

# Peroneus Brevis Tendon Variant Insertion on the Calcaneus

Nathan D. Cecava<sup>1\*</sup>, Scot E. Campbell<sup>2</sup>

1. Department of Radiology, Mike O'Callaghan Federal Medical Center, Nellis AFB, NV, USA

2. Department of Radiology, Landstuhl Regional Medical Center, Landstuhl, Germany

\* **Correspondence:** Nathan Cecava, MD, Department of Radiology, 4700 Las Vegas Blvd, Nellis AFB, NV 89191, USA  
(✉ [natececava@gmail.com](mailto:natececava@gmail.com))

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## ABSTRACT

Insertion of the peroneus brevis tendon normally occurs at the lateral aspect of the fifth metatarsal base. However, there is new evidence that congenital variant insertion of the tendon on the calcaneal peroneal tubercle occurs in a small segment of the population. We report a case of 24-year old male presenting with non-traumatic ankle pain who underwent ankle magnetic resonance imaging. Imaging demonstrated insertion of the peroneus brevis tendon on the calcaneal peroneal tubercle with absence of the tendon distal to the calcaneus. Furthermore, in reviewing 200 consecutive ankle magnetic resonance examinations, the authors discovered one additional case of this variant. We discuss the magnetic resonance imaging characteristics of this anatomic variant, the implications for clinical management, and review the literature on peroneal anatomic variations.

## CASE REPORT

### CASE REPORT

A 24 year old male presented for medical care following a two week history of non-traumatic right ankle pain. The pain was characterized as radiating from the ankle to the base of the fifth metatarsal. The patient had no prior surgical history or significant medical history. No plantar flexion or eversion strength deficits were documented on physical examination.

Radiographs of the right ankle were obtained and were unremarkable. After a 4 week period of conservative measures (rest and non-steroidal anti-inflammatory medications), the patient denied improvement in symptoms.

Magnetic resonance imaging (MRI) of the ankle was then obtained. Imaging techniques included sagittal inversion recovery (TI 150 ms; TE 17 ms; TR 5000 ms; slice 3.5 mm; gap 0 mm; 256 x 192); sagittal proton density (TE 34 ms; TR 4000 ms; slice 3.5 mm; gap 0 mm; 512 x 320; NEX 2); sagittal T1 (TE 10 ms; TR 600 ms; slice 3.5 mm; gap 0 mm; 256 x 192); coronal proton density (as above with slice 4 mm; gap 0

mm); coronal fat suppressed T2 (TE 65 ms; TR 4000 ms; slice 4 mm; gap 0 mm; 256 x 192; frequency selective fat suppression); axial proton density (as above with slice 4 mm; gap 0 mm).

### Imaging Findings

Radiographs of the right ankle demonstrate no osseous or soft tissue abnormalities (figure 1).

Axial, coronal, and sagittal proton density weighted magnetic resonance (MR) images demonstrate the peroneus brevis tendon in normal location posterior to the distal fibula. The tendon inserts on the peroneal tubercle of the calcaneus. There is no peroneus brevis tendon distal to this level. It is absent at the base of the fifth metatarsal (figures 2-4).

### Management

No surgical management was indicated. The patient's symptoms resolved with conservative therapy.

### Follow-up

No imaging follow-up of the patient was obtained.

The authors retrospectively reviewed the images from 200 consecutive ankle MRI examinations performed between May 2012 and March 2013. Images were evaluated for the peroneus brevis tendon inserting on the peroneal tubercle, and absent at the base of the fifth metatarsal. One additional case was identified. The subject was a 20 year old male with diffuse right ankle pain following eversion injury. Ankle radiographs were normal (figure 5). MRI using the imaging parameters described above revealed a peroneus brevis tendon inserting on the calcaneal peroneal tubercle (figure 6-8). The peroneus brevis tendon was absent at the base of the fifth metatarsal.

