Mechanics of Human Movement
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Lecture – 04 Part a
Skeletal Muscles: Functions

So, far in this course we have looked at the bones in the musculoskeletal system. So, basically we have looked at the skeletal which is the framework of which contains sort of the links that will move and the joints you know to which by which they are connected to one another. And we also saw the types of joints that are there in the skeletal system.

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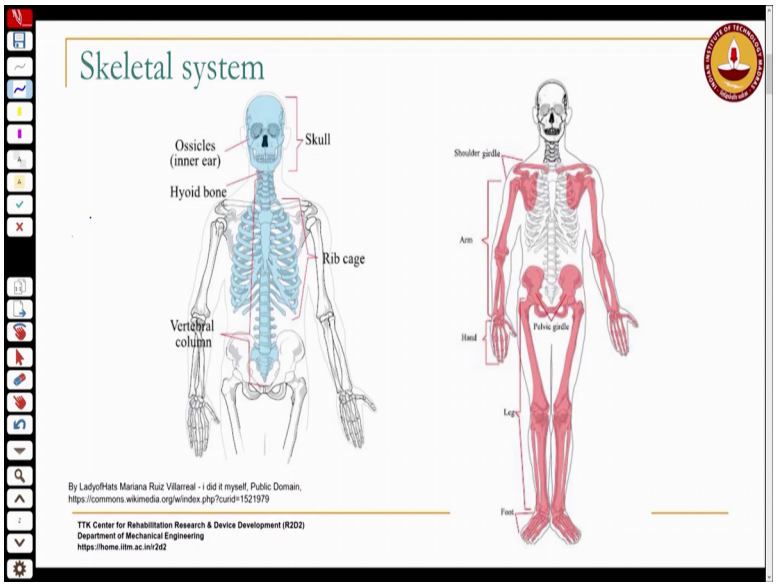

Today we will going to start looking at the next component of the skeletal system which is the musculoskeletal system which is the muscles.

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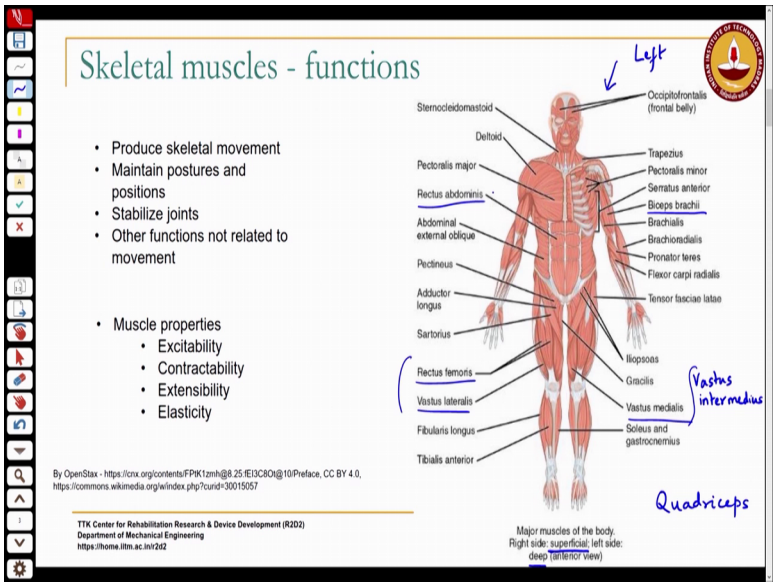

So, the muscles are what are known as the prime movers of the system. So, just as in a mechanical system in order to cause movement or you need to apply forces to cause something to move. So, similarly in the human body the muscles act as the actuators of the system.

So, they have various functions predominantly they apply forces to the bones to produce the skeletal movement. Then even when you are not doing anything; even when you are not moving, the muscles are always acting they are always acting to maintain your posture or to keep you in equilibrium. Because if you look at the human body; we know if you look at the skeleton it is a bunch of long links connected by joints, it is inherently a very unstable configuration ok.

So, if you really had a skeleton without the muscles right; you are not going to be able to hold any post posture for very long. So, the muscles provide that ability; so they provide that control over the skeletal system. And so they also and you also saw the structure of the joints; when we looked at the joints, we saw that many of them are you know unlike the mechanical joints that we design they are not really constrained by the geometry ok. There is a lot of; if you just look at the structure of the joint, they could come apart quite easily. So, these muscles also act to stabilize the joints; to make sure everything stays intact.

And of course, in addition to these function; so, you need your muscles basically to you know lift your body part, lower your body parts, you need to you know to make any movement. In addition to the movement related functions, they also perform other functions for instance maintaining your body temperature. Because when you have muscular action, you produce body heat which is why you know when you do; when you exert your muscles you feel; you feel that body heat being produce.

So, they help to maintain the temperature in the body there are other functions like you know they control basically all the entrances and exits into the body must. You know your ability to speak or swallow, your excretory system everything is controlled by muscles; those are your exits to the entrances and exits to your body and those are all controlled by muscles.

