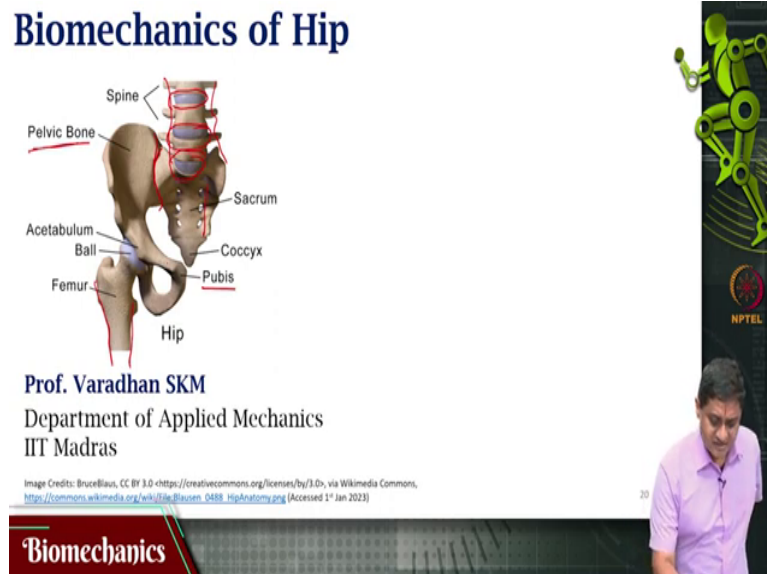


Biomechanics
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Lecture – 34
Hip Anatomy and Movements

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(FL) Welcome to this video on Biomechanics. We have been looking at the biomechanics of the upper limb then the biomechanics of the spine. In this video we will be looking at the Biomechanics of the Hip. In future videos we will be looking at the biomechanics of lower limb, essentially the knee joint and the ankle joint. Here we will be looking at the hip joint.

What is the hip joint? This is a multi-axis ball and socket joint similar to the shoulder joint. When we discuss shoulder joint, we discussed it as a ball and socket joint. So, you have a ball and you have a socket and there is movement that is possible in many directions, multiple directions which is why I can do that. I can do that and I can do that, as well as I can rotate something that based on.

The hip joint is very similar in construction. Although the technical details vary because it turns out that the hip joint is a weight bearing joint. Much of the discussion surrounding the function of the hip joint will involve the weight bearing nature of this.

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Summary

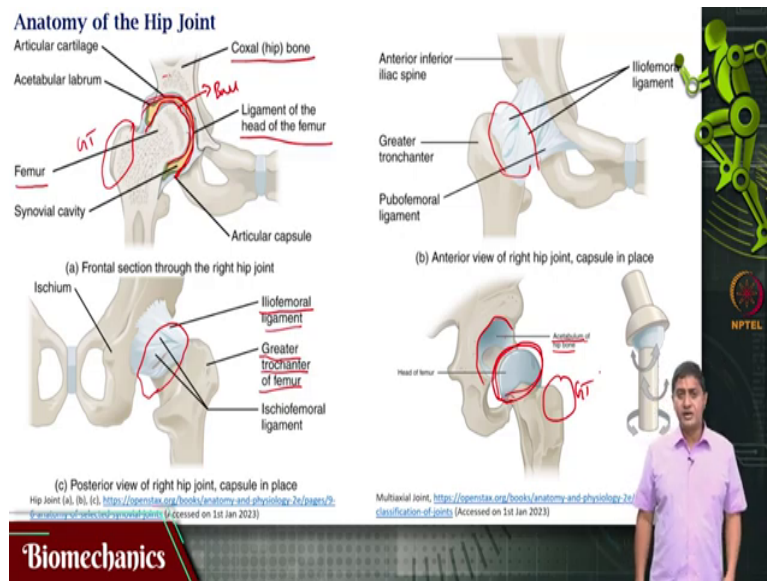
- Anatomy of the hip ✓
- Movements of the hip ✓

Biomechanics



So, in this video we will look at the anatomy of the hip joint and the movements that happen within the hip joint.

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So, what is the hip joint? I already mentioned this. This is the joint between the femur or the head of the femur which is this part, not visible. It is visible it is found below this ligament that is shown between the between the head of the femur here. For example, here this is the head of the femur which is like more like a ball. It is like a ball. You have the ball and socket joint. So, you have the ball and you have the socket.

So, the head of the femur is like a ball and the hip bone has a specific region an enclosure within which this movement happens. Just like you have the shoulder joint. There is an enclosure within which the movement happens. This enclosure this space within the hip bone

within which the movement of the femur head or the femoral head happens. This enclosure is called as acetabulum.

