ANATOMY AND PALPATION
REVIEW OF THE KNEE

http://www.bing.com/images/search?q=4+Ligaments+of+the+Knee&FORM=RESTAB#view=detail&id=7B252CBE0B8EA25F398EAC75D5520BD927ED62C4&selectedIndex=7

General Overview

This course is designed as a review of common or significant areas of injury and palpation for the knee. The course will enhance anatomical knowledge of the area which will assist the PTA clinician in his/her everyday treatment of patients with knee issues.

Course Objectives:

Explore overall anatomy of the knee including muscles, bones, ligaments and motions.

1. Identify locations of bony landmarks on the knee.
2. Identify key ligaments and structures of the knee.
3. Identify common muscles and tendons of the knee.
4. Identify bony and soft tissue structures of the knee by visually assisted and self-guided palpation.
5. Recognize special tests as they relate to various knee pathologies.
7. Review common positions and forces put on the knee joint.
Bones of the knee joint

The knee is primarily made up of 4 bones; the femur, patella, fibula and tibia.

- **Femur**
- **Patella**
- **Fibula**
- **Tibia**

The **femur** has an oblique course from the neck of the femur distally. Because of this, the medial condyle is larger than the lateral condyle and this moves the knee joint itself close to midline of the body’s center of gravity.\(^1\,\)\(^2\) The shape of the medial condyle also causes the use of the “screw home” mechanism to achieve full extension.\(^2\) The posterior area of the femur has a ridge that runs most of the length called the **linea aspera**.\(^3\) The posterior distal end of the femur forms the floor of the popliteal fossa. The distal end also consists of the medial and lateral condyles. These condyles are the attachment site for the medial and lateral heads of the gastrocnemius. The condyles also provide attachment sites for the posterior and anterior cruciate ligaments.

The **tibia** also has medial and lateral condyles located on the proximal end of bone. These condyles are flattened and concave to allow for articulation with the femur. This flattened articulating surface is called the tibial plateau. Located centrally on the anterior surface of the tibia, just distal to the condyles is the tibial tuberosity. On the proximal, medial surface of the tibia, just distal to the medial tibial plateau is the flare of the medial tibia. This area is commonly referred to the pes anserine attachment site.\(^4\) Located on the lateral proximal tibia is the lateral tibial tubercle or “Gerdy’s tubercle”.\(^2\) The distal medial tibia forms the medial malleolus and supports the ankle.

The **fibula** is the most lateral positioned bone of the lower leg. The proximal end of the fibula is located distal and posterior to the lateral tibial tubercle. This is called the fibular head. The fibula does not technically make up the knee joint but does provide attachment sites for key soft tissues of the knee.\(^1\,\)\(^3\) The distal end of the fibula forms the lateral malleolus and provides support to the ankle.

The **patella** is triangular in shape and lies within the patellar tendon. It is the largest sesamoid bone in the body. Because of its location, the patella allows the quadriceps to work as a pulley. This allows for a mechanical advantage during knee extension.\(^2\) The apex is the attachment for the patellar tendon and the base is the attachment site for the rectus femoris. The posterior surface has medial and lateral facets that assist in articulation with the femur.\(^1\)
Knee Ligaments

Medial Collateral Ligament (MCL) The MCL (referred to as the tibial collateral ligament in some texts) is located on the medial side of the knee attaching from the medial femoral epicondyle to the medial flare of the tibia located on the medial tibial condyle. The deeper fibers are connected to the medial meniscus. It is flat and broad and can be injured more easily than its lateral counterpart. It’s primary function is to provide stability against valgus forces.2,5

Lateral Collateral Ligament (LCL) The LCL (referred to as the fibular collateral ligament in some texts) is located on the lateral side of the knee attaching from the lateral femoral condyle to the fibular head. Its primary function is to provide stability against varus forces.5 Due to its strength, this ligament is infrequently injured.3

Anterior Cruciate Ligament (ACL) The ACL attaches to the anterior surface of the tibia and continues to the posterior lateral condyle of the femur. The ACL prevents the femur from being displaced posteriorly on the tibia1,3,5 or when describing it another way, it limits excessive forward translation of the tibia on the femur.

Posterior Cruciate Ligament (PCL) The PCL attaches to the posterior tibia and continues to the anterior femur on the medial condyle. The PCL prevents posterior translation of the tibia on the femur. The PCL is less frequently injured than the ACL1,3,5
The menisci are fibrocartilaginous discs attached to the plateau of the tibia. These discs are thicker on the outside border and are thinner on the inside border. The main functions of the menisci are to provide cushion, weight distribution and friction reduction. The medial meniscus is larger and is more easily palpated on the medial tibial plateau. The menisci may be torn in varying degrees and severity due to the compression and shear forces put on them during quick directional change in motions and pivoting. The medial meniscus may be injured more frequently due to its attachment to the MCL.¹²³⁴⁵
Knee Bursa

There are many bursa located within the knee joint. Some of these bursa are connected with the synovial lining of the joint capsule while others are independent of this lining.

