Middle Foot pain: don't forget the peroneus longus

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Learning objectives

Lateral foot pain is a frequent consulting reason and is defined by a clinical symptomatology along the calcaneum lateral wall, the cuboïd or the fifth metatarsal base. A lateral ankle pain can be explain by a midtarsal joint sprain, peroneus brevis disorders, or fractures of fifth metatarsal base, calcaneal anterior process, or cuboïd.

Often late diagnosed, peroneus longus pathologies have to be known, and we propose to attend this objectif:

- Remember the radiological anatomy of the peroneal tendons
- Propose a didactic classification of peroneus longus injuries
- Illustrate peroneal tendons pathologies with imaging examples
Background

Peroneal tendons anatomy:

Peroneal muscle are lateral muscles in the leg. Their functions are plantar flexion and eversion of the foot, and lateral stabilization of the ankle joint; the peroneus longus primary function is to produce plantar flexion of the first ray of the foot. The peroneal tendons (Fig. 1) share a common peroneal synovial sheath posterior to the lateral malleolus and descend down the lateral leg, passing through a fibro-osseous tunnel posterior to the lateral malleolus called the retromalleolar groove. The tendons are stabilized by the superior peroneal retinaculum and by the calcaneofibular ligament at the level of the retromalleolar groove. Lower, the peroneal tendons go along the lateral wall of the calcaneus: the peroneus brevis tendon inserts into the base of the fifth metatarsal bone; the peroneus longus turns sharply at the cuboid groove (Fig. 2 - 3) and inserts into the lateral aspect of the first metatarsal and medial cuneiform. The peroneus longus tendon is surrounded by a synovial sheath that extends proximally from 3 cm above the tip of the lateral malleolus and distally to the region of the cuboid tunnel. The distal end of the synovial sleeve extends approximately 1 cm distal to the calcaneal peroneal tubercle on the superficial surface of the tendon and to the plantar aspect of the cuboid tunnel on the plantar surface. An area bare of synovial sheath protection occurs where the peroneus longus changes direction into the medial foot.

The os peroneum (Fig. 4) is a round or oval-shaped accessory juxta-articular ossicle within the substance of the peroneus longus tendon located distally near the cuboid bone.

Two protuberances can be seen along the lateral wall of the calcaneus (Fig. 5): the peroneal tubercle and the retro-trochlear eminence. The peroneal tubercle (or trochlear process) is anterior, present in 40 % of individuals and separates the peroneus brevis tendon from the peroneus longus tendon, whereas the retro-trochlear eminence, posterior to the peroneal tubercle and the peroneal tendons, is seen in 98 % of individuals. Saupe defines enlarged peroneal tubercle or retro-trochlear eminence if these structures are higher than 5 mm in measuring the maximal distance between apex and reference line along lateral cortex of calcaneus on transverse MR image.

The peroneus longus tendon presents 3 potential conflict areas (Fig. 6 - 7):

- First direction's shift: retro-malleolar, with an associated lesion of the peroneus brevis tendon
- Calcaneal lateral wall: between the peroneal tubercle and the retro-trochlear eminence
- Second direction's shift: in front of the cuboid, before joining sole of the foot.
**Clinical symptoms:**

Peroneus longus diseases are favored by prolonged and repeated sports with inversion trauma, chronic lateral ankle instability and cavus varus. Clinical symptoms are a lateral pain of the ankle and foot or a cuboid groove's pain going to the sole of the foot.

Clinical examination shows a swelling pain when palpating tendons, a decreased strength, and a limitation of plantar flexion of the first ray.

Symptoms increase in these positions: passive inversion of the hindfoot, in ankle plantar flexion; active eversion against resistance, in ankle dorsiflexion.

**Peroneal tendons and os peroneum imaging:**

The study of the peroneus longus is accessible by the various techniques of tendons exploration, particularly ultrasound. However, MR-imaging allows an analysis of the tendons signal and bones signal, and specially the peroneus longus tendon which presents several changes of directions.

Tendinopathy is defined as the presence of tendon intrasubstance T1 and T2 hypersignal and focal enlargement, verified on two planes images. Tenosynovitis consists in a fluid accumulation in a T2 hypersignal enlarged sheath without tendon anomaly. The amount of tendon sheath fluid is not considered in the criterion because of the wide variability of fluid previously described in asymptomatic individuals. Peroneus longus tear is defined as longitudinal fluid-signal splits (partial tear) or disruption (complete tear) in a pathologic tendon.

Visualization and analysis of the shape of a peroneum bone are best assessed by radiographs and CT-scan (Fig. 8).

Os peroneum fragment separation of 6 mm or more suggests os peroneum fracture and associated full-thickness peroneus longus tendon tear.

