

Anatomy of the Lower Extremity: Hip Joint

[See online here](#)

Every year, a great number of endoprotheses are implanted in the hip joint region. This shows the extreme vulnerability of the capsular ligament complex and, thus, why a physician should be able to know its anatomy, functional anatomy, and pathophysiology. Orthopedists and surgeons hear patients complaining about pain in the hip joint every day. Without sufficient knowledge, it is impossible to help these people competently.



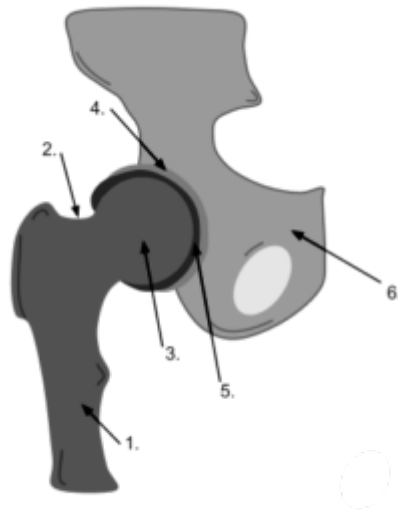
Anatomy of the Hip Joint

The hip joint is a **cotyloid joint** or ball and socket joint. It consists of the **acetabulum (hip socket)** and the **femoral head (ball)** of the femur. It has three degrees of movement flexion/extension, abduction/adduction, and internal/external rotation.

Pelvis/Acetabulum

The **acetabulum** consists of three parts: the **ilium**, **the pubis**, and **the ischium**. They meet in the Y-shaped growth plate. This growth plate is completely closed between the ages of 14 and 16 and forms the proximal articular surface of the hip joint. The articular surface is concave and does not completely surround the femoral head.

Acetabular labrum



[Image](#): "The parts of the hip joint" by Kcotton15 - Own work,
License: [CC BY-SA 4.0](#)

This is a structure consisting of dense connective tissue and fibrocartilage. It has a triangular shape. It forms a ring around the acetabulum and is fixated at the **acetabular limbus**, the osseous ridge that surrounds the acetabulum proximally. It serves as an enlargement of the articular socket surface.

Acetabular incision

The **acetabular incision** is an incision in the socket edge where no labrum is located. It is the suture area between the pubis and the ischium and is covered by the **transverse acetabular ligament**.

Femur

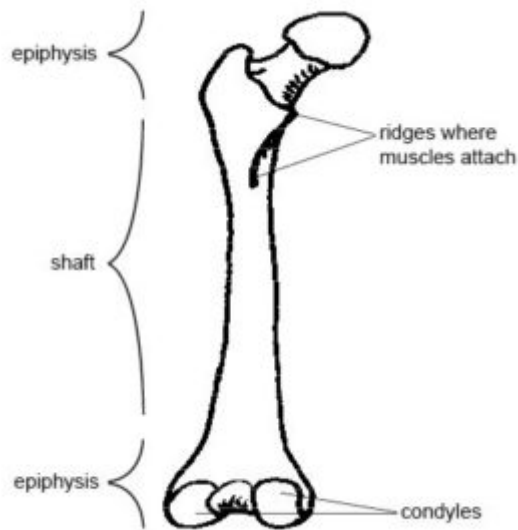
We distinguish between parts of the femur that are a direct part of the joint and those that are close to it:

Femoral parts directly part of the joint	<ul style="list-style-type: none"> • Femoral head
Femoral parts close to the joint	<ul style="list-style-type: none"> • Femoral neck • Greater and lesser trochanter <ul style="list-style-type: none"> • Intertrochanteric line • Intertrochanteric crest • Trochanteric fossa <ul style="list-style-type: none"> • Linea aspera • Gluteal tuberosity • Pectineal line

Femoral Head

The spherical, convex **head of the femur** is the articulating joint surface of the femur and forms the distal part of the hip joint.

