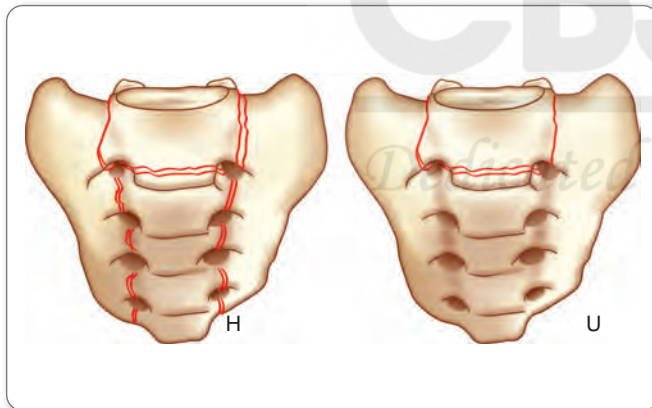


Fig. 4: Jumper's fracture

If there is injury to ring of pelvis, then it is unstable fractures.

DUVERNEY FRACTURE

- Fracture of iliac wing.
- And it is stable fracture.



Fig. 5: Duverney fracture

MALGAIGNE FRACTURE

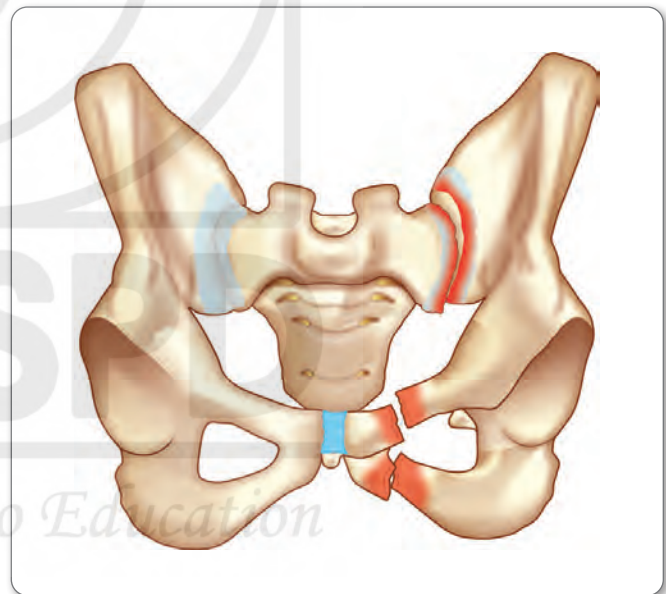


Fig. 6: Malgaigne fracture

- Sacroiliac joint disruption and ipsilateral superior and inferior pubic ramus fracture

Bucket Handle Fracture

- Sacroiliac joint disruption and contralateral superior and inferior pubic ramus fracture.

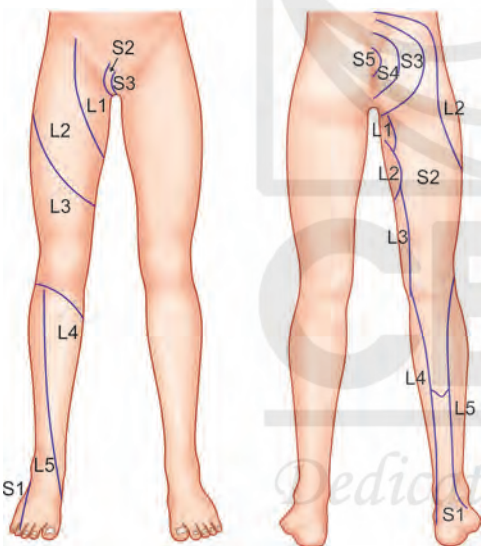


Table 4: Structures supplied by various nerves

Nerve	Supplies
Ilioinguinal nerve L1	Root of penis
Iliohypogastric nerve L1	Upper part of buttock, hypogastric region
Genitofemoral nerve L1,2	Divides lateral to the common and external iliac arteries into femoral and genital branches Genital branch: Supplies cremaster, skin over scrotum and labium majus Femoral branch: Supplies skin over femoral triangle
Femoral cutaneous nerve (Medial, Lateral and Intermediate)	Lateral femoral cutaneous nerve (Entrapment – Meralgia paresthetica)
Obturator nerve	Medial side of thigh
Posterior cutaneous nerve of thigh S1,2,3	Supplies posterior thigh, popliteal fossa, posteroinferior aspect of buttock, scrotum

Remember

Dermatome of lower limb



- L1 – Inguinal ligament
- L2 – Over lateral side of thigh
- L3 – Over lower medial side of thigh
- L4 – Over lateral side of great toe
- L5 – 1st web space – between first and second toe
- S1 – Lateral side of foot
- S2 – Back of thigh
- S3 – Skin over gluteal fold
- S4 – Perineum
- S5 – Perineum

GENERAL ANATOMY OF LOWER LIMB

FASCIA LATA

- Deep fascia of thigh
- Encloses the thigh like stocking
- Saphenous opening: Oval opening in fascia lata, lies 4 cm below and lateral to pubic tubercle.

