

**Exercise & Sports Biomechanics**  
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**Week 02**  
**Lecture06**

**Joint Movements**

[Hello, everyone! Welcome back to this course on exercise and sports biomechanics. In this video, we will explore all the joint movements in relation to planes and axes. Before that, we will have a quick revision of what we have covered before. The first one is the sagittal plane. It divides the body into the left half and the right half, where all the flexion and extension movements take place. The next one is the frontal plane, where the body divides into the front half and the back half. All the adduction and abduction movements take place here. The last one is the horizontal plane, where the body divides into the upper half and the lower half. All the rotation movements take place here.]

Remember that, the movement will always take place along the plane. For example, if this is the sagittal plane, the flexion and extension will take place along the plane, and the axis will always be perpendicular to the plane of motion, which is the frontal axis.

[see video for more clarity as and when required]

**Neck joint:**

**flexion and extension**

[Let us start with the neck joint. The first one is the neck flexion and extension. I will zoom in a little bit for better visualization. So, I am keeping the animation, the model, in the sagittal view, which means I am taking a look from the side view. The first movement is the model looking down, which is flexion. Looking up is extension.]

The angle between the neck and the trunk is reducing, which means it is a neck flexion. If the angle between the trunk and the neck is increasing, then it is extension. You can look at the animation now. Looking down is flexion. Looking up is an extension of the neck. It is taking place in the sagittal plane and frontal axis.

**Lateral flexion of the neck:**

The next one is lateral flexion of the neck. So, you can see the model. The model is bending the neck side to side, which is the lateral flexion of the neck. Here, the angle between the neck and shoulder is reduced. That is why it is lateral flexion towards the right of the model. Similarly, the opposite side is lateral flexion towards the left side of the model. The movement is taking place in the frontal plane and it is the sagittal axis.

## **Rotation of the neck:**

Next is rotation, which takes place in the transverse plane and vertical axis. In the vertical axis, all the rotation movements will take place. You can see the model is moving towards the left side, which is the rotation towards the left, and if it is rotating towards the right. So, in the neck, we have three movements: one is flexion and extension, lateral flexion towards the right and left, and rotation towards the right and left.

## **Shoulder joint:**

### **flexion and extension**

shoulder joint is one of the most complex joints in the human body. The first movement is flexion and extension. [I am changing the view]. If the model is going up, then it is known as flexion, and if the subject is coming down, if it is bringing down towards the anatomical position, then it is known as extension. Have you noticed that if I am bringing it from down, if I am going up, the angle between the shoulder and the trunk is increasing, but I am calling it flexion, why? The movement we are not considering is between the shoulder and the trunk. Here, we are focusing on the articular movement between the glenohumeral joint.

The joint between the glenoid cavity and the humerus is reducing. That is why we are considering this movement as shoulder flexion. The opposite side is the extension. If the subject is moving beyond the anatomical position. So, what is the anatomical position?

If this line is the anatomical position, which is considered as 0, if anything is moving beyond the anatomical position, then we have to add a prefix, which is known as hyper. Now, this movement from here to here is known as hyperextension. So, this movement is taking place in the sagittal plane and frontal axis. So, I am again repeating, which is taking place in the sagittal plane and frontal axis.

### **Adduction and Abduction**

So, if the terms adduction and abduction are coming in, then the first thing is we have to make a midline. The midline is the imaginary line, which is drawn at the center of the body. If the movement is moving towards the midline, then it is considered as adduction, AD. And, if the movement is moving away from the midline, then it is known as abduction, AB.

[let us see the animation].

I am bringing it closer. This is known as adduction. And going away from the midline, this is abduction. It is taking place in the frontal plane. And the sagittal axis.

## **Internal and External rotation**

We will keep the midline, and for this Movement, we will take the top view to give better visualization. If the segment rotates toward the midline of the body, it is known as internal rotation, If the segment is moving away from the midline, it is known as external rotation.

This movement is taking place in the transverse plane and vertical axis. So, remember that rotation always takes place in the vertical axis.

## **Circumduction**

Circumduction describes the circular motion of a segment or a joint, combining flexion, extension, abduction, and adduction. For better understanding, I have changed the background color of the model. I have highlighted the wrist joint, and if you notice, I am moving the segment.

You can visualize the circular motion in the wrist joint or in the elbow joint. The circular motion is very clear here. So, as we discussed, it is a combination of all four movements. When we visualize that from the front view, you can understand much better. Let us start from flexion and adduction, followed by abduction.

and extension. We can visualize that in the front view again. It is starting from flexion and adduction because the movement is closer to the midline of the body. As and when it reaches the top, It is moving away from the midline, which is known as abduction, followed by extension.

That is why circumduction is the combination of flexion, adduction, abduction, and extension.

## **Horizontal adduction and abduction**

If it is adduction and abduction, the movement is towards the midline or away from the midline. As simple as that, right? Now, since it is horizontal in motion, we will take a different look from the top view so that the visualization will be clear.

[You can see the movement in the video]

If the shoulder is moving towards the midline, then it is known as horizontal adduction. You can look at the animation now. The shoulder is moving towards the midline. It is known as horizontal adduction.

If the shoulder is moving away from the midline, then it is known as horizontal abduction. It is coming away from the midline. So, it is occurring in the transverse plane and vertical axis. All the adduction and abduction movements take place in the frontal plane. But here, the horizontal adduction and abduction are taking place in the transverse plane. Here, the arm is moving towards the midline and away from the midline in the transverse plane, which is parallel to the ground. In the frontal plane, the movements are vertical, like moving

the arm sideways up and down. Since the adduction and abduction movements take place in a horizontal motion, they belong to the transverse plane and vertical axis.

