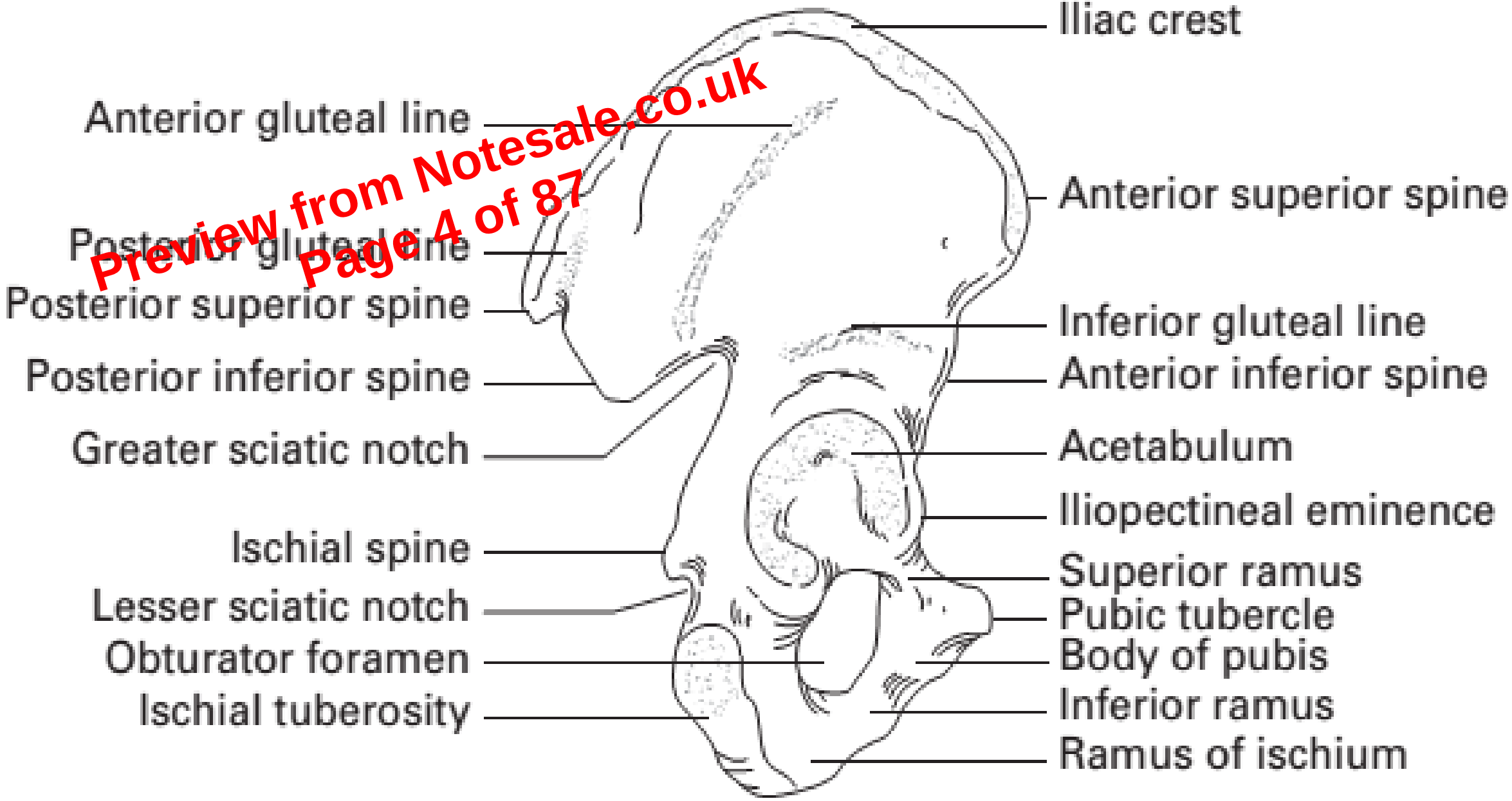
Functions of the Lower Limb

Support the body weight

The ligaments at the hip and knee joints facilitate locking of these joints therefore reducing the amount of muscular energy required to maintain a standing position.