**Anterior**
- Suprapatellar- Between distal femur and quadriceps tendon.
- Prepatellar- Between the patella and the skin.
- Deep infrapatellar- Between the proximal tibia and patellar ligament
- Superficial Infrapatellar- Between the tibial tuberosity and skin.

**Medial**
- Anserine- Deep to Sartorius, gracilis and semitendinosus tendons.

**Lateral**
- Iliotibial- Deep to the iliotibial band at its distal attachment.
- Lateral Collateral Ligament- Deep to the LCL next to the bone.

**Posterior**
- Semimembranosus- Between the tendon of the semimembranosus muscle and tibia.
- Gastrocnemius- Between the lateral head of the gastroc muscle and capsule. Additionally between the medial head of the gastroc muscle and capsule
- Biceps- Between the LCL and biceps tendon
- Popliteal- Between the popliteus tendon and lateral femoral condyle.
Knee Innervation

The primary nerves that innervate the muscles of the knee are the femoral and sciatic nerve. The tibial and common peroneal nerves play lesser roles.

The **knee extensors** are innervated by the **femoral nerve**. These muscles include the rectus femoris, vastus lateralis, vastus intermedius and vastus medialis. The spinal segments associated with knee extensor innervation are **L2, L3 and L4**.

The **knee flexors** are innervated by the **sciatic nerve**. These muscles include the semimembranosus, semitendinosus and the long head of the biceps femoris. The short head of biceps femoris is innervated by the common peroneal nerve. The spinal segments associated with the knee flexor innervation are **L4, L5, S1 and S2**.

Both the **popliteus and gastrocnemius** are innervated by the **tibial nerve**. The popliteus is innervated by spinal segments **L4, L5 and S1**, while the gastrocnemius is innervated by spinal segments **S1 and S2**.

Clinically the spinal cord innervation level is particularly significant when dealing with individuals with spinal cord injuries. In the case of the knee extensors, they receive innervation from a higher level than the knee flexors. This will be critical in determining what type of knee function the patient may or may not have.\(^3\)
## Knee Musculature

<table>
<thead>
<tr>
<th>MUSCLE/Soft Tissue</th>
<th>ORIGIN</th>
<th>INSERTION</th>
<th>PRIMARY MOTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anterior</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectus Femoris</td>
<td>Anterior inferior iliac spine</td>
<td>Patella (base via quadriceps tendon) Acetabulum</td>
<td>Knee extension Hip flexion</td>
</tr>
<tr>
<td></td>
<td>Femur linea aspera</td>
<td>Medial border of patella</td>
<td>Knee extension</td>
</tr>
<tr>
<td></td>
<td>Vastus Medialis</td>
<td>Femur linea aspera Superior trochanter</td>
<td>Knee extension</td>
</tr>
<tr>
<td>Vastus Lateralis</td>
<td>Femur linea aspera</td>
<td>Base and lateral patella</td>
<td>Knee extension</td>
</tr>
<tr>
<td></td>
<td>Vastus Intermedius</td>
<td>Upper 2/3 of shaft of femur</td>
<td>Knee extension</td>
</tr>
<tr>
<td><strong>Posterior</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biceps femoris</td>
<td>Ischial tuberosity</td>
<td>Lateral fibular head</td>
<td>Knee flexion Hip extension</td>
</tr>
<tr>
<td>(long head)</td>
<td>Linea aspera of femur and</td>
<td>Lateral condyle of tibia</td>
<td>Knee flexion Hip extension</td>
</tr>
<tr>
<td></td>
<td>lateral condyle</td>
<td></td>
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</tr>
<tr>
<td>Biceps femoris</td>
<td>Ischial tuberosity</td>
<td>Proximal shaft of tibia</td>
<td>Knee flexion Hip extension</td>
</tr>
<tr>
<td>(short head)</td>
<td>Semitendinosus</td>
<td>Lateral condyle of tibia</td>
<td>Knee flexion Hip extension</td>
</tr>
<tr>
<td></td>
<td>Semimembranosus</td>
<td>Medial condyle of tibia</td>
<td>Knee flexion Hip extension</td>
</tr>
<tr>
<td>Popliteus</td>
<td>Lateral condyle of femur</td>
<td>Proximal posterior aspect of femur</td>
<td>Knee flexion (minimally) Medially rotates the flexed knee</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>Medial and lateral femoral</td>
<td>Posterior calcaneous Achilles tendon</td>
<td>Plantar Flexion</td>
</tr>
<tr>
<td></td>
<td>condyles (posterior)</td>
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</table>

