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Elias, D. A., Carne, A., Bethapudi, S., Engebretsen, L., Budgett, R., O'Connor, P. (2013). Imaging of plantar fascia and Achilles injuries undertaken at the London 2012 Olympics. *Skeletal Radiology, 42*, 1645-1655.

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Imaging of plantar fascia and Achilles injuries undertaken at the London 2012 Olympics.

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Funding / grants : Nil

Abstract

Plantar fascia and distal Achilles injuries are common in elite athletes. Acute athletic injuries of the plantar fascia include acute plantar fasciopathy and partial or complete tears. Underlying most acute injuries is a background of underlying chronic plantar fasciopathy. Injuries may affect the central or less commonly lateral portions of the fascia and acute tears are generally proximal. Athletic Achilles injuries may occur at the mid tendon or the distal insertion, and there may be an underlying chronic tendinopathy. Acute or chronic paratendinopathy may occur as a separate entity or combined with Achilles injury. In this article the spectrum of athletic injuries of the plantar fascia and Achilles is described, illustrated by imaging findings from the London 2012 Olympic games.

Keywords: Achilles tendon, plantar fasciitis, athletic injuries, magnetic resonance imaging, ultrasonography

Introduction

10,568 athletes competed at the London 2012 Olympic games, representing 204 countries in 26 sports featuring 39 disciplines. The athletes principally resided at the Olympic Village over a 4-week period covering the games. The village was equipped with a polyclinic, staffed by specialist medical and paramedical teams, and athletes had free access to medical care and virtually immediate access to imaging facilities at the clinic. Over the games period 835 MRI and 347 ultrasound examinations were performed at the polyclinic. Whilst some national teams travelled with local health professionals who brought ultrasound equipment with them, all injuries requiring MRI during the games period would have been imaged at the Olympic facility. Permission was given by the International Olympic Committee and the London Organising Committee of the Olympic Games for the use of anonymous images from athletes in research. In this article we review anatomy, pathology and imaging findings of athletic injuries of the plantar fascia and Achilles, and describe the spectrum of imaging findings seen at the London 2012 Olympics.

Plantar Fascia

Anatomy

The plantar fascia serves to support the medial longitudinal arch of the foot. It is comprised of a system of plantar subcutaneous fibrous bands, and is divided into central, medial and lateral portions (Fig. 1) [1] [2]. The central portion is the broadest and strongest component of the fascia and it originates at the medial calcaneal tuberosity. Distally at the level of the metatarsals, it divides into five fascicles, and these in turn have superficial and deep branches which have attachments to the skin, to the flexor tendon sheaths, and to the plantar plates of the metatarsophalangeal joints in each toe [1]. The lateral portion originates adjacent to the central portion, and divides into medial and lateral components which insert onto the 3rd or 4th metatarsophalangeal joints and the base of the 5th metatarsal respectively. The medial portion is thinner and forms the fascia over abductor hallucis [1].

Magnetic resonance (MR) imaging demonstrates all 3 portions of the normal plantar fascia. The central and lateral portions are most reliably demonstrated in the sagittal and coronal (short axis) planes, and the fascia is of uniform low signal on all sequences, and tapers smoothly from proximal to distal (Fig. 1b,c). The central and medial portions have soft tissue distal insertions forming the plantar aponeurosis, the lateral band differs somewhat with a bony insertion at the base of the fifth metatarsal [3].

On ultrasound imaging, the central and lateral portions are best demonstrated in the sagittal plane (Fig. 1d). Provided the insonating beam is directed perpendicular to the fascia, it appears as a striated echogenic structure, tapering smoothly from proximal to distal. Within 10mm of its origin, the central portion measures 3-4mm in thickness [1] [4].

Biomechanics/ Mechanism of Injury

Anatomical factors which predispose to plantar fascial stress include a planus or cavus foot, lateral tibial torsion, increased femoral anteversion or leg length discrepancy [5]. Functional predisposing factors may include inappropriate footwear, overtraining especially on hard unyielding surfaces, and Achilles or gastrocnaemius tightness [5] [6]. Such anatomic and functional factors may be associated with an over-pronating gait which can generate excessive plantar fascial stresses, particularly during the initial contact phase of the gait cycle [7]. During this phase, foot pronation and flattening of the longitudinal arch can overstretch the fascia. During running, weight is shifted to the ball of the foot and this increases the stress on the plantar fascia especially if running technique is poor, if shoes provide an inadequate arch support, or where forward pelvic tilt increases forces on the ball of the foot [8]. Repetitive overstretching is thought to cause microtears and chronic myxoid degeneration [9] [7]. This usually occurs within the central portion close to the calcaneal origin, although less commonly the lateral portion may be involved and is prone to more distal disease [10]. In either case, histologic evidence of inflammation has been lacking, and therefore the term, 'plantar fasciopathy' is preferable to 'plantar fasciitis' [10] [9]. Athletes may also present with acute rupture, which may occur on the background of a chronic plantar fasciopathy, often with a history of previous steroid injection [11] [12].

Presentation

Plantar fasciopathy in athletes, is typically seen in running or jumping sports, including track and field, soccer and gymnastics [13]. It presents with a sharp pain under the anteromedial heel, often present on waking and worst on beginning walking. The pain may lessen with further movement, but in athletes, pain increases during activities which distribute weight frequently onto the toes [14].

Plantar fascial rupture is much less common but may occur during athletic activity. In a series of 18 plantar fascia ruptures in athletes [15], 12 were runners, and other sports included hiking, basketball, tennis and soccer. All but one of the patients had a previous history of plantar fasciopathy and 4 patients had previous steroid injection. Patients describe a 'pop' or tearing sensation in the sole of the foot during athletic activity, and there is a subsequent inability to perform a single leg heel raise. There may be plantar bruising and swelling and pain on passive extension of the toes.

Injury at London 2012

Over the Olympic games period 12 athletes were imaged with acute plantar fascia injuries. Additionally, one athlete with an acute Achilles tear was noted to have a previous chronic plantar fascial injury with scarring. The 12 acute plantar fascial injuries included 5 males and 7 females with a mean age of 27.8 years (range 16 – 32 years). Eight athletes had right sided injuries, and four were left sided. Sports included track and field, team handball, basketball, and gymnastics. Five of the athletes underwent ultrasound examination, and all had MR imaging.

Of the 12 acute injuries, 10 had plantar fascial tears, all of which were partial (Figs 2-5). Seven tears were of the central portion of the fascia (Figs 2-4) and 3 were lateral (Fig. 5). At least 6 of the 7 central portion tears showed thickening of the fascia consistent with underlying chronic fasciopathy. Of the 3 lateral portion tears, 1 showed underlying chronic fasciopathy of the lateral portion, 1 showed underlying chronic fasciopathy of the medial portion only and one showed no MR evidence of underlying chronic fasciopathy. Two athletes had features of an acute or acute-on-chronic fasciopathy without a tear (Fig 6).

Imaging Findings

On MR imaging, plantar fasciopathy appears as fusiform thickening of the plantar fascia, generally close to its calcaneal origin [2] [16]. In acute plantar fasciopathy there may be intermediate T1, and high T2 or STIR signal of the fascia and soft tissue oedema superficial or deep to the fascia (Fig. 6). Bone changes are seen with marrow oedema close to the calcaneal attachment of the fascia (Fig. 2b,c); and calcaneal spur formation [7](Fig. 5). HLA B27 positivity in individual patients may determine the predominance of bone involvement [17]. In acute plantar fasciopathy, there is marked fascial and perifascial enhancement following intravenous gadolinium contrast administration [18].

Plantar fascial rupture is described at the proximal origin and at the midsubstance of the fascia, but acute ruptures are more commonly proximal [18]. On MR imaging there is partial or complete disruption of the normally low signal fascial band, replaced by markedly high signal on T2 or STIR, due to haemorrhage and oedema (Fig. 2-5). This signal will often track into the underlying flexor digitorum brevis muscle, with a feathery appearance indicating intramuscular haemorrhage and oedema, due to an associated muscle strain [7] [19] (Fig. 3a, 4f). Where plantar fascial rupture is complete, the fascia may have a wavy appearance due to retraction. Following intravenous gadolinium contrast, acute ruptures demonstrate marked perifascial enhancement [18].

On ultrasound imaging, plantar fasciopathy appears as fascial thickening (>4mm), generally of the central portion, close to its calcaneal origin [7] [20] [21] [4] (Fig. 2a). There is also a reduction in reflectivity of the fascia, but the fascia is seen to remain in continuity. A calcaneal spur may be seen. Increased power Doppler signal has been reported in acute plantar fasciopathy [22]. Plantar fascial rupture is identified on ultrasound as a partial or complete disruption of the fascia (Fig. 2a, 4a). Acutely, this may be associated with anechoic or hypoechoic tissue representing haemorrhage or inflammatory tissue crossing the defect.

Achilles

Anatomy

The medial and lateral heads of the gastrocnemius muscle arise from the posterior aspects of the medial and lateral femoral condyles. The two heads coalesce as they descend and form the Achilles tendon 15-20cm above the calcaneum [23] [24]. The soleus muscle arises from the soleal line at the posterior proximal tibia and adjacent fibula and inter-osseous membrane, deep to the gastrocnemius muscles and forms a tendon which fuses with the gastrocnemius component of the Achilles approximately 5-6 cm above the calcaneal insertion. The Achilles tendon fibres spiral through 90 degrees and insert onto the posterior process of the calcaneum. The Achilles has no sheath but is encased in loose connective tissue known as the paratenon which aids tendon glide and supports vasculature. The plantaris muscle, present in 93% of individuals, arises from the posterior lateral femoral condyle, and its tendon runs between the medial gastrocnemius and soleus and variably inserts onto the calcaneum or medial Achilles. Anterior to the Achilles lies a triangle of fat known as the pre-Achilles fat pad. The retrocalcaneal bursa lies between the distal Achilles and the posterior process of the calcaneum just above the calcaneal insertion whilst the retro- Achilles bursa lies superficial to the distal tendon enthesis.

MR imaging demonstrates the normal Achilles tendon on sagittal images as a uniform low signal band on all sequences (apart from specialised ultra short TE images), with parallel anterior and posterior borders (Fig. 7a) [25]. On axial images the tendon is seen to have a broad elliptical shape. Distally fine speckles of high signal may be seen on axial images, representing its fascicular structure. On ultrasound, the Achilles tendon is seen in sagittal images as a homogenous ribbon-like structure with a parallel fibrillary pattern of tendon fibres outlined by a straight echogenic border representing the paratenon (Fig. 7b). On axial images the fibrillary structure presents a punctuate or 'honeycomb' pattern. The tendon broadens and flattens as it descends to its insertion on the calcaneum and has a maximal thickness of 4-6.7mm but this may be increased in athletes [25]. Vascularity should be assessed using power Doppler with 'low flow' settings, with the knee slightly flexed and the Achilles under as little tension as possible and with care taken not to obliterate small vessels due to excessive transducer pressure [26]. Vascularity should be absent from the normal Achilles and paratenon on power Doppler imaging. Dynamic examination is helpful and active and passive flexion during sagittal plane scanning will demonstrate smooth gliding of a normal tendon.

Biomechanics/ Mechanism of Injury

The gastrocnemius and soleus act via the Achilles to provide the primary propulsive force in walking and running [23]. The soleus has a postural function also during standing. Athletic activities produce considerable forces on the Achilles. During running as much as 6-8 times the patient's body weight can be transmitted through the Achilles, which approaches its maximum tensile strength [23]. The running gait cycle also produces a side-to-side whipping motion in the Achilles as the foot alternates rapidly between supination and pronation and this generates shear forces particularly on the medial side of the tendon [27]. During jumping, the Achilles musculotendinous unit acts as a shock absorber and the 90 degree rotation of the Achilles fibres provides some of its elastic properties akin to the twist in rope fibres. During the landing phase, there is a rapid stretch on the Achilles musculotendinous unit which absorbs the strain and the rotated fibres provide a recoil effect [27] [25].

