Introduction To Human Anatomy

Anatomy is science of the structure and function of the body.

Clinical anatomy is the study of the macroscopic structure and function of the body as it relates to the practice of medicine and other health sciences.

Basic anatomy is the study of the minimal amount of anatomy consistent with the understanding of overall structure and function of the body.

objectives

AN1.1	1-Demonstrate normal anatomical position, various planes, relation, comparison, laterality in our body
AN1.2	2-Describe the variuos types of movements in our body
AN2.1	3-Describe composition of bone and bone marrow
AN2.2	4-Describe the classification system of bones
AN2.3	5-Describe parts, blood and nerve supply of a long bone
AN2.4	6-Enumerate special features of a sesamoid bone
AN2.5	7-Enumerate types of ossification
AN2.6	8-Demonstrate different types of bone markings and explain their formation
AN3.1	9-Describe various types of cartilage with its structure & distribution in body
AN3.2	10-Describe various joints with subtypes and examples
AN3.3	11-Explain the concept of nerve supply of joints & Hilton’s law

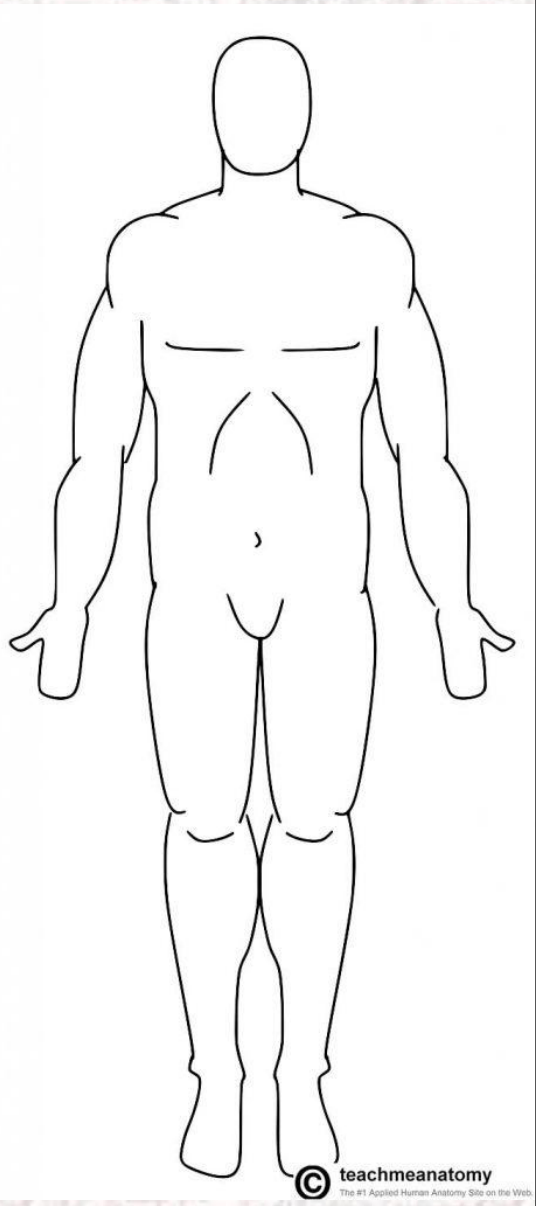
1-The Anatomical Position

The anatomical position is the central concept behind all descriptions of location within the body. It is similar to the position of the famous Vitruvian Man, although a little less exuberant! However, the basics are the same. Here is a general description:

A person standing upright, facing forward.

Arms straight and hands held by the hips, palms facing forward.

Feet parallel and toes pointing forward.



2-Anatomical Planes

A plane is a 2D slice through 3D space, which can be thought of as a glass sheet. The anatomical planes are different lines used to divide the human body. You will commonly see them when looking at anatomical models and prosections. Using anatomical planes allows for accurate description of a location, and also allows the reader to understand what a diagram or picture is trying to show.

2-Anatomical Planes

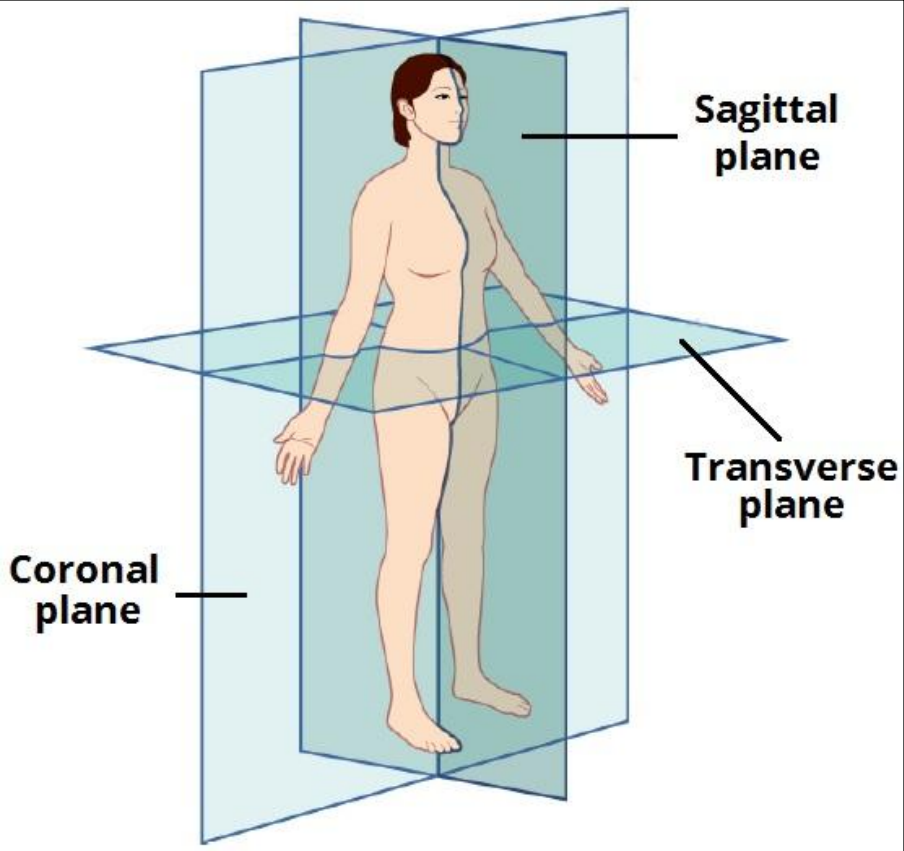
There are three planes commonly used; sagittal, coronal and transverse.

