Anatomy of the Gluteal Region and Posterior Thigh: Popliteal Fossa and Neurovascular Bundle

The gluteal region is located posterior to the pelvic girdle and extends downward on the back of the upper part of the leg as the posterior thigh and then the popliteal fossa. This region consists of the gluteal muscles, the hamstring muscles and several clinically important arteries, veins and nerves. The muscles of the gluteal region help to move the hip joint during walking, standing and sitting and are specialized for bearing weight and maintenance of the horizontal balance of the pelvis.

Gluteal Region

The gluteal region is the area posterior to the pelvic girdle between the iliac crest and the gluteal fold.

It consists of:
Two groups of muscles – the superficial group and the deep group of muscles
- Gluteal Nerves
- Gluteal Blood vessels
- Greater sciatic foramen; lesser sciatic foramen
- Sacrospinous and sacrotuberous

Borderlines of the gluteal region
- Superior side- iliac crest
- Medial side- medial line
- Lateral- a line from anterior superior iliac spine to the greater trochanter
- Inferior side- gluteal fold

Superficial Group of Muscles

The superficial group of muscles consists of the **three large glutei muscles** which extend and abduct the hip joint and the femur and the tensor fascia lata which stabilizes the knee in extension.

**Gluteus maximus**

The Gluteus maximus is the largest of the three gluteal muscles and is responsible for the contour of the buttocks. It originates from the posterior surface of the sacrum, coccyx and the ilium and then inserts in the iliotibial tract and the gluteal tuberosity of the femur. It originates posterior to the posterior gluteal line. It is innervated by the **inferior gluteal nerve** (S1, S2). It is the chief extensor of the hip, flexes it when sitting down and helps with lateral rotation.

But it is not an important postural muscle as it is relaxed when standing and is not used during walking. It is active during forceful movement like running, rising from a sitting position and climbing.
Gluteus medius

The Gluteus medius is **fan-shaped muscle** which originates from the posterior surface of the ilium in between anterior and inferior gluteal line and is inserted into the lateral aspect of the greater trochanter of the femur. It is situated between the gluteus maximus and the medius. The Superior gluteal nerve (L4, L5, S1) innervates the muscle. It abducts and medially rotates the thigh at this hip joint. It fixes the pelvis during movement and prevents the opposite pelvis from dropping. It plays an important role in balancing the pelvic level when the opposite limb is positioned off the ground.

Gluteus minimus

The Gluteus minimus is the smallest and deepest of the three gluteal muscles. It originates from the external ilium in between anterior and posterior lines and then forms a tendon which is inserted into the anterior aspect of the greater trochanter of the femur. It is innervated by superior gluteal nerve (L4, L5, S1). Along with the gluteus medius it **abducts and medially rotates the hip joint as well as fixes the pelvis** during movement thereby preventing opposite pelvic drop.

Tensor fascia lata

The tensor fascia lata is a small muscle originates from the anterior iliac crest and inserts into the iliotibial tract to the lateral condyle of the tibia. It is innervated by the superior gluteal nerve (L4, L5, S1). It helps the gluteus medius and the minimus in **abducting and medially rotating the thigh** as well during walking. It helps in the flexion of hip and stabilization of the knee joint.

Deep Muscles

These are a group of small muscles located deep to the gluteus minimus. They stabilize and laterally rotate the hip joint.

![Sobo 1909 298](image)
Piriformis

Piriformis originates from the anterior aspect of the sacrum and runs inferolaterally via the greater sciatic foramen and finally inserts on the greater trochanter of the femur. It is innervated by the anterior nerve of S1 to the piriformis and helps to laterally rotate the hip which is in extension and abduct the hip joint in flexion.

The piriformis is an important landmark as it divides the gluteal region into a superior and inferior part when it passes through the greater sciatic foramen. Superior gluteal nerves and vessels emerge superior to the piriformis while the inferior gluteal nerves and vessels lie inferior to it. The piriformis also helps locate the sciatic nerve which lies inferior to it and can be identified as a flat, 2cm wide band.

Obturator internus

The Obturator internus originates from the ischium and the pubis near the obturator foramen. It then runs through the lesser sciatic foramen to insert on to the medial surface of greater trochanter of the femur. It is innervated by the nerve to the obturator internus (S1) and helps to laterally rotate extended hip and abduct the hip in flexion.

Gemelli

The superior and inferior Gemelli are two triangular muscles separated by the tendon of the obturator internus. While the superior Gemellus originates from the ischial spine, the inferior Gemellus originates from the ischial tuberosity. They both insert into the medial surface of greater trochanter of the femur. They both laterally rotate and abduct the hip joint. The nerve of the obturator internus (S1) innervates the superior Gemellus and the nerve to the quadratus femoris (L5, S1) innervates the inferior Gemellus.

