

Knee Ultrasonography step by step

Poster No.: C-2809
Congress: ECR 2018
Type: Educational Exhibit
Authors: J. A. Torres de Abreu Macedo, N. Pereira da Silva, A. I. Aguiar, F. Alves, F. Caseiro Alves; Coimbra/PT
Keywords: Image verification, Technical aspects, Ultrasound, Musculoskeletal joint, Anatomy
DOI: 10.1594/ecr2018/C-2809

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org

Learning objectives

The purpose is to describe the knee scanning technique step by step, with didactic schemes, videos and illustrations and make a checklist protocol. The indications, normal anatomy and the most common pathology affecting this articulation will also be reviewed.

Background

Ultrasonography has become an important imaging modality for evaluating pathologic conditions of the knee, with the advantages of good spatial resolution, clinical correlation and dynamic assessment of disease, contralateral comparison and the ability to guide interventions.

The accuracy is dependent on the technique and the skill and experience of the individual performing the ultrasonography examination that must have a very good knowledge of knee anatomy and familiarity with normal imaging findings and imaging pitfalls. To reduce individual accuracy variability, it is usually recommended to follow a scanning protocol that includes a list of main structures.

Findings and procedure details

The evaluation of the knee articulation can be divided into four compartments that will be described step by step: anterior, lateral, medial and posterior.

Anterior knee:

Patient in supine, with a knee flexion of approximately 20°-30°.

The longitudinal US images obtained in the midline show the quadriceps tendon, which has an almost multilayered appearance that unites distally in a single tendon with patellar insertion.

Using the probe in an axial plane and moving it cranially, we can observe the myotendin junctions of the femoral quadriceps.

Fig. 1: Longitudinal scan plane for the quadriceps tendon.

References: - Coimbra/PT

Fig. 2: 1: Superficial layer (from rectus femoris); 2: Intermediate layer (from vastus lateralis and vastus medialis); 3: Deep layer (from vastus intermedius) *: Suprapatellar synovial recess; SP: Suprapatellar fat pad; PF: Prefemoral fat pad; F: Femur; P: Patella.

References: - Coimbra/PT

Suprapatellar and parapatellar joint recesses:

The suprapatellar fat pad is found deep to the distal third of the quadriceps tendon, cranially to the patella.

The prefemoral fat pad is a hyperechoic space that looks superficially to the femur.

The suprapatellar synovial recess is usually a thin hypoechoic S-shaped space. It lies deep in the quadriceps tendon and in the suprapatellar and superficial fat pad for prefemoral fat.

Femoral trochlea:

With full knee flexion, the femoral trochlea and the overlying articular cartilage are examined on axial planes. The quadriceps tendon is pushed anteriorly by the trochlea and assumes a curved course over it.

Fig. 4: Trochlea scan plane.

References: - Coimbra/PT

Fig. 5: *: Articular cartilage of the trochlea; QT: Quadriceps tendon; T: Trochlea.

References: - Coimbra/PT

Patellar retinacula and patellar medial articular facet:

Medial and lateral retinaculums are obtained by placing the probe transversally on each side of the patella. They are bilayerized structures that can't be discriminated from the underlying joint capsule.

The prepatellar bursa is located below the lower pole of the patella and the proximal portion of the patellar tendon. Under normal conditions, the bursa is not visible with the US.

Fig. 6: 1: Medial patellar retinaculum; P: Patella; T: Tibia.

References: - Coimbra/PT

Patellar tendon:

With patient in supine and knee flexion of approximately 20°-30°, we can examine the patellar tendon in longitudinal and transverse planes.

US images across the proximal patellar tendon should also be performed because tendinopathy may occur outside the midline.

The intracapsular Hoffa fat pad lies deep within the patellar tendon.

Fig. 9: Longitudinal scan plane for the patellar tendon.

References: - Coimbra/PT

Fig. 10: PT: Patellar tendon; T: Tibia; P: Patella.

References: - Coimbra/PT

Fig. 7: Transversal scan plane for the patellar tendon.

References: - Coimbra/PT

Fig. 8: PT: Patellar tendon; HFP: Hoffa fat pad.

References: - Coimbra/PT

Medial knee:

Medial collateral ligament and pes anserinus tendons:

To evaluate this compartment the patient has to rotate the leg externally while maintaining 20 ° -30 ° of knee flexion.

Place the probe obliquely oriented longitudinally to the medial collateral ligament. The entire length of this ligament should be evaluated. Dynamic scanning during valgus stress may improve the assessment of its integrity.

Check the immediately superficial soft tissues at the base of the medial meniscus.

Rotating the probe forward in the distal portion of the medial collateral ligament, we obtain an image of the tendons of the pes anserinus complex (sartorius, gracilis and semitendinosus) on its long axes.

Fig. 11: Medial knee joint scan plane.

References: - Coimbra/PT

Fig. 12: 1: Medial collateral ligament; *: Medial meniscus; F: Femur; T: Tibia.

References: - Coimbra/PT

Fig. 13: *: Pes anserinus complex.

References: - Coimbra/PT

Lateral knee:

Iliotibial band:

To evaluate this compartment the patient has to rotate the leg internally while maintaining 20 ° -30 ° of knee flexion.

The iliotibial band is located between the anterior and middle third of the lateral side of the knee and oriented along the major axis of the thigh.

Lateral collateral ligament:

Having the patient with the knee extended, place the lower edge of the probe into the peroneal head, and then rotate its upper lip anteriorly until the lateral collateral ligament appears so elongated.

Deep to the proximal portion of the lateral collateral ligament, we can see the popliteal tendon in its bony furrow.

With the probe positioned transversely, we can evaluate the relationship of the lateral collateral ligament with the tendon of the femoral biceps.

The superior tibiofibular joint should be observed through transverse and longitudinal images on the anterior face of the fibula head.

Fig. 14: Lateral knee joint scan plane.

References: - Coimbra/PT

Fig. 15: *: Lateral collateral ligament; 1: Popliteal tendon; F: Femur; T: Tibia.

References: - Coimbra/PT

Fig. 16: Star: Posterior biceps femoris tendon.

References: - Coimbra/PT

Posterior knee:

Medial tendons:

For evaluation of the posterior knee, the patient is placed in a prone position with the leg extended.

Obtaining transverse images of the posteromedial region of the knee, we can observe the muscle fibers of the sartorius, the tendon of the gracilis and the tendon of the semitendinosus that is located behind the semimembranosus tendon.

Fig. 17: Medial tendons scan plane.

References: - Coimbra/PT

Fig. 19: *: Tendon of the medial head of gastrocnemius; FC: Medial femoral condyle; G: Medial head of gastrocnemius; Star: Semimembranosus tendon; S: Semitendinosus tendon.

References: - Coimbra/PT

Popliteal neurovascular bundle:

In the popliteal fossa, making a transversal scan, we can observe the popliteal neurovascular bundle - popliteal artery (deep), the popliteal vein (in intermediate position) and the tibial nerve (superficially).

For a better evaluation of the popliteal vein one can do a slight knee flexion, which leads to the filling of the popliteal vein and its better detection.

Deeply, in the intercondylar fossa, we observe the mid-distal portion of the posterior cruciate ligament using sagittal oblique planes.

Fig. 20: Popliteal fossa scan plane.

References: - Coimbra/PT

Fig. 21: Star: Popliteal artery; *: Popliteal vein; 1: Tibial nerve; LG: Lateral head of gastrocnemius; MG: Medial head of gastrocnemius.

References: - Coimbra/PT

Posterolateral corner and biceps femoris:

Placing the probe in the posterolateral region of the knee, we can evaluate the muscle and tendon of the biceps femoris, as well as the myotendinous junction, in transverse and longitudinal planes.

