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MR Findings in Peroneal Tendonopathy

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Objective: The purpose of this presentation is to familiarize the reader with the often subtle findings of peroneal tendon derangement on MRI examination.

Materials and Methods: We present four patients who were studied with MR (1.5 T) prior to surgical exploration of the peroneal tunnel. All patients had lateral ankle symptoms for >6 months. Normal MR anatomy and an example of the peroneus quartus tendon are also shown.

Results: Surgery revealed two peroneus brevis and three peroneus longus lesions. A "multipartite" appearance of the peroneus tendon on axial MR images, especially when paired with a "flame-shaped" appearance on more distal axial images, indicates a longitudinal tendon split. Both patients with peroneus brevis tendon splits had insufficient superior peroneal retinacula.

Conclusion: Partial ruptures of the peroneal tendons characteristically take the form of longitudinal tendon splits. Axial MR images through the ankle and hindfoot can help distinguish peroneal tendonitis from longitudinal tendon splits.

Index Terms: Ankle, wounds and injuries—Tendons, wounds and injuries—Magnetic resonance imaging.

Peroneal tendon derangement, including tendonitis, partial rupture or longitudinal tendon splitting, and the rare complete tendon rupture, may be overlooked as a cause of recalcitrant lateral ankle pain. Patients with these lesions typically have a history of prior or repetitive ankle sprains (1,2). Peroneal tendon derangement, like derangements in other tendons, usually results from mechanical attrition rather than a solitary traumatic insult. Acute traumatic peroneal tendon ruptures, while reported, are probably quite rare (3). The MR findings in peroneal tendon derangement can be subtle and may be confused with normal variants. We briefly review the normal MR anatomy of the peroneal tendons and present the MR findings in four patients who underwent surgery for peroneal tendonopathy.

NORMAL ANATOMY

The peroneus longus and peroneus brevis tendons, sharing a common synovial sheath, pass through a fibroosseous peroneal tunnel behind the

distal fibula. The superior peroneal retinaculum forms the roof of the peroneal tunnel. A fibrous ridge may be present along the fibular attachment of the superior retinaculum. The posterior talofibular and calcaneofibular ligaments form the medial margin of the fibroosseous tunnel. In the upper peroneal tunnel, the peroneus brevis is usually anterior and medial to the peroneus longus tendon (Fig. 1a). Occasionally, the tendons may be nearly side by side, with the peroneus longus situated laterally. The distal muscular portion of the peroneus brevis is often present in the upper portion of the fibroosseous tunnel (Fig. 1b).

Below the tip of the fibula, the peroneal tendons run along the lateral surface of the calcaneus anterior to the retrotrochlear eminence, the peroneus longus posterior to the brevis (Fig. 2). In ~32-44% of cases, the tendons may be separated by a smaller bony prominence, the peroneal trochlea (4). The tendons are retained at this level by the inferior peroneal retinaculum, which attaches both on the trochlea and posteroinferior to the retrotrochlear eminence (Fig. 2).

CASE PRESENTATIONS

Case 1

A 31-year-old man presented with a 1 year history of right lateral hindfoot pain unrelated to trauma. Physical

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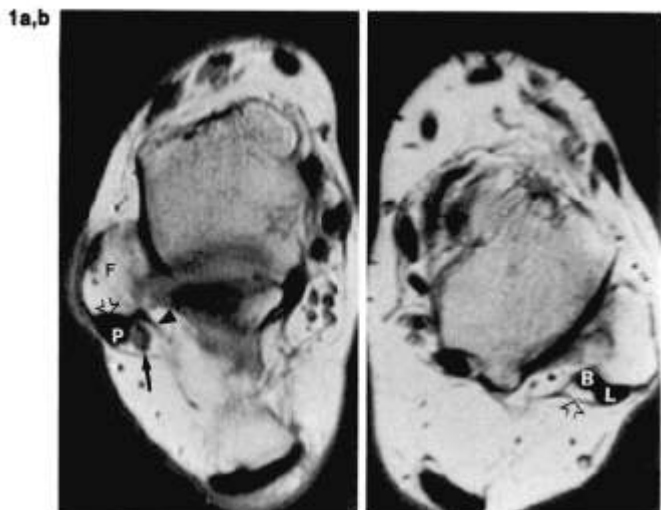


