

Joints

6

**PART ONE –
Classification of
Joints**

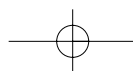
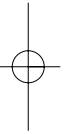
**PART TWO –
Features of Specific
Joints**

Joints of the Head
and Vertebral Column

Joints of the Ribs
and Sternum

Joints of the
Shoulder Girdle
and Upper Limb

Joints of the
Pelvic Girdle and
Lower Limb



The Atlas of Musculo-skeletal Anatomy

With the exception of the hyoid bone in the neck, all other bones form a joint with at least one other bone. Joints are also called *articulations*.

Joints have two functions: to *hold the bones together*, and to *give the rigid skeleton mobility*. When two bones meet, or articulate, there may or may not be movement depending on, (a) the amount of bonding material between the bones; (b) the nature of the material between the bones; (c) the shape of the bony surfaces; (d) the amount of tension in the ligaments or muscles involved in the joint; (e) the position of the ligaments and muscles.

PART ONE – Classification of Joints

Joints are classified in two ways: **functionally** and **structurally**.

Functionally

The functional classification of joints focuses on the amount of movement allowed by the joint.

Immovable Joints (Synarthrotic)

These joints are found mostly in the axial skeleton, where joint stability and firmness is important for the protection of the internal organs.

Slightly Movable Joints (Amphiarthrotic)

Like immovable joints, and for the same reason, these joints are also found mainly in the axial skeleton.

Freely Movable Joints (Diarthrotic)

These joints predominate in the limbs, where a greater range of movement is required.

Structurally

Fibrous Joints

In fibrous joints, fibrous tissue joins the bones. As such, no joint cavity is present. Generally these joints have little or no movement, i.e. they are *synarthrotic*. Fibrous joints are of three types: *sutures*, *syndesmoses*, and *gomphoses*.

1. Sutures

The only examples of fibrous sutures are the sutures of the skull, where the irregular edges of the bones interlock and are bound tightly together by connective tissue fibres, allowing no active movement. Layers of periosteum on the inner and outer layers of the adjoining bones bridge the gap between the bones and form the main bonding factor. Between the adjoining joint surfaces there is a layer of vascular fibrous tissue that also helps unite the bones. This vascular fibrous tissue, along with the two layers of periosteum, is collectively called the *sutural ligament*. The fibrous tissue becomes ossified during adulthood by a process that occurs first at the deep aspect of the suture, progressively extending to the superficial part. This ossifying process is referred to as *synostosis*.

2. Syndesmoses

A syndesmosis is a fibrous joint where the uniting fibrous tissue forms an *interosseous membrane* or *ligament*; i.e. a band of fibrous tissue that allows little movement, situated between the radius and ulna and between the tibia and fibula.

3. Gomphoses

A gomphosis refers to a fibrous joint in which a peg is embedded into a socket. The only examples of such joints in humans consist of the teeth fixed into their sockets.

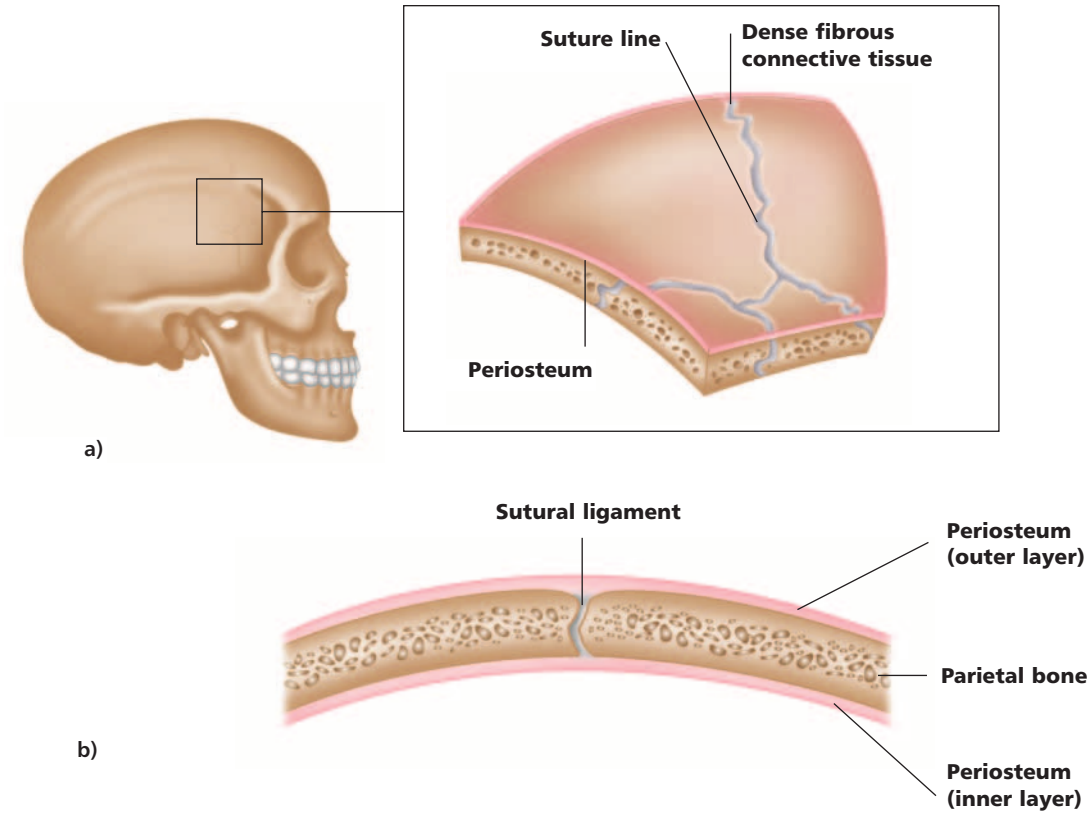
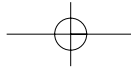


Figure 6.1: a) Position of a suture; b) vertical section through a suture.

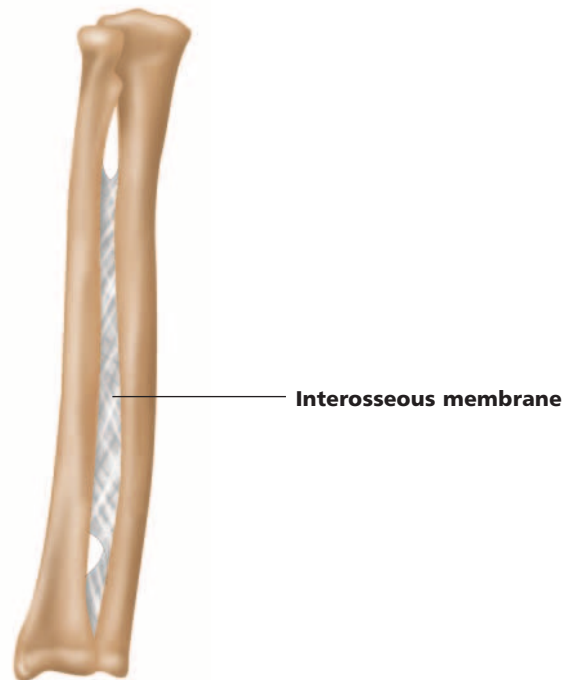
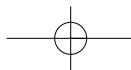


Figure 6.2: The interosseous membrane between the radius and ulna.



Cartilaginous Joints

In cartilaginous joints, a continuous plate of hyaline cartilage or a fibrocartilage disc connects the bones. Again, no joint cavity is present. They can be either immovable (synchondrosis) or slightly movable (symphysis). The slightly movable joints are the more common.

Synchondroses

Examples of cartilaginous joints that are immovable are the epiphyseal plates of growing long bones. These plates are made of hyaline cartilage that ossifies in young adults (*see* page 29). Thus, the place where a joint is united by such a plate is known as a *synchondrosis*. Another example of such a joint that eventually ossifies is the joint between the first rib and the manubrium of the sternum.

Symphyses

Examples of slightly movable cartilaginous joints are the pubic symphysis of the pelvic girdle, and the intervertebral joints of the spinal column. In both cases the articular surfaces of the bones are covered with hyaline cartilage that is in turn fused to a 'pad' of fibrocartilage (fibrocartilage is compressible and resilient, and acts as a shock absorber).

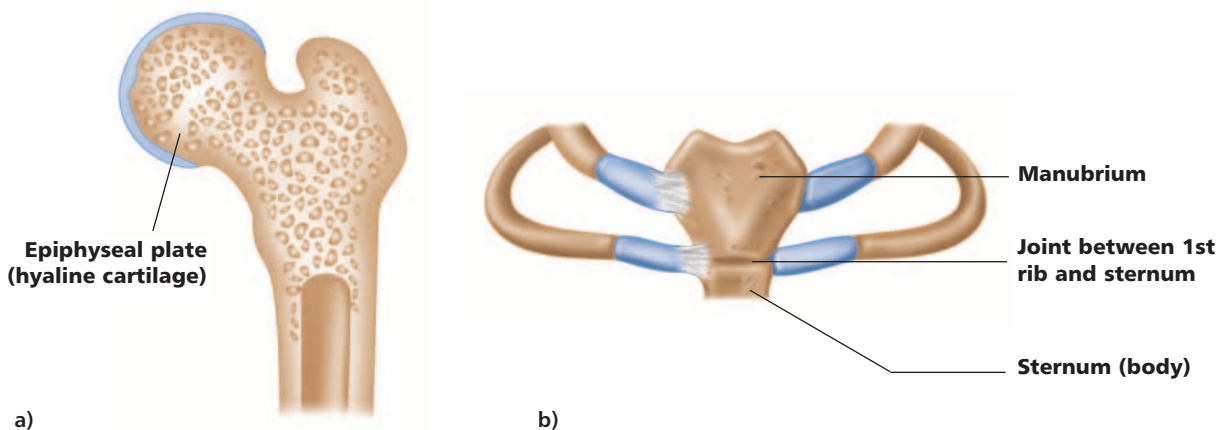


Figure 6.3: Cartilaginous immovable (synchondroses) joints (anterior view); a) the epiphyseal plate in a growing long bone, b) the sternocostal joint between manubrium and first rib.

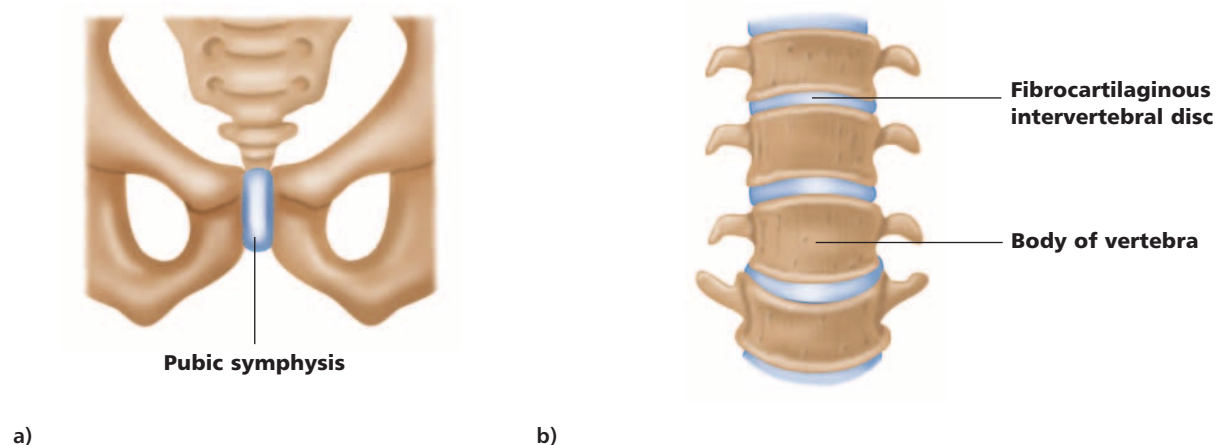


Figure 6.4: Cartilaginous slightly movable (amphiarthrotic / symphysis) joints (anterior view); a) pubic symphysis of the pelvic girdle, b) intervertebral joints.

Synovial Joints

Synovial joints possess a joint cavity that contains *synovial fluid*. They are freely movable, *diarthrotic*, joints. Synovial joints have a number of distinguishing features:

Articular cartilage (or *hyaline cartilage*): covers the ends of the bones that form the joint.

A joint cavity: this cavity is more a potential space than a real one, because it is filled with lubricating *synovial fluid*. The joint cavity is enclosed by a double-layered 'sleeve' or capsule known as the *articular capsule*.

The external layer of the articular capsule is known as the *capsular ligament*. It is a tough, flexible, fibrous connective tissue that is continuous with the periosteum of the articulating bones. The internal layer, or *synovial membrane*, is a smooth membrane made of loose connective tissue that lines the capsule and all internal joint surfaces other than those covered in hyaline cartilage.

Synovial fluid: a slippery fluid that occupies the free spaces within the joint capsule. Synovial fluid is also found within the articular cartilage and provides a film that reduces friction between the cartilages. When a joint is compressed by movement the fluid is forced out of the cartilage; when pressure is relieved the fluid rushes back into the articular cartilage. Synovial fluid nourishes the cartilage, which is *avascular* (contains no blood vessels); it also contains *phagocytic cells* (cells that eat dead matter) that rid the joint cavity of microbes or cellular waste. The amount of synovial fluid varies in different joints, but is always sufficient to form a thin film to reduce friction. During injury to the joint extra fluid is produced and creates the characteristic swelling of the joint. The synovial membrane later reabsorbs this extra fluid.

Collateral or accessory ligaments: synovial joints are reinforced and strengthened by a number of ligaments. These ligaments are either *capsular*, i.e. thickened parts of the fibrous capsule itself, or independent *collateral* ligaments that are distinct from the capsule. Ligaments always bind *bone to bone* and according to their position and quantity around the joint, they will restrict movement in certain directions, and prevent unwanted movement. As a general rule, the more ligaments a joint has, the stronger it is.

Bursae (sing. *bursa*) are fluid-filled sacs often found cushioning the joint. They are lined by synovial membrane and contain synovial fluid. They are found between tendons and bone, ligament and bone, or muscle and bone, and reduce friction by acting as a cushion.

Tendon sheaths are also frequently found in close proximity to synovial joints. They have the same structure as a bursa, and wrap themselves around tendons subject to friction, in order to protect them.

Articular discs (menisci) are present in some synovial joints. They act as shock absorbers (similar to the fibrocartilagenous disc in the pubic symphysis). For example, in the knee joint, two crescent-shaped fibrocartilage discs called the *medial* and *lateral menisci* lie between the medial and lateral condyles of the femur and the medial and lateral condyles of the tibia.

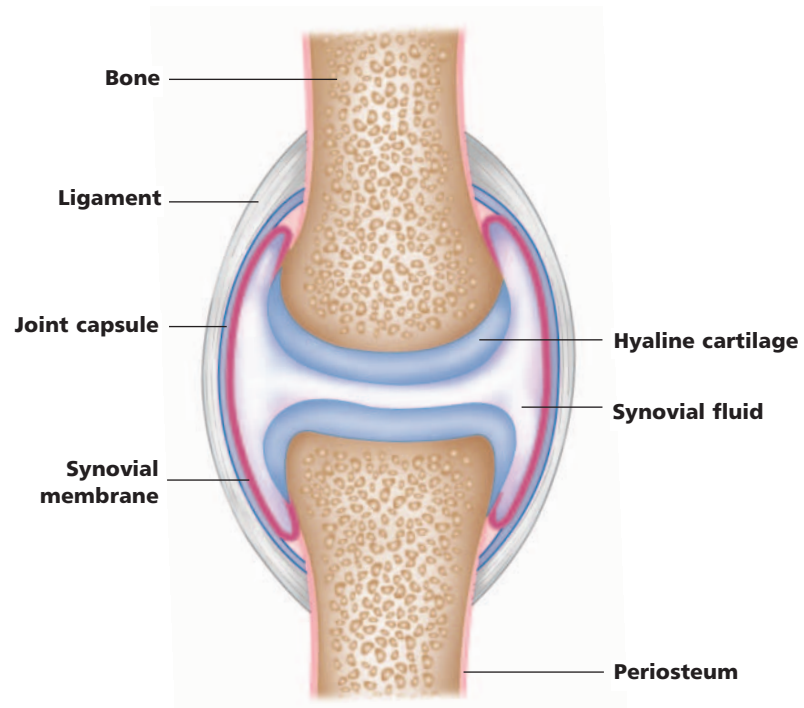
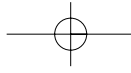


Figure 6.5: A typical synovial joint.

