

The Plantar Soft Tissues

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February 28, 2008

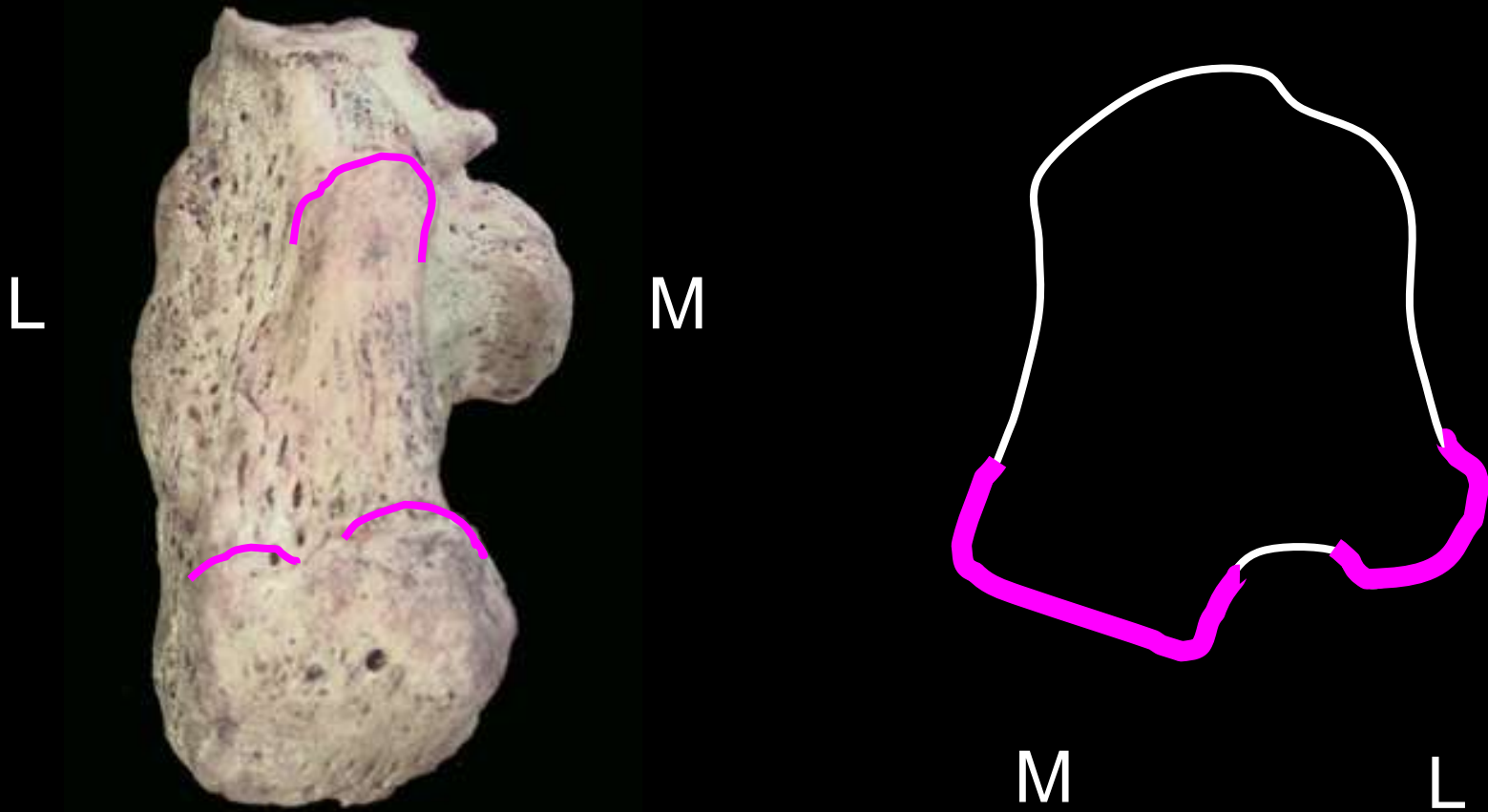


Objectives

- 1) Review normal plantar anatomy of the foot
- 2) Describe optimal technique for MR Imaging of the foot
- 3) Review the most common abnormalities affecting the plantar soft tissues

~~4) Infection~~

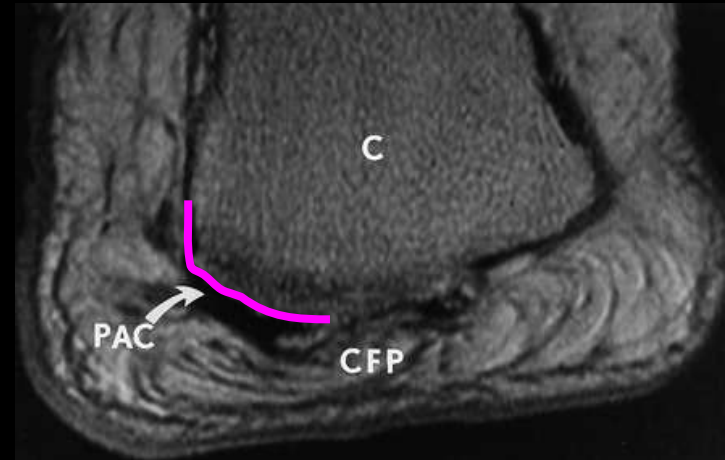
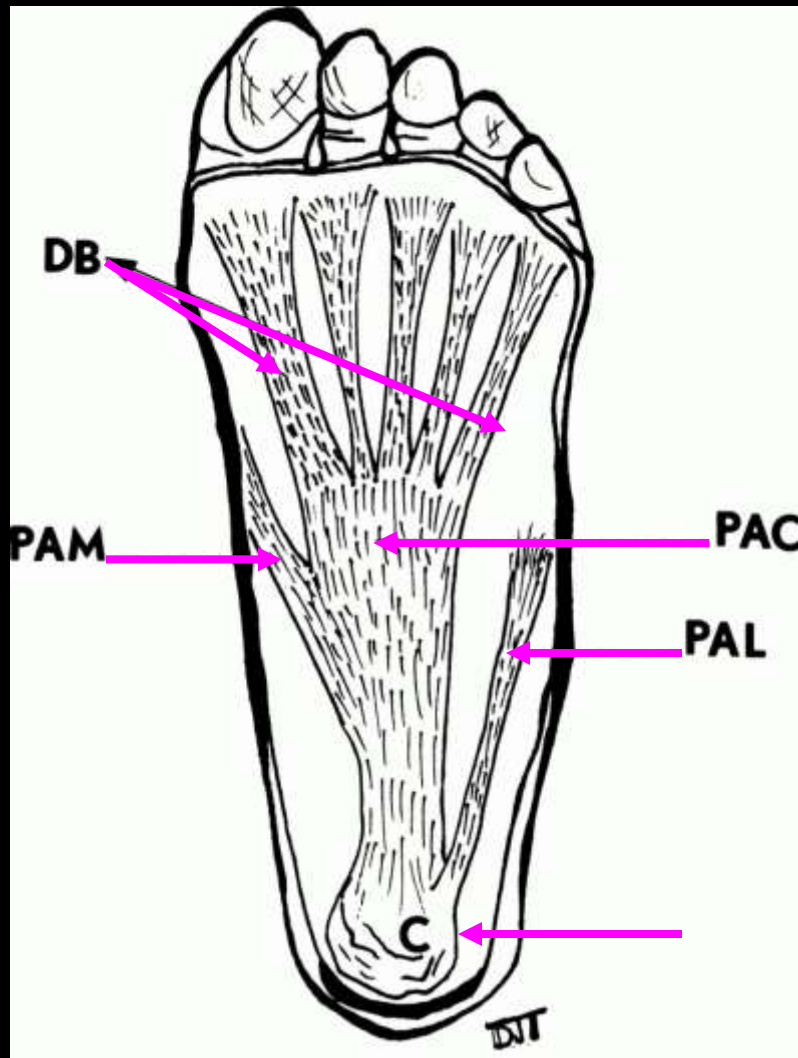
Anatomy - calcaneus



