Peroneal Tendons: Normal Variants and Diseases

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Authors: B. Ruiz¹, I. Corta², F. Diez Renovales¹, G. Iecumberri¹, N. Nates Uribe¹, D. Grande¹, ¹Bilbao/ES, ²Vitoria/ES
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Learning objectives

Know the anatomy and anatomic variants of the peroneal tendons.

Become familiar with the most common pathology.

Background

To be able to diagnose disorders that are frequent in patients with lateral ankle pain is necessary to know not only the anatomy, anatomic variants and pathology but the most useful diagnostic tools.

Ultrasound and magnetic resonance imaging (MRI) are useful diagnostic tools for both, diagnosis and preoperative study.

**Ultrasound** is more profitable economically, has a high spatial resolution with the possibility of a dynamic real-time examination and does not require the administration of contrast. It also allows directing and watching the needle for interventional procedures with higher success than palpation-guided puncture.

However **MRI** is the best tool to characterize joint damage and bone edema.

**Conventional radiology** and **computed tomography (CT)** are used to assess accessory ossicles and bony pathology that would compromise tendons pathway.

Fig. 1 on page 2

Images for this section:
**Fig. 1:** Most useful diagnostic tools for the diagnosis of peroneal tendon pathology.
ANATOMY:

The lateral compartment of the leg is formed by peroneal muscles.

The **peroneus brevis** muscle arises from the distal two-thirds of the lateral fibula and the adjacent intermuscular septa and inserts onto the tuberosity on the lateral aspect of the proximal fifth metatarsal bone.

The **peroneus longus** muscle originates from the lateral condyle of the tibia, the head and proximal two thirds of the lateral fibula, the intermuscular septa, and adjacent fascia, and inserts onto the plantar surface of the first cuneiform bone laterally and the proximal first metatarsal bone.

Myotendinous junction of both muscles is located at different levels; the peroneus brevis one is lower than the longus one.

Their primary function is plantar flexion and eversion of the foot at the ankle. In addition, the peroneal tendons are important stabilizers of the lateral aspect of ankle joint.

**Fig. 2** on page 14

The peroneal tendons share a common peroneal synovial sheath, with small amount of synovial fluid, descend down the lateral leg passing through the so called retromalleolar groove, a fibro-osseous tunnel posterior to the lateral malleolus. This synovial sheath is divided in to parts at the level of the peroneal tubercle.

The peroneus brevis tendon is usually located anteromedial to the peroneus longus thanks to a bone groove in the distal fibula.

The **Superior Peroneal Retinaculum (SPR)** and the calcaneofibular ligament are the main stabilizers of the tendons at the level of the retromalleolar groove. Inferiorly, this role is played by the **Inferior Peroneal retinaculum**.

**Fig. 3** on page 15
ANATOMIC VARIANTS

1) *Enlarged peroneal tubercle:*

Usually two protuberances may be seen along the lateral aspect of the calcaneus: the peroneal tubercle and the retrotrochlear eminence.

The peroneal tubercle separates the peroneus brevis tendon from the peroneus longus tendon and is present in 40% of individuals.

A hypertrophied peroneal tubercle (more than 5 mm height) may irritate the peroneus longus tendon sheath, leading to tenosynovitis and tear. An adventitial bursa can also develop over the peroneal tubercle due to persistent local friction and may be symptomatic when inflamed.

The retrotrochlear eminence is seen in 98% of individuals and is located posterior to the peroneal tubercle and the peroneal tendons. Hypertrophy of the retrotrochlear eminence is often associated with the presence of an accessory peroneus quartus muscle.

Fig. 4 on page 16

2) *Os peroneum:*

It is an accessory sesamoid bone within the distal portion of the peroneus longus tendon usually at or just above the calcaneo-cuboid joint. When ossified, it is visible on 20% of foot radiographs.