Fovea of the femoral head



[Image](#): "The femur". Original uploader was Sunshineconnelly at en.wikibooks - Transferred from en.wikibooks; transferred to Commons by User:Adrignola using CommonsHelper. License: [CC BY 3.0](#)

The fovea of the femoral head is a depression on the femoral head in the fourth, or dorsocaudal, quadrant and serves as the insertion area of the **ligament of the femoral head**. Cranial to the fovea, there is the strongest cartilage-layer of the femoral head with a thickness of up to 4 millimeters.

Femoral neck

The **femoral neck** connects the femoral head with the femoral shaft and transitions into the **intertrochanteric line (ventral)** and the **intertrochanteric crest (dorsal)**.

Greater trochanter

The **greater trochanter** is an **apophysis** and lies laterally of the **trochanteric fossa**. It serves as the insertion of the **gluteus medius and minimus muscles**, the **piriformis muscle**, the **internal obturator muscle**, and the **gemellus muscles**.

Lesser trochanter

The 'little brother of the greater trochanter' is located medially of the **intertrochanteric line** and is, among other functions, the insertion for the **iliopsoas muscle**.

Intertrochanteric line

The intertrochanteric line lies ventrally between the greater and lesser trochanter and serves as the insertion of the **iliofemoral ligament** and as the origin of the **vastus medialis muscle**.

Intertrochanteric crest

The intertrochanteric crest is an osseous ridge that connects the greater and lesser trochanter. Among other functions, it serves as the **insertion of the capsule of the hip joint**.

Trochanteric fossa

The trochanteric fossa is a depression which is located dorso-medial to the greater trochanter. It serves as the insertion of the **external and internal obturator muscles** and the **superior and inferior gemellus muscle**.

Linea aspera

As with the crest, the linea aspera is also an osseous ridge located on the dorsal surface of the femoral shaft. It is the insertion point of the **gluteus maximus muscle**, the **adductor longus, brevis, and magnus muscles**, and the **pectineus muscle**. It is also the origin of the **vastus medialis and lateralis muscles**, and the **short head of the biceps femoris muscle**.

Gluteal tuberosity

The gluteal tuberosity lies cranial to the linea aspera and serves as the insertion point of the **gluteus maximus muscle**.

Pectineal line

It lies ventrally of the linea aspera towards the greater trochanter and is the insertion point of the **pectineus muscle**.

Here you can read more about the [muscles of the hip and thigh](#).

Functional Anatomy: Angles of the Femur

CCD angle



Image: "Lateral view of the femur (red)" by Anatomography - en:Anatomography (setting page of this image), License: [CC BY-SA 2.1 JP](#)

The femoral neck angle is the angle between the femoral neck and shaft of the femur, it is normally between 120 and 135 degrees. When it is over 135 degrees, it is called **coxa valga**. When it is under 120, it is called **coxa vara**.

Angle of anteversion

The femoral head is anterior to the plane of the femur, creating an angle between the frontal plane and the femoral neck. This angle is called the angle of anteversion, normal anteversion is between 5 and 15 degrees. When it is over 15 degrees, the femur is said to be anteverted. When it is below 5 degrees, the femur is retroverted. Patients with increased anteversion may walk with an in-toe (pigeon foot) gait.

Articular Capsule of the Hip Joint

The articular capsule of the hip joint is one of the strongest capsules in the body. It consists of two layers: **fibrous membrane** and **synovial membrane**.

Fibrous membrane

The fibrous membrane is firm and thick with fibril bundles that run in the longitudinal and diagonal direction. They insert in the **edge of the acetabulum**, the **transverse ligament of the acetabulum**, and the **intertrochanteric line** of the ventral femur. The dorsal insertion point is the **femoral neck medially of the intertrochanteric crest**. It is studded with mechanoreceptors, which lead proprioceptive afferents to the central [nervous system](#).