Acetabulum is a part of the hip bone that encloses is more like a cavity it is the socket within which the femur or the head of the femur, within which the ball which is the head of the femur most a crucial function of the hip joint is weight bearing and providing stability. This is where the difference from the shoulder joint begins to appear because it provides stability which is why it is a lot more stable than compared with the shoulder joint.

Because, when we discuss the shoulder joint remember that there is frequent occurrence of the dislocation of shoulder. We must have mentioned this when compared with the hip joint. The shoulder joint is a lot less stable. The hip joint in comparison is a lot more stable functions vary. See in this case the function defines the structure there is a need for weight bearing by the hip joint. There is no such need for the shoulder joint.

So, fundamentally, the function dictates what is the structure that is needed? So, something to keep in mind. So, why is this the case? In particular in humans when compared with the monkeys this is a lot more crucial in humans when compared with monkeys. Why? Well because it turns out humans are bipedal. Monkeys are quadrupeds so, monkeys walk with four legs, whereas humans are bipedal who walk with two legs.

So, our upper limb is essentially not evolved for load bearing and the lower limb is specialized, is evolved for load bearing fundamental difference in function between other primates and humans, fundamental difference. So, the function dictates the structure, so that is the fundamental difference in the anatomy between primates and humans, as in non-human primates and humans fundamental difference.

This must be the case. This is, it is not obvious until now, when I say this, it is obvious but it is not obvious otherwise. So, when you do not know otherwise it is not obvious when I say that monkeys are walking with four legs, you say yeah monkeys are walking with four legs. What is news of this? The news is that humans and their hip bones are specialized for bipedal walking which means that this upper part of the body.

And its entire weight must be supported by the hip joint. So, this weight of the upper body must be supported by the hip joint. Crucial function, especially in humans in particular in humans because humans are bipedal. So, fundamental difference, crucial difference which dictates structure. So, remember at the beginning of this course I would have mentioned that as part of biomechanics.

We are interested in exploring studying and analysing structure function relationships. This is our interest. What are the cases in which a structure dictates function and what are the cases in which function dictates structure? Essentially, this is our specialization. This is our interest. This is biomechanics. So, here the function dictates structure, so, the hip bone and the hip joint evolved for bipedal walking, especially is for bipedal walking.

I would like to spend some time here discussing this because an epidemic that we are seeing in humans throughout the world is the epidemic of obesity. Remember that human hip bones have evolved over millennia over centuries over thousands of years, whereas the food excess that we are seeing is something that we are seeing only in the last century. Only in the last 50 years or maximum.

So, First World War II is when there was an excess of food available in humans. All these Green Revolution, the necessity to have more food or to grow more food, at least expense with a lot of water. This is something that is new to humans, so, this excess food that is going in is has led to this outbreak of the obesity epidemic. It is a huge problem and diabetes. So, obesity related disorder all these problems lead to an increase in weight.

Why is this relevant to biomechanics? It is relevant, please be patient. It is relevant because as people gain more and more weight, what you realize is that the lower part of the body is no longer able to support this weight. Which is why you are seeing an outbreak of hip problems, knee problems, ankle problems and all the orthopedic problems in the lower lip. That is because of the heavier weight of the upper body.

So, remember, evolution of the hip bone and the knee joint is something that has happened over thousands of years. But the obesity epidemic is a much faster process than has happened. So, evolution has not yet caught up with the obesity epidemic. Because of this reason, you are going to see a lot of these problems evolving which is why it is very, very

critical, as listeners of this video, students of biomechanics very critical to keep your body weight in check students of biomechanics.

There is a reason, your body weight if it is in check your lower body will be will thank you. Your lower body will thank you for that. Let us go back so, the hip prone to weakness, osteoarthritis and breaking is a very common, relatively common problem. That is found in people who are older, older adults. You have this problem that they are not. Why is this the case again?

They are heavier and they have used this part of the body for a long period of time. So, this happens after 50, 60 years they need a replacement of the hip. So, one of the first prosthetic device or a device for the replacement was developed for the hip. Because this is a very common or a relatively more common of the problems orthopaedic problems that are found. So, yes, in particular, this is more common in women than men are those who have osteoporosis.

Then those who do not have osteoporosis. So, osteoporosis is this condition in which the bones have more pores, more holes than tissues. So, this leads to weakening of the structures of the bone, essentially leading to an overall weakness of the bone. Leading to breakdown of the functions of the bone which leads to fractures or which leads to excruciating pain. Sometimes that requires a hip replacement.