So, if you look at they also help to protect the internal tissues. So, the other organs of the body are protected by the muscular system. So, that it is your first level of you know after the skin it is your; next level of protection for the internal organs. If you look at and there are certain properties of the muscle that actually enable the muscle to act like it does as the actuator in the system. So, if you look at muscle properties; there are four muscle properties which are basically what is known as excitability or irritability, it is also called irritability then you have contractability or contractility.

Then extensibility and elasticity and we look at each of these in a little bit to understand what they mean. Excitability what does that mean?

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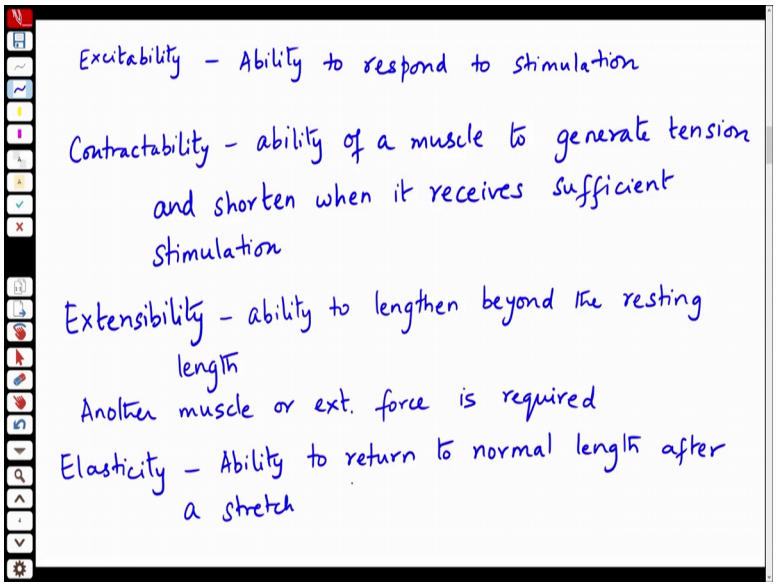

So, it means when there is a stimulus from the nervous system; the muscles actually respond to that and contract. So, the ability of the muscle to respond to the neural stimulus is called irritability or excitability. So, there is a whole body of research that tries to understand how this happens, what are the you know that comes under neuroscience, how the nervous system interacts to excite the muscle tissue.

So, typically the stimulation you have a motor neuron which provides a chemical neurotransmitter; which acts to excite the muscle. And the muscle is such that very quickly you can you know it responds very quickly to a stimulus. So, you know the speed with which you respond ah; so it happens very quickly it can also happen very precisely.

So, there is a lot of control over how quickly you respond how precisely you know; how many fibers are recruited how much force like when you hold something delicate versus when you want to grip something strongly, you have control over how many of these muscles you are going to recruit to perform an action. So, it enables you to do fine motor control.

Now, when you look at contractability; it is the ability of a muscle to generate tension and shorten when it receives sufficient stimulation. So, the thing about a muscle is that it can only pull ok; a muscle cannot push the bone to which it is attached, it can only pull on something and it does that by contracting. So, you have this muscle when it receives

the neural signal; it generates force and it shortens and that pulls on the bone to which it is attached and they can shorten quite a bit.

So, if you take you know they have done experiments with muscles in a lab and they find that it can if a stimulus is applied it can shorten 50 to 70 percent of its resting length ok. In your body typically it does not have to undergo that level of shortening or it does not undergo that because your other body structures prevent it from doing. So, there are limitations imposed by your body structure; so, a muscle may not shorten to that extent, but they are capable of doing that in a in a free setting; in a lab setting where there are no other restrictions on its ability to contract.

The next property is extensibility; so, this is the ability to lengthen beyond the resting length. Now the muscle cannot do this on its own it cannot lengthen on its own. So, there has to be some external force it could be the force of another muscle or some other external force that can cause the muscle to like them; to extend. So, this is force is required in order to do this and then elasticity. So, elasticity implies that once it is stretched past the resting length; it has the ability to a return to its resting length.

So, ability to return to its normal length after stretching; after a stretch is the property of elasticity and this is basically determined not by because like I said the actual job of the muscle is just to contract. So, it is the other connective tissue surrounding the muscle that gives it this elasticity ok. The actual muscle fibers which do the contracting, they do not; they do not have this elasticity.

So, they in the sense like they are not responsible for the elasticity of the muscle; the surrounding soft tissue the connective tissue is what provides the ability to come back to its original length. In contrast if you take the ligaments for instance; so, the connective tissue such that it is elastic; in contrast the ligaments are the very collagenous and which is which makes them rather inextensible.

So, if they are stretched beyond their maximum length; then what happens is they do not return to their original resting length and because of that you will have what is known as laxity in the joint. So, if you apply too much force which is what happens when in ligament injuries; if the force is too much that the ligament gets over stretched then it has no way of returning to its original length. And so because it is not because it is rather inelastic and so you have a problem.

Whereas, in the case of a muscle if it is stretched too far; so that it has some elasticity, but of course, everything has a limit in the case of the muscle usually what happens is the muscle itself tears ok. The muscle tears and then that has to be dealt with, but the failure mechanisms are somewhat different.