A.Sagittal plane – a vertical line which divides the body into a left section and a right section.

B-Coronal plane – a vertical line which divides the body into a front (anterior) section and back (posterior) section.

C-Transverse plane – a horizontal line which divides the body into an upper (superior) section and a lower (inferior) section.

For example, a diagram may be labelled as a transverse section, viewed superiorly. This indicates that you are looking downwards onto a horizontal section of the body.



Anatomical Terms of Movement

Anatomical terms of movement are used to describe the actions of muscles upon the skeleton. Muscles contract to produce movement at joints, and the subsequent movements can be precisely described using this terminology.

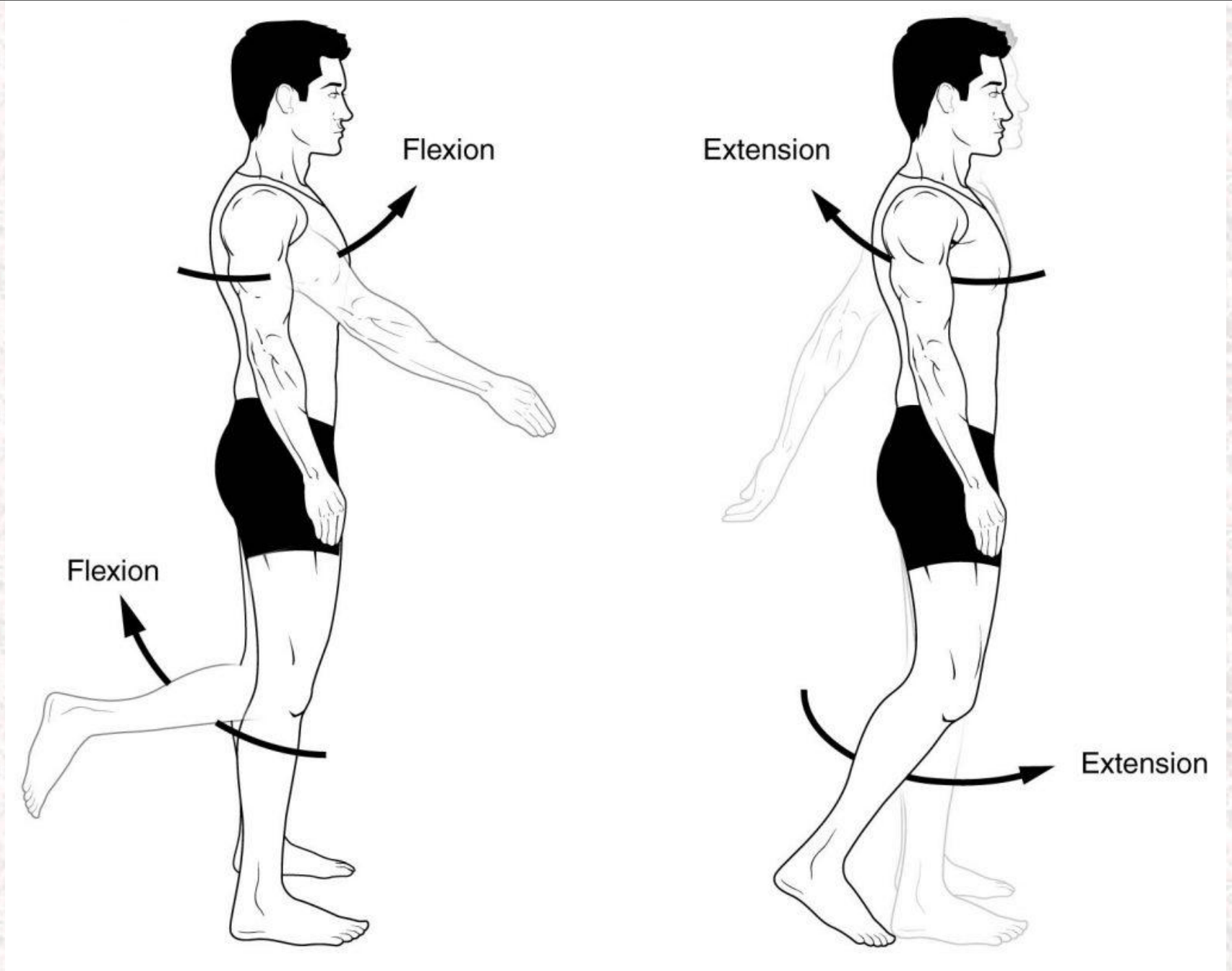
The terms used assume that the body begins in the anatomical position. Most movements have an opposite movement – also known as an antagonistic movement. We have described the terms in antagonistic pairs for ease of understanding.

1-Flexion and Extension

Flexion and extension are movements that occur in the sagittal plane. They refer to increasing and decreasing the angle between two body parts:

Flexion refers to a movement that decreases the angle between two body parts. Flexion at the elbow is decreasing the angle between the ulna and the humerus. When the knee flexes, the ankle moves closer to the buttock, and the angle between the femur and tibia gets smaller.

Extension refers to a movement that increases the angle between two body parts. Extension at the elbow is increasing the angle between the ulna and the humerus. Extension of the knee straightens the lower limb.


