Jonathan Schmid Training

Category: Physical Practice

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Basic Joint Anatomy

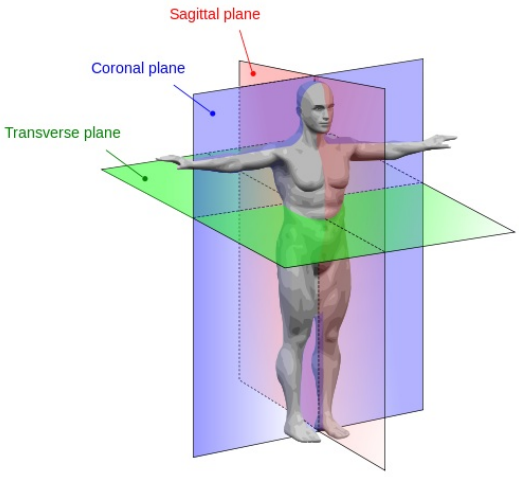
Definitions, Functions, Forms & Ranges

INTRODUCTION

Anatomy is the descriptive science of the structure or shape (morphology) of the human body, its tissues (histology) and their development (embryology). In this lecture you will receive a basic knowledge to joint anatomy which is necessary for our physical practice.

A joint is a movable connection between two or more bony or cartilaginous skeletal elements. In order to be able to orientate oneself on the body and to be able to communicate in language and writing uniformly about the body and movement, a certain basic knowledge of anatomy is necessary. In the course of time we will deepen this further, but this is just the beginning.

In order to ensure understanding and communication, in addition to anatomy, the body has several defined axes and planes in which movement takes place. This body planes are imaginary auxiliary planes that serve to orient the human body. It gives three main planes called Sagittal plane, Transversal plane and Frontal plane. Use the following image and the description next to it to get an overview:



TRANSVERSE PLANE OR AXIAL PLANE
(lateral, horizontal)
= divides the body into cranial and caudal (head an tail) portions

SAGITTAL PLANE OR MEDIAN PLANE
(longitudinal, anteroposterior)
= divides the body into left and right

CORONAL PLANE OR FRONTAL PLANE
(vertical)
= divides the body into dorsal and ventral (back and front; or posterior and anterior) portions

JOINTS OF THE HUMAN BODY

The body has many joints with different joint shapes:

- Hinge joints: These joints are located at the knees, elbows and fingers
- Swivel joints: Examples are at the ulna and radius (deutsch: Elle & Speiche)
- Saddle joints: Thumb base joint
- Ball joints: Ball joints at the hip and shoulder provide movement

Six of the human joints we call big joints. These include the shoulder, elbow, hand, hip, knee and ankle joints. The shoulder, elbow and hand joints belong to the upper body. The hip, knee and ankle joints belong to the lower body. All in all, we have about 140 real joints, but I will not go into them in detail now. In addition to the six large joints, I would also like to mention the spine here.

SPINE

The spinal column consists of 23 movement segments, which are made up of the vertebrae, intervertebral discs and the ligamentous apparatus. The connection between two vertebrae is relatively strong and corresponds approximately to a fake joint (synchondrosis), so that the mobility of a single mobile segment is low. The function of the spine is to stabilize the trunk, to ensure an upright posture and the greatest possible mobility. The spine also provides the spinal cord with bony protection against injuries.

The spine is built up by 24 free and 2 fused vertebrae (lat. vertebra), 23 intervertebral discs (lat. disci intervertebrales) and numerous ligaments (lat. ligamenta). The latter ensure a firm cohesion and also the mobility of the individual vertebrae among themselves. It gives 7 cervical, 12 thoracic and 5 lumbar vertebras. The first 24 vertebrae of the spinal column, starting at C1 of the cervical spine up to L5 of the lumbar spine, are the so-called free vertebrae. They are not firmly connected to each other, but are only held together by numerous ligaments. As a result, the human body is mobile in this region and can bend, stretch and tilt to the side. The vertebrae of the sacral spine (the sacral and coccygeal vertebrae) are fused together, which means they are rigid and cannot move freely like the upper vertebrae.

The 7 cervical vertebrae of the spinal column (vertebrae C1 to C7) and the 5 lumbar vertebrae (L1 to L5) are each curved forward towards the chest and abdomen when viewed from the side. This curvature is known as a lordosis in technical terminology, i.e. cervical lordosis and lumbar lordosis. The 12 thoracic vertebrae (Th1 to Th12) as well as the sacral (S1 to S5) and coccyx vertebrae are curved backwards. This type of curvature is called kyphosis. This is how the thoracic kyphosis on the one hand and the sacral kyphosis on the other hand are created.

