

Acland's DVD Atlas of Human Anatomy

Transcript for Volume 2

© 2007 Robert D Acland

This free downloadable pdf file is to be used for individual study only. It is not to be reproduced in any form without the author's express permission.

PART 1: THE HIP

BONES, LIGAMENTS AND JOINTS

00.00
We'll look at the lower extremity in four sections. In this first section, we'll look at the hip. After that we'll look at the knee; then we'll go down to the ankle, and lastly we'll look at the foot.

00.13
Before we get started, there's a simple term we need to define: the leg. In everyday speech, "the leg" means everything from the hip downwards. In anatomy, only this part, from the knee to the ankle, is the leg, and this part, from the hip to the knee, is the thigh.

00.30
In looking at the hip region, we'll start with the bones, then we'll look at the hip joint and how it moves, then we'll look at the muscles which produce movement at the hip joint, and lastly we'll look at the vessels and nerves. First, let's see the bones.

00.47
Here are the lumbar vertebrae, the pelvis, and the two femurs. We'll look at the pelvis by itself.

00.56
The pelvis is made up of the two hip bones, or innominate bones, and the sacrum. The fibrous joints which unite them, the two sacro-iliac joints behind and the pubic symphysis in front, permit almost no movement. We'll look at the right hip bone by itself.

01.20
The hip bone is formed by the fusion of three bones, the ilium, the ischium, and the pubis. The names of these bones give rise to the names of the various features of the hip bone. Let's look at these features.

01.37
This broad bony plate is the wing, or ala of the ilium. Its broad, roughened edge is the iliac crest, an area where many important muscles attach. The iliac crest ends in front at the anterior superior iliac spine, and behind at the posterior superior iliac spine.

02.00
This is the ischial spine, with the greater sciatic notch above it, and the lesser sciatic notch below it. This is the ischial tuberosity. The ischial tuberosity is another area where many muscles attach. It's also the part of the hip bone that we sit on.

02.17
The socket for the hip joint is called the acetabulum. This broad smooth area is the articular surface. We'll see it again in a minute with the articular cartilage intact.

02.30
The big hole in the lower part of the hip bone is the obturator foramen. This is the body of the pubis, this is the superior ramus of the pubis, and this is the ischio-pubic ramus. This prominence is the pubic tubercle, to which the inguinal ligament is attached

02.53
It's helpful to keep in mind that the upper part, and the lower part of the hip bone face in different directions, like my hands. If we look at the hip bone from in front, like this, we're looking at the inner aspect of the ilium, and the outer aspect of the pubis and ischium. Now that we've looked at the hip bone, let's bring the sacrum back into the picture. We're looking at the bones as they'd be in the upright,

standing position, and it's perhaps surprising to see the angle at which the sacrum lies. Its pelvic surface is more nearly horizontal than vertical.

03.29

The sacrum is attached to the hip bone not only by the sacro-iliac joint, seen here from behind, but also by two big ligaments, one going to the ischial spine, and one going to the ischial tuberosity, as we'll see in a minute.

03.44

Now let's add the femur to the picture. The femur is the longest bone in the body. We'll be looking at its distal end in the next section. For now, let's look at the features of the proximal end.

03.57

This is the head of the femur, this is the neck. Since the head is wide and the neck is narrow, the head of the femur can go a long way in this axis, and in this axis, before bone hits bone.

04.16

This prominent lump is the greater trochanter, and this one is the lesser trochanter. The greater and lesser trochanters are important muscle insertions. This line, the inter-trochanteric line, marks the insertion of a major ligament of the hip joint, which we'll see in a minute. On the back of the femur this prominent ridge, the inter-trochanteric crest, runs from the greater to the lesser trochanter. This broad rough area is the gluteal tuberosity. This rough line running down the shaft of the femur is the linea aspera. Many muscles have their origins or their insertions on the linea aspera, on the gluteal tuberosity, and in this hollow in front of the intertrochanteric crest.

05.10

Now that we've looked at the dry bones, let's see how they look in the living body. The big gap between the sacrum and the ischium is bridged by two massive ligaments. The sacro-spinous ligament goes to the ischial spine, the sacro-tuberous ligament goes to the ischial tuberosity. Let's go round to the front and see those two ligaments from the inside. Here's the sacro-spinous ligament, here's the sacro-tuberous ligament. These two openings are the lesser sciatic foramen, and the greater sciatic foramen. The sciatic nerve passes through the greater sciatic foramen. The obturator foramen is largely closed by the obturator membrane. The obturator nerve and vessels pass through a small tunnel here.

06.09

Now let's take a look at the hip joint. We'll remove the femur for a moment., and look at the acetabulum. Here's the broad, c-shaped articular surface, sometimes called the lunate surface. This non-articular part of the acetabulum is the acetabular fossa. Around the edge of the bony acetabulum this rim of fibrocartilage, the acetabular labrum, adds to the depth of the acetabulum.

06.40

This is the cut end of the ligament of the head of the femur. Its other end is attached here, on the center of the femoral head. Now let's go back to the intact hip joint.