Peroneal nerve:

From the posteromedial region of the knee, slide the probe along the tibial nerve to the origin of the common peroneal nerve from the sciatic nerve. Follow the common peroneal nerve along the lateral region of the popliteal space until reaching the fibular head and neck.

The peroneal nerve is found posteriorly to the biceps femoris.

Images for this section:



Fig. 1: Longitudinal scan plane for the quadriceps tendon.

© - Coimbra/PT

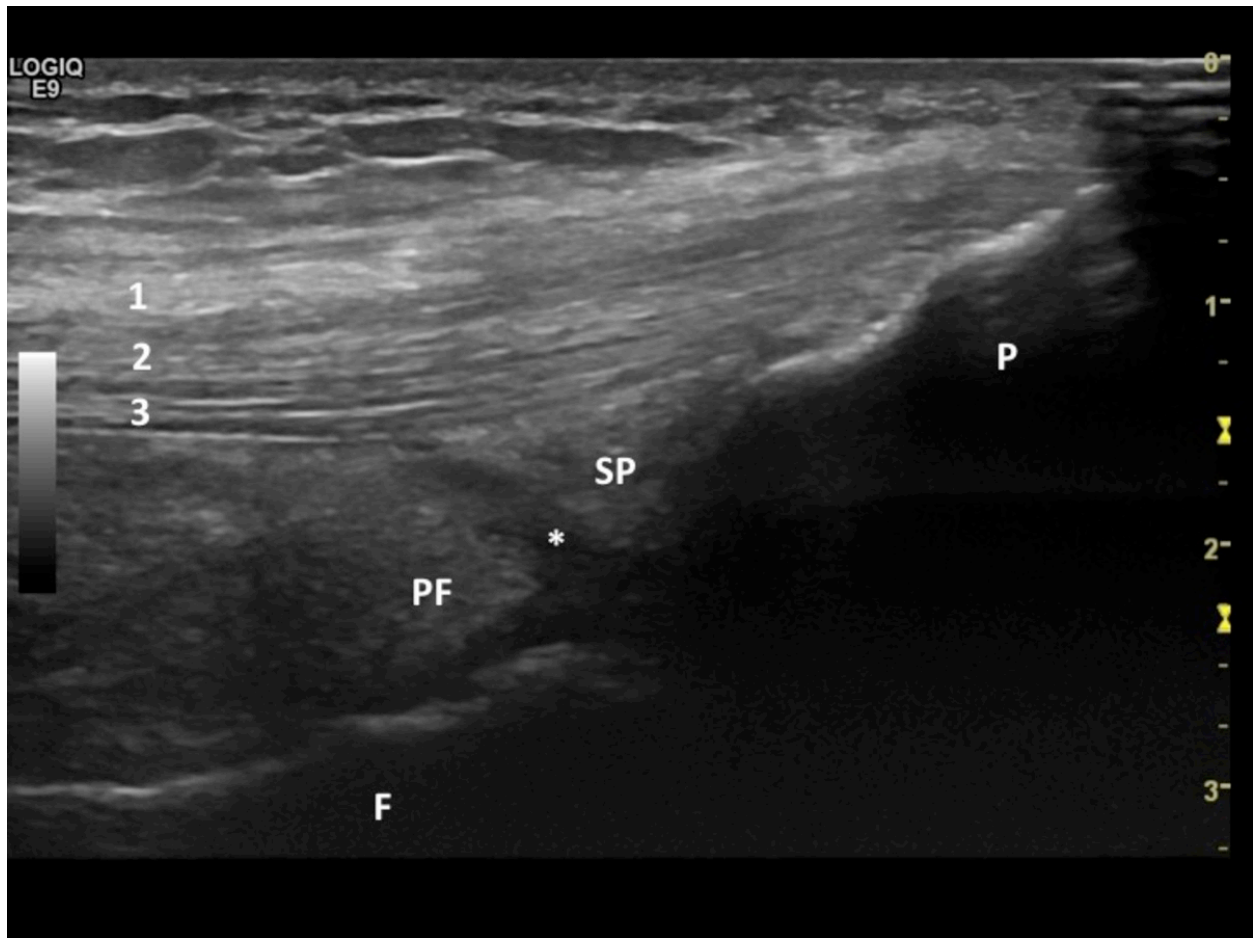


Fig. 2: 1: Superficial layer (from rectus femoris); 2: Intermediate layer (from vastus lateralis and vastus medialis); 3: Deep layer (from vastus intermedius) *: Suprapatellar synovial recess; SP: Suprapatellar fat pad; PF: Prefemoral fat pad; F: Femur; P: Patella.

© - Coimbra/PT

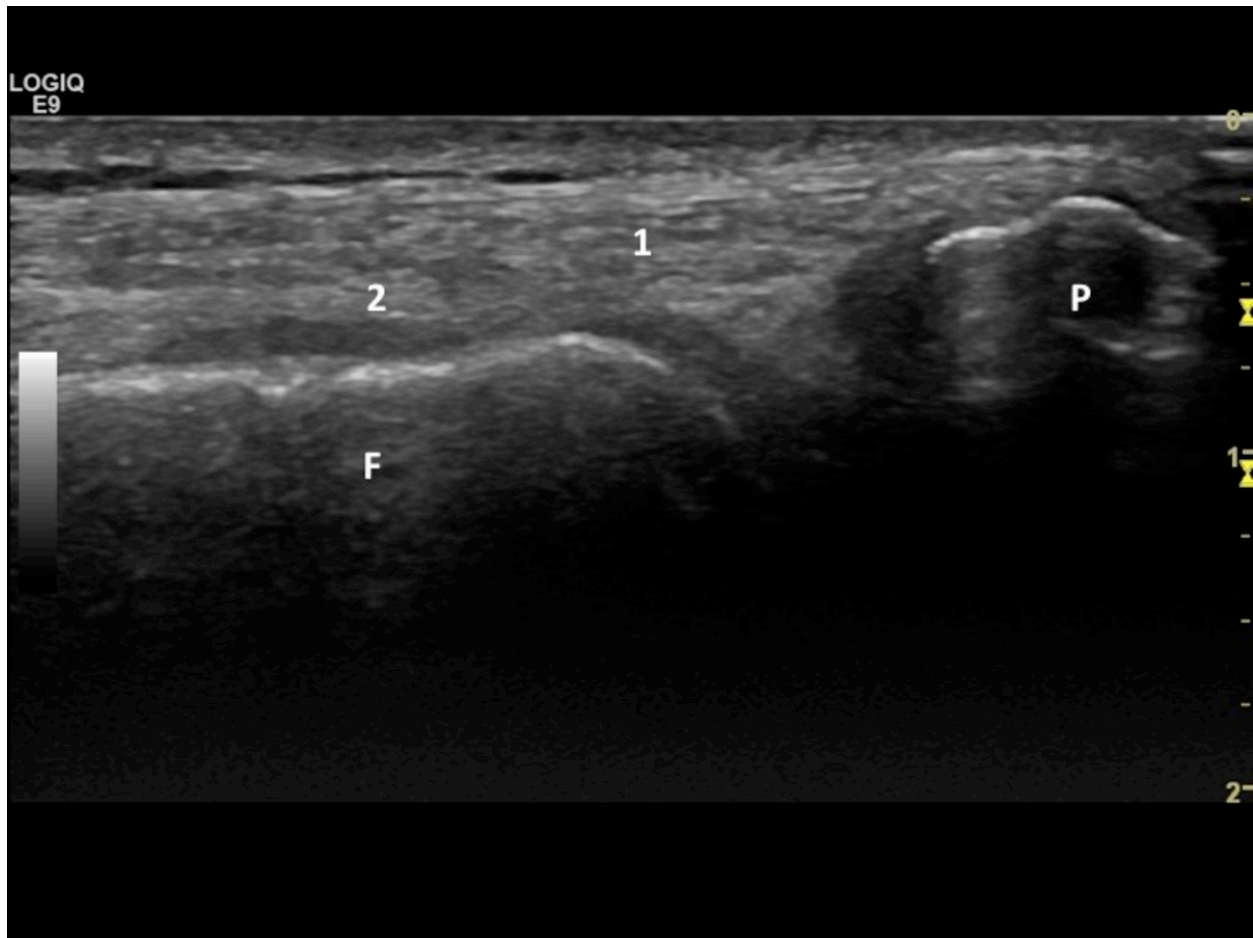


Fig. 3: 1: Lateral parapatellar recess; 2: Lateral patellar retinaculum; F: Femur; P: Patella.