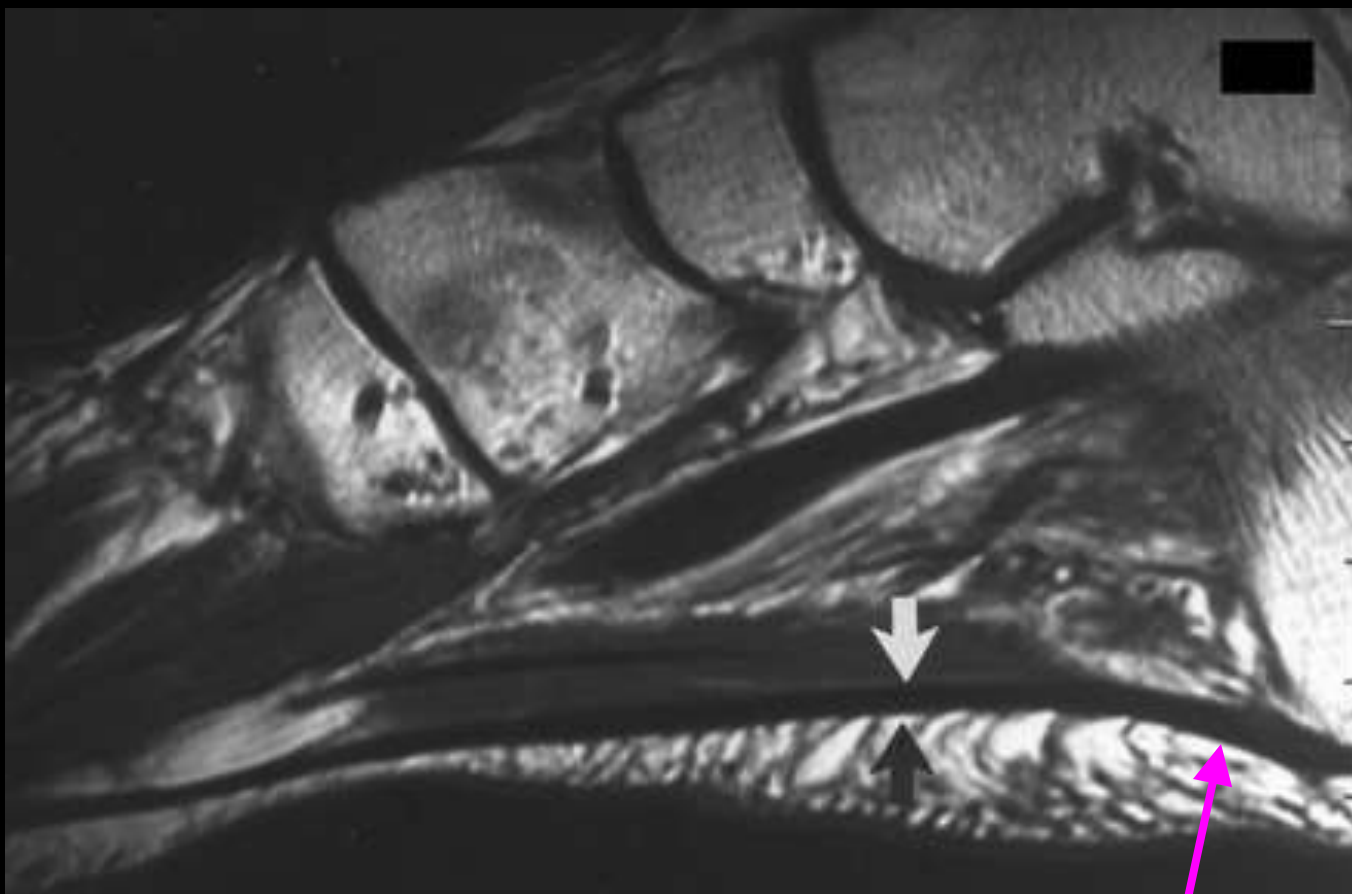
Supporting structures - longitudinal arch

- Plantar fascia
- Long and short plantar ligaments
- Spring ligament
- Tibialis posterior tendon
- Peroneus longus tendon