06.52

The capsule of the hip joint is a sleeve of ligaments. The capsule is thin on the underside. Everywhere else it's thick and strong. This part of the capsule behind is called the ischio-femoral ligament. This anterior part of the capsule, which is the thickest, is known as the ilio-femoral ligament. The fibers of these capsular ligaments become tight when the joint is extended.

07.23

The capsule is attached to the hip bone all the way round the acetabular labrum. On the back of the femur the capsule is attached about halfway along the femoral neck. On the front of the femur the capsule is attached out here, on the inter-trochanteric line.

07.43

Now let's take a look at the various different movements that occur at the hip joint. Movement can occur in three different axes. Forward movement is flexion, backward movement is extension. Movement out to the side is abduction, movement in toward the midline is adduction. Rotation outward is lateral rotation, rotation inward is medial rotation.

08.22

Rotation at the hip joint is accompanied by marked backward and forward movement of the greater and lesser trochanter.

08.31

Now we're almost ready to move on, to look at the muscles of the hip region. Before we do that, let's take a minute to review what we've seen of the bones, and of the hip joint. If you'd like to use this review section to test yourself, turn off the sound, and see how many of the structures you can name. There's another blue sign like this one, at the end of the review section.

08.53

BONE AND JOINT REVIEW

Here's the wing of the ilium, the iliac crest, the anterior superior iliac spine, the posterior superior iliac spine, the ischial spine, the ischial tuberosity, the acetabulum, the obturator foramen, the body of the pubis, the superior pubic ramus, the ischio-pubic ramus, and the pubic tubercle.

09.28

On the femur here's the head, the neck, the greater trochanter, the lesser trochanter, the inter-trochanteric line, the inter-trochanteric crest, the gluteal tuberosity, and the linea aspera.

09.54

Here are the sacro-spinous ligament, the sacro-tuberous ligament, the ischio-femoral ligament, the ilio-femoral ligament, and the obturator membrane.

10.10

MUSCLES

Now let's move on to look at the muscles that produce movement at the hip joint. There are five muscle groups to look at: the short rotators, the flexors, the adductors, and the extensors. We'll look at the six short rotator muscles first, because they lie deep to all the others.

10.33

The short rotator muscles arise from four different bony surfaces, the inner surface of the sacrum, both the inner surface and the outer surface of the area around the obturator foramen, and from the outer surface of the ischium. They all converge on this small area on the back of the femur, just medial to the greater trochanter.

10.58

The one that arises from the sacrum is piriformis. Here it is. Piriformis arises from here on the sacrum. It leaves the pelvis by passing through the greater sciatic foramen, along with the sciatic nerve. We'll go right round to the back to see where it comes out. Here's piriformis emerging. It inserts here, high up on the medial aspect of the greater trochanter.

11.32

Piriformis is an important muscle to understand, because it's closely related a very important structure, the sciatic nerve. Next we'll look at the two obturator muscles, obturator internus and externus. They lie on each side of the obturator membrane.

11.50
Here's obturator externus. It arises from the obturator membrane, and from the adjoining edge of the ischio-pubic ramus

12.00
Obturator externus passes backwards just beneath the neck of the femur. Here's its tendon, passing laterally, to reach its insertion here, below piriformis.

12.16
Next we'll see obturator internus, which comes around the back of the ischium here, from inside the pelvis. We'll go around this way to see where it arises. Here's obturator internus. It arises from this wide area on the ilium and ischium, and from the obturator membrane. It leaves the pelvis through the lesser sciatic foramen. As it passes round the back of the ischium, obturator internus does a 90° turn.

12.54
As it makes the turn, it's joined above and below by these two little muscles, gemellus superior, and gemellus inferior. They arise from the ischium here, and here. Along with obturator internus, they're inserted here.

13.15
The last of the short rotators is quadratus femoris. Quadratus femoris arises from the ischial tuberosity here, and inserts on the femur here, on the intertrochanteric crest.

13.31
All these short rotator muscles have the same action: by pulling the back of the femur medially, they produce lateral rotation at the hip joint. When the foot is on the ground, the same muscle action produces what appears to be a different movement: rotation of the trunk to the opposite side. So contraction of these muscles has two possible effects, depending on whether the limb is free to move, or whether it's fixed. As we'll see, that's holds true for every muscle that produces movement at the hip joint.

14.10
Now we'll move on to look at the groups of muscles which produce adduction, and abduction at the hip. We'll look at the five adductors first. There are three named adductors, adductors magnus, brevis, and longus; and there are two other muscles which adduct, pectineus and gracilis.

14.29
The adducting muscles all arise from this region on the pubis and ischium, and they're all inserted along this line, the lowest, gracilis, right down here on the tibia. Let's start with the named adductors,

14.51
Here's the largest of the them, adductor magnus. Adductor magnus arises from the outer border of the ischio-pubic ramus. Its insertion is in two parts, with a gap in between. The upper part of adductor magnus inserts here, on the linea aspera. The lower part inserts here, on the adductor tubercle of the femur

15.19
This gap is the adductor hiatus. The main blood vessels to the leg pass through here, from the front of the thigh, to the back.