Anatomical factors which may be associated with Achilles injury include a cavus or hyperpronated foot or genu varum, all of which can increase the stretch on the Achilles [23]. Functional factors include a sudden increase in running distance or intensity, especially hill running or interval training. Poorly fitting or new footwear may also be a significant factor.

With increasing age, the normal Achilles develops areas of fibrous, myxoid, fatty or occasionally ossific degeneration with disorganisation of its collagen matrix [28]. Excessive load during vigorous training may further stimulate degeneration, and lack of flexibility and underlying genetic and metabolic variables may play a role [29] [27]. This degeneration may be entirely asymptomatic but symptomatic tendinopathy is thought to occur when these regions become subject to microtrauma or fail. These changes typically occur in the middle third of the tendon (known as the critical zone), particularly medially, and this portion of the tendon is the most poorly vascular [29]. Recent studies using ultrasound of the Achilles have shown that intratendinous hypoechoic areas in asymptomatic ballet dancers [30] or areas of abnormal neovascularity or tendon thickening in asymptomatic runners [31] may be predictive of future symptoms with continued sporting activity.

A more distal insertional tendinopathy, can occur in the presence of underlying seronegative arthropathies and is also seen in athletes [24]. In chronic insertional tendinopathy, changes, including calcification, occur most prominently in the anterior insertional fibres, which have been shown to be relatively shielded from tensile stress. It has therefore been suggested that rather than representing microtears, changes in chronic insertional tendinopathy are adaptive, and represent an attempt to increase the surface area of the bone-tendon interface and protect it from injury [32] [33]. Commonly there is an association with a Haglund's deformity, a bony prominence at the lateral aspect of the posterosuperior calcaneum, and sometimes a retrocalcaneal bursitis [23]. Foot deformities such as a cavus foot or hindfoot equinovarus may be associated with a Haglunds deformity, but this may be asymptomatic unless an ill fitting or rigid heel or training errors combine to cause distal Achilles or retrocalcaneal bursal irritation [23].

Paratendinopathy may occur in isolation or in association with Achilles abnormality. Thickening and inflammation of the paratenon may be localised and nodular, or diffuse. It may be due to abnormal biomechanics or less commonly may relate to direct pressure or friction from poorly fitting footwear [23].

Achilles rupture can occur due to degenerative or mechanical causes. In degenerative cases, repetitive stress in areas of tendon degeneration may form macroscopic clefts producing partial Achilles tears and eventually complete rupture [34] [35]. In the mechanical cases, uncoordinated or excessive muscle contraction due to failure of normal neuromuscular inhibitory mechanisms in fatigued or inadequately trained athletes can lead to a sudden Achilles rupture. This may in part explain why ruptures often occur 30 minutes or more into exercise, and may particularly occur in athletes returning to sport too quickly after an inactive period [35]. The type of force type placed on the Achilles is also important with oblique load stress occurring in sports that require a rapid push-off being a common cause of Achilles tears [34].

Presentation

Mid-portion Achilles tendinopathy is most commonly seen in older athletes, typically middle aged males. It generally presents with a gradual onset of pain following exercise, with localised tenderness and nodular thickening of the Achilles typically at the medial aspect of the mid tendon [36]. Insertional tendinopathy presents in athletes with a gradual onset of exercise-related localised pain, tenderness and swelling at the distal Achilles insertion. In either case, superimposition of single or multiple episodes of sharp pain during running may indicate partial rupture [23]. Paratendinopathy presents with localised or diffuse tenderness and swelling around the Achilles and runners often have pain and stiffness on commencing exercise which they can 'run through' [23].

Achilles ruptures have a peak incidence in the 4th decade and are 5 times more common in males. Athletes generally feel a snap and may have the sensation of having been kicked in the back of the leg. The posterior calf is bruised or swollen and there may be a palpable defect. The Simmonds or Thompson test demonstrates absent plantar flexion on squeezing the calf.

Injury at London 2012

Over the Olympic games period 8 athletes were found to have Achilles abnormality on imaging. 5 athletes underwent MRI alone, 1 had ultrasound alone and 2 had both MRI and ultrasound. Two athletes had chronic Achilles tendinopathy incidentally identified on imaging for acute plantar fascial injury. The remaining 6 athletes with acute Achilles injuries included 5 females and 1 male with a mean age of 30yrs (range 24-33yrs). There were 4 right sided and 2 left sided injuries. Sports included track and field sprinting events, handball and basketball, all sports associated with rapid push-off activity. All 6 acute Achilles injuries were distal, and all had imaging evidence of underlying chronic insertional tendinopathy. One was a complete distal Achilles avulsion (Fig. 8). Four had acute partial distal tears (Fig. 9,10) and one had acute-on-chronic distal tendinopathy with no tear. No mid tendon Achilles injuries presented for imaging at the games.

Imaging Findings

On MR imaging, mid portion Achilles tendinopathy appears as mid tendon thickening with loss of parallelism of the anterior and posterior tendon margins on sagittal images [25] [28]. Intratendinous signal is also seen which may be patchy or diffuse. In insertional tendinopathy, the distal tendon is seen to be thickened with increased signal (Fig 9). Calcifications, when small may be subtle on MRI, but are seen as low signal masses in the tendon. MRI may demonstrate associated marrow oedema in the posterior process of the calcaneum. An associated Haglund's deformity is seen as a prominence of the posterosuperior calcaneum. Fluid insinuating between the distal Achilles and posterior calcaneum is seen in associated retrocalcaneal bursitis. Paratendinopathy is identified as oedema and thickening surrounding the Achilles and this will enhance following intravenous contrast administration. Achilles tears are seen as fluid signal clefts through the tendon substance, with discontinuity in complete tears. Haims et al noted significant overlap in MRI findings between symptomatic and asymptomatic Achilles tendons [37]. In particular mild intratendinous signal changes, mild tendon thickening and pre Achilles oedema were seen in asymptomatic individuals. However, calcaneal marrow oedema and Achilles tears were almost never present in asymptomatic tendons.

Sonographically, mid portion Achilles tendinopathy is seen as thickening of the tendon. There are focal areas of hypoechoechogenicity in which the normal fibrillary pattern is lost, and these areas coalesce as tendinopathy progresses. In insertional tendinopathy, the distal tendon is thickened and hypoechoic with bony irregularity of the distal insertion. Intratendinous calcification may be seen. Fluid in the retrocalcaneal bursa is readily identified. In both mid and insertional tendinopathy there may be intra and peritendinous hypervascularity on Doppler imaging. Paratendinopathy is identified as peritendinous hypoechoic thickening and hypervascularity. In acute partial tears, hypo- or anechoic fluid is seen tracking through the tendon substance (Fig 10). Probe pressure or gentle movements of the ankle may make fluid distort or disperse increasing its conspicuity. In complete tears the tendon ends are discontinuous and seen to move apart on gentle ankle dorsiflexion. There is often shadowing at the tendon margins [26].

Conclusion

Plantar fascia and Achilles tendon injuries are commonly encountered in elite athletes. The majority of the acute plantar fascial injuries imaged during the London 2012 games were partial tears on a background of chronic plantar fasciopathy, most of these affecting the origin of the central portion of the fascia. Less common imaging findings included partial tears of the lateral portion and acute on chronic plantar fasciopathy without a tear.

All of the acute Achilles injuries imaged over the games period involved the distal Achilles, and all had features of underlying chronic insertional tendinopathy. Most had acute partial distal Achilles tears.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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Figures

Fig. 1 a Anatomical drawing of the plantar foot depicting the plantar fascia. Note the central portion (light blue) divides into 5 fascicles which extend to each toe. The lateral portion has medial (open arrow) and lateral (arrows) components. The medial portion (asterisk) is thinner and forms the fascia over abductor hallucis. Anatomy image © Primal Pictures www.primalpictures.com b Sagittal proton density fat saturated MR image of the normal plantar fascia, demonstrating the normal smooth tapering of the central portion (arrows). c Coronal proton density fat saturated image demonstrates the central (arrow) and lateral (open arrow) portions of the normal plantar fascia. The medial portion (arrowhead) forms the superficial fascia of the abductor hallucis muscle belly (AH). FDB, flexor digitorum brevis; ADM, abductor digiti minimi. d Sagittal sonographic image of a normal central portion of the plantar fascia (arrows). The cortex of the posterior process of the calcaneum is seen (arrowheads).

Fig. 2 Acute right partial tear of the plantar fascia in a track and field athlete. a Sagittal sonographic image of the plantar fascia (arrows) shows plantar fascial thickening (callipers) consistent with chronic plantar fasciopathy with a partial tear (asterisks). The calcaneal posterior process (arrowheads) is seen. b Sagittal T2 weighted fat suppressed MRI image demonstrates an acute near full thickness tear (asterisk)of the central portion of the plantar fascia with oedema within the torn fibres. Note the remaining intact fibres (white arrows) and marrow oedema within the calcaneum (arrowhead). Oedema in the underlying flexor digitorum brevis (open arrow) is consistent with an associated muscle sprain. C Coronal T2 weighted fat suppressed MRI image confirms the tear (asterisk) with the more lateral fibres (arrows) of the central portion of the fascia remaining intact.

Fig. 3 Acute right plantar fascia tear in a long distance runner with known chronic plantar fasciitis. a Sagittal T2 fat suppressed MR image demonstrates an acute partial tear (arrow) of the origin of the central portion of the plantar fascia, with thickening (asterisk) of the fascia consistent with underlying chronic plantar fasciopathy. Oedema (arrowheads) tracking into the underlying flexor digitorum brevis is consistent with an associated muscle strain. Note the patchy marrow oedema throughout the ankle bones which is a common finding in long distance athletes.b The corresponding axial T2 fat suppressed MR image confirms the acute tear (arrow). There is a stress injury of the neck of the 5^{th} metatarsal (curved arrow) with surrounding soft tissue oedema.

Fig. 4 Acute left plantar fascia tear in a gymnast presenting with acute heel pain. a The sagittal extended field of view sonographic image of the left heel demonstrates thickening of the origin of the central portion of the plantar fascia (open arrows) with a partial tear (asterisks). The cortex of the posterior process of the calcaneum is seen (arrowheads). b The corresponding sagittal T2 weighted fat saturated MR image demonstrates the thickened origin of the central portion of the fascia (open arrow), with high signal within it consistent with acute injury on a background of chronic plantar fasciopathy. A chronic fibrocartilagenous calcaneonavicular coalition was noted (arrowheads). c The corresponding axial T2 weighted fat saturated MR image shows oedema (open arrow) within the proximal central portion of the plantar fascia. The ankle was strapped, but during training 2 days later there was a more severe episode of acute heel pain and an audible 'pop'. d Repeat sagittal T2 weighted fat saturated MR imaging revealed a new acute partial tear (arrow) of the central portion of the fascia. Note that the tear has resulted in fascial retraction with increased separation between the thickened portion of the fascia (open arrow) and the calcaneal attachment compared with the previous image b. e The corresponding axial T2 weighted fat suppressed MR image demonstrates that the lateral fibres of the central portion of the fascia have torn and retracted (open arrow) since the previous imaging in c, with oedema in the gap (arrow), but the more medial fibres of the central portion remain intact (arrowheads). f The corresponding coronal T2 fat saturated image reveals linear high signal tracks (arrows) within the flexor digitorum brevis muscle deep to the thickened central portion of the fascia (open arrow) consistent with an associated intrinsic muscle strain.

Fig. 5 Acute lateral portion plantar fascia tear in a handball player presenting with heel pain. a Axial T2 fat suppressed MR image of the right ankle demonstrates a partial tear (arrow) of the lateral portion of the plantar fascia. There is associated calcaneal marrow oedema (open arrow). Note that the central portion of the fascia (asterisk) is intact. b The corresponding coronal T2 fat suppressed MR image demonstrates the thickened origin of the lateral portion (arrowhead). The central portion (asterisk) is normal. Note the marrow oedema within the calcaneal spur (arrow).