© - Coimbra/PT



Fig. 4: Trochlea scan plane.

© - Coimbra/PT

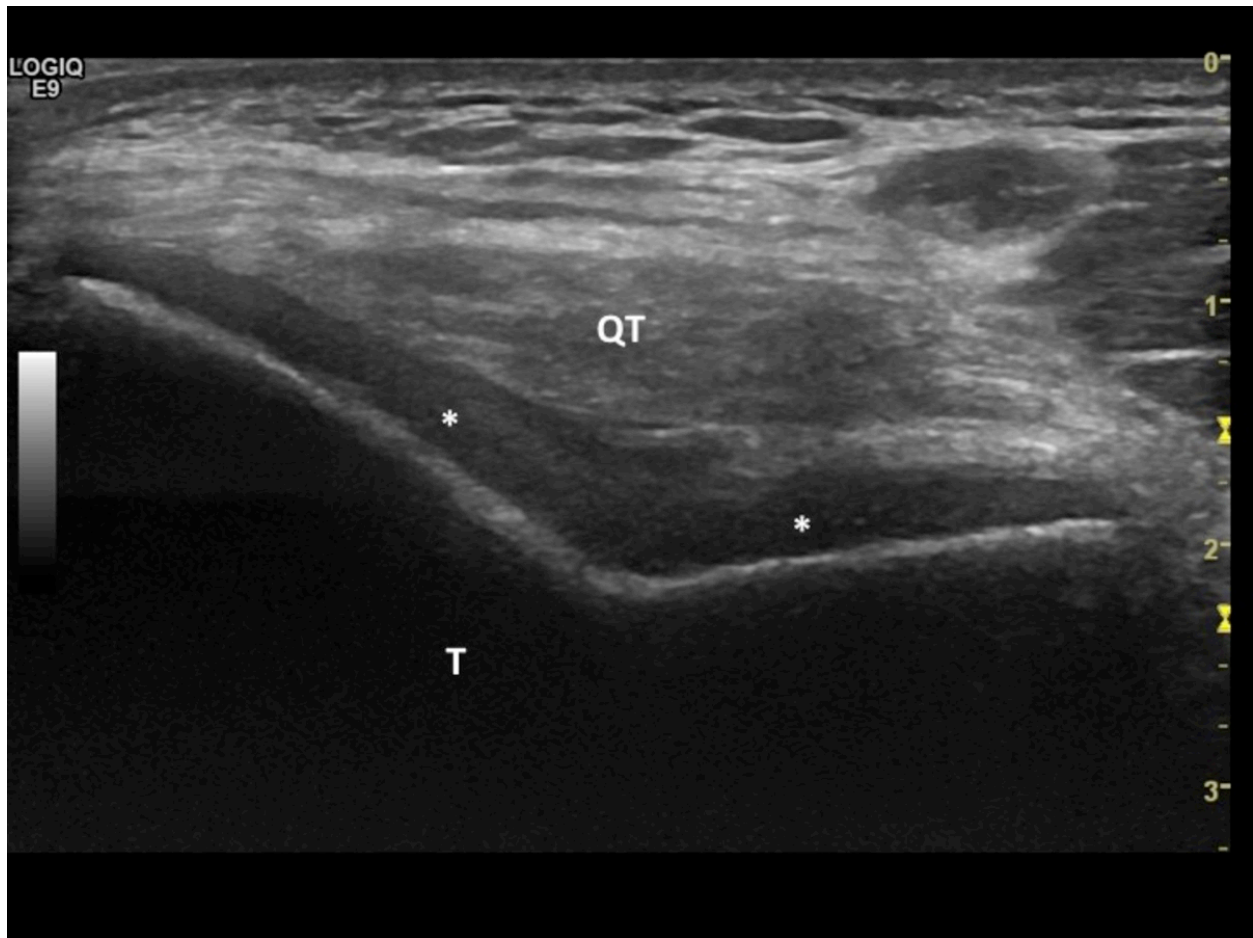


Fig. 5: *: Articular cartilage of the trochlea; QT: Quadriceps tendon; T: Trochlea.

© - Coimbra/PT

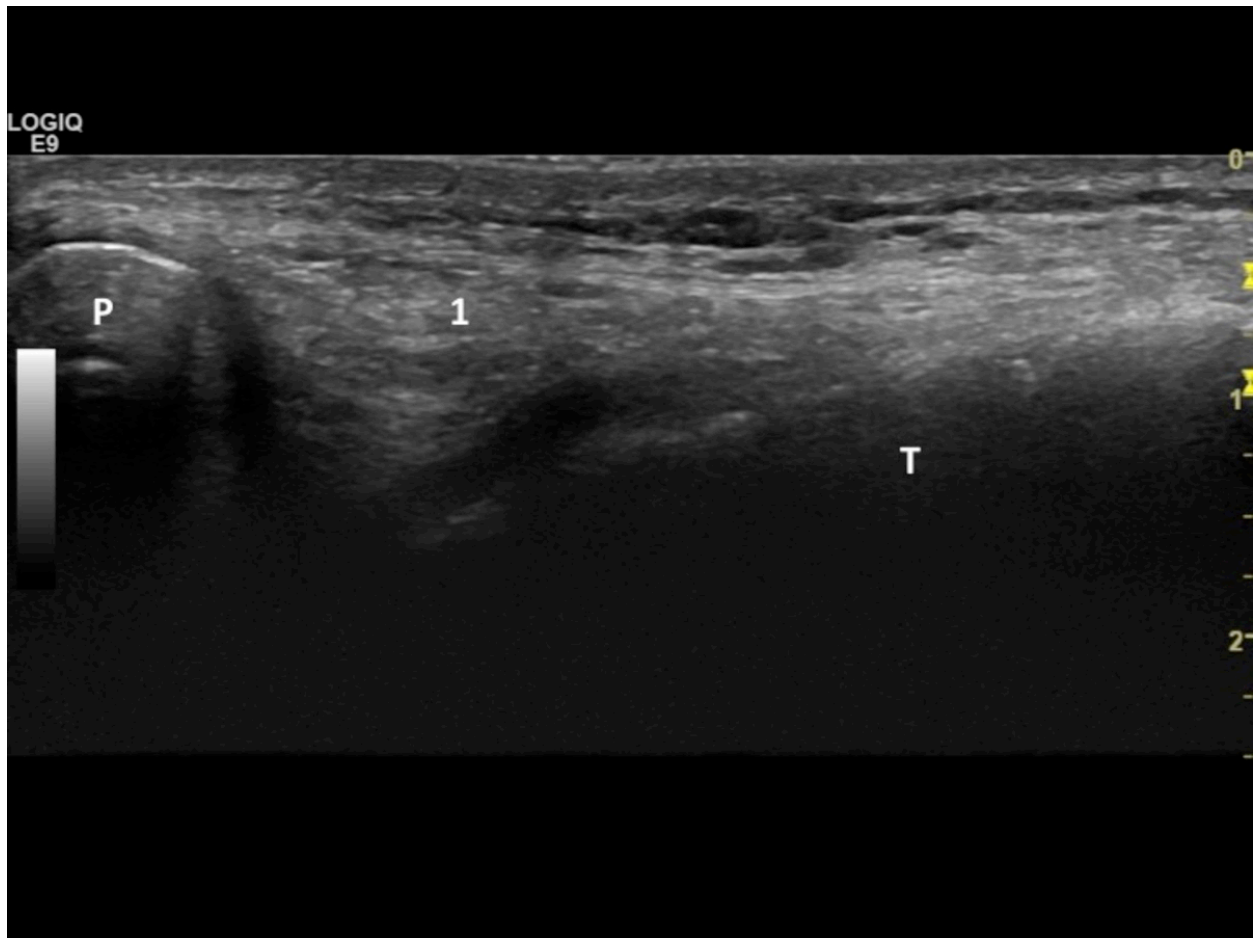


Fig. 6: 1: Medial patellar retinaculum; P: Patella; T: Tibia.

