

Skeletal system

Hello and welcome to module 2, the human body. We have previously discussed an introduction into human movement science. We have understood what the field entails. We have also looked at a couple of interviews of experts in the field and how they utilize movement analysis of the study of human movement science in their day-to-day professional lives. So, before we understand the mechanics of the movement, which we will follow in the next few modules, let us understand the human body. The human body is a very fascinating, complex machine, as you all know.

It consists of different systems in the body. But for first and importantly, let us look at the musculoskeletal system. So, in this module, we will be looking at the human body, specifically the musculoskeletal system, functions of the musculoskeletal system, skeletal structures, so the important structures are there within the musculoskeletal system that allow for movement that are designed for movement. We will also be looking at the anatomy of human joints.

So, how exactly do we move? Where do these bones connect? Right. So, the musculoskeletal system, it is an intricate network of bones and muscles. You also have skeletal structures of tendons, ligaments, and joints that collectively support the body's structure. They enable movement, and they also protect vital organs. So, it is very important that the muscles and bones work in integration or harmonious integration to provide structural integrity and also to allow for movement, which is key for overall functional and well-being of the human body.

So, the skeletal system is made out of 206 bones in our body. The human skeletal system provides structural support, as we learnt earlier. It also helps us protect vital organs and assist in movement. So, it is composed of bones, cartilage, ligaments and tendons. So, all of these are different connective tissues that we will be studying as we progress in this module, and they are quite key to know, they are quite key to understand movement.

So, this system is divided into axial and appendicular skeleton. So, just for our purpose of understanding and for easier understanding per se, it is divided into axial and appendicular skeleton. So, let us look at this nomenclature and the division. So, the axial skeleton plays a fundamental role in maintaining the body's form and function. So, it is very important we know what its role is and what does it consist of.

So, the axial skeleton consists of the skull, it consists of the rib cage that protects your lungs and your heart. So, gives structural support and then also our vertebral column that supports the spinal cord inside. So, in the vertebral column, we have cervical vertebrae, we have thoracic vertebrae, we have lumbar vertebrae and sacrum or sacral vertebrae. So, just a note that although we are covering the human musculoskeletal system for human movement science purposes, of course, we do not delve too much into the detail of what these vertebrae look like. It is key to understand what each function is, how they are designed to know what movement is allowed at each of these vertebrae.

And for you to know more, we do have other modules as well that dwell into anatomy and physiology. So, I would highly recommend to get into the details. But for this module, we will be sticking to brief details of the axial skeleton, its function, and what does it consist of. Specifically, let us look at the skull. What does the skull do? The skull protects the brain and the sensory organs within it.

So, let us do brain, and it protects, so it provides stability there as well. Then, we have the vertebral column that supports and encases the spinal cord, as we spoke about earlier. And the rib cage that protects the thoracic organs like heart and the lungs. The appendicular skeleton facilitates movement, stability, and the interaction within the environment. So, this term appendicular here means parts that append or attach.

So, what that means is, you have the upper limbs and lower limbs of the body that attach to the girdles. Let us look at these girdles in details in the next slide and that connect them to the axial skeleton. So, what are these girdles that we are talking about? So, you have the pelvic girdle, you have the pelvic girdle, and you have the shoulder girdle. So, these upper limbs, what do they do? Their function, it is enable intricate movement, including reaching, grasping, manipulating objects are some of the essential movements of the upper limbs. So, the lower limbs, on the other hand, support body weight, balance and also facilitate locomotion or movement.

So, let us look at these girdles. So, we have something called as the pictorial girdle or the shoulder girdle. So, it connects these this upper limb to the, connects the upper limbs to the axial skeleton. So, what does it consist of? It consists of this shoulder blade. So, the shoulder blade called as scapula, and then you have your collar bone that is your clavicle.

So, that is your pictorial girdle or shoulder girdle. So, its key function is to provide mobility and flexibility to the arms that it is attaching to the axial skeleton. So, the pelvic girdle, it attaches the lower limbs to the axial skeleton. So, that is the pelvic girdle. So, its function is to support body weight and provide stability.

So, as we know that the hip bones take most of the weight of the body and the pelvic girdle that it attaches to, and it provides support and stability. So, let us look at some of the skeletal structures in the body now. So, one of the key or the main skeletal structure is the bone. So, what is the bone? As we spoke about earlier, it is a connective tissue that provides structural support, protects the internal organs, and it also serves as an attachment site for the muscles. It is very important to know this is it serves as an attachment site for the muscles.

