Biomechanics
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Lecture – 38
Knee Muscles

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(FL) Welcome to this video on biomechanics. In this video, we will be continuing with our discussion on biomechanics of the knee joint.

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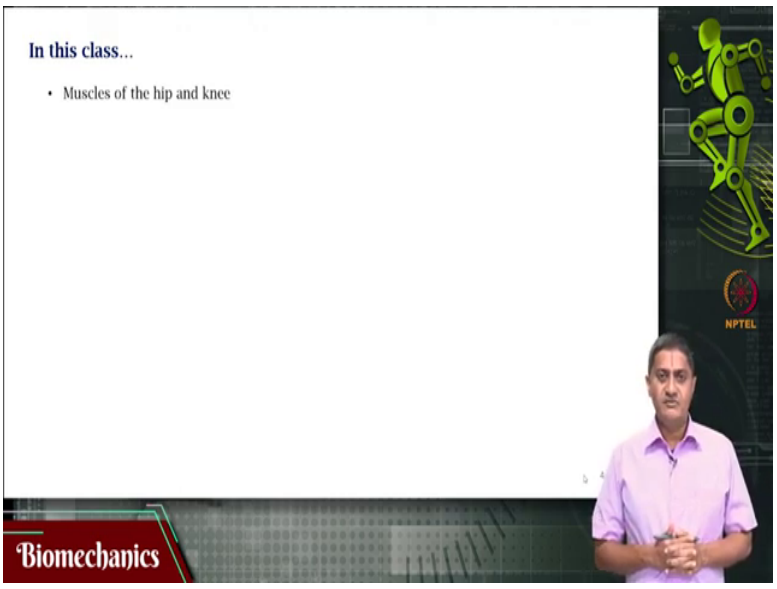

In the previous video, we saw the knee joint, the articulations that are responsible for the so called knee joint itself. And the movements that are possible at the knee joint. In this video,

we will focus on the muscles that are responsible for the knee moments or the muscles of the hip under knee.

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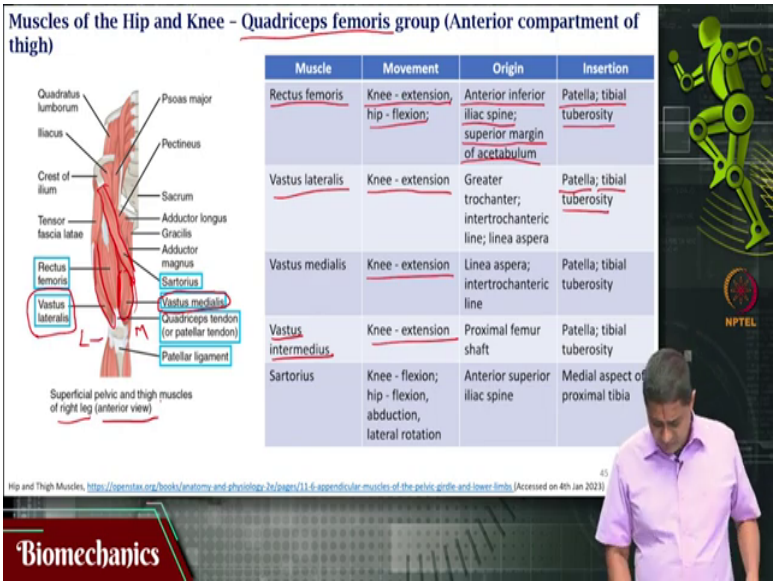

If we are focusing on the muscles, there are at least two broad groups that we could classify the muscles in the thigh. That is a huge muscles the big muscles of the thigh that are responsible for knee flexion and knee extension. Knee extension, means the knee in the position when the person is stranding with the legs straight. So that is the extended knee. This means that the tendon for this will have to attach on the anterior side is it not?

So, we will have to pass through the patella which is a kneecap. Remember from the previous class. The patella is a special sesamoid bone that is embedded within the quadriceps tendon which then continues on to become the patellar ligament. Which then attaches to the tibial tuberosity we have seen these things. So, the muscle that attaches to this patella or the tendon. This muscle or this group of muscles is called as quadriceps femoris group.