## DISCUSSION

### Etiology & Demographics

Variant insertion of the peroneus brevis tendon on the calcaneus is congenital (table 1). Demographics for this variant are currently unknown. For the vast majority of the population, the peroneus brevis tendon inserts on the lateral aspect of the fifth metatarsal base at the styloid process. The peroneus brevis provides a small portion of the foot's plantar flexion power and 28% of the hindfoot eversion power [1].

The authors could find only one previous case report for alternate peroneus brevis tendon insertion on the calcaneus which was discovered during surgical exploration. That particular case report describes a tendon insertion just distal to the peroneal tubercle [2]. To our knowledge, there has been no description or case report of this variant in the radiology literature. In our series, this anatomic variant was present in 2/200 (1%) cases.

Protuberances on the lateral calcaneus include the retrotrochlear eminence, present in nearly all individuals. The more distally positioned and variably present peroneal tubercle separates the peroneus longus tendon from the peroneus brevis tendon. The peroneal tubercle is not present in every individual, with sources reporting its presence in 40%-55% of individuals [3, 4]. It is possible that its presence may be more common in individuals who have variant insertion of the peroneus brevis tendon, or another known variant, such as a peroneal tubercle insertion of a peroneus quartus tendon. Overlying the peroneal tubercle are the fibers of the inferior peroneal retinaculum which blend with the common peroneal tendon sheath [5]. This confluence of fibrous structures may make the peroneal tubercle a suitable alternate insertion site for the peroneus brevis tendon.

A well-known variant at the lateral ankle is the presence of an accessory peroneus quartus muscle. Incidence of this supernumerary muscle has been reported between 6.6 - 22 % on MRI and cadaveric studies [4, 6-9]. The peroneus quartus muscle fibers often arise from the peroneus brevis [8, 10]. Insertion sites of the peroneus quartus tendon include the retrotrochlear eminence, cuboid, fifth metatarsal base, peroneus longus tendon and brevis tendon [6,8]. Insertion on

the peroneal tubercle has also been reported [7]. Since a quartus tendon can insert on the peroneal tubercle, a variant peroneus brevis tendon insertion on the peroneal tubercle without a quartus muscle present may represent a spectrum of these variants.

### Clinical & Imaging findings

It is unknown if variant peroneus brevis insertion on the calcaneus can be identified by history or clinical exam. It would be interesting to study these individuals further to discover if they are subject to higher rates of ankle instability or acute/chronic injuries of the peroneal tendons.

The characteristic image finding for this variant is a peroneus brevis tendon which inserts on the lateral calcaneus on or near the peroneal tubercle. The variant peroneus brevis tendon does not extend past the calcaneus and does not extend to its normal insertion on the fifth metatarsal base. It should also be noted that variant tendon insertion on the calcaneus potential confounds dynamic evaluation of peroneus brevis tendon with ultrasound.

### Treatment & Prognosis

No treatment or prognosis has been described for variant peroneus brevis tendon insertion. It is important for the radiologist to be aware of this variant. Failure to recognize this variant may result in the incorrect diagnosis of a peroneus brevis tendon rupture and an unnecessary attempt at reparative surgery. In the setting of absent peroneal brevis tendon insertion on the fifth metatarsal base, the radiologist should assess the MRI for variant attachment at the peroneal tubercle. Absence of lateral ankle edema and peroneal tenosynovitis should raise suspicion for variant tendon insertion. Surgical treatments for peroneus brevis tendon rupture would include attempted end-to-end repair, sectioned tendon transfer of peroneus longus tendon or tenodesis of the torn brevis to the peroneus longus tendon [5,10].

Potential targets for future research could include variant tendon insertion association with chronic lateral ankle instability or predisposition for acute or chronic tendon tears.

### Differential Diagnosis

The main alternate consideration is a complete tear of the peroneus brevis tendon with tendinous retraction (table 2). MRI findings for complete tear would include absence of a tendon inserting on the base of the fifth metatarsal. In the acute setting, one would expect a significant amount of surrounding edema on MRI.