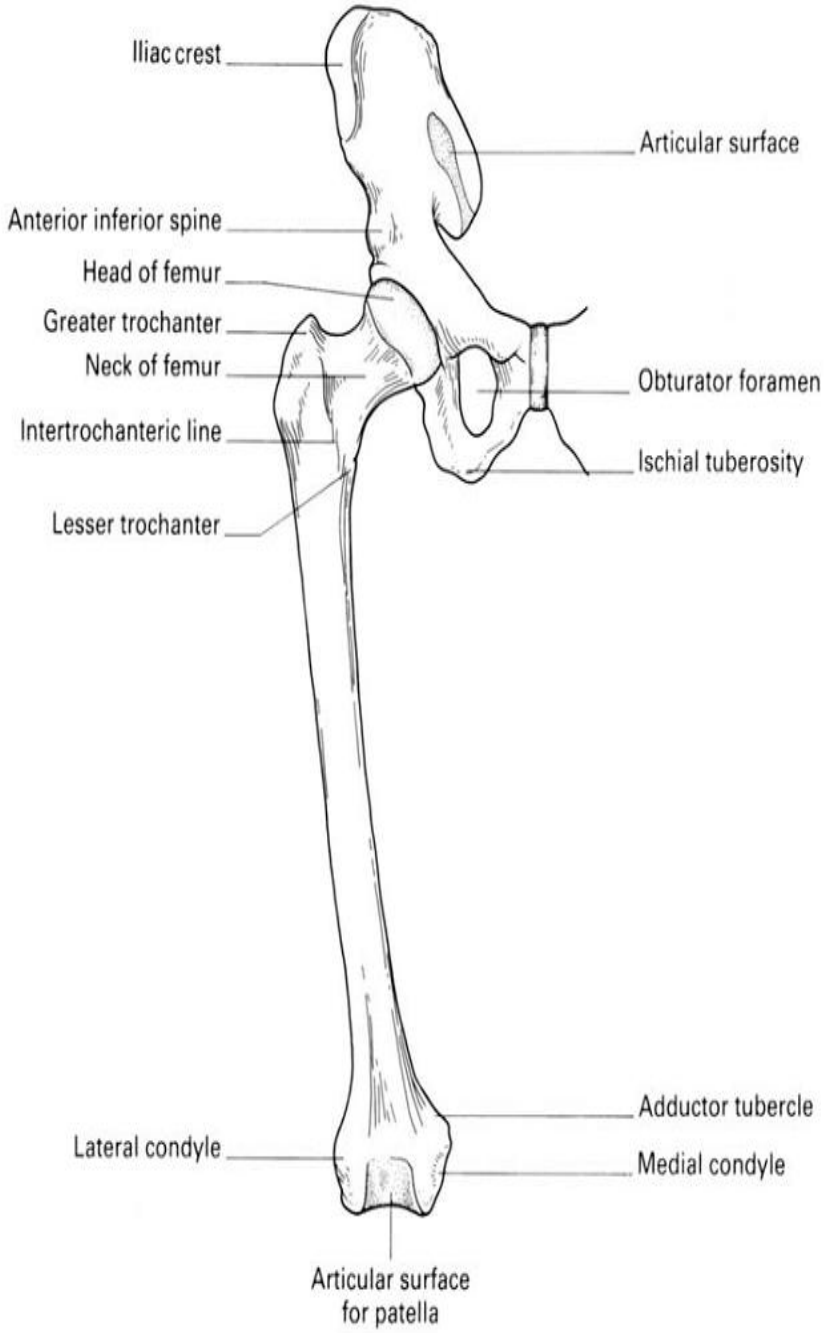
Locomotion

To move the body through space. This involves integration of movements at all joints of the lower limb to place the foot on the ground and move the body over it.



THE FEMUR

The femur is the largest bone in the body. It is 18 in (45 cm) in length, a measurement it shares with the vas, the spinal cord and the thoracic duct and which is also the distance from the teeth to the cardia of the stomach. The femoral head is two-thirds of a sphere and faces upwards, medially and forwards. It is covered with cartilage except for its central fovea where the ligamentum teres is attached. The neck is 2 in (5 cm) long and is set at an angle of 125° to the shaft. In the female, with her wider pelvis, the angle is smaller. The junction between the neck and the shaft is marked anteriorly by the trochanteric line, laterally by the greater trochanter, medially and somewhat posteriorly by the lesser trochanter and posteriorly by the prominent trochanteric crest, which unites the two trochanters.



THE PATELLA

The patella is a sesamoid bone, the largest in the body, in the expansion of the quadriceps tendon, which continues from the apex of the bone as the ligamentum patellae. The posterior surface of the patella is covered with cartilage and articulates with the two femoral condyles by means of a larger lateral and smaller medial facet.

- A direct blow on the patella may split or shatter it but the fragments are not avulsed because the quadriceps expansion remains intact. The patella may also be fractured transversely by violent contraction of the quadriceps—for example, in trying to stop a backward fall. In this case, the tear extends outwards into the quadriceps expansion, allowing the upper bone fragment to be pulled proximally; there may be a gap of over 2 in (5 cm) between the bone ends. Reduction is impossible by closed manipulation and operative repair of the extensor expansion is imperative. Occasionally this same mechanism of sudden forcible quadriceps contraction tears the quadriceps expansion above the patella, ruptures the ligamentum patellae or avulses the tibial tubercle. It is interesting that following complete excision of the patella for a comminuted fracture, knee function and movement may return to 100% efficiency; it is difficult, then, to ascribe any particular function to this bone other than protection of the soft tissues of the knee joint anteriorly.