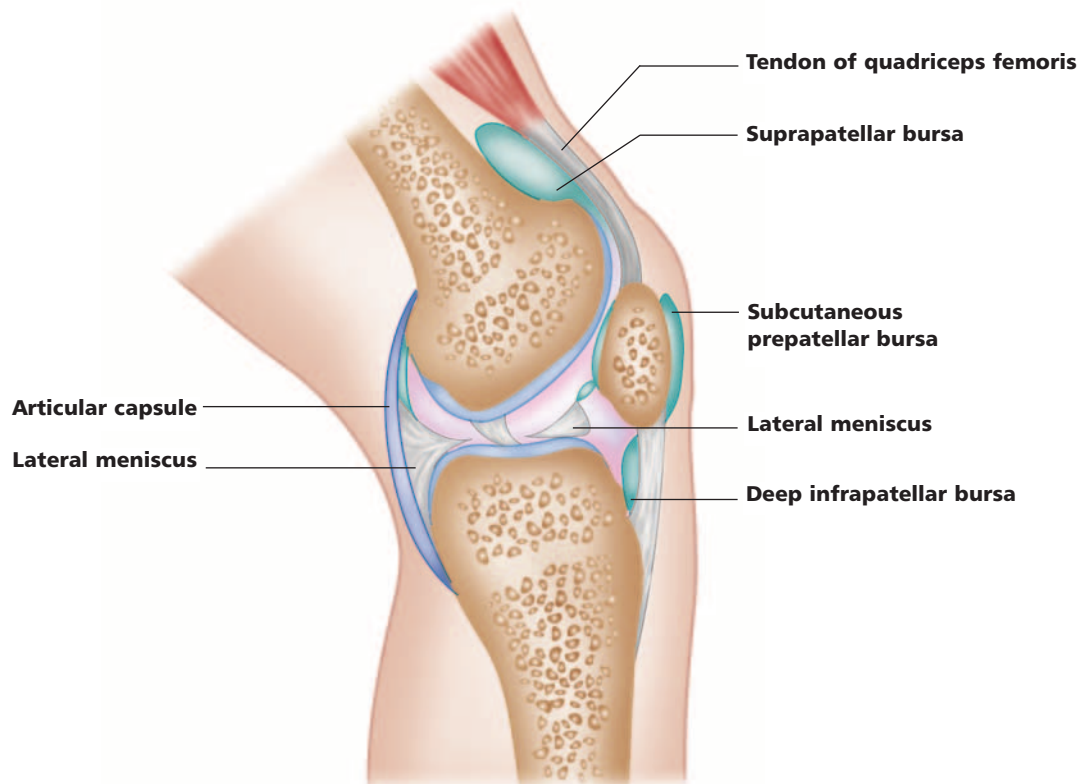
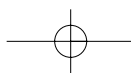
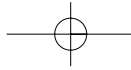


Figure 6.6: Shock absorbing and friction-reducing structures of a synovial joint.





The Seven Types of Synovial Joints

Plane or Gliding

In gliding joints, movement occurs when two, generally flat or slightly curved, surfaces glide across one another. Examples: the acromioclavicular joint; the joints between the carpal bones in the wrist, or the tarsal bones in the ankle; the facet joints between the vertebrae; the sacroiliac joint.

Hinge

In hinge joints, movement occurs around only one axis; a transverse one – as in the hinge of the lid of a box. A protrusion of one bone fits into a concave or cylindrical articular surface of another, permitting flexion and extension. Examples: the interphalangeal joints, the elbow, and the knee.

Pivot

In pivot joints, movement takes place around a vertical axis, like the hinge of a gate. A more or less cylindrical articular surface of bone protrudes into and rotates within a ring formed by bone or ligament. Examples: the dens of the axis protrude through the hole in the atlas, allowing the rotation of the head from side to side. Also, the joint between the radius and the ulna at the elbow allows the round head of the radius to rotate within a 'ring' of ligament that is secured to the ulna.

Ball and Socket

Ball and socket joints consist of a 'ball' formed by the spherical or hemispherical head of one bone that rotates within the concave socket of another, allowing flexion, extension, adduction, abduction, circumduction, and rotation. Thus, they are multiaxial and allow the greatest range of movement of all joints. Examples: the shoulder and the hip joints.

Condyloid

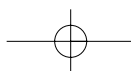
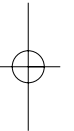
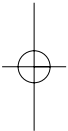
In common with ball and socket joints, condyloid joints have a spherical articular surface that fits into a matching concavity. Also, like ball and socket joints, condyloid joints permit flexion, extension, abduction, adduction, and circumduction. However, the disposition of surrounding ligaments and muscles prevent active rotation around a vertical axis. Examples: the metacarpophalangeal joints of the fingers (but not the thumb).

Saddle

Saddle joints are similar to condyloid joints, except that both articulating surfaces have convex and concave areas, and so resemble two 'saddles' that join them together by accommodating each other's convex to concave surfaces. Saddle joints allow even more movement than condyloid joints, for example, allowing the 'opposition' of the thumb to the fingers. Example: the carpometacarpal joint of the thumb.

Ellipsoid

An ellipsoid joint is effectively similar to a ball and socket joint, but the articular surfaces are ellipsoid instead of spherical. Movements as for ball and socket joints, with the exception of rotation. The shape of the ellipsoid surfaces prevents this. Example: the radio-carpal joint.



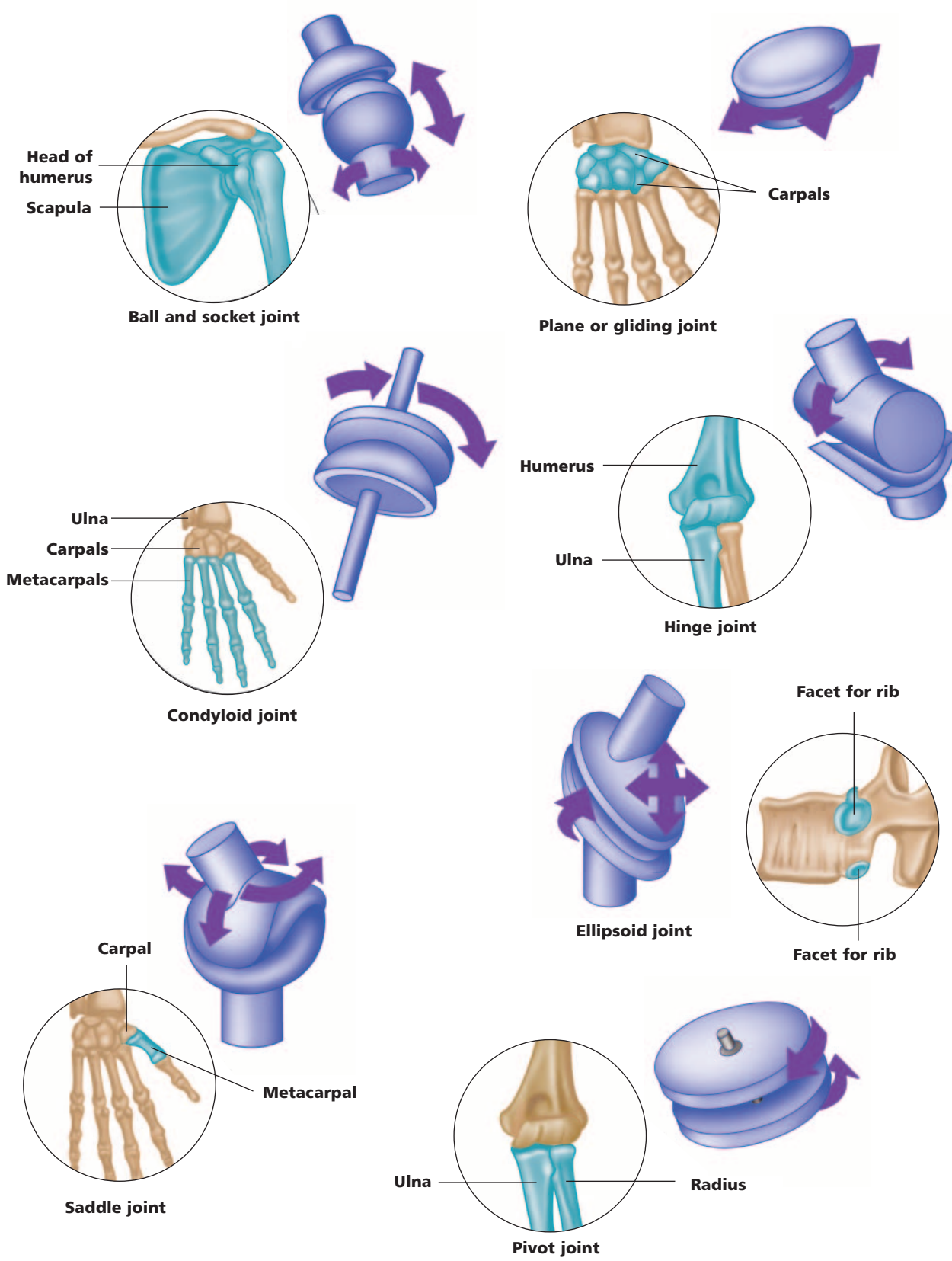
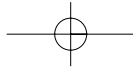
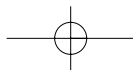


Figure 6.7: Types of synovial joints.



PART TWO – Features of Specific Joints

This section presents a relatively in-depth examination of four synovial joints: i.e. the shoulder, elbow, hip and knee joints. The other joints, of all classifications, are presented in less detail, with minimal accompanying text, but with fully labelled illustrations.

Notes About Synovial Joints:

- Some tendons run partly within the joint and are therefore intracapsular.
- The fibres of many ligaments are largely integrated with those of the capsule and the delineation between capsule and ligament is sometimes unclear. Therefore, only the main ligaments are mentioned.
- Ligaments are termed intracapsular (or intra-articular) when inside the joint cavity, and extracapsular (or extra-articular) when outside the capsule.
- Many ligaments of the knee joint are modified extensions or expansions of muscle tendons, but are classed as ligaments to differentiate them from the more regular stabilizing tendons, such as the patellar ligament from the quadriceps.
- Most synovial joints have various bursae in their vicinity, as shown in the illustrations pertaining to each joint.

Joints of the Head and Vertebral Column

Temporomandibular Joint

Type of Joint

Synovial hinge joint, plus a plane joint.

Articulation

The head of the mandible articulates with the mandibular fossa and the articular tubercle of the temporal bone. A fibrous disc separates the articular surfaces and moulds itself upon them when the joint moves.

Movements

This is the only movable joint in the head. Movement can occur in all three planes: upwards and downwards, backwards and forwards, and from side to side. A gliding action occurs superior to the disc. A hinge action occurs inferior to the disc.

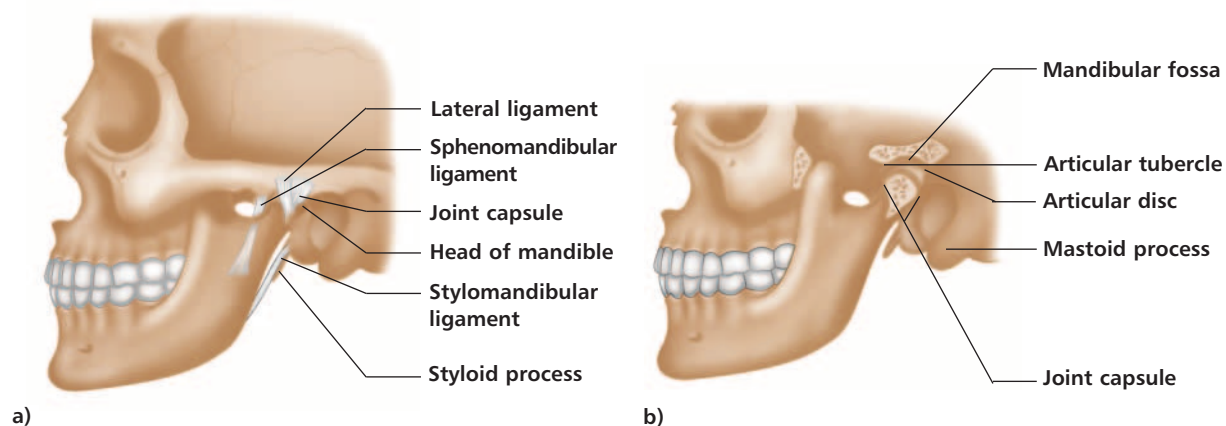


Figure 6.8 (a & b): The temporomandibular joint (lateral view).

Atlanto-occipital Joint

Type of Joint

The articulations of the two sides act together functionally as a synovial ellipsoid joint.

Articulation

Between the occipital condyles and the superior articular facets of the atlas.

Movements

Flexion and extension (as in nodding the head). Lateral flexion.

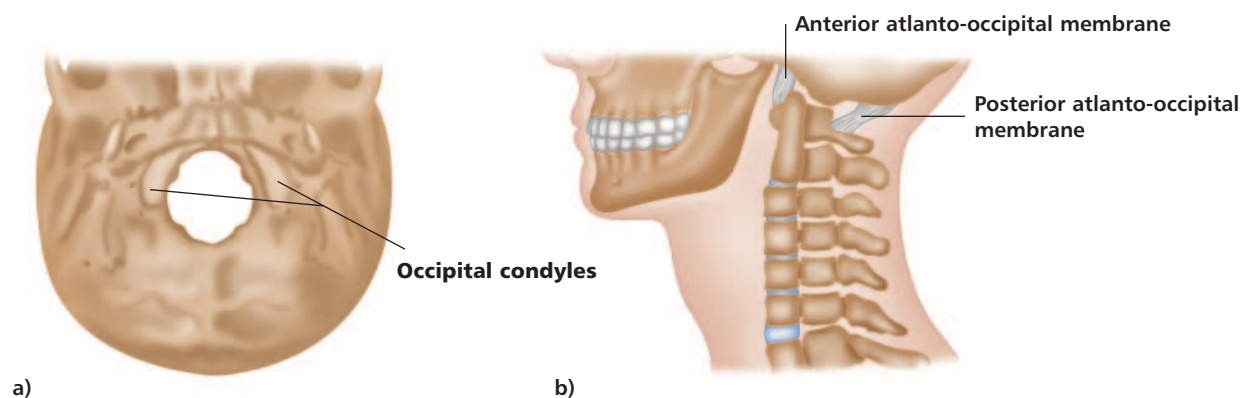


Figure 6.9: The atlanto-occipital joint; a) inferior view, b) lateral view.

Atlanto-axial Joint

Type of Joint

Lateral atlanto-axial joint: Synovial plane.

Median (sagittal) atlanto-axial joint: Synovial pivot.

Articulation

Lateral atlanto-axial joint: Between the opposed articular processes of the atlas and axis.

Median (sagittal) atlanto-axial joint: Between the dens of the axis and the anterior arch of the atlas, and with the transverse ligament.

Movements

Rotation of the head around a vertical axis (the skull and the atlas moving as one).

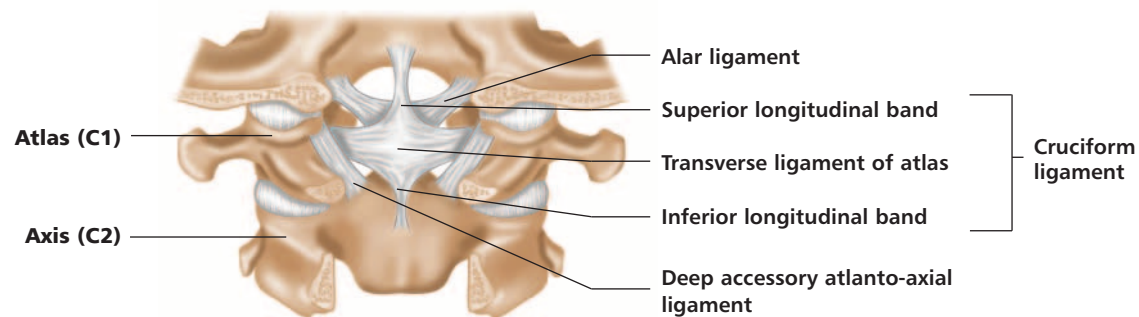


Figure 6.10: The atlanto-axial joint (posterior view).

Joints Between Vertebral Bodies

Type of Joint

Cartilaginous symphysis (slightly movable).

Articulation

Between adjacent surfaces of vertebral bodies, and united by a fibrocartilaginous intervertebral disc.

Movements

Only slight movement occurs between any two successive vertebrae, but there is considerable movement throughout the column as a whole.

Cervical region: Flexion, extension, lateral flexion with rotation, (i.e. lateral flexion cannot occur without an element of rotation and vice versa).

Thoracic region: Rotation, always associated with an element of lateral flexion, and vice versa. Only extremely slight flexion and extension can occur (limited by presence of ribs and sternum).

Lumbar region: Flexion, extension. Only extremely slight rotation can occur (restricted by the angle of the articular processes).

