THE KNEE (Articularis Genu)

Largest and most complicated joint in the body

Hinge joint - but more complicated

3 joints merged into one
Medial tibiofemoral
Lateral tibiofemoral
Patellofemoral
(Sesamoid bone)

Angle of femur Vs. Angle of tibia

The knee is “close packed” (ie. tight and stable) in extension

THE KNEE
Bones and Articular Surfaces

Femur
Medial and lateral condyles (medial > lateral)
Patella surface
Intercondylar fossa
Epicondyles

Tibia
Medial and lateral condyles
Intercondylar eminence
(Transverse lig, Med. meniscus, Ant. cruciate, Lat. meniscus, Tibial spines, Lat. meniscus, Med. meniscus, Post. cruciate)
Lateral Meniscus ‘O’ shaped, only attached medially, can slide on the tibia
Lateral condyle extends over the posterior edge of tibia

Medial meniscus ‘C’ shaped - also attached to medial capsule

Patella - Posterior surface is articular (lateral > medial)
Pointy end is inferior

THE KNEE
Collateral Ligaments

Both collateral ligaments
1. Prevent hyperextension - Tight in extension
2. Loose in flexion - allows some rotation
3. Prevent abduction or adduction

Medial collateral ligament
Thickening of the medial part of the joint capsule (coronary ligament)
From medial epicondyle to medial side of the tibia
Deep part is firmly attached to the medial meniscus
Superficial part covers the insertion of semimembranosus.

Lateral collateral ligament
Extracapsular ligament (maybe derived from the peroneus longus muscle)
From lateral epicondyle to apex of the fibula
Joint capsule (Coronary lig) is thin - attached to the lat. meniscus - allows more movement of the lateral meniscus

Readings
1. Stern – Core concepts – sections 98 and 101 (plus appendices)
2. Faiz and Moffat – Anatomy at a Glance – Section 48
3. Grants Method of Anatomy – shoulder in joints of the upper limb

THE KNEE IN LOCOMOTION

THIS WEEKS LAB:
Knee leg and foot

In this lecture
The Knee Joint
1. bones
2. ligaments
3. muscles
The knee in locomotion
Limps due to knee deficiencies
THE KNEE
Cruciate Ligaments

Both Cruciate ligaments  Remnants of the intercondylar septum
Prevent hyperextension
Prevent anteroposterior displacement of the femur.

Anterior Cruciate ligament
From: Anterior part of the intercondylar area of the tibia
To  Inside of the lateral femoral condyle
Stops femur slipping backwards on the tibia. Eg when gastrocnemius active.

Posterior Cruciate ligament
From: Back of intercondylar area of the tibia
To  Front of intercondylar fossa of the femur
Stops the femur slipping forwards on bent knee. Eg. walking down stairs.
Stops forward roll of the femur during extension

THE KNEE
Muscles of the Knee

Anteriorly - extensors
Quadriiceps - 4 muscles join the patella
Insert via the patella ligament onto tibial tuberosity

Posteriorly - flexors
Hamstrings
Gastrocnemius

Medially - stabilisers (flexors and medial rotators)
3 muscles insert through the “pes anserinus” (beside the tibial tuberosity)
Sartorius
Gracilis
Semitendinosus

Laterally - stabilise the extended knee (and laterally rotate)
Iliotibial tract (Gluteus maximus and Tensor fascia lata)
Biceps femoris

Popliteus - unlocks the extended knee
Lateral rotation of the femur / medial rotation of the tibia
Pulls the lateral femoral condyle and the lateral meniscus posteriorly
Origin: The upper part of the posterior tibia (above soleal line)
Insertion Pit below lateral femoral epicondyle (inside capsule)
+ Lateral meniscus

THE KNEE
Stability and Movements of the knee

Flexion and extension (Knee is stable and "locked" in extension)

Active rotation when the knee is flexed
Medial hamstrings (+ sartorius and gracilis) - medially rotate leg
Biceps femoris - laterally rotates leg

Passive rotation = screw home at the end of extension
Medial femoral condyle > lateral femoral condyle
Lateral condyle come to the end of its run first
Medial condyle continues to move posteriorly (Med. Rotation of femur)
This screw home rotation is pivoting around the anterior cruciate ligament

To begin flexion popliteus must unlock the knee
Pulls lateral condyle backwards (Lat. rotation of the femur)

KNEE IN LOCOMOTION
What movements occur?

STANCE PHASE
1. At Heel strike
Knee flexes (absorbing shock - reducing wear)

2. At Foot flat
Knee starts to extend

SWING PHASE
3. After toe off (1st half of swing)
Knee flexes

4. 2nd half of swing
Knee extends

5. End of swing Knee begins to flex again (preparation for heel strike)
KNEE IN LOCOMOTION

Muscle action

<table>
<thead>
<tr>
<th>Stance Phase</th>
<th>Swing Phase</th>
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<tbody>
<tr>
<td><strong>Vasti</strong></td>
<td></td>
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<tr>
<td>Active after heel strike</td>
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<tr>
<td><strong>Sartorius and short head of biceps</strong></td>
<td>Active after toe off</td>
</tr>
<tr>
<td><strong>Hamstrings</strong></td>
<td></td>
</tr>
<tr>
<td>Active around heel strike</td>
<td>Active at toe off</td>
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Stance Phase

1. At Heel strike
   - Knee flexes (absorbing shock - reducing wear)
   - Ground reaction - quadriceps resisting flexion (eccentric)

2. At Foot flat
   - Knee starts to extend
   - Forward momentum of the trunk extends knee
   - The leg is fixed by ground reaction and the calf muscles

Swing Phase

3. After toe off (1st half of swing)
   - Knee flexes
   - Thigh swings forward - leg lags behind (inertia of the leg)
   - Muscles active? (Short head biceps, sartorius)

4. 2nd half of swing
   - Knee extends
   - Thigh slows down - leg catches up (momentum of leg)

5. Preparation for stance (last part of swing)
   - Extended knee (maybe beginning to flex)
   - Hamstrings decelerating knee extension (eccentric)

KNEE IN LOCOMOTION

Knee extensor Limp (Loss of knee extensors)

Stance Phase Limp

Vasti are active at heel strike absorbing the impact.
They act eccentrically as the knee flexes slightly

If the vasti are not functioning some other mechanism must be employed to maintain knee extension:

1. Throw the body weight forward at the point of heel strike and thus get the centre gravity in front of the knee.
2. Use the hand to press down on the thigh and manually extend the knee

KNEE IN LOCOMOTION

Knee flexor limp (Loss of the knee flexors)

Knee remains extended by unopposed action of the Vasti

Swing Phase Limp

The limb cannot be shortened by knee flexion
Foot would drag on the ground during swing phase.
So the pelvis must be elevated during swing (contralateral abduction of the hip)