FIG. 1. a: Normal anatomy. Axial MR image (TR 1,800/TE 20) through the fibroosseous peroneal tunnel. The peroneus longus (P) is posterior to the peroneus brevis tendon (open arrow). The distal muscle belly of the peroneus brevis (filled arrow) is also present at this level, and the peroneus brevis tendon can be quite flattened in appearance, while the peroneus longus is rounder. (Arrowhead, calcaneofibular ligament; F, fibula). **b:** Normal anatomy. Axial MR image (TR 1,800/TE 20) through the peroneal tunnel in a different subject, showing the peroneus longus tendon (L) more laterally positioned relative to the brevis (B). In this case, the brevis tendon is more ovoid in cross-section. The superior peroneal retinaculum is well seen (open arrow); the variable fibrous ridge or "meniscus analogue" occasionally present at its fibular attachment is not seen in this case.

exam revealed tenderness to palpation along both sides of the hindfoot and at the lateral aspect of the fifth metatarsal. The MR exam revealed peroneal tendon sheath effusion and increased signal along the margin of the peroneus longus tendon (Fig. 3a,b). At surgery, the peroneal tendon sheath was markedly edematous and contained hypertrophic synovial tissue. The peroneus longus tendon showed an area of inflammation with surface fibrosis, but it was not ruptured or split. A synovectomy was performed.

Case 2

A 53-year-old woman complained of long-standing lateral ankle pain. She had suffered an ankle injury during aerobics >10 years earlier. On physical exam there was retrofibular swelling and tenderness. The MR exam revealed a separation of the peroneus brevis tendon in the peroneal tunnel, creating a multipartite appearance to the tendon (Fig. 4a). Below the tip of the fibula, reunification of the peroneus brevis components lent a "flame-shaped" appearance to the tendon (Fig. 4b). The anterior talofibular ligament was thickened and irregular, consistent with a prior injury. At surgery, a 3 cm longitudinal split of the peroneus brevis tendon, centered over the tip of the fibula, was confirmed. The superior peroneal retinaculum was lax, and the peroneal tendons moved freely over the posterolateral edge of the fibula. A primary re-



FIG. 2. Normal anatomy. Axial image below the tip of the fibula (TR 1,800/TE 20) illustrates the normal appearance of the peroneus longus tendon (open arrow) posterior to and larger than the peroneus brevis (arrowhead). Both tendons are low signal and ovoid in cross-section. A portion of the inferior peroneal retinaculum (black arrow) is visualized as it attaches behind the retroretrochlear eminence (R). The peroneal trochlea (not seen) is an inconstant bony ridge that separates the longus from brevis tendons as they pass anterior to the retroretrochlear eminence.

pair of the peroneus brevis was performed, followed by reefing of the superior peroneal retinaculum.

Case 3

A 13-year-old boy had persistent lateral ankle pain 6 months after an inversion injury sustained playing flag football. The patient also complained of ankle instability when running. Physical exam revealed generalized ankle

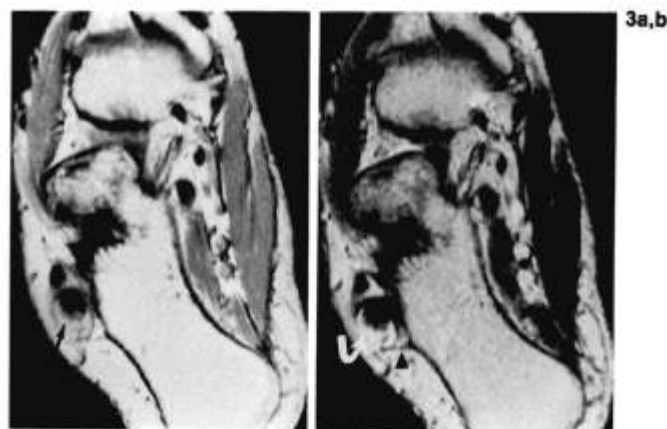


FIG. 3. Case 1. Chronic tendonitis. **a:** Axial image (TR 1,500/TE 15) below the peroneal tubercle illustrates an ill defined, feathery posterior border to peroneus longus tendon (arrow). The diameter of the peroneus longus tendon is also increased. **b:** Axial T2-weighted image (TR 1,500/TE 70) at the same level shows bright, tendon sheath effusion (arrow). The increased signal and the irregularity along the posterior margin of the peroneus longus tendon are less apparent on this longer TE image. Arrowhead, inferior peroneal retinaculum.