A partial tear of the peroneus brevis tendon should be easily distinguishable. In both the acute and chronic setting, partial tear is usually demonstrated by a bisected or "C" shape morphology of the peroneus brevis tendon, most apparent on axial imaging, and often with interposition of the peroneus longus tendon [3]. The tendinous insertion on the base of the fifth metatarsal will be intact. In these cases, peroneal sheath tenosynovitis is usually present on MRI. In one review of 82 patients with chronic lateral ankle instability, MRI sensitivity and specificity of peroneal tendinopathy were reported as 83.9% and 74.5%, respectively [11].

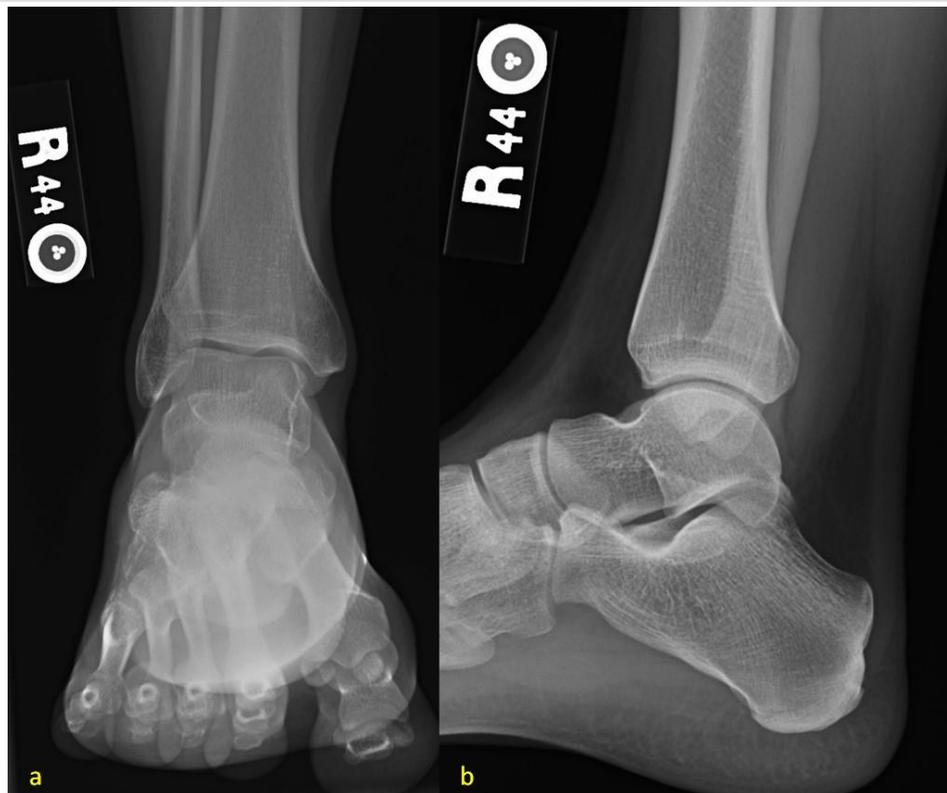
TEACHING POINT

Variant congenital insertion of the peroneus brevis tendon on the calcaneus peroneal tubercle instead of its normal position on the lateral base of fifth metatarsal may occur in up to 1% of the population. Radiologist and surgeons should recognize this variant to prevent the incorrect pre-operative assumption of peroneus brevis tendon tear and performing unnecessary surgery in affected individuals.

