Major joints and their actions - Part 2

Hip joint, one of the most important and crucial joints. It is, again, a ball and socket joint, very much kind of like the shoulder joint. It connects the femur to the pelvic bone. So, this here is the pelvic bone. This is, again, a synovial joint. And despite being a ball and socket joint, it is one of the most stable joints in the human body because it compromises stability for mobility.

So, if you look at the range of motion, which is to say, what is the entire volume in which you can move a particular joint, if I look at the range of motion of my shoulder, there's a huge volume I can cover. On the other hand, if you try to do the same thing with your leg, you will find that there are hard stops, limits beyond which you cannot stretch. I mean, I'm sure there are exceptions to the rule, people who have extreme flexibility, but even they will be limited by other structures. So, with that being said, let's take a look at what are the movements that the hip joint can do.

Again, first of all, there is flexion and extension. So, this here is flexion, and backward is extension. So, flexion and extension are important movements. You do them every day, whenever you're walking, running. Those who are into martial arts, when you're doing a front kick, for example, you are bringing, it is the act of bringing your thigh towards your chest.

If you're doing any sort of exercise for the lower body, flexion and extension are kind of integral to that. When you're doing a squat, you flex your hips. When you're doing a lunge, you extend your real leg. So, the hip joint plays a crucial role in all of these activities. Next up is adduction and abduction.

Abduction is the act of taking it away, and adduction is bringing it back. So hip adduction is an important activity that we use to stabilize ourselves throughout the day. When you're walking, you don't entirely walk in one plane, or rather, you don't entirely move the legs in one plane. Your body is constantly shifting. The center of mass of different segments is constantly moving, and these movements allow for us to stabilize and make sure that the forces are aligned and do not make us topple over.

Next, we have horizontal abduction and adduction. So, this here is abduction, which is taking it away, and abduction and the act of bringing it back is adduction. So just like the shoulder joint, this is equivalent to the abduction-reduction and horizontal abduction-reduction. Same way for the hip joint. Just like there was internal-external rotation in the hip and the shoulder joint, which was a ball and socket joint, we again have internal and external rotation in the hip joint.

So, I know this figure is showing, this video is showing you the foot, but this movement is happening at the hip joint. So external, internal and the directions would be flipped for the left leg. So where is this movement seen? Again, in a lot of dynamic activities, wherever you are changing directions, there is internal rotation and external rotation combined depending on which limb is leading and which limb is lagging. It is used in run and cut movements in sports all the time and it can lead to a very dynamic posture where your leg can be rotated inwards and you are

twisting to the side. So, it basically allows for a very dynamic rang e of motion while you are within the constraints of the.

Finally, if I combine all of these movements, I get the circumduction movement. So, a 3D joint like the ball and socket joint can always move in full 3D movement, and that is what you are seeing here with the circumductory movement. So let us move on to the next joint, which is the knee joint. So, it is formed by the femur, the tibia, and the patella, which is the kneecap. Please note that the fibula is not part of the knee joint.

This is, again, a synovial joint. In fact, this is something you might have heard your grandparents complain about that you know their knees hurt, and there is a lot of friction in the joint, and then the doctors might have told them that the fluid is low, which sounds like a very engineering term but it is the lack of the synovial fluid in the joint or the reduction in that fluid which causes the additional friction. Now the knee joint is stabilized by four cruciate ligaments, the ACL or the anterior cruciate ligament, posterior or the PCL, medial cruciate ligament MCL, and lateral cruciate ligament LCL. So, these are some of the common points of injury as well which you will hear a lot in the world of athletics and sports. So, let's take a look at the movements that the knee joint can do.

So, if what does your intuition say? Given the nature of the joint and if you try to move your knee yourself, it's mostly a hinge joint, right? So, the primary movement that this joint can do is flexion and extension. So, this here is flexion, this here is extension. Where do you use these movements? Pretty much everywhere throughout the day when you're walking during the stance phase, you maintain your dynamic stability of the leg by locking the knee, and when your leg lifts off from the ground, and you are in the swing phase, you are doing a, you perform a flexion, and then an extension movement and then place your leg on the floor and then place your foot on the ground for the next step. Also, limited rotation and abduction, and here is a close-up of some of those ligaments that we were talking about. So, because of the way these ligaments crisscross, and if I was looking at it from the back, you have ligaments going from the back to the front.

You have ligaments on the medial side and the lateral side. So, they form a tight tensigral structure which means that they are taught in place, and they prevent this sort of sideways movement, which is also the cause of injuries. So, if these ligaments are overloaded then they can tear, rupture and that can lead to instability of the knee. So, stability provided by the ACL, PCL, MCL, and LCL, and again, technically, you cannot rotate the knee safely. The rotation primarily happens at the hip joint.

When you try to rotate your foot inwards or outwards, the rotation is predominantly happening at the hip joint. The knee should not be rotating. That rotation is very limited. There is some amount of elasticity built into the knee joint to adjust and accommodate very small deviations but not significant deviations which would eventually lead to injury. We finally come to the ankle joint which is also called the talocrural joint.

This is, again, a synovial joint. It connects the tibia and the fibula. So, tibia and the fibula to the talus of the foot. And the foot has a lot of bones in place, the tarsals, the metatarsals, and a lot of ligaments connecting these bones together, which again form a very tensigral kind of a structure but allow for limited and varied mobility at this joint. So again, the primary movement of the foot happens in the sagittal plane. So, it is primarily a hinge joint but also a complex hinge joint which means it can perform the hinge movement along with slight twisting of the foot.

Let's take a look at it. So plantar flexion and dorsiflexion. So, dorsiflexion is the upward movement, and plantar flexion is the downward movement. This is also very critical for gait phases, for walking, for running. This is what lets you jump up and down, what generates the propulsive force when you're walking and running, and is one of the fundamental movements in pretty much every sport now.

On the other hand, dorsiflexion is more for adjusting the position of the foot. Next, we have eversion and inversion. So, inversion is the rotation of the ankle in this plane towards the centerline of the body, and eversion is its movement away. This is what lets us navigate rough terrain. So, if you're going over a rough patch of road with undulations and you're trying to navigate that, your foot can adapt to that particular terrain which is why it is a complex hinge joint because even after it does, it adapts to that movement, it does a plantar flexion to move forward.

Then it comes back to the normal orientation and then it does a plantar flexion again when it faces another obstacle of another kind. So, you can combine these movements into a rotation. Some of you might recognize this as a very common exercise used to do during your physical training periods in school. So that brings us to a conclusion on the major joints and their actions. So, the major movements that we have looked at happen at all synovial joints.

All in-socket joints, which are the shoulder joints and the hip joints, have a wide range of mobility but hip joint sacrifices a wider range of mobility in favor of stability because it holds the upper body in place. And compound actions like circumduction of the shoulder joint and the hip joint, for example, can be achieved by combining, by the combined ability of the joint to do flexion-extension as well as adduction abduction. Thank you, and I will see you in the next one.