Fig. 6 Acute right plantar fasciopathy in a track and field athlete presenting with acute heel pain. a Sagittal T2 weighted fat suppressed MR image demonstrates oedema (arrows) tracking superficial to the central portion of the plantar fascia consistent with an acute plantar fasciopathy with no evidence of tearing or underlying chronic fasciopathy. b Coronal T2 weighted fat suppressed MR image demonstrated oedema superficial to the central (arrow) and lateral (arrowhead)portions of the plantar fascia.

Fig. 7 a Sagittal proton density fat suppressed MR image of a normal distal Achilles (arrows). The distal muscle belly of soleus (*) is seen inserting on the Achilles. The pre-Achilles fat pad (F) lies anterior to the tendon. FHL = Flexor hallucis longus muscle belly. b Sagittal sonographic image of the central portion of a normal Achilles (arrows). The pre-Achilles fat pad (F) lies anteriorly. The cortex of the posterior calcaneal tuberosity (arrowheads) is seen.

Fig. 8 Acute complete avulsion of the distal Achilles in a track and field athlete. a Lateral ankle radiograph demonstrates an avulsed ossific fragment (arrow). b Sagittal T2 fat suppressed MR image demonstrates a retracted avulsed Achilles with a thickened distal tendon (asterisk). Note the marrow oedema in the posterior process of the calcaneum. c Sagittal sonographic image demonstrates the avulsed ossific fragment (arrow) at the termination of a thickened distal Achilles (asterisk) which is retracted from the calcaneal attachment (arrowheads). FHL – flexor hallucis longus muscle belly.

Fig. 9 Acute on chronic distal left Achilles insertional tendinopathy with a small partial tear in a basketball player. a Axial T2 fat suppressed MR image demonstrates thickening of the distal Achilles (open arrows) with a small partial tear (arrow). b The corresponding sagittal T1 MR image demonstrates the thickened distal Achilles (open arrows) and a Haglund's deformity (asterisk). c Sagittal T2 weighted fat suppressed MR image confirms the thickened distal Achilles (open arrow) and reveals marrow oedema within the Haglund's deformity (asterisk).

Fig. 10 Acute on chronic distal Achilles insertional tendinopathy with a small partial tear in a track and field athlete. a Sagittal sonographic image of the Achilles demonstrates a thickened distal Achilles (open arrows) with a small partial tear (asterisks) just above the calcaneal attachment (arrowheads). b Power Doppler imaging reveals marked hypervascularity in the distal Achilles.

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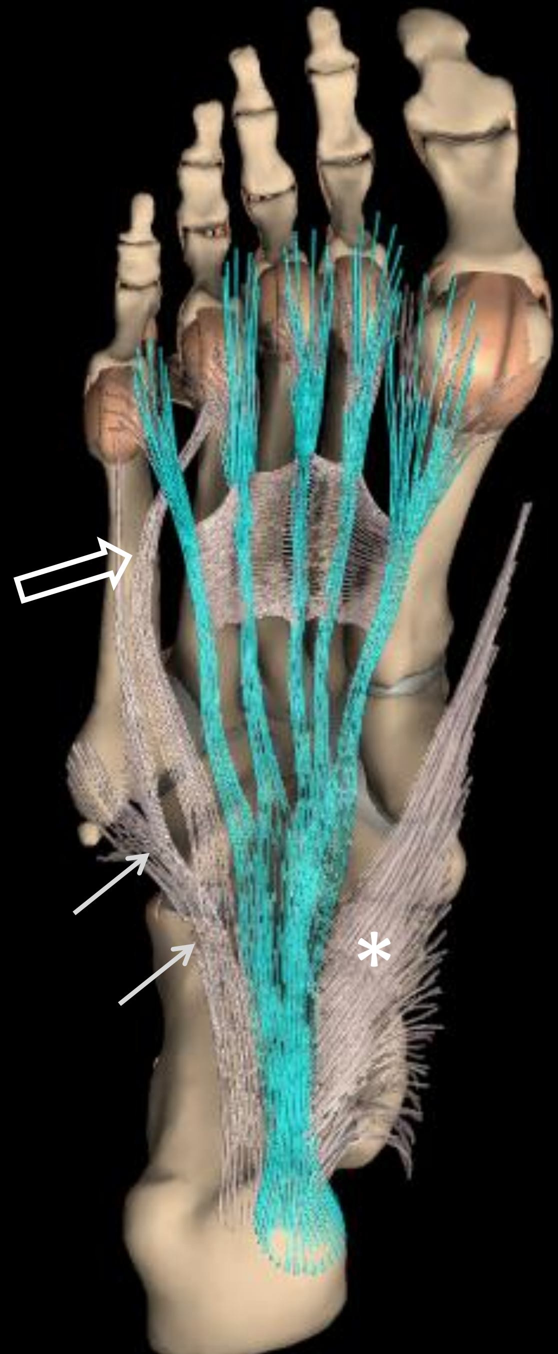

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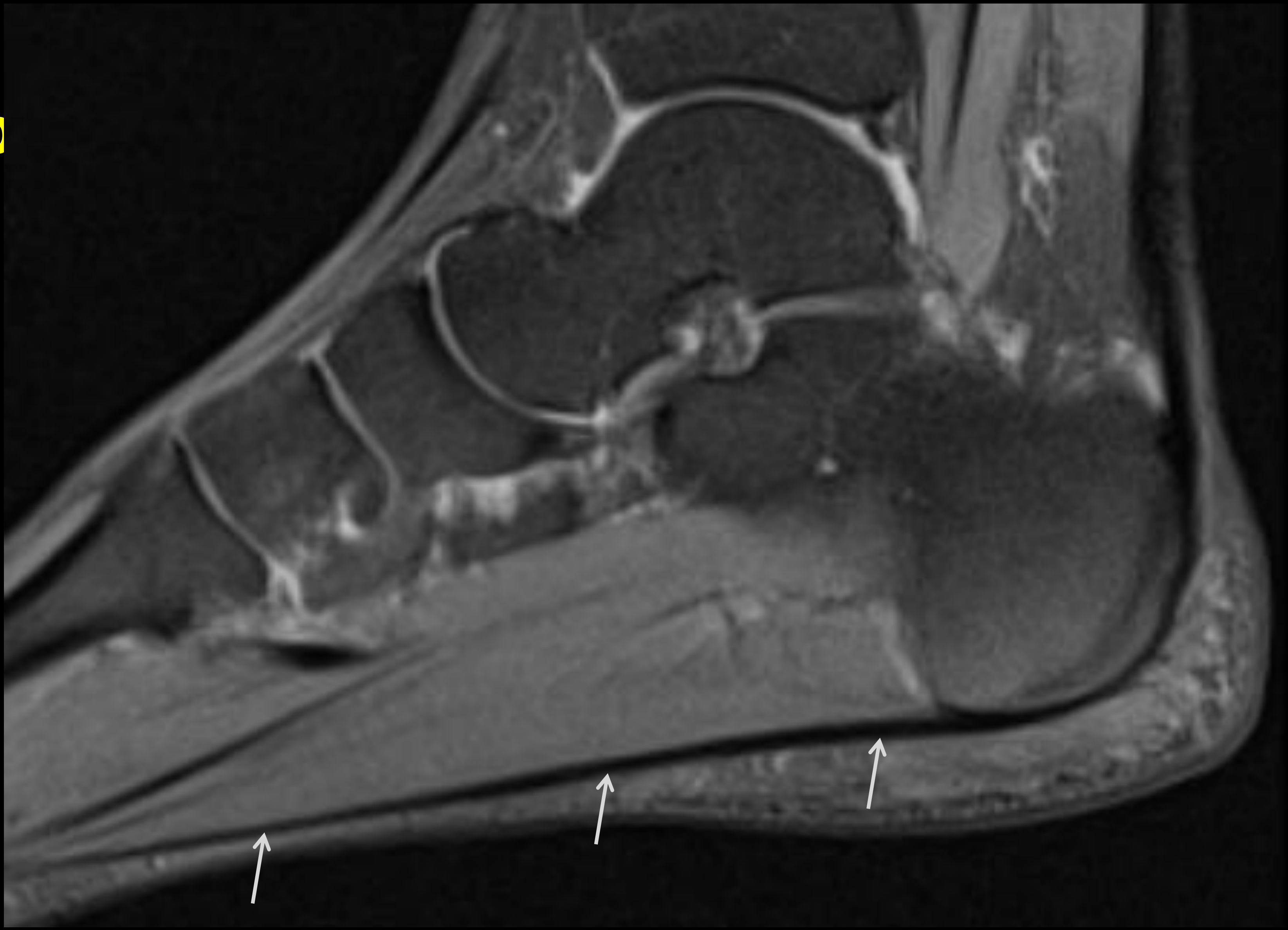

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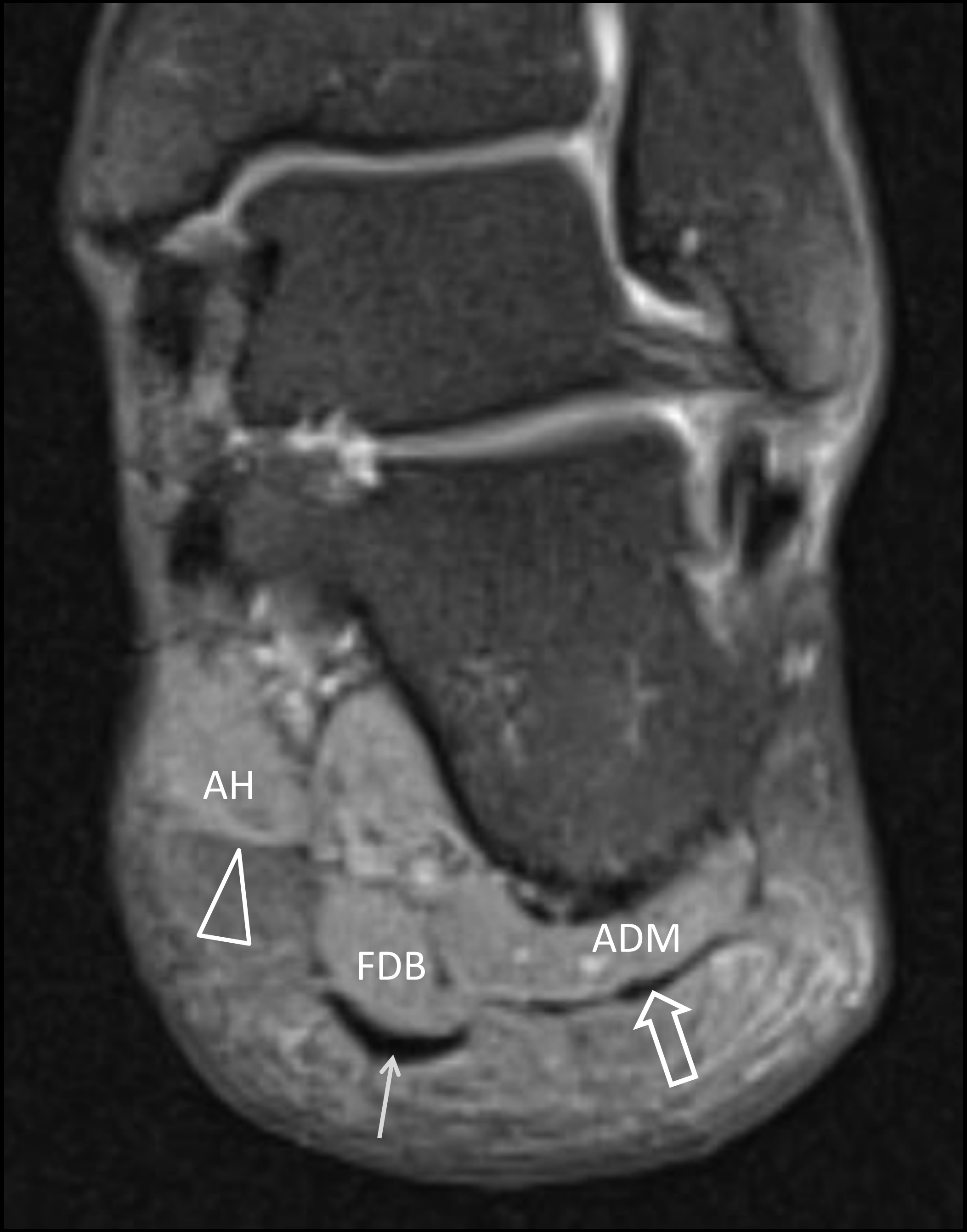