ILIOTIBIAL TRACT

- Thickening of fascia lata
- Attached to lateral condyle of tibia
- Gluteus MAXimus and Tensor fascia lata inserted into iliotibial tract (**Mnemonic – t max**)
- Maintains knee in extended position.

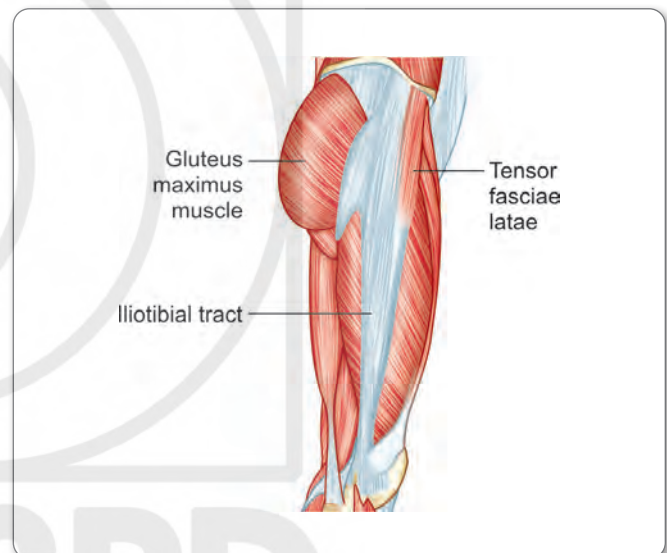


Fig. 38: Iliotibial tract, tensor fasciae latae and gluteus maximus

Clinical Aspect

Contracture of iliotibial tract in polio results in these classical deformities

- Lumbar scoliosis
- Pelvic obliquity
- Limb shortening
- Hip – flexion, external rotation and abduction
- Knee – flexion and valgus
- Tibia – external rotation, posterior and lateral subluxation of tibia
- Foot – equinus.

FEMORAL TRIANGLE

- Triangle in the upper one-third of front of thigh



Lower Limb

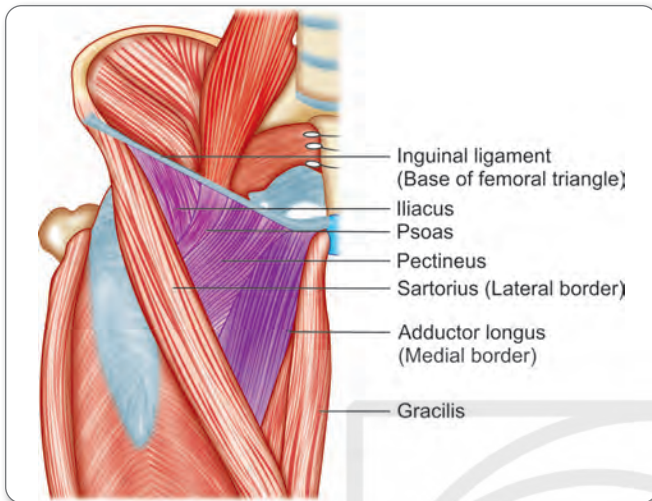


Fig. 39: Femoral triangle

Table 5: Relations of femoral triangle

Laterally	Medial border of sartorius
Medially	Medial border of adductor longus
Floor	Iliacus, tendon of Psoas major, Pectineus and adductor Longus Mnemonic
Roof	Formed by fascia lata
Base	Inguinal ligament
Apex	Meeting point of sartorius and adductor longus
Contents	Femoral artery and its branches Femoral vein and its tributaries Femoral nerve Deep inguinal nodes Part of lateral femoral cutaneous nerve Femoral branch of genitofemoral nerve Fibrofatty tissue

