CHAPTER 1

Scope of Anatomy and Physiology

Chapter Outlines
- Subdivisions of anatomy and physiology.
- Parts of the Body.
- Definition of various terminologies

Human body is unique, comprising of various organs and systems, which work both independently and interdependently according to its needs. The human body has to be studied from its normal structural and functional point of view. Once the normal structure and functions are understood, it is easy to comprehend the diseased state and necessary treatment to bring the status back to normal.

Anatomy is the science of learning the normal structure of the human. **Physiology** deals with learning and understanding the functions of the body. Thus, anatomy and physiology are the two sides of the same coin. Physiology is the enacting of various scenes in anatomy hall/theatre. The two branches of medical science are intimately related.

SUBDIVISIONS OF ANATOMY

The main subdivisions of anatomy are **gross anatomy** including neuroanatomy, **histology** or microscopic anatomy, **embryology** or developmental anatomy.

Surface anatomy is the projection of deeper structures on the skin.

Clinical anatomy emphasizes certain relations that are important to the physician/surgeon/dentist.

Radiological and imaging anatomy is the study of various components of the body by using X-ray, ultrasound, magnetic resonance imaging (MRI), etc.

SUBDIVISIONS OF PHYSIOLOGY

Cell physiology: Study individual activities of the cell to maintain homeostasis.

General physiology: Study of principles, which are basic to the functions of all systems of the body.

Systemic physiology: Study of the functioning of the various systems of the body.

PARTS OF THE BODY

The human body consists of the following parts:

1. Head, neck and brain
2. Trunk divided into upper part or thorax and lower part or abdomen (pelvis).
3. Two upper limbs
4. Two lower limbs.

Body Cavities

The organs that make up the systems of the body are contained in three cavities, i.e. cranial, thoracic and abdominopelvic cavity (Fig. 1.1).

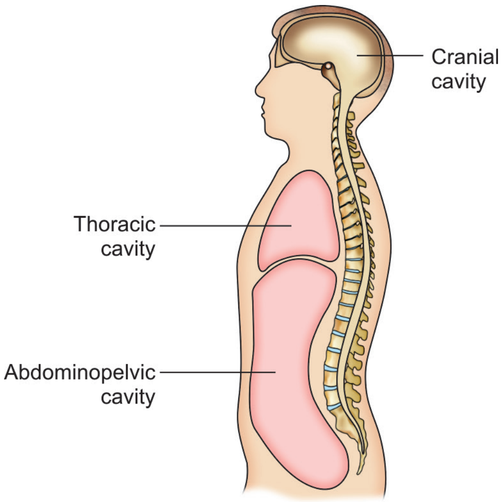

Fig. 1.1: Body cavities

Head is the upper most or cranial part of the body. Bone of the head is the skull (cranial cavity) which contains brain, and special sense organs like eyes, ears, nose and tongue.

Neck follows the head. Bones of neck are 1–7 cervical vertebrae. It contains big blood vessels, nerves and tubes like trachea and oesophagus.

Trunk

It is divided into:

1. An upper part or thoracic cavity.
2. A lower part or abdominopelvic cavity.

Thorax

Thorax lies below the neck. Bones in this part are 1–12 thoracic vertebrae, one sternum and 12 pair of ribs and costal cartilages. All these form the bony thoracic cavity which contains single heart, more to the left side of the body, blood vessels, right and left lungs with trachea and bronchi, oesophagus, nerves and lymph nodes. **Mediastinum** is the space between the lungs including the structures found there, such as heart, oesophagus and blood vessels.

Abdomen

Abdomen is present below the thorax. The thoracoabdominal diaphragm separates the two cavities. Bones here are 1 to 5 lumbar vertebrae. It contains digestive system and urinary system. It also contains spleen, suprarenal glands, blood vessels, nerves and lymph nodes. Many organs are pushed up in thoracic cavity.

Lower part of abdomen is called the **pelvis,** bounded by the two hip bones and sacrum with coccyx. The **pelvic cavity** so formed contains lower part of urinary and digestive systems. In between it contains the reproductive organs which are different in male and female.

The lowest part of abdomen is the **perineum** which contains the openings of urethra and anal canal in male and openings of urethra, vagina and anal canal in female.