15.33
The other two named adductors, brevis and longus, sit in front of adductor magnus. Here's adductor brevis. Here's adductor longus.

15.47
Brevis arises here on the body of the pubis, longus arises here. They're inserted on the femur right next to adductor magnus, brevis above, longus below. The insertion of adductor longus stops just short of the adductor hiatus.

16.08
The other two adducting muscles are a short muscle, pectineus, and a very long muscle, gracilis

16.18

- Pectineus is the shortest of the adductors. It arises from this line on the superior pubic ramus. It inserts here, just in front of adductor brevis. 16.32
- Gracilis is the most medial of all the thigh muscles. It arises here on the pubis, and it's inserted all the way down here, on the tibia. 16.44
- The main effect of all these muscles, is to produce adduction at the hip joint. 16,52
- The gracilis is the first muscle we've met which crosses both the hip joint, and the knee joint. We'll be meeting more muscles like it quite soon. A muscle that crosses both the hip, and the knee can either act at the hip, at the knee, or at both joints at once. The movement that it does produce is determined by what other muscle groups are acting at the same time. 17.19
- For now, when we look at a muscle that goes from above the hip to below the knee, we'll just look at the way it acts at the hip. In the next section we'll take a second look at each of these muscles, and see how it acts at the knee. 17.32
- Now let's move on, and look at the three muscles which produce abduction at the hip joint. The two important abductors are gluteus minimus, and gluteus medius. We'll go round to the back to look at them. 17.44
- Here are the short rotator muscles that we've seen already, quadratus femoris, obturator internus and the gemelli, and piriformis. Now we'll add gluteus minimus to the picture. Gluteus minimus arises from this part of the wing of the ilium. It's inserted here, on the front of the greater trochanter. 18.12
- Overlying gluteus minimus, is gluteus medius. Gluteus medius arises from this part of the ilium. It's inserted here, on the outer aspect of the greater trochanter. 18.30
- Though gluteus medius is mainly an abductor as we'll see, its anterior part also produces medial rotation at the hip 18.41
- The last of the abductors is called the tensor fascia lata. Before we look at it, we need to digress for a minute, and get acquainted with the structure that gives it its name, the fascia lata. 18.51
- The fascia lata is a continuous sheet of dense fibrous tissue that surrounds all the muscles of the thigh. Along the outer aspect of the thigh there's a very marked thickening of the fascia lata called the ilio-tibial tract. It extends all the way from here on the ilium, down to here, on the tibia. 19.17
- Here's the ilio-tibial tract by itself, with the rest of the fascia lata removed. These muscles, in front of it and behind it, we'll be looking at in a minute. Between the muscles is a strong fibrous septum, which attaches the ilio-tibial tract to the femur. At its lower end, the ilio-tibial tract is attached down here on the tibia. 19.43
- The ilio-tibial tract acts as the tendon of insertion of two muscles, a big one back here, gluteus maximus, which we'll see later, and this one, which we were just getting ready to look at, tensor fascia lata. 20.00
- Tensor fascia lata arises from the iliac crest here. It inserts here on the ilio-tibial tract. 20.10

The three hip abductors move the limb to the side. When the foot is on the ground the hip abductors, pulling down on the ilium, raise the opposite side of the pelvis up. This tilting of the pelvis happens in a small way each time we take a step, making it easy for the opposite foot to move forward without touching the ground.

20.38

Now let's move on to look at the muscles which produce flexion at the hip. There are four, two that act only at the hip, and two that act at the hip and also at the knee. The first two are the most important hip flexors - they're called iliacus, and psoas major.

20.57

Iliacus arises here from the iliac crest, psoas major from all the way up here, on the lumbar spine.

21.06

Here's psoas major. Psoas major arises from the transverse processes of all five lumbar vertebrae, and from the sides of the intervertebral discs and the adjoining vertebral bodies. We'll see its insertion in a moment.

21.24

Here's iliacus. It arises from almost all of the inner aspect of the wing of the ilium.

21.34

As they pass downward together, iliacus and psoas major pass over the superior pubic ramus and under a structure here that we haven't been introduced to yet, the inguinal ligament.

21.52

The two muscles pass downward and backward, and insert together down here, on the lesser trochanter. Contraction of the iliacus and psoas major produces flexion of the hip joint.

22.10

When the limb is free to move, flexion brings the thigh forward. When the limb is fixed, as it is here, flexion of both hips brings the body upright.

22.24

The other two muscles which help in hip flexion are rectus femoris, and sartorius. They're more important for their actions at the knee, than for their actions at the hip. We'll look at them briefly here, and in more detail in the next section. Rectus femoris is part of a huge muscle with four heads called quadriceps which we'll see in a moment.

22.46

Here are the muscles that we've seen already: psoas major and iliacus, pectineus, adductor brevis, longus, and magnus, and gracilis. Now let's add quadriceps to the picture.