Femoral Sheath

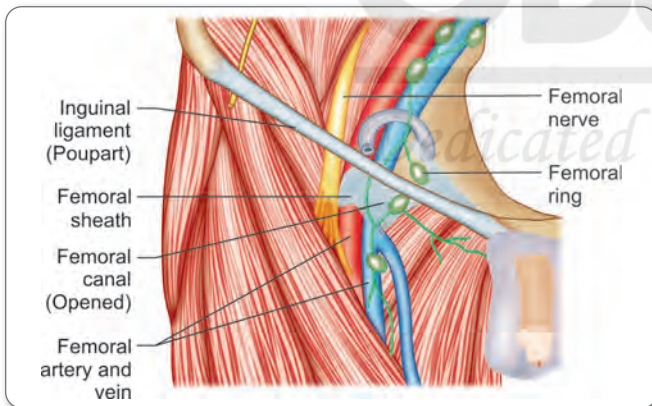


Fig. 40: Femoral sheath

- Funnel-shaped prolongation over proximal femoral vessels
- **Femoral nerve lies outside the sheath**
- In front - transversalis fascia, psoas fascia-behind

- Femoral canal (medial): Femoral canal contains – Lymph nodes of Cloquet, femoral vein intermediate, femoral artery (lateral) with femoral branch of genitofemoral nerve
- Structures piercing are femoral branch of genitofemoral nerve, superficial epigastric, superficial circumflex and superficial external pudendal branch of femoral artery and great saphenous vein.

Femoral Ring

- Upper opening of femoral canal
- Its boundaries are:
 - Anterior: Inguinal ligament
 - Medially: Lacunar ligament
 - Posterior: Pectineus muscle
 - Laterally: Femoral vein

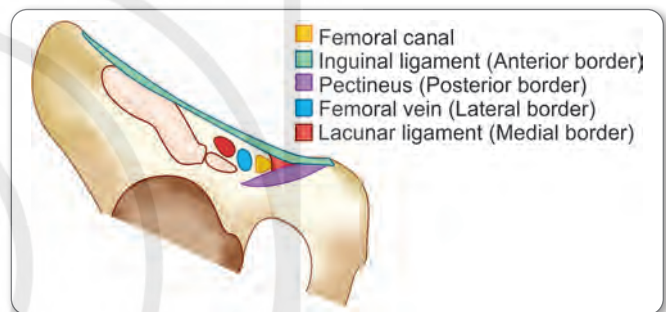


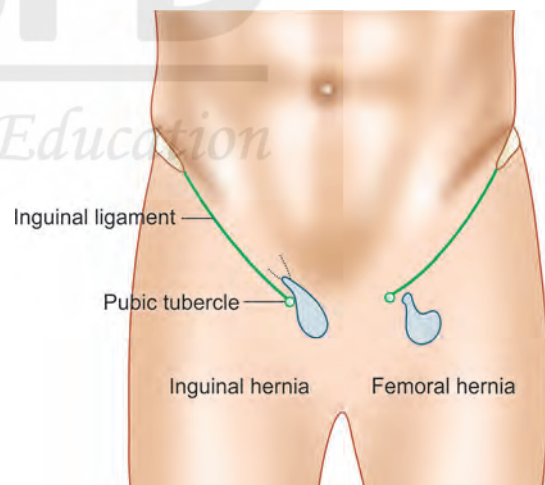
Fig. 41: Boundaries of femoral ring

Clinical Aspect

Femoral hernia

The femoral canal is an area of potential weakness in the abdominal wall through which abdominal contents may bulge out forming a femoral hernia. A femoral hernia is more common in females because the femoral canal is wider. This is associated with the wider pelvis and the smaller size of the femoral vessels, in the female. It is never congenital.

Femoral hernia passes through femoral ring and canal and it lies lateral and inferior to pubic tubercle.



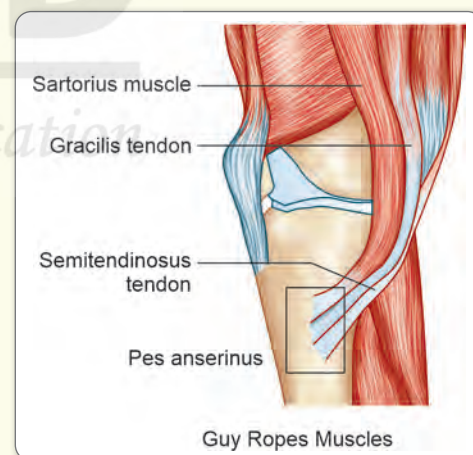
Femoral and inguinal hernia

Contd...