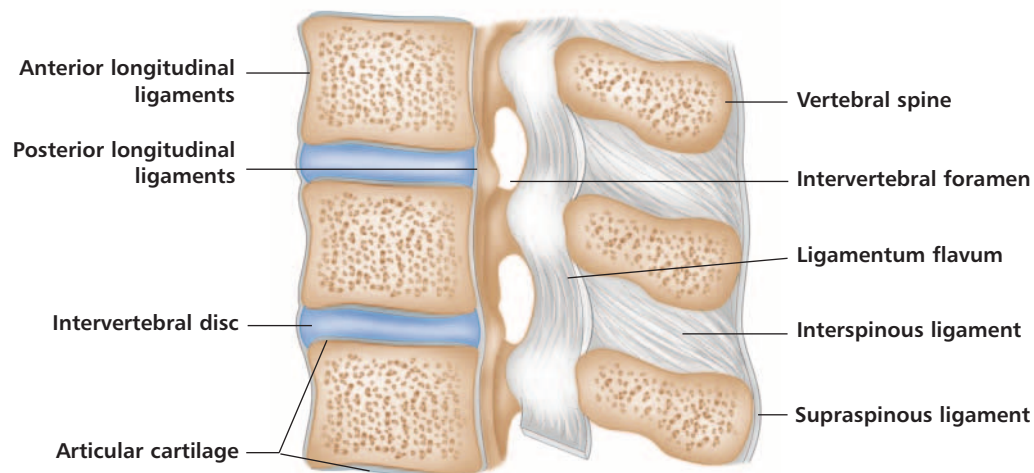


Figure 6.11a: Sagittal section through 2nd to 4th lumbar vertebrae.

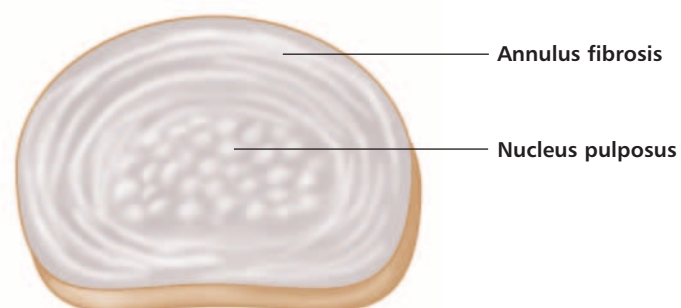


Figure 6.11b: Transverse section of a lumbar intervertebral disc.

Joints Between Vertebral Arches

Type of Joint

Synovial plane.

Articulation

Between opposed articular processes of adjacent vertebrae, to unite adjacent vertebral arches.

Movements

Only slight movement occurs between any two successive vertebrae, but there is considerable movement throughout the column as a whole.

Cervical region: Flexion, extension, lateral flexion with rotation, (i.e. lateral flexion cannot occur without an element of rotation and vice versa).

Thoracic region: Rotation, always associated with an element of lateral flexion, and vice versa. Only extremely slight flexion and extension can occur (limited by presence of ribs and sternum).

Lumbar region: Flexion, extension. Only extremely slight rotation can occur (restricted by the angle of the articular processes).

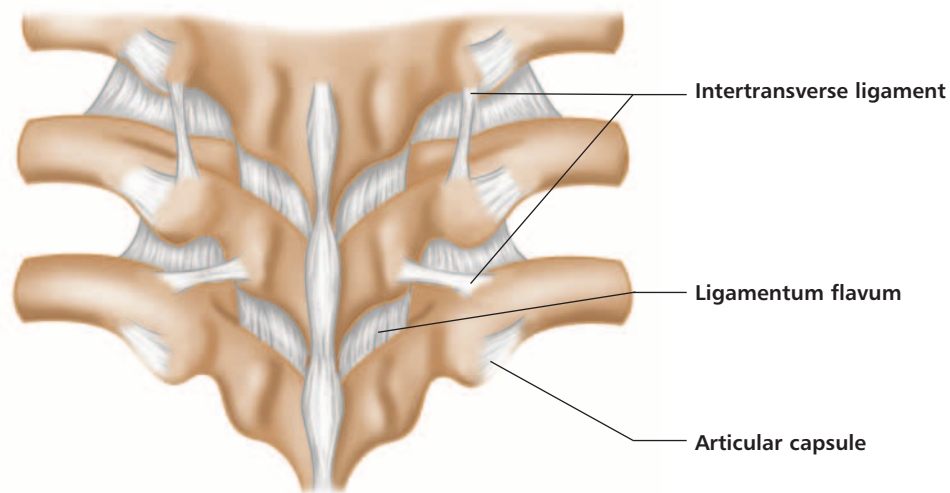


Figure 6.12: A typical vertebral arch joint (posterior view).

Joints of the Ribs and Sternum

Costovertebral Joints

Type of Joint

Joints of the heads of ribs (capitular joints): Synovial plane.

Costotransverse joints: Synovial plane.

Articulation

Joints of the heads of ribs (capitular joints): Superior and inferior articular facets on the head of each typical rib articulate with the facets on two adjacent vertebral bodies (i.e. the rib's head sits between two vertebral bodies, and also against a shallow depression on the intervertebral disc).

Costotransverse joints: The tubercle of each typical rib articulates with the transverse process of the lower of the two vertebrae to which its head is joined (but ligaments attach it to the transverse processes of both vertebrae).

NOTE: The first rib and last two or three ribs have atypical vertebral connections, because the head of these ribs have only one facet, not two; and therefore articulate with one vertebral body rather than two. The tubercles of the lowest ribs do not form synovial joints with the transverse processes.

Movements

The capitular and costotransverse joints of each rib together form a hinge, causing the anterior part of the rib to be raised (with some lateral 'expansion') during inspiration, and lowered (with some medial 'contraction') during expiration. This effectively increases and decreases the anteroposterior and transverse diameters of the thorax with each in-breath and out-breath.

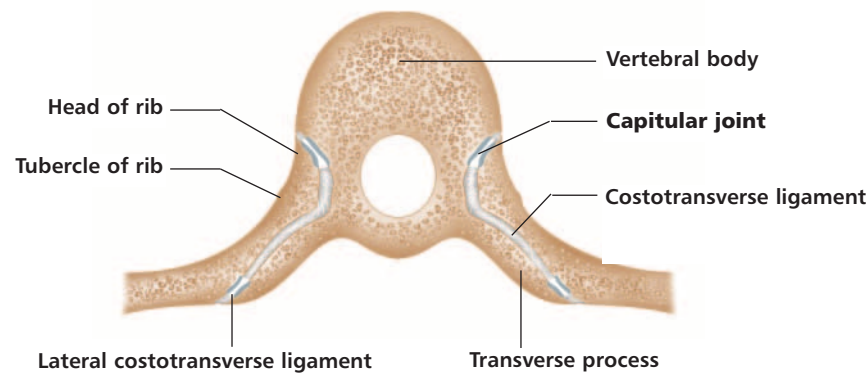


Figure 6.13a: Transverse section through a typical costovertebral joint.

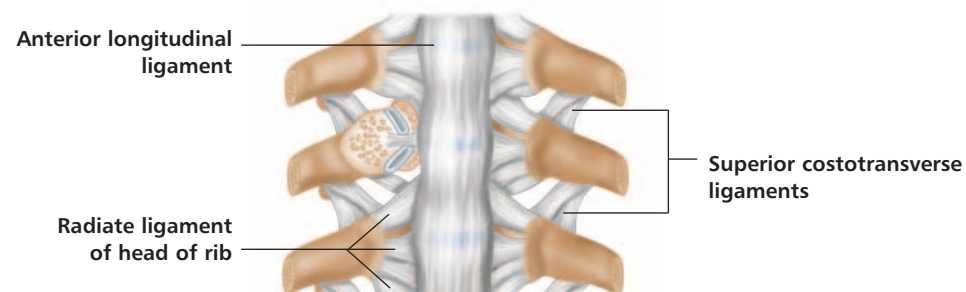


Figure 6.13b: The costovertebral joint (anterior view).

Sterncostal Joints

The hyaline cartilage that is continuous with the anterior end of each rib is called the *costal cartilage*.

Type of Joint

First rib: Cartilaginous immovable (synchondrosis).

Ribs 2–7: Simple synovial plane.

Ribs 8–10: Simple synovial plane articulations at interchondral joints.

Articulation

First rib: Via costal cartilage to the body of the sternum.

Ribs 2–7: Via costal cartilages to facets on the side of the body of the sternum. The joint cavities are divided in two by an intra-articular ligament (until cavities disappear in old age).

Ribs 8–10: Their costal cartilages unite with the costal cartilage of rib 7.

Ribs 11–12: Do not articulate anteriorly, but end freely in the muscles of the flank. They are therefore called floating ribs.

Movements

Enables expansion and contraction of the ribcage, as described under costovertebral joints (*see* page 83).

Sternal Joints

Type of Joint

Manubriosternal joint: Similar in appearance to a cartilaginous symphysis (slightly movable) joint.

Xiphisternal joint: Cartilaginous immovable (synchondrosis). Usually becomes ossified in old age.

Articulation

Manubriosternal joint: Between the manubrium and body of the sternum, adjacent to the second costal cartilage.

Xiphisternal joint: Between the body of the sternum and the xiphoid process. This joint marks the inferior extent of the thoracic cavity.

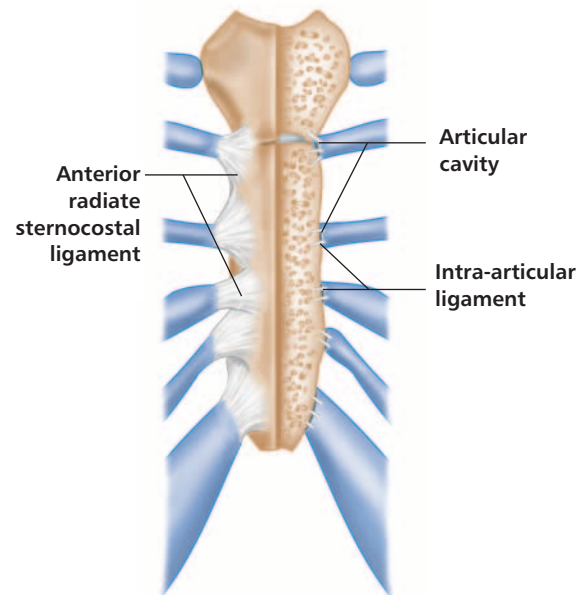


Figure 6.14: The sternocostal joint (anterior view).

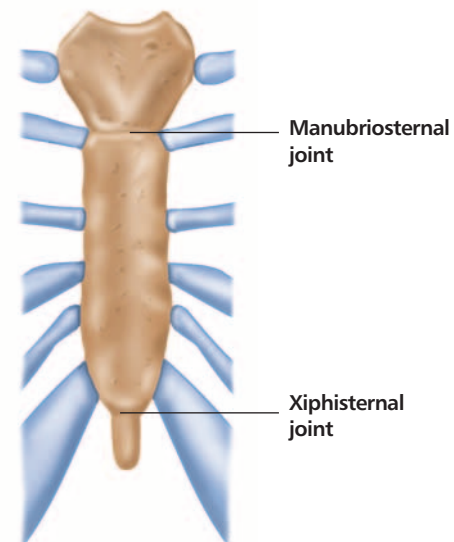


Figure 6.15: The sternal joints (anterior view).

Joints of the Shoulder Girdle and Upper Limb

Sternoclavicular Joint

Type of Joint

Functionally, a synovial ball and socket joint. But unlike most articular surfaces, the articular cartilage is fibrocartilage rather than hyaline cartilage.

Articulation

Between the sternal (medial) end of the clavicle, the clavicular notch of the manubrium, and the costal cartilage of the first rib.

NOTE: A fibrocartilage articular disc separates the joint space into two separate synovial cavities.

Movement

Like other ball and socket joints, movement occurs in all planes, but anteroposterior movement and rotation is slightly restricted. It is involved in the collective movements of the shoulder girdle.

Acromioclavicular Joint

Type of Joint

Synovial plane.

Articulation

Between the lateral end of the clavicle, and the medial border of the acromion of the scapula.

NOTE: A fibrocartilage articular disc partially divides the articular cavity, although it is sometimes absent.

Movement

It is involved in the collective movements of the shoulder girdle, enabling the scapula to change its position in relation to the clavicle.

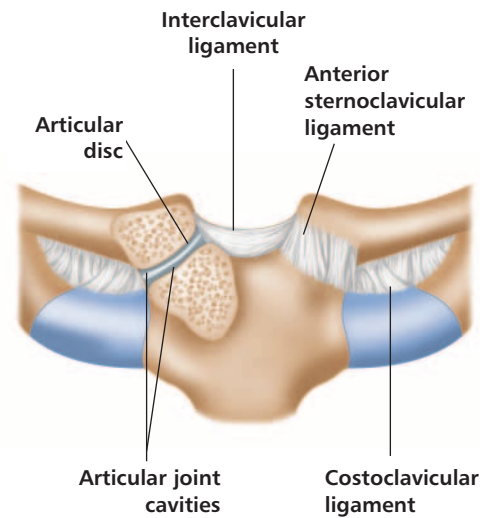


Figure 6.16: The sternoclavicular joint (anterior view).
Note: Posterior aspect of joint has a posterior sternoclavicular ligament similar, but weaker, than anterior sternoclavicular ligament.

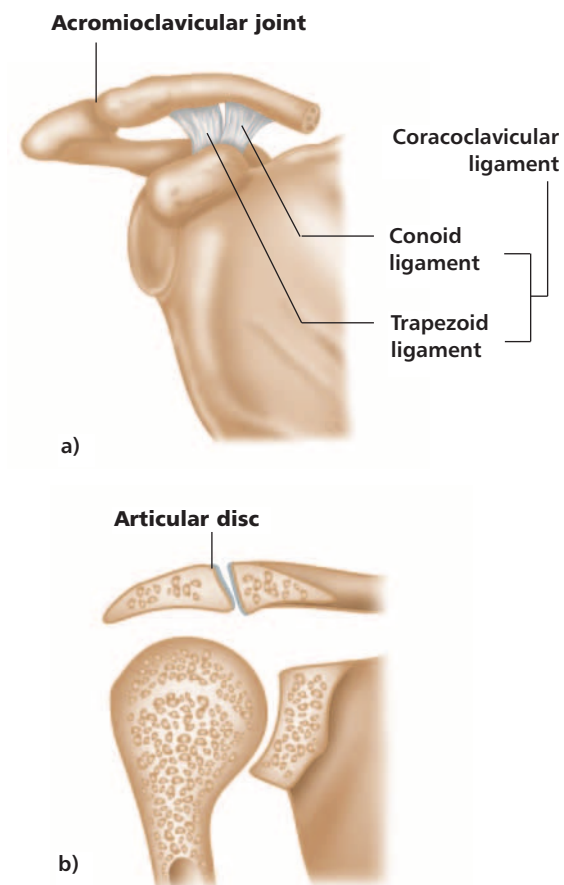


Figure 6.17: The acromioclavicular joint;
a) anterior view, b) coronal view.

Shoulder (Glenohumeral) Joint

Type of Joint

Synovial ball and socket.

Articulation

The head of the humerus articulates with the shallow pear shaped glenoid cavity (fossa) of the scapula. This articulation is inherently unstable due to the glenoid cavity being only approximately one-third the size of the humeral head, although it is slightly deepened by a rim of fibrocartilage called the *glenoid labrum* or *labrum glenoidale* (triangular in cross-section). The shoulder joint is the most freely moving joint of the body, precisely because stability has been sacrificed to enable maximum range of movement.

Articular Capsule

Extends from the margin of the glenoid cavity (including part of the labrum), to the anatomical neck of the humerus. The thin capsule is very loose, thus enabling maximum movement of the joint. When the arm is by the side, the lower part of the capsule hangs in a loose fold, which becomes progressively more taut as the arm is abducted; increasingly so if the arm continues into elevation. The capsule contributes very little to the stability of the joint. The surrounding muscles, whose attachments are intimately related to the capsule, largely supply joint stability.

Ligaments

Transverse humeral ligament: Spans the gap between the humeral tubercles. It holds the long head of the biceps brachii in the intertubular sulcus as it leaves the joint.

Glenohumeral ligament: Three slightly thickened bands of longitudinal fibres on the internal surface of the anterior part of the capsule. May be absent.

Coracohumeral ligament: Extends from the coracoid process of the scapula to the upper part of the anatomical neck of the humerus. It greatly reinforces the capsule superiorly and slightly anteriorly.

Coraco-acromial ligament: This ligament is totally unconnected to the articular capsule. It forms a shelf above the joint, running between the coracoid process and the acromion process of the scapula.