© - Coimbra/PT



Fig. 7: Transversal scan plane for the patellar tendon.

© - Coimbra/PT

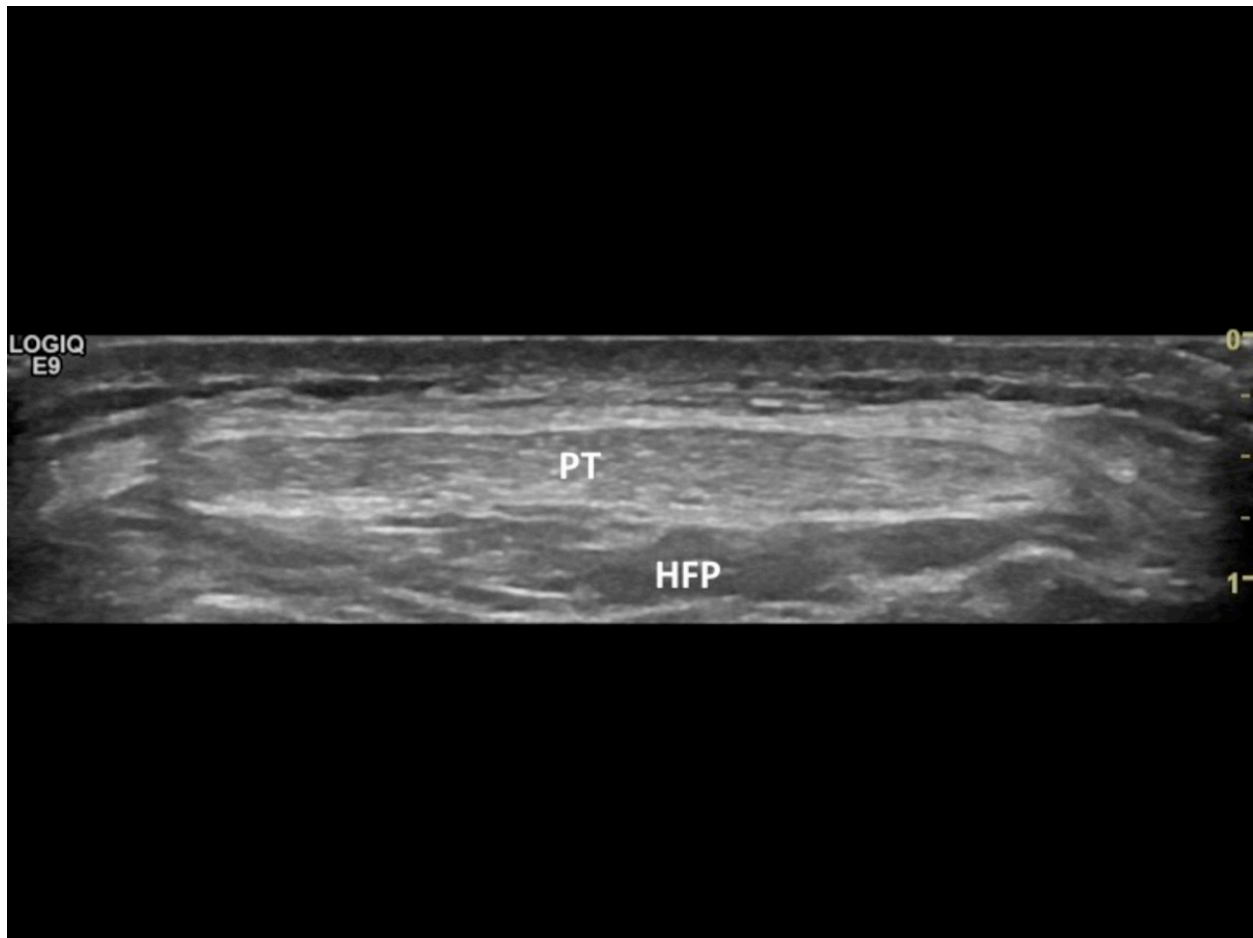


Fig. 8: PT: Patellar tendon; HFP: Hoffa fat pad.

© - Coimbra/PT



Fig. 9: Longitudinal scan plane for the patellar tendon.