Chapter at a Glance

- Anterior compartment of thigh is supplied by : Femoral nerve
- Adductor compartment of thigh is supplied by : Obturator nerve
- Posterior compartment of thigh except short head of tibial part of sciatic nerve biceps is supplied by : Common peroneal nerve
- Gluteus medius, minimus and tensor fasciae latae are supplied by : Superior gluteal nerve
- Gluteus maximus supplied by : Inferior gluteal nerve
- Adductor magnus is supplied by : Tibial part of sciatic nerve + obturator nerve
- Flexor compartment of leg is supplied by short head of biceps supplied by common peroneal nerve : Tibial nerve
- Intrinsic muscles of foot is supplied by : Plantar branch - tibial nerve
- Peroneal or lateral compartment is supplied by : Superficial - peroneal nerve
- Extensor or anterior compartment is supplied by : Deep peroneal nerve
- Thickest nerve in body : Sciatic nerve
- Longest cutaneous nerve : Saphenous nerve
- Guy ropes muscles : Sartorius, gracilis and semitendinosus. Stabilizes pelvis on femur
- Anserine bursa: Separates tendons of Sartorius, Gracilis and Semitendinosus
- Brodie's bursa: Medial head of gastrocnemius
- Spring ligament: Plantar calcaneonavicular ligament – maintains medial arch of foot
- Sacrotuberous ligament is pierced by inferior gluteal artery
- Oblique popliteal ligament is pierced by middle genicular vessels
- Deltoid ligament of ankle joint is attached to tibia, talus, calcaneus, spring ligament
- Inversion and eversion take place at subtalar joint
- Talus bone does not have any muscular attachment
- Fibula bone violates the law of ossification
- Nutrient branch to tibia from posterior tibial artery is the largest nutrient branch in body
- Longest muscle: Sartorius
- Soleus muscle: Peripheral heart
- Hamstring muscles originate from ischial tuberosity and is inserted to bones of leg
- Adductor magnus is attached to adductor tubercle in femur not to bones of leg
- Short head of biceps is not true hamstring
- Hamstring muscle: Flexion of knee joint and extension of hip joint
- Rectus femoris: Flexion of hip joint and extension of knee joint
- Piriformis is key muscle in gluteal region
- Action of sartorius: Flexion of hip joint, abduction of hip joint, lateral rotator of hip joint, knee joint flexion and medial rotation
- Tibialis posterior muscle is attached to all tarsal and metatarsal bones except talus and 1st and 5th metatarsal bones
- Trendelenburg's sign: Gluteus medius and minimus – superior gluteal nerve – lurching gait
- Sural nerve: Cutaneous branch of tibial nerve, accompanies short saphenous vein
- In lower limb, popliteal artery is difficult to palpate
- Structures attached to anterior superior iliac spine: Inguinal ligament and Sartorius
- Structures attached to anterior inferior iliac spine: Iliofemoral ligament and straight head of rectus femoris
- Structures passing through lesser sciatic foramen: Pudendal nerve, internal pudendal artery, nerve to obturator internus and tendon of obturator internus.