Various bursae are associated with the shoulder joint. The most important is the subacromial bursa that separates the coraco-acromial ligament from the supraspinatus tendon located above the shoulder joint.

Stabilizing Tendons

Long head of biceps brachii tendon: Runs from the superior aspect of the glenoid labrum to enter and travel within the joint cavity, thus travelling within the articular capsule (hence it is covered with a sheath of synovial membrane). On leaving the cavity, it enters the intertubular groove of the humerus. Its location secures the head of the humerus tightly against the glenoid cavity, thereby acting as a steadying influence during movements of the shoulder joint.

Rotator cuff tendons: The four rotator cuff tendons (supraspinatus, infraspinatus, teres minor, and subscapularis) encircle the joint and fuse with the articular capsule. Consequently, the rotator cuff muscles or tendons are prone to injury if the joint is vigorously circumducted, as in throwing a ball.

NOTE: Because overall, the reinforcements of the shoulder joint are weakest inferiorly, the humerus is more prone to dislocate downwards.

Movements

Flexion, extension, abduction, adduction, medial and lateral rotation, circumduction, plus elevation through flexion and abduction (see pp. 14–16, 19).

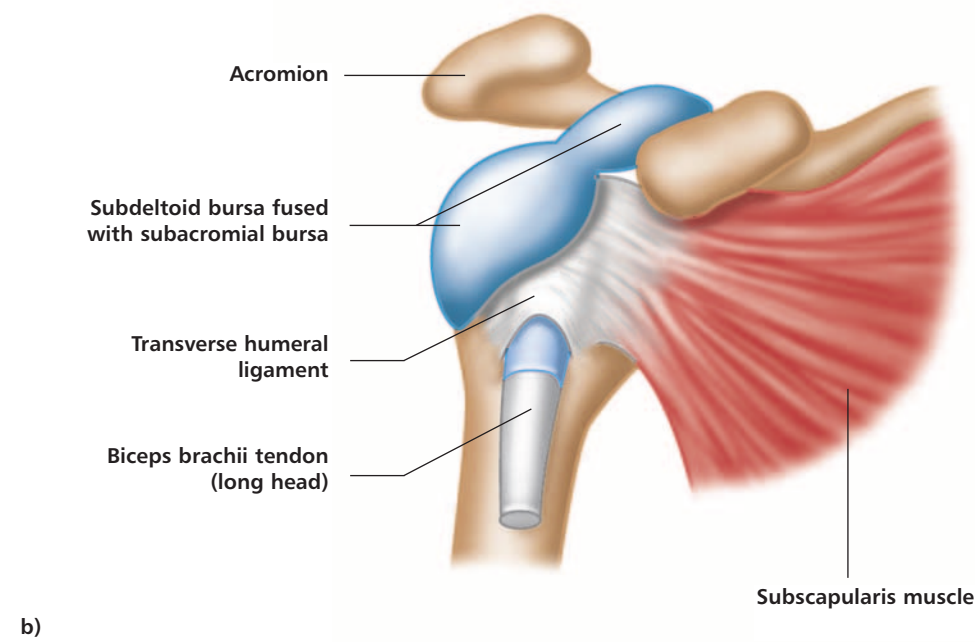
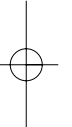
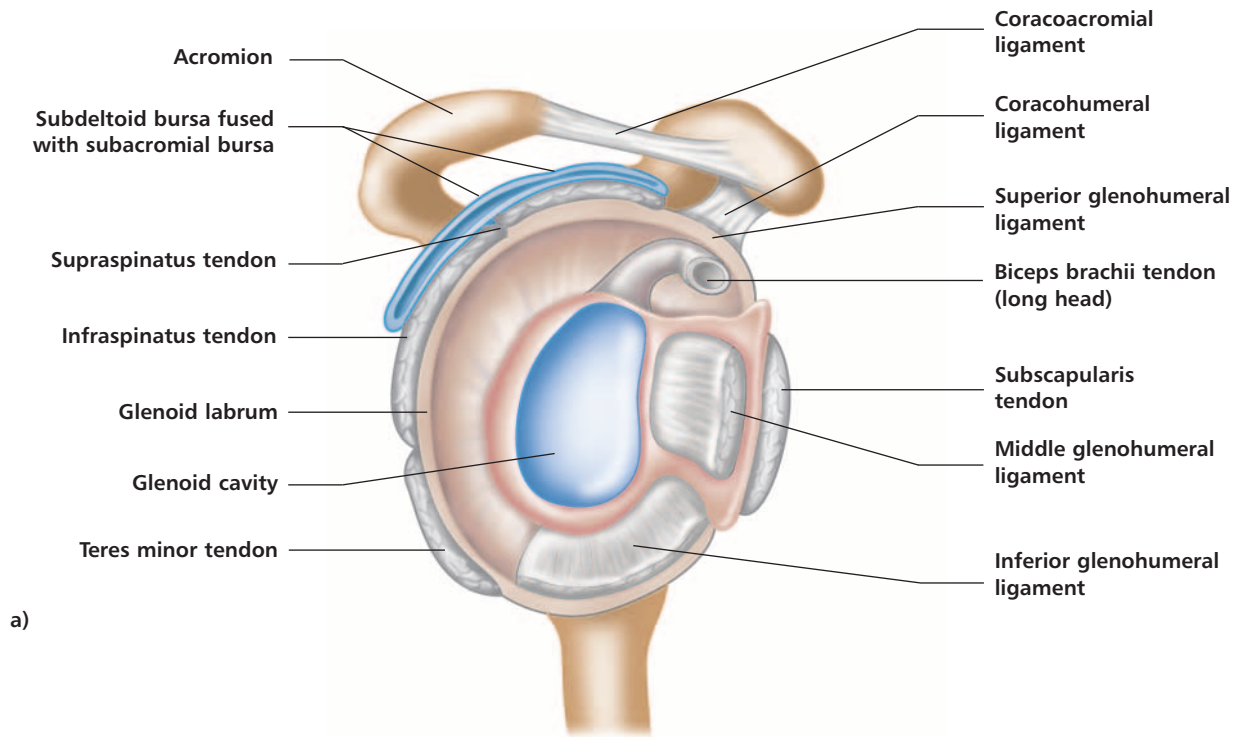
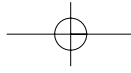
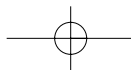


Figure 6.18: The shoulder joint; a) right arm, lateral view, b) right arm, anterior view (cut).



Elbow Joint

Type of Joint

Synovial hinge (ginglymus).

Articulation

Upper surface of the head of the radius articulates with the capitulum of the humerus. The trochlear notch of the ulna articulates with the trochlea of the humerus (which constitutes the 'hinge' mechanism and the main stabilizing factor).

Articular Capsule

The relatively loose articular capsule extends from the coronoid and olecranon fossae of the humerus to the coronoid and olecranon processes of the ulna, and to the annular ligament enclosing the head of the radius. The capsule is thin anteriorly and posteriorly to allow flexion and extension, but is strengthened on each side by collateral ligaments.

Ligaments

Ulnar (medial) collateral ligament: Three strong bands reinforcing the medial side of the capsule.

Radial (lateral) collateral ligament: A strong triangular ligament reinforcing the lateral side of the capsule.

Stabilizing Tendons

The tendons of the biceps brachii, triceps brachii, brachialis, plus many muscles located on the forearm: These tendons cross the elbow joint and provide extra security.

Movements

Flexion and extension only.

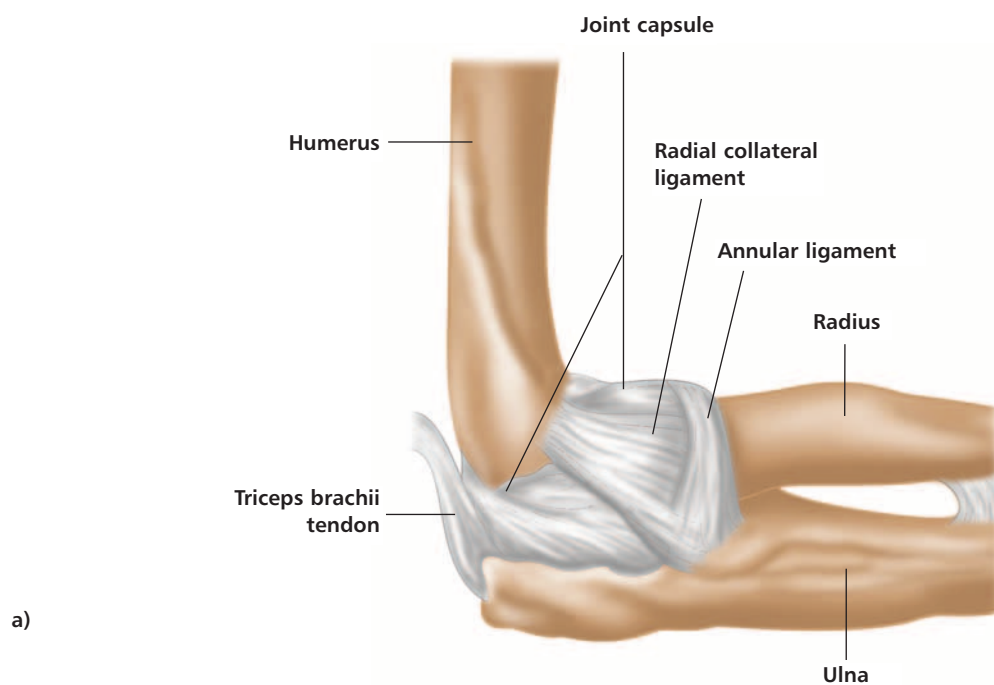


Figure 6.19: The elbow joint; a) right arm, lateral view.

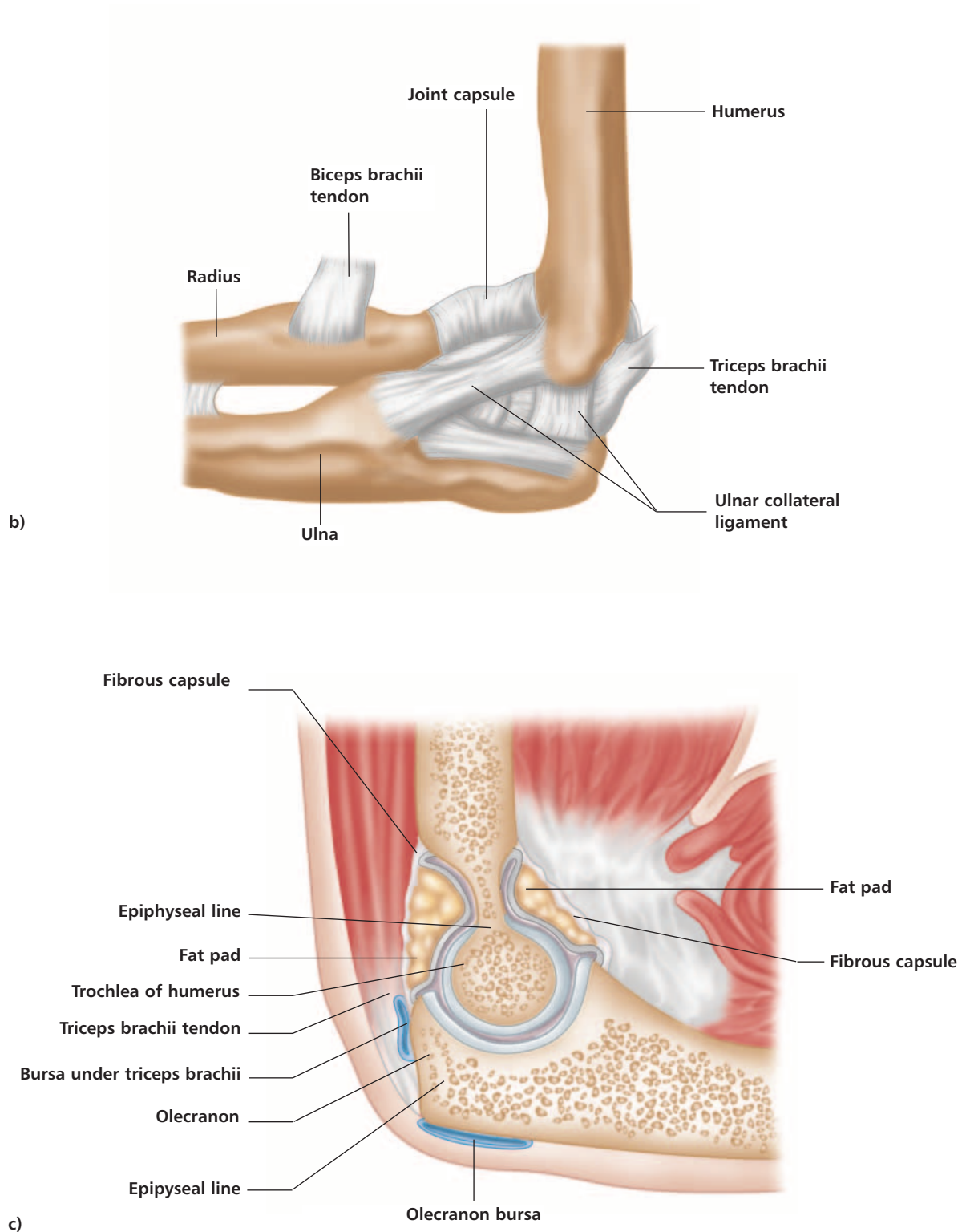
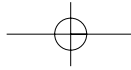
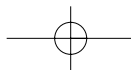


Figure 6.19: The elbow joint; b) right arm, medial view, c) right arm, mid-sagittal view.



Proximal Radio-ulnar Joint

Type of Joint

Synovial pivot.

Articulation

The disc shaped head of the radius rotates within a ring formed by the radial notch on the ulna and the annular ligament of the radius.

NOTE: The synovial cavity of this joint is continuous with that of the elbow joint.

Movements

Pronation and supination of the forearm.

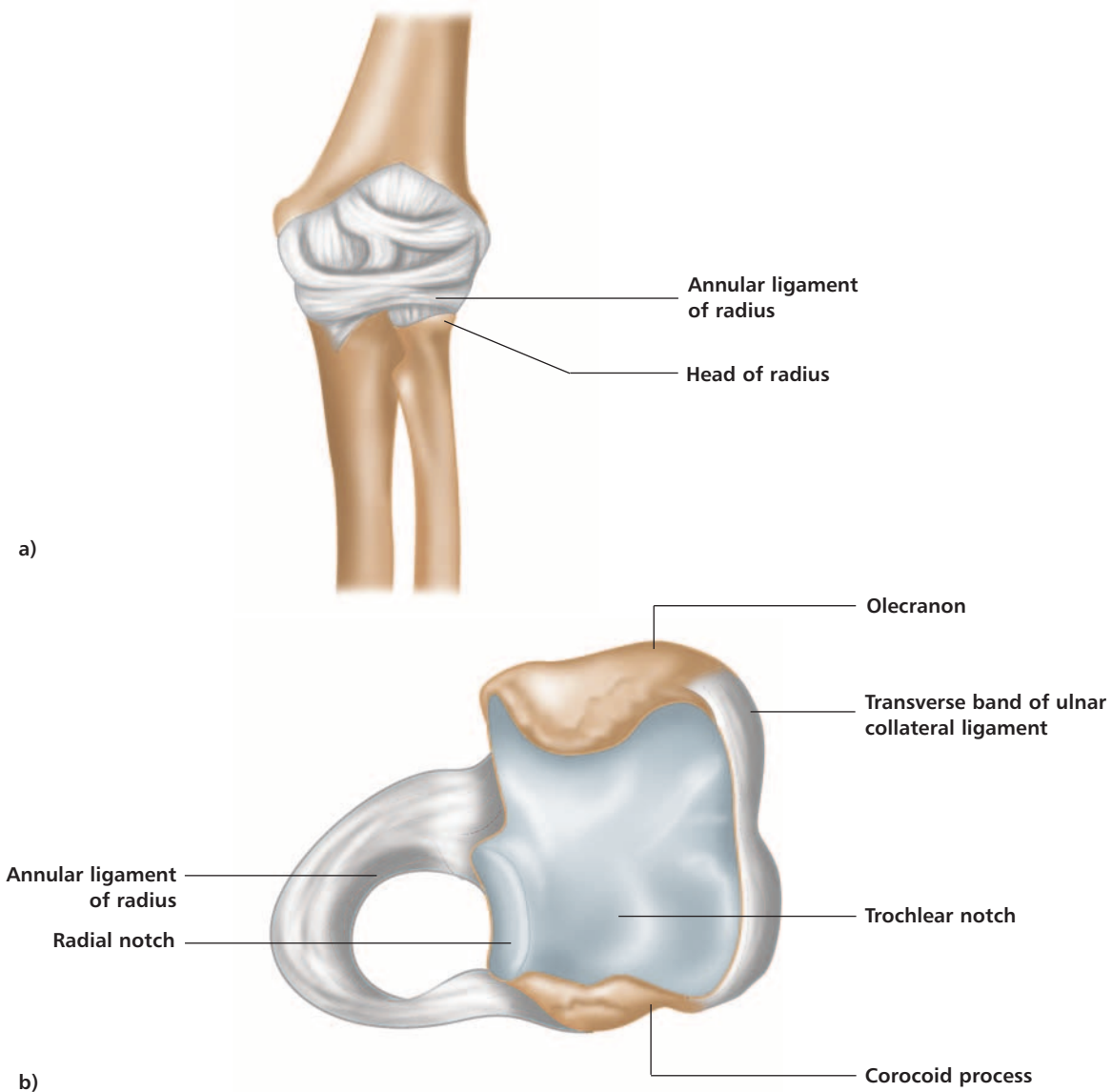


Figure 6.20: The proximal (superior) radio-ulnar joint; a) left arm, anterior view, b) left arm, superior view.