23.06

All this is quadriceps. It's the main muscle that extends the knee. The only part of quadriceps which acts as a hip flexor is this part, rectus femoris. It's the only part that arises from above the hip joint, which is here.

23.23

Rectus femoris arises by two heads here and here, just above the acetabulum. Its final insertion, along with the other three heads of quadriceps, is right down here on the tibia. Rectus femoris is quite a weak hip flexor.

23.43

Now we'll add the last hip flexor, sartorius. Sartorius is a very long narrow muscle that lies outside all the others. It runs in a spiral, starting here on the anterior superior iliac spine, and ending up all the way down here, on the tibia. Sartorius helps to flex the hip. It can also produce lateral rotation at the hip.

23.12

Now let's move on to look at the four muscles that extend the hip. The first three, which are known collectively as the hamstring muscles, act at the hip and at the

knee. The fourth one, gluteus maximus, acts only at the hip. We'll come to it last because it lies outside the others and covers them up

24.30

Here's the back of the thigh as we saw it last. Here's gluteus medius, here are all the short rotators, here's adductor magnus, and here's the back of quadriceps.

24.43

The three hamstring muscles all arise from the ischial tuberosity. Here they are. Two of them run down to the medial aspect of the leg, one runs to the lateral aspect. The lateral one is biceps femoris. The two medial ones are semimembranosus, and semitendinosus.

25.05

Here's semimembranosus by itself. It has a long flat membrane-like tendon of origin, which arises from here on the ischial tuberosity. It's inserted here on the back of the tibia.

25.22

Here's semitendinosus, lying behind semimembranosus. It has a long cord-like tendon of insertion. It arises from here, next to semimembranosus. It inserts down here on the medial aspect of the tibia, close to two other muscles that we've seen already, sartorius and gracilis.

25.50

Now that we've seen these two, we'll add biceps femoris to the the picture. Biceps femoris has two heads of origin, a long head, and a short head.

26.04

The long head arises from here on the ischial tuberosity, along with semitendinosus. The short head arises from almost the whole length of the linea aspera, and from this supracondylar line

26.22

The two heads of biceps femoris join together, forming a tendon that runs down behind the lateral aspect of the knee, then runs forward to insert here, on the head of the fibula.

26.33

We'll be taking another look at the hamstring muscles, their insertions, and their actions at the the knee, in the next section. We'll look at their action at the hip in a minute, but before we do that we'll add the last and largest of the hip extensors, gluteus maximus, to the picture.

26.49

Here's the upper end of the hamstring muscles, here, overlying them, is gluteus maximus. It's a thick, flat sheet of muscle. Gluteus maximus arises from here on the back of the ilium, and from the side of the sacrum, and from the sacrotuberous ligament.

27.09

The upper three quarters of gluteus maximus inserts into the ilio-tibial tract. The lower one quarter of gluteus maximus passes more deeply, and inserts here on the back of the femur, on the gluteal tuberosity.

27.25

Now let's look at the actions of the hip extensor muscles, starting with the hamstring muscles. Contraction of the hamstring muscles can produce both knee flexion, and hip extension. When knee flexion is held in check by the action of quadriceps, the hamstrings just produce extension at the hip, which is the action that propels us forward in normal walking.

27.54

Gluteus maximus isn't used in the gentle action of normal walking. It comes into play when a powerful action is needed, especially an action that opposes the force of gravity. The action of gluteus maximus extends the hip from a position of full flexion, as in climbing stairs, or rising from a squatting or sitting position. The

same action, balanced against the force of gravity, controls the rate of hip flexion, as we sit down.

28.24

Gluteus maximus is one of the two big anti-gravity muscles of the lower extremity. The other one, acting at the knee, is quadriceps as we'll see in the next section.

28.33

Gluteus maximus has yet another set of actions when the lower extremity is fixed and upright. Then the action of gluteus maximus pulls the back of the pelvis downward, raising the body from a forward bend at the hips, or, when balanced against gravity, controlling the rate of bending forward.

28.54

Now we've looked at all the muscles that produce hip movement. As we've seen, several of them also have important actions at the knee, and we'll be looking at these a second time in the next section. We're now almost ready to move on, to look at the vessels and nerves of the hip region, but before we do that, let's review what we've just seen of the muscles.

29.14

REVIEW

Here's gluteus maximus, biceps femoris, semitendinosus, and semimembranosus.

29.26

Here's gluteus medius, and gluteus minimus.

29.33

Here's piriformis, obturator internus, and quadratus femoris; and here's adductor magnus, seen from behind.

29.43

On the front, here's tensor fascia lata, sartorius, and rectus femoris, psoas major, and iliacus, pectineus, adductor brevis, adductor longus, and magnus, and gracilis, and here again are piriformis, obturator internus, and obturator externus.

30.18

BLOOD VESSELS

Now we'll move on, and look at the blood vessels and nerves of the hip region. We'll follow the course of the vessels and nerves from the inside of the body, to the proximal part of the thigh. In the next section we'll follow them on down to below the knee. To understand the course of the main blood vessels, the femoral vessels, there's a structure we need to look at, that we saw before, the inguinal ligament; and there's a space between muscles that we need to understand, called the femoral triangle.