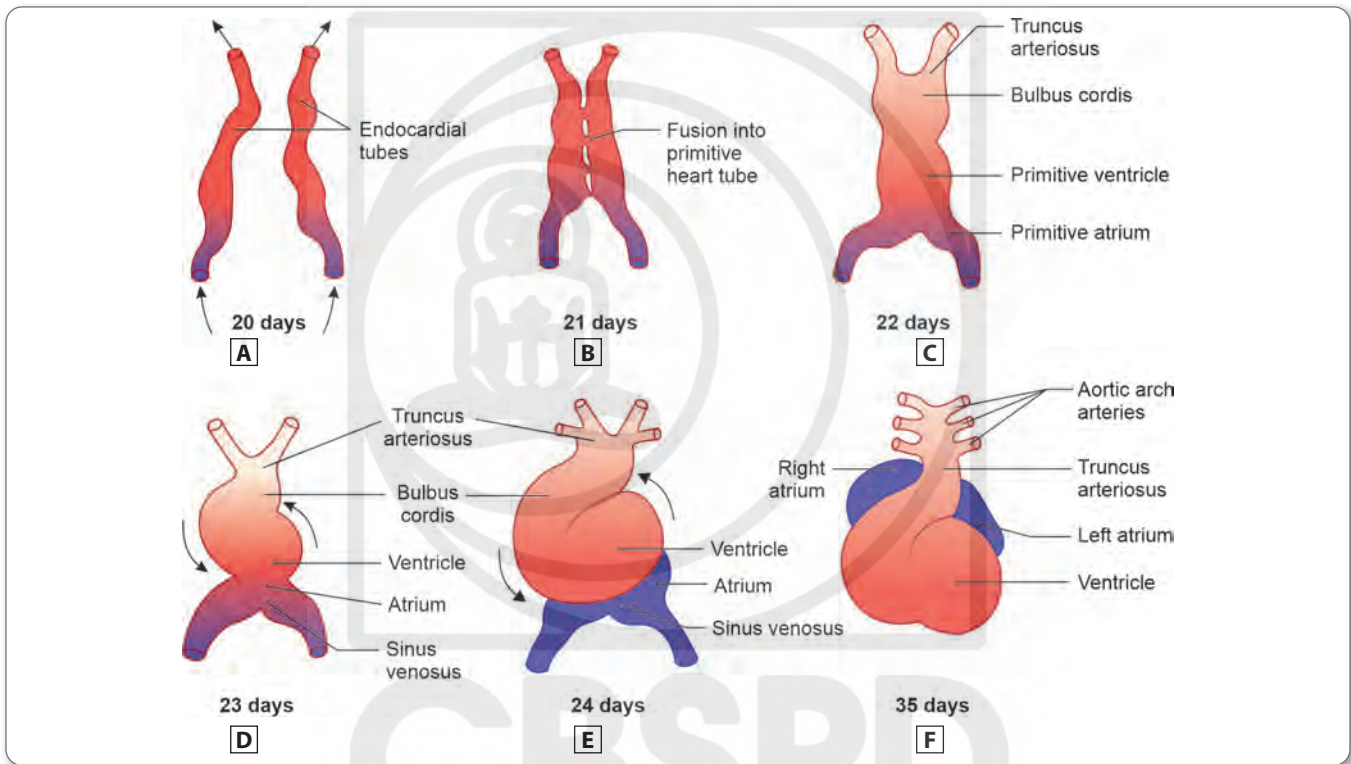




Thorax

Table 1: Primitive heart tube dilatations at embryonic and adult stage

Embryonic dilatations	Derivative
Bulbus cordis – distal third Truncus arteriosus	Ascending aorta and pulmonary trunk
Bulbus cordis middle third – conus part	Outflow tract of both right and left ventricle
Bulbus cordis proximal one third	Trabeculated part of right ventricle
Primitive ventricle	Trabeculated part of left ventricle
Primitive atrium	Rough part of both right and left atrium
Right horn and body of sinus venosus	Smooth wall of right atrium
Left horn of sinus venosus	Coronary sinus and oblique vein of left atrium



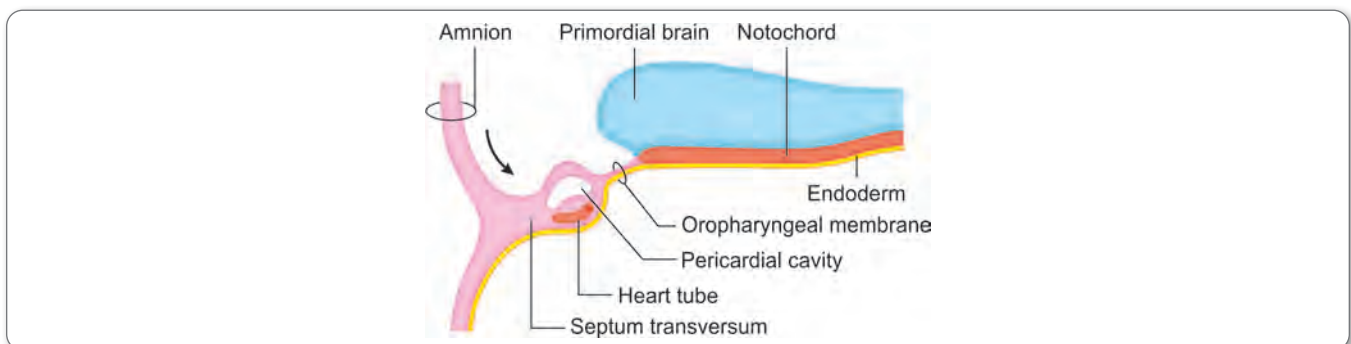
Figs 4A to F: Development of heart tube into adult derivatives

Note:

- Smooth part of left atrium is formed by incorporation of **pulmonary veins** into atrial wall
- **Crista terminalis** – Junction of rough and smooth part of right atrium.

Dedicated to Education

POSITION OF HEART TUBE IN RELATION TO PERICARDIAL CAVITY





Anal Canal

- Terminal part of alimentary canal
- Measurement – 3.8 cm
- From anorectal junction to anal orifice.