Flexion
Flexion
Extension
Extension

2-Abduction and Adduction

Abduction and adduction are two terms that are used to describe movements towards or away from the midline of the body.

Abduction is a movement away from the midline – just as abducting someone is to take them away. For example, abduction of the shoulder raises the arms out to the sides of the body.

Adduction is a movement towards the midline. Adduction of the hip squeezes the legs together.

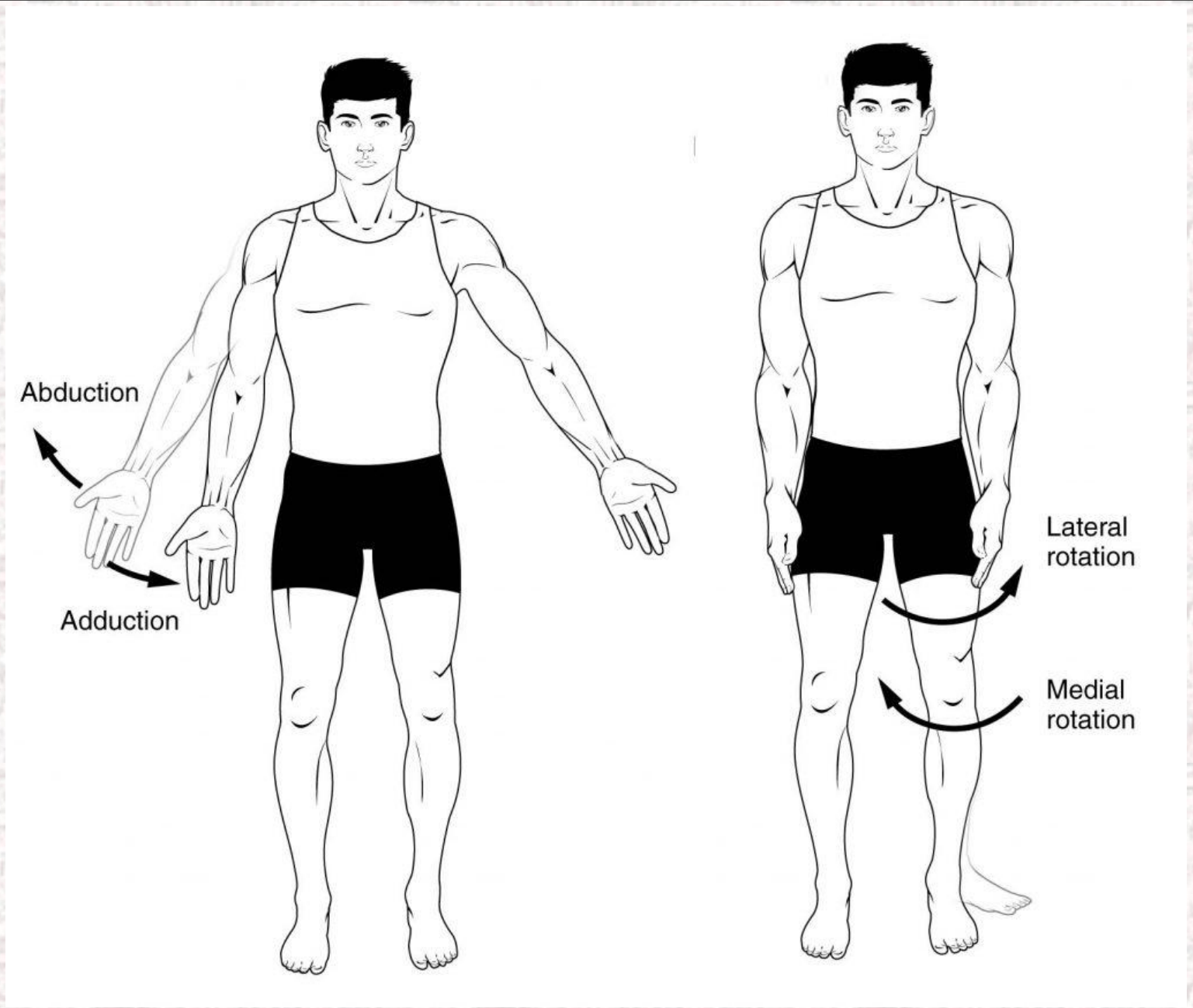
In fingers and toes, the midline used is not the midline of the body, but of the hand and foot respectively. Therefore, abducting the fingers spreads them out.

3-Medial and Lateral Rotation

Medial and lateral rotation describe movement of the limbs around their long axis:

Medial rotation is a rotational movement towards the midline. It is sometimes referred to as internal rotation. To understand this, we have two scenarios to imagine. Firstly, with a straight leg, rotate it to point the toes inward. This is medial rotation of the hip. Secondly, imagine you are carrying a tea tray in front of you, with elbow at 90 degrees. Now rotate the arm, bringing your hand towards your opposite hip (elbow still at 90 degrees). This is internal rotation of the shoulder.

Lateral rotation is a rotating movement away from the midline. This is in the opposite direction to the movements described above.


Abduction
Adduction
Lateral rotation
Medial rotation

3-Elevation and Depression

Elevation refers to movement in a superior direction (e.g. shoulder shrug), depression refers to movement in an inferior direction.

4-Pronation and Supination

This is easily confused with medial and lateral rotation, but the difference is subtle. With your hand resting on a table in front of you, and keeping your shoulder and elbow still, turn your hand onto its back, palm up. This is the supine position, and so this movement is supination.

Again, keeping the elbow and shoulder still, flip your hand onto its front, palm down. This is the prone position, and so this movement is named pronation.

These terms also apply to the whole body – when lying flat on the back, the body **is supine**. When lying flat on the front, the **body is prone**.

5-Dorsiflexion and Plantarflexion

Dorsiflexion and plantarflexion are terms used to describe movements at the ankle. They refer to the two surfaces of the foot; the dorsum (superior surface) and the plantar surface (the sole).