30.51

Here's the inguinal ligament. It's a strong, tight band that forms the lowest part of the anterior abdominal wall. The inguinal ligament passes from the anterior superior iliac spine, to the pubic tubercle. The inguinal ligament isn't an isolated structure, it's the lower edge of this large sheet of tendon-like material, the external oblique aponeurosis. Here's the inguinal ligament. The fascia lata, which we've seen already, is attached to it along here.

31.22

The gap between the inguinal ligament and the superior pubic ramus is occupied partly by the iliacus and psoas muscles, and partly, as we'll see, by the femoral nerve, artery and vein, and the inguinal lymph nodes. The other muscle in the picture here is obturator externus.

31.45

Now let's add all the other thigh muscle to the picture, and see the femoral triangle. Here, the fascia lata has been left intact; here, it's been removed. The femoral triangle is the name given to this deep hollow. It's bounded by sartorius laterally, adductor longus medially, and the inguinal ligament above. In the depths of the triangle pectineus, psoas major and iliacus pass backward toward their insertions.

32.19

Now that we understand the inguinal ligament and the femoral triangle, we can move on and look at the blood vessels in the hip region, starting with a brief look at the principal veins. Almost all the veins in the region run parallel to arteries of the same name, so we won't need to look at them all separately. There's just one important vein we do need to look at, that has no corresponding artery - the long saphenous vein, also called the greater saphenous vein. With the main vein there's a change of name that we need to understand. Below the inguinal ligament it's called the femoral vein. Above the inguinal ligament it's called the external iliac vein. It's the same with the artery. The vessels themselves don't change, just their names.

33.00

Here's the thigh with just the skin removed. The anterior superior iliac spine is here. Here's the long saphenous vein, which starts at the ankle, and passes up the medial side of the knee, and up to the top of the thigh. We'll remove all the subcutaneous fat to see it better. The inguinal ligament runs from here to here. Here's the fascia lata. Superficial veins from other parts of the region join the upper end of the long saphenous vein which passes through an opening in the fascia lata, the saphenous hiatus. Here, near the top of the saphenous vein are two of the inguinal lymph nodes. The main lymphatic vessels draining the lower extremity pass under the inguinal ligament here.

33.55

To see where the saphenous vein goes, we'll remove the fascia lata, and the underlying fat. Here are the main blood vessels to the leg - the femoral vein, and artery, and this is the femoral nerve. The long saphenous vein ends by joining the femoral vein here.

34.16

The femoral vein passes beneath the inguinal ligament. To see where it goes, we'll remove the abdominal wall, leaving just the inguinal ligament. This is the inguinal ligament, this is the top of the pubis. Here the vein is called the femoral vein, here above the inguinal ligament it's the external iliac vein; it's all the same vessel. To see where it goes, we'll remove the artery.

34.45

This muscle is the psoas major muscle. The external iliac vein is joined by the internal iliac vein to form the common iliac vein. The right and left common iliac veins join in the midline to form the inferior vena cava.

35.03

Now we'll remove all the veins from the picture so that we can look at the arteries. We'll look first at the internal and external iliac arteries. Then we'll look at the femoral and deep femoral arteries which supply almost all of the lower extremity; then we'll look at the gluteal arteries which supply the gluteal or buttock area.

35.23

Here's the abdominal aorta, dividing to give off the left and right common iliac arteries. The common iliac divides, into the internal iliac and external iliac arteries. The external iliac passes under the inguinal ligament, emerging as the femoral artery.

35 44

The femoral artery gives off two small branches and one large branch. The small branches are the superficial circumflex iliac, which runs laterally, and the external pudendal, which runs medially. The large branch is the deep femoral artery, which we'll look at in a minute. The femoral artery itself runs downward, and passes beneath the sartorius muscle. We'll follow its further course in the next section of this tape.

36.10

Below the point where it gives off the deep femoral, the femoral artery is often referred to as the superficial femoral. It supplies everything from about here downward, but the main artery that supplies the thigh is the deep femoral.

36.24

To follow the deep femoral artery, we'll remove the femoral artery. We'll also remove the sartorius muscle and the femoral nerve.

36.34

Early in its course, the deep femoral gives off two large branches, the medial circumflex femoral, and the lateral circumflex femoral. It then passes behind adductor longus, which we'll remove.

36.48

Here's pectineus, adductor brevis, adductor magnus, rectus femoris. The deep femoral artery runs down in front of adductor brevis and adductor magnus, giving off numerous muscle branches, including several which run backward through adductor magnus to supply the posterior thigh muscles.

37.11

Now we'll go up to the internal iliac artery again, to look at the gluteal vessels, which provide the blood supply for the buttock.

37.20

The left side of the pelvis has been removed to give us a better view. Here's the internal iliac artery. Its branches which go to the pelvic viscera have been divided. Here, arising from the internal iliac, are the superior gluteal and inferior gluteal arteries. They both pass backward through the greater sciatic foramen, one above and one below the piriformis muscle, which is here. To see where they emerge, we'll go right round to the back, and remove gluteus maximus.