Distal Radio-ulnar Joint

Type of Joint

Synovial pivot.

Articulation

Between the head of the ulna, and the ulnar notch of the radius.

NOTE: A fibrocartilage articular disc unites the styloid process of the ulna and the medial side of the distal radius.

Movements

Pronation and supination of the forearm.

Intermediate Radio-ulnar Joint

Type of Joint

Syndesmosis.

Articulation

Connects the interosseous border of the radius with the interosseous border of the ulna, via the interosseous membrane. Also, a slender fibrous band called the *oblique cord* connects the ulnar tuberosity to the proximal end of the shaft of the radius.

Function

Increases the surface of origin of the deep forearm muscles; helps bind the radius and ulna together; and transmits to the ulna any force passing upwards from the hand along the radius.

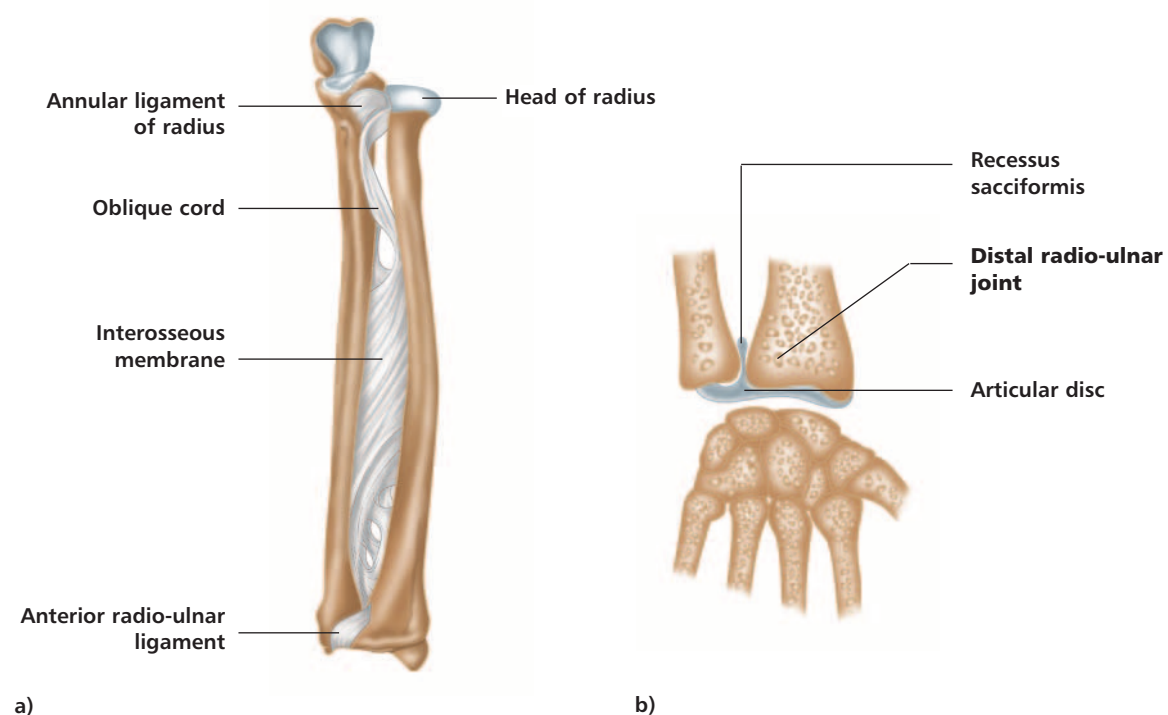


Figure 6.21: The distal and intermediate radio-ulnar joints; a) left arm, anterior view, b) left arm / hand, coronal view.

Radio-carpal Joint (Wrist Joint)

Type of Joint

Synovial ellipsoid.

Articulation

The distal surface of the radius and the articular disc (the same disc as described with the distal radio-ulnar joint, *see* page 91) articulates with the proximal row of carpals, which are the scaphoid, lunate and triquetral (triquetrum).

Movements

Movements are in combination with the intercarpal joints: flexion, extension, adduction (ulnar deviation), abduction (radial deviation) and circumduction.

Intercarpal Joints

Type of Joint

A series of synovial plane joints.

Articulation

This joint has articulations between the two carpal rows (midcarpal joint), plus articulations between each bone of the proximal carpal row and of the distal carpal row.

Movements

Movements are in combination with the radio-carpal joint: flexion, extension, adduction (ulnar deviation), abduction (radial deviation) and circumduction.

Carpometacarpal Joint of the Thumb

Type of Joint

Synovial saddle joint.

Articulation

Between the trapezium and the base of the first metacarpal bone (the thumb).

Movements

Flexion, extension, abduction, and adduction. At the extreme range of flexion, the first metacarpal medially rotates so that the palmar surface of the thumb becomes opposed to the pads of the fingers. Conversely, slight lateral rotation occurs when the thumb approaches full extension. Combining these movements create approximate circumduction of the thumb.

Common Carpometacarpal Joint

Type of Joint

Synovial plane.

Articulation

Between the distal row of carpal bones and the bases of the medial four metacarpal bones of the hand.

Movements

Very little movement is possible. However, the articulation at the fifth metacarpal with the hamate is a flattened saddle joint, allowing slight opposition of the little finger across the palm.

Intermetacarpal Joints

Type of Joint

Synovial plane.

Articulation

Between adjacent sides of the bases of metacarpal bones 2–5.

Movements

Limited movement between adjacent metacarpals.

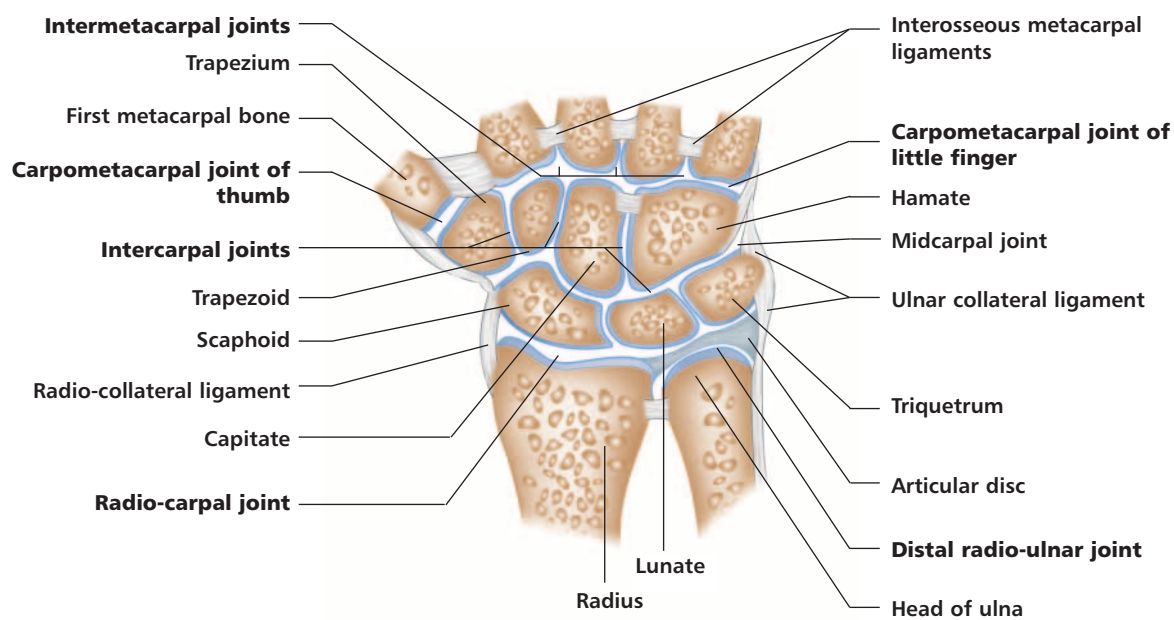


Figure 6.22: The radio-carpal (wrist), intercarpal, carpometacarpal and intermetacarpal joints (coronal view).

Metacarpophalangeal Joints

Type of Joint

Synovial condyloid.

Articulation

Between the head of a metacarpal and the base of a proximal phalanx.

NOTE: The capsule is deficient on the dorsal aspect, where it is replaced by an expansion of the long extensor tendon.

Movements

Flexion and extension. Abduction and adduction (possible only in extension, but with very little movement at the thumb). Combined movements may produce circumduction.

Interphalangeal Joints

Type of Joint

Synovial hinge.

Articulation

Between the proximal and middle phalanges (proximal interphalangeal joint, abbreviated PIP), or the middle and distal phalanges (distal interphalangeal joint, abbreviated DIP).

Movements

Flexion and extension.

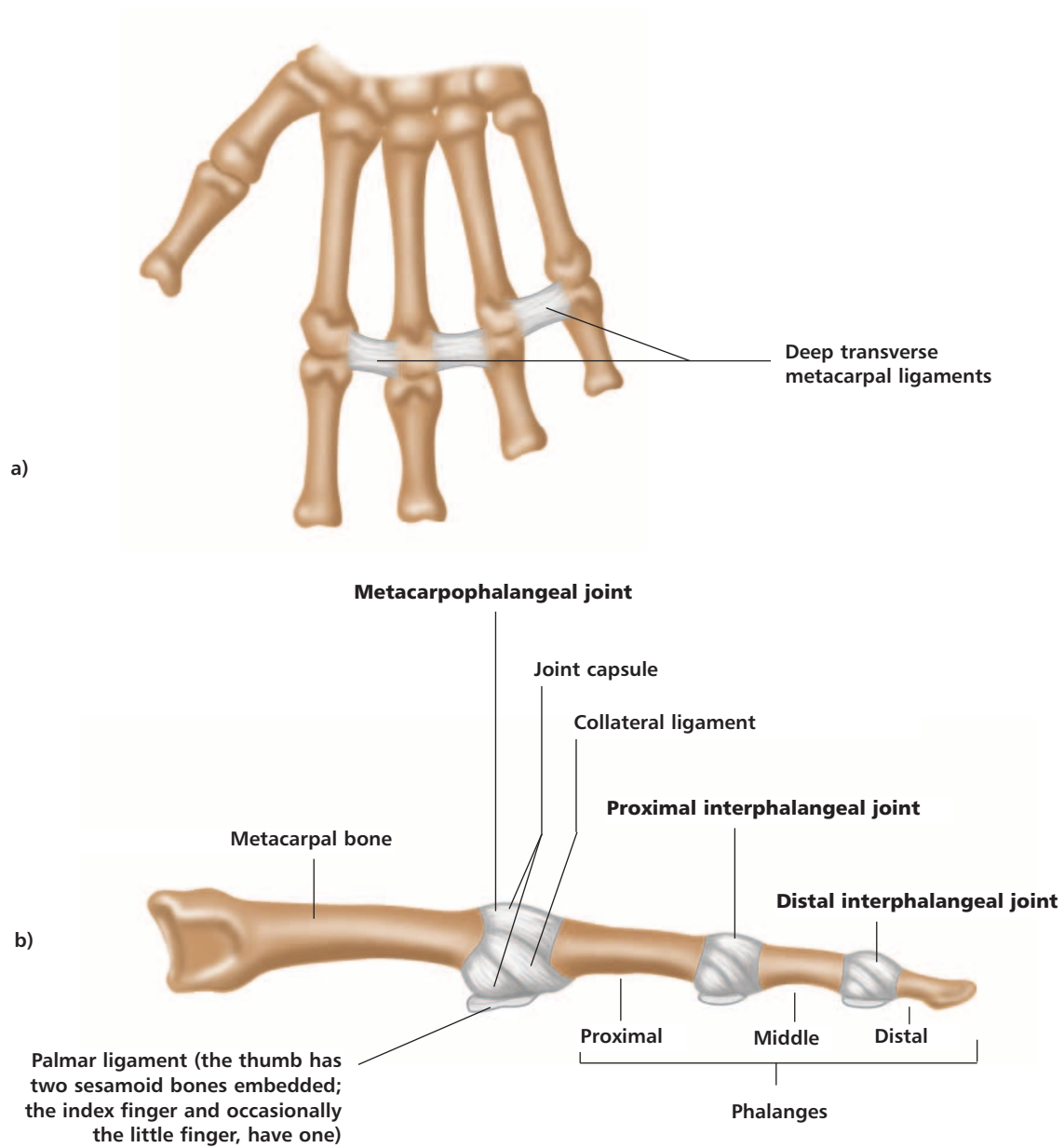


Figure 6.23: The metacarpophalangeal and interphalangeal joints; a) anterior view, b) medial view.

Joints of the Pelvic Girdle and Lower Limb

Lumbosacral and Sacrococcygeal Joints

Type of Joint

Both joints: cartilaginous symphysis (slightly movable).

Articulation

Lumbosacral: Between the fifth lumbar vertebra (L5) and the body of the first sacral segment (S1). This joint has the same features as other typical intervertebral joints, with the addition of the iliolumbar ligament.

Sacrococcygeal: Between the last sacral and first coccygeal segments. It is reinforced all round by the sacrococcygeal ligaments.

NOTE: Both joints contain a fibrocartilaginous intervertebral disc.

Movements

The lumbosacral joint contributes to the collective movements of the lumbar vertebral joints. The sacrococcygeal joint has very little functional movement, and is often partially or fully obliterated in old age.

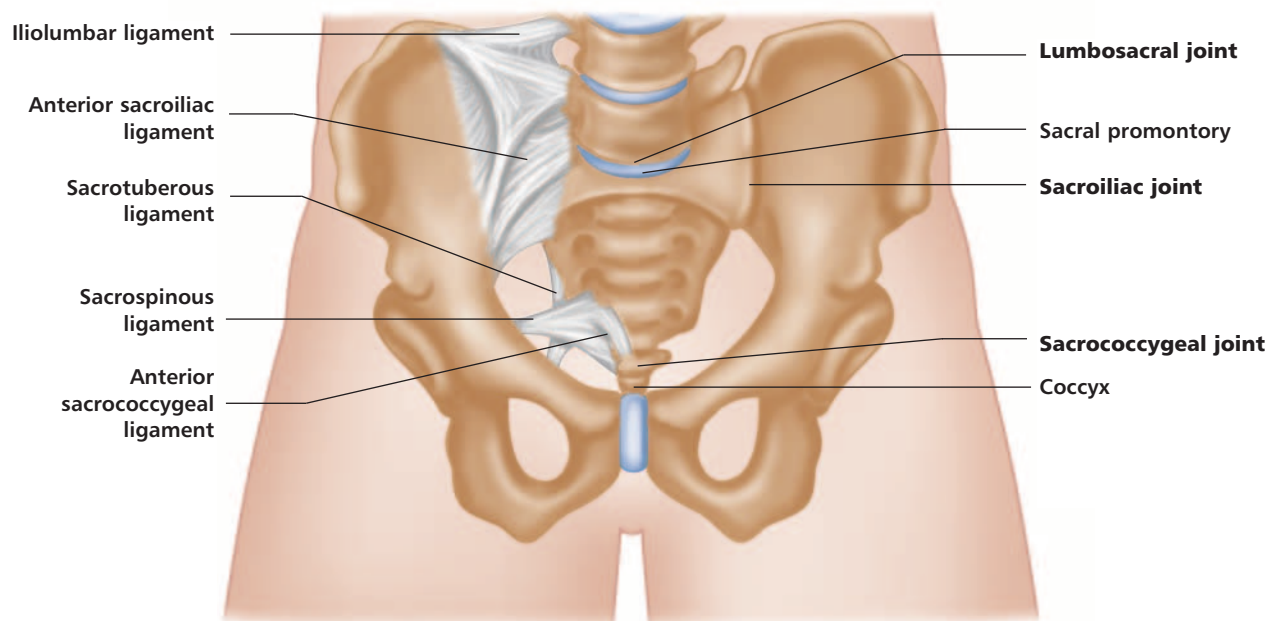


Figure 6.24: The lumbosacral, sacroiliac and sacrococcygeal joints (anterior view).