© - Coimbra/PT

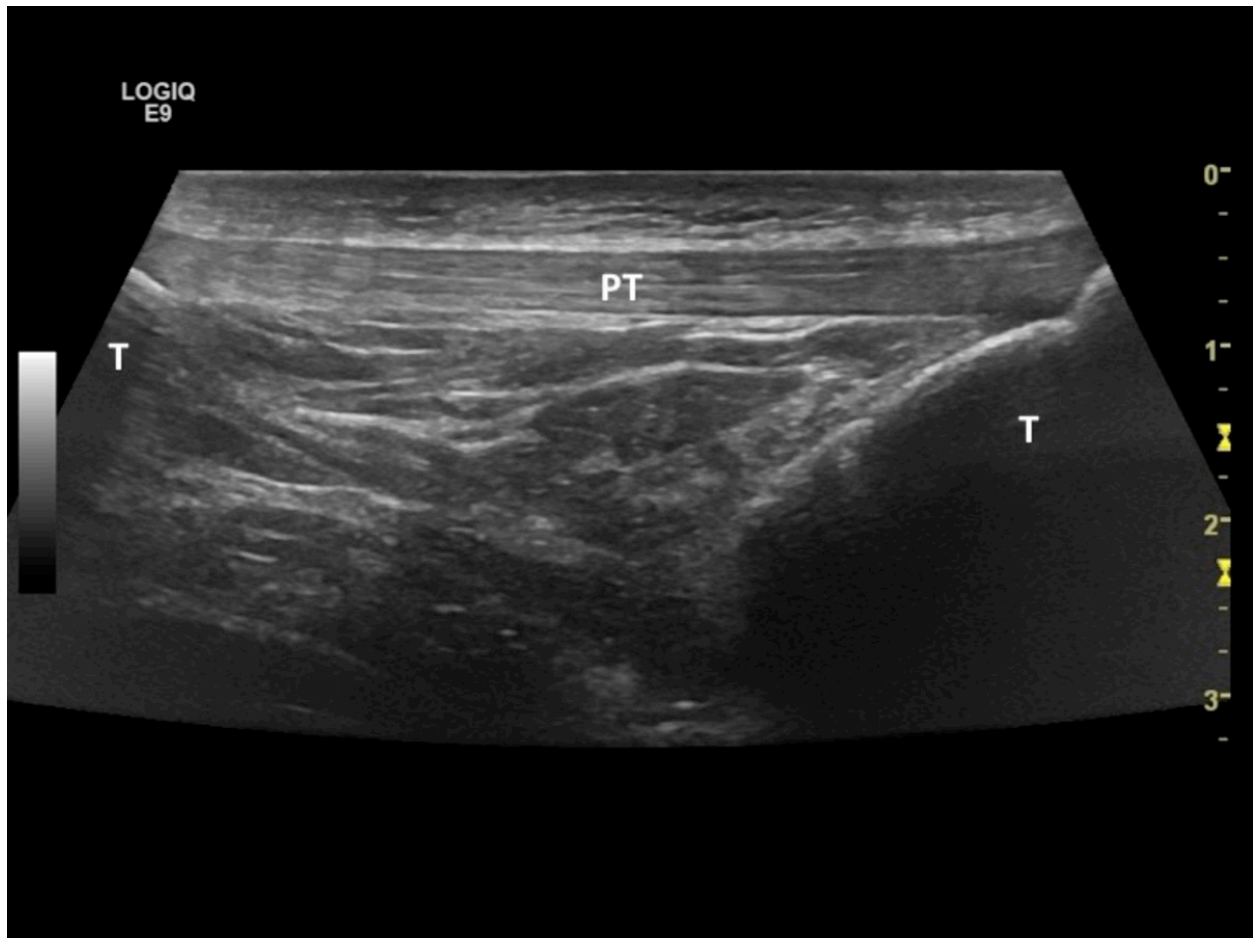


Fig. 10: PT: Patellar tendon; T: Tibia; P: Patella.

© - Coimbra/PT



Fig. 11: Medial knee joint scan plane.

© - Coimbra/PT

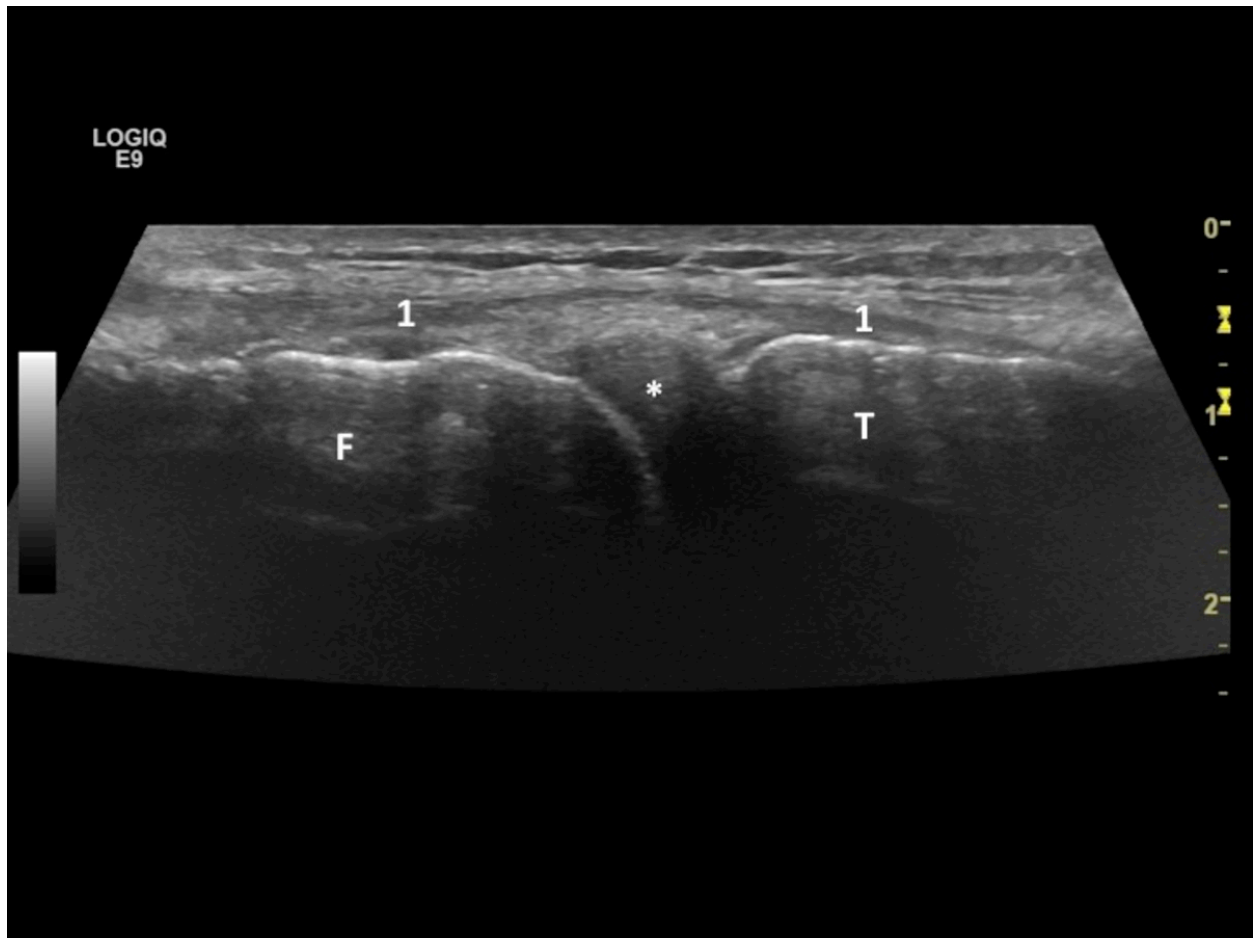


Fig. 12: 1: Medial collateral ligament; *: Medial meniscus; F: Femur; T: Tibia.