### **Diagonal adduction and abduction:**

Similarly, there will be a midline. The movement is going to take place towards the midline and away from the midline. Towards and away. If the arm is diagonally moving towards the midline, this is diagonal adduction.

[You can see the animation].

if it is diagonally moving up, it is known as diagonal abduction. Now, the movement is becoming a bit complex because it is the combination of multiple planes and axes.

### **Elbow joint:**

#### **flexion and extension**

if the angle between the humerus and radius decreases, then it is flexion. See the animation. If the angle between the two segments increases, then it is known as extension. So, this movement is taking place in the sagittal plane and frontal axis.

#### **Pronation and supination:**

Pronation and supination take place in the transverse plane and vertical axis, describing the rotation of the forearm where the palm is facing upward in supination.

[Look at the animation.]

It's moving down and then moving up. So, the upward direction is supination. The next one is pronation, which describes the same rotation of the forearm but with the palm facing down. The palm will face down. If the palm is facing up, it is supination. If the palm is facing down, it is pronation.

### **Wrist joint:**

#### **flexion and extension**

flexion and extension movement takes place in the sagittal plane and frontal axis. The angle between the hand and the forearm is reducing, then it is known as flexion. If the angle between the forearm and hand is increasing, then it is extension.

## **Wrist joint:**

### **radial and ulnar deviations:**

In the previous classes, we have already discussed how to identify the ulna and radius. So, the example is the U shape forming here. The opposite side of this U shape is the ulnar, and the outer side is the radius. So, what is meant by radial deviation? So, from the midline, if the wrist joint is abducting, which is moving away from the midline, it is known as radial deviation. If the wrist joint is adducting, moving towards the midline, it is known as ulnar deviation.

[Next, we move on to the lower body.]

## **Hip joint:**

### **flexion and extension**

If the angle between the femur and torso decreases, then it is flexion. If the angle between the torso and femur increases, then it is extension. These movements are taking place in the sagittal plane and frontal axis. So, flexion and extension.

### **adduction and abduction**

The first step is, as you know, we will draw a midline. If the segment is coming closer to the midline, it is adduction. If it is moving away, it is abduction. Now, let us look into the movement of the hip. It is moving away from the midline, which is abduction. A B And coming back towards the midline is adduction, AD. The movement is taking place in the frontal plane and sagittal axis.

### **Hip rotation**

The hip rotation takes place in the transverse plane and vertical axis. Let us see from the top view. Imagine that this is the midline, and if it is moving away from the midline, it is known as external rotation. It is completely externally rotated, and if the hip segment is moving towards the midline, it is known as internal rotation. So, external rotation and internal rotation take place in the transverse plane and vertical axis.

### **diagonal adduction and abduction**

The first step is there would be a midline. If the segment is moving towards the midline, it is diagonal adduction. If it is moving away from the midline, it is diagonal abduction. See now, the movement is diagonal abduction, and coming back is diagonal abduction. Again, it is a complex movement where multiple planes and axes take place in this movement.

### **Hip circumduction**

The circumduction is the combination of flexion, extension, adduction, and abduction.[Let us see this from the top view, see video].

So, you can clearly see that there is a circular motion in this. First, it is moving straight, which is the flexion of the hip joint, and then it is moving away from the median line, which is the abduction and coming back, closing toward the median line, which is the adduction of the hip joint, and then coming back and joining in the same position, which is the extension. So, it is starting from flexion, abduction, adduction, and extension.

### **knee joint:**

#### **Flexion and extension**

knee flexion takes place in the sagittal plane and frontal axis. If the angle between the shin bone and the thigh decreases, it is flexion, and if it increases, it is extension. You can see the animation. Flexion and coming back is extension.

#### **Knee internal and external rotation.**

This rotational movement takes place in the transverse plane and vertical axis. The first step is there is a midline which crosses the center of the body, and if the lower part of the segment, which is the shin bone, if it moves towards the midline, then it is internal rotation. If the segment moves away from the midline, then it is known as external rotation.

### **Ankle joint:**

#### **Dorsiflexion**

if the angle of tibia and the foot decreases, then it is known as dorsiflexion.

#### **Plantar flexion**

if the angle between the shin bone and the foot increases Then it is known as plantar flexion.

[Let us look into the movement.]

The first one is dorsiflexion, the tibia, which is the shin bone, and the foot. So from here, it decreases the angle between them. In the same way, if the angle between the shin bone and the foot increases, then it is plantar flexion.

If the foot is pointing, the plant on the ground is known as plantar flexion. Since it is a specific movement, have you noticed that both movements, even if one is going towards the shin bone and the other is moving away from the shin bone, are known as flexion? That is why we are emphasizing it. If the foot is moving towards the shin bone, then it is dorsiflexion; if it is moving away from the shin bone, it is plantar flexion.

#### **Inversion and Eversion**

If the sole of the foot is moving towards the midline, then it is known as inversion.

If the sole of the foot is moving away from the midline, it is known as eversion.

[Let us look into the movement].

So, this is the midline; if the sole of the foot is moving towards the midline, it is inversion, and if it is moving away from the midline, it is known as eversion.

[So, thank you, and see you in the next video.]