Sacroiliac Joint

Type of Joint

A synovial joint with pronounced irregular depressions and tubercles on the articular surfaces.

NOTE: The articular surface of the sacrum is hyaline cartilage, but that of the ilium is usually of the fibrous type.

Articulation

Between the auricular surfaces on the sacrum and the iliac bone.

Movements

Very limited movements occur because of the irregular joint surfaces and the strong sacroiliac ligaments.

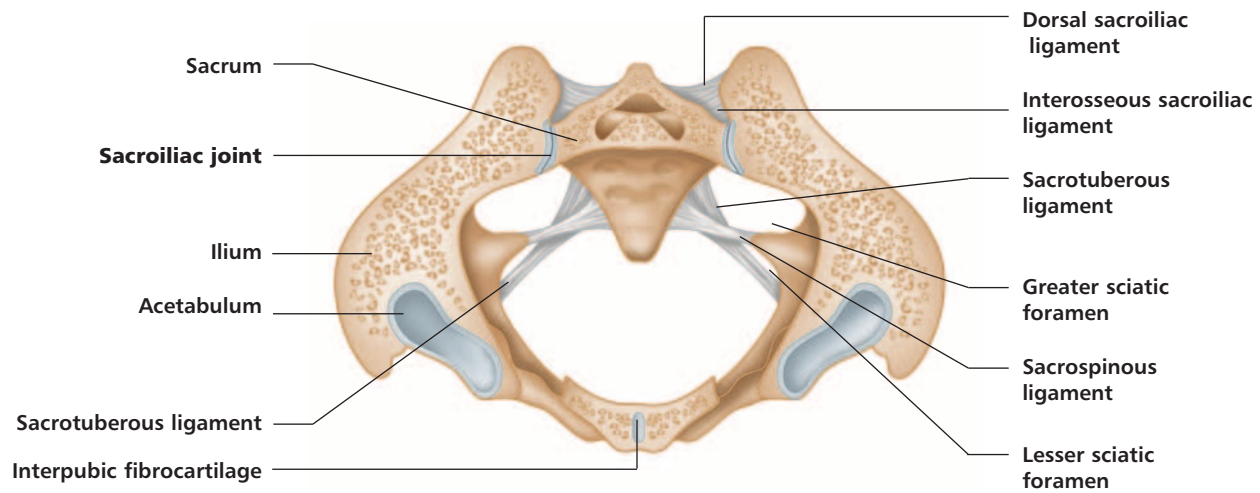


Figure 6.25: Transverse section of pelvis.

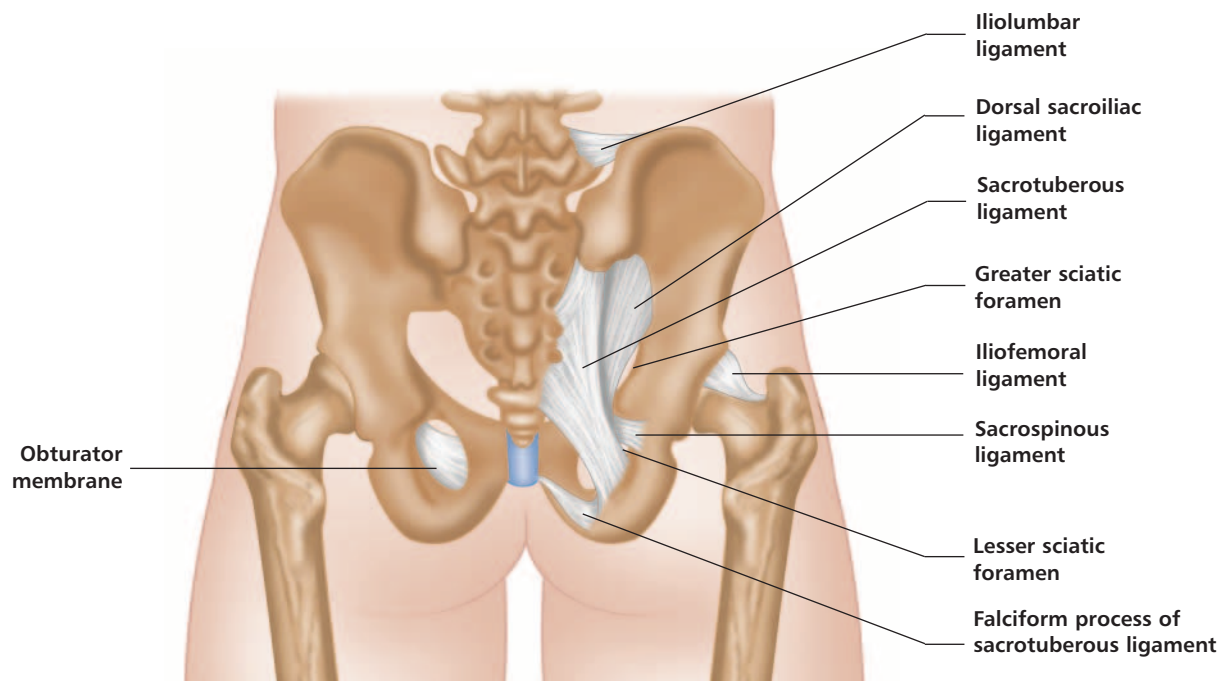
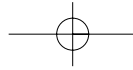


Figure 6.26: Pelvic ligaments (posterior view).



Pubic Symphysis

Type of Joint

Cartilaginous symphysis (slightly movable).

Articulation

The midline joint between the superior rami of the pubic bones.

NOTE: The joint contains a fibrocartilaginous interpubic disc with a slit-like cavity, which in women, can develop into a large cavity.

Movements

No significant movement occurs other than some separation of the pubic bones in women during pregnancy and childbirth.

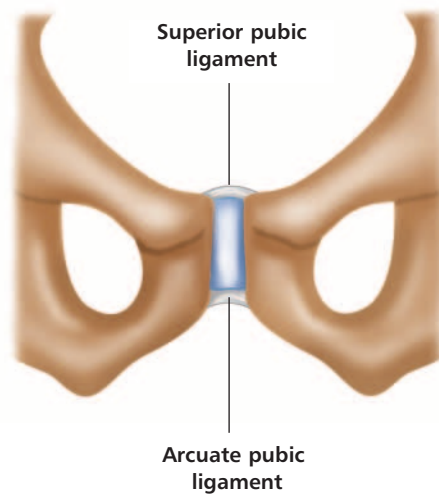
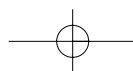
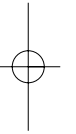
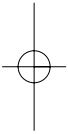


Figure 6.27: Pubic symphysis (anterior view).



Hip Joint

Type of Joint

Synovial ball and socket.

Articulation

The spherical head of the femur articulates with the cup-like acetabulum of the coxal (hip) bone. A circular rim of fibrocartilage called the *acetabular labrum* or *labrum acetabulare*, which grasps the femoral head, enhances the depth of the acetabulum. Unlike the articulation of the shoulder joint, the hip articulation fits securely together.

Articular Capsule

Extends from the rim of the acetabulum to the neck of the femur. It is very strong and tense in extension, which contrasts to the thin and lax capsule of the shoulder joint.

Ligaments

Iliofemoral ligament: A thick and strong triangular band situated anteriorly.

Pubofemoral ligament: A triangular thickening of the inferior aspect of the capsule.

Ischiofemoral ligament: A spiral ligament situated posteriorly.

These three ligaments are arranged so that when a person stands up (i.e. hip joint moves from flexion to extension), the head of the femur is 'screwed' into the acetabulum, and held firmly in position.

Ligament of the head of the femur:

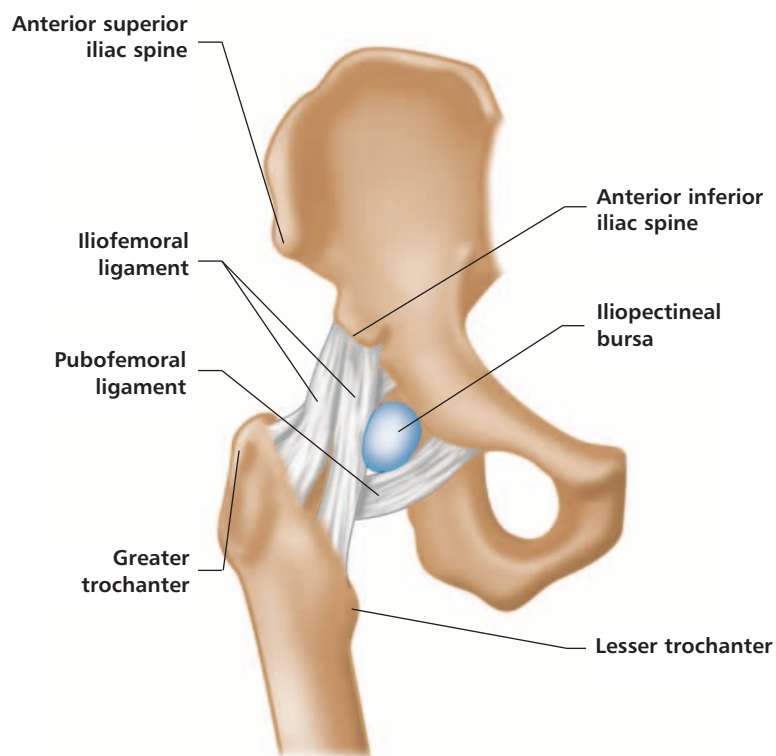
Also called the ligamentum teres or the capitate ligament, this flat intracapsular ligament runs from the femoral head to the lower lip of the acetabulum. It contains an artery that is a source of blood for the head of the femur. It is slack during most hip movements and therefore does not contribute to the joint's stability.

Stabilizing Tendons

This joint is inherently stable by virtue of its structure and ligaments. All surrounding muscles and tendons contribute to its stability, but in a very minor capacity compared to those of the shoulder joint.

Movements

Flexion, extension, abduction, adduction, medial and lateral rotation, circumduction (limited, compared to the shoulder joint).



a)

Figure 6.28: The hip joint, a) right leg, anterior view.

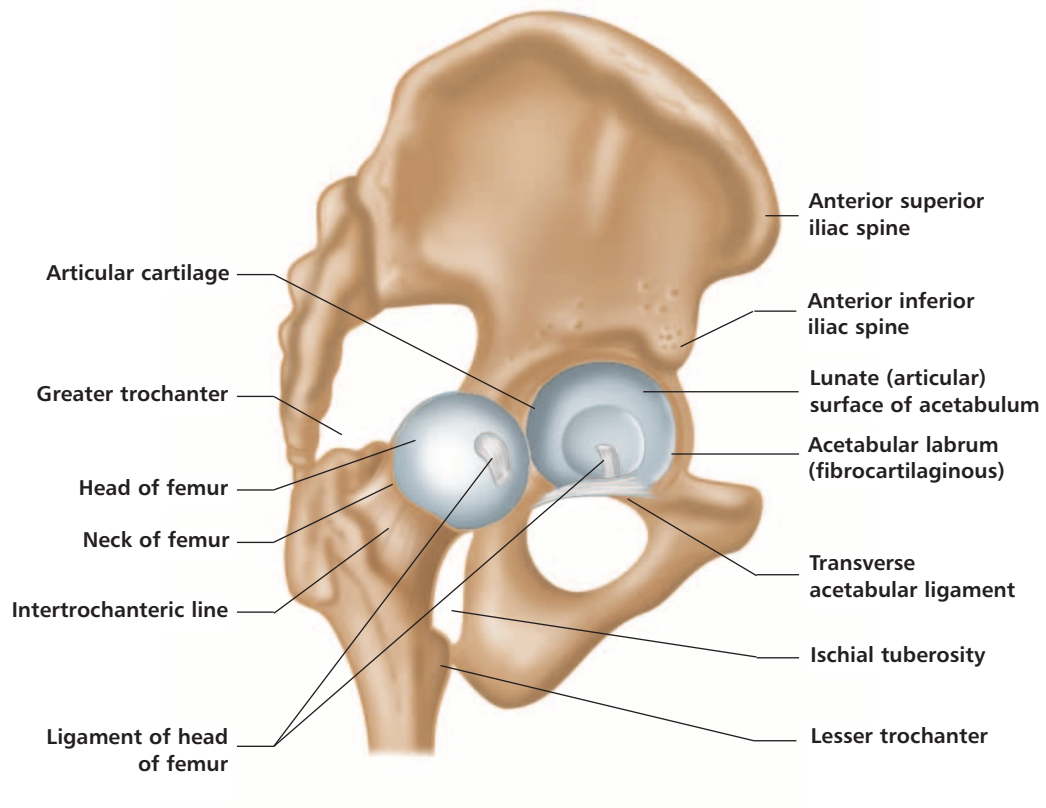
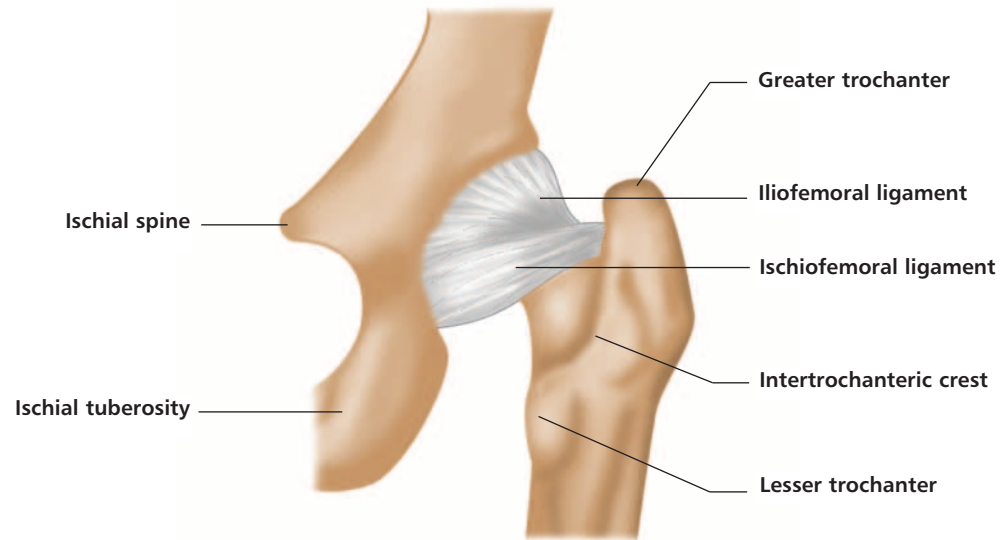
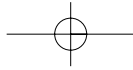
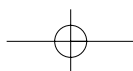


Figure 6.28: The hip joint, b) right leg, posterior view, c) right leg, lateral view.



Knee Joint

The knee joint is the largest and most complex joint in the body. Within its joint cavity it contains three articulations: the lateral and medial articulations of the *tibiofemoral joint*, and the *femoropatellar joint*.

Type of Joint

Tibiofemoral joint: Functionally a modified synovial hinge joint, but structurally a condyloid joint.

Femoropatellar joint: Synovial plane joint.

Articulation

Tibiofemoral joint: Condyles of the femur articulate with the condyles of the tibia; but with two C-shaped menisci or semilunar cartilages between the opposing articular surfaces.

Femoropatellar joint: Posterior surface of patella articulates with patellar surface at the lower end of the femur.

Articular Capsule

The knee is the only joint where the capsule only partially encloses the joint cavity. Instead, the true capsular fibres are integrated within a ligamentous sheath composed of muscle tendons or expansions from them, which collectively encapsulate the joint. True capsular fibres are located only at the sides and posterior of the joint.

Extracapsular (extra-articular) Ligaments

Tibial (medial) collateral ligament: A broad, flat band running from the medial epicondyle of the femur, downwards and forwards to the medial condyle of the tibial shaft. Some fibres are fused to the medial meniscus.

Fibular (lateral) collateral ligament: A round, cord-like ligament, fully detached from the thin lateral part of the capsule. It extends from the lateral epicondyle of the femur, downwards and backwards to the head of the fibula.

Oblique popliteal ligament: An expansion of the semimembranosus tendon, that passes upward and laterally over the posterior of the joint.

Arcuate popliteal ligament: Extends from the head of the fibula upwards and medially, spreading into the back of the capsule and to the lateral condyle of the femur; thus reinforcing the back of the joint.

Intracapsular (intra-articular) Ligaments and Menisci

Anterior cruciate ligament: Extends obliquely upwards, laterally and backwards from the anterior intercondylar area of the tibia to the medial surface of lateral femoral condyle. It prevents posterior displacement of the femur on the tibia, and also helps check hyperextension of the knee.