Fig. 5 on page 17

3) *Accessory Peroneus Quartus muscle:*

The accessory peroneal muscles are a group of muscles located in the anterior and lateral aspect of the leg with variable origins and insertion sites.

The peroneus quartus muscle is the most prevalent (12 to 22%) accessory muscle in the ankle. Usually originates at the intramuscular portion of the peroneus brevis tendon, distal third of the leg, and descends medial and posterior to the peroneal tendons. Its distal insertion is variable and includes retrotrochlear eminence of the calcaneus, the base of the fifth metatarsal bone, the peroneal tendons, the lateral retinaculum and the cuboid bone. The appearance of the myotendinous joint is also very variable.

It is often asymptomatic but can cause peroneus brevis tenosynovitis, dislocation and tear due to friction in the retromalleolar groove secondary to crowding structures.
Typically it is represented as a separate myotendinous structure adjacent to peroneal tendons by a fatty plane and a distal insertion in retrotrochlear eminence.

4) Low-lying Peroneus Brevis Muscle Belly

It is a very common anatomic variant. It is an abnormal extension of the muscle tissue of peroneus brevis distal to the fibular groove. It may be responsible for abnormal retromalleolar groove occupancy predisposing to superior peroneal retinaculum distention and peroneal tendon disease (peroneus brevis longitudinal tears, tenosynovitis and dislocation).

However, the level of the myotendinous junction may be affected by the foot position, so it is important to ensure that it is actually an anatomical variant and is not secondary to a forced dorsiflexion of the ankle.

Fig. 6 on page 18

5) Morphological variations in the retromalleolar fibular groove:

In 82% of individuals a concave and smooth retromalleolar groove is found. However it can be flat (11 %) or even convex (7%), predisposing to increased risk of dislocations and longitudinal tears, especially if an irregular contour is associated.

Fig. 7 on page 19

DISEASE

- Tendinosis

It represents a non-inflammatory degenerative process very frequent in athletes who practice sports such as jogging, ballet dancers... involving repetitive stress on the tendon.

However, it has also been described in elderly patients, diabetics, patients with inflammatory arthritis, and patients with displaced fractures of the lateral malleolus and calcaneus.

On MRI thickening and intrasubstance increased signal in the peroneal tendons is seen, without evident tendon tear although often coexist.
On **ultrasound** appears as a diffuse tendon thickening with altered echotexture and hypoechoic edema without evident fibrillar defects.

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**Fig. 8** on page 20

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**- Tenosynovitis:**

Tenosynovitis is described as inflammation around the tendon or tendon sheath, and is a frequent lateral ankle pathology.

Usually it is secondary to local repetitive stress / trauma in the retromalleolar groove, peroneal tubercle or cuboid tunnel; secondary to systemic articular disease (rheumatoid arthritis, ankylosing spondylitis…) or infection.

A small amount of fluid in the peroneal tendon sheath is normal in asymptomatic individuals. However, a significant amount of fluid is diagnostic of tenosynovitis.

It is important to assess the integrity of the calcaneofibular ligament, because tears of this ligament may determine the presence of fluid in the tendon sheath due to their intimate relationship.

Remember that the peroneal tendons proximally have a common tendon sheath that separates at the level of peroneal tubercle.

On **MRI** fluid and sheath thickening is seen, tendon thickening with altered signal intensity and occasionally bone marrow edema along the lateral wall of the calcaneus or within bone protuberances such as the hypertrophied peroneal tubercle.

On **ultrasound** irregular and hypoechoic thickening of the tendon sheath and the tendon itself may be seen. Synovial fluid can be defined as an anechoic area surrounding the tendon. Color Doppler helps determining the degree of activity or inflammation of the sheath and can detect changes in the hypervascular synovial tendon sheath.

Stenosing tenosynovitis occurs when synovial proliferation and fibrosis surround the tendons preventing their free movement.

