

## Anatomical planes and axes of motion

Hello, and welcome to week two of Human Movement Sciences. In this module, we will be looking at functional anatomy. So, you might be asking, we just finished anatomy, and that was human anatomy. So, what is functional anatomy? Now functional anatomy relates to how the body moves, not just the components of it. So, we have studied the individual components so far, like skeletal system, muscular system, neuromuscular system, joints, neural system. All of these are individual components. How they come together to work as a cohesive unit is what functional anatomy is all about.

So, within functional anatomy, by the end of this module, you will be able to identify some of the key things, the key terminologies which are used for defining, which are used for defining the movements within the context of functional anatomy. So, some of those things are the anatomical planes and the axes of motion. Further, you look at the major joints within the skeletal system and what are their actions, the kinds of movements they can exhibit, which muscles might be involved in that, explain the role of muscles in movement, and finally, differentiate between different kinds of posture, which is to say, understand the form of a particular movement. And in that, we will also cover static posture, which is how you hold yourself and dynamic posture, which is how you move.

So let us dive into anatomical planes and axes. So, what are anatomical planes? These are imaginary flat surfaces, which are used to describe the orientation of the human body and to describe the movements that happen within the body. So, there are three planes, sagittal, frontal, and transverse. So let us look at these individual planes. The sagittal plane divides the body into left and right halves.

So, it is like this. If this is the human body, there is a plane that goes straight through the middle of the body. Movements in this plane usually include flexion and extension. So, if I was looking at, say, the side view of certain movements, here the knee is flexing and extending. Here the ankle is flexing and extending.

So, this is. So essentially, you are looking at the movements from the side view. You are looking at the movements from the side view. Frontal plane divides the body into front and rear halves like

so. So, there is a plane that goes straight through the middle of the body, dividing it into front and back parts.

Movements in this plane usually include adduction, which is the exercise of moving the segment away from the body. So, this is adduction or abduction, where you are bringing it closer to the centerline of the body. So, this is the centerline of this body here, and you are bringing it closer. This is abduction. You are taking it further away, that is adduction.

The transverse plane divides the body into upper and lower half. So, above your waist and below your waist. So rotational motions, you know when you are doing a twist, those kinds of movements are typically in the transverse plane. So, for example, you are basically looking at the movement from the top view. So, the hand here is moving in the transverse plane.

Now let us take a look at anatomical axes of rotation. So, axes are always associated with some sort of rotation. So, these are imaginary lines around which a particular joint move. There are three principal axes corresponding to each of the planes. You have the sagittal axis, the frontal axis, and the vertical or longitudinal axis.

So, the sagittal axis is part of the sagittal plane and runs from front to back like so. So, movements like adduction and abduction happen along this axis. Frontal axis is in the frontal plane and goes from left to right like so. And movements in the sagittal plane, such as flexion and extension are associated with this particular plane. So again, this is the axis going into the plane, and that is your frontal axis, and the movement is a flexion and extension.

The longitudinal axis runs vertically from top to bottom. So, this goes along this particular direction and the rotations happen in this. So, the rotations in the transverse plane are typically associated with the longitudinal axis. Again, the same twisting movements if you were to perform those. Finally, anatomical directions.

So, these are standardized terms and references that are used to describe directions when you talk about the human body. It is just to make sure that everyone who is a stakeholder in this exercise is on the same page and using a similar language, across healthcare professionals, researchers, and everyone else who is involved in this. So let us take a look at these. So, to start with, let us first

define what is the anatomical position. A position in which the body is upright, facing forward, palms facing forward, and feet are parallel.

So, in 3D, this is the same. So, this is the image that we saw for the frontal plane. And the palms are facing forward, the feet are facing forward and parallel and the stature or the posture is upright, looking forward. So, in this anatomical position, all the directions are defined with respect to this particular position. So let us take a look at these positions.

So, first of all, we have medial and lateral positions. So, all of these are defined with respect to the centerline of the body. So, if this is the centerline of the body, this will be in the front view. So, I can say that the ears, the ears are lateral to the nose. So, these are further away from the nose, from the central line.

So, these are lateral to this particular centerline. So, these are lateral to the nose. Now the nose is medial to either of the eyes. So, this example was a bit obvious because the central line is passing through the nose itself. But let us look at some other points.

So, I have my knee here. So, these are called the epicondyles. So, this is medial epicondyle. And the reason this is medial is because this is the one closer to the centerline, towards the centerline for the right-side segment. And this one is the lateral epicondyle.

All right. Same way, you can say the shoulder joint is lateral to the clavicle. So, this here is the clavicle. The shoulder joint, the joint center is somewhere here. That is lateral to the clavicle. Same way you can have points on the left side as well.

So, this would be the medial point, and this would be the lateral point. So, this is of particular importance because these terms are used for motion tracking as well. When you are trying to quantify the movement of a person, then some of these terms are used for anatomical positions and for defining directions of motion, and referencing limb segments. Next, we have anterior and posterior. So, if this was the midline that was passing through the side view of the body, then this is the anterior direction, and this is the posterior direction.

So those of you who have, you might have heard the term posterior chain, which refers to your, the muscles and the neuromusculature in the rear part of the body. There are terminologies. These terminologies are used to define, say movement as well. So, movement in the anterior posterior

direction is when I am moving forward and backward. And by that logic, everything can be defined in terms of forward and backward.

So, the chest is in front of the spine. So, we will say the chest is anterior to the spine. Same way for posterior. You have your ribcage here. So, the shoulder blades, which are these, which is this structure here, is posterior to the ribcage. So superior or cranial refers to structures being higher or above another.

So, as you can probably guess, the brain or the head is superior to the chest or superior to the neck, not just because it is the brain but because it is above in this direction. Same way, you have inferior, which refers to structures being below another. So again, the neck is inferior to the brain. The feet are inferior to the knees.

So, it is the downward direction. These are, again, relative terminologies that are used. Further, we have proximal and distal. So, these are used primarily for the appendages and with respect to the joint where the appendages, where the particular limb segment is attached to the previous segment. So, at the shoulder joint, the elbow is closer to the shoulder joint, and wrist is further away from this joint. Proximal to the wrist. Again, the palm, which is this region behind here, and these are the fingers.

So, if I was looking away from here, then the fingers are distal to the palm. Same way, this is the distal end of my leg of this leg. This is the proximal end of the leg. The knee is proximal to the foot. So that concludes all the primary terminology that we will be using in this course and in this community in general.

Some practical examples. I can look at a person on a stationary bicycle. So stationary bicycle. Now the movements will happen in which plane? As this person cycles the movements are happening in this plane parallel to the center of the body. So, the primary movements are in the sagittal plane.

That is correct. Are there any movements in the frontal plane or in the coronal plane? There might be. So, as you are holding the bicycle, you might be swaying or moving to keep balance of some sort or to not fatigue the muscles, and then you have movement in the coronal plane as well. Especially if it is one of those exercise bikes, not these stationary bikes, one of those ones which

have the hand movements as well. In that, you have movements in the sagittal plane in the coronal plane. But this by itself is a predominantly sagittal plane activity.

So predominantly sagittal plane. On the other hand, let us take a look at something like a golf swing. So, the movement happens across the body. The body has to turn and twist, also swing. So, there is movements in all the planes. Maybe the primary movement is in the coronal plane.

Components of movements are also there in the sagittal plane and in the frontal plane. And I will see you in the next one.