So, bones, they are quite dynamic. They undergo constant remodeling through bone reabsorption, there is bone formation. So, whenever you have an injury, and you know, you are building a new bone, or when you have a fracture, and the bone is broken down, it has the capacity of healing. So, they are quite dynamic, and they undergo constant remodeling through the processes of bone resorption and bone formation. So, bone health is quite crucial for structural integrity, the overall

integrity of the human body, and it requires good diets, good nutrition, good balance of exercise, hormonal regulation, quite key for bone health.

So, how are these bones categorized into? You know, it is very important to know them, we have 206 of them. So, let us look at how these bones are categorized, and based on the categorization, what is their function? So, the first category is long bones. So, they are called long because they are longer than they are wide. So, imagine the femur bone in the body. So, that is your femur, which is your thigh bone.

You can also look at humerus, which is that bone, so your upper arm bone. So, these are longer, so they are longer than they are wider. So, what is its function? They support body weight, and they enable movement. The next category of bones is short bones. So, as opposed to the long bones, they are nearly equal in length and width.

So, as you can see, it is pretty much equal in length and width. So, you can look at our wrist bones or our ankle bones, that are equal in length and width. So, these are short bones, and they provide stability and support. Also, in addition, they are also attachment sites for your ankle and wrist muscles. Flat bones, on the other hand, which is our third category, they are thin, and they are quite flattened.

So, example, the skull bones, quite thin, flattened, right? Also, your scapula, another example of a flat bone, and your sternum. So, your sternum is where your rib attach. So, as you can see here, they protect the organs and provide surface for muscle attachments. So, all of your rib muscles, which are called as intercostal muscles, so they attach here. Your shoulder muscles or rotator cuff attached to the scapula, and then, of course, the skull protects the brain inside it. A fourth category is something called as irregular bones.

So, we have looked at long, short, and flat, but something of an irregular bone is they do not have a particular shape. So, they are complexed shaped. So, for example, vertebrae, as you can see, they are neither long, neither short, neither flat; it is an irregular bone. And what they do is they form the vertebral column. So, they form this vertebral column, and they provide support and protection to the spinal cord, as we have looked at earlier.

So, based on just an additional information for you, based on where these are located, so based on location, the shape of these bones, shape of these vertebrae, they change. So, let us look at our fifth category, which is the sesamoid bones. So, sesamoid bones are, they are quite small and they usually embedded within the tendon. So, let us look at tendons in the next few slides, but for you to remember, they are small and they are embedded in the tendon. So, for example, your kneecap, that is the best example.

So, that is your kneecap, and you have the patella bone that is embedded in the kneecap. So, what is the function of the sesamoid bone? They reduce friction and protect tendons from excessive wear and tear. So, all of your ACL injuries, PCL injuries, very, very, very important to keep a

healthy knee joint that is protecting the patella bone and the tibia and the femur that is attached to it. So, let us look at type of joints. Now that we know the different type of bones and how they are categorized based on shapes, let us look at type of joints.

So, what is a joint? A joint is a connection between two or more bones. So, this is particularly to allow movement. So, for us to understand movement, where it is occurring, how does it occur, it is very important for us to understand the type of joints. So, these type of joints, they are classified by movement capability.

So, let us look at the first one. So, synarthrosis is an immovable joint. So, syn here means held together firmly, coming together firmly. And arthrosis means it is a medical term. So, it is a medical term for joints. Just makes the understanding and remembrance of this word easier.

So, your syn means together firmly, and arthrosis means joints. So, synarthrosis is an immovable joint. So, example, the sutures of the skull, so they do not really move. So, it is a joint where, as we said, bones are held together firmly and do not allow for movement. So, their role is to provide stability and support to the structures they connect.

So, we have looked at it enough now that the skull protects the brain and the structures within it and provides stability as well to your head. So, let us look at diarthrosis, which is our second type of joint. So, di is either two or both. And arthrosis, as we know, is a joint.

So, these are freely movable joints. For example, elbow, shoulder, and hip. So, in this joint, two articulating surfaces, so two surfaces that are attaching together, are within a joint cavity that allow for a wide range of movement. They are also known as synovial joints. So, synovial joints is because of this liquid, which is a synovial fluid that is important for shock absorption.

So, important for shock absorption. And they are the most common type of joints in the human body. So, they are characterized, as we said, by a joint capsule. So, there is usually a capsule, the fluid, and an articular cartilage. So, we will see more about cartilages and tendons in the following few slides. All you have to remember is they are categorized by a joint capsule, synovial fluid, and articular cartilage that allow for smooth and flexible movement.

