



US of the common peroneal nerve and ITS two terminal branches: how to do it; a detailed didactic approach

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Learning objectives

- Illustrate regular anatomy and US appearance of the common peroneal nerve and its two terminal branch: deep peroneal nerve and superficial peroneal nerve.
- Describe a correct and systematic technique for US evaluation of these structures.
- Produce anatomical schemes with didactic purpose and show correlation with US imaging.

Background

Ultrasonography (US) is an established method for peripheral nerves imaging.

In the short axis, the nerve has a honeycomb-like appearance, with multiple rounded hypoechoic areas in a homogeneous hyperechoic background.

In the long axis, it has a striated appearance composed of multiple parallel hypoechoic and hyperechoic bands. This image resembles that of an electric cable. This type of US appearance can be defined as fascicular structure. The transverse image (short axis) is much more frequently used in clinical practice, as it allows for the nerve to be examined by the so-called elevator technique which consists of finding the set nerve at a characteristic anatomic point and 'tracking it' either proximally or distally. In this way, it is possible to assess the nerve's shape, echogenicity and thickness and its relation to the surrounding tissues, the surface area of the nerve and its vasculature.

If an abnormality is seen in the transverse view, the nerve should be examined in the longitudinal view.

The common peroneal nerve is the lateral terminal branch of the sciatic nerve. It supplies the motor innervation of the anterior and lateral compartments of the legs and the sensory innervation of the skin of the anterolateral aspect of the leg and of the dorsum of the foot. The two terminal branches of the common peroneal nerve are deep and superficial peroneal nerve. In the popliteal fossa, the common peroneal nerve runs obliquely passing along the medial border of biceps femoris muscle; then distally it lies between the tendon of the biceps femoris (medial) and the lateral head of the gastrocnemius muscle (lateral) until reaching the posterior surface of the head of the fibula and then passes over the peroneal head. Then the common peroneal nerve moves anteriorly perforating the lateral intermuscular septum and enters in a tunnel between the long peroneal muscle and the proximal metaphysis of the fibula, passing in the anterior compartment of the leg.

At this location, the common peroneal divides into two terminal branches: the superficial and deep peroneal nerves. In the popliteal fossa, the common peroneal nerve gives off articular branches and a small communicating branch, which, together with a reciprocal communicating branch from the tibial nerve, forms the sural nerve. The sural nerve supplies sensory innervation to the posterior and lateral surfaces of the distal third of the leg. The common peroneal nerve can be entrapped during its passage through the fibular tunnel or the biceps femoris tunnel or during its superficial course around the knee. This clinical condition can present as foot drop, due to the denervation of the anterior compartment of the leg.

The deep peroneal nerve runs inferiorly close to the fibular neck between

the long peroneal muscle and the bony surface of the fibula, on the anterior aspect of the interosseous membrane of the leg. At the level of the ankle joint it passes longitudinally through the anterior tarsal tunnel beneath the extensor retinaculum.

Approximately 1.5 cm above the ankle joint, in the dorsum of the foot, the deep peroneal nerve splits into a medial and a lateral branch.(Fig10)

The deep peroneal nerve supplies the muscles of the anterior compartment of the leg that allow dorsiflexion and inversion of the foot.

It supplies sensory innervation to the first web space and the adjacent sides of the first two toes and the tarsal and metatarsophalangeal joints of the middle three toes. It provides sensation to the ankle joint and the sinus tarsi.

Deep peroneal nerve palsy causes an inability to dorsiflex the ankle and loss of sensation in the first dorsal web space. The symptom is clinically described as "foot drop." Causes of compression or lesion of the deep peroneal nerve could be ganglion cyst, osteophytes from the talonavicular joint, subluxations or fractures, direct injury, an external pressure on the dorsum of the foot due to a long history of wearing shoes with tight laces, repeated extreme plantar flexion of the foot (e.g., in ballet dancers), and pes cavus.

The superficial peroneal nerve is the smaller of the two terminal branches of the common peroneal nerve. It supplies motor innervation to the lateral compartment of the leg, innervating the peroneus longus and brevis muscles which originate from the fibula. It also provides sensory innervation to the lateral compartment of the leg and dorsum of the foot.