Upper Limbs

They are made of the following parts:

1. *Shoulder girdle* is made of two bones, the **clavicle and scapula** and includes pectoral region in the front of chest, scapular region in the back of chest and shoulder joint. Axilla lies between the upper aspect of thorax and the medial side of upper limb (Fig. 1.2).
2. *Arm or brachium* extends between shoulder joint and the elbow joint. Only one bone, **humerus** forms the skeleton of arm.
3. *Forearm or antebrachium* extends between the elbow and the wrist joints. Two bones, the **radius** laterally and **ulna** medially lie in this region. Radius rotates over ulna causing movements of pronation of forearm with the palm facing backwards. When the two bones are parallel to each other, the position is called supine, with the palm facing forwards.
4. Hand or carpal region extends from the wrist to the tips of the digits. Bones in this region are 8 small carpal bones, 5 metacarpals and 14 phalanges.

The **palm** is the region over the metacarpals and the phalanges form the skeleton of the digits.

There are five digits from lateral to medial side. These are called 1st digit or thumb, 2nd digit or index finger, 3rd digit or middle finger, 4th digit or ring finger and 5th digit or little finger (Fig. 1.2).

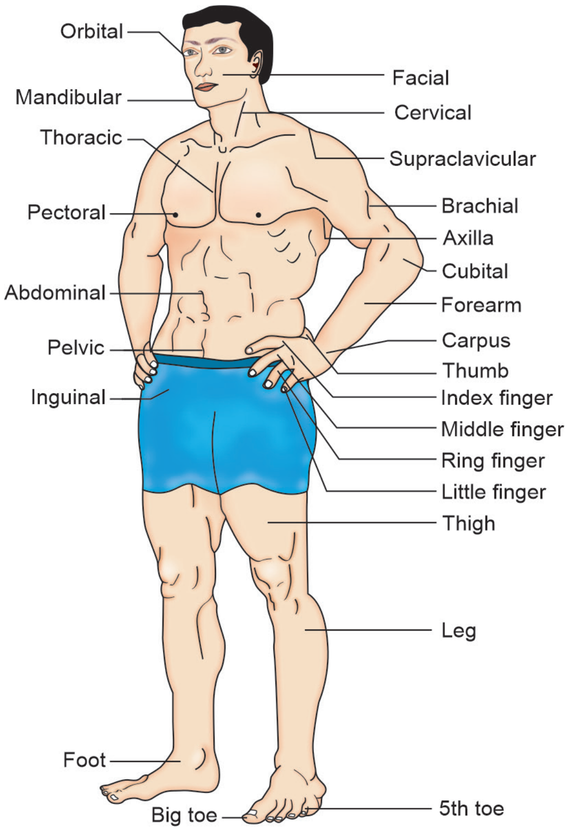

Fig. 1.2: Regions of the body

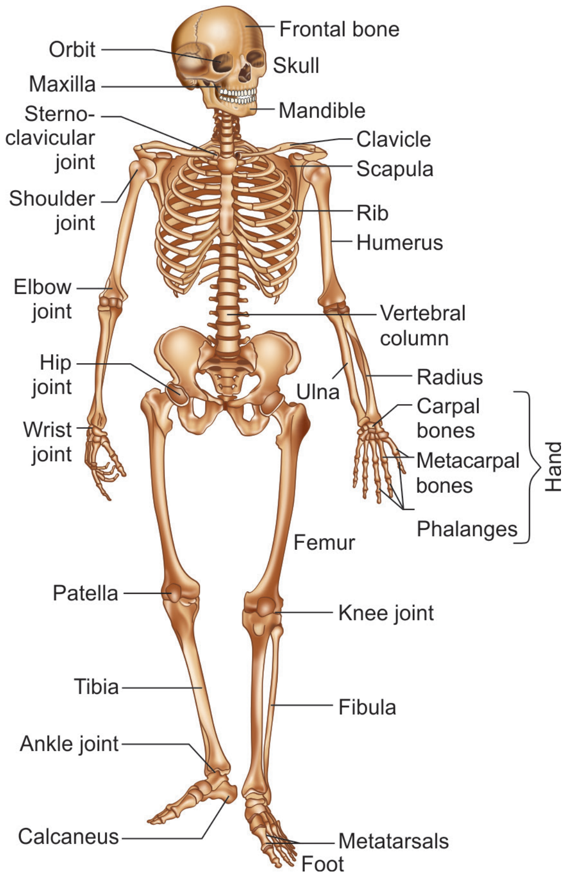

Fig.1.3: Human skeleton

Lower Limbs

These are two identical limbs. Its various parts are:

1. *Pelvic girdle* comprised of two hip bones and a sacrum. Each **hip bone** is made up of three bones: (1) The ilium, (2) ischium and (3) pubis. Inguinal region in front is at the junction of abdomen and lower limb and gluteal region is on the back of ilium and ischium (Fig. 1.3).
2. *Thigh* extends between the hip and knee joints. **Femur** is the only bone lying in this area.
3. *Leg* extends between the knee and ankle joints. Two bones, a large **tibia** and slender **fibula** form skeleton of this region.
4. *Foot* lies distal to the ankle joint. Bones forming the foot are 7 tarsal bones, 5 metatarsal bones and 14 small phalanges.

Phalanges are very small and form skeleton of the small digits. The digits are named from medial to lateral as 1st digit or big toe, 2nd digit or 2nd toe to 5th digit or 5th toe. The sole of the foot faces plantarwards (Fig. 1.2).

TERMINOLOGY

Anatomical Position

When a person is standing straight, with eyes looking forwards, both arms by the side of body, palms facing forwards, both feet together, the position is anatomical position. All the descriptions of viscera, vessels and nerves are done as if the body is in anatomical position (Fig. 1.4).

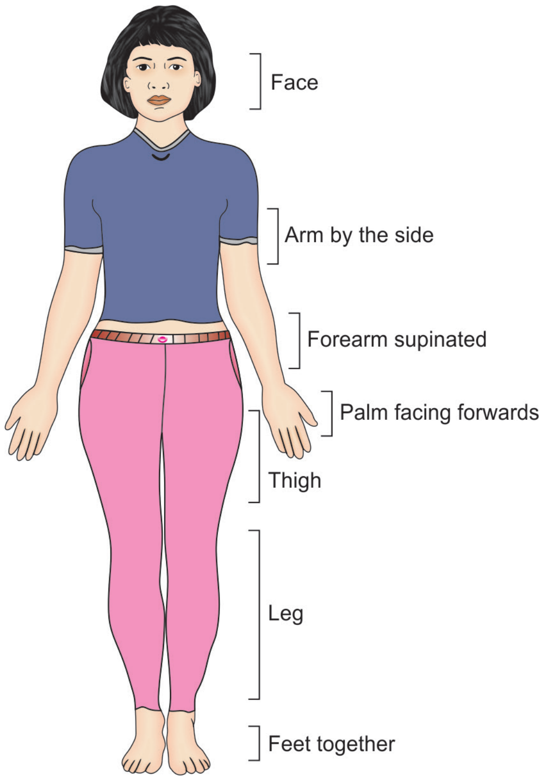

Fig. 1.4: Anatomical position

Supine Position

When a person is lying on his/her back, arms by the side, palms facing upwards and feet together, the position is supine position.

Prone Position

Person lying on his face, chest and abdomen, is said to be in prone position.

Lithotomy Position

Person lying on her back with legs up and feet supported with straps. In this position, the perineal region is well visualised. This position is mostly used for delivery of the baby (Fig. 1.5).

Planes

A plane passing through the centre of the body dividing it into two equal right and left halves is **median** or **midsagittal plane** (Fig. 1.6).