Posterior cruciate ligament: Passes upwards, medially and forwards from the posterior intercondylar area of the tibia to the lateral side of the medial femoral condyle. Thus it lies on the medial side of the weaker anterior cruciate. It prevents anterior displacement of the femur on the tibia.

The *cruciate ligaments* are within the joint capsule, but outside the joint cavity. Synovial membrane covers most of their surface.

Menisci: Between the femoral and tibial condyles are two crescent shaped fibrous wedges called menisci that help compensate for the incongruence of the articular surfaces. They also help absorb shock transmitted to the knee joint. The menisci are attached only at their outer margins and are prone to tearing. The medial meniscus is also attached to the tibial collateral ligament, and is therefore much more firmly anchored than the lateral meniscus, which does not attach to the fibular collateral ligament.

Medial and lateral coronary ligaments: Capsular fibres that attach the menisci to the tibial condyles.

Transverse ligament of the knee: A fibrous band that joins the anterior parts of the menisci.

Stabilizing Tendons

Patellar ligament (*ligamentum patellae*): This strong ligament is actually the distal part of the quadriceps tendon. It runs from the patella (which is embedded within the tendon as a sesamoid bone – see page 33) to the tibial tuberosity. Other thinner bands called the *medial and lateral patellar retinacula* pass down the sides of the patella to attach to the front of each tibial condyle; effectively substituting for the capsule anteriorly.

Tendon of *semimembranosus*: Helps reinforce the posterior of the knee joint.

The muscles surrounding the knee joint are particularly crucial as stabilizers.

Movements

Flexion, extension. Some rotation can occur when the knee is flexed. Also, as a result of the tightening of various ligaments (especially the cruciates) and tendons, slight medial rotation of the femur occurs upon the fixed tibia as the knee straightens into full extension. (When both the femur and tibia are not fixed, as in kicking, the tibia rotates laterally at the end of extension and medially at the beginning of flexion).

NOTE: The popliteus muscle ‘unlocks’ the extended knee joint prior to flexion, enabling flexion to occur.

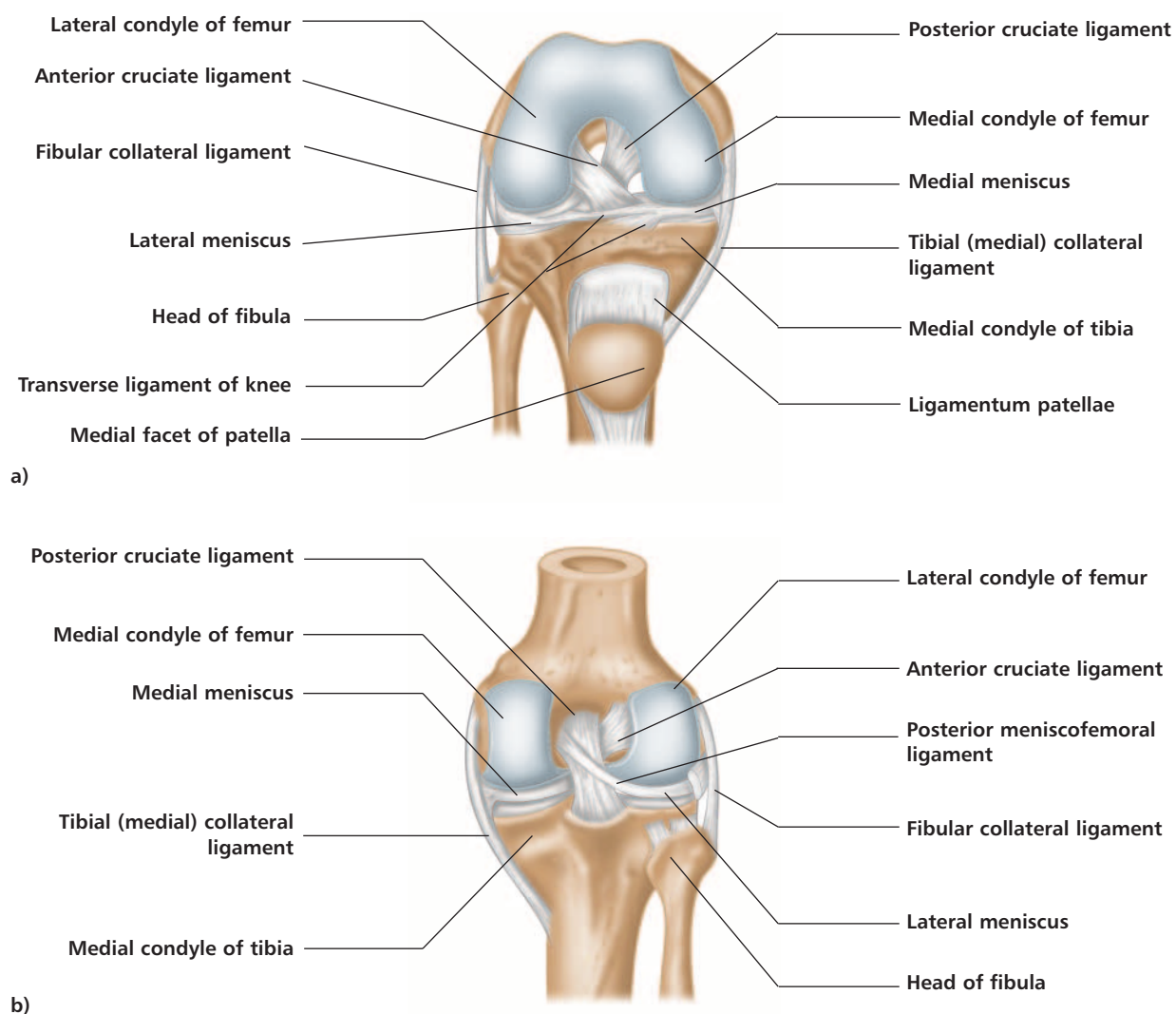
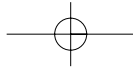
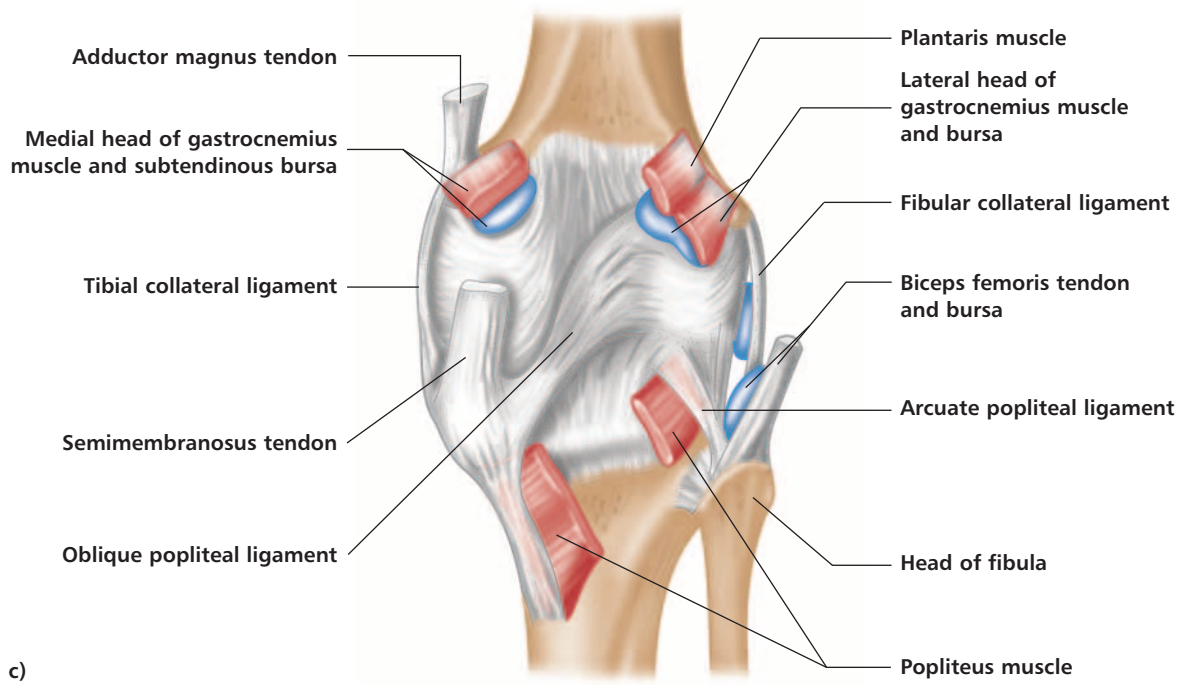


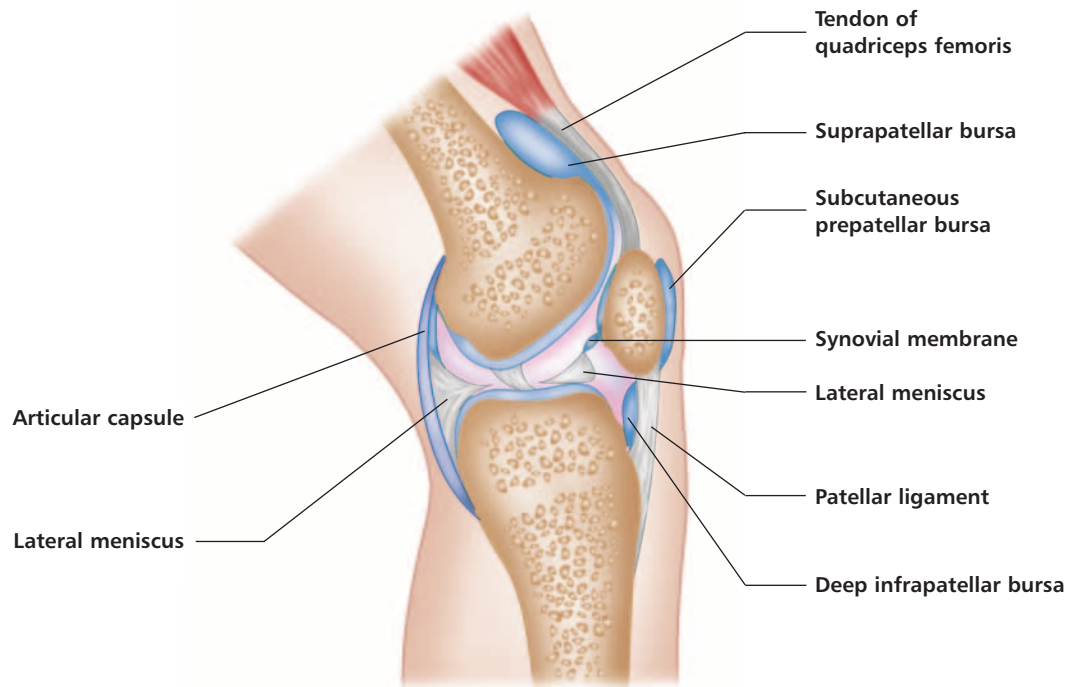
Figure 6.29: The knee joint; a) right leg, anterior view, b) right leg, posterior view.



The Atlas of Musculo-skeletal Anatomy

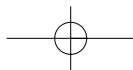


c)



d)

Figure 6.29: The knee joint; c) right leg, posterior view, d) right leg, mid-sagittal view.



Proximal Tibiofibular Joint

Type of Joint

Synovial plane.

Articulation

Between a facet on the head of the fibula and a similar facet on the lateral condyle of the tibia.

Movements

Movement is slight and passively occurs along with movements of the ankle joint.

Distal Tibiofibular Joint

Type of Joint

Syndesmosis.

Articulation

Between the rough, triangular, opposed surfaces at the distal end of the tibia and fibula.

Movements

Movement is slight and passively occurs along with movements of the ankle joint.

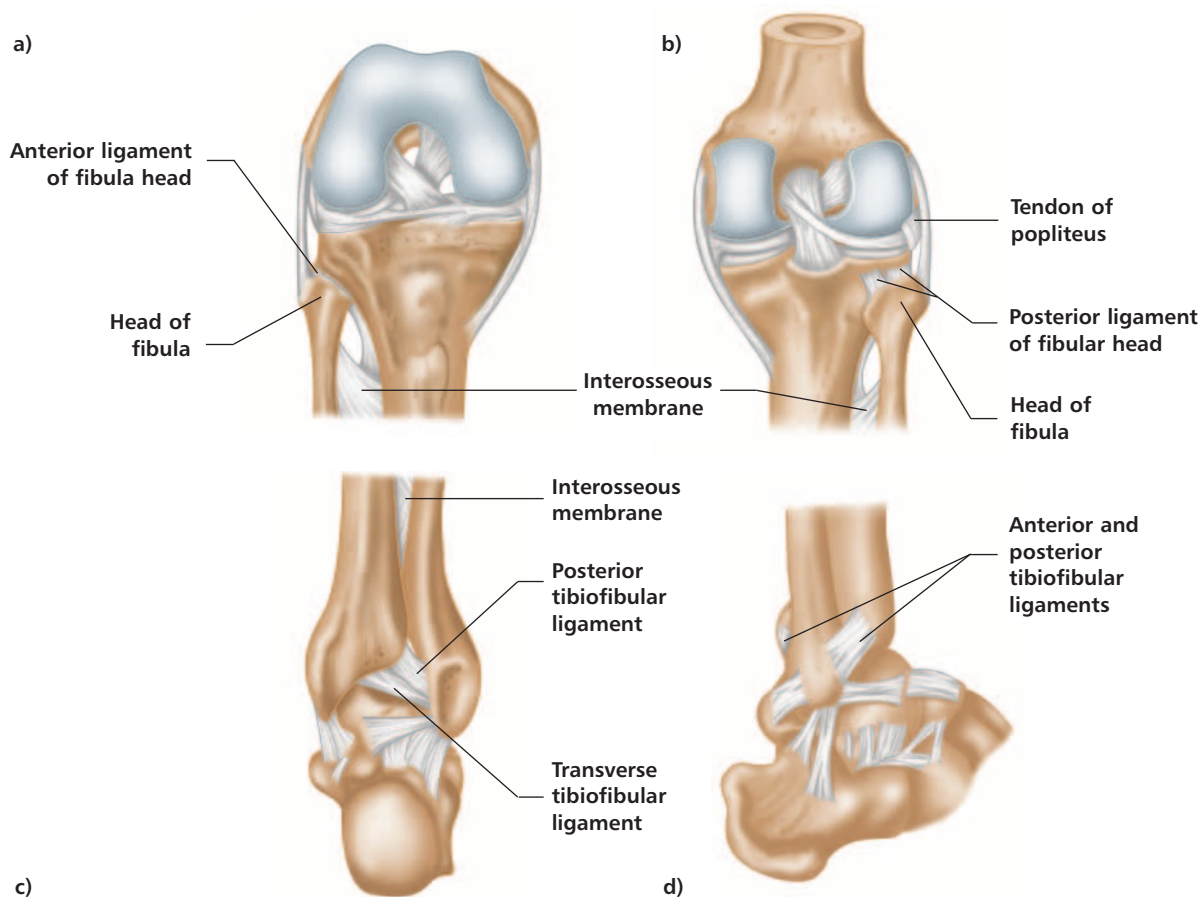


Figure 6.30: The tibiofibular joints; a) proximal tibiofibular joint, right leg, anterior view, b) proximal tibiofibular joint, right leg, posterior view, c) distal tibiofibular joint, right leg, posterior view, d) distal tibiofibular joint, right leg, lateral view.

Ankle Joint

Type of Joint

Synovial hinge.

Articulation

Between the distal tibia, the medial malleolus of the tibia, the lateral malleolus of the fibula and the talus. Therefore, the lower ends of the tibia and fibula provide a socket for the talus.

Movements

Dorsiflexion and plantar flexion.

