Biomechanical Analysis of Joints of Upper Limb
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Lecture – 21
Shoulder Joints and Muscles: Biochemical analysis of joints of upper limb

(Video Starts: 00:17) Welcome to this video on Biomechanics. So, we are interested in studying the Biomechanical Analysis of Joints of the Upper Limb. So, when we say joints of the upper lip what exactly do we mean? **(Video Ends: 00:36)**

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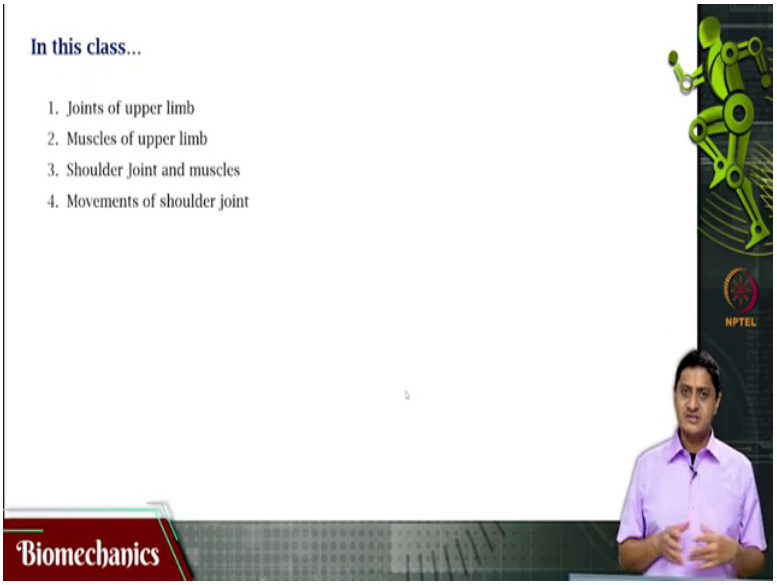

So, we are interested in shoulder joint, elbow joint, wrist joint and all the joints of the fingers. So, in this video we will be looking at what are the joints of the upper limb? What are the muscles that represent in the upper limb? Shoulder joints and the muscles that span the shoulder joint and movements that happen in the shoulder joint. So, we will introduce to the broad topic and then we will focus more on shoulder joint in this video.

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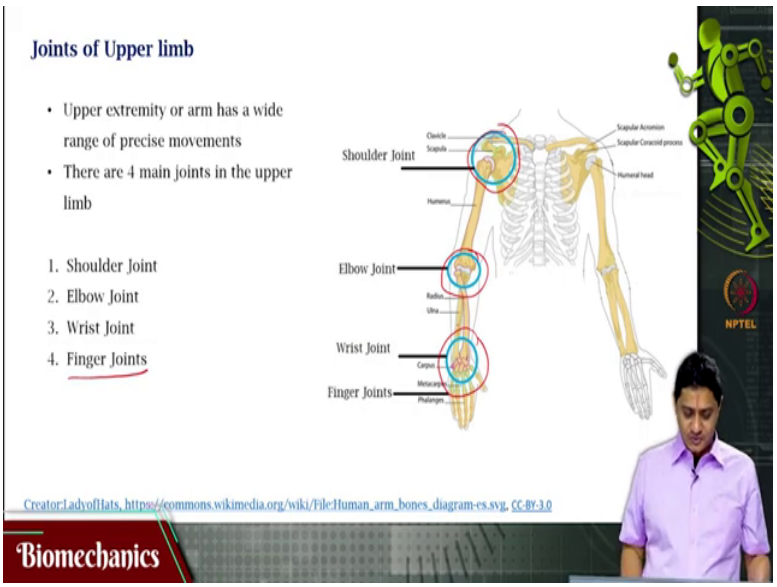

So, when we say joints of the upper limb primarily what comes to our mind are three joints, shoulder joint, elbow joint, wrist joint. There are other joints for example, all these joints that I am now flexing and moving, these are all the various joints that we are doing. All these, some of the joints are flex, some of the joints are extended. And then I also have the thumb main joint so, all these joints within the hand.

So, I call that part of the arm that is distal to the wrist joint as hand, all the joints in the hand, I am calling as hand and finger joints that is a lot of joints. But I have to classify somehow we have to have a working definition. So, I am going to call all these as hand and finger joints. And we will look at the hand and finger joints in a future video because once you remove this a lot of complexity is immediately removed.

