Chapter 9
Articulations and Joints

Hi, everyone. The next chapter that we’re going to discuss is articulations and joints. Because the bones of the skeleton are relatively inflexible, movement can only occur at articulations or joints, and this is where two bones interconnect.

Each joint reflects a compromise between the need for strength and the need for mobility. As a result, articulations differ in the amount of movement permitted and this property is known as range of motion. The anatomical structure of a joint determines the type and amount of movement that may occur. There are functional classifications of joints, which are based on the range of motion allowed.

Synarthrotic joints allow no movement. At a synarthrotic joint, the bony edges are quite close together and may even interlock. These extremely strong joints are located where movement between bones must be prevented.

Amphiarthritic joints allow only slight movement. An amphiarthrotic joint permits more movement than a synarthrotic joint, but is much stronger than a freely movable joint.

A diarthrotic joint is a freely movable joint.

These joints provide a wide range of motion, as typical in the joints of our appendages. Joints will weaken with increased range of motion and there are reinforcing structures that are in our joints to counteract weakening. We will discuss some of those later on in this presentation – and a dislocation is one type of joint injury that may occur, when you have a forced change at the articulating surfaces of a joint.

Joints can also be classified based on their structure. The structural classification of a joint is based on the anatomical components that make up a joint. There are three main categories – fibrous joints, cartilaginous joints, and synovial joints.

Fibrous joints are held together by fibrous connective tissue, but lack cartilage and possess no cavity between the bones. Fibrous joints are either synarthrotic or amphiarthrotic.

Cartilaginous joints are held together by fibrous connective tissue – such as ligaments, but they also possess either hyaline cartilage or fibrocartilage. Cartilaginous joints lack a joint cavity and are either synarthrotic or amphiarthrotic.

Synovial joints are held together by fibrous connective tissue, hyaline cartilage, and/or fibrocartilage, and DO possess the joint cavity. All synovial joints are diarthrotic. Synovial joints are quite complex in structure, are the most numerous type of joint in the body, and permit the greatest range of motion and because of this – we will talk about synovial joints in detail.

There are also sub-classifications of each of the joints. For example –

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

Cartilaginous joints can be sub-classified as synchondrosis or symphyses.
And then, synovial joints – we’ll discuss their special features.

But let’s first take a look at fibrous joints. Fibrous joints – one of the subcategories are sutures. Sutures are a synarthrotic joint, located only between the bones of the skull. The edges of the bones are interlocked and bound together at the suture by dense fibrous connective tissue.

Syndesmoses are a type of fibrous joint, where the bones are connected by an interosseous ligament and are amphiarthrotic. The most common example is the distal articulation between the tibia and fibula called the tibiofibular joint.

Gomphoses is a synarthrotic joint also known as a peg-and-socket joint. This type of joint is found on the maxilla and mandible, where the teeth are fixed securely in the sockets of the alveolar margins. The fibrous connective tissue between a tooth and its socket is called a periodontal ligament.

Cartilaginous joints can be subcategorized as synchondrosis or symphyses. A synchondrosis joint is a rigid, highly-cartilage bridge that unites the bones of this type of joint. One example is the cartilaginous joint found between the ends of the first pair of ribs and the manubrium of the sternum. Another example is the epiphyseal plate found holding the epiphysis of a long bone to the diaphysis. Symphyses are where you have articulating bones that are separated by a wedge or pad of fibrocartilage. The articulation between the vertebrae, where a thick pad of fibrocartilage forms the intervertebral disk, is a common example of this type of joint.

The pubic symphysis is another example of this type of joint. And here you can see the intervertebral discs – as one of the examples we just mentioned – and the pubic symphysis.

Synovial joints – remember – are freely movable and these types of joints have some characteristics; they have articulating bones that are separated by a fluid-filled cavity – a joint cavity. So not only are synovial joints composed of fibrous connective tissue and possess cartilage, they also possess a space between the articulating bones called the synovial cavity and they contain synovial fluid. This fluid is largely derived from blood and has a clear, viscous, egg-white consistency – even in the large joint such as the knee, the total quantity of synovial fluid is normally less than 3 milliliters. There are 3 primary functions of synovial fluid – lubrication, nutrient distribution, and shock absorption.