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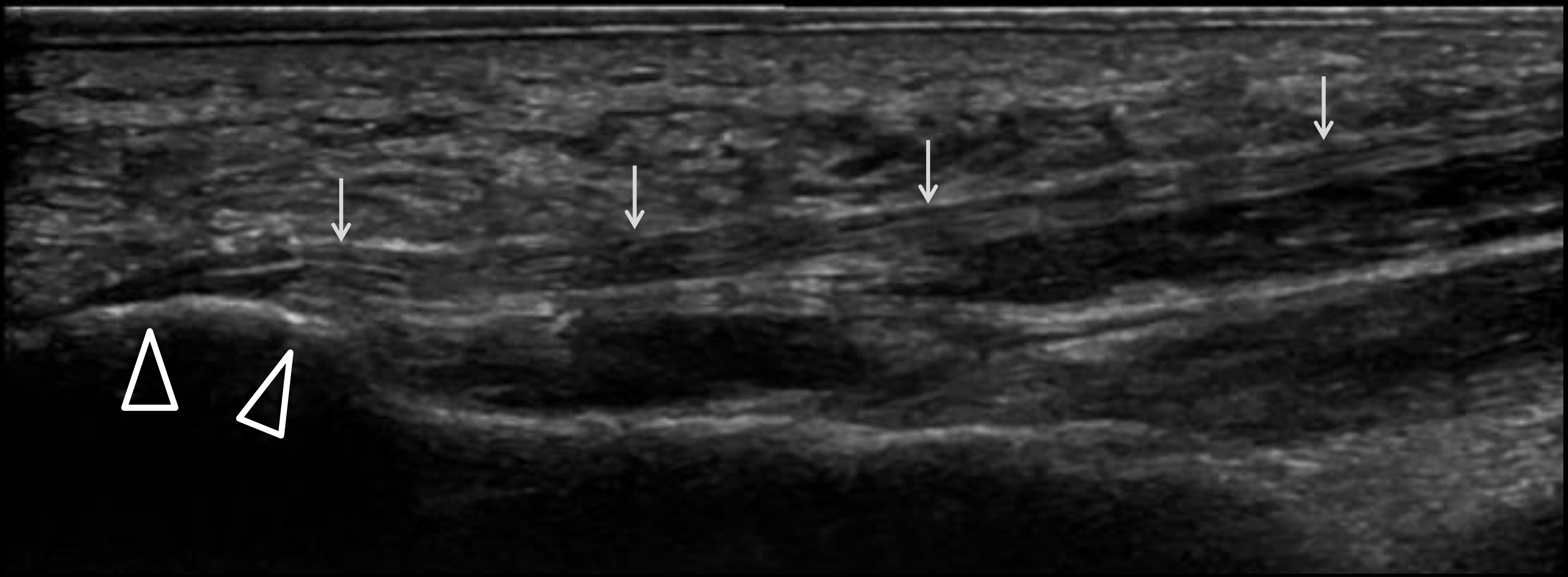

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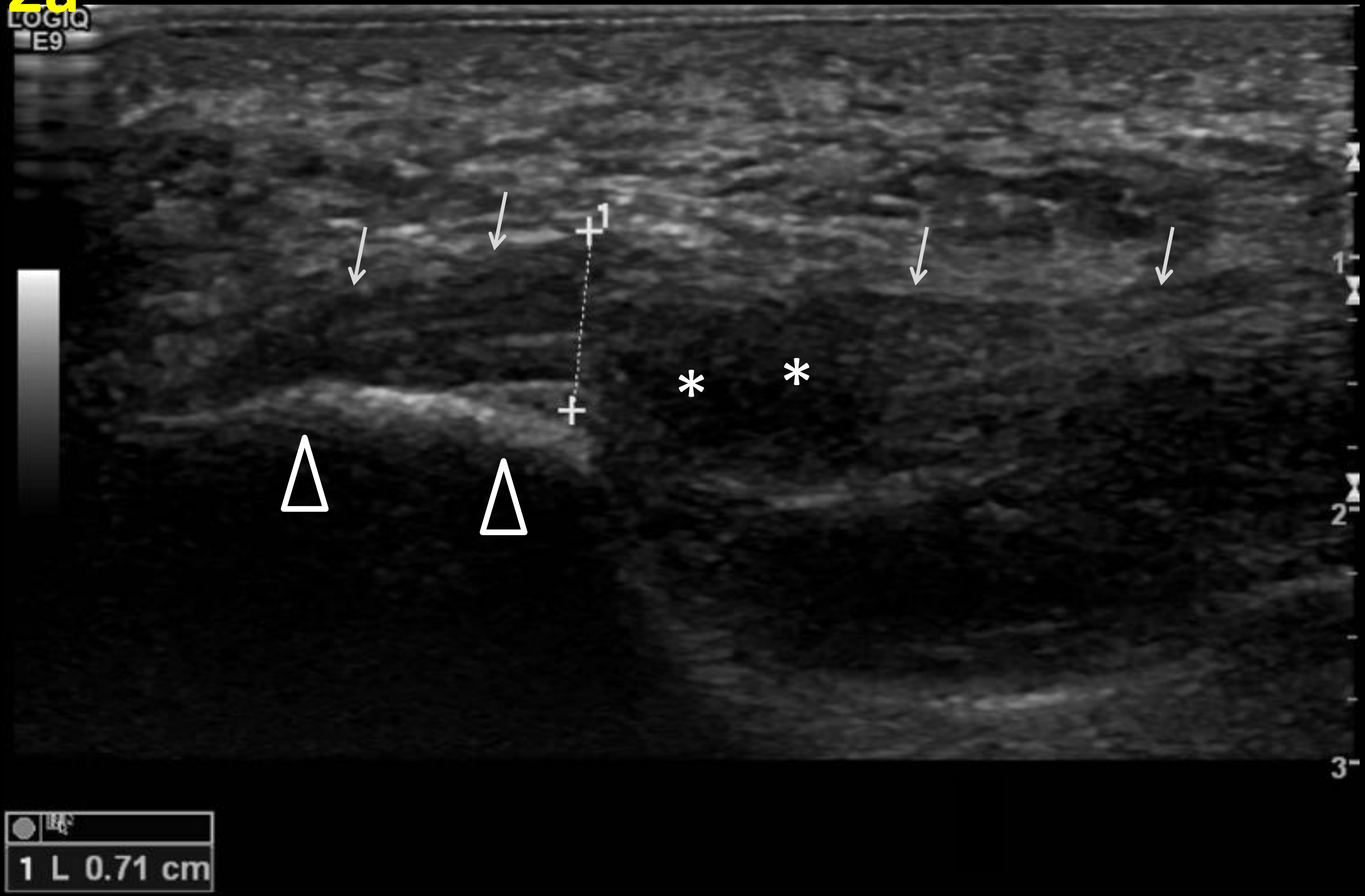

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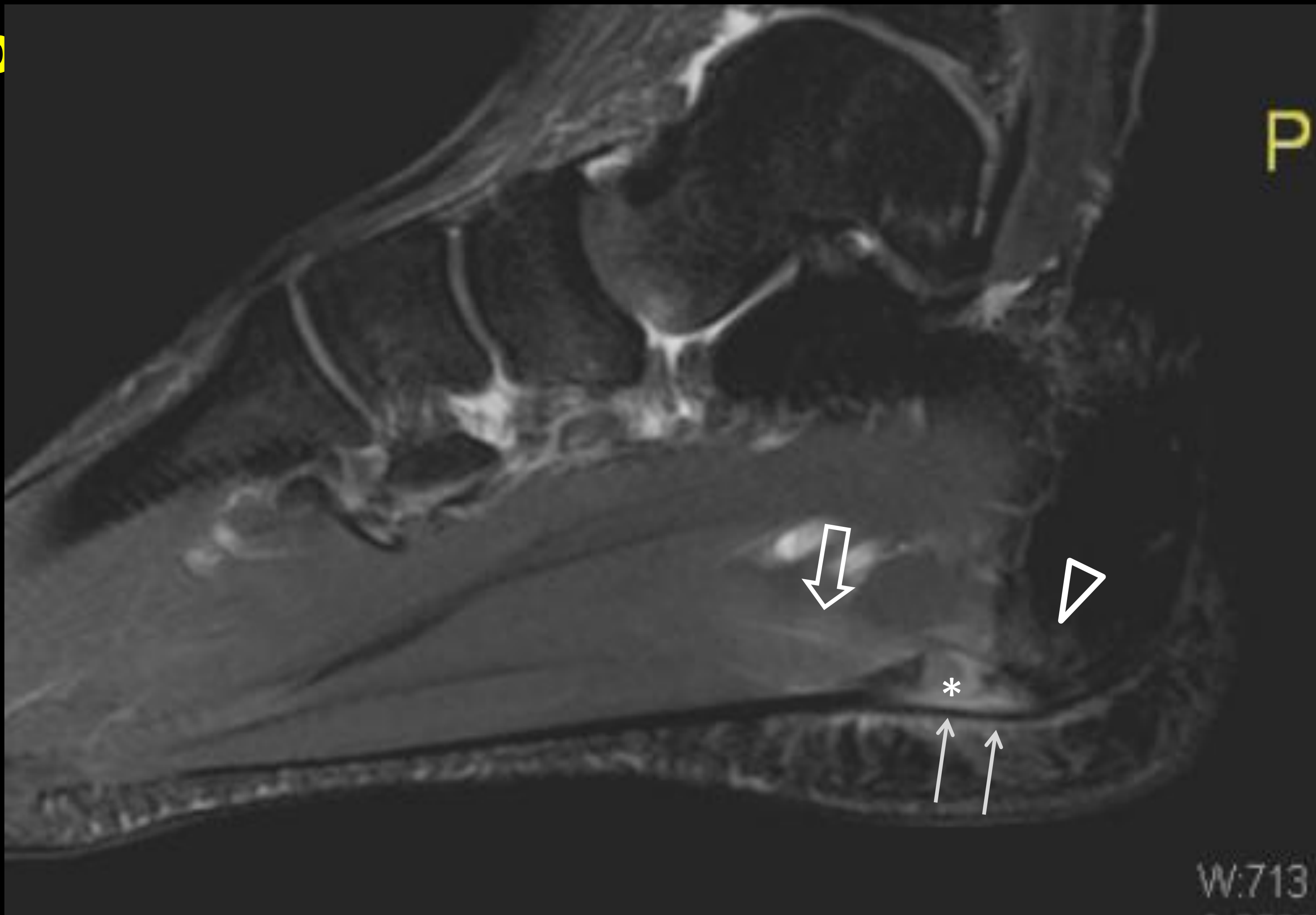