Any plane parallel to median plane is a **sagittal plane.**

Fig. 1.5: Lithotomy position

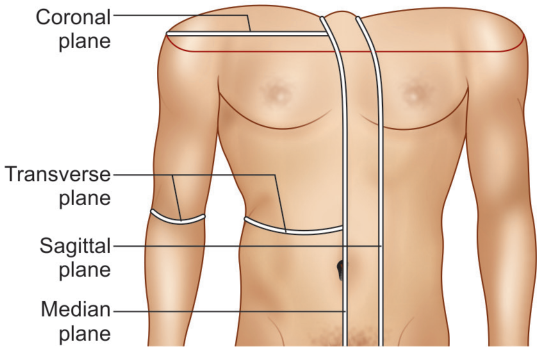

Fig. 1.6: Anatomical planes

A plane at right angles to median/mid-sagittal plane which divides the body into anterior and posterior halves is called a **coronal plane.**

A plane at right angles to both sagittal and coronal planes which divides the body into upper and lower parts is called a **transverse plane.**

Terms Used in Relation to Trunk

- *Ventral or anterior is* the front of trunk (Figs 1.7 and 1.8).
- *Dorsal or posterior* is the back of trunk.
- *Medial* is a plane close to the median plane.
- *Lateral* is plane away from the median plane.
- *Cranial/superior* is close to the head end of trunk.
- *Caudal/inferior* is close to the lower end of the trunk.
- *Superficial* is close to skin/towards surface of body.
- *Deep* is away from skin/away from surface of body.

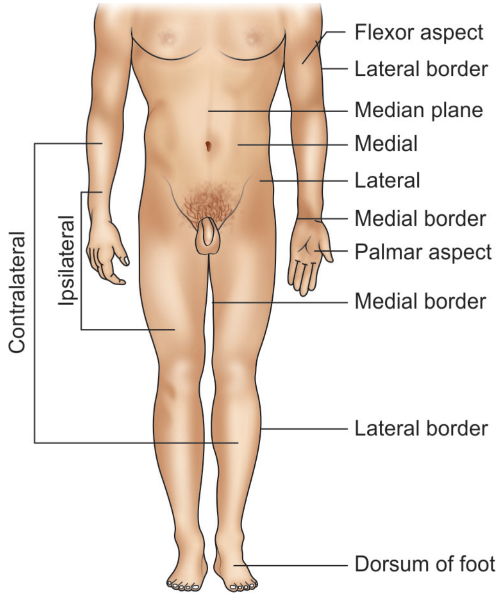

Fig. 1.7: Anatomical terms

- *Ipsilateral:* On the same side of body as another structure (Fig. 1.7).
- *Contralateral:* On opposite side of body from another structure (Fig. 1.7).

Terms Used in Relation to Upper Limb

- *Ventral or anterior* is the front or flexor aspect (Fig. 1.7).
- *Dorsal or posterior* is the back aspect.
- *Medial/postaxial border* lies along the little finger, medial border of forearm and arm.
- *Lateral/preaxial border* follows the thumb, lateral border of forearm and arm.
- *Proximal* is close to root of limb, while **distal** is away from the root (Fig. 1.8).
- *Palmar* aspect is the front of the palm.
- *Dorsal* aspect of hand is on the back of palm.
- *Flexor* aspect is front of upper limb.
- *Extensor* aspect is back of upper limb.

Terms Used in Relation to Lower Limb

- *Ventral* aspect is the back of lower limb (Fig. 1.8).
- *Dorsal* aspect is the front of lower limb.

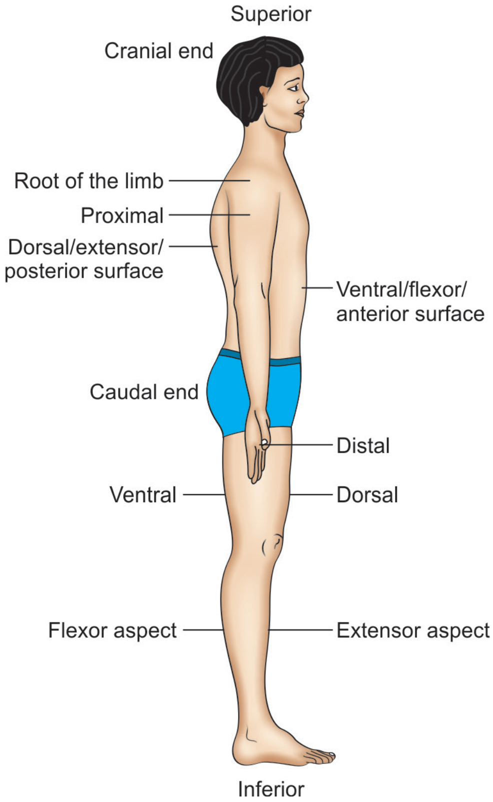

Fig. 1.8: Anatomical terms

- *Medial border* lies along the big toe or hallux, medial border of leg and thigh (Fig. 1.7).
- *Lateral border* lies along the little toe, lateral border of leg and thigh (Fig. 1.7).
- *Flexor* aspect is back of lower limb.
- *Extensor* aspect is front of lower limb.
- *Proximal* is close to the root of limb, while **distal** is away from it.