Dorsiflexion refers to flexion at the ankle, so that the foot points more superiorly. Dorsiflexion of the hand is a confusing term, and so is rarely used. The dorsum of the hand is the posterior surface, and so movement in that direction is extension. Therefore we can say that dorsiflexion of the wrist is the same as extension.

Plantarflexion refers extension at the ankle, so that the foot points inferiorly. Similarly there is a term for the hand, which is palmarflexion.

6-Inversion and Eversion

Inversion and eversion are movements which occur at the ankle joint, referring to the rotation of the foot around its long axis.

Inversion involves the movement of the sole towards the median plane – so that the sole faces in a medial direction.

Eversion involves the movement of the sole away from the median plane – so that the sole faces in a lateral direction.

Opposition and Reposition

A pair of movements that are limited to humans and some great apes, these terms apply to the additional movements that the hand and thumb can perform in these species.

Opposition brings the thumb and little finger together.

Reposition is a movement that moves the thumb and the little finger away from each other, effectively reversing opposition.

7-Circumduction

Circumduction can be defined as a conical movement of a limb extending from the joint at which the movement is controlled.

It is sometimes talked about as a circular motion, but is more accurately conical due to the 'cone' formed by the moving limb.

8-Protraction and Retraction

Protraction describes the anterolateral movement of the scapula on the thoracic wall that allows the shoulder to move anteriorly. In practice, this is the movement of 'reaching out' to something.

Retraction refers to the posteromedial movement of the scapula on the thoracic wall, which causes the shoulder region to move posteriorly i.e. picking something up.

Anatomical Terms of Location

The anatomical terms of location are vital to understanding and using anatomy. They help to avoid any ambiguity that can arise when describing the location of structures.

Note: There are some anatomical terms that are specifically used in embryology. Learn about them here.

9-Medial and Lateral

Imagine a line in the sagittal plane, splitting the right and left halves evenly. This is the midline. Medial means towards the midline, lateral means away from the midline.

Examples:

The eye is lateral to the nose.

The nose is medial to the ears.

The brachial artery lies medial to the biceps tendon.

10-Anterior and Posterior

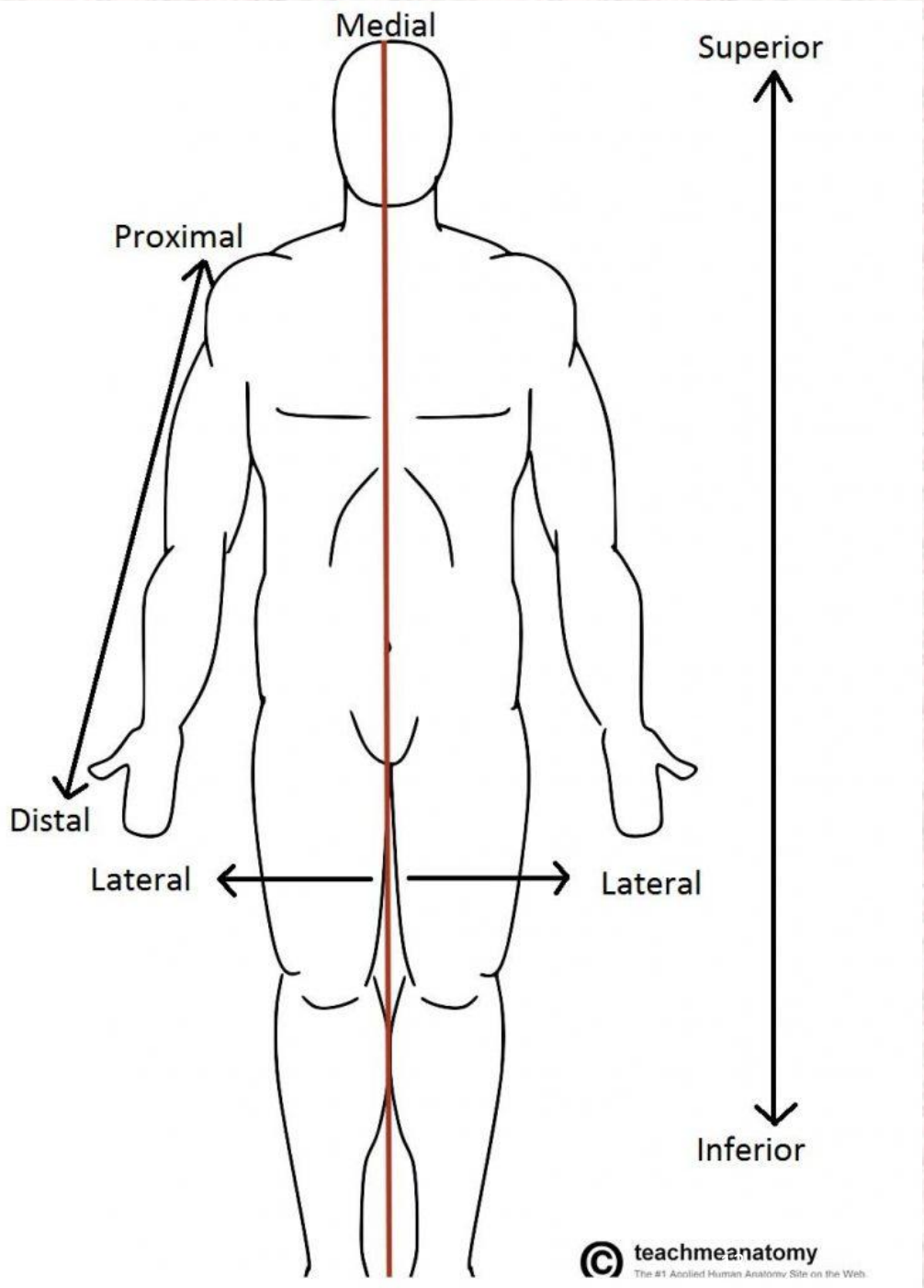
Anterior refers to the ‘front’, and posterior refers to the ‘back’. Putting this in context, the heart is posterior to the sternum because it lies behind it. Equally, the sternum is anterior to the heart because it lies in front of it.