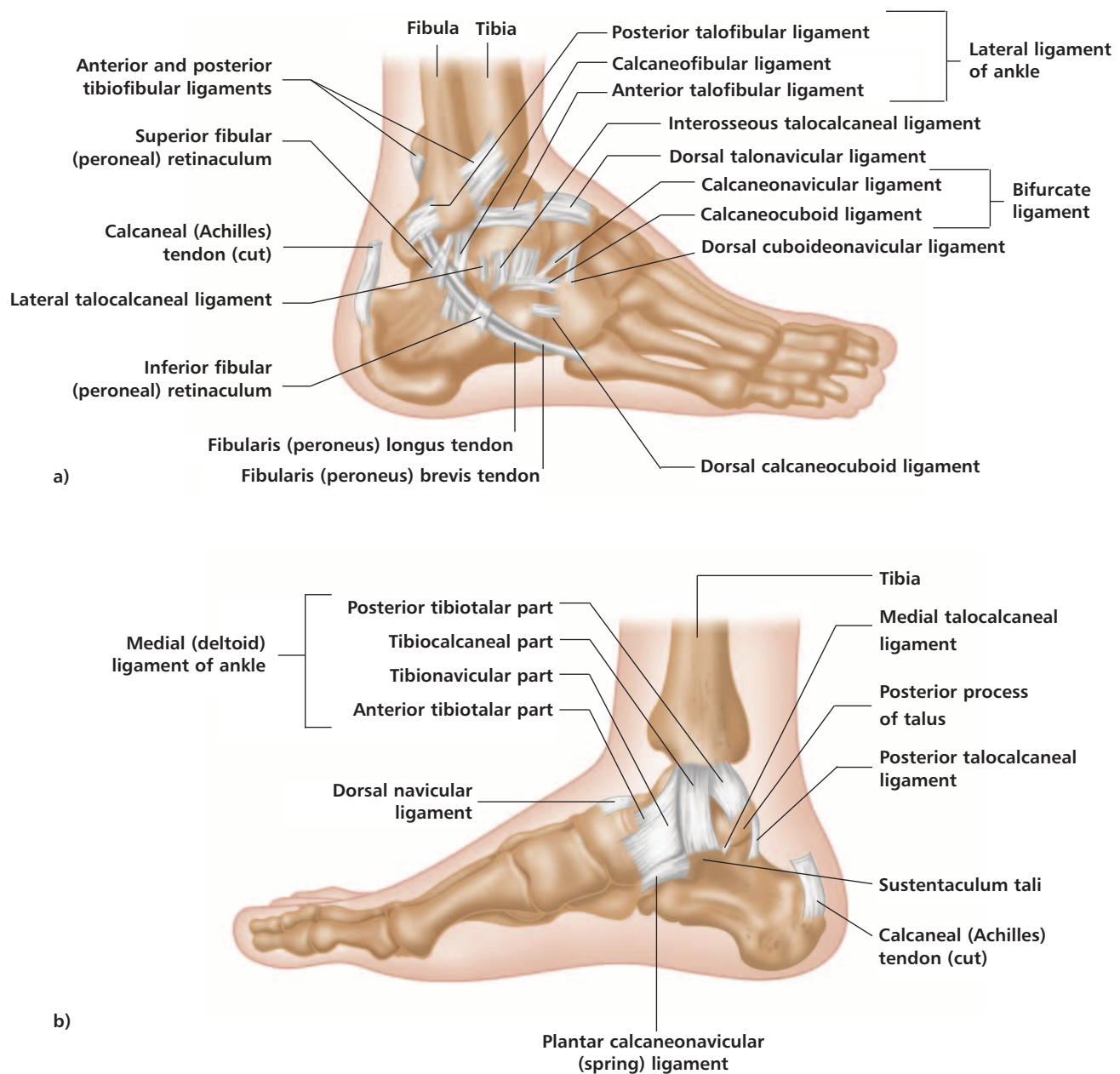


Figure 6.31: The ankle joint; a) right foot, lateral view, b) right foot, medial view.

The Arches of the Foot

The longitudinal arch:

- A series of synovial plane joints.
- It extends from the calcaneus to the metatarsals via the talus, navicular and cuneiforms.
- The shapes of the metatarsal bones form it.
- The calcaneonavicular (spring) ligament, a number of small interosseous ligaments, and the tendons of the tibialis anterior and tibialis posterior muscles support it.
- The arch is higher on the medial side than the lateral side.

The transverse arch:

- A series of synovial plane joints.
- It is placed through the distal row of tarsal bones.
- The shape of the tarsal bones, many small interosseous ligaments and the tendons of the peroneus longus, tibialis anterior and tibialis posterior muscles support it.

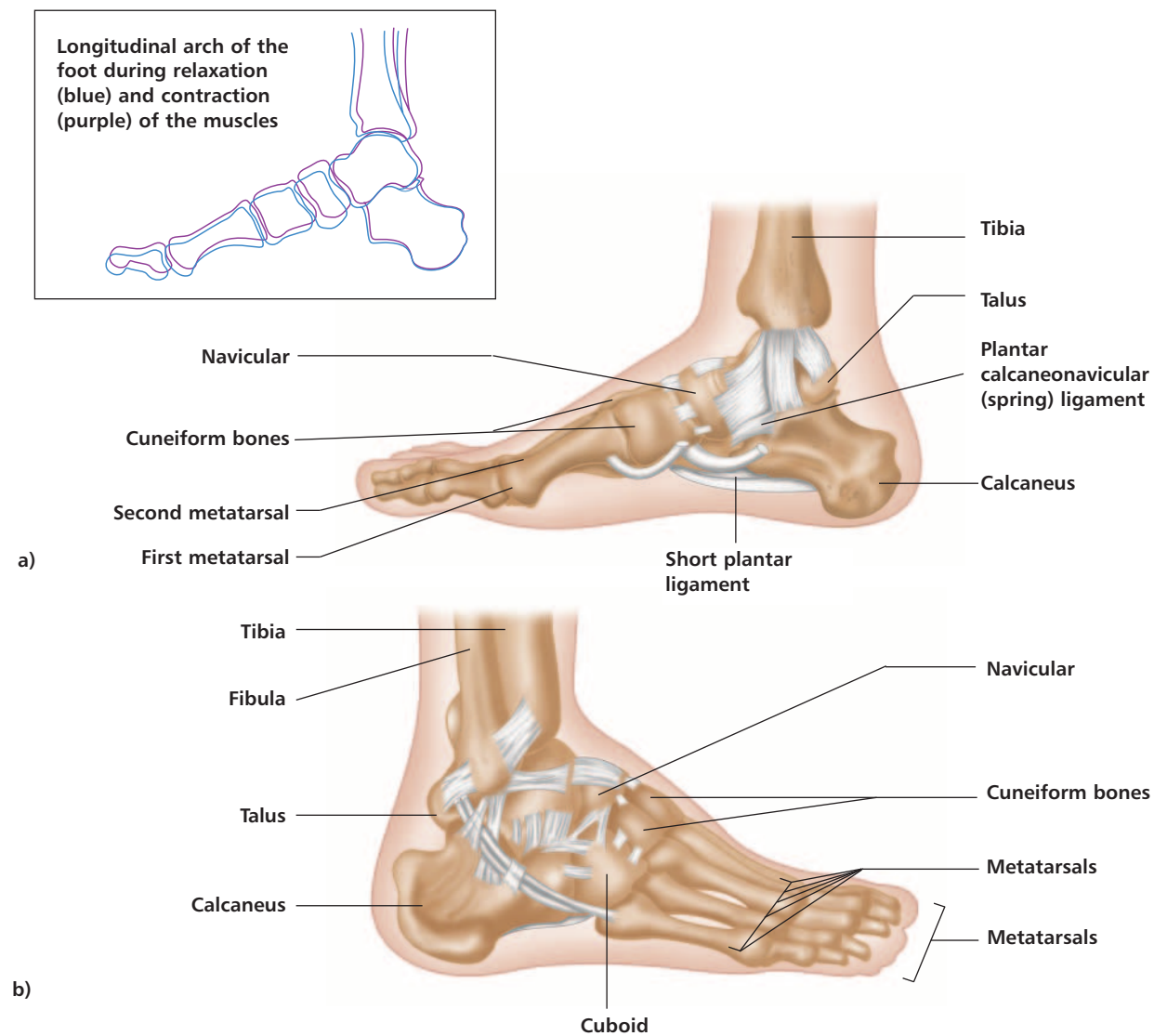


Figure 6.32: The arches of the foot; a) right foot, medial view, b) right foot, lateral view.

Intertarsal Joints

Type of Joints

A complex set of synovial plane joints.

Articulation

Subtalar joint: Between the inferior surface of the talus and the superior surface of the calcaneus.

Talocalcaneonavicular joint: Between the talus, calcaneus and navicular.

Calcaneocuboid joint: Between the calcaneus and cuboid.

Transverse tarsal joint: A term to describe the transverse plane extending across the full width of the tarsus, comprising the talocalcaneonavicular joint and the calcaneocuboid joint.

Cuneonavicular joint: Between the cuneiform and the navicular.

Intercuneiform joints: Between the three cuneiform bones.

Cuneocuboid joint: Between the lateral cuneiform bone and the cuboid bone.

Movements of the Tarsus

Inversion and eversion of the foot.

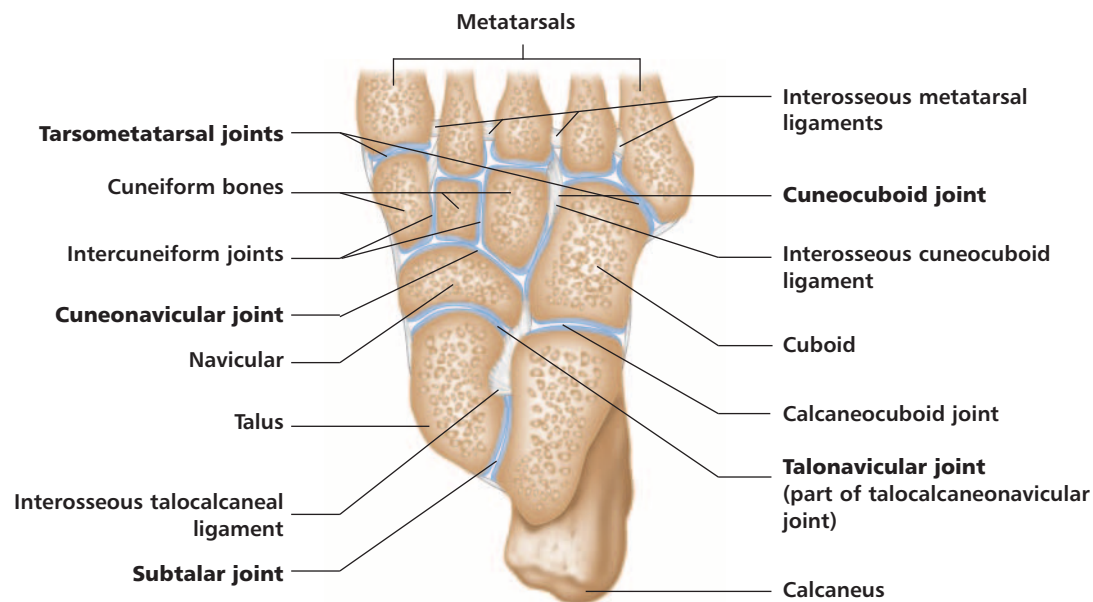


Figure 6.33: The intertarsal joints (horizontal section of right foot).

Tarsometatarsal and Intermetatarsal Joints

Type of Joints

Synovial plane.

Articulation

Tarsometatarsal joints: Between the distal (anterior) row of tarsal bones (the cuboid and three cuneiforms) and the bases of the metatarsal bones.

Intermetatarsal joints: Between facets on adjacent sides of the bases of all lateral metatarsal bones.

Movements

Small gliding movements of the metatarsals, limited by ligaments and the interlocking of the bones, contribute slightly to inversion and eversion of the foot.

Metatarsophalangeal Joints

Type of Joint

Synovial condyloid.

Articulation

Between the head of a metatarsal and the base of a proximal phalanx.

NOTE: The capsule is deficient on the dorsal aspect, where it is replaced by an expansion of the extensor tendon.

Movements

Flexion and extension. Abduction and adduction. Combined movements may produce passive circumduction.

NOTE: In flexion, the toes are drawn together; in extension they tend to spread apart and incline slightly laterally. Movements are less extensive than at the corresponding joints of the hand.

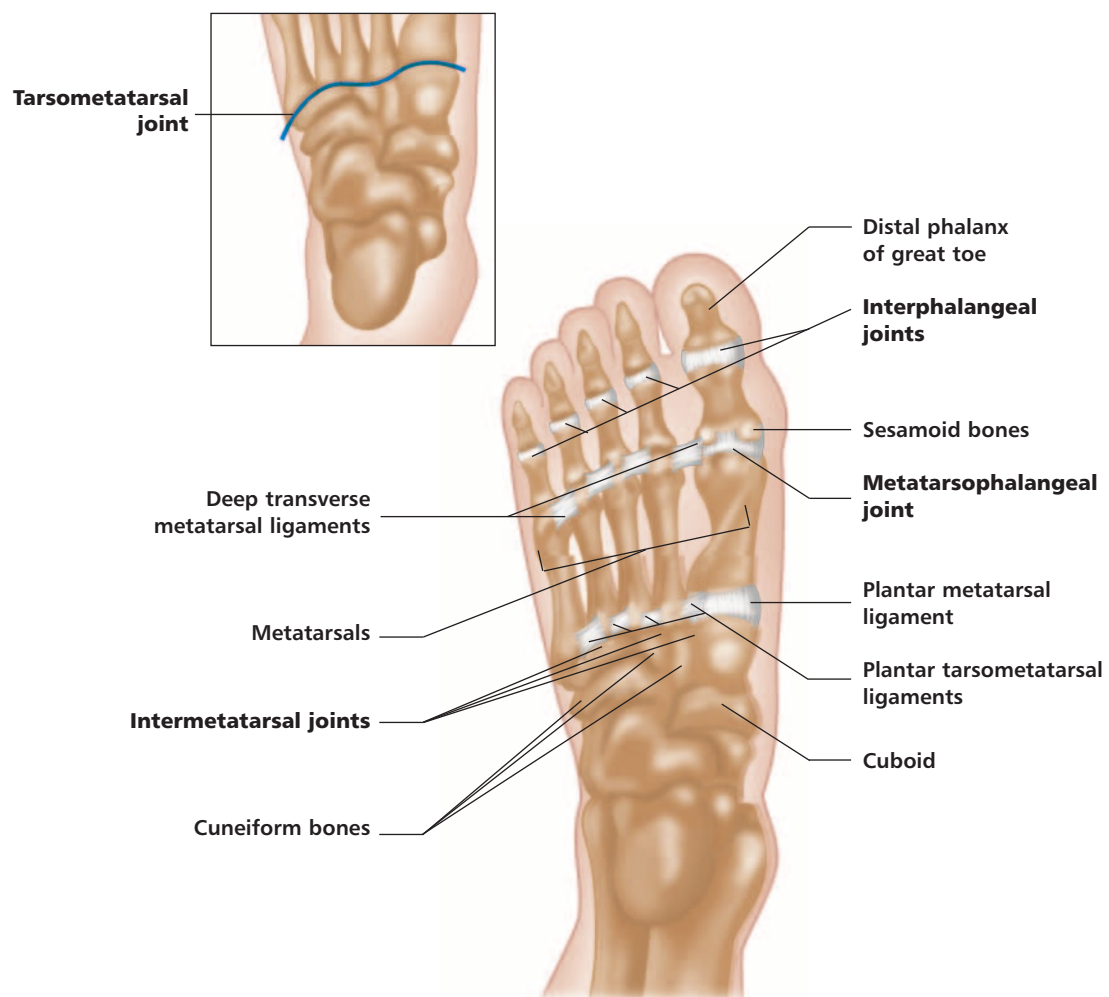


Figure 6.34: The tarsometatarsal, intermetatarsal and metatarsophalangeal joints (plantar view).

Interphalangeal Joints

Type of Joint

Synovial hinge.

Articulation

Between the proximal and middle phalanges (proximal interphalangeal joint, abbreviated PIP), or the middle and distal phalanges (distal interphalangeal joint, abbreviated DIP).

Movements

Flexion and extension.

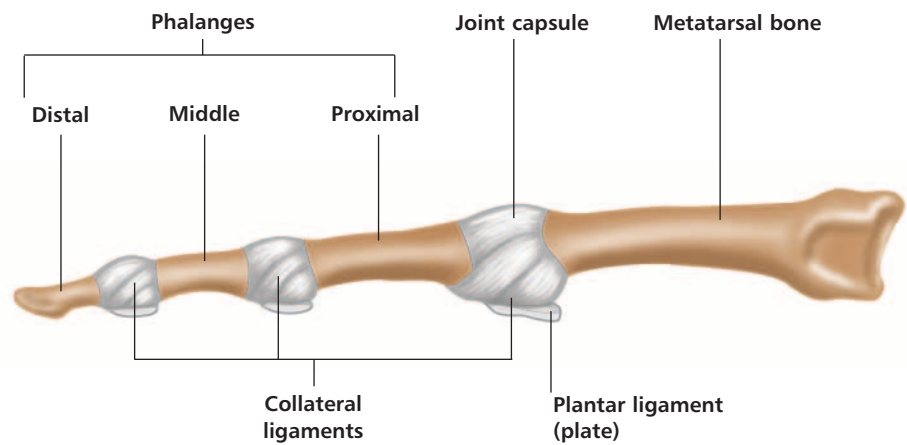


Figure 6.35: The metatarsophalangeal and interphalangeal joints (lateral view).