Because it turns out that the hand is one of the most articulated organs within the human body which is why it is having so much dexterity. Much of the civilization as we know it today was perhaps built with the dexterity of the human hand. Imagine a world in which you do not have this much dexterity, we might still be crawling on trees jumping from tree to tree just saying.

So, going back we are interested in the joints of the upper lip immediately there are three major joints the shoulder joint, this joint, the elbow joint and the wrist joint. These are the three joints of interest although we call this as shoulder joint, shoulder is not a single point this whole area in general in English, we call it this as shoulder. Yet when it is shoulder joint I am talking about this joint.

If this is the shoulder there must be other joints that come into the picture and they do, likewise for the elbow, likewise for the wrist. So, let us look at this step by step.

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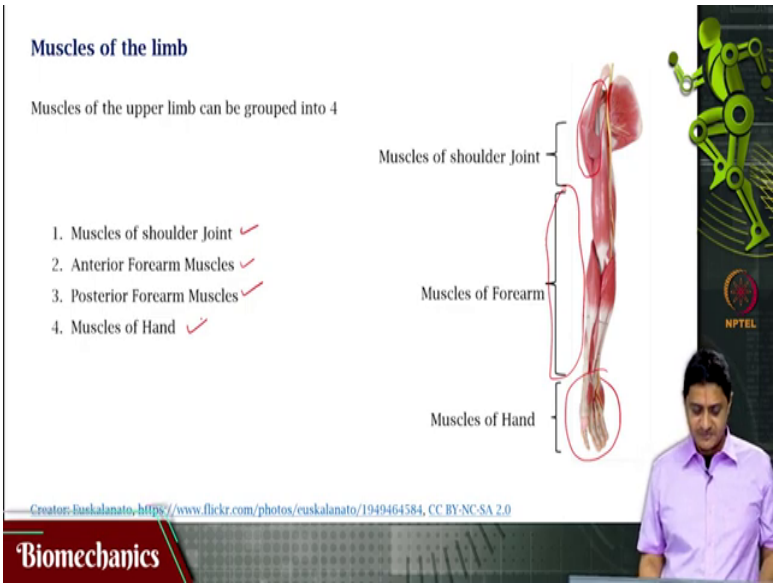

Also, when we are discussing muscles, muscles that span the shoulder joint these muscles. And then muscles that span the elbow joint are the muscles of the forearm and then muscles that supply the hand itself. So, muscles of the shoulder joint, muscles of the forearm the anterior side or the side that is facing front, the posterior side, side that is facing the back.

And then muscles of the hand when you say muscles off the hand muscles that are supplying the hand may be their muscle bellies are located in the forearm. And then muscles that are located within the hand so, there are two major types of muscles. When we discuss muscles of the hand, we will look at all these in future videos maybe.

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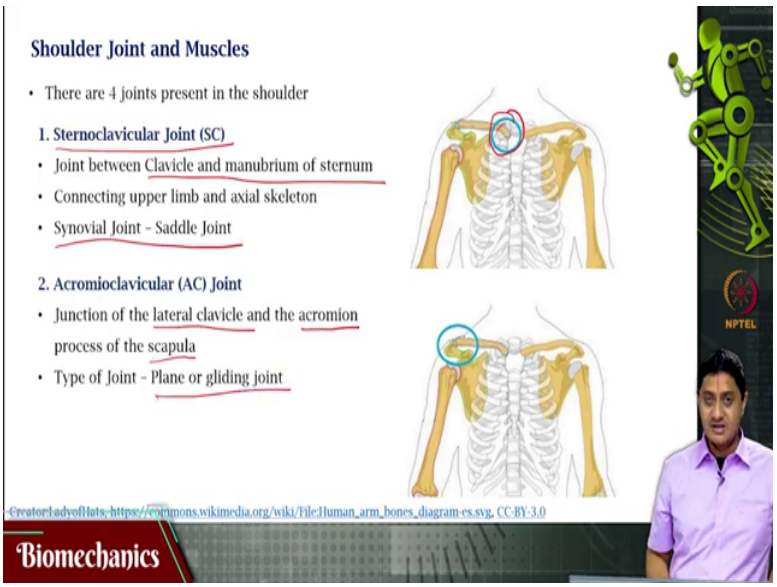

Coming back to the shoulder joint, actually it is not a single joint that is present in the shoulder there are multiple joints. First is the sternoclavicular joint this is the joint between the clavicle and manubrium of the sternum located here on the on the axial skeleton, close to the axial skeleton. This connects the upper limb to the axial skeleton this is a saddle joint it is a synovial joint.