© - Coimbra/PT

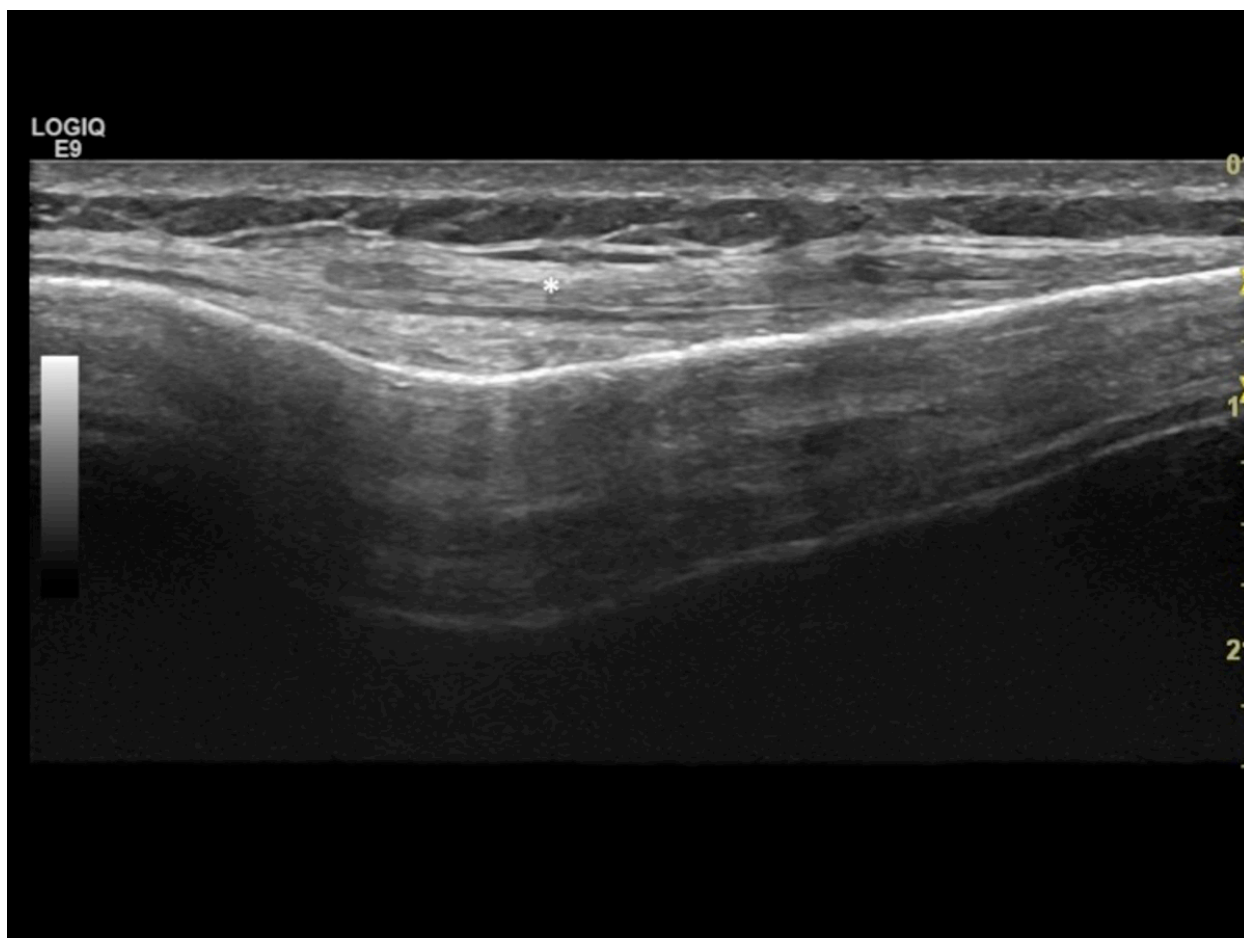


Fig. 13: *: Pes anserius complex.

© - Coimbra/PT



Fig. 14: Lateral knee joint scan plane.

© - Coimbra/PT

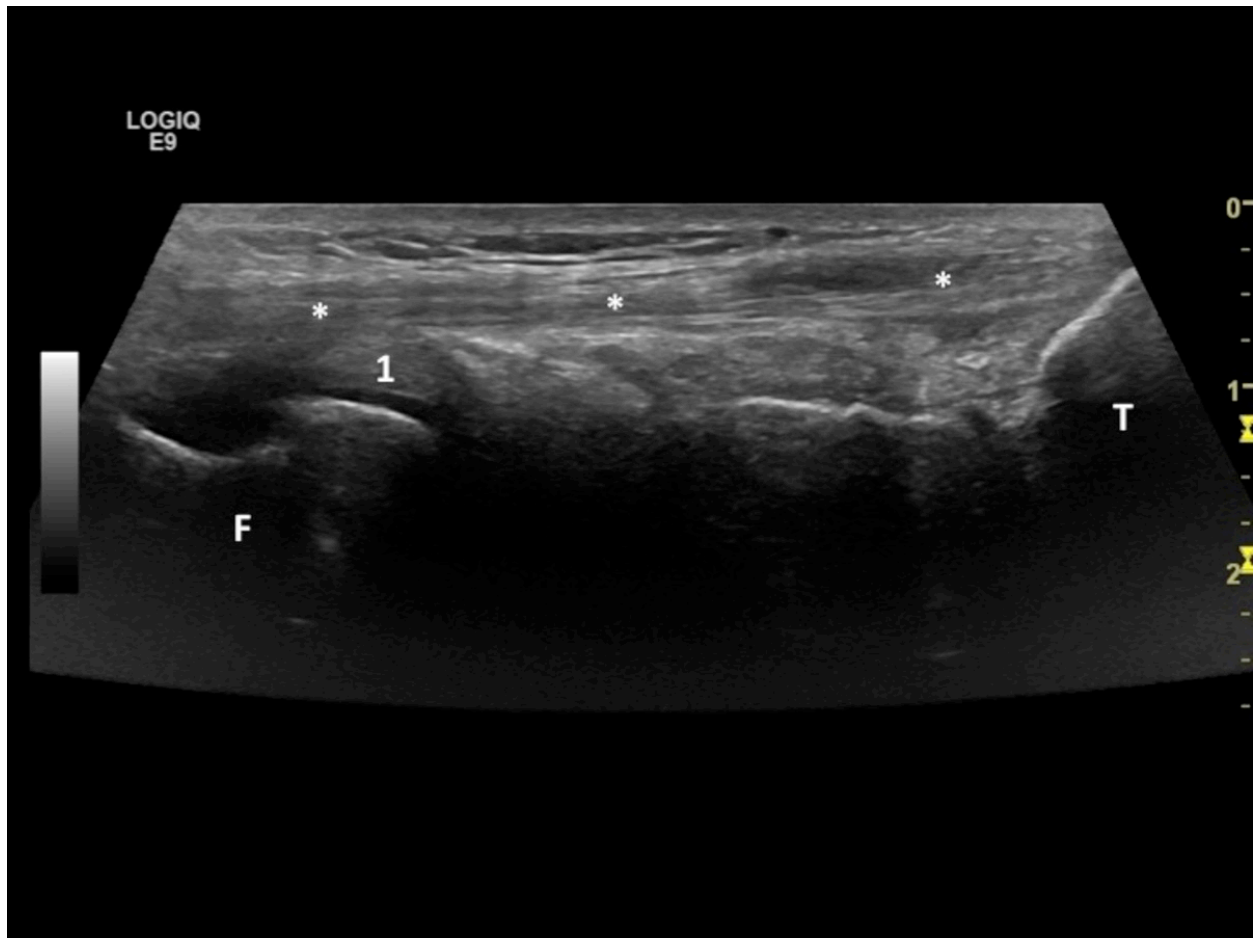


Fig. 15: *: Lateral collateral ligament; 1: Popliteal tendon; F: Femur; T: Tibia.

