Joints: Structure and Types of Motion

(0:00 - 0:28)

Professor Dave here, let's check out some joints. We just learned about all the bones in the human body, but if these are so hard, how is it that the human body is so flexible and bendy? Such variety of motion is made possible by things called joints. These are found where bones meet, so let's go through the structure and function of all the joints in our bodies.

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First of all, we can classify joints either by their structure or by their function. If by function, we are referring to the extent of mobility that is provided by the joint. Synarthroses are immovable, amphiarthroses are slightly movable, and diarthroses are freely movable.

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These each serve their own particular purpose within the skeletal system. Then if going by structure, we can discuss fibrous joints, which tend to be immovable, synovial joints, which tend to be freely movable, and cartilaginous joints, which exhibit a range of mobilities. Let's zoom in on each structural classification.

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First, with fibrous joints, there is a lot of dense fibrous connective tissue, and no joint cavity to speak of. These joints are for connecting bones that don't require a lot of movement. There are three types of fibrous joints.

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These are sutures, syndesmoses, and gomphoses. We talked about sutures when we looked at the skull, and this is the only place we will find them. They contain many interlocking fibres of connective tissue that are connected to the periosteum of each bone, allowing them to tightly interlock, and this tissue eventually turns into bone, or ossifies, so that by middle age, the skull bones are all fused together, at which point the sutures become synostoses.

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The next type of fibrous joint is syndesmoses. This is where bones are connected only by ligaments, which are bands of fibrous tissue. We see this connecting the radius and the ulna.

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Here the fibres are short, which prevents movement. And the last type of fibrous joint are gomphoses, which are like a peg-in-socket type of joint. This only occurs between a tooth and its alveolar socket, as the teeth are more or less embedded in these, and the ligament present

is called periodontal ligament.

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Next after fibrous joints, we have cartilaginous joints. Here as one might guess, bones are connected by cartilage. These also lack a joint cavity and are not particularly movable.

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There are two types of cartilaginous joints. The first are synchondroses, which contain hyaline cartilage. Before we mentioned the epiphyseal plate in long bones of children which allow for bone growth, and that is an example of this type of joint.

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The first rib also has one of these between the costal cartilage and the manubrium of the sternum. The other type of cartilaginous joints are symphases, and these are made of fibrocartilage. This is compressible, so these joints are meant to be shock absorbers.

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We can find these in between vertebrae and in the pelvis. Lastly, we have synovial joints. These are the ones that have an actual cavity filled with fluid, which allows for substantial mobility.

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Most joints are of this type, especially the ones in our limbs. The structure of these is more complicated, but let's note a few features. First, articular cartilage covers each opposing bone surface, protecting the ends of the bones.

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Then there is the joint cavity. This contains synovial fluid, which is very viscous, containing hyaluronic acid secreted by cells that are in the nearby synovial membrane. This fluid acts as a lubricant and reduces friction between the layers of cartilage.

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The synovial membrane together with the fibrous layer that flanks it comprise the articular capsule, and beyond that are some reinforcing ligaments as well as nerves and blood vessels. Beyond this basic structure, some synovial joints have fatty pads or discs of fibrocartilage separating the articular surfaces. These are also known as menisci.

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Closely associated with synovial joints are often bursae, flattened fibrous sacs containing synovial fluid, as well as tendon sheaths, which are similar but much longer and wrap around a

tendon. These serve to lubricate certain surfaces and reduce friction between adjacent structures. Now that we know about the types of joints and their structural features, let's learn about the terminology that refers to the types of motion they allow.

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Muscles, which we will discuss next, have an origin attached to an immovable bone and an insertion attached to a movable bone. When muscles contract around joints, we get movement, and we can describe this motion by referencing certain lines or axes, as well as certain planes of space. First for synovial joints, there can be non-axial movement, which are slipping movements, uniaxial movement, which happens in one plane, biaxial movement, which happens in two planes, and multiaxial movement, which happens in all three planes of three-dimensional space.

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Beyond this, motion can be gliding, angular, or rotation. Gliding movement happens when one flat bone surface slips over another. This happens at the intercarpal and intertarsal joints, allowing for left and right wrist motion.

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Angular movement happens when the angle between two bones changes. An example of this is flexion, which decreases the angle of the joint, like when bending the head forward, or bending forward at the waist. The opposite of this is extension, which increases the angle of the joint.

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Straightening your neck or elbow or knee will achieve this. And hyperextension goes beyond this, like when bending your head back, bending backwards at the waist, and so forth. Then there is abduction.

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This is motion of a limb away from the midline plate of the body, such as moving your arms up and away from your sides. Adduction is the opposite, moving a limb toward the midline plate of the body, like bringing your arms down to your sides. Circumduction involves making circles with a limb, such as arm circles.

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And lastly, rotation involves the turning of a bone around its own axis. This happens at hips and shoulders, and it can be categorised as either internal rotation or external rotation. Beyond this are some special movements that don't fit into these categories, like supination and pronation, which has to do with the radius moving around the ulna in the forearm, dorsiflexion and plantarflexion in the foot, as well as protraction and retraction of the mandible, among others.

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There is much more we could say about each individual joint, but since we have the basics covered, that completes our introduction to the skeletal system. Now we are ready to learn about the muscles that are attached to these bones and joints, which will give us a much better understanding of how the human body works, so let's check out muscles next. And as always, feel free to email me.