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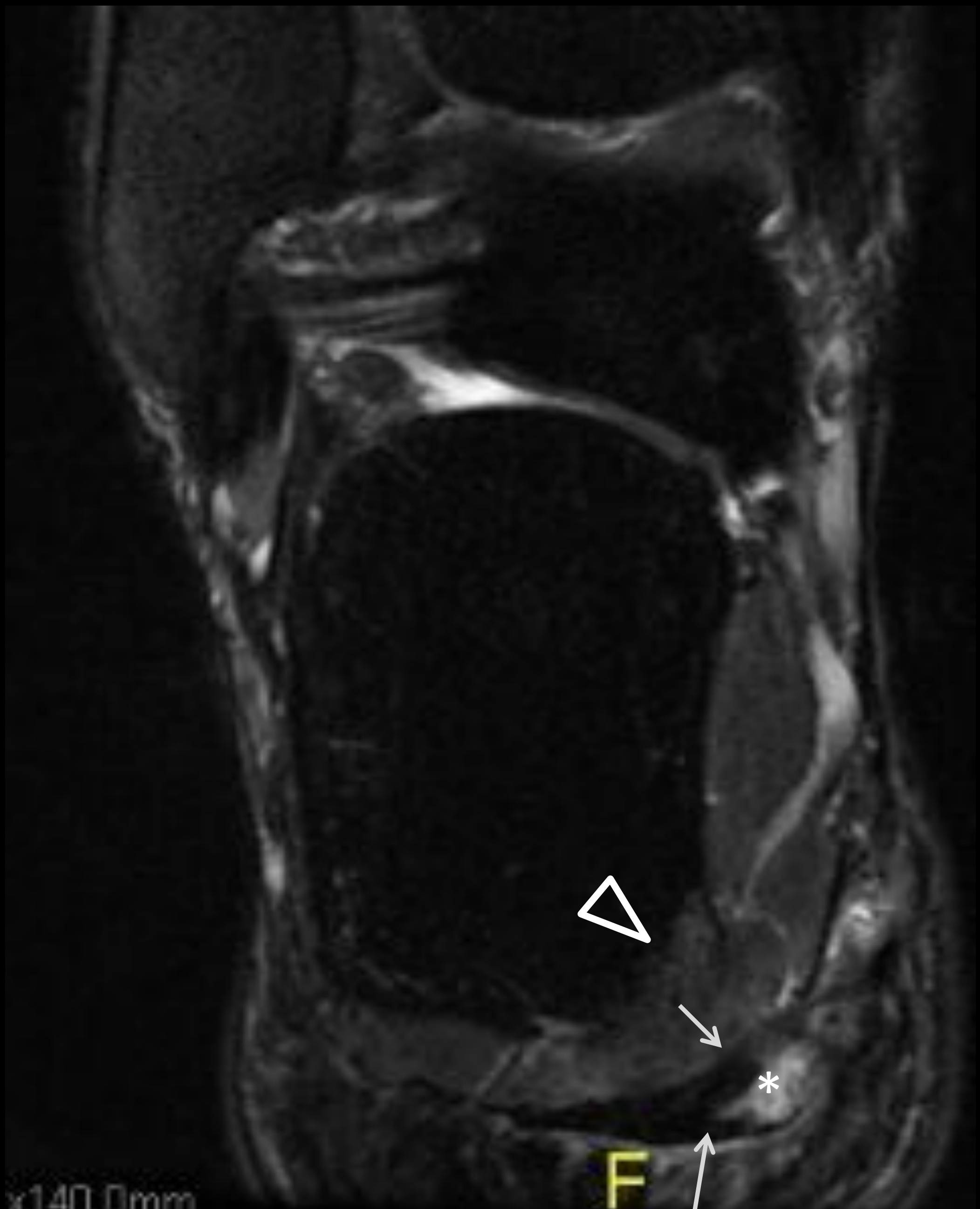

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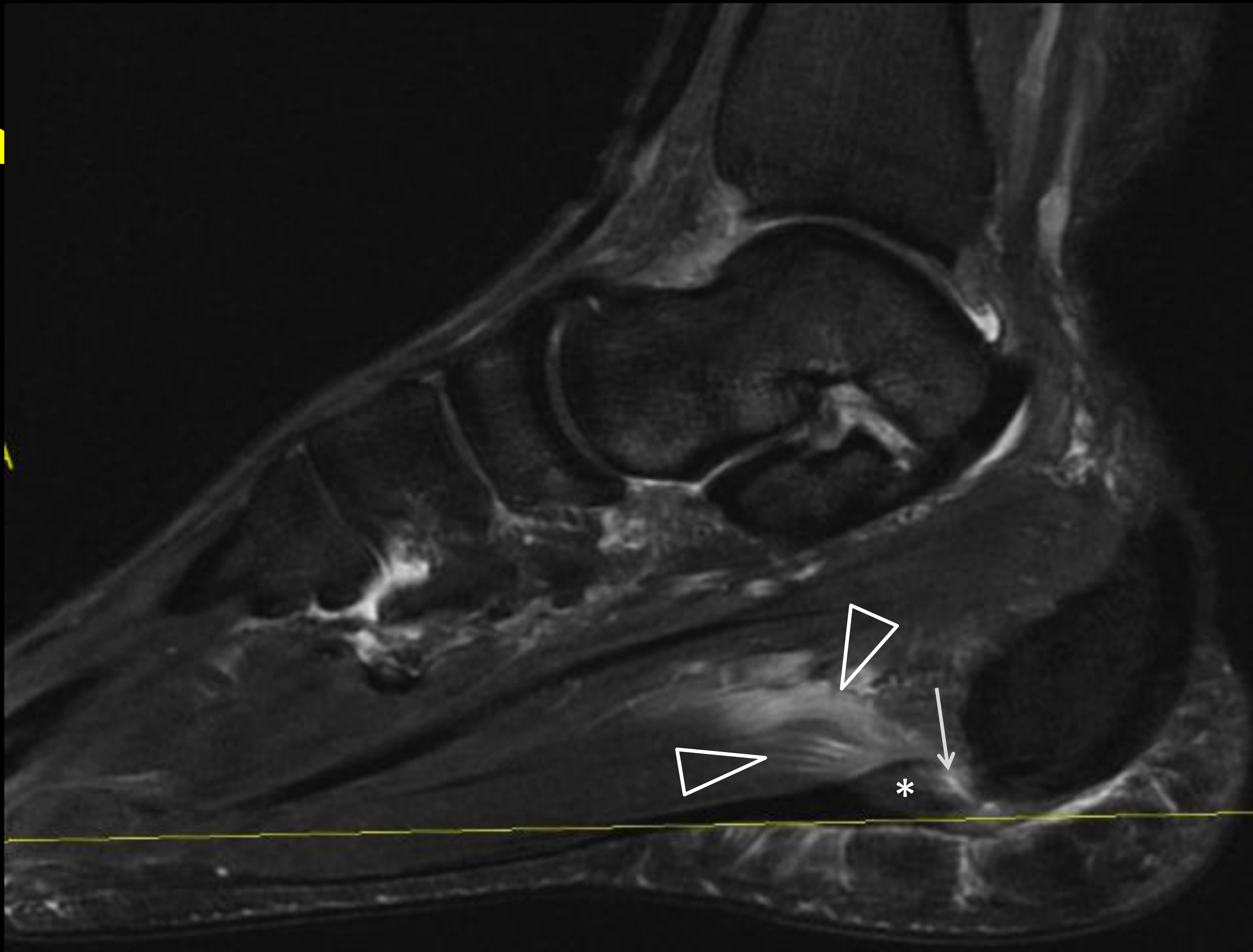

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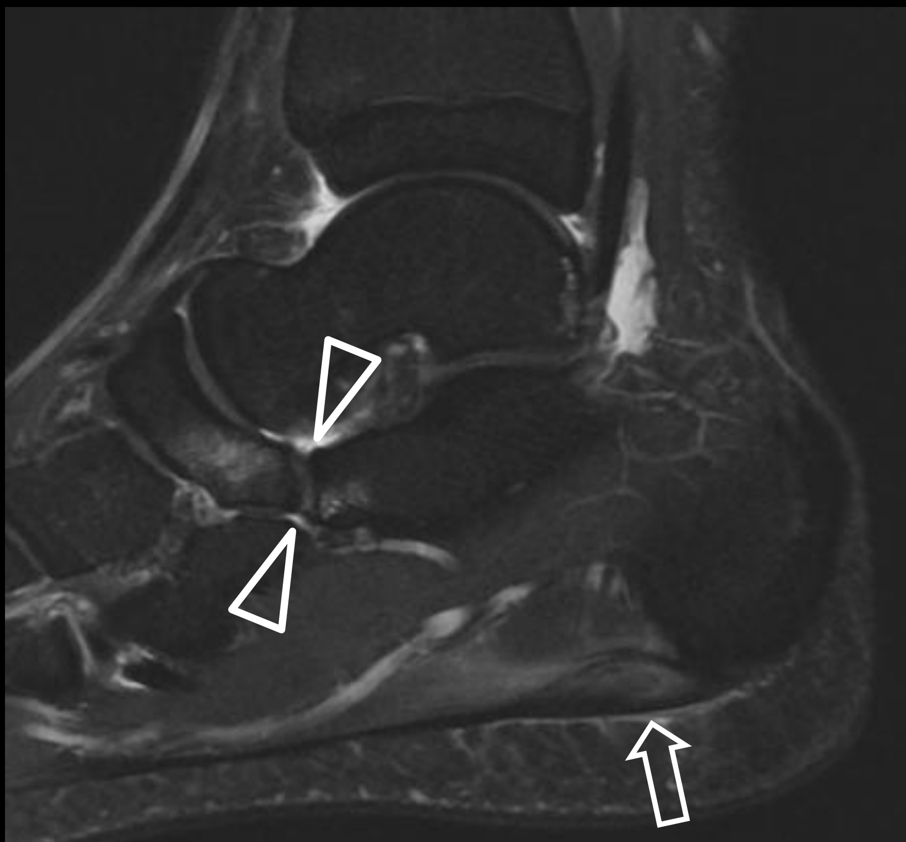

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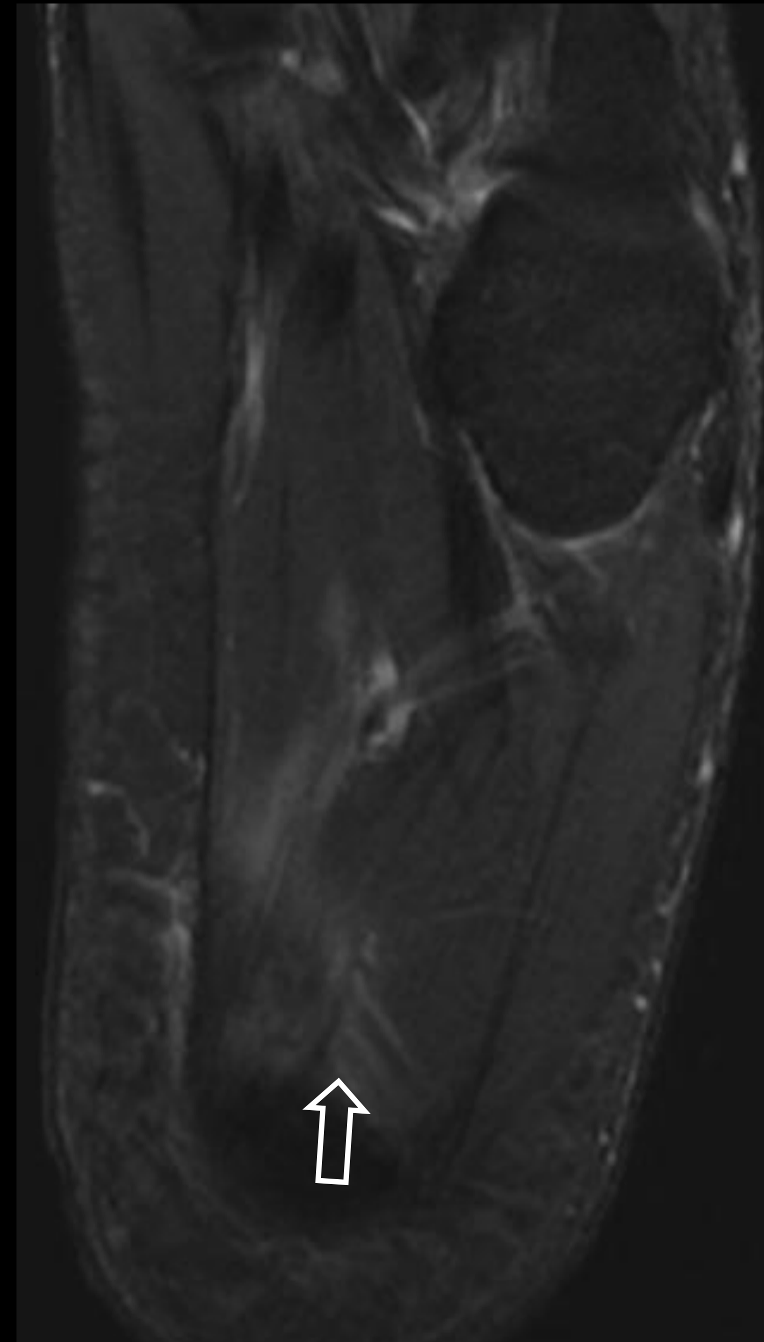