Examples

Pectoralis major lies anterior to pectoralis minor.

The triceps are posterior to biceps brachii.

The patella is located anteriorly in the lower limb.10-



11-Superior and Inferior

These terms refer to the vertical axis. Superior means ‘higher’, inferior means ‘lower’. The head is superior to the neck; the umbilicus is inferior to the sternum.

Here we run into a small complication, and limbs are very mobile, and what is superior in one position is inferior in another. Therefore, in addition to the superior and inferior, we need another descriptive pair of terms:

Examples

The shoulder joint is superior to the elbow joint.

The lungs are superior to the liver.

The appendix is inferior to the transverse colon.

11-Proximal and Distal

The terms proximal and distal are used in structures that are considered to have a beginning and an end (such as the upper limb, lower limb and blood vessels). They describe the position of a structure with reference to its origin – proximal means closer to its origin, distal means further away.

Examples:

The wrist joint is distal to the elbow joint.

The scaphoid lies in the proximal row of carpal bones.

The knee joint is proximal to the ankle joint.

Classification of Joints

A joint is defined as a connection between two bones in the skeletal system.

Joints can be classified by the type of the tissue present (**fibrous, cartilaginous or synovial**), or by the degree of movement permitted (synarthrosis, amphiarthrosis or diarthrosis).

In this article, we shall look at the classification of joints in the human body.

Classification by type of tissue:

- Fibrous – bones connected by fibrous tissue.
- Cartilaginous – bones connected by cartilage.
- Synovial – articulating surfaces enclosed within fluid-filled joint capsule.

Classification by degree of movement:

- Synarthrosis – immovable.
- Amphiarthrosis – slightly moveable.
- Diarthrosis – freely moveable.

Fibrous Joints

A fibrous joint is where the bones are bound by a tough, fibrous tissue. These are typically joints that require strength and stability over range of movement.

Fibrous joints can be further sub-classified into sutures, gomphoses and syndesmoses.

1-Sutures

Sutures are immovable joints (synarthrosis), and are only found between the flat, plate-like bones of the skull.

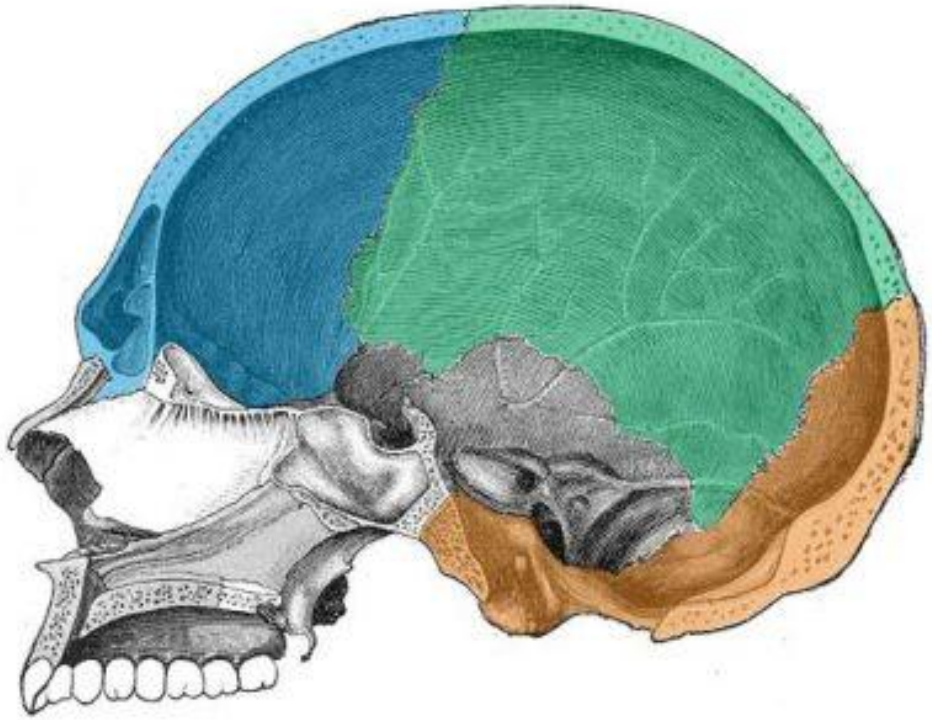
There is limited movement until about 20 years of age, after which they become fixed and immobile. They are most important in birth, as at that stage the joints are not fused, allowing deformation of the skull as it passes through the birth canal.