© - Coimbra/PT

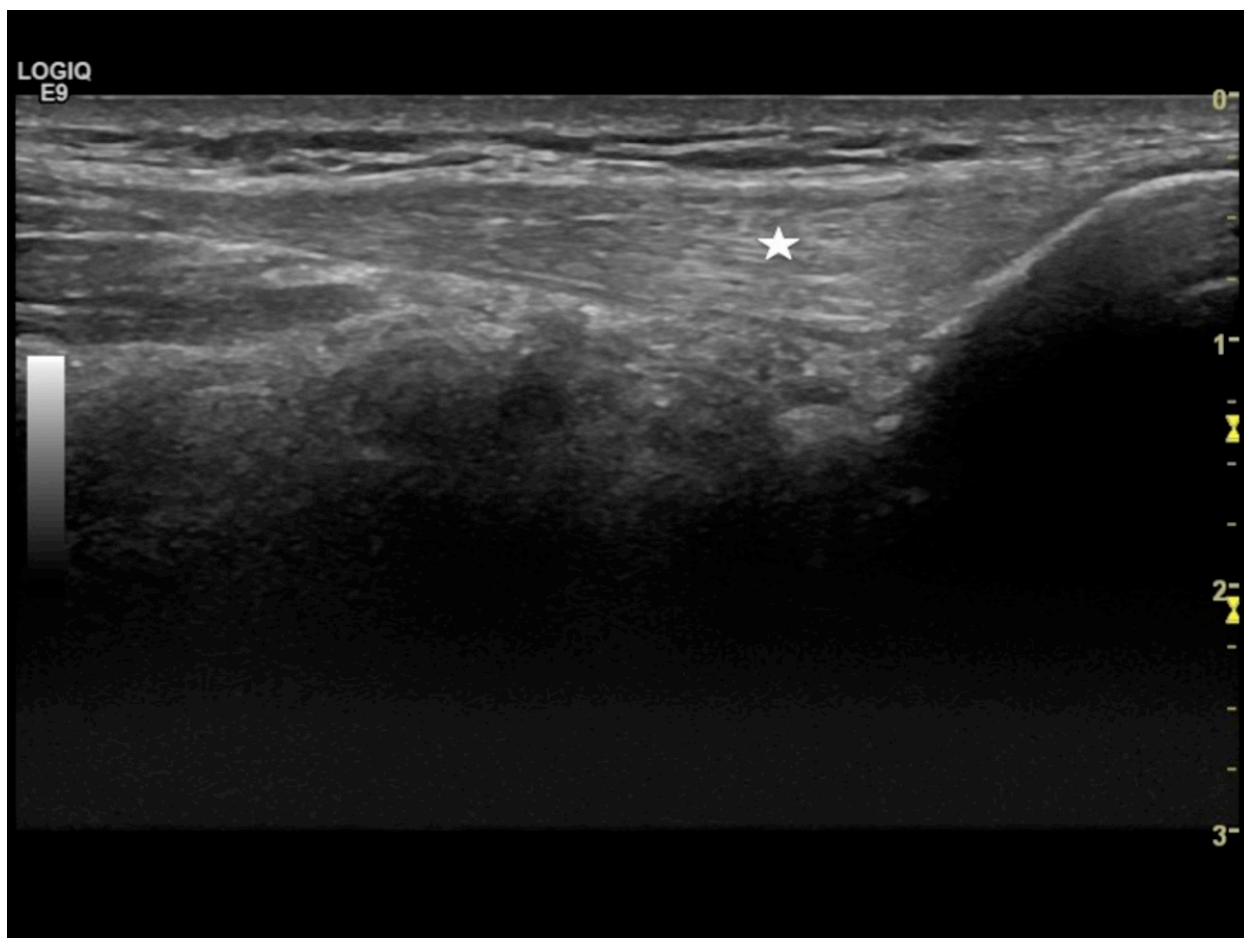


Fig. 16: Star: Posterior biceps femoris tendon.

© - Coimbra/PT



Fig. 17: Medial tendons scan plane.

© - Coimbra/PT

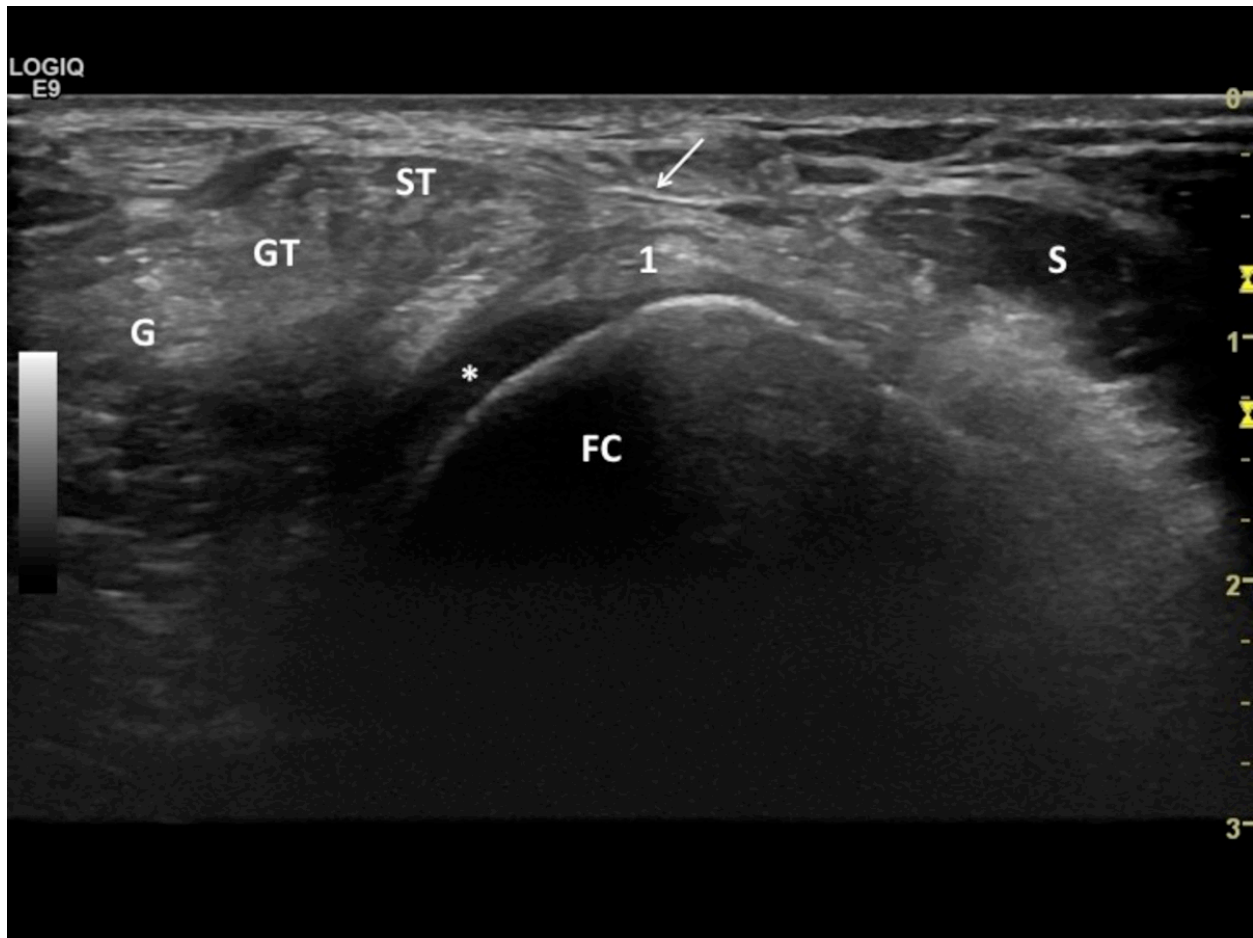


Fig. 18: *: Articular cartilage of the medial femoral condyle; ST: Semitendinosus tendon; Arrow: Saphenous nerve; FC: Medial femoral condyle; G: Medial head of gastrocnemius; S: Sartorius muscle; 1: Gracilis tendon; GT: Tendon of the medial head of gastrocnemius.