Table 16: Division of interior of anal canal

	Upper area	Intermediate area (Area of pecten or transitional zone)	Lower area (anal verge)
Measurement	1.5 cm	1.5 cm	0.8 cm
Lined by epithelium	Simple columnar	Nonkeratinized stratified squamous	Keratinized stratified squamous
Features	Containing anal column of Morgagni, anal valves of Ball and anal papillae	Without sweat glands, sebaceous gland and hair follicle	With sweat glands, sebaceous gland and hair follicle
Nerve supply	Autonomic supply therefore insensitive to pain	Somatic supply therefore sensitive to pain	Somatic supply therefore sensitive to pain

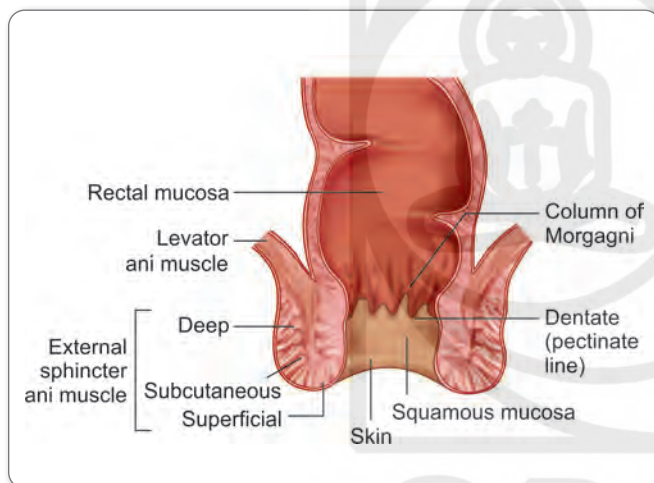


Fig. 55: Interior of anal canal

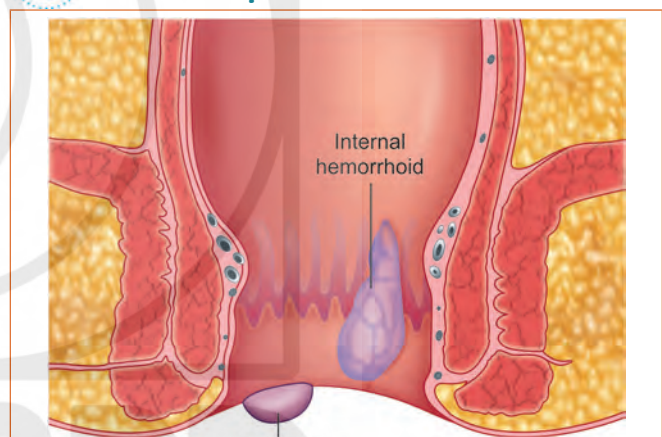
Pectinate Line or Dentate Line

- It is the mucocutaneous junction of the anal canal
- Pectinate line acts as watershed line

Table 17: Area above and below the pectinate line

Area above the pectinate line	Area below the pectinate line
<ul style="list-style-type: none"> • Developed from endodermal cloaca • Upper area supplied by superior rectal artery • Drained into portal system • Upper area drains into internal iliac nodes • Supplied by autonomic nerves • Simple columnar epithelium 	<ul style="list-style-type: none"> • Developed from ectodermal proctodeum • Lower area supplied by inferior rectal artery • Drained into systemic veins • Lower area drains into superficial inguinal • Supplied by somatic nerves • Nonkeratinized stratified squamous epithelium

Clinical Aspect



Internal and external hemorrhoids

Internal and external hemorrhoids

Internal hemorrhoids	External hemorrhoids
<ul style="list-style-type: none"> • Situated above the pectinate line • Painless • Innervated by autonomic system 	<ul style="list-style-type: none"> • Situated below the pectinate line • Painful • Innervated by somatic nerve

High Yield Point

Hilton's Line

Represented by anal intersphincteric groove situated at the lower end of internal sphincter muscle.