Terms of Position of Body Movements

Movements in general at synovial joints are divided into four main categories.

1. *Gliding movement:* Relatively, flat surfaces move back-and-forth and from side-to-side with respect to one another. The angle between articulating bones does not change significantly.
2. *Angular movements:* Angle between articulating bones decreases or increases. In **flexion** there is decrease in angle between

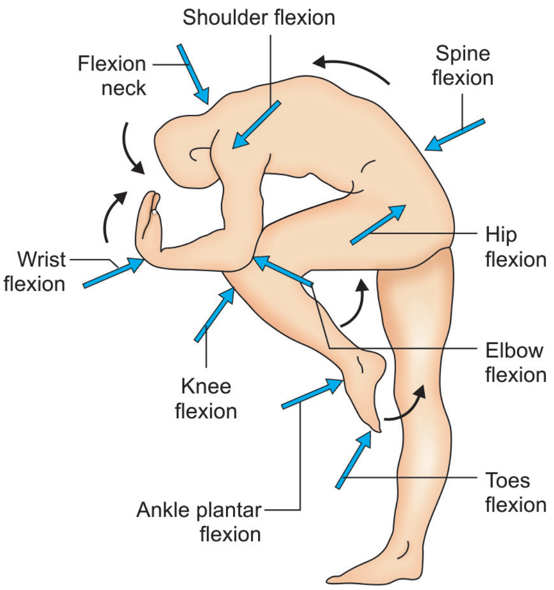

Fig. 1.9: Flexion

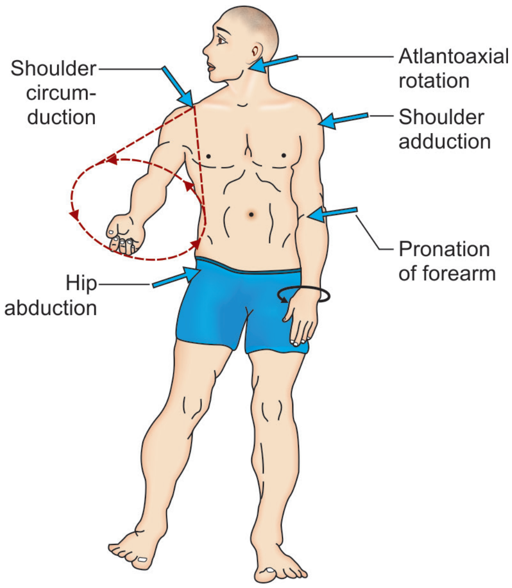

Fig. 1.11: Movements

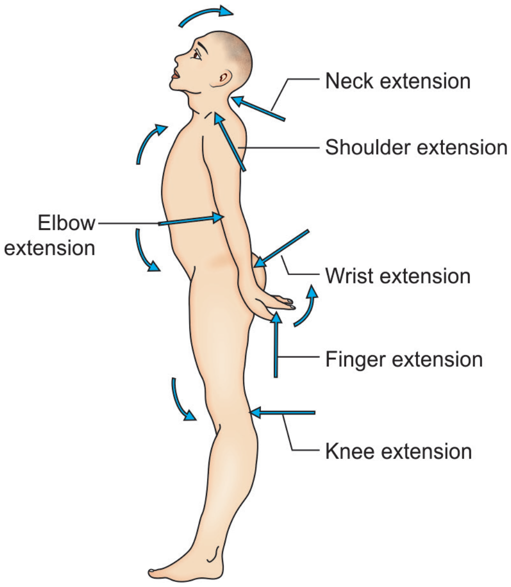

Fig. 1.10: Extension

articulating bones and in **extension** there is increase in angle between articulating bones (Figs 1.9 and 1.10). **Lateral flexion** is movement of trunk sideways to the right or left at the waist. **Adduction** is movement of bone towards midline whereas **abduction** is movement of bone away from midline (Fig. 1.11)