© - Coimbra/PT

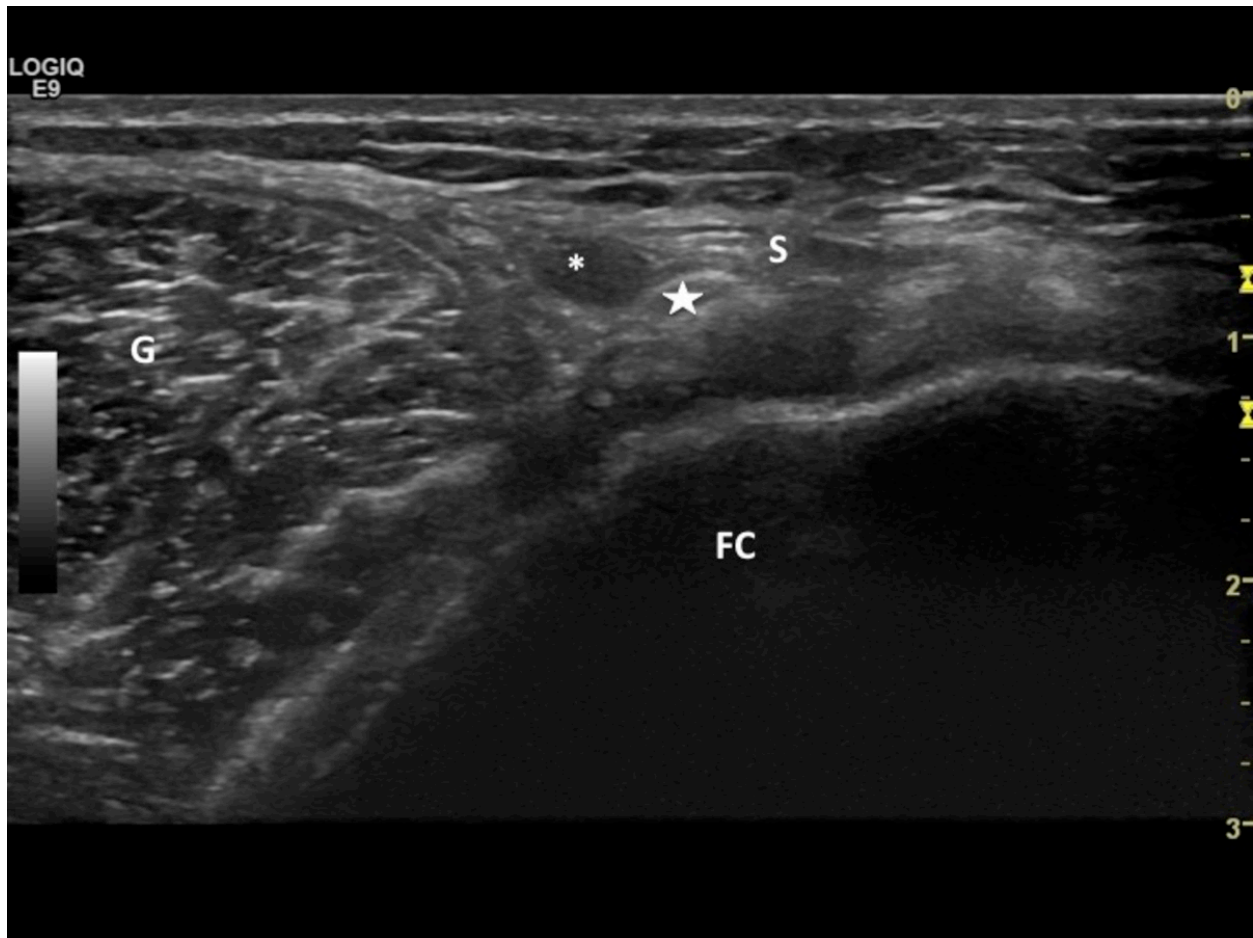


Fig. 19: *: Tendon of the medial head of gastrocnemius; FC: Medial femoral condyle; G: Medial head of gastrocnemius; Star: Semimembranosus tendon; S: Semitendinosus tendon.

© - Coimbra/PT



Fig. 20: Popliteal fossa scan plane.

© - Coimbra/PT

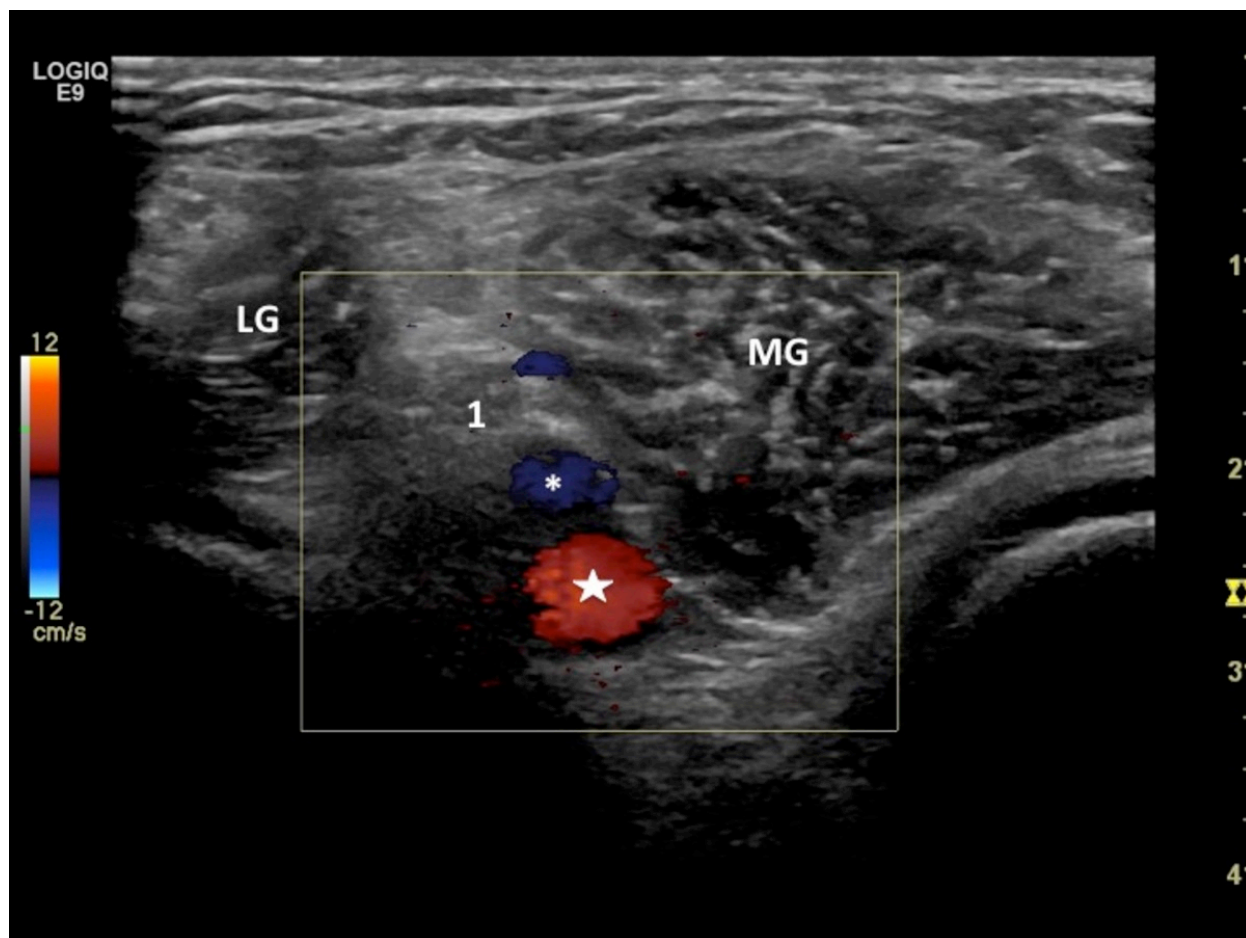


Fig. 21: Star: Popliteal artery; *: Popliteal vein; 1: Tibial nerve; LG: Lateral head of gastrocnemius; MG: Medial head of gastrocnemius.

© - Coimbra/PT

Conclusion

Knee ultrasonography is an excellent diagnostic imaging modality for a large spectrum of diseases that affect this articulation. It is, nevertheless, essential to have a thorough understanding of the anatomy and to perform ultrasonography of the shoulder on a regular basis and in a standardized way.

Personal information

References

Ian Beggs, UK; #Stefano Bianchi, Switzerland#; Angel Bueno, Spain#; Michel Cohen, France#; Michel Court-Payen, Denmark; Andrew Grainger, UK; #Franz Kainberger, Austria#; Andrea Klauser, Austria; #Carlo Martinoli, Italy#; Eugene McNally, UK#; Philip J. O'Connor, UK#; Philippe Peetrons, Belgium#; Monique Reijnierse, The Netherlands; Philipp Rempik, Germany#; Enzo Silvestri, Italy; Musculoskeletal Ultrasound Technical Guidelines - V. Knee; European Society of Musculoskeletal Radiology.

Timothy I. Alves, MD Gandikota Girish, MBBS Monica Kalume Brigido, MD Jon A. Jacobson, MD; US of the Knee: Scanning Techniques, Pitfalls, and Pathologic Conditions; Radiographics 2016; Volume 36; 1759 - 1775.