

# Musculoskeletal studies: the knee joint essay



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Musculoskeletal studies: the knee jointIntroductionThe knee joint is a specialized and very complex hinge joint that connects the femur on one side and the tibia and fibula on the other end. The joint, generally described as a joint with limited movement, is the largest and most complex joint in the lower extremities and perhaps the most vulnerable to injury due to its orientation, position and structures. Besides carrying the weight of the body, the knee joint prevents hyperextension of the legs, which would have been possible, if the patella was not present. It also restricts posterior bending of the legs, thus enabling the body to stand upright (Dunleavy, 2008).

However, unlike other major joints of the body, the structures of the knee joint do not provide enough support to ensure stability of the joint. In other major joints of the body, take the hip joint for example, the bony structures of the joint gives the joint the required basic stability, which is then enhanced by the ligaments and muscles surrounding the joint. In the case of the knee joint, such basic bony support is not available. The knee joint is basically formed by the barrel shaped lower end of the femur (condyles) sitting on the almost flat upper tibia surface. As a result, the knee joint must depend on supporting ligaments and must importantly, muscles, to provide support and stability. In the absence of good muscle control, the knee joint is an 'unstable joint, heavily loaded by the body above and vulnerable to injury' (Backhouse, 2008).

Structures of the Knee JointLike every other joint in the body, the knee joint is formed by bones, muscles, ligaments, cartilages and synovial membranes and fluids. The bones that make up the knee joint, primarily include, the femur, the tibia, fibula and the patella. The femur or thigh bone is the

strongest and longest bone in the body. The tibia and the fibula, supports and assist the femur in providing strength and support for the body. From the head of the femur in the hip joint, the neck of the femur extends out laterally so that the shaft of the bone runs from this wide upper, bending inward slightly to meet the upper surface of the tibia at an angle. So, in contrast to the apparent parallel structure of the legs, the bones forming the lower extremities actually meet at angle at the knee joint. This angling of the femur on the tibia creates a lateral force that tend to drive the knee medially (Powers, 2003), a situation known as knocked knee, thus adding to the stability and vulnerability problems of the knee joint.

Although, to counteract this force, the medial muscles and ligaments, in the knee joint, are much larger and stronger than the lateral ones (Backhouse, 2008). Angle of the FemurThe patellar also known as the knee cap is an important component of the knee joint. It is a triangular shaped bone located in front of the meeting point of the femur and tibia, thus constituting an important part of the joint.

It as been suggested that it's location in front of the articulation surface of the two bones in the joint is to restrict complete, free movement of the joint. And actually, if the patella were to be absent or not in that position, complete hyperextension of the legs would have been possible and support for the human body would, thus have been extremely limited (Dunleavy, 2008; Gross Anatomy, 2006).; From the above, it is evident that the knee joint essentially comprises of the femur, tibia and patella bones, and in real fact, two different joints occur at the knee joint, thus it is sometimes referred to as the knee joint complex. The first and principal joint is between the

femur above and the tibia bone below known as the Tibiofemoral joint (TF joint), while the second, but smaller joint is between the femur and the patella, the Patellofemoral joint (PF joint). The tibiofemoral joint is the meeting point of the convex femoral condyles and the concave superior surface of the tibia plateau.

The tibiofemoral joint also divided into a medial and lateral part. The patellofemoral joint, on the other hand is the meeting point of the convex femoral condyles with concave facets of the patella. However, the knee joint can still be regarded and discussed as one entity for the sake of simplicity.; The knee joint depends, to a large extent, on muscles and ligaments for support and stability. As a result, the joint enjoys extensive muscles above and below the joint. Above the knee joint are two major muscles groups; the hamstrings and quadriceps.

The quadriceps is comprised of the vastus lateralis, vastus medialis, vastus intermedius, and rectus femoris. These muscles run down the anterior part of the thigh and function as powerful extensors of the knee. To achieve this function, the tendons of the four muscles making up the quadriceps converge to form a single strong tendon that inserts into the patella (Dunleavy, 2008). The hamstrings, on the other hand, lie behind the thigh and thus function as flexors of the knee. This muscle group comprised of semitendinosus, semimembranosus and biceps femoris, diverge as they approach the knee to the knee, with the tendons of the first two going to the medial side and that of biceps to the lateral side of the joint. This arrangement allows for a wider control over the joint's movement and also creates the hollow behind the knee (Backhouse, 2008). Two other individual

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muscles that strengthen the knee joint are the sartorius and the gracilis. The sartorius, the longest muscle in the body, support medial and lateral movement of the leg; while the gracilis gives medial rotation to the leg.

Below the patella, the primary muscles that provide support and movement to the joint include the gastrocnemius and the soleus. After muscles, taut and strong ligaments also provide support for the knee joint. The major ligaments of the knee joint are the cruciate, lateral, and capsular ligaments. Again, due to the tendency of the knee joint to be driven medially, the medial ligaments are much broader and stronger than the lateral ones. The anterior and posterior cruciate ligaments are found behind the knee joint, the anterior is attached to the front of the tibia, while the posterior is attached to the back. Their primary function is to act as a direct bond of union between the tibia and the femur, thus preventing forward and backward sliding of the femur on the tibia.