Quadratus Femoris

The Quadratus Femoris is a flat muscle situated deep to the gluteal and gemelli muscles. Its origin is from the lateral aspect of the ischial tuberosity and insertion is on the quadratus tuberosity on the intertrochanteric crest. It is innervated by the nerve to the quadratus femoris (L5, S1) and laterally rotates the hip and for fixation of the femur in acetabulam.

Gluteal Nerves

There are several nerves in the gluteal region. The sciatic nerve (L4– S3), a branch of the sacral plexus, passes through the greater sciatic foramen, deep to the piriformis and then separates into two parts, the tibial and fibular part. The nerve then descends deep to the gluteus maximus into the middle part of the posterior thigh. The other nerves in this region include the superior gluteal nerve (L4, S1, S2), inferior gluteal nerve (L5, S1, S2), the pudendal nerve and the posterior femoral cutaneous nerve of the thigh (S1, S2).
Gluteal Vessels

The gluteal arteries arise from the internal iliac arteries within the pelvis either directly or indirectly. Accompanied by the superior gluteal nerve, the similarly named artery passes deep to the gluteus maximus muscle and divides into branches which supply the gluteal muscles. The inferior gluteal artery also a branch of the internal iliac artery, runs deep to the gluteus maximus and medial to the sciatic nerve. The gluteal veins drain into the internal iliac vein.

Greater Sciatic Foramen

This foramen in the posterior aspect of the pelvis is formed by the sacrospinous and sacrotuberous ligament. It is wider in women compared to men.

The boundaries of the foramen are:

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<thead>
<tr>
<th>Boundaries</th>
<th>Foramen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anteriorly</td>
<td>Ischial tuberosity</td>
</tr>
<tr>
<td>Posteriorly</td>
<td>Sacrotuberous ligament</td>
</tr>
<tr>
<td>Superiorly</td>
<td>Ischial spine and sacrospinous ligament</td>
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</tbody>
</table>

The piriformis muscle passes through the foramen and divides it into a superior and an inferior compartment. The suprapiriformis compartment contains the superior gluteal vessels and nerves while the infrapiriformis compartment contains the inferior gluteal vessels and nerves, the pudendal nerve and vessels, the sciatic nerve, the posterior femoral cutaneous nerve, the nerve to the obturator internus and the nerve to the quadratus femoris.

Lesser Sciatic Foramen

This foramen is formed between the pelvis and the posterior aspect of the thigh by the sacrotuberous and sacrospinous ligament.

The boundaries of the foramen are:

<table>
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</thead>
<tbody>
<tr>
<td>Anteriorly</td>
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<td>Ischial spine and sacrospinous ligament</td>
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The foramen has boundaries formed by the sciatic notch and the two ligaments. The Obturator internus tendon, the pudendal nerves and vessels and the nerve to the obturator internus pass through the lesser sciatic foramen.

Ligaments

Sacrotuberous ligament is a part of the biceps femoris muscle and runs from the transverse processes of the lower sacral tubercles, the sacrum and coccyx to the ischial tuberosity. Branches of the inferior gluteal artery, the perforating cutaneous nerve and branches of the coccygeal plexus pass through the ligament.

Sacrospinous ligament is intermingled with the sacrotuberous ligament and runs from the sacrum and coccyx to the ischial spine. It divides the greater sciatic notch into the greater and lesser sciatic foramina through which several nerves and vessels pass.
These two ligaments together prevent excessive upward tilt of the sacrum and provide pelvic support to the pelvic organs.

Posterior Thigh

The posterior compartment of the thigh consists of three hamstring muscles, nerves and blood vessels. The hamstring muscles (biceps femoris, Semimembranosus, and the Semitendinosus) all except the short head of the biceps femoris, originate from the ischial tuberosity and their insertion is on the tibia and fibula crossing two joints, hip and knee. They help to extend the hip and also flex the knee joint. They are innervated by the Sciatic nerve.

![Thigh cross section](https://example.com/thigh_cross_section.png)

The laterally situated Biceps femoris has a long head which originates from the ischial tuberosity and a short head which originates on the linea aspera and lateral supracondylar line of the femur. The two heads converge to form a single tendon which runs down to insert on the lateral surface of the fibular head. The Semimembranosus and the Semitendinosus are situated medially with the Semitendinosus tendon on top of the Semimembranosus tendon.