At MR imaging appears as a thickened synovium with linear areas of intermediate or low signal intensity within the synovial fluid with all pulse sequences. Gadolinium enhancement and complete obliteration of the fluid may also be seen.
**Peroneus Brevis Tendon Rupture**

Peroneus brevis tendon is located between the retromalleolar groove and the peroneus longus tendon, due to its position is more susceptible to degenerative changes and tendon tears.

Longitudinal tears of the peroneus brevis tendon, referred as peroneal split syndrome, are frequent in young athletes as well as in the elderly. Often associated with ligamentous injuries, superior peroneal retinaculum failure, calcaneofibular ligament thickening, crowding of retromalleolar groove due to the presence of a peroneus quartus muscle or low-lying peroneus brevis muscle belly, retromalleolar groove irregularity, and peroneal tendon dislocations.

Once a tear is initiated, the peroneus longus tendon migrates into peroneus brevis tendon tear, thus preventing healing.

On **ultrasound** the key data includes displaying a full split of the tendon and the formation of two hemitendons, tendon irregularity and signs of associated tenosynovitis.

On **MRI** the peroneus brevis longitudinal tendon tear has a V-shaped configuration which partially envelops the peroneus longus. A boomerang shaped peroneus brevis tendon indicates an initial phase of rupture and represents the thinning and weakening of the central portion of the tendon.

Other common secondary findings in peroneus brevis tendon tear that can be seen are clefts, fragmentation, irregularity of tendon contour, and increased signal intensity on T1- and T2-weighted images.

One-third of peroneus brevis tendon tears associate peroneus longus tear due to its anterior migration abutting the fibular groove.

On sagittal MR images longitudinal extension of the tendon tear can be assessed. It must be taken into account the magic angle artifact before defining any tendon rupture. Because of the curved path around the lateral malleolus of peroneal tendons T2 weighted images with a 20° plantar flexion are useful to reduce this artefact.
- **Peroneus Longus Tendon Rupture:**

  Isolated peroneus longus tendon ruptures are uncommon and usually happen at the level of **cuboid tunnel**.

  However, peroneus longus tendon tear associated with peroneus brevis tendon one occurs at the **retromalleolar groove**.

  The most common cause of an acute rupture of the peroneus longus is direct trauma or injury related to sports. Fracture of the os peroneus may also be associated with an acute rupture of the peroneus longus.

  *Painful Os Peroneus Syndrome* represents a spectrum of conditions including fracture, diastasis or stress changes of multipartite/bipartite os peroneus; tendon disease from tenosynovitis to a tear. In distal peroneus longus tendon ruptures displacement and migration of the os peroneus may be seen. The distance among bone fragments In multipartite os is 2 mm, a distance greater than 6 mm indicates fracture or diastasis would indicate full-thickness peroneus longus tendon rupture.

**Fig. 10 on page 22**

**Fig. 11 on page 23**

Chronic degenerative peroneus longus tendon tears are associated with mechanical friction against either a hypertrophic peroneal tubercle or the cuboids tunnel.

**MR imaging** findings in peroneus longus tendon tears are signal-intensity and morphologic abnormalities within the tendon, including longitudinal splits or disruptions. Secondary findings include a hypertrophic peroneal tubercle, bone marrow edema of the tubercle, lateral calcaneal wall, or cuboid bone can be seen as well.

**Fig. 12 on page 24**

On ultrasound imaging partial tears may appear as tendon thinning or thickening with an irregular, hypoechoic internal pattern and loss of normal fibrillar structure.

A full-thickness tear is seen as an extensive longitudinal tendon rupture or tendon disruption with retraction and often associated with tenosynovitis.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>CAUSE</th>
<th>ORIENTATION</th>
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Peroneal tears classification.

- Peroneal Tendon dislocation and superior peroneal retinaculum injury:

Peroneal tendons subluxation - dislocation is an uncommon but not rare condition that occurs in 0.3-0.5 % of the traumatic events to the ankle. Occurs when one or both tendons move from the retromalleolar groove, sometimes transiently, during ankle movements or tendon contractions.