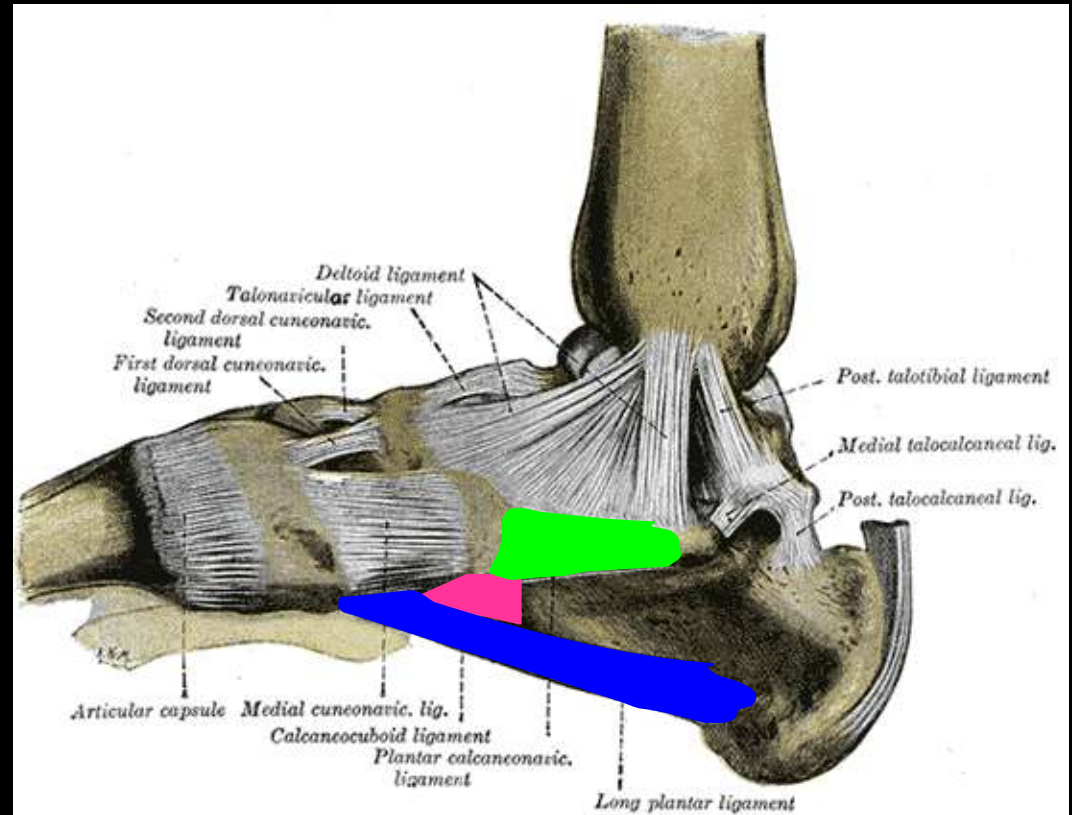
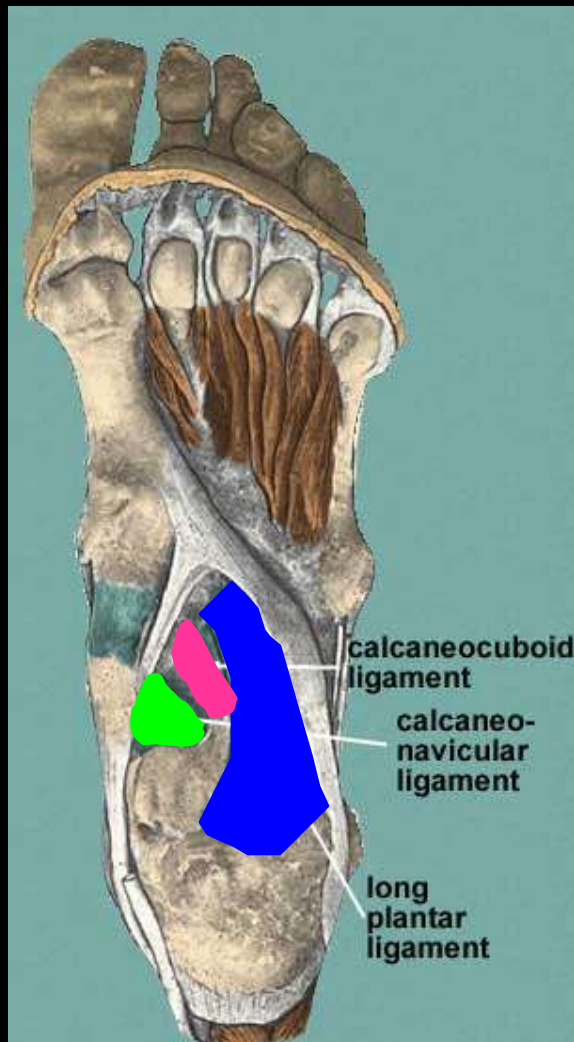
Anatomy - plantar fascia



Plantar fascia

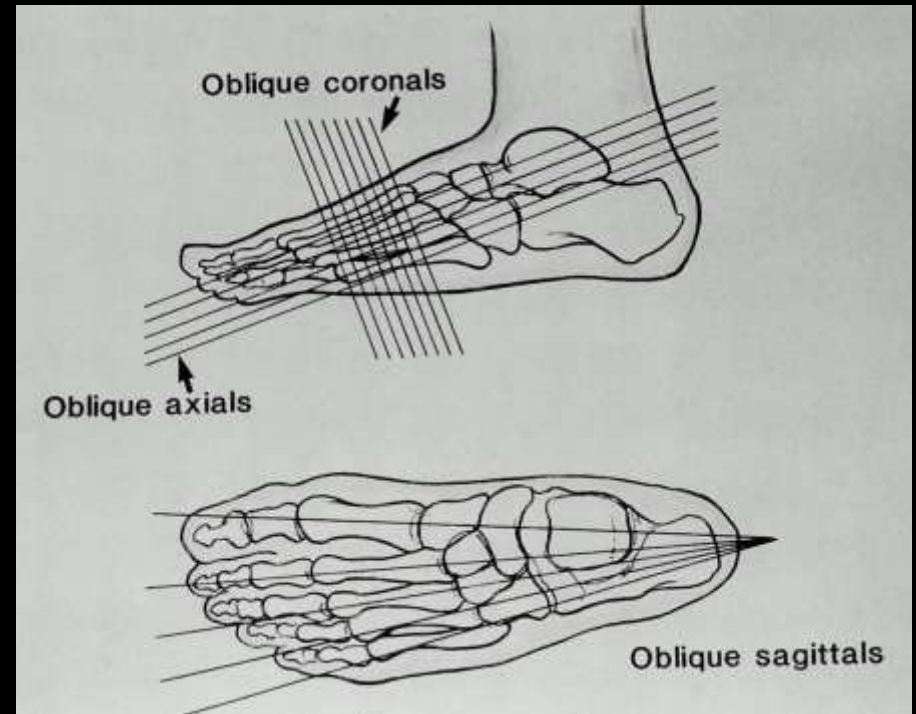


Anatomy – plantar ligaments



MRI Technique

- Extremity surface coil
- Small FOV (12 cm)
- Slight plantar flexion
- T1 sequence in 1 plane
- Fluid sensitive sequence in all 3 planes



Plantar fasciitis

- Inflammation of the plantar fascia and perifascial structures
- Undersurface heel pain with weight bearing
- Etiology
 - Mechanical: pes cavus, pronated foot
 - Degenerative: heel pad atrophy, increase in foot pronation
 - Systemic: RA, seronegatives



Plantar fasciitis



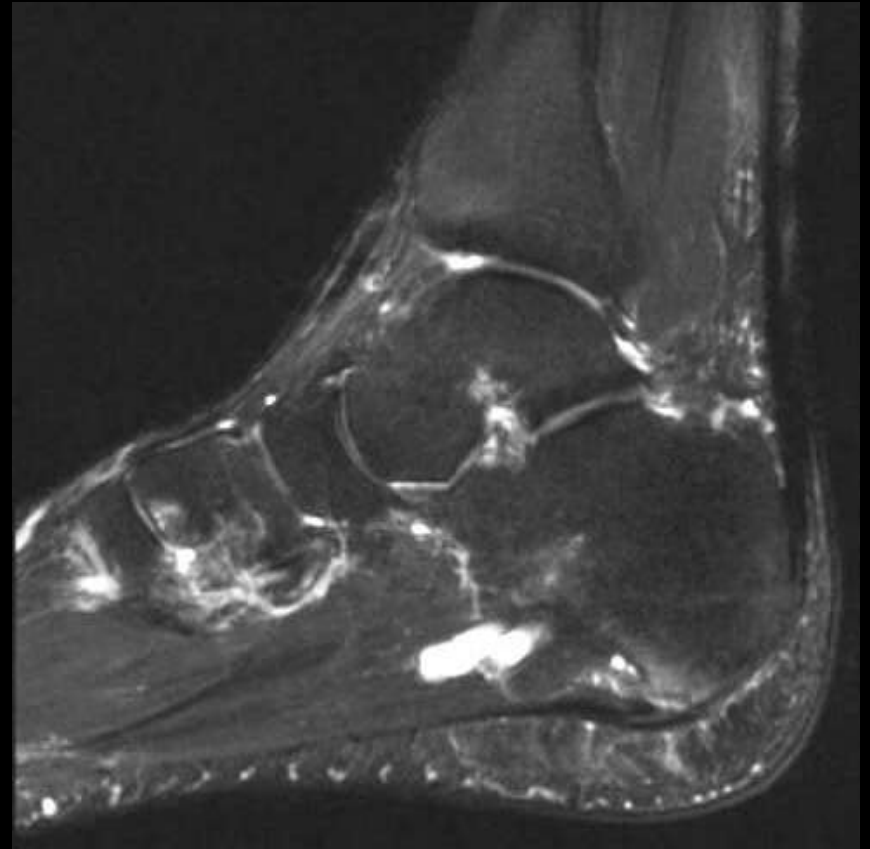
Plantar fasciitis

- MR Imaging

T1 weighted	Fluid sensitive	Post Gad
Thickened plantar aponeurosis	Edema in PA, calcaneus, and surrounding soft tissues	Enhancement usually present