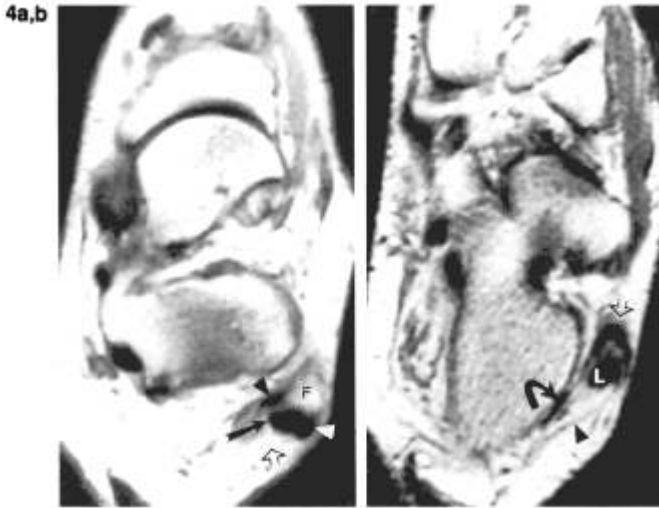


FIG. 4. Case 2. Longitudinal peroneus brevis tendon split. **a:** Axial image (TR 1,800/TE 20) above the tip of the fibula (F) shows division of the peroneus brevis into two components (arrowheads), one medial and one lateral to the peroneus longus tendon (filled arrow), creating a multipartite appearance. The lateral component (open arrow) should be distinguished from the fibrous ridge sometimes seen at the fibular attachment of the superior retinaculum (8). **b:** Axial T2-weighted image (TR 1,800/TE 70) below the tip of the fibula shows reunification of the peroneus brevis tendon components, creating a "flame-shaped" appearance of the tendon at this level (open arrow). These findings are consistent with a longitudinal tendon split. There is no significant tendon sheath effusion. Curved arrow, distal attachment of the calcaneofibular ligament; arrowhead, inferior retinaculum; L, peroneus longus.

swelling and tenderness, most pronounced posterior and inferior to the lateral malleolus. An MR exam (Fig. 5a) revealed findings of peroneal tenosynovitis, and below the tip of the fibula, a flame-shaped appearance of the peroneus brevis tendon was present, suggesting a longitudinal tendon split. Signal changes in the tarsal sinus indicated a talocalcaneal interosseous ligament sprain (Fig. 5b). At surgery, a large, chronic-appearing longitudinal tear was seen in a flattened peroneus brevis tendon; a smaller split, not suspected at MR, was also present in the peroneus longus tendon laterally. There was synovial hypertrophy throughout the peroneal tendon sheath. The superior peroneal retinaculum was lax, allowing lateral subluxation of the peroneal tendons. The peroneal tendon splits were repaired, and the retinaculum was tightened and repaired.

Case 4

A 24-year-old man reported left lateral ankle pain with tenderness and swelling of 4 year duration. Physical examination was notable for tenderness and swelling over the peroneal tendon sheath. The MR examination showed an enlarged peroneal trochlea. At the level of the tip of the fibula, there was a multipartite appearance of the peroneus longus tendon, suggesting longitudinal splitting of the tendon (Fig. 6). Surgery confirmed a 3 cm longitudinal tear along the medial surface of the peroneus longus ten-