Student: Ma'am.

Yes.

Student: So, difference between excitability and contractability because both happens on (Refer Time: 13:35).

Yes. So, when you excite something it responds, contractability is how does it respond ok; I can excite you, you can get angry, you can get you know or you can laugh you know there are various ways you can respond; the ability to respond is the excitability, how it responds is the contractability.

Student: In case of muscles only contraction?

Only contraction; contraction is the only way that they can respond to the stimulus ok. So, now let us look a little bit at the structure of the muscle.

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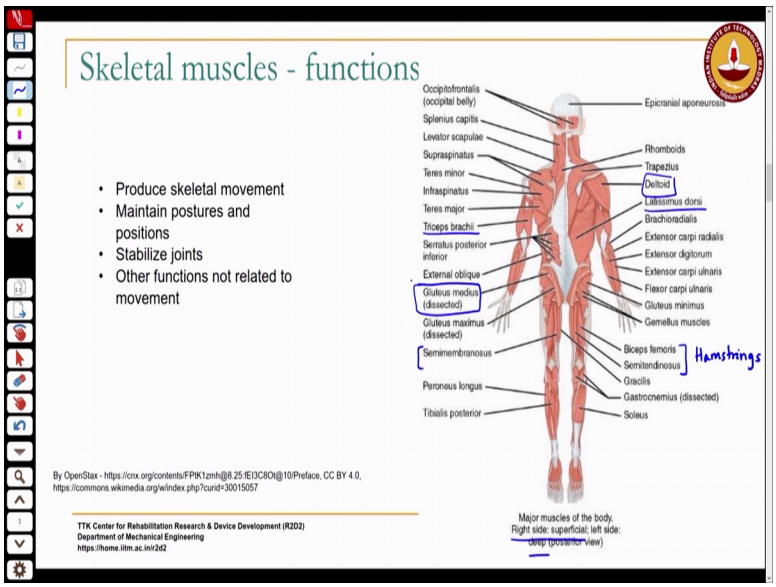

So, again these are some major muscles; you can see the first slide here shows some of the major muscles of the body. You can see on the right side you have what are the superficial; so, super remember this is another term to describe the relative location.

Superficial is closer to the skin something that is deep is inside ok; superficial is closer to the skin and deepest inside. So, you have here a view an anterior view of the body with some of the major muscles. And on the right side you have the superficial or the upper layer; you know some of the muscles you can see on that.

And then because you have layers of this on the left side; remember right and left is always with respect to the subject not with respect to what we are looking at ok. So, I am looking at this, but this is the; this may be my right side, but this is the left side of the subject. Again everything like we said the relative locations are with respect to the anatomical position.

So, if you look at the major muscles of the body; you can see you we will not be you will not be expected to remember all of these muscles. But some which are responsible for movement as we go along you will become more familiar with those, but this is just to show you the architecture. So, you have a layer of superficial muscles; then you may have other layers of muscles beneath those and. So, this is in the you can see some of the muscles located in the deep on the left side and then of course, you have the superficial muscles on the right side.

This is a posterior view of some of the muscles; so you have muscles on both sides; obviously, the anterior and the posterior of your body. And again here this diagram shows on the right side, you have the superficial muscles and on the left side you have the deep muscles. Some of the muscles that we will get very familiar with are like what are known the hamstring group.

So, in the posterior you have the hamstring group which is formed with the biceps femoris, semitendinosus and semimembranosus. So, these are the muscles at the back of your thigh and they are the hamstring muscles. Then in the arm we will talk about the triceps; you are all familiar with the triceps brachii muscle in the arm.

So, this is again on the posterior side of the muscle; then another set of muscles are in your shoulder what are called the deltoid muscles. Some of these names come from the

shapes of them, their locations etcetera. Then of course, you have the muscles of the back; the latissimus dorsi and of course, these are the extensors and flexors of the fingers.

So, you can see it has to do with the digits are the fingers. So, you can kind of guess some of their functions from the names of the muscles. This muscle is also something that we will see later because it is something that is very important for walking; the gluteus medius which sort of stabilizes the pelvis as you walk.

Then in here I want to point out some of the important muscles are your quadriceps. So, you have the vastus medialis, the rectus femoris and one more which is missing which is the vastus intermedius; in between. So, these four muscles together form the quadriceps; so we will collectively refer to them many times as the quadriceps muscles. And they are very important for stabilizing the knee the quadriceps and the hamstrings are very important for the good functioning of the knee joint, for stable functioning of the knee joint. And then you have other muscles like the iliopsoas etcetera which are hip flexors; we will look at those as well later.

And then in the arm the biceps brachii, your in all we call it just the biceps usually right; in Layman terms; when we say biceps we talk about we are actually talking about the biceps brachii. Here you have to be a little more precise because there are biceps muscles in the leg as well which are part of the hamstring group ok. Then of course, you have your six pack here, the abdominal muscles that is what they look like when they are well defined and then you have the oblique muscles etcetera ok.

So, this is just to give you a feel for some of the major muscles of the body that we will be looking at.