Commonly are associated with injury to the superior retinaculum. The upper peroneal retinaculum is a fibrocartilagenous band of the deep fascia with variable thickness, originating from the posterior aspect of the lateral surface of the distal fibula, which extends posteriorly and inferiorly to insert indistinctly onto the lateral wall of the calcaneus, conjoined or isolated attachment insertion onto the aponeurosis of the Achilles tendon.

The SPR is often associated with a small triangular fibrous ridge that can be identified on axial MR imaging at its fibular origin.

The most common mechanism of injury to the retinaculum includes sudden dorsiflexion of the foot with concomitant violent contraction of the peroneal muscles. Other causes including congenital foot deformities, crowding of the retromalleolar groove, and fractures of the distal tibia and calcaneus

SPR injuries are graded with Eckert’s/ Oden's classification system.

**TYPE I:**

It is the most common injury pattern. There is a periosteal detachment at the level of the fibular groove without injury to the cartilaginous portion forming a "pocket" where tendons can dislocate into (usually the peroneus longus tendon).

**TYPE II:**

Detachment of the retinaculum and injury to the fibrocartilaginous portion.

**TYPE III:**

Detachment of the retinaculum, injury to the fibrocartilaginous portion and bony avulsion.

**TYPE IV:**
Complete rupture of the retinaculum with peroneal tendon displacement superficially and laterally to the retinaculum. This is the rarest type of injury.

Type I is the most common followed by type III. In type II, III and IV can produce a complete dislocation of the tendons.

**Fig. 13** on page 25

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**Fig. 13**: Schematic image showing the classification of Eckler / Davis modified by Oden for the tendon dislocation. Yellow arrowhead points the Superior Peroneal retinaculum.

**References**: literature. Reference 3

Intra-sheath peroneal tendon subluxation (I *): occurs when the tendons invert their normal anatomic location in the groove with an intact peroneal retinaculum. It is divided into two subtypes (Raikin):
Type A: change in the normal anatomical position without retinaculum or tendon ruptures (peroneus longus tendon has a deeper and a more medial position)

Type B: Deep dislocation of the peroneus longus tendon through a longitudinal tear in the peroneus brevis tendon.

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Fig. 15: Schematic Classification of intrasheath subluxation. References: - Bilbao/ES

On MR and ultrasound imaging tendon dislocations and retinaculum ruptures can be seen. Dynamic ultrasound relieves intermittent dislocation and subluxation of these tendons in the retromalleolar groove during dorsiflexion and eversion maneuvers

Fig. 14 on page 26
Ganglion Cyst.

It is the most common soft tissue tumour in foot and ankle. Appears as a cyst with a fibrous wall without synovial lining and containing a viscous fluid that may be secondary to mucoid degeneration of the peritendinous connective tissue.

Although frequently have their origin in the tendon sheath there are rare cases in which the origin is in the tendon itself. Besides the intratendinous ganglion cyst is much less common in peroneus brevis tendon. Their etiology is unclear, may correspond to intratendinous degeneration.

On MRI the ganglion is shown as a well-defined lobulated lesion containing a simple or complex fluid signal. Occasionally a peripheral enhancement after gadolinium administration may be seen. neck-shaped close communication with the adjacent tendon sheath or joint is diagnostic of ganglion cyst.

On ultrasound they are seen as well defined hypo or anechoic lobulated masses sometimes containing hyperechoic septa and possible posterior acoustic enhancement.