The superficial peroneal nerve emerges at the bifurcation of the common peroneal nerve and runs between the peroneal muscles, supplying them with motor innervation. Initially it runs along the peroneus brevis muscle, under the peroneus longus. In the distal part of the leg, it runs underneath the fascia of the calf and descends between the peroneus muscles and the extensor digitorum longus. In the lower third of the leg, it pierces the deep fascia through a short fibrous tunnel, to enter the subcutaneous tissue. This exit point is located at the level of a defect in the crural fascia, typically located about 10 cm above the ankle joint.(Fig11)

More distally it divides into two cutaneous terminal branches: the medial dorsal cutaneous nerve and the intermediate dorsal cutaneous nerve, which supply the dorsal foot.

The Superficial peroneal nerve is the only nerve in the human body that can be visible in the dorsum of the ankle.

Depending on the location of the entrapment or lesion of superficial peroneal nerve, symptoms may vary:proximal location in the lateral compartment of the leg it causes weak ankle eversion and dorsiflexion due to affected innervation of the peroneus longus and

brevis muscles; at level of the crural fibrous tunnel, it causes pain in the anterolateral leg, hyposensation, or paresthesia over the dorsal foot, sparing the first web space.

Images for this section:

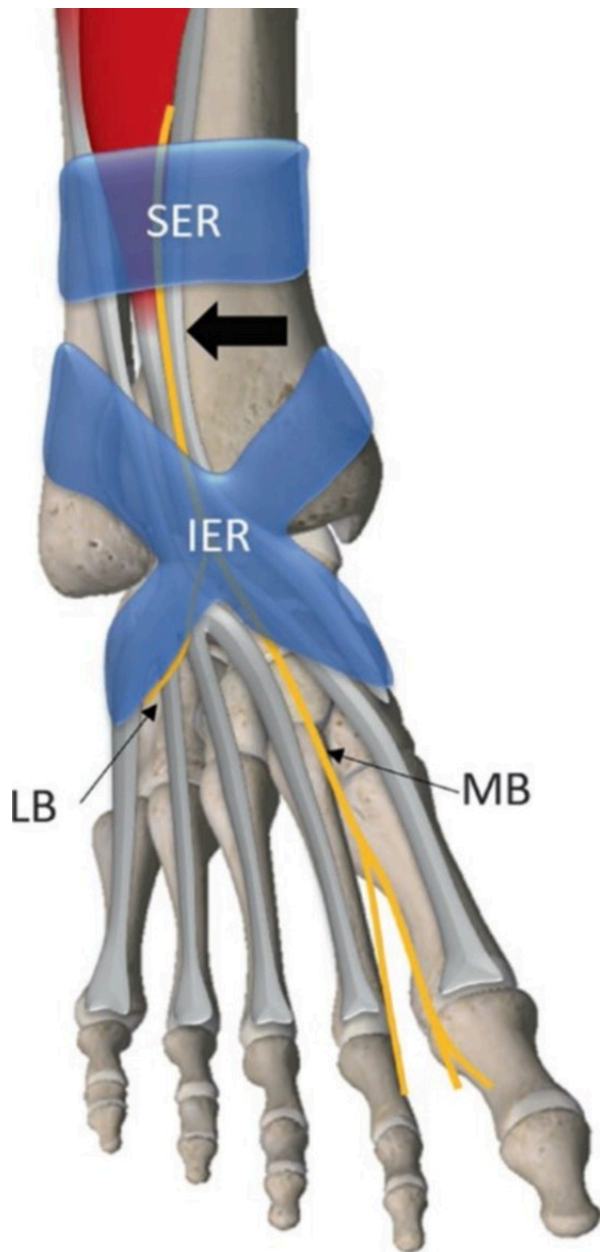


Fig. 10: Anatomical scheme at the level of the ankle, showing the deep peroneal nerve (black arrow) and its medial terminal branch (MB) and lateral terminal branch (LB) and its relationships with the superficial extensor retinaculum (SER) and inferior extensor retinaculum (IER)