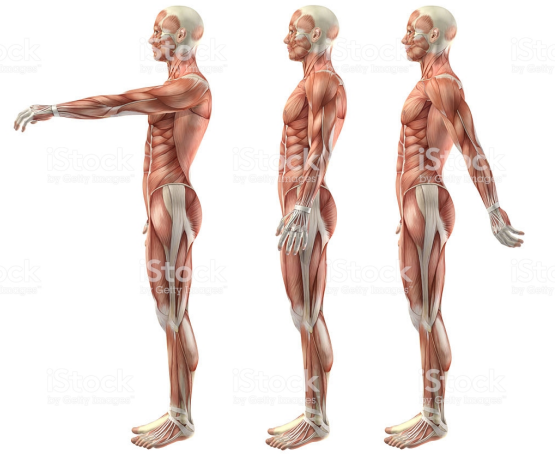
The resulting double S-curvature of the spinal column acts like a spring, which absorbs and evenly distributes shocks, as they occur with every movement of the body, over the entire spinal column. In this way, for example, the rather sensitive brain can be protected from the rather violent shocks that occur when walking.

SHOULDER JOINT

The shoulder joint (Articulatio humeri, humeroscapular joint) forms the shoulder together with the paraplegic joints, collarbone (clavicle), shoulder blade (scapula) as well as muscles, tendons, ligaments and bursae. It is the junction of the upper arm (humerus) and the shoulder blade.

The shoulder joint is a ball and socket joint and the most flexible joint in our body. It has a range of motion of 360 degrees. Because of this high degree of mobility, the shoulder is susceptible to injuries. This is partly because there are often stability deficits, but also because the joint is often underused. By this I mean that only a few percent of the 100 percent range of motion (360 degrees as a reminder) is used. Few people do much with their arms above their head and almost nobody uses the arms behind the body.

The range of motion of the shoulder is divided into flexion and extension. Flexion is the bending of a joint. The opposite movement is called extension. As a side note, this goes for all joints.



Source: iStock

The image on the left shows the shoulder flexion. This means shoulder flexion is the range with the arms in front of the body.

The image in the middle shows the neutral shoulder position.

The image on the right shows the shoulder extension. This means shoulder extension is the range with the arms behind the body.

The shoulder girdle has eight movement possibilities. The movement designations are used to describe the change in position and orientation of the body parts according to their biomechanical possibilities taking place in the joints. The eight possibilities are:

Elevation - Depression
Raising (towards the ears)/lowering (away from the ears) of the shoulder girdle (vertical body plane)

Protraction - Retraction
Forward/backward movement of the shoulder girdle (horizontal body plane)

Scapular outer rotation/scapular inner rotation
Outward/inward rotation (rotation of the humerus in the shoulder joint)

Scapula abduction/scapula adduction
Moving the arm away from the body/moving the arm towards the body

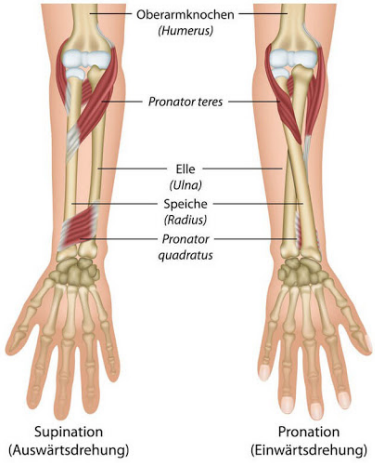
These possibilities of movement are important to understand, because they are demanded differently. Rarely alone, mostly in combination. The video Shoulder Positions & Anatomy gives a visual introduction.

ELBOW JOINT

The elbow joint is a compound joint (Articulatio composita) in which the humerus articulates with radius and ulna. In the elbow joint, flexion and extension of the forearm in relation to the upper arm and pronation and supination of the radius in relation to the ulna are possible. The following ranges of motion are based on the neutral zero position.

The flexion/extension takes place in the Articulatio humeroradialis and in the Articulatio humeroulnaris. A flexion can be performed up to 150° (angle between forearm and upper arm). An extension ability beyond the neutral position is not regularly given. From time to time there are cases which show a hyperextensibility of about 10°. In elbow extension, the triceps is contracted and the biceps (antagonist = opponent) is relaxed. In elbow flexion, the biceps is contracted and the triceps is relaxed.

Pronation/supination takes place in the Articulatio radioulnaris proximalis in cooperation with the Articulatio radioulnaris distalis. Both movements are possible up to an angle of 80-90°. When the radius is rotated, the Caput radii in the humeroradial joint moves with it. In pronation, the radius and ulna are in a cross position when viewed from the anterior side, and in supination they are in a parallel position. If the hand is in a position in between we call it neutral elbow position. When standing and the arms are hanging from the side the thumbs point to the front.



WRIST JOINT

The wrist is a colloquial term and describes the joint between the forearm and the proximal wrist (Articulatio radiocarpalis), as well as the articulated connection between the proximal and distal row of carpal bones (Articulatio mediocarpalis). It is a composite joint (Articulatio composita).

The Articulatio radiocarpalis is functionally considered an ovarian joint; it allows two different levels of movement which are palmar flexion and dorsal extension as well as radial abduction and ulnar abduction. Palmar flexion is the bending (flexion) of the hand or fingers towards the palm (palma manus). Dorsal extension is the stretching (extension) by fingers or hand in the direction of the back of the hand (dorsum manus). Radial abduction is the lateral displacement (abduction) of the hand or fingers in the direction of the radius. Ulnar abduction is the lateral displacement (abduction) of the hand or fingers towards the ulna.