Images for this section:
**INTRODUCTION**

**US**
- Economically profitable
- Real-time scanning and dynamic
- Guide for interventional procedures

**MR**
- Economically profitable
- Real-time scanning and dynamic
- Guide for interventional procedures

**Fig. 1:** Most useful diagnostic tools for the diagnosis of peroneal tendon pathology.
Fig. 2: Anatomical image of the peroneal tendons and structures that form the fibro-osseous retromalleolar tunnel
Fig. 3: Anatomical image of the peroneal tendons and fibro-osseous tunnel structures by MRI (sagittal and axial T2 weighted sequences).
Fig. 4: Representation of normal peroneal tubercle and hypertrophy of peroneal tubercle. The hypertrophic peroneal tubercle is considered when measures more than 5 mm height in coronal plane. Axial T2 and coronal T1-weighted MR images, and axial US image.
Fig. 5: Representation of os peroneus by means of schematic image, plain film, MRI (coronal T2-weighted Fat Saturated) and ultrasound. On MRI os peroneus pointed with red arrow.
**Fig. 6:** An axial T2-weighted image on top. The curved arrow indicates the Peroneus Quartus accessory muscle. The lower one corresponds to an axial T1 weighted image (literature ref. 1). The straight arrow points a low lying peroneus brevis muscle belly.
**Fig. 7:** Normal and abnormal morphology of retromalleolar peroneal groove. Axial T2-weighted MR images.
Fig. 8: Tendinosis: ultrasound sagittal image showing a substantial tendon thickening and disruption of normal fibrillar echotexture of the peroneus longus tendon. Sagittal and axial T1-weighted and T2-weighted Fat-Saturated MR images showing signal alteration and thickening of the peroneus longus tendon. Tenosynovitis: US axial image showing a longitudinal peroneus brevis tendon rupture, thickening of the peroneus longus tendon and fluid in the synovial sheath. Axial T2-weighted and sagittal T2-weighted fat saturated showing morphologic and signal intensity alteration of the peroneal longus tendon and fluid within the peronealtendon sheath.
**Fig. 9:** Axial ultrasound images at the level of the peroneal tendons. Longitudinal split of the peroneus brevis tendon into two hemitendones (red circle) and peroneus longus tendon (blue circle) interposed between them.
**Fig. 10:** Axial T2-weighted FS images showing a longitudinal tear of the peroneus brevis tendon and interposition of the peroneus longus tendon between both hemitendones. Red arrow points the location of the peroneus brevis tendon and blue arrow the peroneus longus tendon one. The green arrowhead indicates the peroneus longus tendon rupture zone and its division into two hemitendones with the characteristic "v" shape.
**Fig. 11:** "Painful Peroneal Os" Syndrome. T2 weighted fat-saturated coronal images (top) and sagittal images (below) showing a longitudinal tear of peroneus longus tendon on its plantar way associated to an os peroneus within the tendon fibers, bone marrow edema both in the os peroneus and cuboid bone and edema in the surrounding soft tissue. The red arrow points the path of the peroneus longus tendon. The orange arrowhead indicates the os peroneus and the green arrow longitudinal rupture zone. Marked synovitis of the peroneus brevis tendon also appreciated.
Fig. 12: Peroneus longus tendon rupture due to peroneal tubercle’s hypertrophy. Sagittal ultrasound image, axial and coronal T2-weighted images without and with fat saturation. The red arrow points to hypertrophic peroneal tubercle with bone edema separating both peroneal tendons. Yellow arrowhead indicates tendon rupture.
**Fig. 13:** Schematic image showing the classification of Eckler / Davis modified by Oden for the tendon dislocation. Yellow arrowhead points the Superior Peroneal retinaculum.
Fig. 14: Type B intrasheath subluxation. Axial US image at the level of the retromalleolar groove in correlation with axial T2-weighted fat-saturated images. Red arrows indicate the two hemitendones of the peroneus brevis and blue arrowhead points the location of the peroneus longus tendon.
Fig. 15: Schematic Classification of intrasheath subluxation.
Conclusion

- Alterations of the peroneal tendons are common in musculoskeletal disorders.
- It is important to know the most common anatomic variants and disease.
- The best assessment is performed by MRI and ultrasound with dynamic maneuvers.

References


Personal Information