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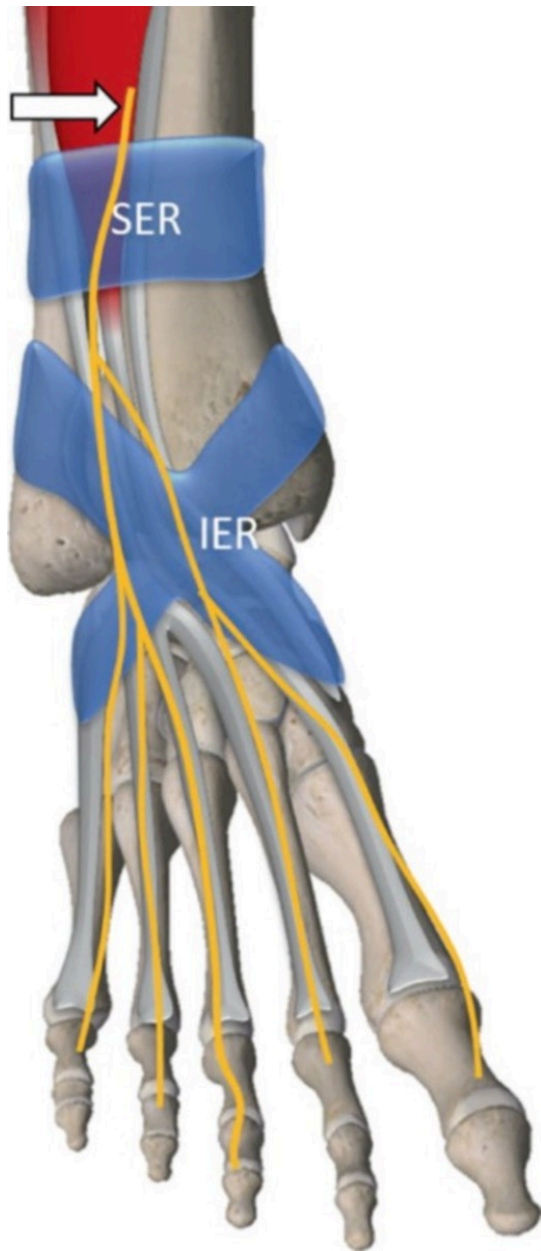


Fig. 11: Anatomical scheme at the level of the ankle, showing the superficial peroneal nerve (white arrow) and its relationships with the superficial extensor retinaculum (SER) and inferior extensor retinaculum (IER)

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Imaging findings OR Procedure Details

We will provide, for each of these structures, a dedicated US image compared with a detailed anatomic scheme, and a practical guide on "how we do" a US scan of common peroneal nerve, deep peroneal nerve and superficial peroneal nerve.

With the patient supine, for the study of common peroneal nerve, place the transducer in the transverse plane at the proximal popliteal fossa to visualize the distal part of the sciatic nerve, which branches into the common peroneal nerve laterally and the tibial nerve medially. (Fig2)

Follow the common peroneal nerve moving the probe along and lateral to the tendon of the biceps femoris. It passes between the biceps femoris and the lateral head of the gastrocnemius muscle and runs to the lateral aspect of the proximal third of the leg. (Fig3)

It then crosses the fibular head and passes under the proximal end of the peroneus longus. Move the probe in a transverse plane caudally until the nerve divides into the superficial and deep peroneal nerves. (Fig4)

Turn the probe by 90° to examine the nerve in a longitudinal axis to evaluate the internal echostructure.

For the study of deep peroneal nerve start the US exam placing the probe on a transverse plane on the anterolateral aspect of the proximal leg, at the level of the fibular head, where the deep peroneal nerve arises with the superficial peroneal nerve. It is very close to the fibula, under the peroneus longus muscle. Follow the nerve caudally in the leg.