37.56

Here's piriformis, here's gluteus medius. Again, all the veins have been removed to simplify the picture. Here's the superior gluteal artery, and here's the inferior gluteal artery, branching to supply the muscles of the buttock region.

38.17

NERVES

Now that we've looked at the blood vessels of the hip region, we can move on to look at the nerves. We'll look first at the femoral nerve and the obturator nerve, which supply the front and the medial aspect of the thigh, then we'll look at the gluteal nerves and the sciatic nerves, which supply the buttock and the back of the thigh. All the nerves of the lower extremity come from the anterior rami of the second to the fifth lumbar nerves, and the first, second and third sacral nerves. To see where these arise, let's take a look at the lumbar spine and the sacrum.

38.52

Below each vertebra there's an intervertebral foramen. An anterior ramus emerges through each foramen. The anterior rami of the sacral nerves emerge from the anterior sacral foramina. Each anterior ramus is numbered according to the vertebra, or the sacral segment, that's above it. Here's the third lumbar vertebra, here's where the L3 ramus emerges.

39.19

We'll start by looking at the femoral nerve, and the obturator nerve. This is the femoral nerve, this is the obturator nerve. The white structure between them is the psoas major tendon. Both these nerves arise from the lumbar plexus, which lies up here within the thickness of the psoas major muscle.

39.40

The femoral nerve emerges lateral to psoas major, the obturator nerve medial to it. We'll follow the femoral nerve. It runs across the iliacus muscle, and passes under the inguinal ligament just lateral to the femoral artery. Below the inguinal ligament the femoral nerve breaks up into several branches.

40.01

The femoral nerve supplies iliacus, all four heads of quadriceps, and also pectineus, and sartorius.

40.14

Now let's look at the obturator nerve. Emerging below the medial border of psoas major, it crosses the wing of the sacrum, then runs along the back of the ischio-pubic ramus. It leaves the pelvis by passing forward through the obturator canal, just above obturator internus. To see where it emerges, we'll remove pectineus.

40.41

Here's the obturator nerve, emerging over the top of obturator externus. Its branches run down between the adductor muscles. The obturator nerve supplies obturator externus, adductor brevis, and longus, and the anterior part of adductor magnus.

41.04

Now we'll look at the two gluteal nerves, the superior and the inferior, and at the largest nerve of the lower extremity, the sciatic nerve, which supplies the posterior thigh muscles, and also almost everything below the knee. The gluteal and sciatic nerves arise from the sacral plexus.

41.24

Here's the sacral plexus. It's formed by the anterior rami of L4 and 5, and S1, 2 and 3. The sacral plexus overlies the piriformis muscle.

41.39

This is the sciatic nerve. It arises from L4 through S3. This is the superior gluteal nerve. The inferior gluteal nerve arises out of sight behind the sciatic nerve. All three nerves leave the pelvis through the greater sciatic foramen. To see where they come out, we'll go round to the back, and remove gluteus maximus

42.02

Here, the vessels have been removed to simplify the picture. Here's piriformis. Here's the sciatic nerve, here's the inferior gluteal nerve, and here's the superior gluteal nerve, disappearing beneath gluteus medius. The superior gluteal nerve supplies gluteus medius, gluteus minimus, and tensor fascia lata. The inferior gluteal nerve supplies gluteus maximus.

42.33

The sciatic nerve runs down the middle of the thigh. Deep to it are quadratus femoris, and lower down, adductor magnus. This is the long head of biceps femoris which crosses over the nerve obliquely, and covers it up. We'll follow the sciatic nerve further, in the next section of this tape.

42.55

In the thigh, the sciatic nerve supplies semitendinosus, semimembranosus, and also biceps femoris, and the posterior part of adductor magnus.

43.09

Lastly, there are a few hip muscles which have their own individual nerve supply. Psoas major is supplied by several small branches of the lumbar plexus. Small separate branches of the sacral plexus supply piriformis, obturator internus, and quadratus femoris

43.32

Now let's review the vessels and nerves of the hip region.

43.37

REVIEW

Here's the long saphenous vein, and the femoral vein, becoming the external iliac vein.

43.50

Here's the common iliac artery, the internal iliac, giving off the superior gluteal and inferior gluteal arteries. Here's the external iliac, becoming the femoral artery.

44.06

Here's the superficial circumflex iliac, and the external pudendal. Here's the deep femoral, giving off the lateral circumflex femoral, and the medial circumflex femoral arteries.

44.20

Now the nerves: the femoral nerve, the obturator nerve, the sciatic nerve, the inferior gluteal nerve, and the superior gluteal nerve.

44.37

That brings us to the end of this section on the hip region.
In the next section we'll look at the knee.

END OF SECTION 1

PART 2: THE KNEE

BONES, LIGAMENTS AND JOINTS

00.00
In this section, we'll look at the knee. First we'll look at the bones, then the knee joint and how it moves, then the muscles that move it, and lastly the vessels and nerves. Let's see the bones, starting with the femur.