So, there is a synovial fluid and this is a saddle joint. Remember in one of our early introduction of the types of joints, we discussed a saddle joint, remember this is how the joint will look like. So, there can be movement like this and movement like this, it is like a saddle there are two moments that are possible, it is a saddle joint. Then you have acromioclavicular joint this is where the acromion process of the scapula which is one of the big bones located on the back side, around the posterior side.

The acromion process of the scapula and the lateral clavicle, lateral means towards the side, medial clavicle is meeting the sternum here. So, this is the sternoclavicular joint with the lateral clavicle meets the posterior bone which is the scapula. So that means this bone is not running like this horizontally, rather it is inclined. When I am looking from the top, you are going to see not a line like this.

But rather incline it is running from the front to the back like that, that is the clavicle. This is a plane joint, or a gliding joint.

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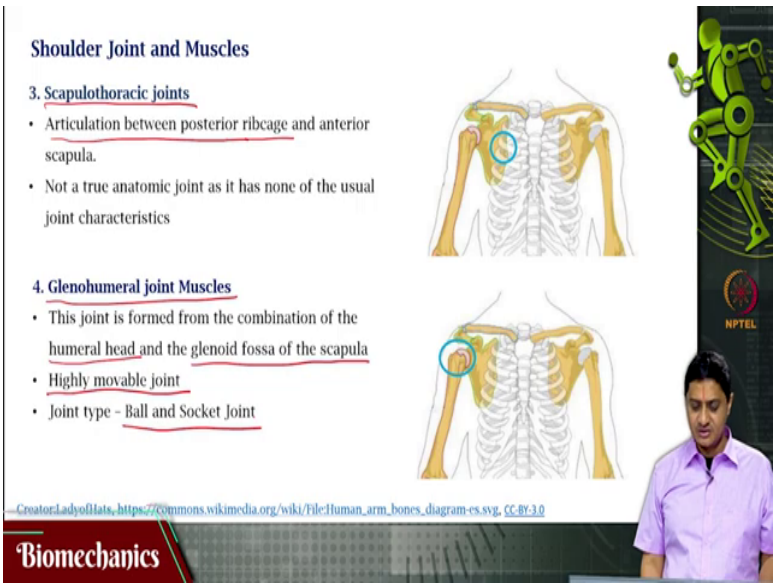

Then you have the scapulothoracic joints, scapula is this bone that is located in the back and this articulation between the posterior ribcage. Posterior ribcage means the ribcage is the set of bones that are present to protect some very important organs. What are these? The heart and the lungs of course. So, the heart and the lungs are protected by this bony structure, the ribcage.

The back side of the ribcage which is why it is called posterior ribcage, the posterior ribcage and the front side of the scapula bone itself that is a an articulation, this articulation is called as scapulothoracic joint. Except because there might be many because in the ribcage there are many small bones. So, there are many such joints but technically this is not a joint in the technical sense.

Because it does not show any of the joint characteristics in terms of movements and so but there is this articulation that exists. Then you have the glenohumeral joint this is the where the glenoid fossa of the scapula and the head of the humerus. Humerus is this bone and glenoid fossa of the scapulas here these two attach. In general, when people in biomechanics field say shoulder joint, they are referring to this joint.

So, in this course for the rest of this course whenever I say shoulder joint it refers to the glenohumeral joint. It is a very movable joint it is a highly mobile joint and it has and we have already spoken about this that it is a ball and socket type joint. Ball and socket type joint means, it so, suppose this is the socket and this is the ball, it can actually rotate in many different directions.

So, which is why you see that I can perform this movement, I can perform that moment, I can perform that moment abduction adduction this is fraction extension. I can perform a combination of these very complicated movements can be performed by this, a very movable joint. Normally this ball of the humerus is almost always located within the socket. In some relatively pathological conditions you have this location.

It is an extremely painful process in which sometimes for some specific set of people it is still unclear why this is happening? Some specific set of people seem to have frequent dislocation of their shoulders. And when that happens they will have to need, they will have to take urgent orthopaedic help. Alright but normally, you can most normal people can perform this humongous huge range of movements that is offered by this shoulder joint.