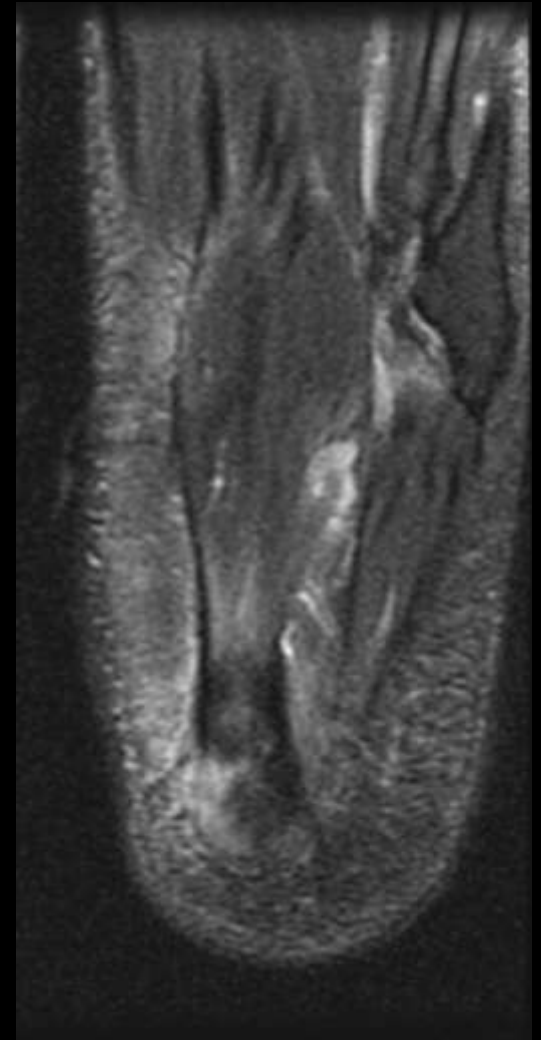
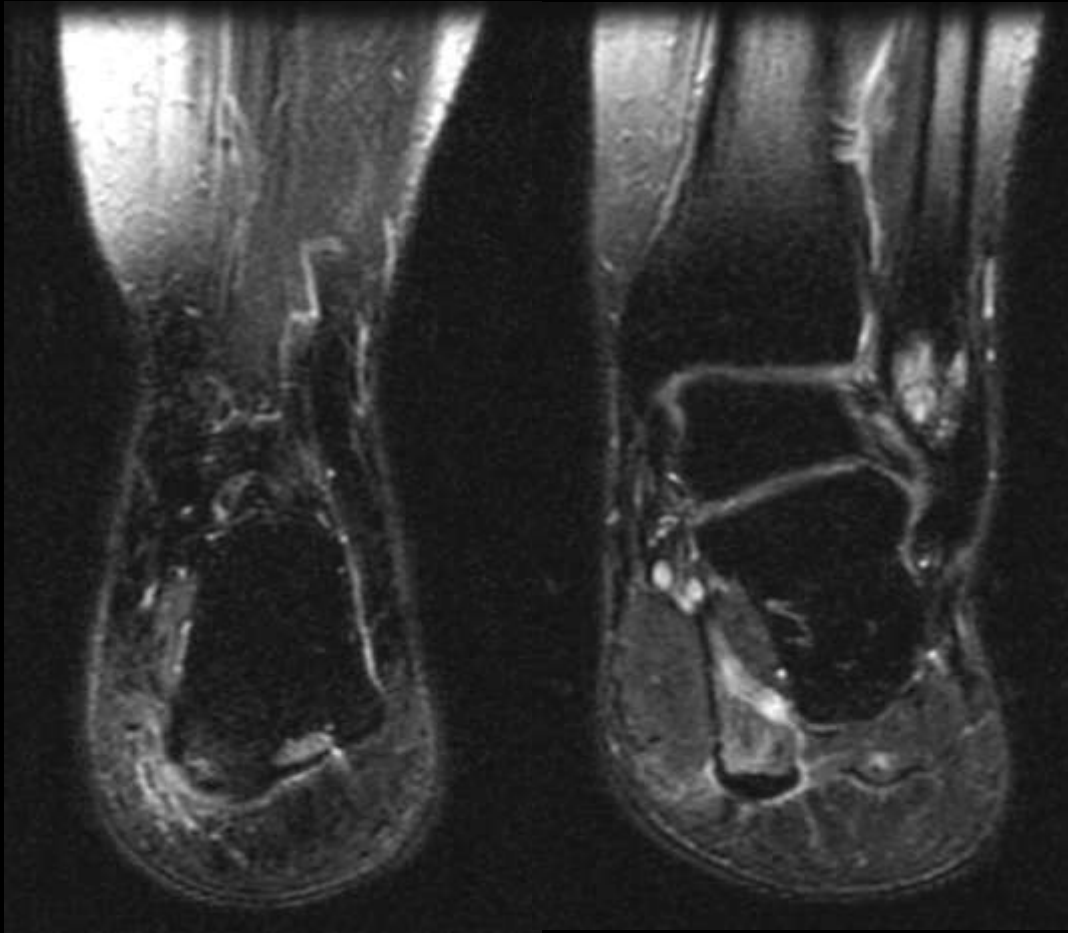
Plantar fasciitis