00.21
We saw the proximal end of the femur in the last section. Now let's look at the distal end.

00.28
The two smoothly curved surfaces are the lateral condyle and the medial condyle. The deep notch which separates them is the intercondylar notch. Above the two condyles are the epicondyles, lateral and medial. The sharp corner on the medial epicondyle is the adductor tubercle. This prominent ridge is the medial supracondylar line, this one is the lateral supracondylar line. Now we'll add the tibia and the fibula to the picture.

01.12
The tibia and the fibula are fixed to each other firmly by two joints, the proximal, and distal tibio-fibular joints. There's almost no movement at either of these joints. Let's take a look at the proximal end of the tibia.

01.33
This is the medial condyle, this is the lateral condyle. On top of the two condyles are two quite separate articular surfaces. They're much flatter than those on the femur. The rugged expanse between the articular surfaces is the inter-articular area. This prominent lump on the front, the tibial tubercle, is the final insertion of the quadriceps tendon. The small facet under here is for the fibula, which we'll add.

02.06
This is the head of the fibula, this is the neck. The head of the fibula is the point of attachment of a major ligament of the knee joint, as we'll see.

02.15
The space on each side of the knee between the femoral condyle and the tibial condyle is occupied by a crescent shaped piece of cartilage, a meniscus, which we'll see shortly. The space in the middle, the intercondylar notch is occupied by the two cruciate ligaments. The intercondylar notch and its contents divide the knee joint into two almost separate halves.

02.42
There's one more bone to add to the picture, the patella, or kneecap. The patella, as we'll see, is embedded within the quadriceps tendon, which comes from up here, and inserts on the tibia down here on the tibial tubercle. On the back of the patella the articular surface is divided into facets. These articulate either with the femoral condyles when the knee is flexed, or with this central articular area when it's extended.

03.16
Now that we've seen the bones of the knee joint, let's see how the joint looks in the living body.

03.22
In building up our picture of this quite complicated joint, there are several structures that we need to understand: first the two joint cartilages or menisci, then the ligaments, the two cruciate ligaments and the two collateral ligaments, then the patella and the quadriceps tendon on the front, and lastly the capsule which encloses the joint.

03.44

Here are the two articular surfaces of the tibia. The two menisci sit on top of them. Here are the menisci. They're made of flexible fibrocartilage. They're shaped a little differently, the lateral one is almost a circle, the medial one is more C-shaped. In cross section, each meniscus is thick at the outer edge and thin at the inner edge. The two ends of each meniscus are attached to the inter-articular area of the tibia, the medial ones far apart, the lateral ones close together.

04.26

In addition each meniscus is attached all the way round its edge, both above and below, to the joint capsule. Here's part of the joint capsule. We'll see more of it later.

04.41

The lateral meniscus is much more mobile than the medial one, partly because its two ends are attached close together, partly because of a big difference in the mobility of the joint capsule around the edge.

04.56

By filling in the spaces between the femoral and tibial condyles, the menisci produce an even distribution of synovial fluid, to nourish and lubricate the articular cartilage of the femur and tibia. Now let's look at the two pairs of ligaments which hold the bones together at the knee joint - the two cruciate ligaments on the inside, and the two collateral ligaments on the outside.

05.21

We'll look at the cruciate ligaments first. They're the important structures which prevent forward and backward movement of the femur on the tibia. Their name comes from the fact that they form a cross like this.

05.36

Here's the anterior cruciate ligament, seen from in front. Here's the posterior cruciate ligament, seen from behind. To get a better look at them, we'll remove the lateral condyle of the femur.

05.53

Now we can see the whole of the anterior cruciate ligament. The anterior cruciate ligament goes from here on the tibia, to here on the femur, on the inner aspect of the lateral condyle. The anterior cruciate ligament prevents the femur from moving backward in relation to the tibia.

06.21

Now we'll look at the posterior cruciate ligament. We'll remove the anterior cruciate ligament to see it better. The posterior cruciate ligament goes from here on the femur, to here on the back of the tibia. The posterior cruciate ligament stops the femur from moving forward on the tibia.

06.42

By preventing backward and forward movement, the cruciate ligaments ensure that the condyles of the femur stay in one place, as they roll on the condyles of the tibia. Without them, the femur would roll off the back of the tibia in flexion, and would roll off the front of it in extension.

07.04

Now let's look at the two collateral ligaments, the fibular collateral ligament on the lateral side, and the tibial collateral ligament on the medial side. The tibial collateral ligament goes from the medial epicondyle of the femur, to the anteromedial aspect of the proximal tibia.

07.26

The tibial collateral ligament blends with the capsule of the knee joint behind, and also in front. On its inner aspect, it's firmly attached to the edge of the medial meniscus, which is here. Now let's look at the rather different fibular collateral ligament. It goes from the lateral epicondyle of the tibia, to the head of the fibula.