So, this is also called as broken hip. It is called as broken hip but essentially what this is it is a fraction of the femoral bone. It is a fracture of the femur is the neck of the femur that gets broken which is not able to take this weight because of this reason it breaks. Remember this fracture may be caused due to a fall. Remember fall in older adults is also a relatively common phenomenon.

It is a very complicated topic because I work on this topic. I work on a balance posture. I work on in general human motor control falls in older adults. I know is more common than in younger adults. This is a very detailed topic which we do not have much time to discuss as part of this class. But I will just mention this that this is because a loss of neural control, a loss of re-weighting between the vestibular system and visual system and many other.

Such relatively complicated reasons which we do not understand. It turns out that balance and posture are compromised in older adults and they are also people who have used this part of the body for a long time and some of them are obese already. All these things together cause falls in older adults. So, older adults are more prone to falling than younger adults. You are again asking what is news?

I am just trying to list the reasons why this happens and when they fall. And if they have weakened bones, they are more likely to break and it turns out that when compared with younger adults, the possibility that they will heal reduces as you age, the ability of the body to heal itself in general reduces. In particular, the ability of the bones to heal themselves reduces a lot all these things put together caused us a situation in which the surgeon is forced to make a decision.

Can we have this replacement? So, this is a fundamental challenging problem, so, this is a fundamentally challenging problem that is faced by practically the entire world. So, when people fall they break that is one thing or sometimes the weak weakness itself may cause the fall. So, the fall may cause the breaking or the fracture may cause the fall. So once people fall they there will be a fracture of there may be fracture of the lower part of the body.

But suppose, if the head and its integrity is affected that could cause that could have dangerous consequences. So, it could lead to mortality, it could cause, serious disease or it could even cause death. So, some serious issues here, with the function of the hip and the structure of the hip. So, we are discussing this so because of all these reasons. So, essentially there will be this these surgical procedures are in general expensive hip replacement is in general expensive.

So, the healthcare cost associated with broken hips is a major factor in older adults to take care of. So, something to keep in mind a simple way to avoid this problem is to keep your weight under check. So, a very simple, so, students of biomechanics remember this students are biomechanics, will keep their weight under check something to keep in mind. Of course, any surgical procedures such as this, in particular those that involve this kind of surgery for the lower limb will mean that the recovery period is relatively long.

It will be a prolonged recovery period. They will have to be a bit ridden for a while and then the therapy walking therapy will take a long time, especially in older adults. If people remain bedridden for a long time. There are many problems that come, for example, pneumonia or for example, bed source. These are problems that are difficult to tackle and difficult to avoid if a person is bedridden for a long time.

So, the of course the better thing is to not get the problem but that would require very conscious effort on the side of people to keep their weight under check. So, something so it all comes down to this because the hip is designed to take only so much load. It is not designed to take as much load as we are having on the upper body right now. The current human generation this much weight is something that the hip joints cannot take.

This is the reason why we are seeing an explosion of the hip replacement places. That is not to say that people did not break their hips, though 1000 years ago they did but the proportion was much lower. Because the availability of food was a challenge in the good old days when compared with now. So, coming back to the structure of this, so, there is this part which is the ball or the head of the femur and this part of the femur that is called as the greater trochanter name technical term.

Greater trochanter, greater trochanter is that part of the femur something to keep in mind. And this is what articulates within the acetabulum of the hip. So, the hip itself, if you go back if we go back the hip itself, so, this is the ball of the femur and the acetabulum not clearly visible in this picture is the socket within which the ball moves and this is the long bone. The longest bone in the body femurous one of the strongest bone also.

So, it is not that we are not designed for this. We are but it can only take so much load that is the point. The hip bone itself is this bone the hip bone itself is this bone it is and it has this part which is called as pubic. It is also sometimes separately called as a pubic bone but this is one single bone composed of the pelvic part or the pelvis sometimes called pelvis and this part is called as pubis or the pubic bone and this part itself is called as the hip bone.

Sometimes all this put together is called as the hip bone. What is this? This is something that we saw in the previous videos. This is the spine. What are these? These are the intervertebral discs. So, this is the intervertebral discs of the Sac of the lumbar region. Then you have the

fused vertebra of the sacrum. Then you have the tailbone or the coccyx. Something that we saw in the previous video. So, there is pelvis or the pelvic bone.

There is pubis or the pubic bone and then there is the hip. Sometimes all these things together is called as the hip bone. But the hip joint itself is this joint between the femur and the hip bone are the acetabulum of the hip bone. So one another view of the same. So this is the femur, so, this is the ball or the head of the femur and this is the greater trochanter. This is the greater trochanter, this is the ball.