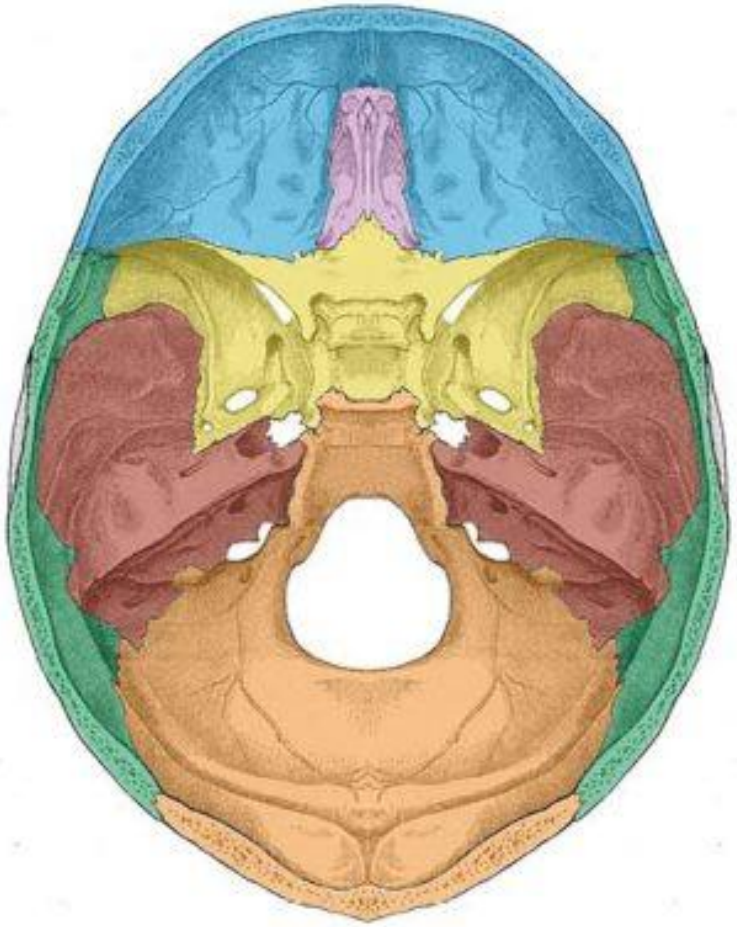
2-Gomphoses

Gomphoses are also immovable joints. They are found where the teeth articulate with their sockets in the maxilla (upper teeth) or the mandible (lower teeth). The tooth is bound into its socket by the strong periodontal ligament.

3-Syndesmoses

Syndesmoses are slightly movable joints (amphiarthroses). They are comprised of bones held together by an interosseous membrane. The middle radioulnar joint and middle tibiofibular joint are examples of a syndesmosis joint.





Frontal
Sphenoid
Temporal
Parietal
Occipital
Ethmoid

a) Bones of the calvarium

b) Bones of the cranial base

Cartilaginous

In a cartilaginous joint, the bones are united by fibrocartilage or hyaline cartilage.

There are two main types: synchondroses (primary cartilaginous) and symphyses (secondary cartilaginous).

1-Synchondroses

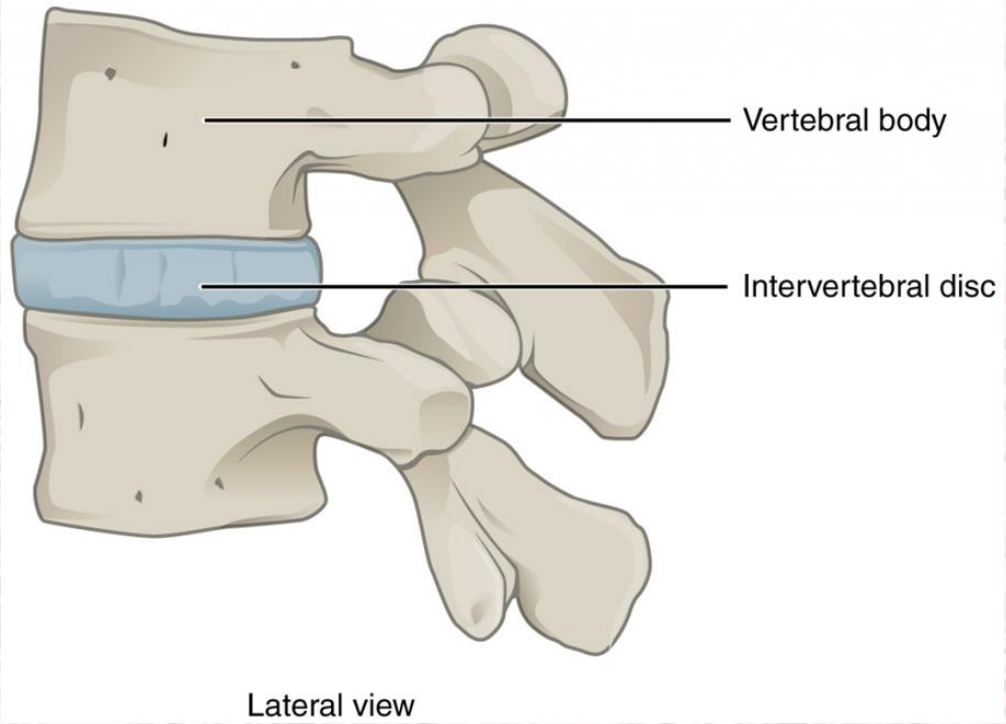
In a synchondrosis, the bones are connected by hyaline cartilage. These joints are immovable (synarthrosis).

An example of a synchondrosis is the joint between the diaphysis and epiphysis of a growing long bone.

2-Symphyses

Symphysial joints are where the bones are united by a layer of fibrocartilage. They are slightly movable (amphiarthrosis).

Examples include the pubic symphysis, and the joints between vertebral bodies.



Lateral view

Synovial

A synovial joint is defined by the presence of a fluid-filled joint cavity contained within a fibrous capsule. They are freely movable (diarthrosis) and are the most common type of joint found in the body. Synovial joints can be sub-classified into several different types, depending on the shape of their articular surfaces and the movements permitted:

1-Hinge – permits movement in one plane – usually flexion and extension. E.g. elbow joint, ankle joint, knee joint.

2-Saddle – named due to its resemblance to a saddle on a horse's back. It is characterised by opposing articular surfaces with a reciprocal concave-convex shape. E.g. carpometacarpal joints.