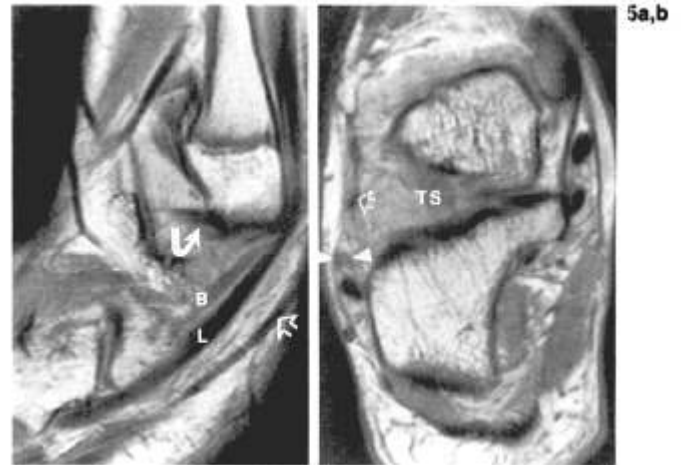


FIG. 5. Case 3. Longitudinal peroneus brevis tendon split. **a:** Sagittal image (TR 2,100/TE 22) through the peroneal tunnel reveals increased signal in the peroneus brevis tendon (B), suggesting derangement. Sagittal images, however, are generally unreliable for tendon assessment because of potential volume averaging effects. Curved arrow, anterior talofibular ligament; open arrow, lesser saphenous vein. **b:** On coronal image (TR 2,400/TE 22) anterior to tip of the fibula, the peroneus brevis tendon assumes a "flame-shaped" appearance (arrowheads), suggesting a longitudinal split. Edema in the tarsal sinus (TS) indicates interosseous ligament sprain, with associated injury to inferior extensor retinaculum (open arrow).

don at the level of the inferior peroneal retinaculum. The peroneus brevis, which appeared normal on MR exam, showed evidence of chronic tendonitis, and chronic synovitis was present throughout the peroneal tendon sheath. Osteophytes were found in the inferior peroneal tunnel along the peroneal trochlea, and these were removed with a rongeur. A subtotal synovectomy was performed after primary repair of the peroneus longus split.



FIG. 6. Case 4. Longitudinal peroneus longus tendon split. Axial image (TR 1,800/TE 20) at the level of an enlarged peroneal trochlea (arrow) shows a multipartite appearance of the peroneus longus tendon (arrowheads), consistent with longitudinal splitting of the tendon. The peroneus brevis appears normal.

DISCUSSION

Chronic lateral ankle pain commonly results after an ankle sprain. Causes for persistent lateral ankle symptoms include ligamentous instability, loose bodies, osteochondral lesions, tibiotalar or subtalar arthrosis, anterolateral impingement (5), sinus tarsi syndrome, and peroneal tendon dysfunction. Most patients with peroneal tendonopathy have a history of remote or recurrent ankle sprains. On physical examination they may have swelling and focal tenderness behind the lateral malleolus. Pain and palpable tendon subluxation may be evident on resisted eversion of the foot (6). Peroneal tendon ruptures rarely present acutely after a single insult; reported cases typically involve the peroneus longus, often at the level of the cuboid, and result from direct trauma (3), forced supination (3,7), or inversion injuries in mild plantar flexion (8).

An ankle "sprain" may precipitate peroneal tendon derangement by injuring the peroneal retinaculum rather than the tendons themselves. Acute peroneal tendon dislocation has been described in forced dorsiflexion injuries of the ankle sustained in skiing (9,10) and may also result from inversion injuries that occur with the foot in minimal flexion (8). Retinacular injuries occasionally cause a characteristic cortical avulsion fracture on the lateral margin of the fibula (10).

Retinacular insufficiency leads to peroneal tendon subluxation, which may in turn predispose to mechanical attrition of the peroneus brevis tendon as it repeatedly slides over the lateral edge of the fibular groove or tip of the fibula (11,12). Consequently, partial ruptures of the peroneus brevis tendon take the characteristic form of longitudinal tendon splits centered at the tip of the fibula (12). The more posterior position of the peroneus longus tendon in the fibroosseous peroneal tunnel tends to protect it from mechanical attrition during subluxation (11,13). Peroneal tenography can detect stenosing tenosynovitis, but is inaccurate in diagnosing longitudinal splits of the peroneal tendons (8).

Peroneal tendon subluxation may be aggravated by a shallow or absent fibular groove (14) or by ankle instability (1). Other anatomic factors may also predispose to peroneal tendonopathy. These include a large peroneal trochlea (Case 4), which has been associated with peroneal tendonitis (15). An accessory tendon, the peroneus quartus, may crowd the peroneal tunnel and contribute to mechanical tendon attrition (16). A peroneus quartus tendon might be mistaken on MR examination for splitting of the peroneus brevis tendon (Fig. 7). There are multiple variants of the peroneus quartus, including the peroneus accessorius, peroneus digiti minimi, and peroneocuboideus (17). The most common variant is a supernumerary tendon arising from the peroneus brevis muscle belly that attaches to