3. *Rotation:* A bone revolves around its own longitudinal axis. In **medial rotation,** anterior surface of a bone of limb is turned toward the midline. In **lateral rotation,** anterior surface of bone of limb is turned away from midline.
4. *Special movements:* These occur only at certain joints, e.g. pronation, supination in forearm; protraction and retraction at temporomandibular joint.

In Upper Limb

1. *Flexion:* When two flexor surfaces are brought close to each other, e.g. in elbow joint when front of arm and forearm are opposed to each other (Fig. 1.9).
2. *Extension:* When extensor or dorsal surfaces are brought in as much approximation as possible, e.g. straightening the arm and forearm at the elbow joint (Figs 1.10 and 1.12).
3. *Abduction:* When limb is taken away from the body (Fig. 1.11).
4. *Adduction:* When limb is brought close to the body (Fig. 1.11).
5. *Circumduction:* It is movement of distal end of a body part in a circle. A combination of

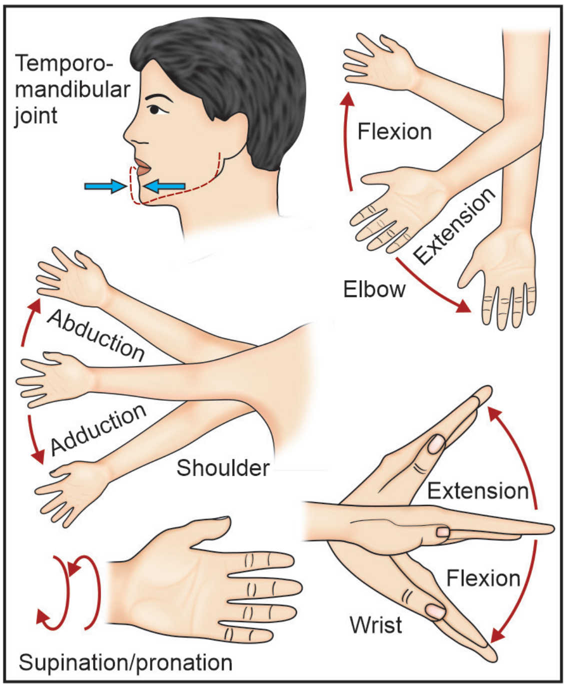

Fig. 1.12: Movements of some of the joints

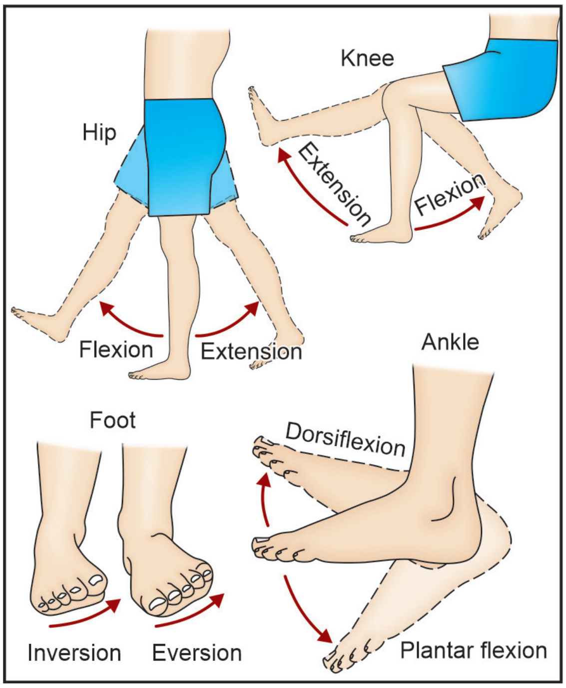

Fig. 1.13: Movements of joints of lower limb

flexion, abduction, extension and adduction in a sequence is called circumduction as in bowling (Fig. 1.11).

