Biomechanics
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Lecture – 24
Elbow Theory: Biomechanical Analysis of Joints of Upper Limb

(Video Starts: 00:17) Welcome to this video on biomechanics, we have been looking at the upper limb, specifically in this class. We will be looking at the Biomechanics of upper limb actions and motion. **(Video Starts: 00:37)**

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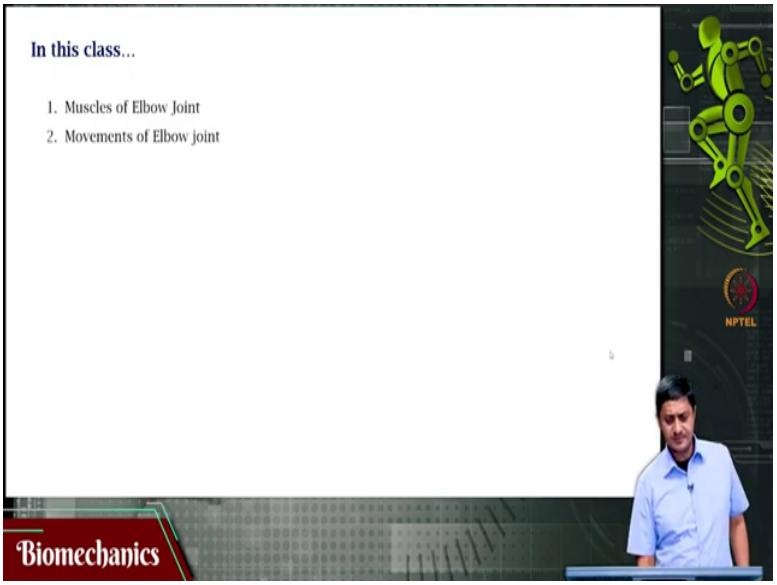

More specifically in this video, we will be looking at the muscles of the elbow joint and how these muscles cause movements at the elbow joint? Let us move forward.

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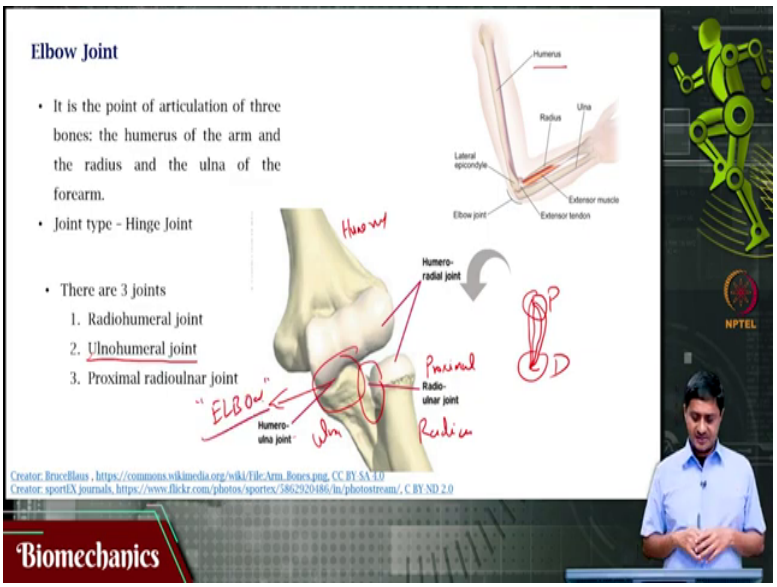

So, the elbow joint is this joint that is formed by the long thin bone of the upper arm called as a humerus, the bone underlying the upper arm is called humerus. And the two bones that form the forearm which is the radius and ulna. Radius is on the thumb side, ulna on the little finger side these two things, radius, ulna, humerus. Since there are three bones that are involved, essentially there are three joints that are possible.

One is the joint between the radius and ulna at the proximal end, radius ulna joint at the proximal side. Then the joint between the radius and humerus and then the joint between the ulna and the humerus these are the three possibilities. So, which one of these constitutes the elbow joint? By the way let us remember, the elbow joint has a single degree of freedom that is it is a hinge joint, it has only one degree of freedom this movement is called flexion and extension.

So, there are these three joints, radiohumeral joint, ulnohumeral joint and proximal radioulnar joint. Remember radius and ulna are like this so, this is say the radius and that is one more bone this is the ulna and they both so, there are two joints proximal, distal. The joint and the proximal side, the radioulnar joint and the proximal side appears near the elbow, the one that is on the distal side appears near the wrist.