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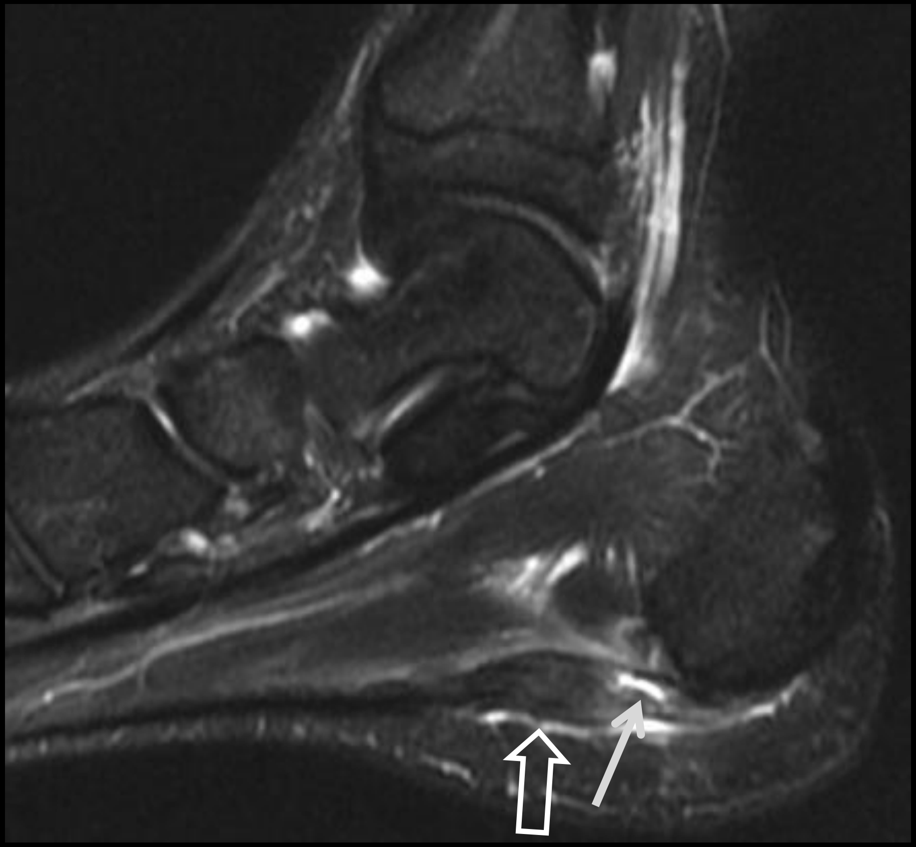

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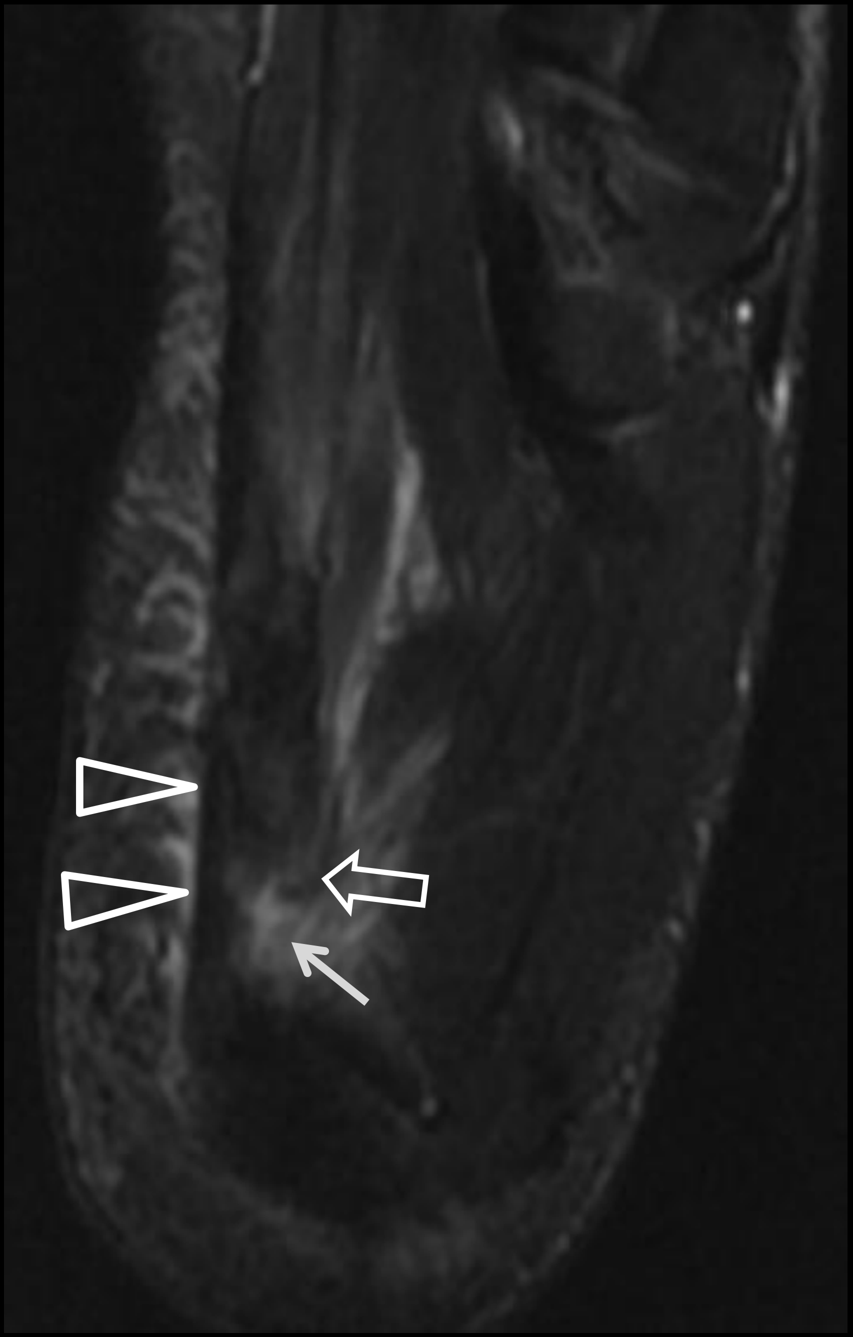

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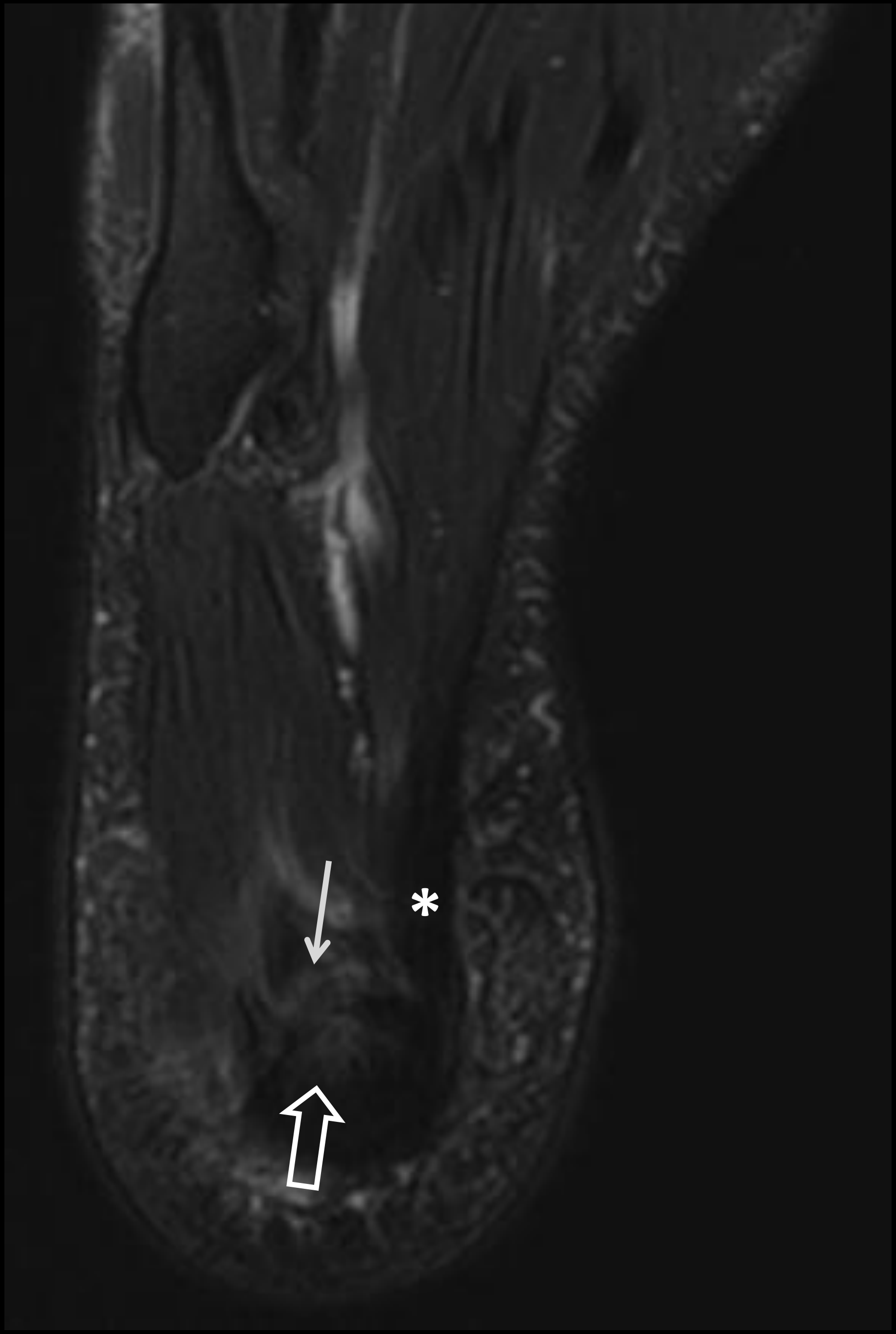