6. *Medial rotation:* When the arm rotates medially bringing the flexed forearm across the chest.
7. *Lateral rotation:* When arm rotates laterally taking the flexed forearm away from the body.
8. *Supination:* When the palm is facing forwards or upwards, as in putting food in the mouth (Fig. 1.12).
9. *Pronation:* When the palm faces backwards or downwards, as in picking food with fingers from the plate (Fig. 1.11).
10. *Adduction of digits/fingers:* When all fingers get together (*see* Fig. 4.39A).
11. *Abduction:* When all fingers separate. The axis of movement of the fingers is the line passing through the centre of the middle finger (*see* Fig. 4.39B).
12. *Opposition of thumb:* When tip of thumb touches the tips of any of the fingers.
13. *Circumduction of thumb:* Movement of flexion, abduction, extension and adduction in sequence (Fig. 1.11).

In Lower Limb

1. *Flexion of thigh:* When front of thigh comes in contact with front of abdomen (Figs 1.9 and 1.13).
2. *Extension of thigh:* When person stands erect (Figs 1.10 and 1.13).
3. *Abduction:* When thigh is taken away from the median plane (Fig. 1.11).
4. *Adduction:* When thigh is brought close to median plane.
5. *Flexion of knee:* When back of thigh and back of leg come in opposition (Figs 1.9 and 1.13).
6. *Extension of knee:* When thigh and leg are in straight line as in standing (Figs 1.9 and 1.13).
7. *Dorsiflexion of foot:* When dorsum of foot is brought close to front of leg and sole faces forwards (Fig. 1.13).
8. *Plantar flexion of foot:* When sole of foot or plantar aspect of foot faces backwards (Fig. 1.13).

9. *Inversion of foot:* When medial border of foot is raised from the ground (Fig. 1.13).
10. *Eversion of foot:* When lateral border of foot is raised from ground.

In the Neck

1. *Flexion:* When face comes closer to chest (Fig. 1.9).
2. *Extension:* When face is brought away from the chest (Fig. 1.10).
3. *Lateral flexion:* When ear is brought close to shoulder.
4. *Opening of the mouth:* When lower jaw is lowered to open the mouth.
5. *Closure of the mouth:* When lower jaw is opposed to the upper jaw, closing the mouth.
6. *Protraction:* When lower jaw slides forwards in its socket in the temporal bone of skull (Fig. 1.12).
7. *Retraction:* When lower jaw slides backwards in its socket in the temporal bone of skull.

In the Trunk

1. Forward bending is **flexion** (Fig. 1.9).
2. Backward bending is called **extension** (Fig. 1.10).
3. Sideward movement is **lateral flexion**.
4. Sideward rotation is **lateral rotation**.

Points to Remember

1. Anatomical position is the most important position for understanding anatomy.
2. Median plane is only one plane in the trunk.
3. Pronation and supination of forearm are special movements which permit "picking up of food (pronation)" and "putting it in the mouth (supination)".
4. Big toe being in the same plane as rest of the toes is unique to human.
5. Median/midsagittal plane divides the body into right and left halves.
6. Coronal plane divides the body/any part into anterior and posterior parts.
7. Transverse/horizontal plane divides the body/part into upper and lower portions.

MCQs

1. **Anatomical position has following features *except*:**
   (a) Person standing erect
   (b) Forearms are pronated
   (c) Feet together
   (d) Eyes looking forwards
2. **Define abduction:**
   (a) Movement away from central axis
   (b) Movement towards central axis
   (c) Approximation of the ventral surfaces
   (d) Approximation of the dorsal surfaces
3. **What is the position of forearms in the anatomical position?**
   (a) Pronated
   (b) Supinated
   (c) Midprone
   (d) None of the above
4. **Plane at right angle to the long axis of body/ body part is called:**
   (a) Sagittal
   (b) Median
   (c) Transverse/horizontal
   (d) Oblique
5. **The term cranial means:**
   (a) Towards the head
   (b) Towards the back
   (c) Towards the tail
   (d) Towards the front
6. **Preaxial border of upper limb is:**
   (a) Its inner border
   (b) Its outer border
   (c) Its anterior median line
   (d) Its posterior median line

Ans! 1 b 2 a 3 b 4 c 5 a 6 b