The lateral ligament; internal and external, both run from the femur to the bones of the lower leg, with the internal attaching to the tibia and the external attaching to the fibula. They both help in preventing lateral bending of the knee joint. The capsular ligaments provide additional support for the joint, extending from the femur to the back of the tibia and inserting in the space left by the other ligaments (Backhouse, 2008; Dunleavy, 2008). The load bearing surfaces of the femur and tibia, as in other joints, are covered by hyaline cartilages. The cartilages found at the knee joints are the internal and external semilunar cartilages, they are called semilunar or menisci because they are circular in shape with thick outer parts and thin inner parts.

The internal cartilage is found in front of the anterior cruciate ligament and attaches to the superio-anterior part of the tibia. The external cartilage also lies in front of the tibia and blends with the anterior cruciate ligament. The joint also have numerous bursae, within, on the sides and on the front of the knee. Together with the cartilages, the bursae act as cushions for the joint. An extensive, delicate synovial membrane also line the non- load bearing aspects of the joint, extending from the upper part of the patella to the inferio-anterior part of the femur.

Structures of the Knee Joint  
Movements of the Knee Joint  
From the orientation, the knee joint can be seen as a simple hinge joint that allows a unidirectional movement; from straight into full flexion, though certain degree of rotation is possible. In the straight position, the knee joint hold the weight of the body, while the flexion provides support during motion. During flexion, rotation of the bones of the joint, to certain degree, is possible, due to the fact that the patella rest on the fat between the femur and the tibia, allowing for inward gliding of the tibia. Also, during extension, certain degree of rotation is possible, since the patella moves up to make contact with the femur on the articular surfaces, allowing for slight lateral twist of the tibia on the femur. The foot plays influences the functions of knee joint significantly, due to its function in motion and especially, due to the close biomechanical relationship between the tibia and the bones forming the subtalar joint - talus and calcaneus (Powers, 2003). Discussing gait, Pribut (2008) explained that the gait cycle of each leg is divided into two phases - the stance phase and the swing phase.

The stance phase is described as the time when the foot is in contact with the ground while the swing phase is the period in which the foot is off the ground and swinging forward. During walking, the stance phase takes about 60% of the gait cycle, although this proportion decreases with the speed of walking or running. During these phases of the gait cycle, the motion of the subtalar joint causes rotation of the tibia relative to the femur. Pronation of the subtalar joint induces internal rotation of the tibia, while supination of the joint causes external rotation of the tibia. During the first 30% of the gait cycle, normal subtalar joint supination occurs and this induces a 6-10 degree internal rotation of the tibia, due to the inward rotation of the talus as it falls into the 'space created by the inferior and lateral movement of the anterior portion of calcaneus' (Powers, 2003 p. 641). However, this close relationship between the bones of the foot and the tibia is responsible for a lot of knee joint injuries. For instance, it has been argued that abnormal pronation of the subtalar joint contributes to patellofemoral joint dysfunction.

Excessive or abnormal pronation of the subtalar joint adversely affects the knee joint because it results in excessive tibial internal rotation which in turn places rotatory strain on soft tissues of the lower extremity. Injuries to the Knee Joint The load bearing function of the knee, its functions and the inherent vulnerability exposes the knee joint complex to a lot of injuries. Common causes of knee injuries are overuse or overload, due to repetitive motions especially in sports, sudden stops and twists or direct blows to the knee. Injuries to the knee can be sub divided into sprains, strains, tendinitis, meniscal tears, fracture and dislocation, cartilage injuries and other varying forms of infections and injuries.

Strains occur when a ligament is overstretched or torn, while the most serious ones involve the tear of one or more ligaments. Common knee sprains involve over damage to the anterior cruciate ligament. Tear or damage of this ligament usually occur when there is a sudden hyperextension or rotational force exerted on the ligament, and this occurs primarily in sports requiring the foot to be planted and the body to change directions rapidly, such as in basketball. Symptoms of knee sprains commonly include a popping or snapping sound in the knee at the time of injury; pain that seems to come from within the knee, especially with movement; fluid behind the kneecap or not being able to put any weight on that leg.

Meniscal tears are also common in sports. The meniscus grows weaker with age and thus tear can occur with minor injuries in older patients, however, in younger people, tear of the meniscus is usually the result of a forceful pull, commonly experienced in sports where sudden changes in speed or side-to-side movements is the norm. Strains are more serious than sprains and usually involves partially or completely tearing a muscle or tendon, although the symptoms and causes are commonly similar to a sprain except that it is usually accompanied by bruises around the injured area.

Tendinitis occur when a tendon gets inflamed or irritated, which is also often caused by overuse. Fractures and dislocations occur when a one of the bony parts of the joint is either shattered, cacked or broken. Patellar dislocation usually occurs when the patella is knocked off to the side of the knee joint, either due to twisting or some other kind of forceful impact.



Other parts of the joint can experience dislocation or fracture in serious injuries, although this is usually uncommon (Dunleavy, 2008) Ligament Tears Another injury involving the patellofemoral joint is simply called the Patellofemoral Pain syndrome; it is described as retropatellar or peripatellar pain resulting from physical and biochemical changes in the patellofemoral joint (Mark and Juhn 1999). This syndrome is believed to be caused by overuse and overload. The constant pressure exerted on the knee is believed to wear out the joint resulting in painful experiences. Also repeated weight bearing impact such as running, step hill climbing, uneven surfaces all tend to increase the pressure between the patella and its various points of contact with the femur, resulting in pain due to the wear and tear of these parts (Mark and Juhn 1999). Bibliography Backhouse, Kenneth (2008). The Knee Joint. The ISTD Institute.

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