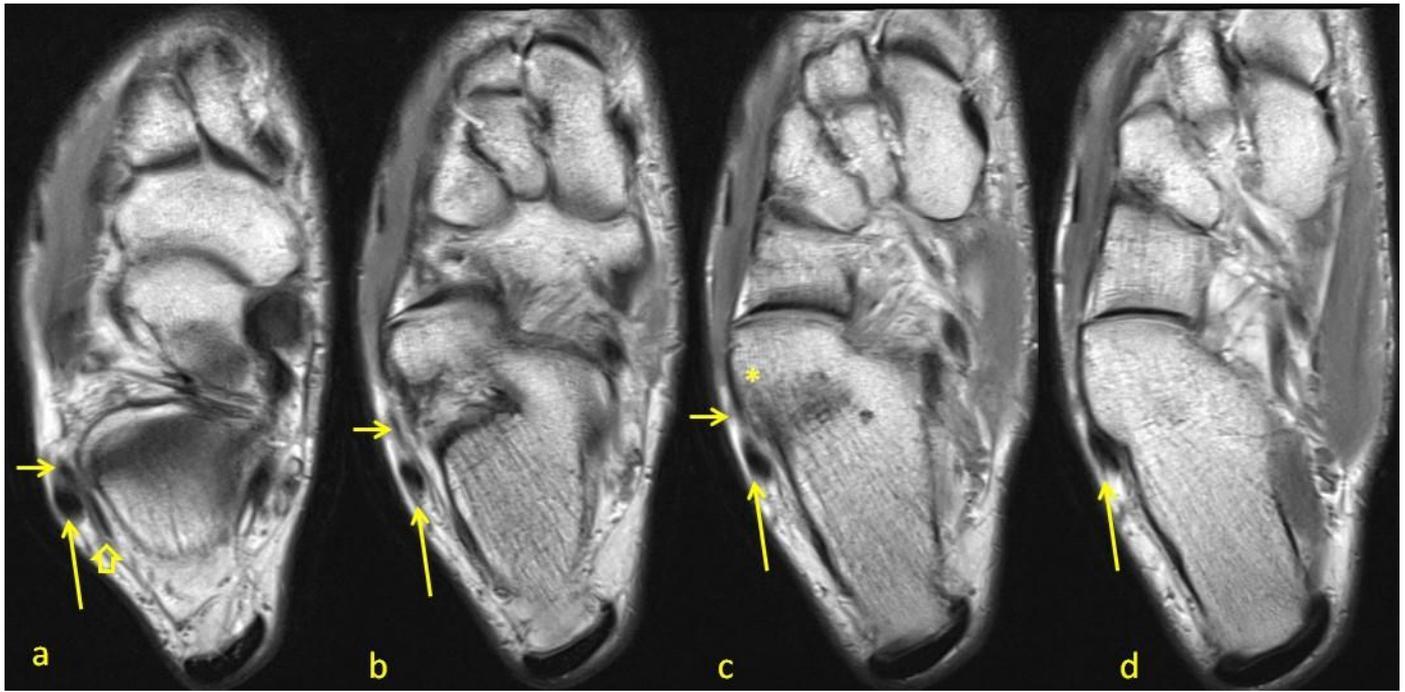
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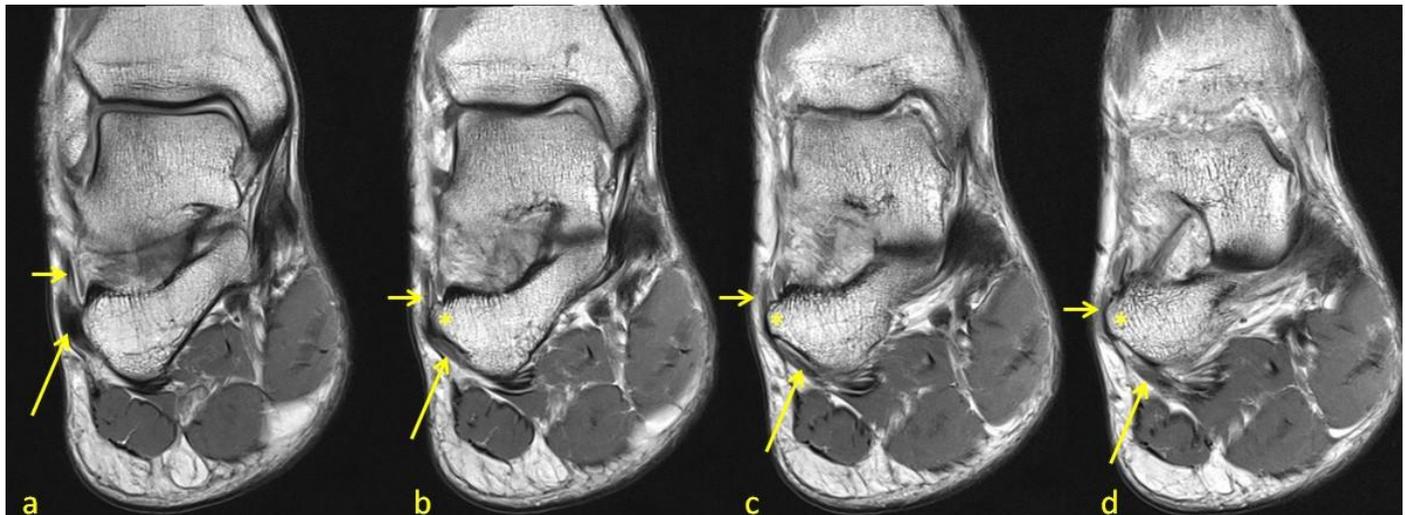
FIGURES