Synovial membrane

The insertion of the synovial membrane is the outer edge of the base of the **acetabular labrum**. Since the pointy edge of the labrum does not articulate with the membrane, the **recessus periligamentarius** is formed between the capsule and the labrum.

It inserts at the cartilage-bone border and at the intertrochanteric crest. They serve as an

axis for vessels and supply the femoral neck with blood on their way to the hip head. Also, the synovial membrane forms a tube around the ligament of the femoral head and secludes the joint from the acetabular incision and the acetabular fossa.

Ligaments and Bursae of the Hip Joint

The ligaments of the hip joint serve as guides and limitations of movements and ensure the complete stabilization of the hip joint. In anatomy, there is a distinction between **intra-articular and extra-articular ligaments**:

Intra-articular ligaments	<ul style="list-style-type: none"> • Ligament of the femoral head • Transverse ligament of the acetabulum
Extra-articular ligaments	<ul style="list-style-type: none"> • Iliofemoral ligament • Pubofemoral ligament • Ischiofemoral ligament • Zona orbicularis

Ligament of the femoral head

The ligament of the femoral head lies in the joint and is covered by a synovial membrane. The bundle of fibers runs from the **anterior and posterior cornu of the facies lunata** and the **superior edge of the transverse ligament of the acetabulum** to the fossa. It is subject to tension when the movements flexion/adduction/external rotation combine. This ligament is often referred to as **teres femoris ligament** in other medical textbooks and journals.

Transverse ligament of the acetabulum

This ligament supports the head of the femur inferiorly and connects the **ends of the labrum** (outer layer) and the two **cornua of the facies lunata** (inner layer).

Iliofemoral ligament

This ligament has a V-shape and is divided into a **lateral part** and a **medial part**. The common insertion is the **intertrochanteric line**, and the tip of the V is fused with the **rectus femoris muscle**. The lateral part, also called **Bertini's ligament**, is the strongest ligament in the human body since it can resist tensile stress of up to 350 kilograms. The medial part is the lower tract and is very thin compared to the lateral one. The fibers spiral with each other. They relax in case of external rotation.

Pubofemoral ligament

This ligament runs from the **iliopectineal eminence** and the **obturator crest** to the **intertrochanteric line** where it connects to the iliofemoral ligament. Additional connections are established with the articular capsule and the **zona orbicularis**.

Ischiofemoral ligament

The ischiofemoral ligament originates from the **dorsocaudal edge of the socket** and the **cranial edge of the ischial tuberosity** and helically runs in craniolateral direction. It inserts at the **inner surface of the greater trochanter** and the **zona orbicularis**. The ligament fuses with the lateral part of the iliofemoral ligament.

Zona orbicularis

The **zona orbicularis** is a loop of the ligament which contains fibers of all extra-articular ligaments. It is connected to the articular capsule.

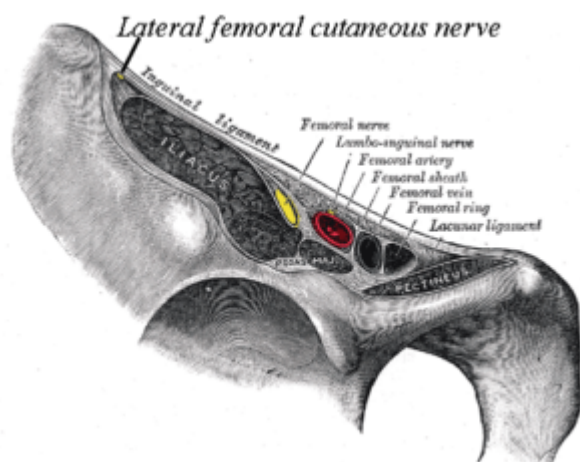
Iliopectineal bursa

The **iliopectineal bursa** serves the protection of the very thin articular capsule and is located between the iliofemoral and the pubofemoral ligaments. It is located under the tendon of the powerful iliopsoas muscle.

