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PERFORMANCE POINT

THE PHYSICS OF HUMAN MOVEMENT

THE KNEE

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The knee is the largest joint in the body and one of the joints most frequently injured. Most daily activities as well as sport activities require full functional movement of this joint. So what actually makes up the knee, and how is it supposed to move? What components make it unique? How can we ensure we have healthy, stable knees?

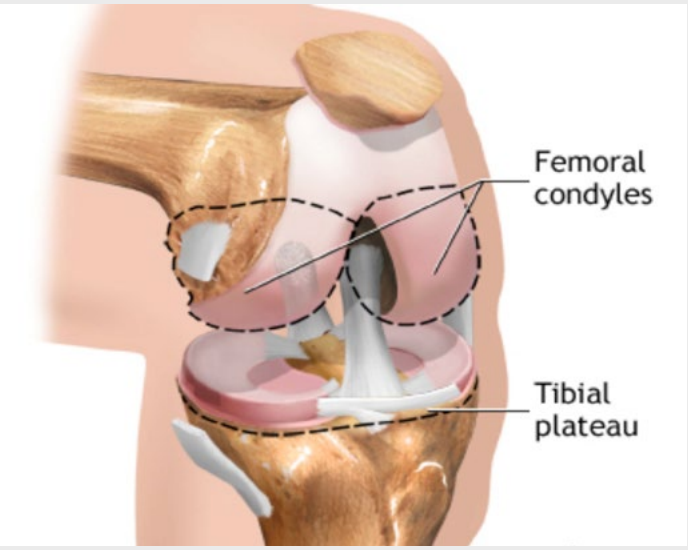
COMPONENTS OF THE KNEE

The knee is composed of three bones:

1. Femur
2. Tibia
3. Patella

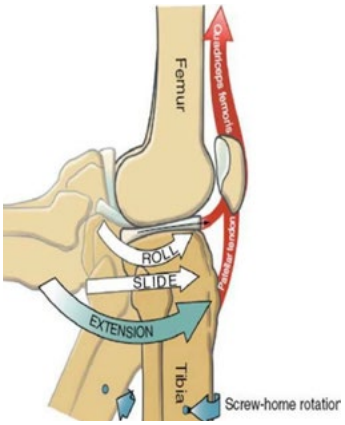
There are three joint surfaces that work together to produce the primary movements of the knee (flexion, extension, and tibial rotation).

1. Medial tibiofemoral: the medial (inside) condyle of the femur to the tibia
2. Lateral tibiofemoral: the lateral (outside) condyle of the femur to the tibia
3. Patellofemoral: the patella moving against the femur

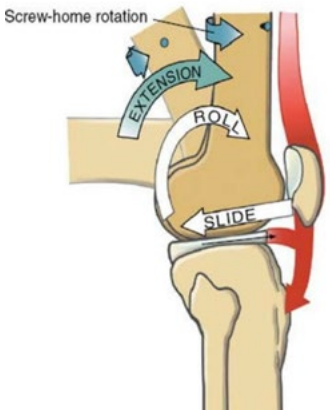


**** The fibula is not considered part of the knee joint as it sits distally (below) the knee joint, but rather part of the ankle joint.***

TIBIOFEMORAL



Femoral condyles are larger than the tibial plateau, therefore the bones don't work as a true door-like hinge when flexing or extending at the knee. The arthrokinematics (how the tibia and fibula move on each other) consist of a rolling movement at flexion initiation and then slide along the tibia near the end of knee flexion. This roll and slide movement of the femoral condyles on the tibia is crucial to maintaining an Instantaneous Center of Rotation (ICR). This means the center of axis of the joint is constantly changing throughout the range of motion (ROM) of the knee to be in a constant position for efficient muscular contraction.



Open vs. closed kinetic chains differ in how the joint arthrokinematics work. An example of the knee in an open kinetic chain movement (image A) is the kicking of a soccer ball. With this movement the femur is stable and the tibia is rolling and gliding on the femur in the same direction. An example of a closed kinetic chain (image B) is the planted leg during a kick, or an athlete performing a squat movement. In a closed kinetic chain the femur is dictating the movement of the tibia and the femur will roll anterior and glide posteriorly on the stable tibial base.

These movements are critical to maintaining stability in the joint while the two bones are moving on each other. If any of these movements are out of alignment, or not working in the correct sequence, the joint may become unstable and increase the possibility of injury.

A unique characteristic of this joint is called the 'screw home mechanism'. This mechanism involves the rotation of the femur on the tibial plateaus. The rotational movement of the joint will lock your knee when in full extension, and unlock the knee when flexion is initiated.

PATELLOFEMORAL JOINT

The patellofemoral joint is the connection between the patella (sesamoid bone embedded into the quadriceps muscle tendon) and the femur.

This joint is largely dependent on soft tissues (muscles and tendon) for stability. On the back side of the patella are articulating surfaces (poles) that differ in their contact position on the femur. As you move from full extension to flexion the patella will sit on the femur in different orientations. This order of contact is critical to maintaining a full, pain-free range of motion. When one of the patella poles is contacting the femur at the wrong time, pain results and can lead to the development of Patellafemoral Syndrome (pain during knee ROM).

The main function of the patella in this joint is to centralize the force produced by the quadriceps. This will increase the internal momentum of these muscles and maintain an efficient contraction throughout the entire knee ROM.

ASSESSMENT

Joint ROM is a great way to gather two pieces of information about the athlete's knee:

1. How far can the athlete actively flex and extend the knee?
2. Is the athlete capable of getting more range when the coach/practitioner passively moves their knee?

These pieces of information will help identify if the athlete is experiencing issues of a muscular origin (1) or of a capsular/ligament origin when the muscles are disengaged (2).

Everyone is different, and one athlete's "normal ROM" will differ from another athlete's. However, on average a normal, healthy knee will display these ROM values.
*Pain or decreased ROM associated with these movements may signal instability at the joint and be worth further investigation into the structures surrounding the knee to prevent possible damage or future injury.

Movement	ROM (degrees)
Flexion	135
Extension	0 - 15

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