So, we will focus on this joint the glenohumeral joint and the muscles that span the glenohumeral joint and the muscles that are responsible for the movements of the glenohumeral joint. Going forward I will be referring the glenohumeral joint as the shoulder joint, remember this. Every time I say shoulder joint, I am meaning the glenohumeral joint.

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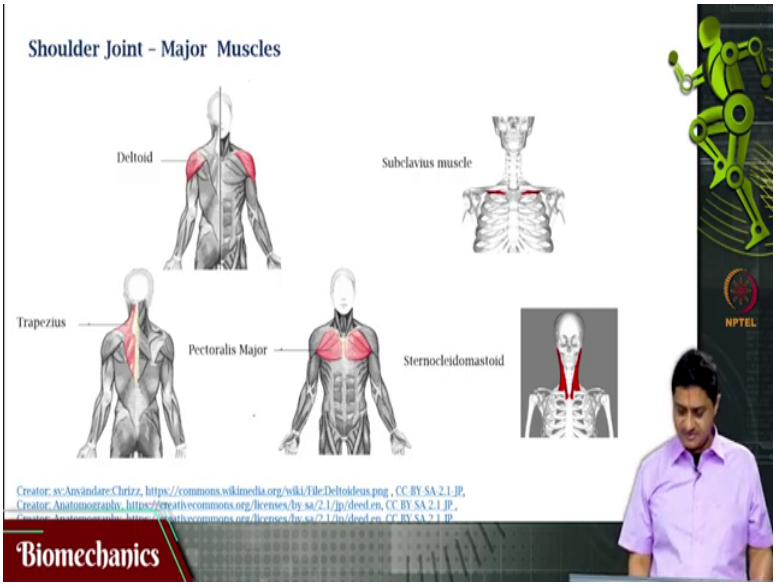

What are the muscles that span this joint? There are actually many muscles, one is the deltoid muscle, the other is the trapezius muscle, the third one is the muscle in the chest called as the pectoralis major. Then some muscles, small muscles subclavius muscle and then there is the muscle that is responsible for the movement of the head this is the stenocleidomastoid muscle.

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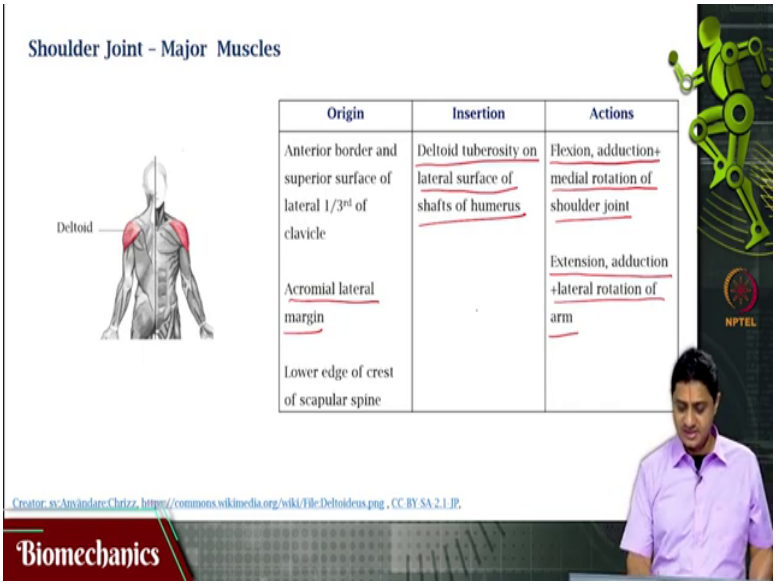

Deltoid this is a muscle that is having many heads that is why origins are given at many points, anterior border and superior surface of the lateral one-third of the clavicle. So, somewhere here, lateral one-third of the clavicle is where and there also so, remember it is still not clear whether the muscle is a functional unit or a structural unit. Is it an anatomical classification or is it a physiological classification?

So, we continue to use terminology that has been given to us. So that means that many times there might be different heads of the same muscle that might originate at different points. And we might call the whole thing as a single muscle because this is anatomy. Please hang on with me as we discuss some technical terms. So, the other part is originating and the acromial lateral margin.

Then you have some parts that originate at the lower edge of the crest of the scapular spine. They all insert on the humerus, of course and now it makes sense. Before this they are starting at multiple points here, fine they are all attaching to the deltoid tuberosity on the lateral surface of the shafts of the humerus. Here they all attach they span the joint and then they attach, what is the purpose? What does it do? What does this muscle do?