- 53 y.o. man with heel pain



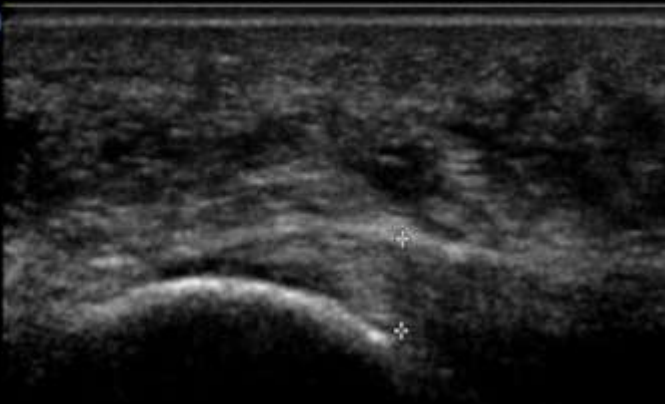
Plantar fasciitis

- 40 y.o. man with heel pain



Plantar fasciitis

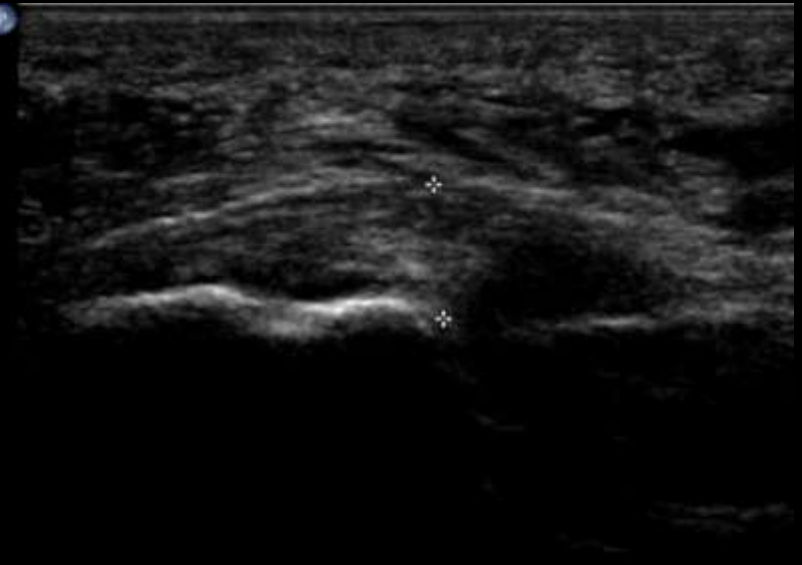
C 56
P Med
Res



✦ Dist 0.377 cm

lt lo

C 53
P Med
Res



Dist 0.617 cm

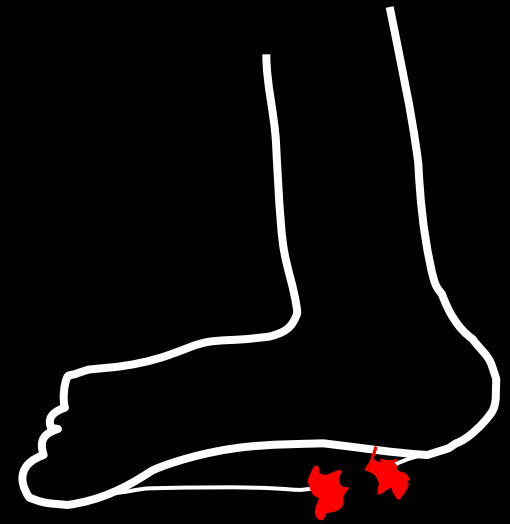
rt lo

Plantar fasciitis

- Treatment
- **Conservative:** Most often successful (rest, stretching & strengthening, orthotics, anti-inflammatories)
- Local corticosteroid injections, ESWT
- **Surgery:** plantar fascial release, open or endoscopic
 - 50-80% of the plantar fascia transected medially
 - successful in 70-80% of pts.

Plantar fascia rupture

- Rare c/w plantar fasciitis
- Occur following corticosteroid injections
- Spontaneous much less common, usually athletes involved in running or jumping
- “snap” followed by intense localized pain
- Partial or complete



Plantar fascia rupture

- MR Imaging
- Gap in plantar fascia with edema/fraying of the torn ends
- Edema in adjacent plantar musculature
- Partial rupture may be difficult to distinguish from fasciitis on imaging. Clinical history helpful.