Innervation of the Hip Joint

Altogether, five nerves supply the hip joint and its structures. They are the **femoral nerve**, the **obturator nerve**, the **ischial nerve**, the **superior gluteal nerve**, and the **quadratus femoris nerve**.

Femoral nerve



[Image](#): "Lateral femoral cutaneous nerve" by Dan Hoey - edit of PD image Gray546.png, License: [Public Domain](#)

This nerve gives rise to a branch to the anterior articular area. This branch runs distally of the lateral circumflex femoral artery.

Obturator nerve

The obturator nerve sends fibers to both the hip and the knee joints. The fibers originate from the segments L3-L4 and run to the caudal hip joint.

Ischial nerve

The **ramus acetabularis coxae** of the ischiadic nerve branches off shortly before the **infrapiriform foramen** and supplies the dorsal hip joint.

Superior gluteal nerve

This nerve supplies the superior lateral part of the hip joint.

Quadratus femoris nerve

Branches of the quadratus femoris nerve innervate the dorsocaudal hip joint.

Clinical Hip Joint

Arthritis

Arthrosis: 1) osteophyte 2) subchondral sclerosis 3) subchondral cyst 4) joint space

Progressive abrasion of the cartilage due to arthritis of the hip joint. Patients suffer from immobilization and pain in the joint. This can be treated surgically with **total hip arthroplasty** (joint replacement).

Pectineal bursitis

If patients suffer from pain when contracting the iliopsoas muscle, there is a high probability of **pectineal bursitis**. Inflammation in the bursa can damage the tissue and may develop from continuous oversteering or infections.

Instability and dislocation



Image: "Congenital dislocation of the hip joint" by James Heilman, MD – Own work, License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

Dislocation of the hip joint mostly occurs in cases of high energy **trauma**. At extreme external rotation, the femoral head can be pressed ventrally and levered out of the socket. Inappropriate patient behavior can result in postoperative dislocation after total hip replacement surgeries.

Fracture of the femoral neck and necrosis

If the femoral neck breaks due to falling trauma or **osteoporosis**, the blood supply of the femoral head can be stopped if the fracture line runs within the capsule. If such a lesion is not (surgically) treated as soon as possible, **post-traumatic necrosis** can occur due to the lack of supply of the bone.

Necrosis can also occur due to high age if the ligament of the femoral head as the accompanying ligament of the obturator artery is not sufficiently supplied and

degenerates.

Hip dysplasia

Hip dysplasia is an innate or acquired malformation of the hip socket. If it is diagnosed too late or not at all, it results in irreversible damages in the articulating osseous structures, which leads to pain and limp. Extreme dysplasia makes the hip joint chronically unstable and vulnerable to dislocation. Treatment of dysplasia depends on the degree of the disease.

Review Questions

The solutions can be found below the references.

1. Which angle measure does the CCD angle have after the growth phase?

- A. Ca. 125 degrees
- B. Ca. 130 degrees
- C. Ca. 135 degrees
- D. Ca. 140 degrees
- E. Ca. 145 degrees

2. Which of the following structures is not one of the extra-articular ligaments of the hip joint?

- A. Iliofemoral ligament
- B. Pubofemoral ligament
- C. Ischiofemoral ligament
- D. Ligament of the femoral head
- E. Zona orbicularis

3. Which of the following nerves does not supply the hip joint?

- A. Femoral nerve
- B. Obturator nerve
- C. Ischiadic nerve
- D. Superior gluteal nerve
- E. Inferior gluteal nerve

References

Henche, H. (1980). Preliminary Notes on the Anatomy of the Knee Joint. *Arthroscopy of the Knee Joint*, 34-36. doi:10.1007/978-3-662-02316-7_13

Last, R. J. & McMinn, R. M., 1994. *Last's anatomy, regional and applied..* Edinburgh: Churchill Livingstone.

Correct answers: 1B, 2D, 3E

Legal Note: Unless otherwise stated, all rights reserved by Lecturio GmbH. For further legal regulations see our [legal information page](#).