The tibial artery is a very important landmark to identify the nerve course in the leg: in fact the neurovascular bundle runs superficial to the interosseous membrane and deep to the tibialis anterior, extensor digitorum longus, and extensor hallucis longus muscles. (Fig5)

In the distal third of the leg, proximal to the ankle joint, with the transducer placed in a transverse orientation at the level of the extensor retinaculum, the deep peroneal nerve crosses the anterior tibial artery from a medial to a lateral position. The nerve usually appears hyperechoic, lateral to the tibial artery, on the surface of the tibia. (Fig6)

At the level of the ankle, place the transducer at the anterior ankle joint in the transverse plane. The deep peroneal nerve is small and can be difficult to visualize: it lies, with the dorsalis pedis artery, lateral to the extensor hallucis longus tendon. (Fig7)

For the study of superficial peroneal nerve place the probe in a transverse plane on the anterolateral aspect of the proximal leg, at the level of the fibular head, where the superficial peroneal nerve merges. Follow the nerve until the proximal end of the peroneus brevis, where it passes between the fibula and the peroneus longus muscle. Distally it lies between the peroneus longus and brevis muscles. (Fig8)

At the level of the ankle, with the transducer placed on the anterior superior aspect of the lateral malleolus, the superficial peroneal nerve lies in a small groove between the extensor digitorum longus muscle anteriorly and peroneus brevis muscle posteriorly. Identify the tendon of the peroneus longus (not the muscle belly). Identify the hyperechoic structure that lies in the subcutaneous tissue immediately superficial to the fascia. (Fig9)

The nerve can then be followed more proximally, to the point where it pierces the fascia and enters the muscle. At this level the extensor hallucis longus muscle is an excellent landmark for identifying the superficial peroneal nerve, which is located in this intermuscular septum, just deep to the fascia.

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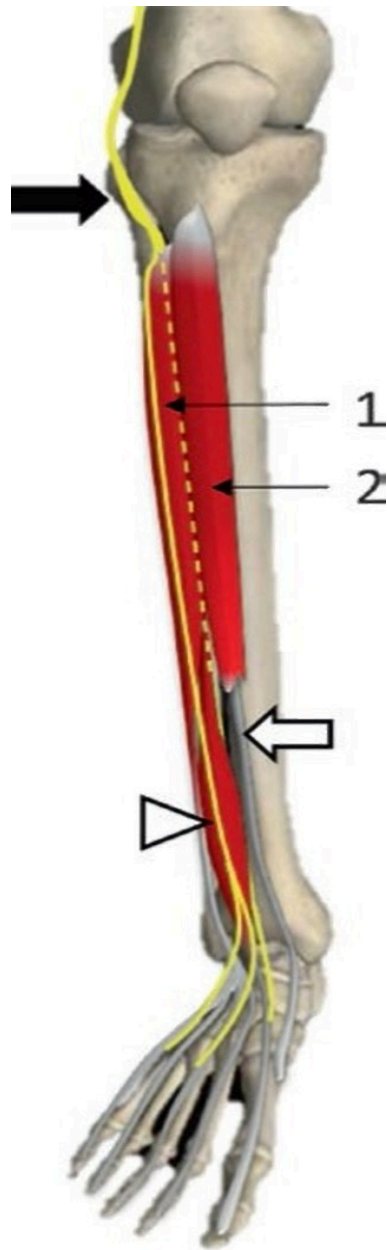


Fig. 1: Anatomical scheme of the peroneal nerve at the level of the leg. 1 peroneus longus muscle, 2 peroneus brevis muscle, Black Arrow common peroneal nerve, White Arrow deep peroneal nerve, Arrowhead superficial peroneal nerve

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Fig. 2: Probe position to evaluate the common peroneal nerve in the popliteal fossa and the corresponding ultrasound scan. Yellow circle tibial nerve, Light Blue Circle common peroneal nerve, A popliteal artery, V popliteal vein, F femur.