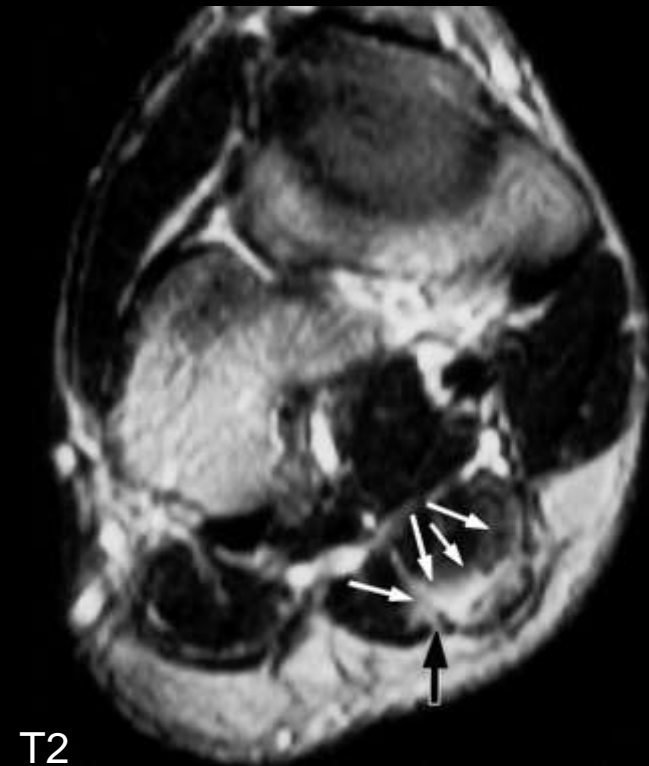
Plantar fascia rupture

Pitfall: prior
plantar fascial
release

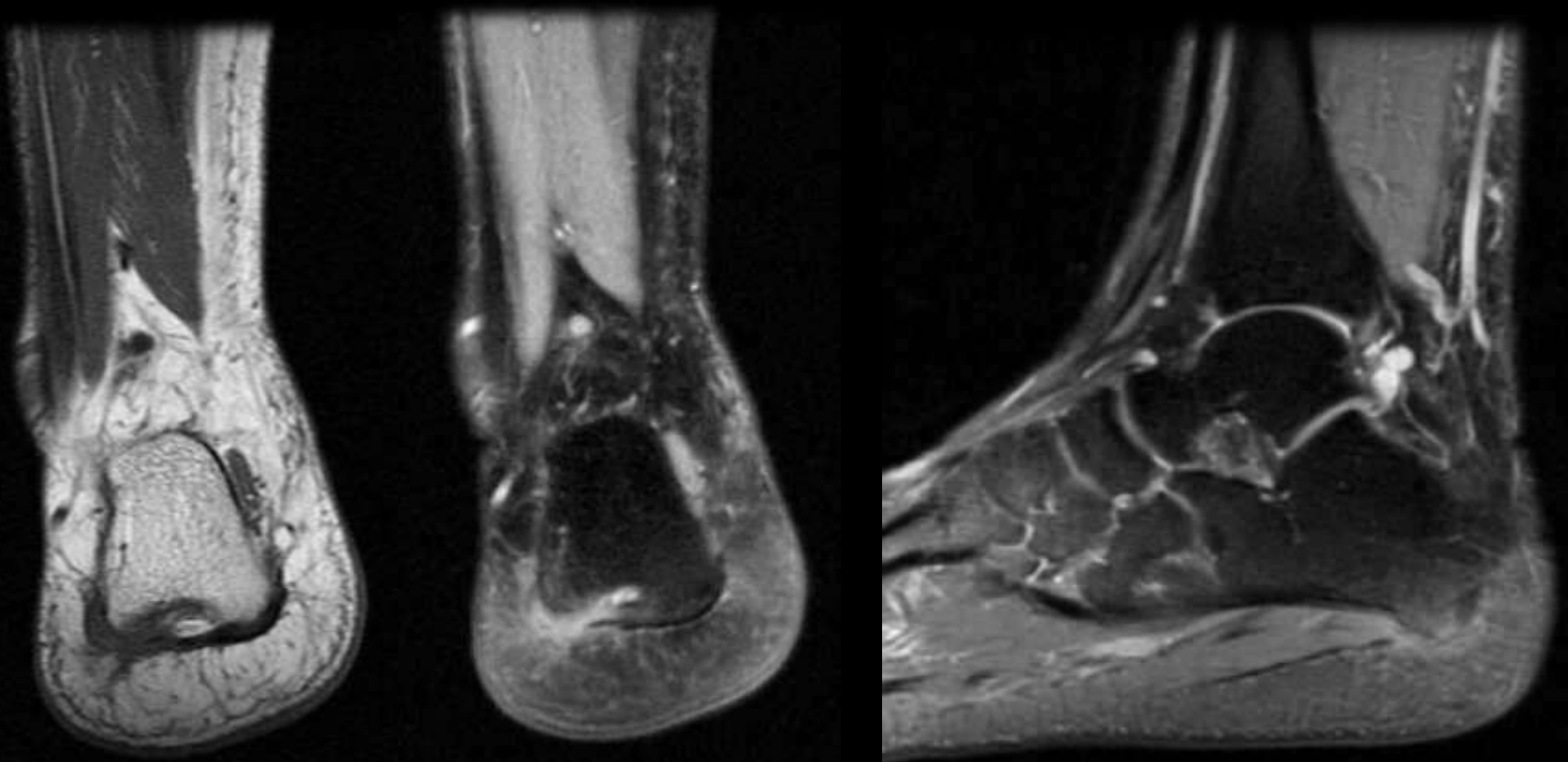


Partial plantar fascia rupture

- 22 y.o. professional basketball player



Plantar fascia rupture



Plantar fascia rupture

- Treatment
- **Conservative:** rest, boot brace followed by stiff sole athletic shoe, physical therapy
- **Surgery:** plantar fascia release with resection of scar tissue, calcaneal osteotomy, lengthening of the lateral column of the foot

Plantar fibromatosis

- Originally described by Georg Ledderhose in 1897. “Ledderhose’s disease”
- **Non-neoplastic process** – fibrous proliferation and replacement of portions of the PA with abnormal fibrous tissue
- Typically involve the medial and central portions
- Solitary or multiple / unilateral or bilateral
- Possible association with Dupuytren’s contractures and Peyronie’s disease

Plantar fibromatosis

- Usually asymptomatic and discovered by palpation
- All ages, men > women



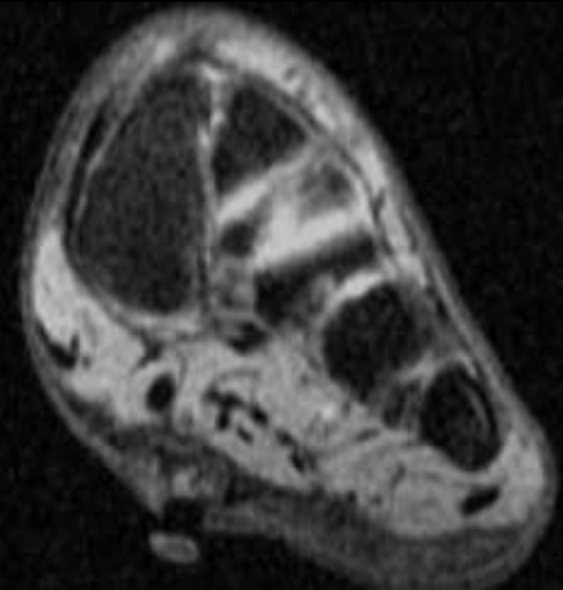
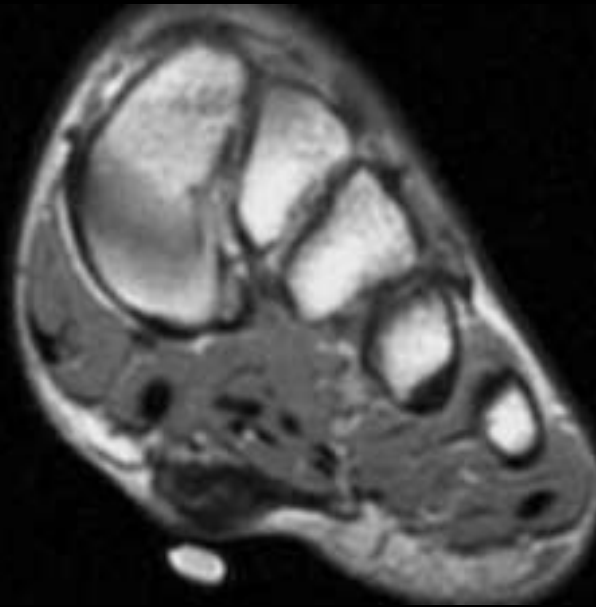
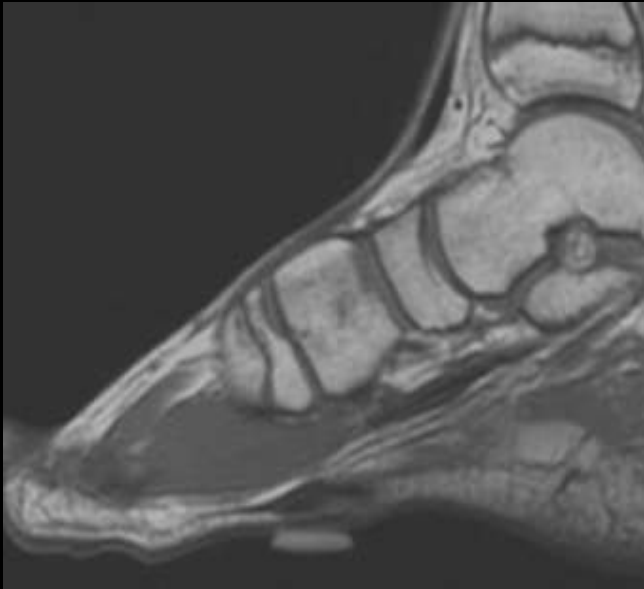
Plantar fibromatosis

- MR Imaging

T1 weighted	Fluid sensitive	Post Gad
low signal usually < 3 cm	low – intermediate (possible regions of high signal)	variable – ranges from none to marked 50% avid