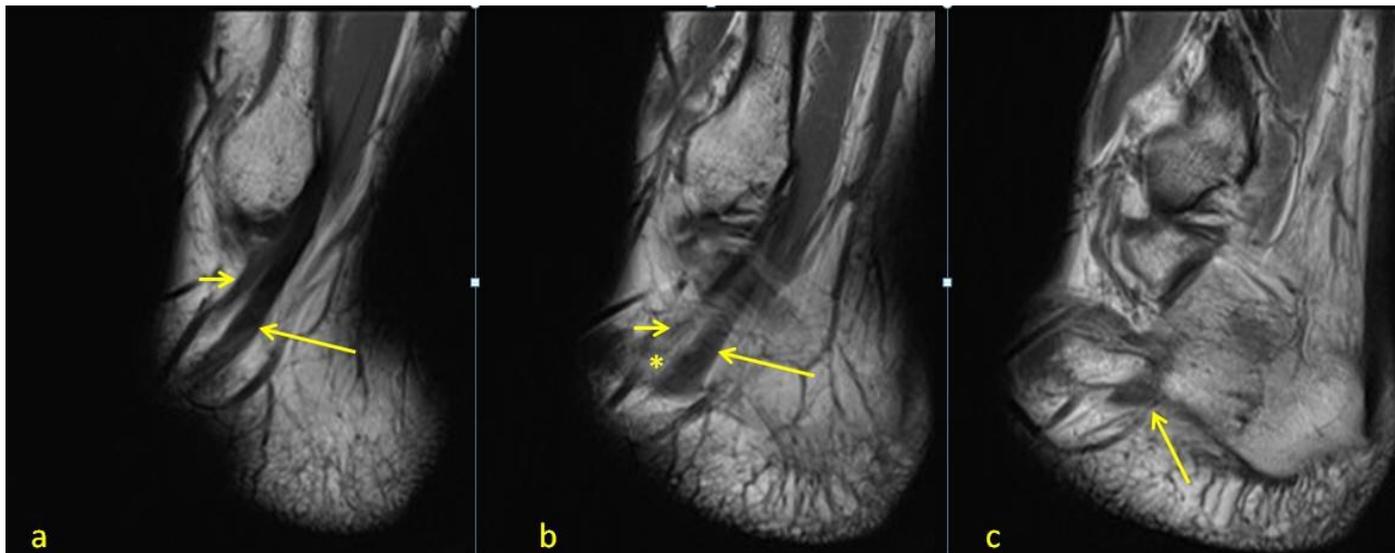
**Figure 1:** 24 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: AP and lateral radiographs of the right ankle show no osseous or soft tissue abnormalities. TECHNIQUE: Digital radiography.