In general, when we say the elbow joint we usually refer to this humeroulno joint or ulnohumeral joint. This is what is commonly referred to as the elbow joint so, whenever someone says elbow joint this is the joint that they are referring to. So, this is the humerus,

this is the ulna and this is the radius, remember there is also this is the proximal radioulnar joint.

This is the ulnar humorous joint this is what is generally called as the elbow joint, this is the elbow joint as it is called.

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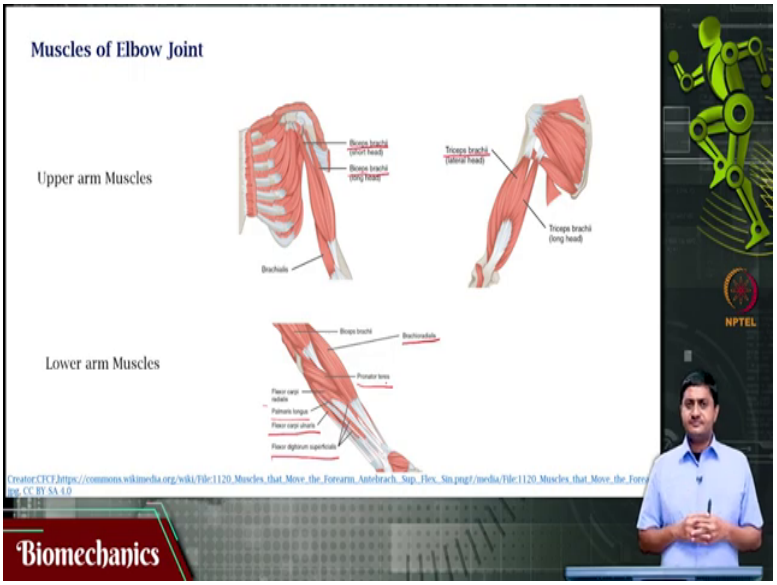

So, what are the muscles that are responsible for the motion at the upper limb, specifically the elbow joint? So, these muscles are located in the upper arm to start with. So, biceps shortly called as biceps it has two heads technically called as biceps brachii has two heads, a short head and a long head. And then there is a muscle called triceps, generally called triceps but technically called triceps brachii.

Then there is this brachioradialis there is the brachialis not shown in this picture. And then there are muscles in the forearm or the lower arm, these are flexor carpi radialis, palmaris longus, flexor carpi ulnaris, flexor digitorum superficialis and then there is the pronator teres. We will not be looking at the origin insertion and action of all these muscles, we will take the most prominent muscles among these and discuss there origin, insertion and action at some level of detail.

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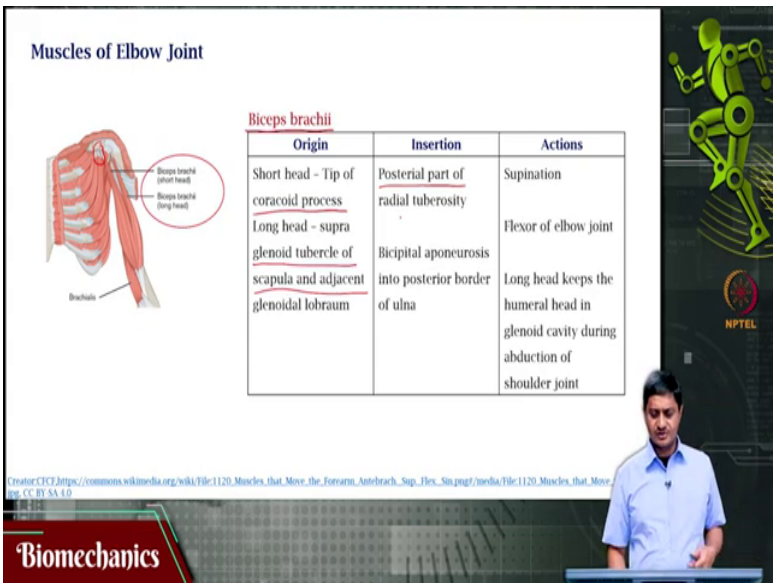

So, let us look at the major flexor of the elbow joint which is biceps, biceps brachii. The short head attaches to the coracoid process which is a forming or nearly forming the part of the shoulder, it is quite close to the shoulder. And the long head attaches to the glenoid tubercle of the scapula, again part of the complex system of articulations that together form what is called as a shoulder.