Enlarged peroneal tubercle or retrotrochlear eminence is assessed if these structures are higher than 5 mm with Saupe criterias.

**Peroneus longus injuries classification:**

Non-inflammatory diseases of the peroneus longus tendon have a micro or macrotraumatic origin.
Associated with an os peroneum, the POP syndrome was described by Sobel in 1994 on a retrospective study of only 10 patients, but this classification seems vague and essentially related to the presence of a pathological os peroneum.

In our experience, pathologies associated with an os peroneum fracture are exceptional and the term « POPsyndrome » overused. MR-imaging was not performed in Sobel's patients. Furthermore, several articles in the literature report isolated cases of tendon conflicts (calcaneum -Boles Skeletal Radiol 1997-, cuboid -O Donnell Skeletal Radiol 2005-).

So we propose a classification based on the nature of the tendon disease and the conflict zone:

**Type 1**: diffuse and isolated peroneus longus disease (tendinosis / tenosynovitis). Inflammatory (psoriatic arthritis, rheumatoid arthritis) or traumatic deseases are described.

**Type 2**: os peroneum pathology
- 2A (Fig. 9) : Microtraumatic (ossicle oedema on MRI, normal radiograph / CT)
- 2B (Fig. 10) : Macrotraumatic (fractured OP)

**Type 3**: Bone to tendon conflict
- 3A : Retromalleolar conflict (not described here because of associated peroneus brevis disease)
- 3B (Fig. 11) : Undermalleolar conflict
- 3C (Fig. 12) : Laterocalcaneal conflict
- 3D (Fig. 13) : Cuboid conflict with or without cuboid edema
Fig. 1: Peroneal tendons anatomy at the lateral wall of the ankle

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Fig. 5: Axial CT-scan slice showing peroneal tendons and their osseous relationship at the lateral wall of the calcaneum

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Fig. 2: Coronal CT-scan (left) and T2 FS (right) images: peroneus longus tendon in the cuboid groove

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Fig. 3: Sagittal T2 FS (A) and CT-scan (B, C) : longus peroneus tendon in the cuboid groove

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**Fig. 6:** Potential peroneus longus conflict areas at the lateral wall of the calcaneum

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**Fig. 7:** Potential peroneus longus conflict area at the sole of the foot
Fig. 4: Oblique radiograph of the foot demonstrate a multipartite os perineum (A) and a solitary os perineum (B)
**Fig. 8:** Sagittal CT-scan (A), sagittal T1-weighted MR (B) images, oblique radiograph of the foot (C): radiographs and CT-scan allow a better analysis of the shape of a peroneum ossicle than MR-imaging.

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Fig. 9: Axial T1 (A), axial (B), sagittal (C) and coronal (D) T2 FS weighted images in a 72 year old man with chronic pain of the right foot. Os peroneum edema (arrows) associated with peroneus longus tenosynovitis without tear.

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Fig. 10: CT-scan (A) and MR-imaging (B) in a 47 year old man with post-traumatic acute lateral pain of the right foot. Important bone edema of the peroneum ossicle (blue arrowheads) whereas CT-scan assess the fracture (white arrow).

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**Fig. 11:** Coronal MR (A) and CT-scan imaging in a 66 years-old woman with a lateral foot pain (old fracture of calcaneus resulting in calcaneus dysmorphia and secondary talocalcaneal osteoarthritis). Tenosynovitis and tendinosis of peroneal tendons (white arrow), caught between the tip of the fibula and the lateral edge of the calcaneus (blue arrowheads).

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**Fig. 12:** MR-imaging in a 70 years-old man with chronic pain of the left foot, without perineum ossicle on foot radiograph. We note enlarged peroneal tubercle and retrotrochlear eminence with bony edema (blue arrowheads) due to the conflict and explaining the peroneus longus paratendinopathy (white arrow).

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**Fig. 13:** MR-imaging in a 32 years-old woman with a chronic non-traumatic lateral pain of the right ankle, without os peroneum. MR shows a peroneus longus paratendinopathy without tendinosis (normal signal of the tendon) associated with a cuboid edema (arrows) due to the chronic conflict.

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Findings and procedure details

MR-imaging allows an analysis of the tendons signal and bones signal, and specially the peroneus longus tendon which presents several changes of directions.

Protocol included systematically an axial T1 acquisition, associated with 3 PD-weighted acquisitions with fat signal saturation (axial, coronal and sagittal).

Visualization and analysis of the shape of a peroneum bone are best assessed by radiographs and CT-scan.
Conclusion

This classification of lesions of the peroneus longus shows in our daily activity a large predominance of cuboid conflict (3D) compared to other types, especially the fractured os peroneum which seems exceptional.

However, the presence of an os peroneum could play a promoting role.

A prospective study is being published.
References


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