It is very important that synovial joints as they are the most common type of joints in the human body. So, another type of joints is amphiarthrosis. Amphi means both, which means that it has limited mobility. So, it does not have much mobility, and it also has mobility, which is why it is called amphiarthrosis, as he looked at his joints.

So, example, the adjoining vertebrae. So, they have limited mobility within them. So, joint which allows for a slight or limited movement on both sides. So, it is important. So, imagine yourself side bending or doing a slight flexion. So, you have these adjoining vertebrae that are providing this movement on both sides.

So, they provide stability and support while allowing for limited movement, as we looked at. So, now that we looked at the different categorization of the joints, let us look at how are these named and, based on their type or the shape of these joints, how exactly the function happens. So, based on the nature and the type of the joint, movement availability varies. How the movement availability varies and what movement is available at each joint, we will be looking at that in module 3.

For now, let us look at the type of joints. So, the first type of joint is a pivot joint. So, that is a first type of joint. So, what do you mean by the word pivot? So, this joint got its name for categorization from something that pivots. So, which has a rotational movement and it has around a central axis. So, around that axis, you are having this rotational movement.

So, example of that is a neck joint. So, here at your cervical vertebra, so again, for your more understanding, at C1, C2 vertebra, you have the neck joint. So, what does it allow for? It provides necessary range of motion, which is nothing but movement while providing stability and support. So, that is your pivot joint. The next type of joint is saddle joint. So, as this word suggests, saddle, the joint is shaped like a saddle.

So, as you can look here, it has concave and convex surface. So, this is your concave and convex surfaces. So, where are these present? They are present in the carpometacarpal joint of the thumb. So, it is present in the carpometacarpal joint of the thumb. Now, based on its shape, it allows for wide range of motion.

So, we have wide range of motion at the thumb, and its function is to look at fine movements. So, the fine movements that we do with the thumb, like writing, you know, like holding, grasping, all of those movements. It also provides for a unique motion, which is, you know, the ability for you to touch your thumb and your pinky finger or all your fingers. So, it allows for unique motion because of its shape.

So, that is the saddle joint. The next type of joint is the plane joint. So, plane joint here, as the name suggests, is characterized by flat and relatively smooth surfaces. So, imagine these flat and relatively smooth surfaces that can slide and glide. So, your two surfaces that can slide and glide over each other, over, that is, the plane joint. So, what are they designed for? They are designed for again stability.

Most of the joints, of course, are designed for stability, and they are also quite versatile as they provide wide range of motion. So, these are, for example, your intertarsal joint here. So, the next type of joint let us look at is hinge joint. So, as the name suggests here, hinge again. Imagine like a mechanical hinge on the door, which allows for movement in one direction. So, again, like the previous joint, we have a convex and a concave interlock, same as the hinge.

So, you have the convex and the concave interlock interlock-like door, like the door hinge. So, it primarily allows for one-direction movement, same like the door. So, how the door opens and

closes and provides stability as we know, all joints do and control for specific movements. So, in this case here, imagine bending your arm and straightening it. What is this motion called? We will look at it in the next coming modules.

So, that is at the elbow joint, and another example is the knee joint. Both of them are hinge joints. Now, let us look at condyloid joint. Now, this condyloid word here comes from one of the sides of the joint being shaped like an oval, which is also called an ellipsoid, and the other one has a ball head. So, one side has the ball head, the other one has a ellipsoidal, you can say cavity or a depression where it attaches.

So, its function is again to provide stability and versatility for wide range of movements. And the example here is a wrist joint. So, your radiocarpal joints, you have a lot of movements at the wrist. Again, detail of these movements, we will look at it in the coming modules, and also your knuckle joints as well. So, let us again, this joint provides unique actions like waving your hand, fingers in multi-direction.

Now, let us look at the last type of joint, which is your ball and socket joint. So, again, here you have a concave socket, that is your concave socket and then you have the bone with the ball head. So, that when these two attach, you get a ball and socket joint. So, these allow for wide range of movements in multiple directions, and because of that, they are the most mobile joints in the body.

So, example of this is your hip joint and then also your shoulder joint. So, your hip joint, that is the hip joint and your shoulder joint. So, they provide stability, mobility, flexibility, and they are quite versatile as they provide wide range of movements. Now, that we have looked at bones, type of bones, let us look at some of the structures that we mentioned earlier and then we came across earlier, which are tendons, ligaments, cartilage, and fascia. So, as you can see here in the image, tendons, cartilage, ligaments, and fascia are quite crucial connective tissues. So, they all have a very distinct role that they play, but commonly, they support and enable movement and provide structural integrity similar to the, as the bone does.