Flexion, adduction and medial rotation of the shoulder joint many different things. So, it can do flexion, and adduction, remember when the shoulder goes like this it is abduction, this is adduction. And for the whole arm made it might appear as if it is doing extension adduction and lateral rotation of the arm done by the other heads.

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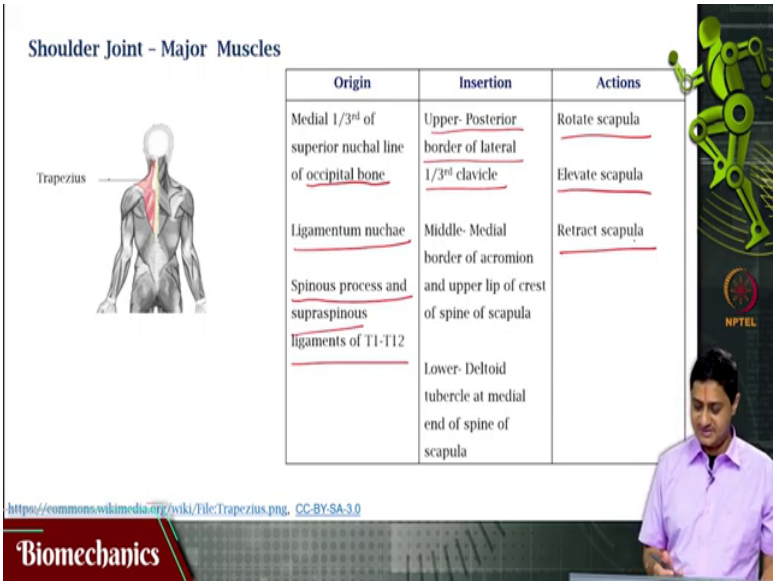

Then you have the trapezius muscle, this is a relatively large muscle that starts at the skull at the base of the skull. Occipital bone, medial one-third of the superior nuchal line of the occipital bone, somewhere here starts. And it inserts into the upper-posterior border of lateral one-third of the clavicle here, upper-posterior border of the lateral one-third. So, you will have to use all three dimensions, upper-posterior on the back side.

And lateral means on the side, remember this clavicle is a bone that goes like this. Purpose is to rotate scapula although our interest is shoulder joint the glenohumeral joint it still makes sense for us to understand all the muscles. So, I know immediately hey but this is not attaching to the humerus yes, this is not. But these movements will also eventually influence our indirectly or sometimes directly influence the movements within the shoulder joint.

So, it is useful to keep this in our armour, we may not use it, we may not need it but we must it makes sense for us to still understand how this works? And the other heads, start below the head in the spinal cord in the region of the spinal cord, spinous process and supraspinous ligaments are T1 to T12, somewhere. So, it is a long relatively large muscle. So, they have this job of rotating the scapula, elevating the scapula, retracting the scapula all these things.

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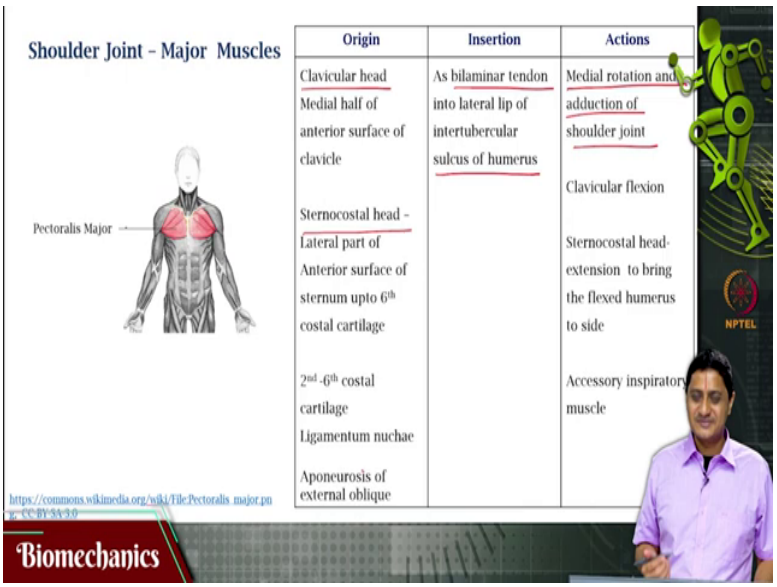

Then you have the chest muscle, the big muscle in the chest these methods the pectoralis major. So, this partly contributes to the medial rotation and adduction of shoulder joint. It is so, different heads are there so, there is a clavicular head, there is the sternocostal head and they are attached to the humerus at different locations. So, we will focus for example on the clavicular head.

