Structure and Function of the Hip
The Hip

• The most proximal joint of the lower extremity responsible for motion **in all 3 planes**.
• This mobility makes the hip prone to injury if all of the support structures are not working properly.

“The San Francisco 49ers placed Frank Gore on the injured reserve list on Tuesday after the Pro Bowl running back suffered a season-ending hip fracture a day earlier.” 12/1/10
Osteology of the Hip

The “pelvis” is really the union of 3 bones:

- The ilium, the ischium & the pubis
Osteology of the Hip

The “pelvis” is really the union of 3 bones:
- The ilium, the ischium & the pubis
Osteology of the Hip
Osteology of the Hip

- Ilium
  - Iliac fossa
  - Iliac crest
  - ASIS
  - AIIS
  - PSIS
  - PIIS

- Ischium
  - Body
  - Ramus
  - Ischial tuberosity
  - spine
Osteology of the Hip

- Pubis
  - Body
  - Superior ramus
  - Inferior ramus
  - Symphysis pubis
  - Pubic tubercle
Osteology of the Hip

The Acetabulum

- deep cup shaped structure encasing the head of the femur formed by all 3 bones of pelvis

Permits motion in all 3 planes

Bony landmarks also formed by a combination of the pelvic bones

- Obturator foramen
- Greater sciatic notch
Osteology of the Hip: Proximal Femur

Femur
- Head
- Neck
- Greater trochanter
- Lesser trochanter
- Intertrochanteric crest
Osteology of the Hip: Proximal Femur
Osteology of the Hip: Proximal Femur

The Bony Features of the Femur

Anterior Aspect Right Femur

- anatomical neck

Posterior Aspect Right Femur

- greater trochanter
- intertrochanteric crest
- gluteal tuberosity

Femur
- Linea aspera
- Pectineal line

surgical neck
Hip Joint

- Ball and socket joint
- Articulation of femoral head and acetabulum

Allows for:
- flexion/extension
- internal/external rotation
- ABDuction/ADDuction
- circumduction
The Hip Joint Structure

Angle of Inclination
- Angle between the shaft and neck of the femur
- Normal is 125 degrees
- May be lesser or greater due to congenital deformity, trauma, disease
  - Coxa vara: angle less than 120 degrees
  - Coxa valga: angle greater than 135 degrees
Pelvis and Ligaments, Front View, Male

- 4th lumbar vertebra
- Anterior longitudinal ligament
- Iliolumbar ligament
- Intervertebral disc
- Anterior sacroiliac ligament
- Anterior superior iliac spine
- Inguinal ligament
- Sacroiliac joint
- Articular capsule of hip joint
- Superior pubic ligament
- Iliofemoral ligament
- Oburator membrane
- Greater trochanter
- Obturator canal
- Pubic arch (note acute angle)
- Arcuate pubic ligament
- Interpubic disc, symphysis pubis
Ligaments of the Pelvis

Pelvis and Ligaments, Rear View, Female

- Supraspinous ligament
- Iliolumbar ligament
- Posterior sacroiliac ligament
- Interosseous sacroiliac ligament
- Dorsal sacroiliac ligament
- Deep dorsal sacrococcygeal ligament
- Articular capsule of the hip joint
- Greater trochanter
- Falciform process
- Sacrotuberous ligament
- Superficial dorsal sacrococcygeal ligament
- Arcuate pubic ligament
- Sacrospinous ligament (Attaches to ischial spine)
Supporting Structures of the Hip Joint

- Joint capsule
- Ligaments
  - Iliofemoral ligament
  - Pubofemoral ligament
  - Ischiofemoral ligament
  - Inguinal ligament
- Acetabular labrum
  - Fibrocartilaginous structure around rim of acetabulum
  - Increases depth of acetabulum
The Ilioinguinal Ligament

This ligament runs from the ASIS to the pubic tubercle.