Remember this is the coccyx and this part of the hip bone is called as acetabulum just mentioned it acetabulum. And there are specific ligaments that ligament of the head of the femur and there is the iliofemoral ligament. So, these ligaments are responsible for maintaining the stability of the hip. Remember we compared the shoulder bone and the hip bone. The articulation that you get in the shoulder bone is much more.

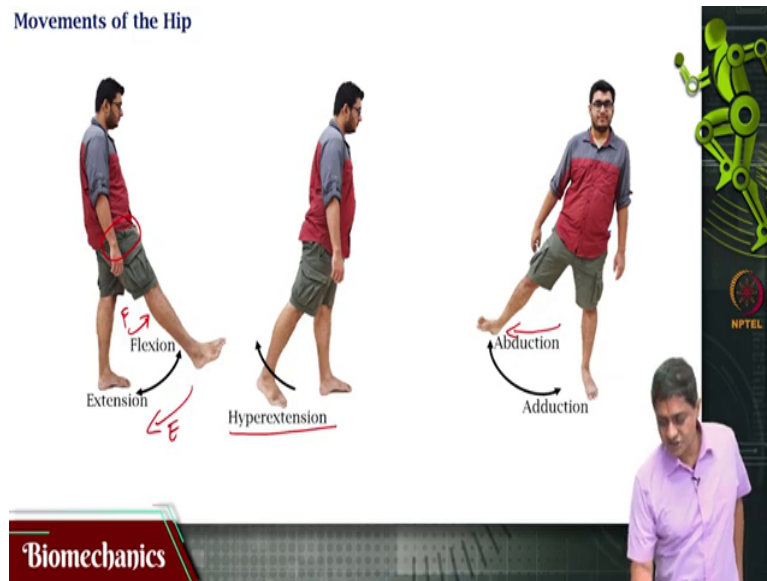
The articulation that you get in the shoulder joint is much, much greater when compared with the articulation that you get in the hip joint. But what you lose in terms of mobility and articulation you gain in terms of stability. A lot of this stability is because of the presence of these strong ligaments these ligaments that are and also but what is the need for this stability once again going back? It needs to support the weight of the whole upper body.

The weight of the whole upper body will have to be born by this bone and further pass down to further joints such as the knee joint, such as the ankle joint and to the ground. So, it is not actually, a trivial aspect of biomechanics something to keep in mind. So, this is one more view. This is the acetabulum and this is the head and this is the greater trochanter. So, remember that the rotation can happen in all three directions.

So, movement can happen in the anterior posterior direction. So, you can actually, move your hip forward and backward. The movement can happen in the medial lateral direction and there can also be rotation.

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Movements of the Hip



So which we will see in the next few slides. So, flexion extension as here. This is my student PhD student Anuragupta, who is trying to demonstrate a very nice pictures. So, there is flexion extension. There is forward movement of the entire lower limb. That means that that is happening at the hip joint here. That is happening at the hip joint here, so, this movement is called as flexion and that moment is called as extension.

Something to keep in mind. I can of course perform a limited amount of hyper extension. What is hyper extension? Extension in the back side or rather flexion on the back side. So, extension beyond the neutral position is what you call as hyper extension to a limited extent hyper extension is possible. And you can also perform abduction, adduction, to abduct is to take away so, you the leg, moves away from the midline of the body.

When that happens, it is called as ab duction, abduction and when it moves towards the mid lane of the body, it is called as ad adduction.

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Movements of the Hip



Something to remember but we are not done yet. Another movement that is possible is rotation. Rotation, internal rotation, rotation of the toe towards the midline of the body is called as internal rotation. Such that the toe comes closer to the midline like this is called as internal rotation, when the toe moves away from the midline that is called as external rotation. So, three sets of movements possible flexion extension, abduction, adduction and rotation.

These are the possible movements at the hip. So, in this video we have seen the anatomy of the hip the special nature of the hip joint and its crucial function in terms of weight bearing and how that is done in comparison to its humongous job. It is a relatively simple system that is performing this job of you know bearing the entire weight of the upper body. So, the head of the femur or the ball articulates within the acetabulum or the socket and is responsible for all these movements that we discussed.

So, we saw the anatomy of the hip and these are the movements that are possible and what are these movements? Forward, backward movements are anterior, posterior movements also called as flexion, extension, medial, lateral movements or the side based movements also called as abduction, adduction and rotation. Internal rotation and external rotation with this we come to the end of this video. Thank you very much for your attention.