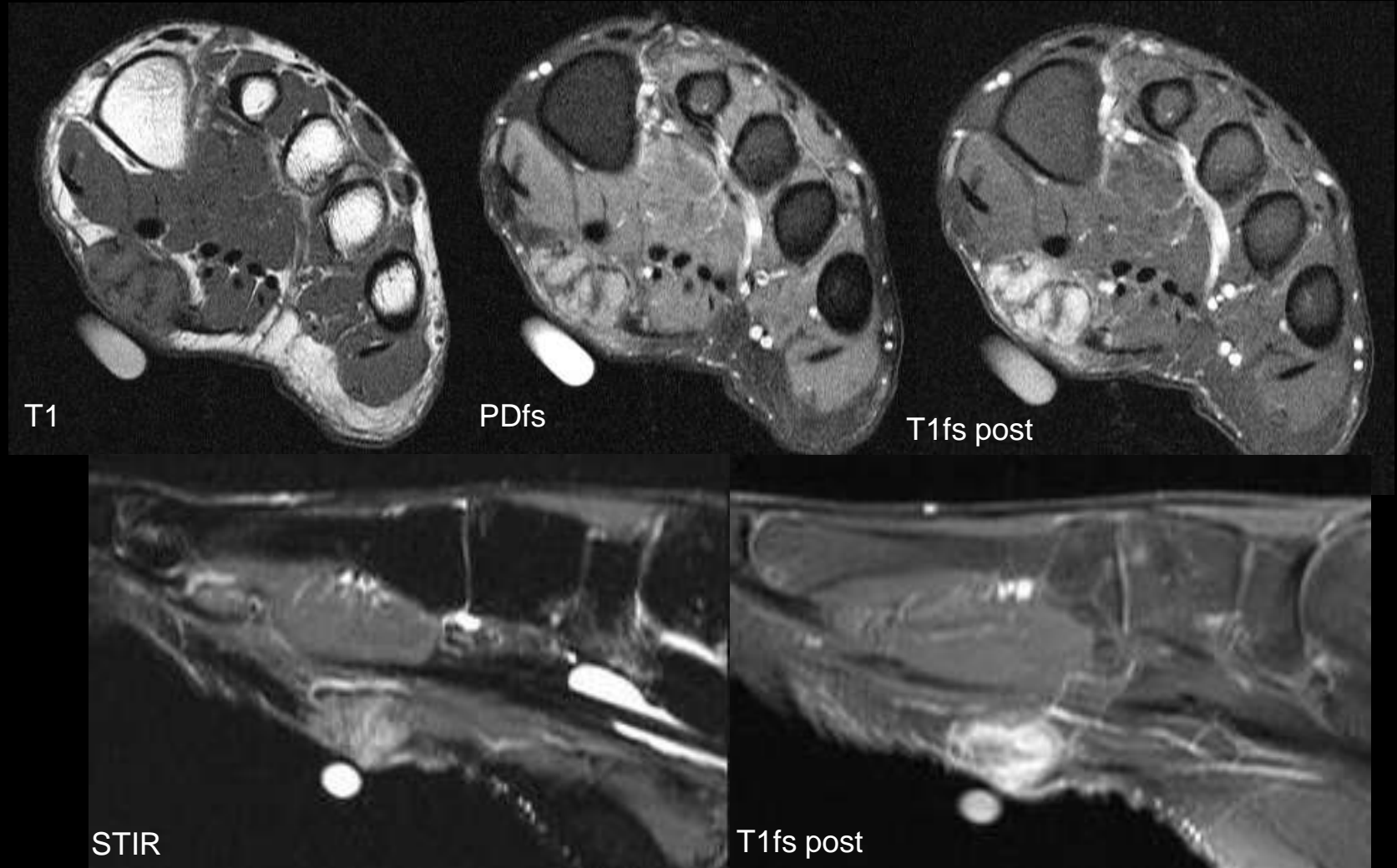
Plantar fibromatosis

- 18 y.o. man with plantar mass



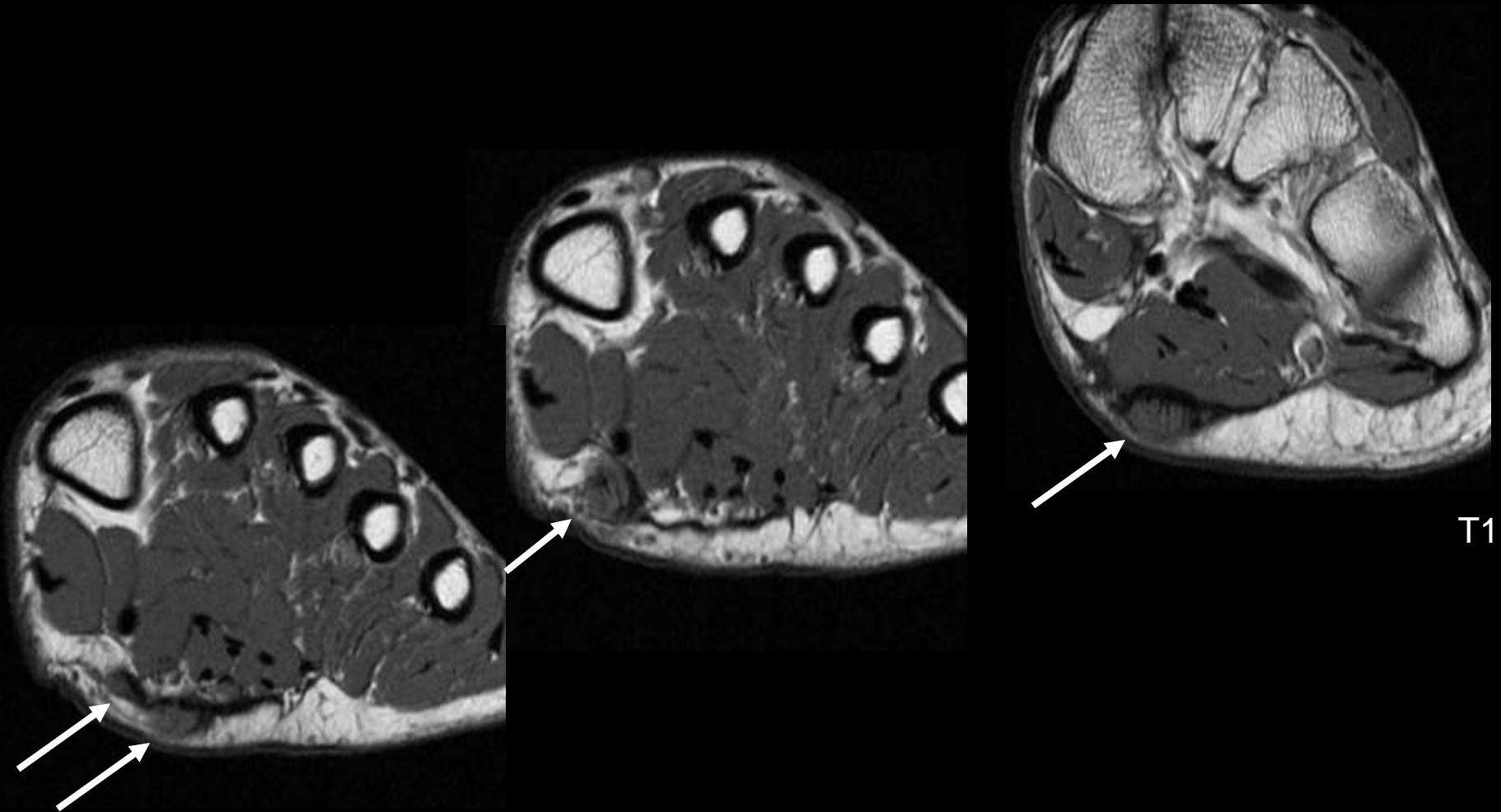
Plantar fibromatosis

- 27 y.o. man with swelling on sole of foot