Quad means four it has four muscles whenever you say quad four, try means three and penta means five and so on and so, forth so, we know this. So, there are four muscles. There is this discussion that goes on in this field as to whether a muscle refers to an anatomical construct or whether it refers to a physiological construct. Or is it a structural unit or is it a functional unit.

The moment in the beginning of this course, we saw that mostly we will be focusing on structure function relationships. We are still discussing whether this quadriceps femoris, for

example, is considered a single muscle or is it a group of muscles. Well, we can actually, say that these are actually, four muscles that are synergists that perform very similar functions. This is not a single muscle.

It is a group of four muscles that have similar function. These four muscles are synergists. And these four muscles are rectus femoris. This is originating at the anterior, inferior iliac spine. So, one head of the origin is in the spine. The other head is in the superior margin of the acetabulum. Now, it is attachment or it is insertion or distal attachment is on the patella which then continues on to become the patellar ligament which then attaches to the tibial tuberosity.

Note that it has two distinct functions. One is flexion at the hip joint. The other is extension at the knee joint. Now because there are two distinct functions for this muscle when it is performing one of these functions it is capacity to perform the other function is compromised. Something that we will revisit in just a little while. But let us keep this in mind. This is a muscle that has more than one function.

This can perform knee extension as well as hip flexion. It can flex the hip as well as extend the knee. When it is fluxing the hip it is ability to extend the knee is compromised and vice versa. Of these four muscles, the rectus femoris is located on the anterior side of the thigh that is the rectus femoris. This picture is of the right leg, remember that this picture is of the right leg.

So, the big muscle that you see on the thigh is essentially mostly rectus femoris and sartorius mostly rectus femoris. So, the anterior side of the thigh is where the rectus femoris is located. Then you have vastus lateralis from this name I can guess that it is present on the side. How do I know that? Because of the name lateralis, it is here vastus lateralis that is this muscle present on the side.

Then you have the vastus medialis. This is on the medial side of the thigh. So that is here, vastus medialis. Not seen in this is the vastus intermediaries which is found deep beneath the rectus femoris that is posterior to the rectus femoris. Remember rectus femoris is a superficial muscle that is on the most anterior side. So that is the most prominent or visible muscle of the thigh on the front side.

Below it deeper to it are more posterior to this is the vastus intermedius not seen in this picture. All these four muscles together perform approximately the same function which is knee extension. They are all responsible for knee extension. Their origins are different for example, vastus lateralis origin is greater trochanter and intertrochanteric line. Their insertions are all the same.

They all insert on the patella which then further continues on as the patella ligament and attaches at the tibial tuberosity. A very special muscle that is found on the anterior side is the so called sartorius is a band like muscle that is found on the front side is called as sartorius. It has this unique function of fluxing the knee, fluxing the hip and performing abduction and lateral rotation of the leg.

It originates at the anterior superior iliac spine. So, it originates at the spinal level which is why it is able to perform movements at the level of the hip. It attaches on the medial side of the tibia this is the remember. This is the lateral side this is the medial side because this is the right leg that is being shown anterior view. I am seeing the right leg from the front anterior view.

This is a very special muscle that is band like and that can perform many functions, such as flexion at the hip flexion at the knee abduction and lateral rotation of the leg. This is the special muscle that is helping us to sit cross-legged. Because that action, where you flex and object the leg is achieved with the help of this muscle. If there was some difficulty in using this muscle, people cannot release it cross-legged something to keep in mind.

So, these are the muscles that are responsible for extension at the knee joint. But then while you are walking, there are two things, one is flexion and the other is extension. These four muscles which are the four rectus femoris, vastus lateralis, vastus medialis and vastus intermedius. Together form the quadriceps or this quadriceps group is responsible for extension of the knee then what causes flexion.