It is originating on the medial half of the anterior surface of the clavicle, medial half means that half that is closer to the middle line, the medial half of the anterior surface, anterior means towards the front. By the way this is something that I will require all the students to remember what anterior, posterior means? What medial, lateral means? What superior, inferior means and so on? We have spent some time discussing the directional terms.

Because there is going to be quite a bit of this kind of language, medial half of the anterior surface of the clavicle is somewhere here, is it not? This is a major origin, remember this is a convergent muscle. So, you will have a very small starting point and then the muscle broadens out it is a convergent muscle something that we can say. And this is responsible for medial rotation and adduction of the shoulder joint.

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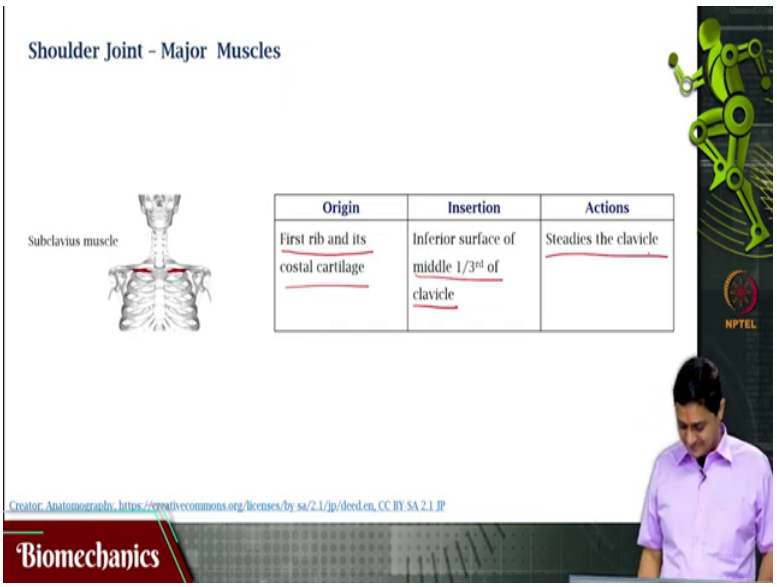

Then you have this subclavius muscle this is originating in the first rib and it is cartilage associated with the first trip. It is insertion is on the clavicle itself so, there are many attachments that happen at the clavicle it seems. Yes, there are many origins and insertions that happen on this bonus very important bone this one. It is job trivial as it might seem is steadying the clavicle.

Making sure that the clavicle itself does not move because of the other muscle actions steadying it this is a function.

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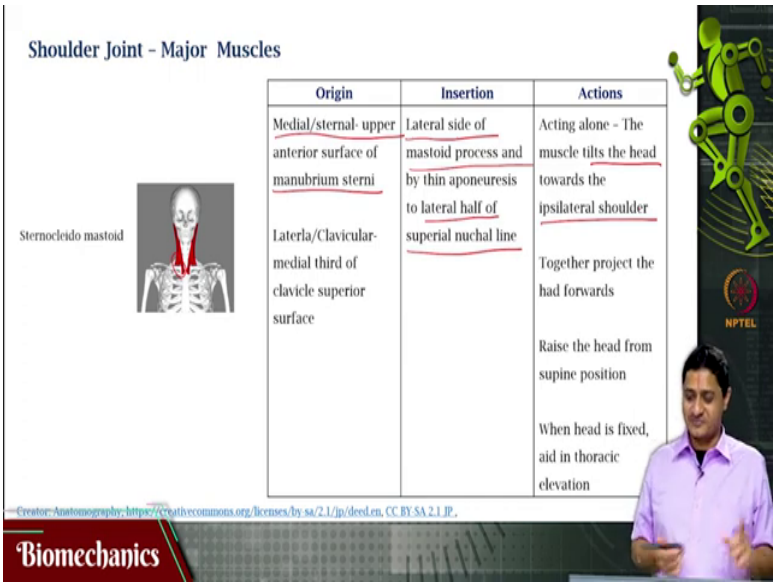

Then, the sternocleidomastoid muscle this origin is the medial sternal or upper anterior surface of the manubrium sterni so somewhere here. And the insertion is on the side of the master process here, lateral side of the mastoid process here. By a thin aponeuresis to lateral

half of the superior nuchal line somewhere here in this. It is job is to tilt the head like this or the this muscle tilts the head like this and this muscle tilt the head like this.