HEAD AND NECK

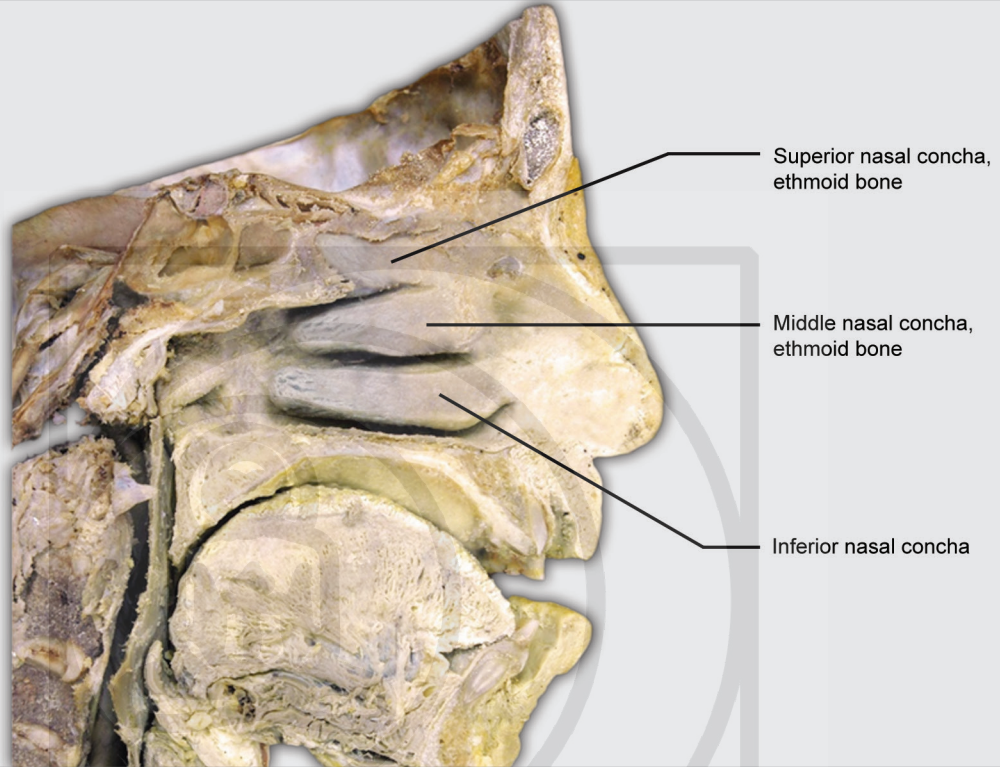


Fig. 1: Nasal cavity

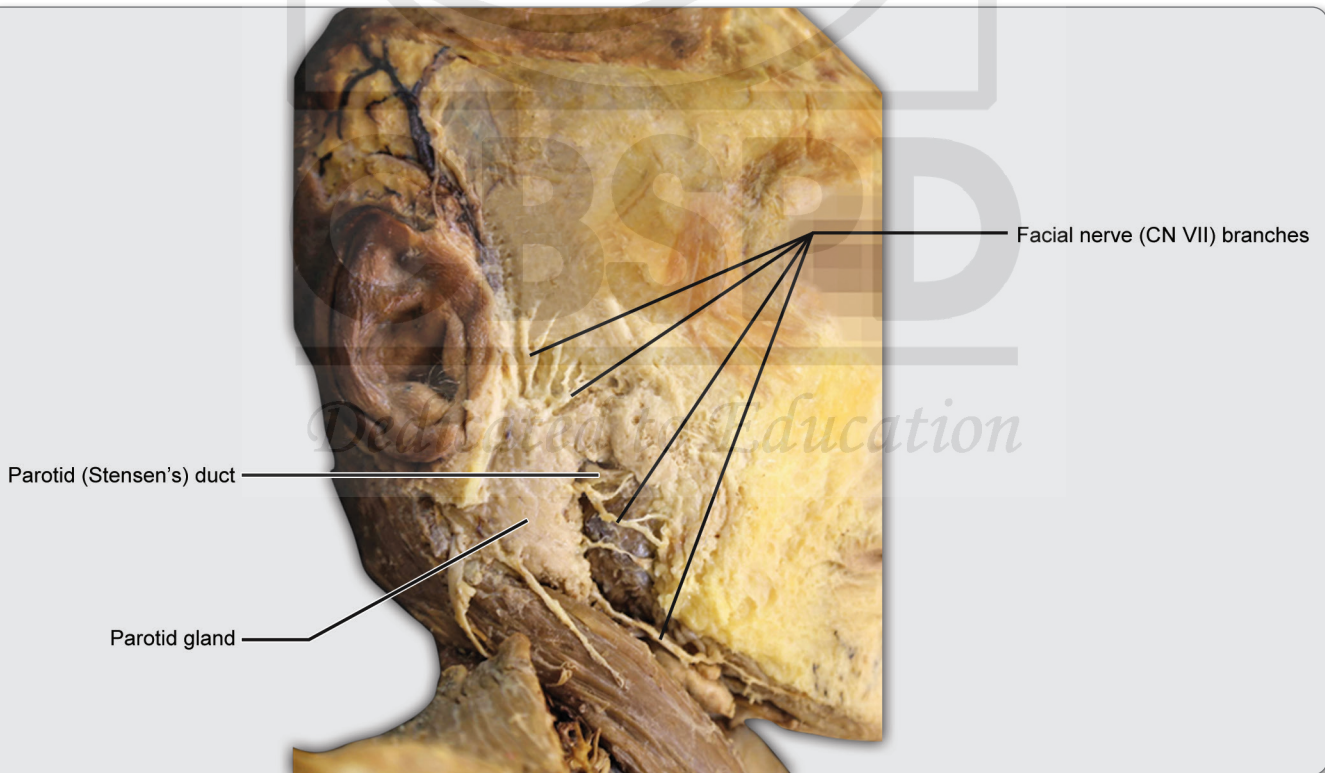


Fig. 2: Parotid gland



CADAVERIC IMAGE—HUMAN ANATOMY

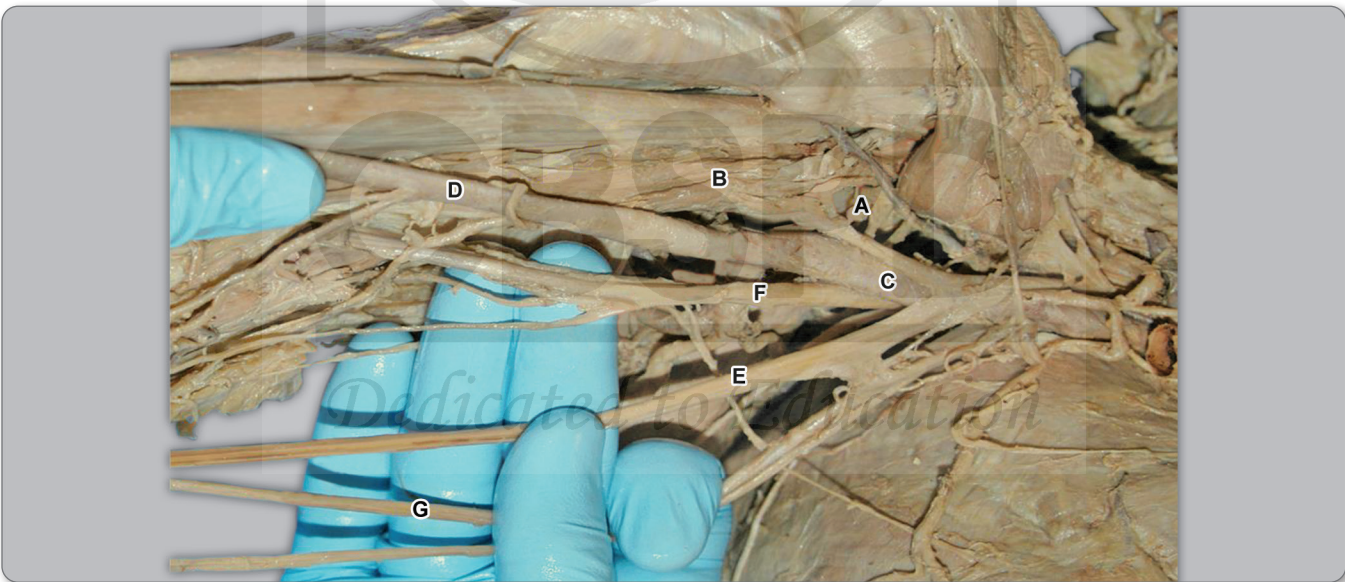
Cadaveric Images Part 1

Image 1



- A. Long thoracic nerve
- B. Thoracodorsal nerve
- C. Latissimus dorsi
- D. Musculocutaneous nerve
- E. Coracobrachialis
- F. Short head of biceps
- G. Long head of biceps
- H. Median nerve

Image 2



- A. Musculocutaneous nerve
- B. Coracobrachialis
- C. Axillary artery
- D. Brachial artery
- E. Median nerve
- F. Radial nerve
- G. Ulnar nerve

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About the Author

K Raviraj, MBBS, MD (Anatomy), a young and dynamic anatomist, completed his graduation from Government Stanley Medical College, Chennai, Tamil Nadu and postgraduation from PESIMSR, Kuppam, Andhra Pradesh. He has been mentoring the medical aspirants across the nation for the last 6 years. His flawless knowledge, teaching skills and grasp on the subject make him the best faculty of Anatomy. He is highly popular amongst the students for his vivacious delivery of lecture. His positive approach makes anatomy extremely simple to understand. Students in the medical fraternity admire him for his unique style of teaching and he is always a source of inspiration for them. He is also a successful author of several books, like FMGE Fire Aid Anatomy Manual and KONCPT-20.



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