The insertion is on the back side posterior part of the radial tuberosity. So, the attachment is somewhere posterior side which is here and the radial tuberosity somewhere here is where you are looking at. Major action is to supinate the elbow joint or supinate the arm, remember supination is this configuration in which you can hold a bowler, you can hold a soup supination.

So, when the arm is like this to do this you need to supinate. The other is flexion, flexor of the elbow. Now, the question is well if one muscle has two functions, why is it that at any given point in time either supinate or flexor? Suppose I want to do only one of these two actions, I am able to do it. If this muscle is responsible, it is not like when I am flexing I am always supinating.

I can also do that it is pronated and I can also do that and I can also I can simply do this without flexing. Flexing is like an amount of independence is achieved but how? Is a question that I will let you think for some time. So, you can think about this why is it that I am able to independently perform supination and flexion of the elbow joint. Although the same muscle

is responsible for these two functions, think about that we will come back to that in a future video.

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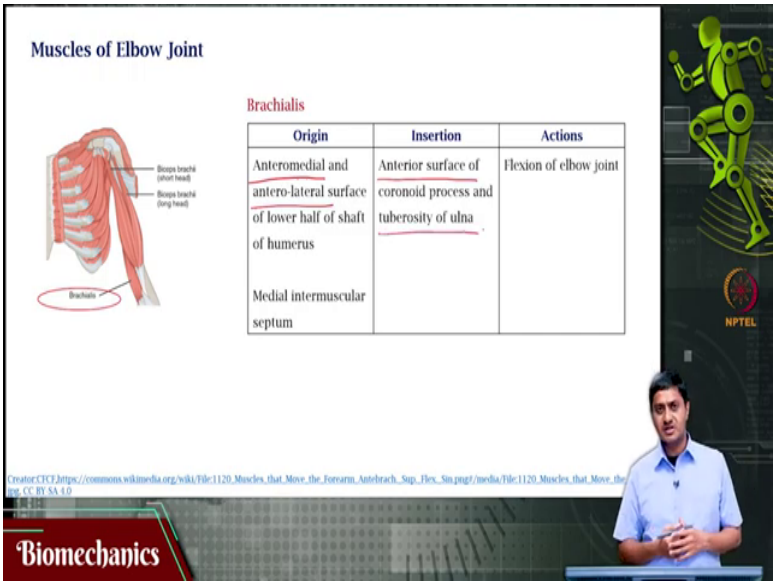

So then there is the brachialis, brachialis is on the anteromedial and antero-lateral surface of the lower half of the shaft of the humerus. So, anteromedial, antero-lateral lateral means on the side, medial means towards the midline antero means on the front side of the lower half of the shaft of the humerus somewhere here is what you are looking at. And the insertion is closer to the ulnar tuberosity again same function, elbow flexion.

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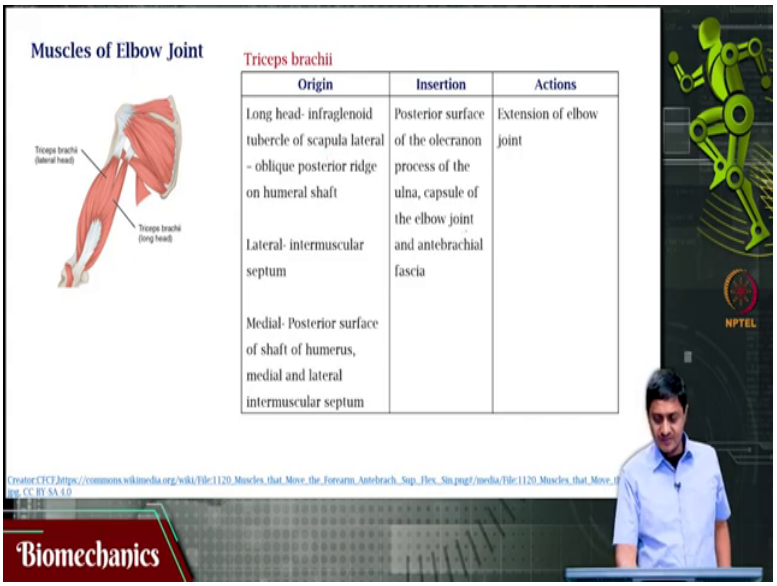

So then you have the triceps brachii which is a major extensor of the elbow joint. It is long head is on the infra glenoid tubercle of the scapula and on the posterior side. So, on the posterior segments here are closer to here this is the muscle that comes. And then it attaches

on the posterior surface of the olecranon process of the ulna somewhere here is where this attachment is.