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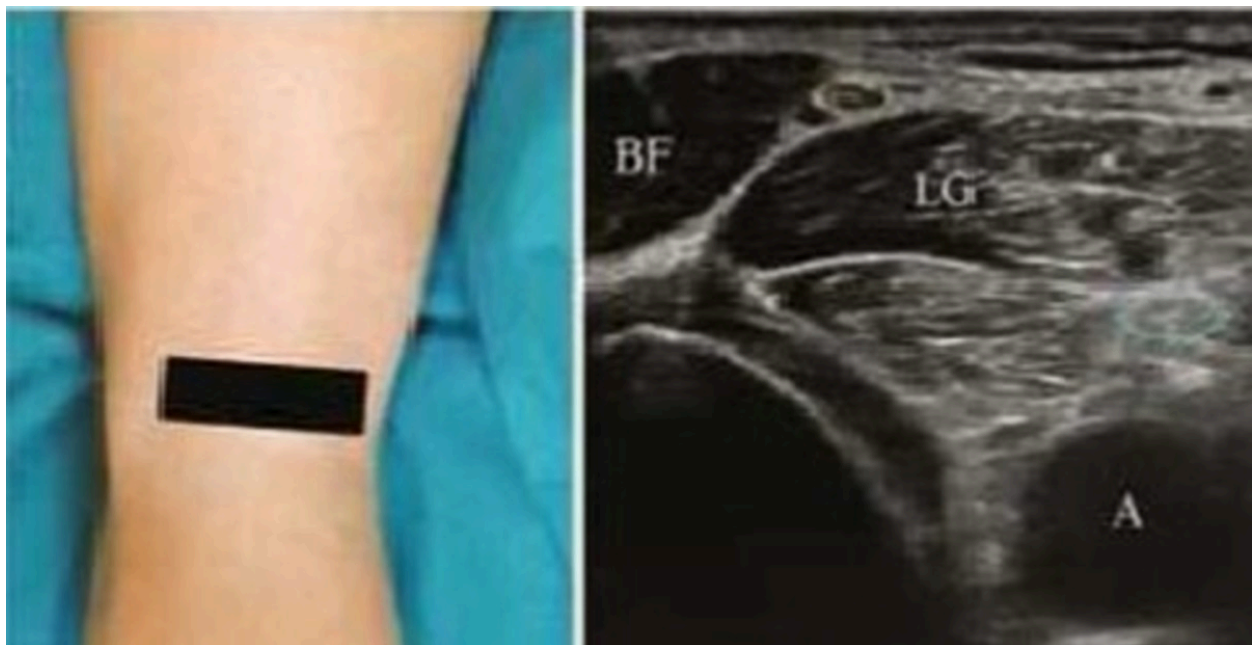


Fig. 3: Probe position to evaluate common peroneal nerve at the proximal third of posterior leg and the corresponding US scan. BF biceps femoris long head, LG gastrocnemius lateral head, A posterior tibial artery, Yellow Circle common peroneal nerve, Blue Circle tibial nerve.