HIP JOINT

The hip joint is the articulated connection between the pelvis and the thigh bone, which enables the movement of the leg and thus walking while stabilizing the body. The hip joint consists of the acetabulum and the femoral head (caput femoris). The acetabulum is formed by parts of the os ilium, the os pubis and the os ischii, which are connected by a Y-shaped joint in the area of the acetabulum. The upper edge of the socket is reinforced by a cartilaginous rim, the limbus acetabuli. The femoral head is an approximately spherical extremity of the femur, which presses into the acetabulum and thus enables a connection between the leg and the trunk. The hip joint is thus a nut joint, which is a sub-form of the ball joint (Articulatio spheroidea).

The hip joint has three degrees of movement (degrees of freedom), but these are restricted in their scope by the bony, cartilaginous and ligamentous guidance. Thus the hip joint is called the nut joint (enarthrosis) or cup joint (Articulatio cotylica). The hip joint has the following movement possibilities:

- Extension and flexion
- External rotation and internal rotation
- Abduction and adduction

In addition to the neutral position of the pelvis, it is also possible to tilt the pelvis forward (anterior pelvic tilt, short APT) or backward (posterior pelvic tilt, short PPT). The video 3 Pelvis Positions shows exactly this and also how you can find your neutral pelvis position.

KNEE JOINT

The knee joint is the articulated connection between the thigh bone (femur), shin bone (tibia) and kneecap (patella).

The knee joint is supported by two menisci (meniscus medialis = inner meniscus & meniscus lateralis = outer meniscus), two collateral ligaments (ligamentum collaterale medial, short MCL = inner ligament & ligamentum collaterale lateral, short LCL = outer ligament), two cruciate ligaments (Ligamentum cruciatum anterius, short ACL = anterior cruciate ligament & Ligamentum cruciatum posterius, short PCL = posterior cruciate ligament) and other ligaments.

Four movements are possible around the vertical axis and the horizontal axis, these are extension - flexion (through the hinge joint) and external rotation - internal rotation (through the swivel joint).

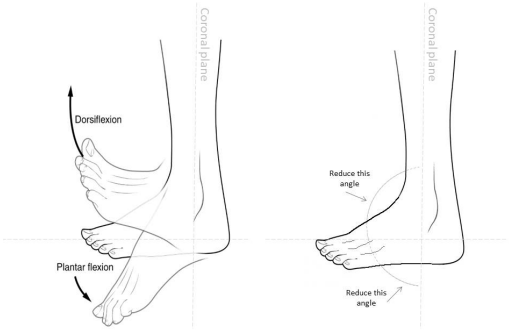
ANKLE JOINT

The ankle joint is the two main joints of the foot, which are composed of two partial joints, the upper ankle joint (Articulatio talocruralis) and the lower ankle joint (Articulatio talotarsalis)
(this is divided into anterior lower ankle joint (Articulatio talocalcaneonavicularis)
and posterior lower ankle joint (Articulatio subtalaris).

In the upper ankle joint (OSG) the following movements are possible:

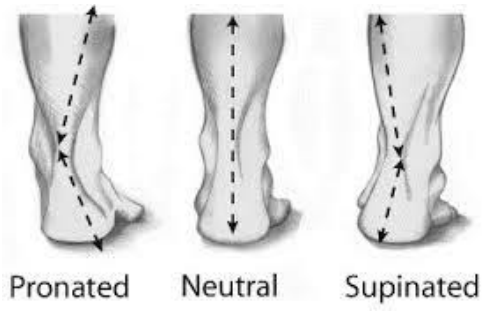
• Dorsal flexion (extension) of the foot up to 20°
Extension of foot or toes in the direction of the back of the foot (dorsum pedis)

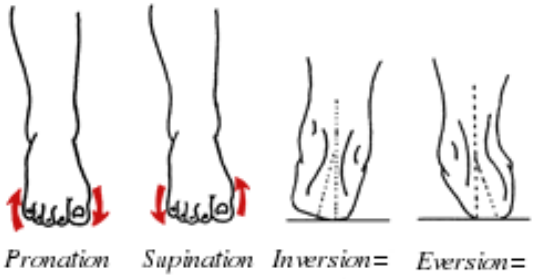
• Plantar flexion of the foot up to 30
Bending (flexion) of the foot or toes towards the sole of the foot (planta pedis)



In the lower ankle joint (USG) the following movements are possible:

- Supination (lifting the medial edge of the foot while simultaneously lowering the lateral edge of the foot) up to 50°
- Pronation (lifting the lateral edge of the foot while simultaneously lowering the medial edge of the foot) up to 30°
- Inversion (supination & plantar flexion & adduction together)
- Eversion (pronation & dorsiflexion & abduction together)





That's it about the basic joint anatomy. Before I finish this lecture please notice again this is a basic introduction. There are many more joints and also many more information about the listed joints. This document is intended to be an introduction to this topic, simply described, to which you can refer again and again in the future. So you have another chance to find out and understand things on your own. You are welcome to take inspiration from it and continue your own research in this subject area.