



# Pseudo-tear appearance of the posterior tibiotalar ligament on fluid-sensitive sequences

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## Abstract

**Purpose** This study aimed at studying the MR imaging appearance of the tibiotalar ligament in asymptomatic volunteers. **Materials and methods** Forty-two ankles were imaged on a 3T MR system using proton density weighted images with fat saturation (TR, 2969 ms; TE 30 ms; NA, 2; slice thickness, 2.5 mm). Subjects with acute ankle conditions or history of previous trauma were not included in the study group. Images were obtained in the three orthogonal planes. The posterior tibiotalar ligament was assessed on coronal imaging, by consensus of two radiologists. The signal intensity was recorded as isointense, hypointense, or hyperintense relative to muscle. The morphology of the ligament was classified as homogenous or striated. Descriptive statistics were obtained. **Results** There were 8 men and 14 women with a mean age of 24.7 years (range 19–43 years). The ligaments were classified as hyperintense in 30/42 (70%) of ankles and isointense in 9/42 (21%) of ankles. A striated appearance was seen in 34/42 (80%) of ankles. **Conclusion** The posterior deep deltoid ligament is commonly hyperintense. It is usually striated although it can be homogeneously hyperintense. This appearance simulates a tear.

**Keywords** Ankle · MR · Ligaments

## Introduction

In our clinical practice, we have observed frequent diagnosis of deltoid ligament tears on MR imaging. In some cases, the diagnosis had led to further work-up even in the absence of associated injuries. In the early days of MR imaging the posterior tibiotalar ligament was described as a homogenous hypointense band on T1 weighted images [4]. With advances in MR and US a multilayered appearance to the ligament became recognized [2, 5]. This appearance can usually be appreciated on US and is appreciated on MR imaging as well [1, 8]. On MR imaging, the hypointense fibers are commonly

intermixed with hyperintense striations on T2 weighted images. The striations may even be absent and the ligament may be homogeneously hyperintense. This prevalence of this appearance has not been studied systematically. It is important to be aware of this aspect as it may lead to misdiagnosis of a tear. The purpose of this study was to investigate the appearance of the posterior tibiotalar ligament in asymptomatic volunteers.

## Materials and methods

Our study was approved by the ethical board of the hospital. Twenty-one asymptomatic volunteers (42 ankles) were imaged on a 3T MR system (Philips, Achieva, Best, The Netherlands). Proton density weighted images with fat saturation (TR, 2969 ms; TE, 30 ms; NA, 2; slice thickness, 2.5 mm; FOV, matrix size). Patients with ankle pain or a history of previous ankle trauma were excluded. Images were obtained in the three orthogonal planes. The images were stored on PACS (Agfa, Mortsel, Belgium).

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The posterior tibiotalar ligament was assessed by two experienced radiologists by consensus. The signal intensity of the ligament was categorized as hypointense, isointense, or hyperintense, with reference to muscle tissue. The ligament morphology was classified as homogenous or striated. Descriptive statistics were calculated (SPSS, Chicago, ILL, USA).

## Results

There were 8 men and 13 women with a mean age of 24.7 years (age range 19–43 years). None of the volunteers had a history of recent or remote ankle trauma. The results are summarized in Table 1. The ligament was hyperintense in 30/42 (70%) of ankles and isointense in 9/42 (21%) of ankles. A striated appearance was seen in 34/42 (81%) of ankles. A hypointense aspect was seen in 3/42 (7%) of ankles. A hyperintense striated appearance was the most common pattern, seen in 26/42 (62%) of ankles. A striated isointense appearance (the most normal appearing aspect) was seen in 7/42 (16%) of ankles. The same findings were present bilaterally in 9/21 (43%) of volunteers.

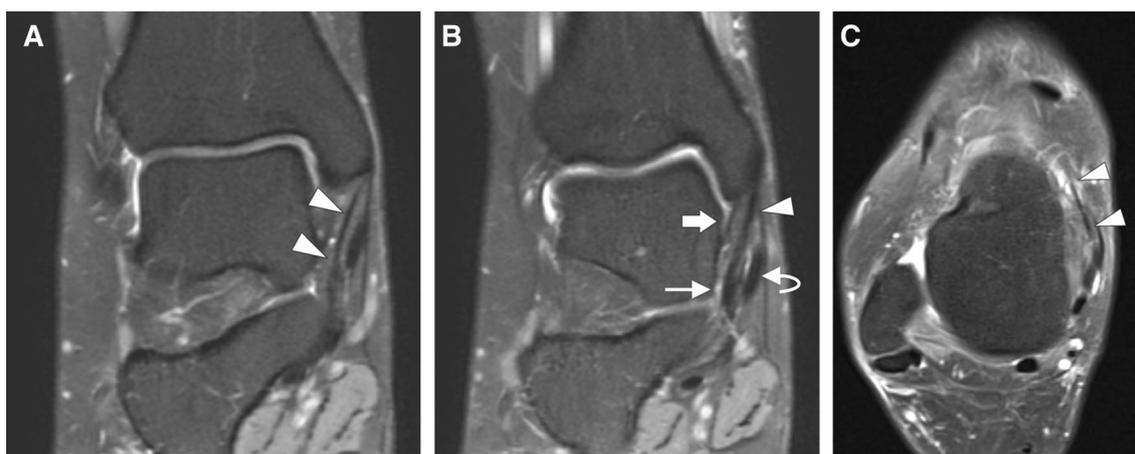
**Table 1** Appearance of the posterior deltoid ligament in 21 volunteers (42 ankles)

	Hyperintense	Isointense	Hypointense
Homogenous	3	2	2
Heterogenous	1	0	0
Striated	26	7	1

## Discussion

In our clinical practice we observed many MRI diagnoses of tibiotalar ligament tears that led to further work up. We questioned if this was not the result of overdiagnosis of deep deltoid ligament tears. These ‘tears’ were typically reported as isolated findings. When reviewing the literature this appears an unlikely event. It is rare for the deep deltoid ligament to be injured without an associated injury of the superficial components [9, 10]. In addition, such injuries are typically associated with ankle fractures or lateral ligament injuries. We conducted a study on the normal MR appearance of the posterior tibiotalar ligament in normal volunteers, without ankle pain or a previous history of trauma.