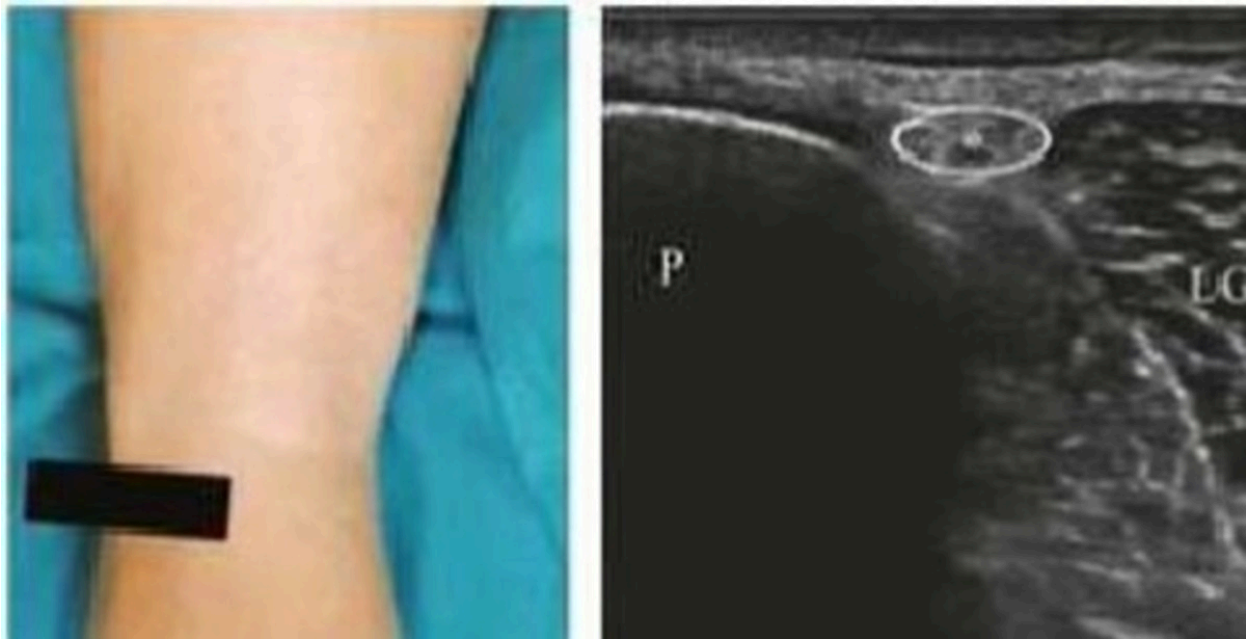


Fig. 4: Probe position to evaluate the common peroneal nerve at the level of peroneal head and the corresponding ultrasound scan.(asterisk) common peroneal nerve, LG gastrocnemius lateral head, P peroneal head



Fig. 5: Probe position to evaluate the deep peroneal nerve (asterisk) at the proximal third of the leg and the corresponding ultrasound scan. EDL extensor digitorum longus, PL peroneus longus, P peroneal bone

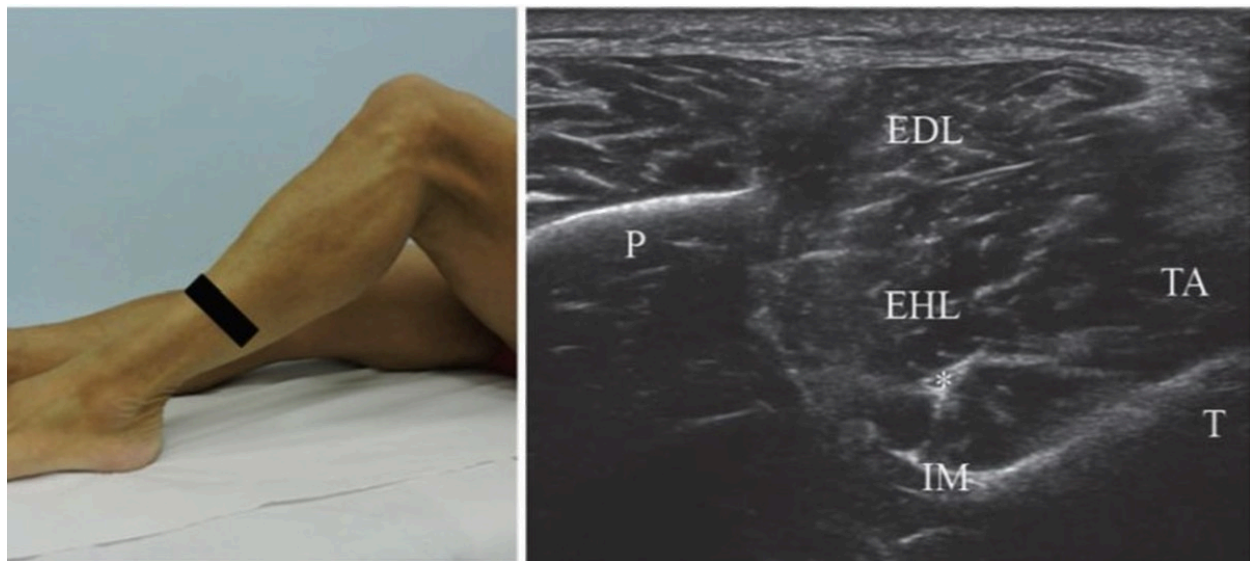


Fig. 6: Probe position to evaluate the deep peroneal nerve (asterisk) at the distal third of the leg and the corresponding ultrasound scan. P peroneal bone, EDL extensor digitorum longus, EHL extensor hallucis longus, TA tibialis anterior, IM interosseous membrane, T tibia