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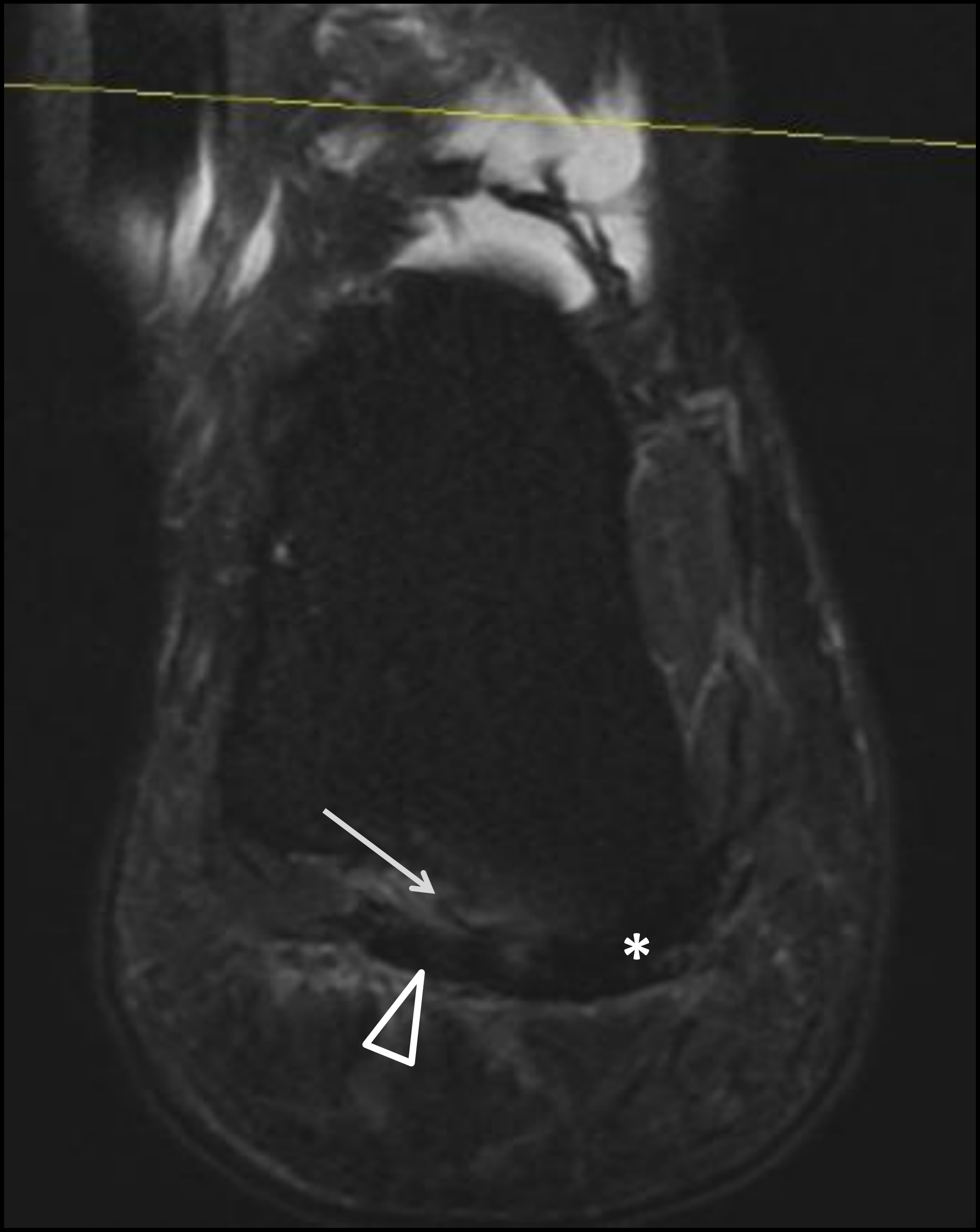

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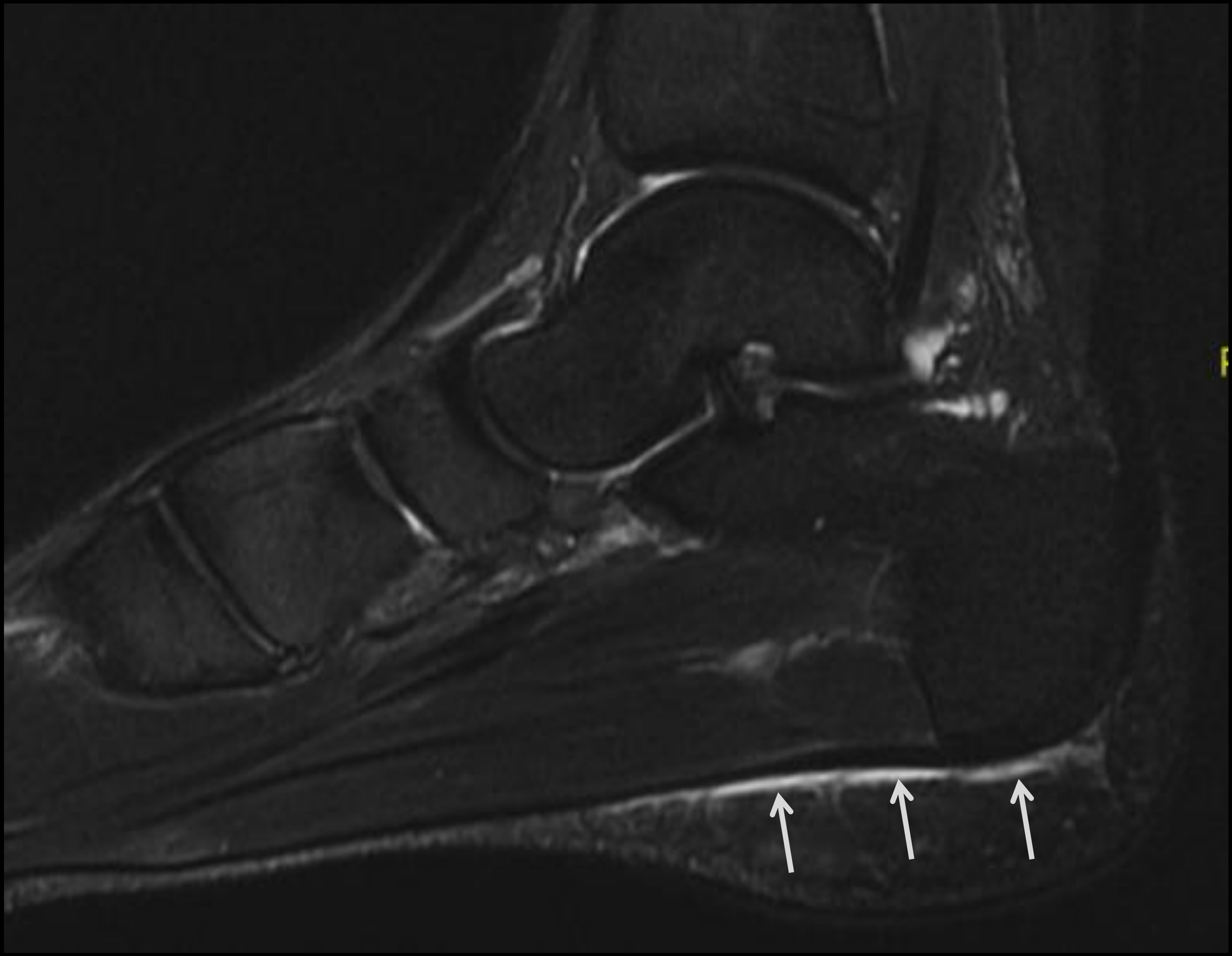

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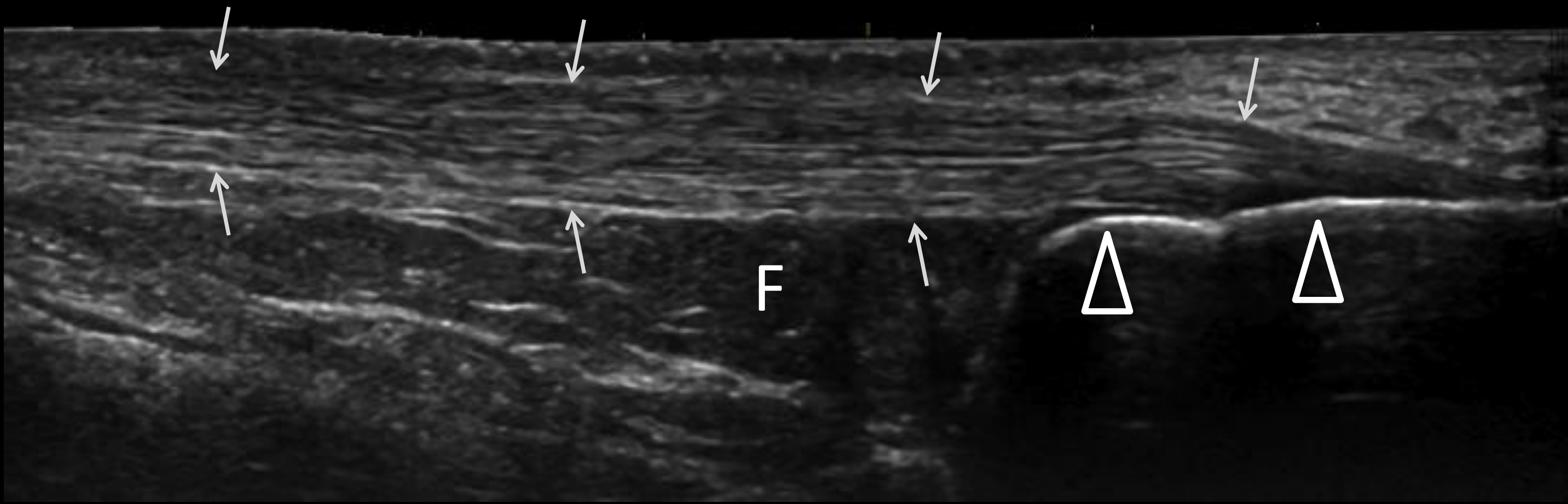