Reduction of a dislocated hip is quite simple providing that a deep anaesthetic is used to relax the surrounding muscles; the hip is flexed, rotated into the neutral position and lifted back into the acetabulum. Occasionally, forcible abduction of the hip will dislocate the hip forwards. Violent force along the shaft (e.g. a fall from a height) may thrust the femoral head through the floor of the acetabulum, producing a central dislocation of the hip.

MOVEMENT OF THE KNEE JOINT

The principal knee movements are flexion and extension, but note on yourself that some degree of rotation of the knee is possible when this joint is in the flexed position. In full extension, i.e. in the standing position, the knee is quite rigid because the medial condyle of the tibia, being rather larger than the lateral condyle, rides forward on the medial femoral condyle, thus 'screwing' the joint firmly together. The first step in flexion of the fully extended knee is 'unscrewing' or internal rotation. This is brought about by popliteus, which arises from the lateral side of the lateral condyle of the femur, emerges from the joint capsule posteriorly and is inserted into the back of the upper end of the tibia.

The principal muscles acting on the knee are:

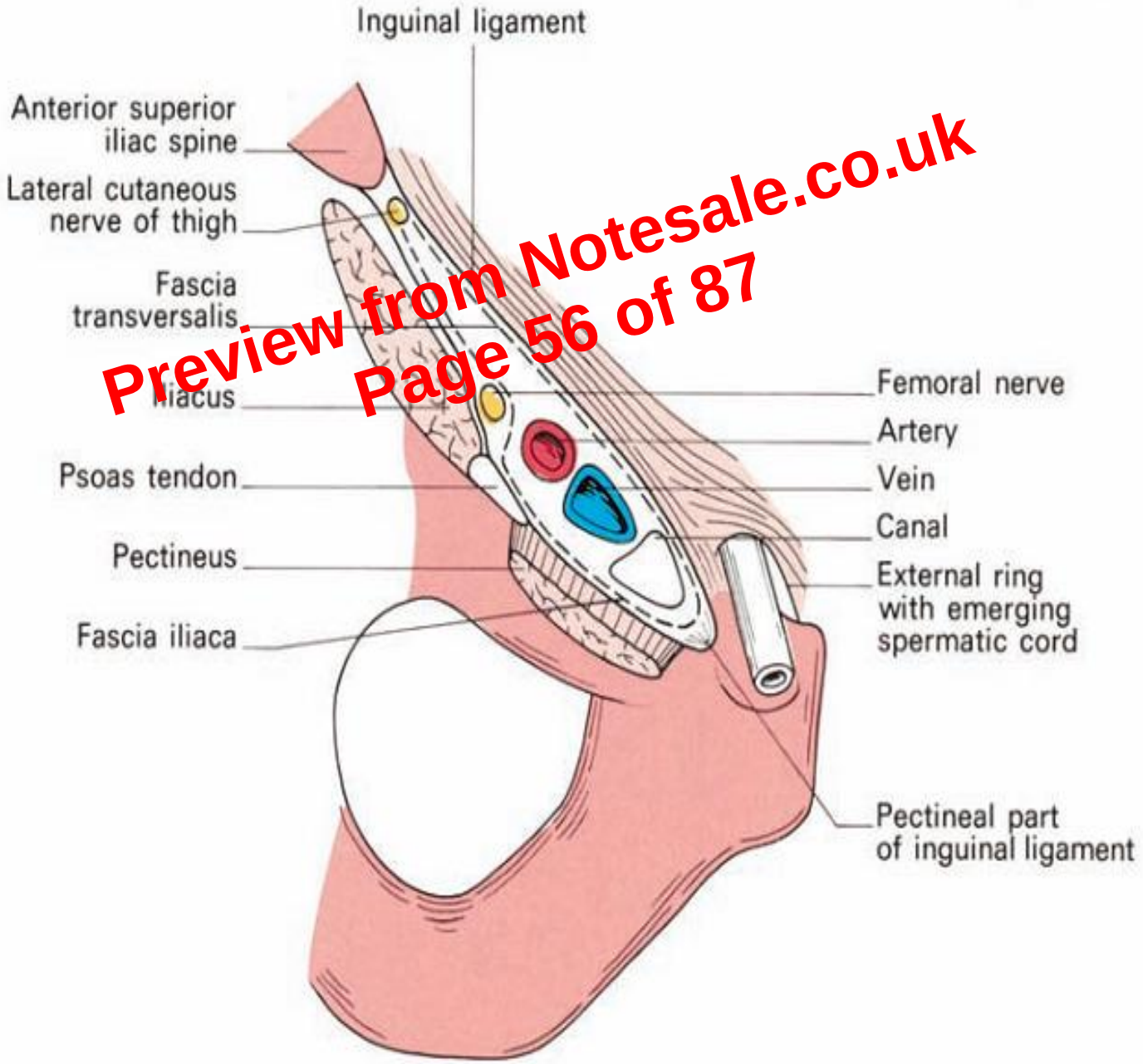
I. extensor—quadriceps femoris;