Trivial as it might seem this is an important function, sometimes children are born with one of these two muscles, there are two muscles on the two sides of the body. One of these two muscles is just a tad bit stronger than the other muscle then what happens? When this happens at birth what happens? That the child keeps the head tilted like this. Because the head is always tilted like this.

The child has a tendency to sleep on one side of the head leading to asymmetrical shape of the head, the whole head itself. A lot of problems happen because of this very small muscle and a very small problem in this muscle. So, many things will have to work properly for what is considered normal function? Something that healthy people take for granted, something to keep in mind.

So, the function is to tilt the head towards the ipsilateral shoulder, what is ipsilateral shoulder? Ipsi means on the same, lateral means side. Ipsilateral means tilting the head to the same side, you must be able to tilt actually, older people cannot tilt as much. But people who are younger must be in a position to tilt the head that much that the ear touches the shoulder like that. I am now touching the ear with the shoulder by raising the shoulder that is not fair.

Children and young adults must be in a position to tilt the head, so that the ear touches the shoulder, the head should touch the shoulder, the shoulder should not be raised. Many times when children who have this problem are asked to touch the shoulder with the ears they will raise the shoulder because that is the compensatory movement, remember this.

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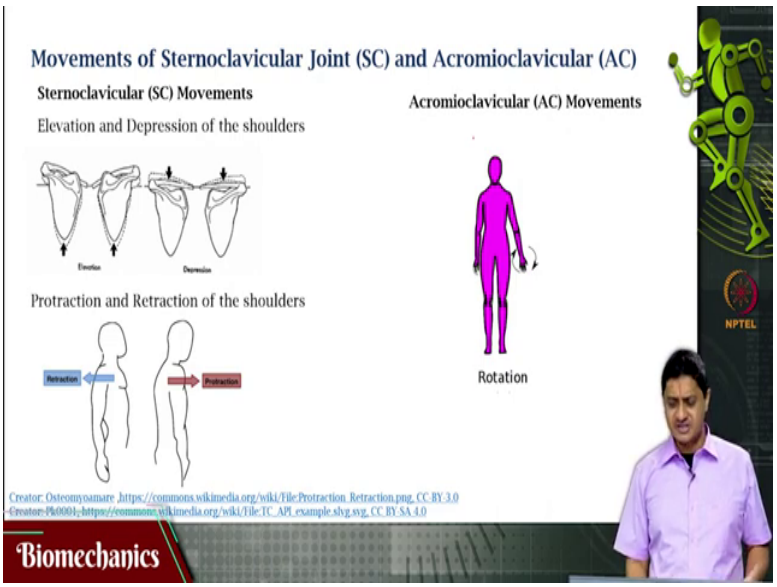

So, what are the movements of the sternoclavicular joint and acromioclavicular joint? Elevation and depression of the shoulder sternoclavicular joint, elevation and depression of the shoulder like this. And protraction and retraction of the shoulder doing that retraction and protraction of the shoulder. These are not very articulated movements that is normally discussed.

But since we are discussing the shoulder joint it makes sense for us to be complete about this. Then for the acromioclavicular movements, rotation of the shoulder, the whole shoulder not just this rotation this is supination pronation, we will discuss that in future this whole rotation. Again not a very articulated moment, not discussed in much detail, of course, we will restrict our attention to movements in the glenohumeral joint.