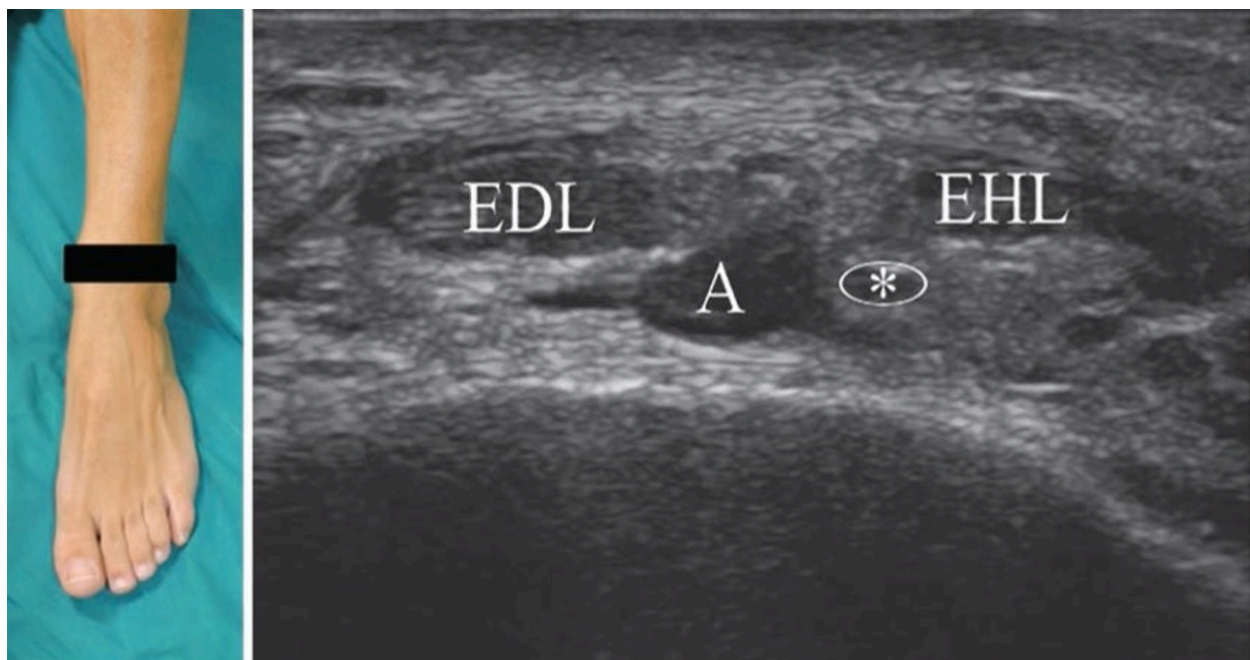


Fig. 7: Probe position to evaluate the deep peroneal nerve at the level of the ankle. Corresponding ultrasound scan of the deep peroneal nerve (asterisk). EDL extensor digitorum longus, EHL extensor hallucis longus, A anterior tibial artery