It separates the anterior abdominal wall from the thigh.
Myology of the Hip

Anterior
- Iliopsoas
- Rectus femoris
- Sartorius

Medial
- Pectineus
- Adductor magnus
- Adductor longus
- Adductor brevis

Posterior
- Gluteus maximus
- Semimembranosus
- Semitendinosus
- Biceps femoris
- Deep rotators (6)

Lateral
- Gluteus medius
- Gluteus minimus
- TFL
### Myology of the Hip

#### Iliopsoas

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Psoas Major: transverse processes of T12-L5</td>
</tr>
<tr>
<td></td>
<td>Iliacus: Iliac fossa</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Lesser trochanter of the femur</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Femoral n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip flexion, trunk flexion, anterior pelvic tilt</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Rectus Femoris

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Anterior-inferior iliac spine</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Tibial tuberosity via the quadriceps tendon</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Femoral n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip flexion, knee extension</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>One of the heads of the “quads”</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Sartorius

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>ASIS</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Proximal-medial surface of the tibia (<em>via the pes anserinus</em>)</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Femoral n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip flexion, hip ABD, Hip ER, knee flexion</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>Longest muscle in the body</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Tensor Fascia Latae

<table>
<thead>
<tr>
<th><strong>Origin</strong></th>
<th>Outer surface of the iliac crest posterior to the ASIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insertion</strong></td>
<td>Proximal 1/3 of the ITB</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Superior gluteal n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip flexion, hip ABD, hip IR</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Gluteus Maximus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Posterior ilium, sacrum, coccyx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>ITB, gluteal tuberosity of the femur</td>
</tr>
<tr>
<td>Innervation</td>
<td>Inferior gluteal n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip extension, hip ER</td>
</tr>
</tbody>
</table>
### Myology of the Hip

#### Semitendinosus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Ischial tuberosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Proximal-medial surface of the tibia (<em>pes anserinus</em>)</td>
</tr>
<tr>
<td>Innervation</td>
<td>Tibial portion of the sciatic n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip extension, knee flexion,</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>One of the hamstrings</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Biceps Femoris

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Ischial tuberosity</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Head of the fibula</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Tibial portion of the sciatic n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip extension, knee flexion</td>
</tr>
<tr>
<td><strong>“tidbit”</strong></td>
<td>One of the hamstrings</td>
</tr>
</tbody>
</table>

![Biceps femoris diagram](image)

A: Bicep F  
B: Bicep F  
C: Semimem  
D: Semiten
# Myology of the Hip

## Semimembranosus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Ischial tuberosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Medial condyle of the tibia, posterior aspect</td>
</tr>
<tr>
<td>Innervation</td>
<td>Tibial portion of the sciatic n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip extension, knee flexion</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>One of the hamstrings</td>
</tr>
</tbody>
</table>
### Gluteus Medius

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Outer surface of the ilum</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Greater trochanter of the femur</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Superior gluteal n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip ABD</td>
</tr>
</tbody>
</table>

![Image of Gluteus Medius and Gluteus Maximus muscles with annotations for iliac crest and greater trochanter of the femur.]
### Myology of the Hip

<table>
<thead>
<tr>
<th>Gluteus Minimus</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Origin</strong></td>
<td>Outer surface of the ilium, inferior to the gluteus medius</td>
</tr>
<tr>
<td><strong>Insertion</strong></td>
<td>Greater trochanter</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Superior gluteal n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip ABD, hip IR</td>
</tr>
</tbody>
</table>
Trendelenberg Sign

The Hip ABDuctors play an important role in maintaining an upright posture during single limb support.

If hip weakness is suspected, single limb support over the affected limb would look like this when the uninvolved limb is lifted.

The pelvis drops down toward the unsupported side.
## Myology of the Hip

### Pectineus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Pectineal line on superior ramus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Pectineal line on posterior surface of the femur</td>
</tr>
<tr>
<td>Innervation</td>
<td>Obturator n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip ADD, hip flexion</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## ADDuctor Longus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Anterior surface of the body of the pubis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Middle 1/3 of the linea aspera of the femur</td>
</tr>
<tr>
<td>Innervation</td>
<td>Obturator n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip ADD, Hip flexion</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
# Myology of the Hip