So, tendons, let us look at them first. They are connective tissues that attach muscle to the bone. So, they either wrap around bones or they pass over joints. So, this here is a tendon. It is attaching the muscle to the bone. So, what is their function? They transmit the force that is generated by the muscles.

So, the force then gets transmitted by the muscle to the bones, and hence, they are quite important for efficient movement and stability. So, injuries such as tendonitis, which is an inflamed tendon, or any kind of tear here, so any kind of tear here may result from either overuse, very common if we do not pay attention to how our workouts and everything are designed, if we do it or if we overworkout. If there is any trauma, improper technique, we will talk about this in module 6, improper technique during physical activities or sport. So, it is quite important to maintain good tendon health so that the force that is transmitted by the muscles can reach the bone that allows for efficient movement.

The next skeletal structure we are looking at is a ligament. Let us not get too overwhelmed with this picture of the knee. We just have couple of things that we spoke about earlier. We have the femur bone, which is your thigh bone, and then this is your tibia. This is patella. So, we spoke about earlier which is a sesamoid bone, and then we have this as your tendon, like we looked at in the previous slide.

So, it is attaching the quadriceps muscle to the patella. So, it is called a quadriceps tendon. So, this is the articular cartilage that we talk about. Let us look at it in the next slide. And the ligament here, it connects bones to bones. So, as you can see it in the picture, it connects bones to bones and provides stability to the joint.

So, for example, this one here, which is your anterior cruciate ligament, which is nothing but your ACL, and your posterior cruciate ligament, which is nothing but your PCL. Two very important ligaments of the knee, we will be looking at how to manage injuries, reduce injuries with related to these two ligaments in sport. So, for now, ligament is a skeletal structure that connects bones to bones to provide stability. Now, the ligament here, which has got your patellar tendon ligament, it is connecting the small bone of patella to the tibia. So, it is very important that your ligaments help your knee to maintain a natural alignment and prevent excessive and abnormal joint movement.

So, injuries to the ligaments, like sprains or tears, are generally a result of sudden twisting motion or excessive force on the joint. So, in sport like soccer and basketball, ACL injuries are quite common. We will be looking at the injury mechanics in the following modules. But for you to remember that sprains and tears of the ligament are due to the sudden twisting motion or excessive force on the knee joint.

Another skeletal structure that we finally come to is the cartilage. So, cartilage is a tough, it is a very tough, flexible connective tissue, and its main function is to cushion the joints. So, it provides structural support and also allows for smooth movement between the bones. So, for example, if you have a look at here, you have your articular cartilage.

So, this cartilage here, for example, it is very important that it cushions the joint. So, it cushions the joints and also allows for the movement. So, damage to the cartilage, such as in osteoarthritis, which is a clinical condition, can lead to joint pain and decreased mobility. Another important skeletal structure is what we know as fascia. So, fascia is a connective tissue that surrounds muscles.

So, we have looked at muscle to bone, bone to bone. Another important connective tissue is the cartilage that we looked at in the earlier slides. But fascia here is a connective tissue that surrounds muscles or group of muscles or blood vessels and nerves. So, what it does is it provides support and protection to these structures.

So, as we can see here, that is a fascia. So, it is providing, it is surrounding this muscle. So, it also helps compartmentalize different muscle groups. So, imagine the muscle groups in your calf muscles. Fascia helps compartmentalize these different muscle groups and provides pathway for blood vessels and nerves to travel through the body. So, it is an important connective tissue. So, injuries to the fascia can occur when it becomes extremely tight and also develops trigger points.

So, as you must have, you know, going to your physio with tight trigger points or fascia being tight, it can lead to discomfort or pain in the muscles and the tissue. So, that is a minor injury to the fascia. So, in this entire module, let us just recap and look at the summary. So, what did we learn about? We learnt about the human skeletal system, its major role, which is to provide structural integrity, protect vital organs, and also assist in movements. What is it composed of? It is composed of your bones, skeletal structures like cartilage, ligaments and tendons.

A bone, as we looked at, is a specialized connective tissue, and they are classified based on their shape. When two bones come together to form a connection to allow for movement, it is known as a joint, and these are categorized based on movement capability. We also looked at tendons, cartilage, ligaments, and fascia, which are crucial connective tissues that each have a very unique role that help in providing structural integrity again, support and also allowing for movement.