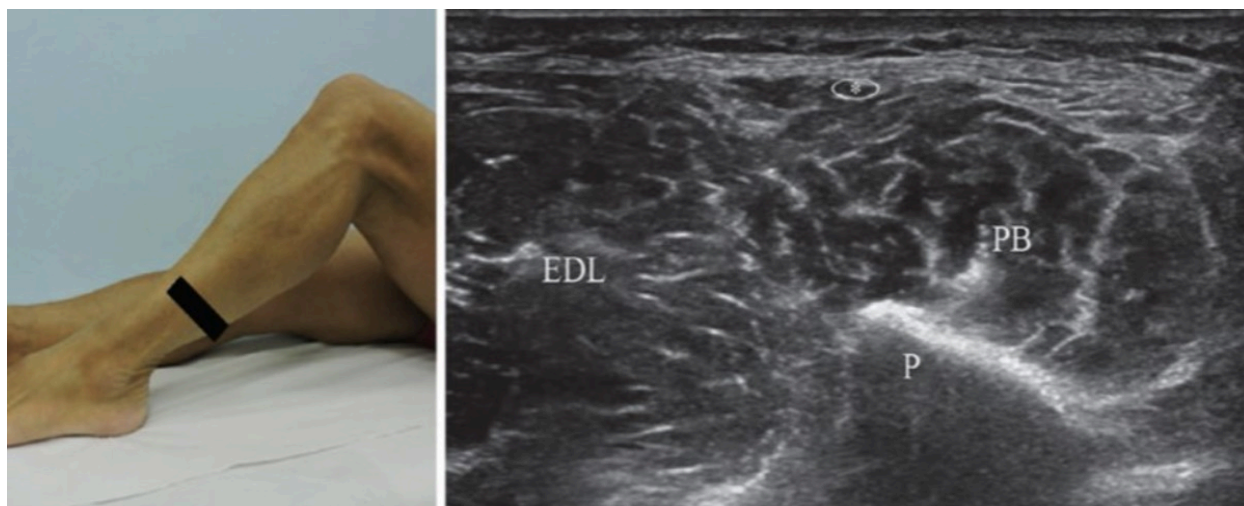


Fig. 8: Probe position to evaluate the superficial peroneal nerve (asterisk) at the middle third of the leg and the corresponding ultrasound scan. EDL extensor digitorum longus, PB peroneus brevis, P peroneal bone.

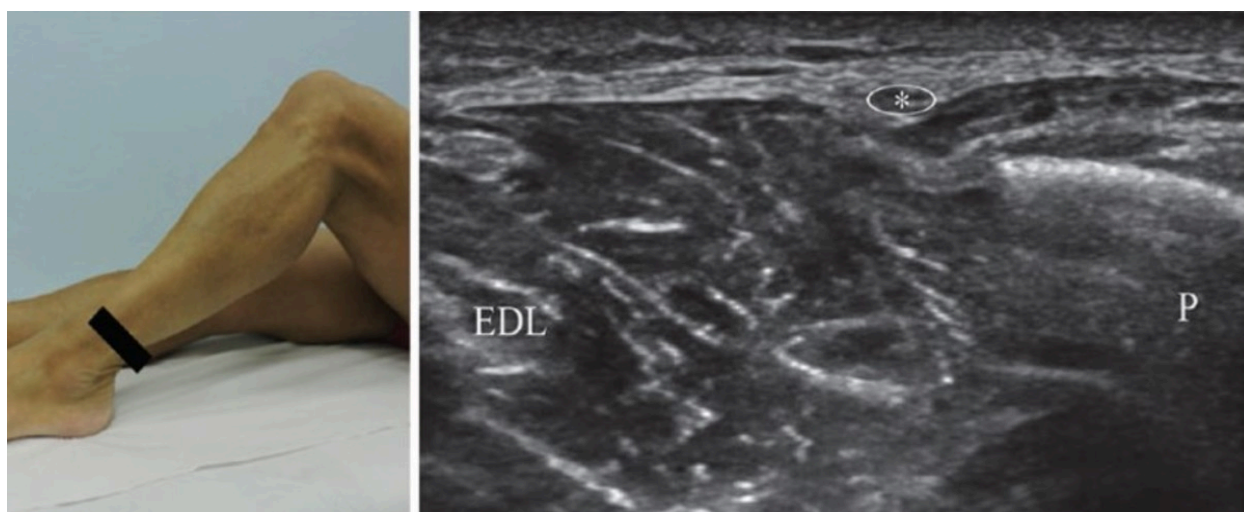


Fig. 9: Probe position to evaluate the superficial peroneal nerve (asterisk) at the distal third of the leg and the corresponding ultrasound scan. P peroneal bone, EDL extensor digitorum longus

Conclusion

US provides a quick, dynamic and real time images for the evaluation of peripheral nerve, with greater sensitivity than MRI.

In addition is very important the possibility to compare ultrasonography findings against the controlateral side. To carry out ultrasonography of peripheral nerve is essential to know the perfect anatomy of each nerve, paying attention to anatomic landmarks and common sites of injury.

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