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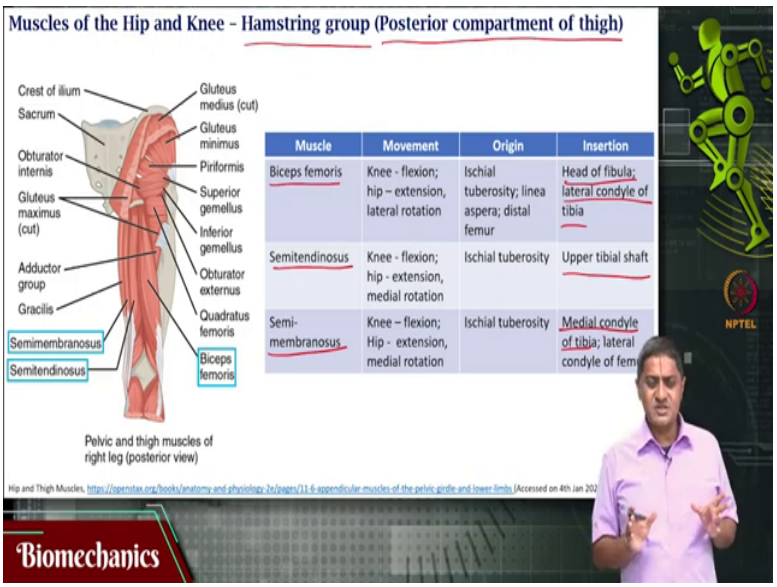

Well that is the so called hamstring group of muscles. This is seen on the back side of the thigh or the posterior compartment of the thigh. And there are three different muscles that form the hamstring group. One is the biceps femoris, the other is semitendinosus, the other is semi-membranosus. All these three muscles are synergists that have approximately the same function, a very similar function.

They all are responsible for flexion of the knee and extension of the hip. Remember, what I mentioned that? If the hip is extended, you can only flex so much at the knee. This is because the muscles responsible for both these actions have shared functions. They perform both of these functions. So, if you are using this muscle for one purpose, you cannot use the same muscle for the other purpose.

This leads to this so, called passive and active insufficiency in terms of trajectories or in terms of kinematics. So, if you are performing one act, you really cannot perform the other act because the muscle is otherwise fully engaged. All these muscles originate at approximately the same points are similar close to each other ischial tuberosity. And they insert at the back of the shin or the shank is it not?

One of them attaches at the head of the fibula and the lateral condyle of the tibia semitendinosus attaches at the upper tibial shaft. And semi-membranosus attaches at the medial condyle of the tibia and the lateral condyle of the femur. So, their purpose is different, depending on where they insert or which head attaches to which side. Then again, we get the question, how do you activate which groups of muscle fibers to perform which function?

If you perform different groups of muscle fibers to perform different functions. For example, that branch or that head of the semi-membranosus that attaches to the femur, if it is activated. Mostly it, is going to perform the hip extension more than the knee flexion. Why? Because the insertion is at the femur. How do you know which is which? If these are indeed two different functions that are separately controlled are these two different muscles.

Because in that case we are dealing with a functional constructive which is a physiological unit? But structurally it looks like a single muscle or anatomically it is a single unit that has two different functions. So, this debate continues. But for our purpose we will just say that semi-membranosus performs both knee flexion and hip extension.

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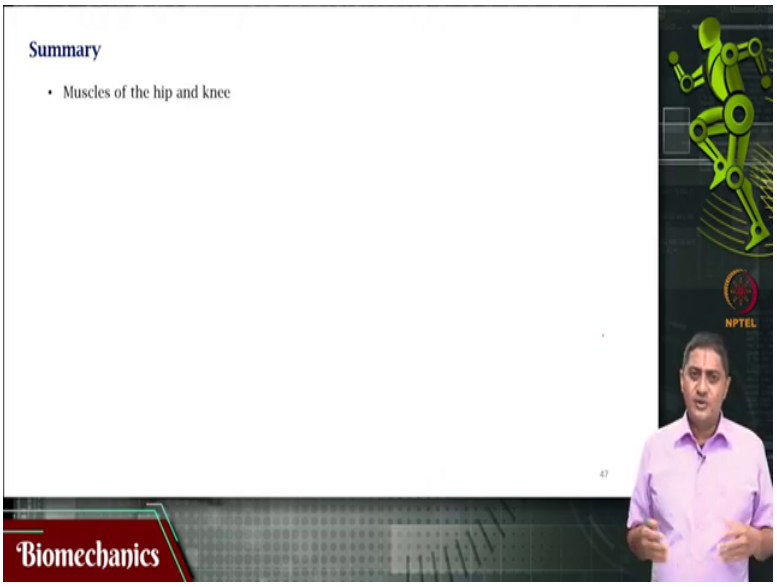

With this we come to the end of this video. Thank you very much for your attention.