Lubrication is when part of an articular cartilage is compressed during movement. Some of the synovial fluid is squeezed out of the cartilage and into the space between the opposing surfaces. In turn, this thin layer of fluid markedly reduces friction between the moving surfaces. This is called weeping lubrication.

Nutrient distribution is when the synovial fluid in a joint must circulate continuously to provide nutrients and waste disposal for the chondrocytes of the articular cartilage. It circulates whenever the joint moves and the repeated compression and expansion of the articular cartilage pumps synovial fluid into and out of the cartilage matrix.
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Shock absorption is when a joint is subjected to compression. The synovial fluid provides a cushion against the shock. For example – when you jog, your knees are severely compressed and the synovial fluid distributes that force evenly across the articular surfaces and outward to the joint capsule.

Now there are some accessory structures that are typical of a synovial joint. Bursa is one. Bursa is a small, fluid-filled pocket that forms in a connective tissue. It contains synovial fluid and is lined by a synovial membrane. Bursa often form where a tendon or ligament rubs against other tissues. It's located around most synovial joints and this reduces friction and acts as a shock absorber.

Fat pads are another type of accessory structure in a synovial joint. Fat pads are localized masses of adipose tissue, covered by a layer of synovial membrane. They are commonly superficial to the joint capsule. Fat pads protect the articular cartilage and act as packing material for the joint. When the bones move, the pads fill in the spaces created, as the joint cavity changes shape.

Meniscus is a pad of fibrous cartilage, situated between opposing bones, within a synovial joint. Menisci may subdivide a synovial cavity, channel the flow of synovial fluid, or allow for variations in the shapes of the articular surfaces.

Ligaments also support, strengthen, and reinforce synovial joints. You can have an intrinsic ligament – also called capsular ligaments, which are parallel bundles of fibers creating thickenings within the joint capsule.

Extrinsic ligaments separate from the joint capsule and may pass outside – extracapsular – or inside – intracapsular – the joint capsule.

Now many different types of movements are allowed at synovial joints and you should be familiar with the types of movements.

For example – extension is a type of movement that increases an angle between the limbs. It's an angular movement within the anterior-posterior plane that increases the angle between the articulating elements. An example of this would be lowering the dumbbell back to a starting position if you are working out.

Plantar flexion is a type of movement that is the opposite to dorsiflexion – mentioned later, where you extend the angle – I'm sorry, ANKLE, and elevate the heel – like when you point your toes.

Hyperextension is an angular movement, where the body part is extended past the anatomical position – like when you're looking up at the stars.

Flexion is the opposite of extension and this is where you are decreasing or reducing the angle between the articulating elements – like lifting a dumbbell, as in a biceps curl.

And there are subcategories: lateral flexion and dorsiflexion.
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Dorsiflexion is flexion at the ankle joint and elevation of the sole – like when you dig in your heel.

Circumduction is where you move a limb in a circle, creating a cone in space.

Abduction is an angular movement within the lateral medial plane that moves the body part away from the longitudinal axis – like the first part of a jumping jack.

Adduction is opposite to abduction, and it's an angular movement within the lateral medial plane that moves the body part toward the longitudinal axis – the second part of a jumping jack.

Rotation – Rotation is where you're moving around a fixed point.

Medial rotation – for example, is where the anterior surface of a limb turns toward the midline of the body.

Lateral rotation is the opposite to medial rotation and that's where the anterior surface of a limb turns away from the midline of a body.

Supination – In the anatomical position, the forearm is supinated, with the radius and ulna lying parallel to each other and the palm is facing anteriorly.

Pronation is when the shaft of the radius rotates, the distal epiphysis of the radius rolls across the anterior surface of the ulna, so that the bones are crossing, the palm faces posterior – like when a basketball player pronates to dribble the ball.

Other types of synovial joint movements – Opposition is the movement of the thumb towards the surface of the palm or the pads of the other fingers – like when you snap to music.

Protraction is when you move a body part anteriorly in the horizontal plane.

Retraction is the opposite to protraction, and that's when you move a body part posteriorly in the horizontal plane.

Inversion is a twist motion of the foot that turns the sole inward, elevating the medial edge of the sole.

Eversion is the opposite to inversion, and that's a twist motion of the foot that turns the sole outward.

Depression is when a structure moves inferiorly – like opening the mouth.