07.54

The fibular collateral ligament stands out from the side of the knee joint. Unlike its tibial counterpart, it doesn't blend with the joint capsule. It's not attached to the meniscus.

08.07

When the knee joint is extended, both the collateral ligaments are tight. When it's flexed, they become less tight. The function of the collateral ligaments is to keep the femoral and tibial condyles together, and thus to prevent the knee joint from bending from side to side like this, or like this.

08.34

In addition to the obvious knee movements - flexion and extension - it's also possible for the tibia to rotate a little on the femur, like this. This rotation can happen only when the knee is flexed - when it's extended the tightness of the collateral ligaments makes rotation impossible. The next structure we need to add in building up our picture of the knee joint is the quadriceps tendon, and along with it, the patella.

09.02

Here's the distal end of the quadriceps muscle, which we'll see in more detail later in this section. Here's the quadriceps tendon. The patella, which is here, is enfolded within the tendon. The part of the tendon below the patella is known as the patellar ligament. On the medial side, and on the lateral side, the tendon is continuous with the capsule of the knee joint.

09.32

Between the quadriceps tendon and the femur is an extension of the knee joint cavity, the quadriceps bursa. It's lined with synovial membrane. This lubricated pocket enables the quadriceps tendon to slide easily on the femur.

09.49

Now we'll complete our picture of the knee joint by adding the fibrous capsule which encloses it.

09.56

Here's the knee joint with the joint capsule intact. On the medial side the thin capsule is continuous with the tibial collateral ligament, but on the lateral side the capsule is separated from the fibular collateral ligament. On the back of the joint the capsule is thick and strong. The thickened posterior capsule prevents hyperextension of the knee joint.

10.26

Here we've divided the fibrous capsule to see its inner surface. It's lined on the inside with synovial membrane all the way round the joint, except at the back. At the back, as we'll see if we remove the capsule, the thin synovial membrane (here it is) passes forwards around the cruciate ligaments, covering them on the front.

10.54

Besides being the largest joint in the body, the knee joint is also much the most complicated! Before we move on to look at the muscles which produce knee movement, let's review what we've seen of the bones, and of the knee joint.

11.06

REVIEW

On the femur, here's the lateral condyle, and epicondyle; the medial condyle, and epicondyle; the adductor tubercle, and the intercondylar notch.

11.28

On the tibia, here's the lateral condyle, the medial condyle, the tibial tubercle, and the facet for the fibula.

11.40

Here's the head of the fibula, the neck of the fibula, the proximal tibio-fibular joint, and the patella.

11.54

Here's the medial meniscus, the lateral meniscus, the anterior cruciate, and posterior cruciate ligaments. The fibular collateral ligament, the tibial collateral ligament, the quadriceps tendon, the patellar ligament, and the joint capsule.

12.24

MUSCLES

Now we'll move on to look at the muscles which produce movement at the knee joint. We've met most of them already. The one muscle that extends the knee is the massive quadriceps. We saw it briefly in the last section. We'll take a better look at it now. The main flexors of the knee are the so-called hamstring muscles, semi-membranosus, semitendinosus, and biceps femoris. Besides flexing the knee, the hamstring muscles also extend the hip. We took a good look at them in the last section. Here, we'll just re-visit their insertions. In addition we'll look at three muscles at the back of the knee that we haven't yet seen - popliteus, gastrocnemius, and plantaris.

13.12

We'll start with quadriceps. Its name comes from the fact that it has four heads. Oddly, these are named as though they were separate muscles. Three of the heads arise from the femur. They're all called vastus intermedius, vastus medialis, and vastus lateralis. The fourth head, rectus femoris, arises from the hip bone. All four heads converge on the quadriceps tendon, which we've seen. We'll start with the deepest of the heads, vastus intermedius.

13.43

Here it is. It forms a bulge on the front of the femur. Vastus intermedius arises from this broad area around the lateral aspect and front of the femur.

13.56

Wrapped around the outside of vastus intermedius are vastus medialis, and vastus lateralis. These two cover vastus intermedius almost completely. Their fibers run obliquely, all the way round to the back. Here's lateralis, here's medialis, almost meeting it.

14.23

Vastus lateralis arises from the lateral edge of the linea aspera, and from the side and front of the greater trochanter. Vastus medialis arises from the medial edge of the linea aspera, and from just below the lesser trochanter. The thin strip of bone between these two lines of origin provides the insertion of all the adductor muscles, and also the origin of the short head of biceps.

14.53

Now let's add rectus femoris to the picture. Here it is. Rectus femoris arises from the ilium just above the hip joint. Its tendon of origin has two parts, a posterior or reflected part and an anterior or straight part. The anterior part arises from this prominence, the anterior inferior iliac spine. The posterior part arises from just above the acetabulum.

15.28

All four heads of quadriceps converge on the quadriceps tendon. The lowest fibers of vastus lateralis and medialis insert into the sides of the patella.

15.40

The principal action of the quadriceps muscle is to extend the knee. When the foot is off the ground, that action simply straightens the leg, and holds it straight. When the foot is on the ground, the action of quadriceps has several important effects.