## Gracilis

<table>
<thead>
<tr>
<th>Origin</th>
<th>Body and inferior ramus of the pubis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Proximal-medial aspect of the tibia (<em>pes anserinus</em>)</td>
</tr>
<tr>
<td>Innervation</td>
<td>Obturator n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip ADD, hip flexion, knee flexion</td>
</tr>
</tbody>
</table>
### ADDuctor Brevis

<table>
<thead>
<tr>
<th><strong>Origin</strong></th>
<th>Proximal Attachment: Anterior surface of the inferior pubic ramus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insertion</strong></td>
<td>Proximal 1/3 of the linea aspera of the femur</td>
</tr>
<tr>
<td><strong>Innervation</strong></td>
<td>Obturator n.</td>
</tr>
<tr>
<td><strong>Action</strong></td>
<td>Hip ADD, Hip flexion</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
## Myology of the Hip

### ADDuctor Magnus

<table>
<thead>
<tr>
<th>Origin</th>
<th>Extensor Head: Ischial tuberosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>Extensor Head: ADDuctor tubercle on distal femur</td>
</tr>
<tr>
<td>Innervation</td>
<td>Tibial portion of the sciatic n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip extension, Hip ADD</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>

### ADDuctor Magnus

<table>
<thead>
<tr>
<th>Origin</th>
<th>ADDUctor Head: Ischial ramus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion</td>
<td>ADDUctor Head: entire linea aspera of femur</td>
</tr>
<tr>
<td>Innervation</td>
<td>Obturator n.</td>
</tr>
<tr>
<td>Action</td>
<td>Hip ADD, Hip flexion</td>
</tr>
<tr>
<td>“tidbit”</td>
<td>What’s in a name?</td>
</tr>
</tbody>
</table>
Myology of the Hip

Intrinsic Hip ER (deep rotators): (6 muscles)
Piriformis, Obturator Internus, Obturator Exterunus, Gemelus Superior, Gemelus Inferior, Quadratus Femoris

Piriformis Syndrome:
The sciatic nerve passes deep to the piriformis in most cases (approximately 85% of people) but can in fact pierce the piriformis itself, predisposing to piriformis syndrome and subsequent sciatica. Even if the sciatic nerve runs deep to the piriformis, muscle guarding in this muscle can put direct pressure on the nerve, causing pain and discomfort.
Sciatic Nerve Distribution & the Piriformis

Piriformis Syndrome
Common Hip Pathologies

Congenital Hip dysplasia
- Shallow acetabulum
- Causes femoral head to slide upward

Legg-Calve’Perthes Disease
- Femoral head undergoes necrosis
- Children 5-10
- Head death 2-4 years then remodels

Avascular Necrosis of the Femoral Head

Fig. 1. Blood Supply to Head and Neck of Femur
Common Hip Pathologies

Osteoarthritis of the hip
- Degeneration of the articular cartilage of the joint
- Trauma
- Wear & tear
- Later in life
Common Hip Pathologies

Iliotibial Band Syndrome
- Overuse injury causing lateral knee pain
  - Cyclists
  - Runners

Hamstring Strain
- Overload of the muscle

Coxa vara

Coxa valga

“Hip Pointer”
- Pelvic injury
  - Severe bruise caused by direct contact to the iliac crest of the pelvis
Common Hip Pathologies

Hip Fractures
- intertrochanteric
- femoral neck

Type 1
Two part undisplaced

Type 2
Two part displaced

Type 3
Three part, loss of posterolateral support

Type 4
Three part, loss of medial support

Type 5
Four part
Identify what you can! *(in the hips)*

Hip ADDuctors
- Sartorius
- ADDuctor Longus
- ADDuctor Brevis
- ADDuctor Magnus

Hip Flexors
- Rectus femoris
- TFL

Hip ABDuctors
- TFL
Identify what you can! *(in the hips)*

- Gluteus Maximus
- Gluteus medius
- Hamstrings
  - Semimembranosus
  - Biceps Femoris
  - Semitendinosus
- TFL

OK go for it!
Pick out everything else!
How do you stretch the hip flexors?

How do you strengthen the hip extensors?

How do you stretch the hip adductors?

How do you strengthen the hip abductors?

How do you stretch the hip internal rotators?

How do you strengthen the hip external rotators?