An elevation is when a structure moves superiorly, as when you close the mouth.
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Now our joints do provide for mobility and we get a greater – when we have a greater range of motion, it can result in a weak or joint. So our synarthrotic joints are the strongest joints because they have no movement – and the diarthrotic joints are the most mobile joints and generally are the weakest.

One type of joint injury is a dislocation, which is also known as a luxation – and this is when reinforcing structures cannot protect a joint from extreme stress. The articulating surfaces may be forced out of position. The displacement may damage the articular cartilage, tear ligaments, or distort the joint capsule. Although the inside of a joint has no pain receptors, nerves that monitor the capsule, ligaments, and tendons are quite sensitive – so dislocations are very painful. A partial dislocation is called a subluxation.

There are 6 types of synovial joints that you should be familiar with and they are listed here – pivot, hinge, saddle – and then we'll talk about plane, condyloid, and ball-and-socket.

Now for each of these types of joints, they are described based on the types of surfaces or the shape of the articulating surfaces of the bones. So they're basically an anatomical class of synovial joint, based on the shape of the articulating surfaces of the bone.

A pivot joint is where you have the rounded end of one bone that protrudes into a sleeve or ring composed of a bone or ligament. The proximal radioulnar joint is an example; the dens of the axis to the atlas is another example.

A hinge joint is where you have a cylindrical projection of one bone that fits into a trough-shaped surface on another bone. Your elbow joint or knee joint are examples of this.

A saddle joint is where you have an articulating surface that has a concave area on one that fits with the convex area of the other. The first carpometacarpal joint and the thumb is an example.

A plane joint is also known as a gliding joint, and this is where you have articular surfaces that are flat and only allow for short gliding movements. The sacroiliac joint is an example.

A condyloid joint is also known as an ellipsoid joint, and this is where you have an oval articular surface of one bone into a complimentary depression in another. The radiocarpal joint is an example of this.

And finally the ball-and-socket, where you have the spherical end of one bone that articulates with a cup-like socket of another bone. Your shoulder and hip joints are examples of these types of bones.

And here you can see an example of a pivot joint – that we talked about earlier.

Now there are various types of joint injuries that you should be familiar with. We already discussed dislocations, but sprains are another type of common joint injury – and a sprain is where you stretch or tear a ligament across the joint capsule.
Bursitis, tendinitis, and synovitis are all referring to inflammation – whether it's inflammation of the bursa; inflammation of a tendon; or inflammation of the synovial membrane.

Arthritis is an inflammatory – or a degenerative – disease of the joint, where synovial membranes thicken and fluid production decreases resulting in friction and pain. Arthroscopic surgery may be necessary to treat joint injuries or artificial joints may need to be installed, when a joint is damaged beyond repair.

Osteoarthritis is also known as degenerative arthritis or degenerative-joint disease and generally affects individuals age 60 or older. It can result from the cumulative effects of wear and tear on the joint surfaces or from genetic factors affecting collagen formation. In the United States, about 25 percent of women and 15 percent of men – over the age of 60 – show signs of this condition.

Rheumatoid arthritis is an autoimmune disease and this can occur at any age – but is more common in the middle-aged and women. Women get more rheumatoid arthritis than men. Infection, genes, and hormone changes may be linked to this disease. Rheumatoid arthritis usually affects joints on both sides of the body equally. The disease often begins slowly, with only minor pain, but progressively can become very debilitating.

Gouty arthritis is gout, which is caused by too much uric acid in the blood. Most of the time having too much uric acid is not harmful. Many people with high levels in their blood never get gout, but when uric acid levels in the blood are too high, the uric acid may form hard crystals in your joints and it can cause an attack of sudden burning pain; stiffness; and swelling in a joint – usually in the big toe. These attacks can happen over and over unless gout is treated and it's more common in men.

And here are some examples of the types of movements that we talked about earlier demonstrating the different types of movements at synovial joints. So you've got some representative pictures demonstrating flexion, extension, hyperextension, abduction, adduction, etcetera.

And then finally – knee injuries. Again the synovial joints of the body are the weakest because they allow for the greatest range of motion and if you have – for example – a strong blow to the lateral side of an extended knee, it can cause injuries; it can cause tearing of ligaments; damage to the meniscus; or rupture of ligaments – and surgery may be needed to correct this.

This concludes the chapter on articulations and joints.