The deltoid ligament of the ankle consists of a superficial part and deep part. There is considerable anatomical variation as to how well developed each part is [5, 6, 9]. The superficial part consists of tibionavicular, tibiospring, and tibiocalcaneal ligaments (Fig. 1). These ligaments do not represent well-defined separate structures, but rather a continuum of blending fibers. The tibiospring ligament connects to the superomedial band of the spring ligament. The deep tibiotalar part consists of an anterior and posterior part. It is well recognized that the anterior part is rather poorly developed, whereas the posterior part is a well-developed, thick and strong structure [9]. Mengiardi et al. [7] described this deltoid component in detail. They observed it was typically striated, a pattern that was more commonly observed in younger patients. They did not report, however, that the ligament commonly appears hyperintense on fat saturated T2 images,



**Fig. 1** **a** Superficial deltoid. Note tibio-calcaneal ligament outlined by arrowheads. **b** Superficial deltoid ligament. Tibiospring ligament is outlined by arrowheads. Note superomedial component of spring ligament (arrow), and adjacent posterior tibial tendon (curved arrow). At

this level the anterior tibiotalar ligament is seen (bold short arrow). **c** Tibionavicular ligament. Note proximal part of tibionavicular ligament (arrowheads) just inferior to medial malleolus



**Fig. 2** Deep posterior deltoid ligament. Note striated appearance with isointense signal in between the hypointense ligament fibers. This aspect appears ‘most normal’ but is exceptional



**Fig. 4** Deep posterior deltoid ligament. Striated appearance with hyperintensity in between the hypointense ligament bundles. This appearance is most common but simulates an injury



**Fig. 3** Deep posterior deltoid ligament. Homogenous hypointense appearance. This appearance is also uncommon. Absence of hyperintensity suggests absence of recent injury, although the absence of typical striations may suggest a remote injury



**Fig. 5** Deep posterior deltoid ligament. Homogenous hyperintense appearance. This aspect suggests an injury but may be seen in normal volunteers

an appearance that suggests a tear. We showed in our work, that the ligament commonly is striated or even non-striated hyperintense.

MR imaging can visualize the different ligament parts [2, 5]. The anatomy is best displayed on T1 or proton density weighted images, whereas ligament edema is assessed on T2 fat saturated images. On T1 images, the ligament parts show a hypointense appearance well outlined by hyperintense fatty tissue. On T2 with FS images, the ligament bundles appear hypointense also outlined by the slightly less hypointense appearance of saturated fat (Figs. 2, 3). Our study showed that in normal volunteers the deep tibiotalar ligament often shows a hyperintense appearance, striated or homogenous (Figs. 4, 5), leading to difficulty in assessment of tears.

Our results show that the deep ligament appears hyperintense in the majority of normal volunteers. This appearance simulates a low-grade tear. In addition to being hyperintense, the normal striated appearance may be absent, and the ligament may be homogeneously hyperintense. This appearance simulates a high-grade tear. Both these appearances may result in overdiagnosis of deep deltoid ligament tear on MR images. Anatomically, the ligament is made up of bundles of parallel fibers running obliquely from the tibia to the talus. The hyperintensity is likely related to fibrofatty tissue interspersed between the ligament bundles as well as magic angle artifact.

Prior literature suggests that deep deltoid ligament tears typically do not occur in an isolated fashion [2, 3, 5, 6, 10]. Instead, the deep deltoid ligament tears are typically

associated with superficial deltoid ligament tears. While a hyperintense appearance of the deep deltoid ligament may not be a reliable sign of an injury, the presence of bony avulsion seems a more reliable indicator of recent trauma. Deltoid ligament tears also are observed in the setting of ankle fractures and lateral ligament injuries. A review of the Lauge-Hansen classification is beyond the scope of this article, but this system describes the patterns of different ankle fractures and injured ankle ligaments.

Our study has limitations. First, our sample size was relatively small. Nevertheless, even in this small sample, the majority of tibiotalar ligaments showed ‘abnormal’ features. Second, we cannot entirely exclude that remote trauma was not remembered and caused the ligament to exhibit hyperintensity. Third, we studied our normal population only on one MR system. This system is, however, state of the art. The TE of our proton density images was 30 ms which may contribute to the high signal of the ligament. However, this is a typical sequence used to assess the ligament.

In conclusion, on MR imaging the posterior tibiotalar ligament commonly appears hyperintense on T2 FS images, either striated or homogenous. This appearance may simulate a tear leading to overdiagnosis. This ligament part is essentially difficult to assess on MR imaging. Clues to a real injury may include bony avulsions along the course of the ligament, associated lateral ligament tears, and ankle fractures.

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