So, if this muscle contracts you are going to have so, this part is going to contract and then the elbow joint is going to extend. So that is the reason that is this muscle is essentially almost fully located on the posterior side.

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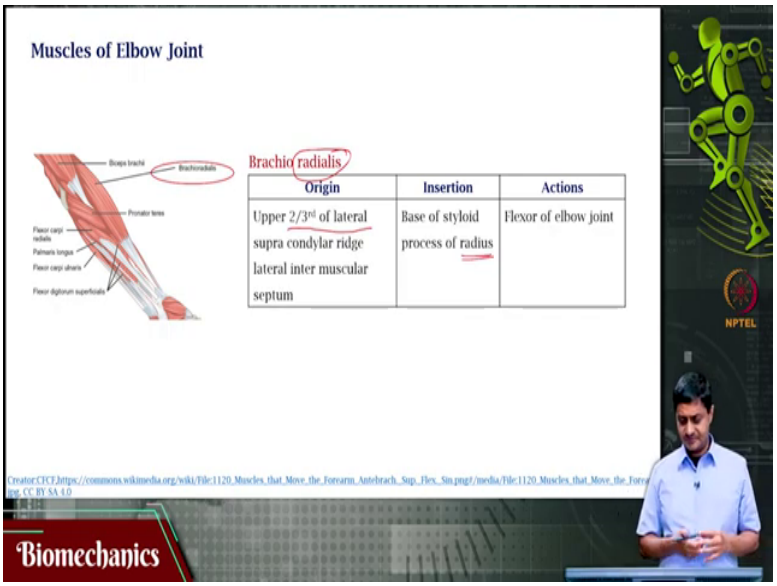

Then you have the brachio radialis this is again a flexor of the elbow joint. What are the other two flux stress that we saw that are responsible for flexion of the elbow joint? One is biceps brachii, other is brachialis. And you have the brachio radialis this is origin it has it is origin in the upper two-third of the lateral supra condylar ridge and remember from the name.

I can guess that it is attaching the radius base of the styloid process of the radius, responsible for friction of the elbow joint. So, there are indeed three flexors of the elbow joint.

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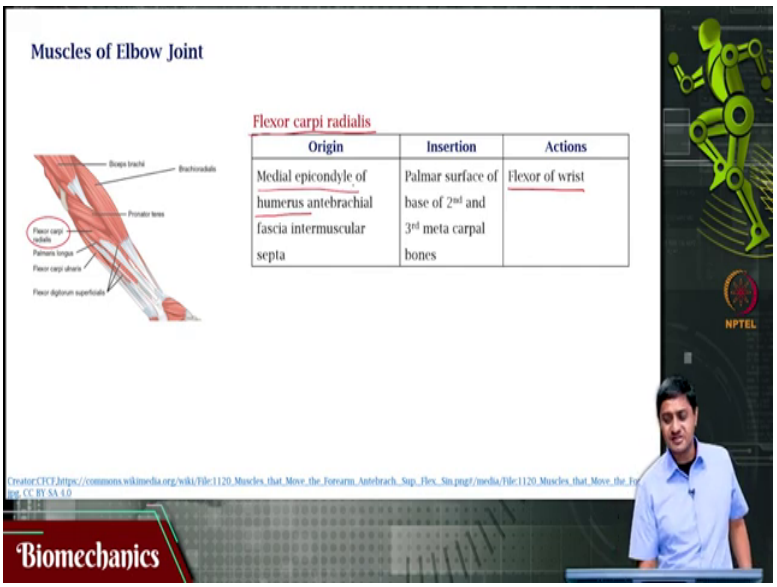

Then what other muscles? Then you have muscles that are located across the elbow joint but do not necessarily play a role in the action or movement of the elbow joint. Also, one more thing to note is that some of these muscles like the flexors and extensors also help in stabilizing the shoulder joint by keeping the shoulder in it is place. So, some of them are responsible for that.

Some muscles whose bodies are present across the elbows joint particular whose origin is in the upper arm. But whose function may not necessarily involve the movement of the elbow joint. We are classifying them as elbow joint because they cross the elbow joint they do not necessarily play a role in movement or action of the elbow joint. One is the flexor carpi radialis muscle this is responsible for flexion of the wrist for that action.