II. flexors—hamstrings assisted by gracilis, gastrocnemius and sartorius;

III. medial rotator—popliteus ('unscrews the knee').

The fascia lata

The deep fascia of the thigh, or fascia lata, extends downwards to ensheath the whole lower limb except over the subcutaneous surface of the tibia (to whose margins it adheres), and at the saphenous opening. Above, it is attached all around to the root of the lower limb—that is to say, to the inguinal ligament, pubis, ischium, sacrotuberous ligament, sacrum and coccyx and the iliac crest. The fascia of the thigh is particularly dense laterally (the iliotibial tract), where it receives tensor fasciae latae, and posteriorly, where the greater part of gluteus maximus is inserted into it. The iliotibial tract, when tensed by its attached muscles, assists in the stabilization of the hip and the extended knee when standing. The tough lateral fascia of the thigh is an excellent source of this material for hernia and dural repairs.



The femoral canal and its surrounds.

NB, The femoral nerve lies outside the femoral sheath

The adductor canal (of Hunter) or subsartorial canal

This canal leads on from the apex of the femoral triangle. Its boundaries are:

posteriorly—adductor longus and magnus;

anterolaterally—vastus medialis;

anteromedially—the sartorius, which lies on a fascial sheet, forming the roof of the canal.

The contents of the canal are the femoral artery, the femoral vein (which lies behind the artery), the saphenous nerve and, in its upper part, the nerve to vastus medialis from the femoral nerve. John Hunter described the exposure and ligation of the femoral artery in this canal for aneurysm of the popliteal artery; this method has the advantage that the artery at this site is healthy and will not tear when tied, as may happen if ligation is attempted immediately above the aneurysm.

Clinical features

The popliteal fossa is another good example of the value of thinking anatomically when considering the differential diagnosis of a mass situated in a particular anatomical area. When examining a lump in the popliteal region, let these possibilities pass through your mind:

- skin and soft tissues—sebaceous cyst, lipoma, sarcoma;
- vein—varicosities of the short saphenous vein in the roof of the fossa;
- artery—popliteal aneurysm;
- lymph nodes—infection secondary to suppuration in the foot;
- knee joint—joint effusion;
- tendons—enlarged bursae, especially those beneath semimembranosus and the heads of gastrocnemius;
- bones—a tumour of the lower end of femur or upper end of tibia.

Branches

In the groin, the femoral artery gives off:

- the superficial circumflex iliac artery;
- the superficial epigastric artery;
- the superficial external pudendal artery.

These three vessels are encountered in the groin incision for repair for an inguinal hernia. Their corresponding veins drain into the great saphenous vein. The profunda femoris arises posterolaterally from the femoral artery 2 in (5 cm) distal to the inguinal ligament. It is conventional to call the femoral artery above this branch the common femoral, and below it, the superficial femoral artery. The profunda passes deep to adductor longus and gives off medial and lateral circumflex branches and four perforating branches. These are important both as the source of blood supply to the great muscles of the thigh and as collateral channels which link the rich arterial anastomoses around the hip and the knee.

Anterior tibial artery

The anterior tibial artery arises at the bifurcation of the popliteal artery. It passes forwards between the tibia and fibula under the lower border of popliteus over the upper margin of the interosseous membrane and descends on this structure in the anterior compartment of the leg. At first deeply buried, it becomes superficial just above the ankle between the tendons of extensor hallucis longus and tibialis anterior, being crossed superficially by the former immediately proximal to the line of the ankle joint. The artery continues over the dorsum of the foot as the dorsalis pedis (where its pulse may be palpated); this gives off the arcuate which, in turn, supplies cutaneous branches to the backs of the toes. Dorsalis pedis itself plunges between the 1st and 2nd metatarsals to join the lateral plantar artery in the formation of the plantar arch, from which branches run forwards to supply the plantar aspects of the toes.

Branches

The trunk of the sciatic nerve supplies the hamstring muscles (biceps, semimembranosus, semitendinosus) and also the adductor magnus, the latter being innervated also by the obturator nerve. All the muscle branches apart from the one to the short head of biceps arise on the medial side of the nerve; its lateral border is therefore the side of relative safety in its operative exposure. The tibial nerve(L4, 5, S1–3) is the larger of the two terminal branches of the sciatic nerve; it traverses the popliteal fossa superficial to the popliteal vein and artery, which it crosses from the lateral to the medial side.