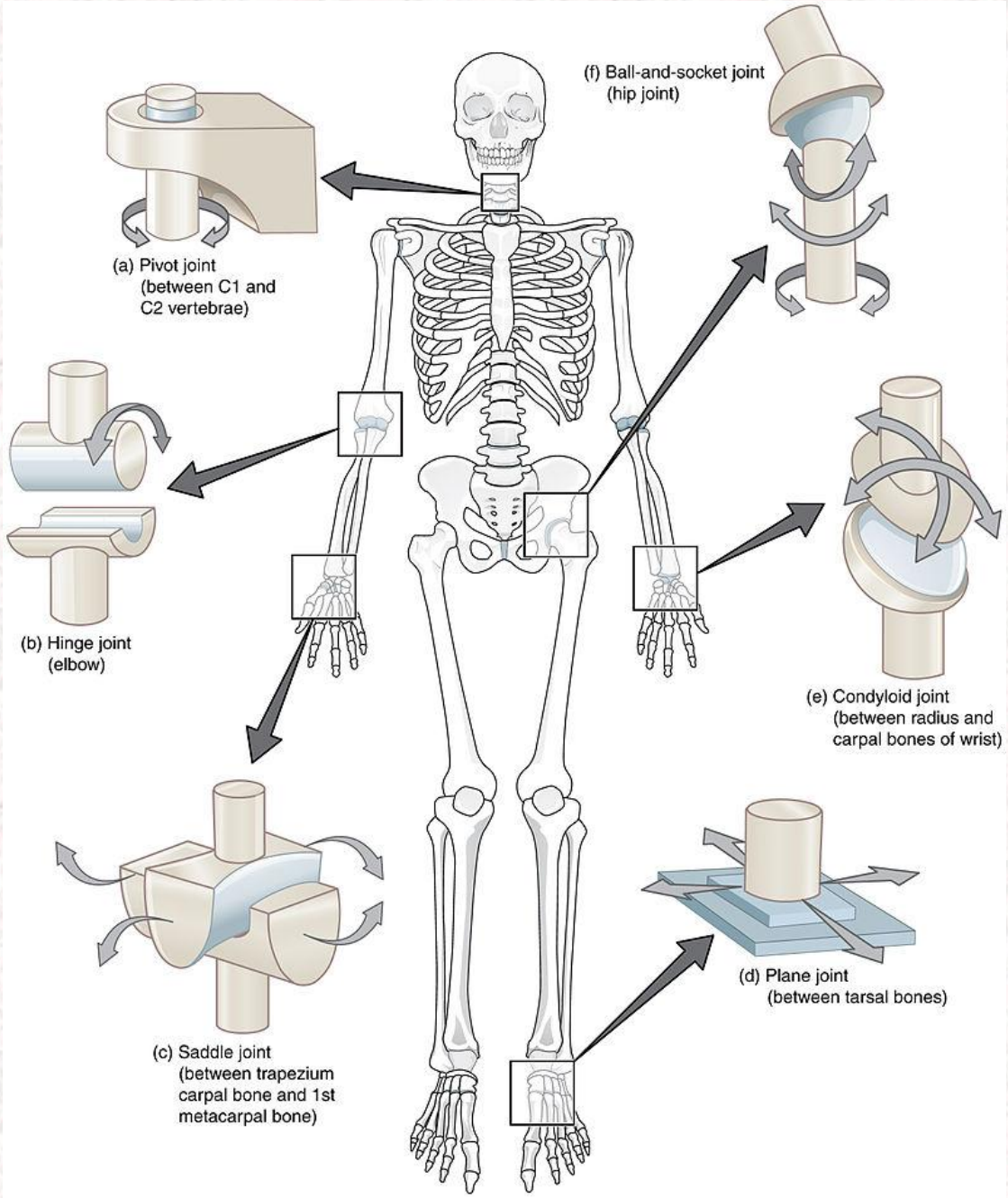
3-Plane – the articular surfaces are relatively flat, allowing the bones to glide over one another. E.g. acromioclavicular joint, subtalar joint.

Synovial

4-Pivot – allows for rotation only. It is formed by a central bony pivot, which is surrounded by a bony-ligamentous ring E.g. proximal and distal radioulnar joints, atlantoaxial joint.

5-Condyloid – contains a convex surface which articulates with a concave elliptical cavity. They are also known as ellipsoid joints. E.g. wrist joint, metacarpophalangeal joint, metatarsophalangeal joint.

6-Ball and Socket – where the ball-shaped surface of one rounded bone fits into the cup-like depression of another bone. It permits free movement in numerous axes. E.g. hip joint, shoulder joint.


(f) Ball-and-socket joint
(hip joint)
(a) Pivot joint
(between C1 and
C2 vertebrae)
(b) Hinge joint
(elbow)
(e) Condyloid joint
(between radius and
carpal bones of wrist)
(c) Saddle joint
(between trapezium
carpal bone and 1st
metacarpal bone)
(d) Plane joint
(between tarsal bones)