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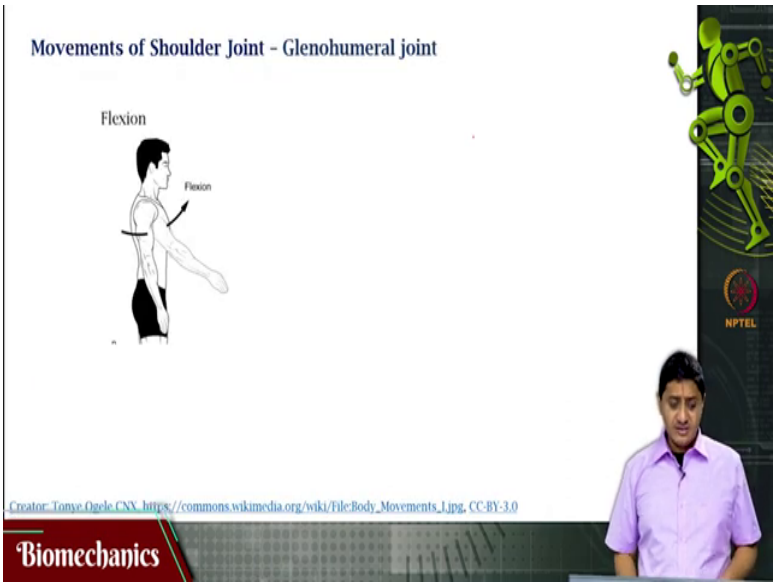

In the glenohumeral joint of course, I can do flexion.

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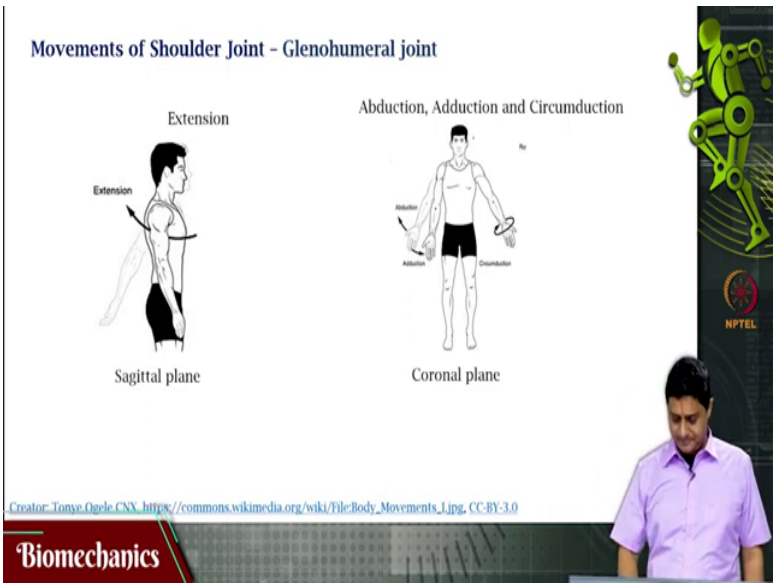

I can do extension, I can do that so that is flexion, extension. Remember these are moments in the sagittal plane, we did discuss this when we discussed movements of the sagittal plane. So, flexion, extension and abduction, adduction so, abduction, adduction and then I can also do circumduction, I can do that. These moments are happening in the frontal plane are in the coronal plane.

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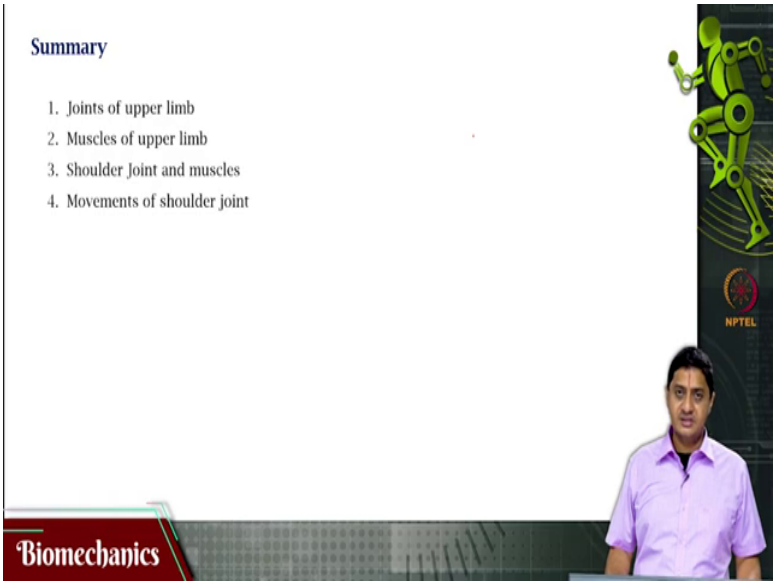

So, with this we come to the end of this video. In this video, we discussed what are the various joints in the upper limb? The muscles that are there in the upper limb. We focus our attention on the shoulder joint and muscles of the shoulder joint and movements that happen in the shoulder joint. Thank you very much for your attention.