Multiple sources listed on Reference page
Key anterior and posterior knee and hip musculature

http://www.bing.com/images/search?q=pictures+of+the+knee+joint&qpvt=pictues+of+the+knee+joint&FORM=IGRE#view=detail&id=C9ECBDD29E94D1DD2E087B87B16A0CA42ECSFE9&selectedIndex=5
**Functions:** The patella plays an intricate role in the proper function of the knee joint. The functions of the patella include the following:

- Improve the efficiency of the last 30 degrees of extension
- Guide the quadriceps (patellar)tendon
- Reduce friction in the quadriceps mechanism
- Facilitate transmission of quadriceps forces
- Control capsular tension in the knee
- Act as a bony shield
- Improve the esthetic appearance of the knee

**Motions:** When moving the patella, the typical motions include the following: medial glide, lateral glide, caudal glide, cephal glide and patellar tilting (not pictured).
Patellar Loading with Activity

WALKING
0.3 times the body weight

CLIMBING STAIRS
2.5 times the body weight

DESCENDING STAIRS
3.5 times the body weight

SQUATTING
7 times the body weight
The knee joint is the largest joint in the body. It is classified as a synovial joint and can be thought of a modified hinge joint due to it having a rotational component in addition to flexion and extension. There are three joints associated with the knee. The tibiofemoral joint, the patellofemoral joint and the tibiofibular joint.

The **tibiofemoral joint** (blue in diagram below) is what we commonly think of as the “knee joint”. We often think of this component of the joint flexing and extending. This is true but there are additional motions that are built into flexion and extension. For example, during knee extension, as the femur rolls on the tibia it must also glide posteriorly to keep the bones in alignment. The surface of the medial femoral condyle is greater than the lateral condyle. As the knee moves further into extension the lateral femoral condyle runs out of room while the medial side must glide posteriorly to accommodate for all of its articulating surface. This posterior glide during the last few degrees of extension causes the tibia to spin laterally on the femur and lock the knee into extension. This is referred to as the **locking** or **screw home mechanism**. Once the knee is in full extension this is referred to as **close packed position**. The **loose packed position** of the joint is at midflexion.

The **patellofemoral joint** (green in diagram below) refers to the articulation between the trochlear groove of the femur and the patella. This joint is key in creating the mechanical advantage for the quads to operate effectively.

The superior **tibiofibular joint** (orange in diagram below) is a synovial joint between the tibia and the fibular head. Although not key for knee movements, laxity in this joint will clinically show itself as knee pain.

![Diagram of knee joint with labels](http://www.bing.com/images/search?q=4+Ligaments+of+the+Knee&FORM=RESTAB#view=detail&id=7B252CBE0B8EA25F398EAC7505520BD927ED62C4&selectedIndex=7)
Range of Motion:

Normal range of motion is **0-150 degrees** according to the American Association of Orthopedic Surgeons. Excessive extension of the knee (hyperextension) is referred to as **genu recurvatum**.

Knee position

The **Q angle** is the angle formed by lines that connect the ASIS to mid-patella to the tibial tubercle. This angle is key for the angle that the patella tracks.

**Genu valgum** is created by an increased Q- angle caused by an inward angling of the femur and tibia with the knees coming together in a “knock kneed” fashion. (see pic below)

**Genu varum** is created by an outward angling of the femur and tibia creating a “bow legged” affect. (see pic below)
There are many special tests to check the integrity of the knee. We will focus on a few of the more common tests.

The **Lachman Test** is used to detect ACL tears. It is a test for one plane anterior instability.  

The **Apley Compression** (pic shown)/or **Distraction test** (pic not shown). If rotation plus distraction is more painful, it is likely a ligament issue. If rotation plus compression is more painful, it is likely a meniscus issue.

The **Anterior Drawer Test** is used to detect uniplane instability. If excessive movement (greater than 6 mm) occurs, it may indicate an ACL injury.

The **Lateral Pivot Shift Test** is used to assess anterolateral rotary instability. In addition the test is used to detect ACL injuries.

The **McMurray Test** is used to determine a meniscus injury.

The **Medial Stress Test** (not pictured) is used to determine injuries to medial structures, particularly the MCL.

The **Lateral Stress Test** (not pictured) is used to determine injuries to the lateral structures, particularly the LCL.
Palpation Review of Anterior Knee

Suprapatellar tendon
Located just above the patella. “Supra” meaning above.

Superior Pole of Patella
Continue distally until you feel the top of the patella.

Pre-Patellar Bursae
Located under the patella, this area is palpated with the bursa itself not palpable.
Clinical significance: Common site for “Housemaid’s knee”
Inferior Pole of Patella
Located at the most distal part of the patella.

Infrapatellar Tendon
Continue distally off of the patella. The next structure is the infrapatellar tendon. This tendon is palpable from the distal patella to the tibial tubercle.