Medial epicondyle of the humerus antebrachial fascia and intermuscular septa. So, it is a muzzle that originates in the upper arm and it is inserts into the metacarpal bones somewhere here relatively long muscle. So, insertion is on the metacarpal bones because this is responsible for flexion of the wrist. Palmar surface of the metacarpal bonds, not on the back side. So, this is the dorsal surface the posterior surface.

So, on the anterior surface are on the palmar surface is where you are going to happen because that makes sense. So because if this muscle is contracting so, the muscle starts here and it sends it is sentence like that and if this muscle is contracting, the hand is going to get pulled like this is the action that is called as wrist flexion.

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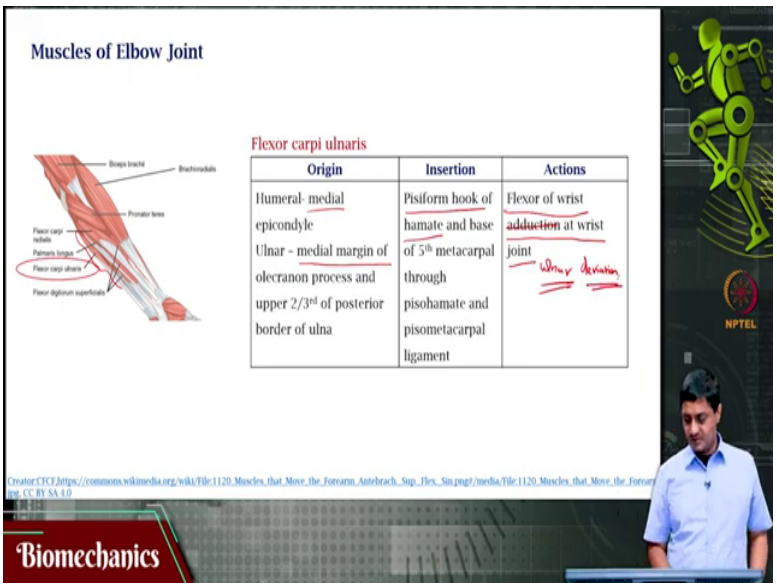

Then we have flexor carpi ulnaris this has two things, two functions. One is flexion of the wrist joint the other is adduction of the wrist joint but what exactly is this action? This is we say we mentioned this is abduction it is also called as a radial deviation. But in general, we prefer to use instead of addiction a large deviation and not that makes sense because this is a muscle that attaches across the ulna.

So, the humeral origin is at the medial epicondyle, the ulnar origin is at the medial margin of the olecranon process. So, it starts here so, this is the flexor carpi ulnaris. The attachment is in the fifth metacarpal and the pisiform hook of the hamate bones which is a bone in the hand, responsible for the wrist fraction and ulna deviation.

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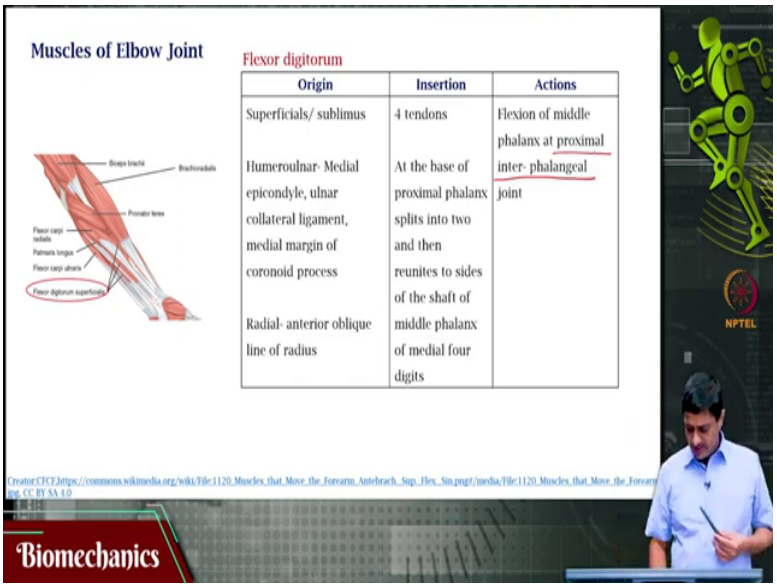

Then you have flexor digitorum, there are two, three types of these flexor digitorum. Superficialis, flexor digitorum, profundus etcetera. So, this sense four tendons so, there are four tendons that get attached to the base of the proximal phalanx this is the proximal phalanx. The segment of the finger that is closest to the palm is called as a proximal segment or the proximal phalanx.