**Figure 2:** 24 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous axial proton density MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon (long arrow) and calcaneofibular ligament (open arrowhead) are also annotated. TECHNIQUE: Siemens Verio 3T, axial proton density sequence without injected contrast (TR 4830, TE 35, 4mm slice thickness/spacing).



**Figure 3:** 24 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous coronal proton density MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon with magic angle artifact (long arrow) is also annotated. TECHNIQUE: Siemens Verio 3T, coronal proton density sequence without injected contrast (TR 4030, TE 39, 4mm slice thickness/spacing).



**Figure 4:** 24 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous sagittal T1 MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon (long arrow) is also annotated. TECHNIQUE: Siemens Verio 3T, sagittal T1 sequence without injected contrast (TR 898, TE 12, 3mm slice thickness/spacing).



**Figure 5:** 20 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: AP and lateral radiographs of the ankle show no osseous or soft tissue abnormalities. TECHNIQUE: Digital radiography.



**Figure 6:** 20 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous axial proton density MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon (long arrow) and calcaneofibular ligament (open arrowhead) are also annotated. TECHNIQUE: Siemens Verio 3T, axial proton density sequence without injected contrast (TR 4830, TE 35, 4mm slice thickness/spacing).



**Figure 7:** 20 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous coronal proton density MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon with magic angle artifact (long arrow) is also annotated. TECHNIQUE: Siemens Verio 3T, coronal proton density sequence without injected contrast (TR 4030, TE 39, 4mm slice thickness/spacing).



**Figure 8:** 20 year old male with variant peroneus brevis tendon insertion on the calcaneus. FINDINGS: Contiguous sagittal proton density MRI images of the right ankle demonstrate the peroneus brevis tendon (short arrow) descending to its attachment on the calcaneal peroneal tubercle (asterisk). A normal peroneus longus tendon (long arrow) is also annotated. TECHNIQUE: Siemens Verio 3T, coronal proton density sequence without injected contrast (TR 3850, TE 36, 3mm slice thickness/spacing).

<b>Etiology</b>	Congenital
<b>Incidence</b>	Not established (The authors discovered 2 cases in 200 examined ankle MRI exams)
<b>Gender Ratio</b>	Unknown
<b>Age Predilection</b>	Not applicable for congenital variant
<b>Risk Factors</b>	Unknown
<b>Treatment</b>	None
<b>Prognosis</b>	Unknown
<b>Findings on Imaging</b>	Radiography: None MRI: A peroneus brevis tendon which inserts on the lateral calcaneus on or near the peroneal tubercle. The variant tendon does not extend past the calcaneus and does not extend toward its normal insertion on the fifth metatarsal base.

**Table 1:** Summary table for variant peroneus brevis tendon insertion on the calcaneal peroneal tubercle.

Differential Diagnosis	Imaging Findings		
	Radiography	MRI	CT
<b>Peroneus Brevis Tendon Rupture</b>	None	Avulsion of the peroneus brevis tendon from the lateral base of 5 <sup>th</sup> metatarsal with tendinous retraction.	Distal peroneus brevis tendon indistinctness with local fluid collection/edema.
<b>Peroneus Brevis Partial Tear</b>	None	Often a split tear with bisected or “C” shape appearance of the tendon with interposition of the peroneus longus tendon.	Soft tissue edema in region of peroneus brevis partial tear.
<b>Variant Peroneus Brevis Insertion on the Calcaneus</b>	None	Insertion of the peroneus brevis tendon on the lateral calcaneus, on or near the peroneal tubercle.	Absence of peroneus brevis tendon insertion on 5 <sup>th</sup> metatarsal base.

**Table 2:** Differential diagnosis table for peroneus brevis tendon abnormality with description of image findings.

**ABBREVIATIONS**

MR = magnetic resonance  
MRI = magnetic resonance imaging

**KEYWORDS**

Peroneus brevis; peroneal tubercle; peroneal variant; peroneus quartus; peroneal tendon tear

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