Superficial Infrapatellar Bursa
This structure is palpated immediately under the infrapatellar tendon.

Clinical significance: Common site for “Jumper’s knee”
**Tibial Tubercle**
Located distal to the infrapatellar tendon is the tibial tubercle. This “bump” is easy to locate as it is the most prominent spot on the anterior leg. It is the attachment site of the patellar tendon.

*Clinical significance: Site of Osgood Schlatter’s Disease*

**Vastus Medialis**
Located on the anterior/medial side of the femur. When defined this muscle will appear teardrop in shape. Most medial of the quad muscles.

**Vastus Intermedius**
Located along the center of the femur. This quad muscle runs deep and is non-palpable.
**Vastus Lateralis**
Most lateral of the quad muscles. Runs along the anterior/lateral femur.

**Rectus Femoris**
This last quad muscle runs from the anterior inferior iliac spine to the patellar tendon. This muscle assists with hip flexion and knee extension.

*Clinical significance: 2 joint muscle. This must be taken into account for strengthening and especially for stretching.*
Palpation Review of Medial Knee

**Medial Femoral Condyle**
Locate this structure by running your hand along the femur from mid shaft towards the knee until you feel the femur flare. At the widest point will be the femoral condyle.

**Adductor Tubercle**
Moving posterior to the femoral condyle in the natural depression between the VMO and hamstrings. You will need to wrap around behind the condyle and pull back towards you to find this slight protrusion.

**Medial Meniscus**
Located distal to the femoral condyle sitting on the tibial plateau.
Medial Tibial Plateau
Located along the joint line of the knee. On either side of the patella at the joint line, there are small divots. Pulling downward into these divots, your fingers will catch on a slight ledge. This ledge is the tibial plateau.

Pes Anserine Insertion
Dropping off the medial tibial plateau distally you will notice the tibia flaring. At the flare of this tibia is located the pes anserine insertion.

Clinical significance: Insertion point for the sartorius, gracilis and semitendinosus muscles.

Medial Collateral Ligament
Located between the medial femoral condyle and the flare of the medial tibia.
Palpation Review of
Posterior Knee

**Popliteal Fossa**
Area directly behind the knee where many structures are located including nerves, and blood vessels. The boundaries are created by the hamstring tendons and the heads of the gastrocnemius.

Clinical significance: Common area for a Baker’s cyst.

**Biceps Femoris Tendon**
Located on the lateral side of the popliteal fossa. Resist knee flexion to have this tendon become more distinguishable.

**Semitendinosus Tendon**
Located on the medial side of the popliteal fossa. The most medial tendon of the hamstrings. Resist knee flexion to have this tendon become more distinguishable.
Semimembranosus Tendon
Located immediately next to the semitendinosus tendon. Also located on the medial side of the popliteal fossa.

Heads of the gastrocnemius
2 heads are palpable at their origin at the posterior femoral condyles.
# Palpation Review of Lateral Knee

<table>
<thead>
<tr>
<th>Location</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lateral Femoral Condyle</strong></td>
<td>Locate this structure by running your hand along the femur from mid shaft towards the knee until you feel the femur flare. At the widest point will be the femoral condyle.</td>
</tr>
<tr>
<td><strong>Lateral Meniscus</strong></td>
<td>Located distal to the femoral condyle on the tibial plateau. It may be difficult to palpate specifically. Be sure to put the knee into slight flexion and press into the joint space.</td>
</tr>
<tr>
<td><strong>Lateral Tibial Plateau</strong></td>
<td>Located along the joint line of the knee. On either side of the patella at the joint line, there are small divots. Pulling downward into these divots, your fingers will catch on a slight ledge. This ledge is the tibial plateau.</td>
</tr>
<tr>
<td>Lateral Tibial Tubercle</td>
<td>Fibular Head</td>
</tr>
<tr>
<td>------------------------</td>
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</tr>
<tr>
<td>Dropping off of the lateral tibial plateau a rather large protuberance will be located. This tubercle is also known as Gerdy’s tubercle.</td>
<td>Locate this by moving posterior and distal to the lateral joint line on a 45 degree angle to locate this structure on the far lateral side of the leg.</td>
</tr>
</tbody>
</table>

**Clinical significance:** Site of IT Band syndrome pain.

<table>
<thead>
<tr>
<th>Lateral Collateral Ligament</th>
<th>Iliotibial Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Located between the lateral femoral condyle and the fibular head. This will be very prominent and feel cordlike if palpated with the leg crossed over and the ankle resting on the opposite femur.</td>
<td>Palpate along the lateral side of the femur. The band will narrow down as it nears the knee joint. It inserts on the lateral tibial tubercle.</td>
</tr>
</tbody>
</table>
ANATOMY AND PALPATION REVIEW OF THE KNEE

References