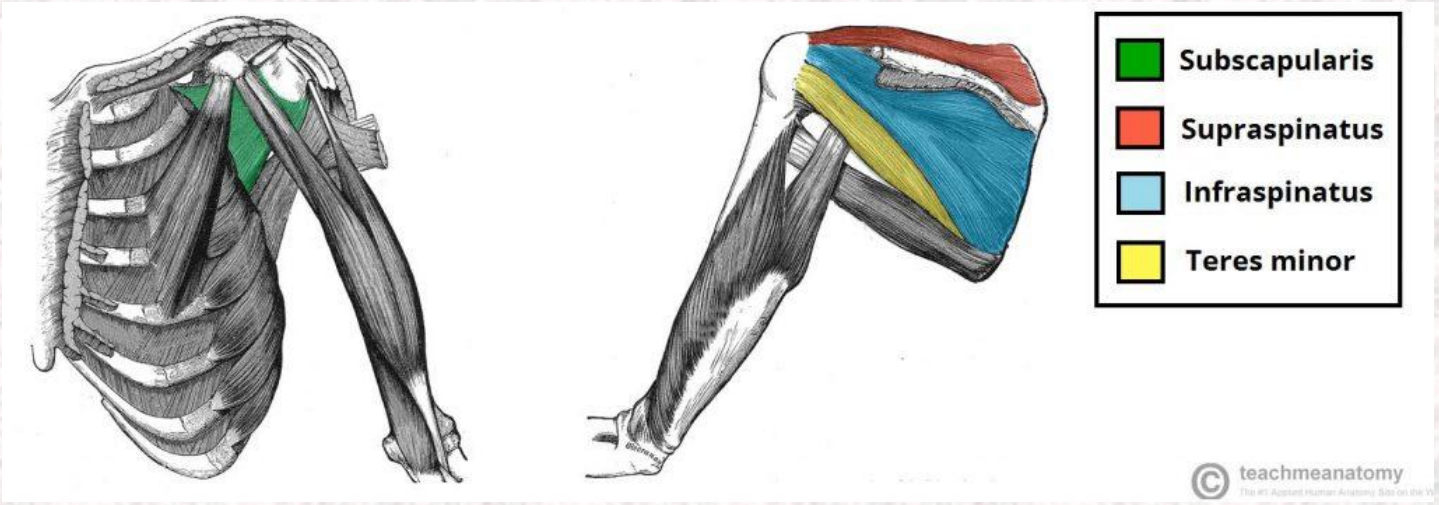
Joint Stability

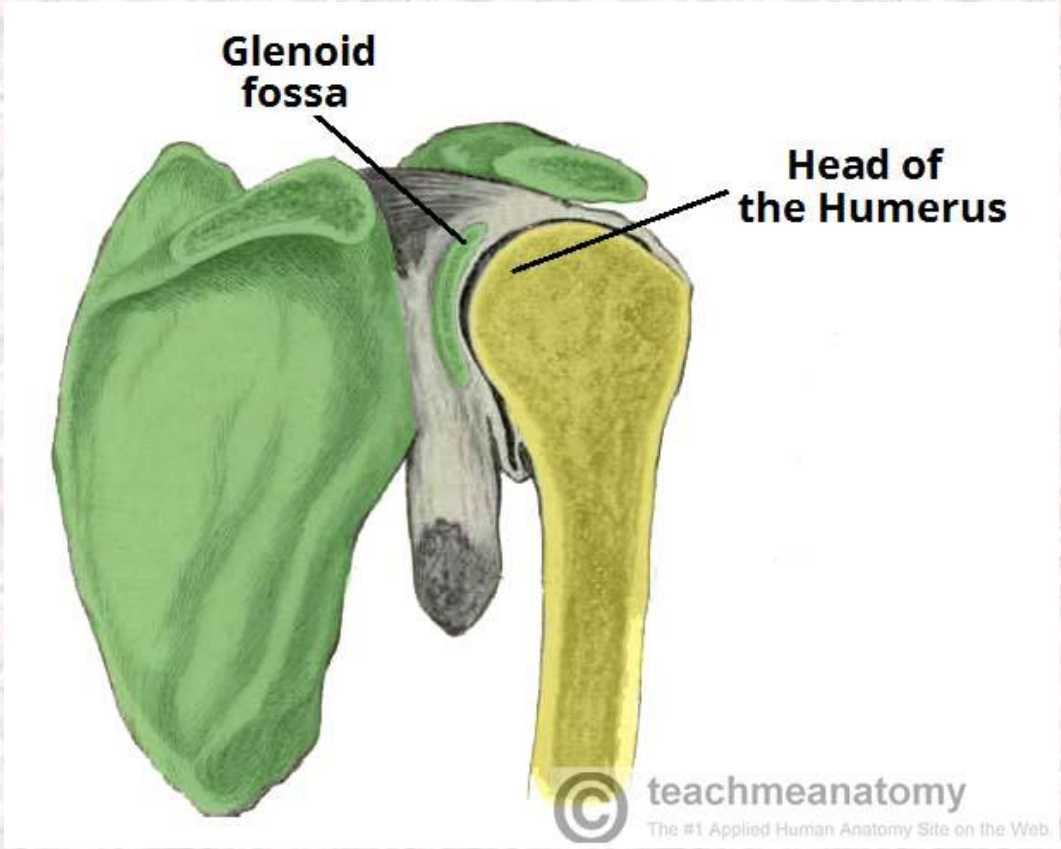
The stability of joints is a topic of great clinical importance; it explains why some joints are more prone to dislocation and injury than others. It also underlies the clinical basis of treating joint injuries. In this article we shall look at the various factors that contribute towards joint stability.

1-Shape, Size and Arrangement of Articular Surfaces

The joints of the body come in all shapes and sizes. The most important factor to consider here is the relative proportion of the two articulating surfaces. For example, in the shoulder joint, the humeral head of the upper arm is disproportionately larger than the glenoid fossa of the scapula that it sits in – making the joint more unstable, as there is less contact between the bones.

In contrast, the acetabulum of the pelvis fully encompasses the femoral head, and this makes the hip-joint far more stable. However, whilst the hip is more stable, the shoulder has a greater range of movement. Each joint has this trade-off that is particular to its function.


Subscapularis
Supraspinatus
Infraspinatus
Teres minor
© teachmeanatomy


Glenoid fossa
Head of the Humerus
© teachmeanatomy
The #1 Applied Human Anatomy Site on the Web

2- Ligaments

The ligaments of a joint prevent excessive movement that could damage the joint. As a general rule, the more ligaments a joint has, and the tighter they are, the more stable the joint is.

However, tight ligaments restrict movement, and this is why extra stability of a joint comes at the cost of loss of mobility. If disproportionate, inappropriate or repeated stress is applied to ligaments, they can stretch, tear or even damage the bone they attach to – this is why sportspeople are more susceptible to ligament injuries.

3-Tone of Surrounding Muscles

The tone of the surrounding muscles contributes greatly to the stability of a joint. A good example of this is the support provided by the rotator cuff muscles, which keep the head of the humerus in the shallow glenoid cavity of the scapula. If there is a loss of tone, such as in old age or stroke, the shoulder can dislocate.

Dislocations of the shoulder joint can tear the rotator cuff muscles, making the patient more susceptible to further injuries. Similarly, the tone of muscles around the knee are crucial to its stability. Through inappropriate or unbalanced training, the knee can be made prone to injury through muscle imbalance. This can lead to chronic pain.

The end of first part