Then it splits into two and then reunites to the sides of the shaft of the middle phalanx this is the intermediate phalanx. The segment in the middle of the finger is called as a intermediate phalanx or the middle phalanx of the four digits. These four digits it attaches and reunites and then attaches here. Because of this reason when this tendon moves you are able to perform that action.

This is the flexion of the middle phalanx at the proximal inter-phalangeal joint. The joint that is found or that is formed between two phalanges is called as the inter-phalangeal joint and that interphalangeal joint that is on the proximal side is called as the proximal inter-phalangeal joint. And that inter-phalangeal joint that is on the distal side is called as a distal inter-phalangeal joint.

Sometimes called shortly as pip joint and dip joint this are the pip joints these are the dip joints, these are formed within the finger. So, flexion of the middle phalanx by moving the pip joint, proximal interphalangeal joint. Then what do we have?

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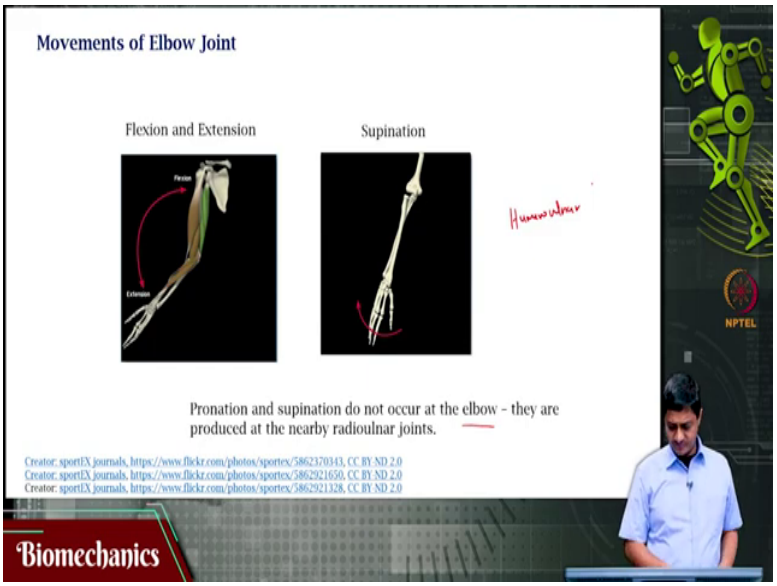

So, let us look at these moments at the elbow joint, you have this flexion. So, you have these flexion, extension of the elbow joint and then supination, pronation. So, essentially at the elbow joint, when we are discussing we are interested in supination and flexion, extension these are the movements. Pronation and supination are not exactly moments of the elbow, they are produced at the nearby radioulnar joint.

Remember, elbow joint refers to the humeroulnar joint but then again this moment is a relative moment of radius and ulna rotation of the radius and ulna that is called as the radioulnar joint.

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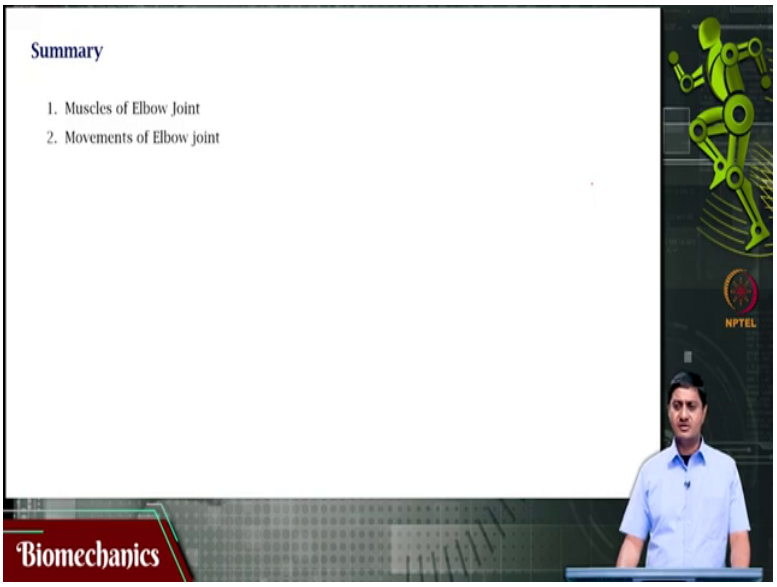

So, with this we come to the end of this video. In this video, we looked at the various muscles that form or that cross the elbow joint and the specific movements that these muscles contribute to. Thank you very much for your attention.