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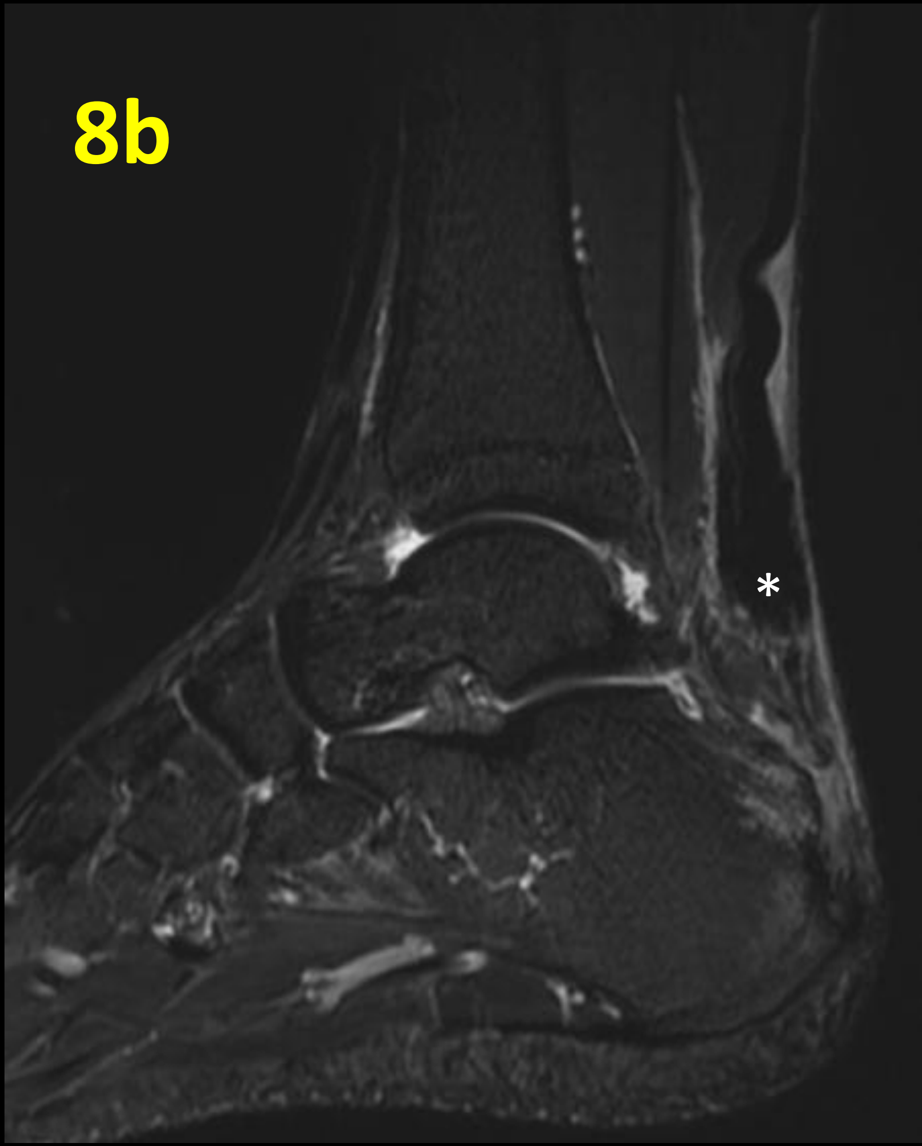
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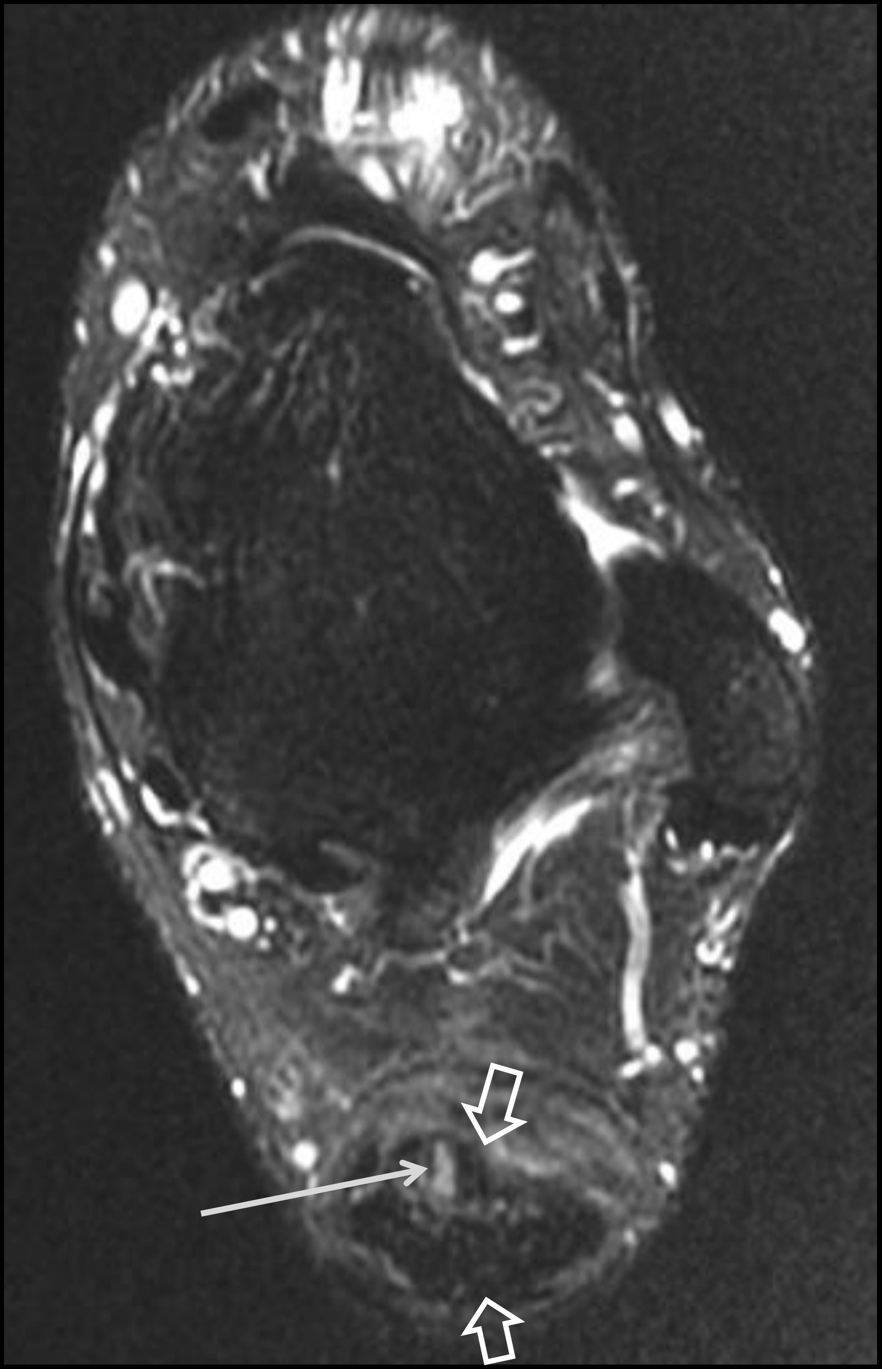

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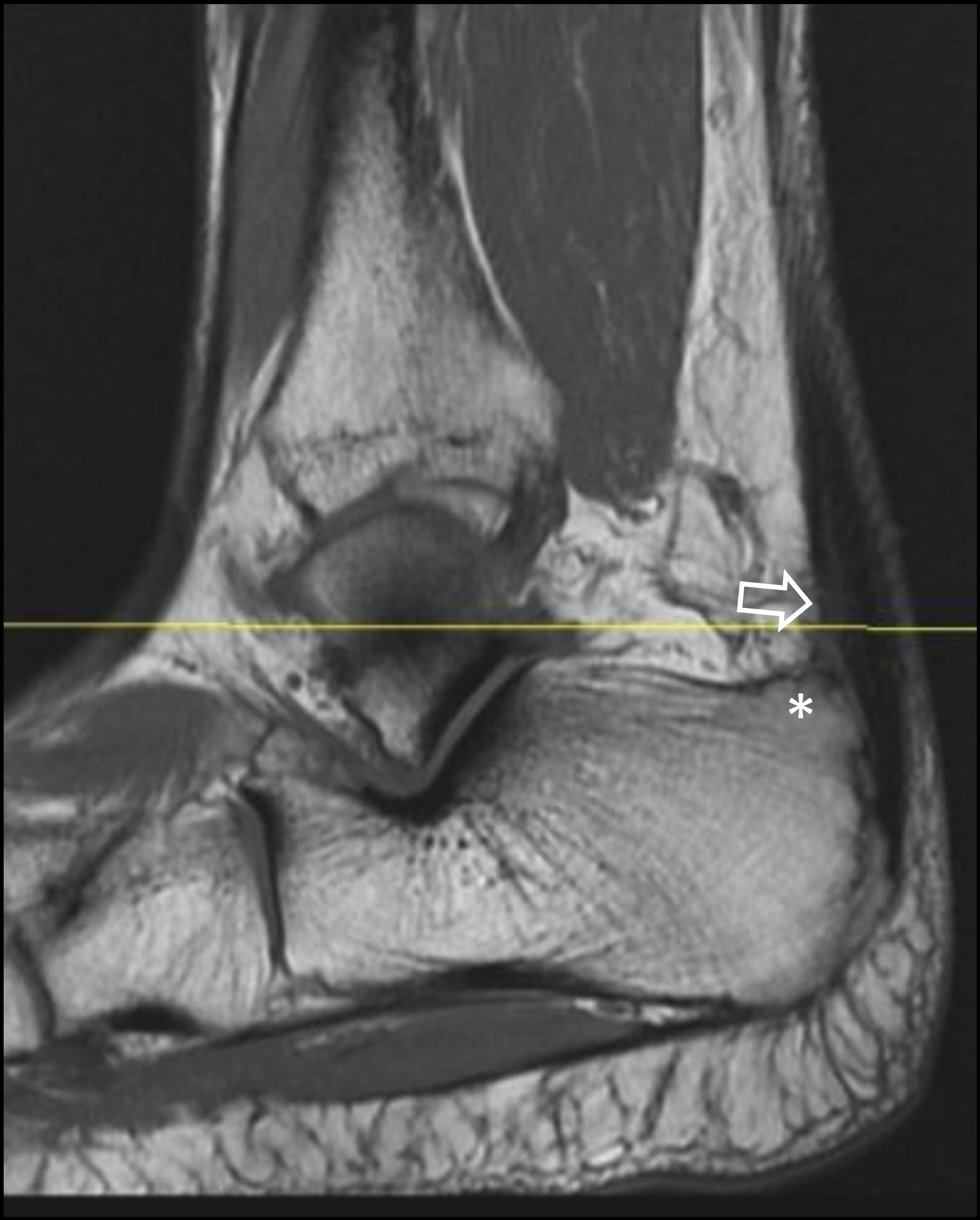

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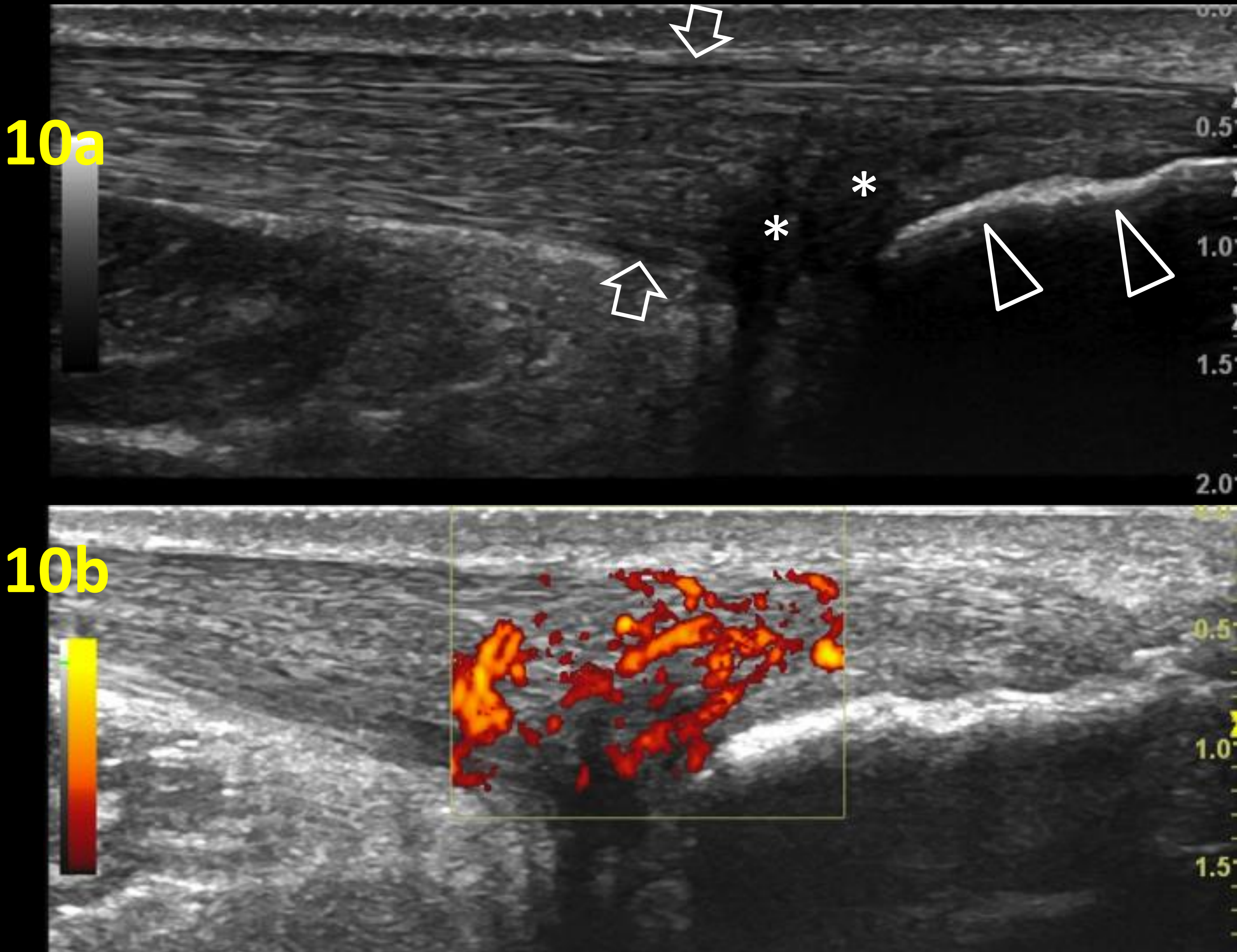
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