Both originate from the ischial tuberosity but the Semimembranosus is inserted on the posterior aspect of the medial femoral and tibial condyles while the Semitendinosus inserts on the medial aspect of the proximal tibia behind the gracilis muscle. Both of them are supplied by the tibial division of sciatic nerve (L5, S1) Both muscles help to extend the hip and flex the knee joint. Semimembranosus muscle also assist in the medial rotation when the knee joint is flexed.

Popliteal Fossa

The popliteal fossa or the knee pit is a diamond shaped, shallow depression on the posterior aspect of the knee joint. Its location corresponds to the posterior aspect of the lower part of the femur and the upper part of the tibia. It contains all the structure related to the neurovascular system that travel from the thigh to the leg.

The roof of the fossa from superficial to deep is formed by the skin, superficial popliteal fascia (containing the small saphenous vein, the lateral and medial sural nerves, the
terminal branch of the posterior cutaneous nerve of the thigh and the posterior division of the medial cutaneous nerve). The popliteal fascia is continuous with the fascia lata.

The floor of the fossa is formed by the posterior or popliteal surface of the femur, the knee joint capsule, the oblique popliteal ligament and the fascia covering the popliteal muscle.

**Boundaries of fossa are:**

<table>
<thead>
<tr>
<th>Superomedially</th>
<th>Semimembranosus muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superolaterally</td>
<td>Biceps femoris</td>
</tr>
<tr>
<td>Inferomedially</td>
<td>Medial head of the gastrocnemius</td>
</tr>
<tr>
<td>Inferolaterally</td>
<td>Lateral head of the gastrocnemius</td>
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Contents of the popliteal fossa from medial to lateral include:

**The popliteal artery with its branches**

The artery is a continuation of the femoral artery in the leg and lies deep to the other structures in the popliteal fossa. It starts at the hiatus magnus in the thigh and terminates by dividing into the anterior and posterior tibial arteries. It divide into 5 genicular arteries that form anastomosis to supply the capsule and ligaments of the knee joint.

**The popliteal vein with its tributaries**

The popliteal vein is formed at the inferior border of the popliteus by the union of the anterior and posterior tibial veins and continues subsequently as the femoral vein at the hiatus magnus.

**Tibial nerve and the common peroneal nerve**

They are branches of the sciatic nerve and lie most superficially in the fossa. The common peroneal nerve runs along the lateral margin of the fossa following the biceps femoris tendon. It leaves popliteal fossa by entering deep into the gastrocnemius. In popliteal fossa it maintains nerve supply to the muscles near popliteal fossa and knee joint.

**Other contents of the popliteal fossa are:**

- Genicular branch of the obturator nerve
- Posterior cutaneous nerve of the thigh
- Popliteal lymph nodes
- Popliteal pad of fat
- Small saphenous vein (enters by piercing the popliteal fascia and drains into the popliteal vein)

**Clinical Relevance**

Popliteal artery can be used for the measurement of blood pressure. The pressure in the popliteal artery is lower than the pressure of the brachial artery in case of coarctation of the aorta.

Intramuscular injections in the gluteal region can be safely given in the superolateral quadrant of the buttock as it is an area devoid of nerves and vessels.
Injury to the superior gluteal nerve following an intramuscular injection or other trauma can cause paralysis of the gluteus medius and minimus. This results in the patient having a typical waddling or lurching gait. This is clinically noticed with a positive Trendelenburg sign – when the patient is asked to stand unsupported on each leg, the pelvis drops on the unsupported leg. E.g. if the left gluteal muscles are paralyzed, then the right pelvis will drop when the patient attempts to stand on the left leg with the right leg being unsupported.

Prolapse of the vagina or uterus due to the laxity or absence of pelvic ligaments is treated with a surgery called the sacrospinous suspension. In this, the sacrospinous ligament is sutured to the vaginal vault or the cervix to restore support to these organs.

Baker’s cyst is a fluid-filled sac usually associated with knee joint arthritis. The fluid develops in the semimembranous bursa leading to its inflammation and swelling and often resolves without treatment. Occasionally the cyst may rupture leading to swelling in the back of the leg resembling deep vein thrombosis.

Abnormal dilatation of the popliteal artery more than 50% of its diameter can lead to compression of the tibial nerve with diminished plantar flexion and paresthesia of the foot and posterolateral aspect of the leg. Diagnosis of the popliteal artery aneurysm is based on palpation of pulsation in the popliteal fossa or auscultation of a bruit.

The other causes of the presence of popliteal mass are adventitial cyst of the popliteal artery, deep vein thrombosis and malignancy.

References

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