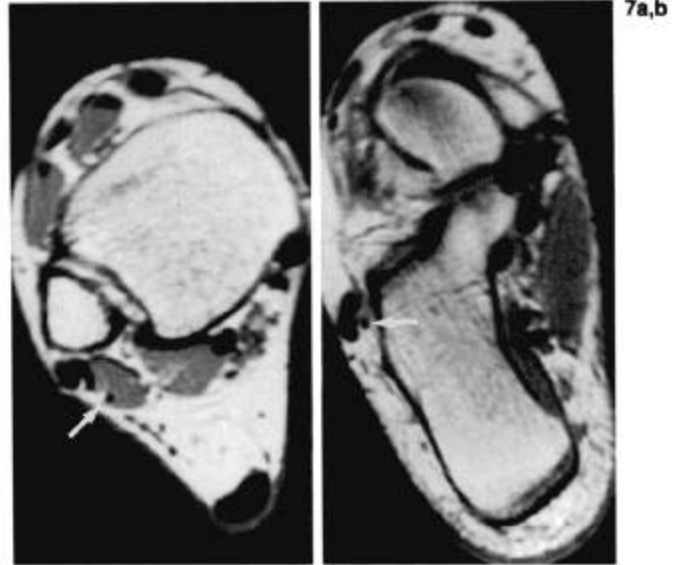


FIG. 7. Normal variant—peroneus quartus. **a:** Axial image (TR 1,800/TE 16) through the upper peroneal tunnel shows a small, supernumerary tendon (arrow) along the lateral aspect of the distal peroneus brevis muscle belly. **b:** Axial image just above the peroneal tubercle shows persistence of this additional tendon (arrow) medial to the peroneus longus tendon. This finding represents a so-called peroneus quartus tendon, in this case inserting on the peroneal trochlea. It should not be interpreted as a multipartite appearance of the peroneus brevis or longus tendon.

the peroneal trochlea (17). The peroneal trochlea may be enlarged in such cases. The peroneus quartus tendon is posteromedially situated in the peroneal tunnel and is smaller than the other two tendons (18). It should be distinguishable from a tendon split on MR exam by its depicted course on serial images and by its regular margin and round contour.

In our experience, the most valuable MR sequence for evaluating the peroneal tendons is an axial, double echo, SE scan. These images are improved if the foot is positioned in mild plantar flexion. Oblique axial images perpendicular to the tendon course are also useful, but for technical reasons oblique images may have poorer signal-to-noise ratio and diminished resolution. Axial images around the tip of the fibula should be closely scrutinized, as tendon splits are centered at this level. There may be a "blind area" at the precise level of the tip of the fibula due to volume averaging. Artifactual signal changes in the tendons may also result from the "magic angle" phenomenon (19), which typically occurs where the tendons change direction below the tip of the fibula. Analyzing T2-weighted images and positioning the foot in mild plantar flexion help resolve true from artifactual signal changes in the peroneal tendons.

Peroneal tendonitis is manifested on MR by tendon sheath effusion and/or synovitis and possibly minor signal abnormalities within the tendons them-

selves. These changes may give the tendons ill defined margins. A partial rupture or longitudinal tendon split should be suspected when a "multipartite" appearance of the tendon is noted in the peroneal tunnel, indicating a separation of tendon fibers. This multipartite appearance is more specific for longitudinal splitting than severe flattening of the peroneus brevis, which can be seen in asymptomatic subjects. On axial images below the tip of the fibula, the deranged peroneus brevis tendon may have an "arrowhead" or "flame-shaped" appearance in cases of longitudinal splitting, as the separate tendon fascicles reunite below the longitudinal rent.

Peroneal tendonitis is usually responsive to conservative measures, but may occasionally require open decompression and synovectomy. Symptomatic peroneal tendon splits may respond well to primary surgical repair of the split (8). More severe partial ruptures with attrition of the tendon may require peroneus brevis to longus tenodesis (or vice versa) (1). At surgery, a torn or insufficient peroneal retinaculum should be repaired; reconstructive procedures to deepen the peroneal tunnel have also been advocated in cases of tendon subluxation (9,10). The extent and severity of a partial peroneal tendon rupture may influence surgical management. Estimation of the extent of tendon derangement may be possible at MR evaluation. This estimation, like the diagnosis of derangement, is best made on axial images through the tendons.

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