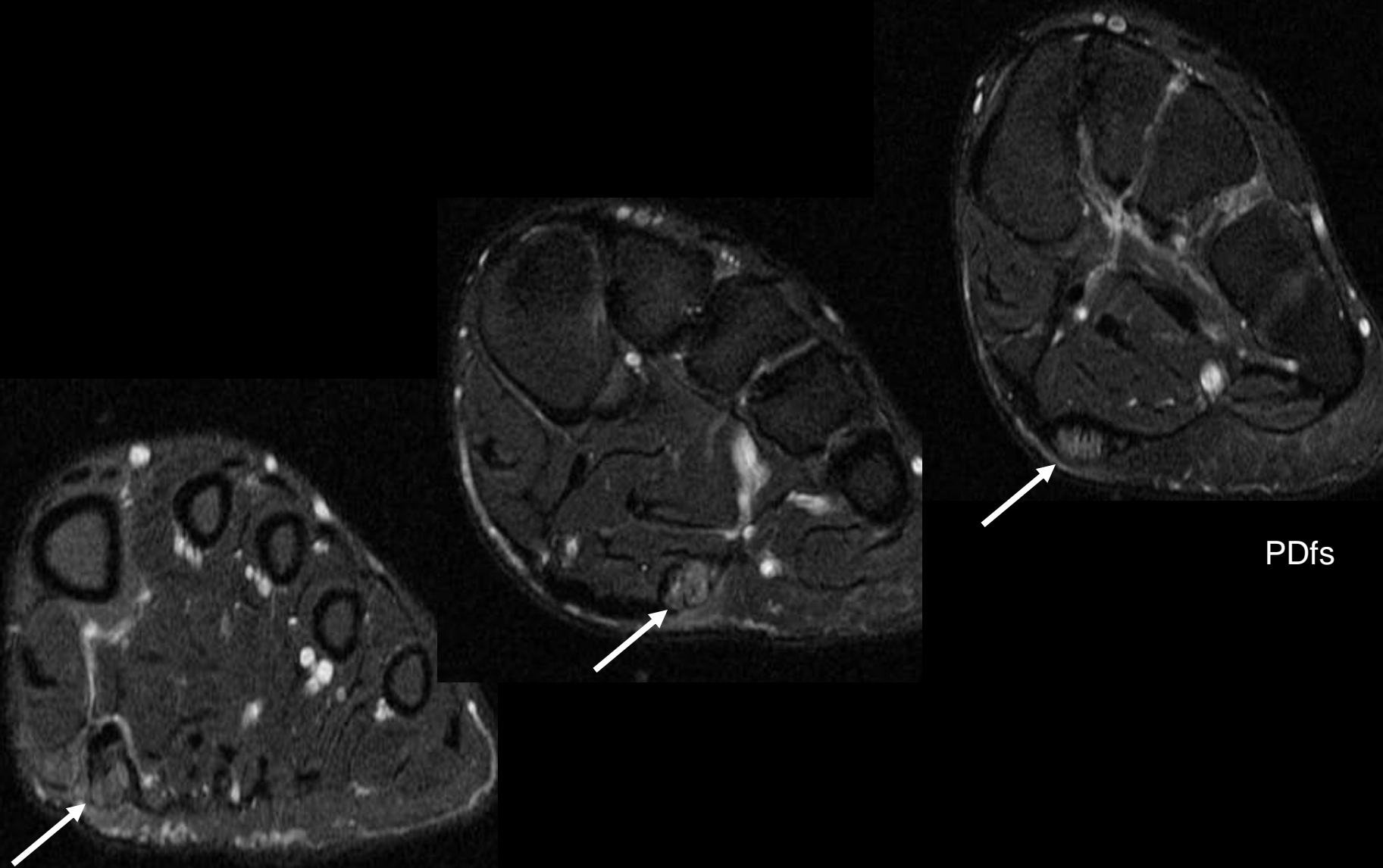


Plantar fibromatosis

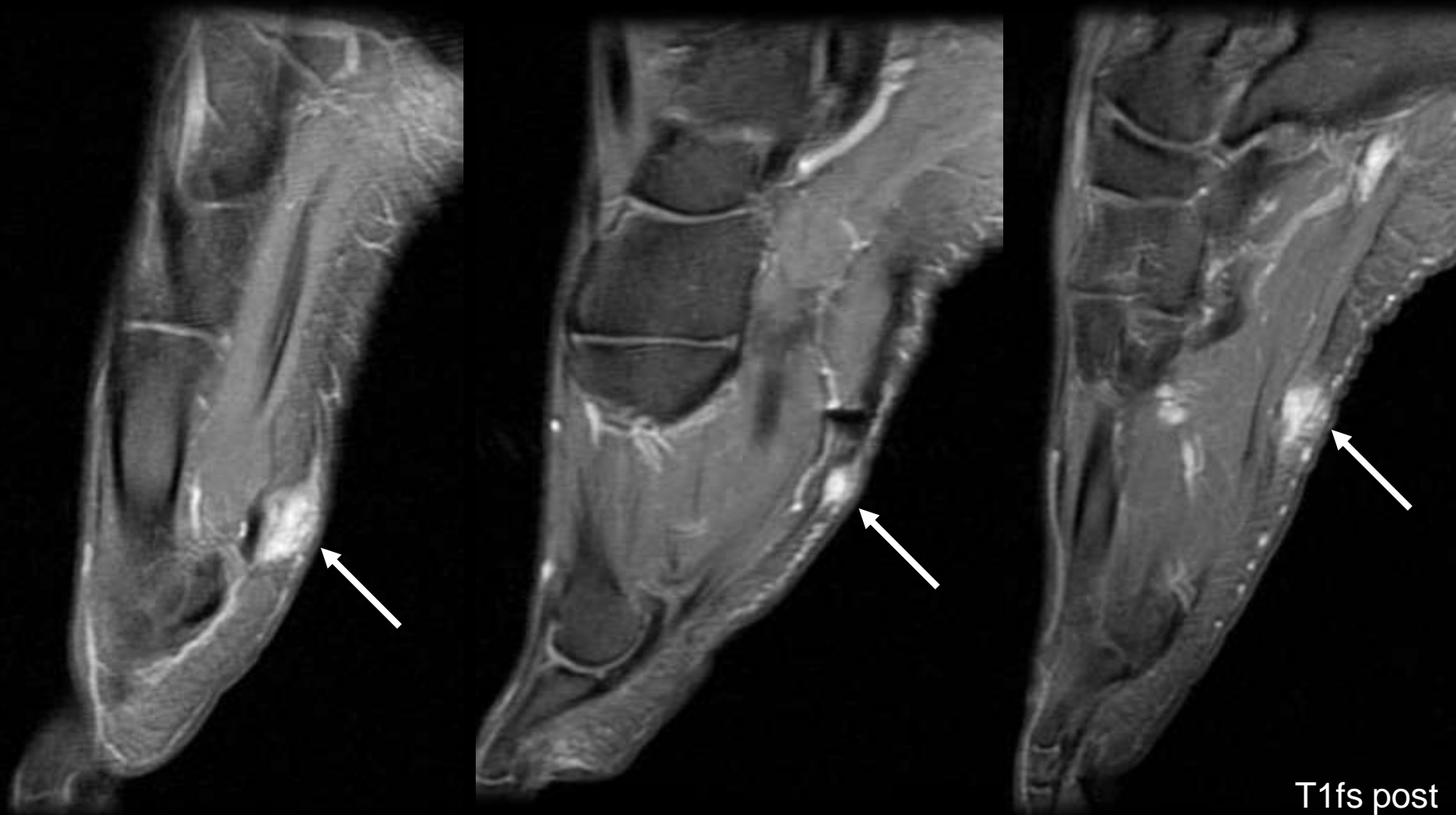
- 27 y.o. man with palpable foot nodules



Plantar fibromatosis

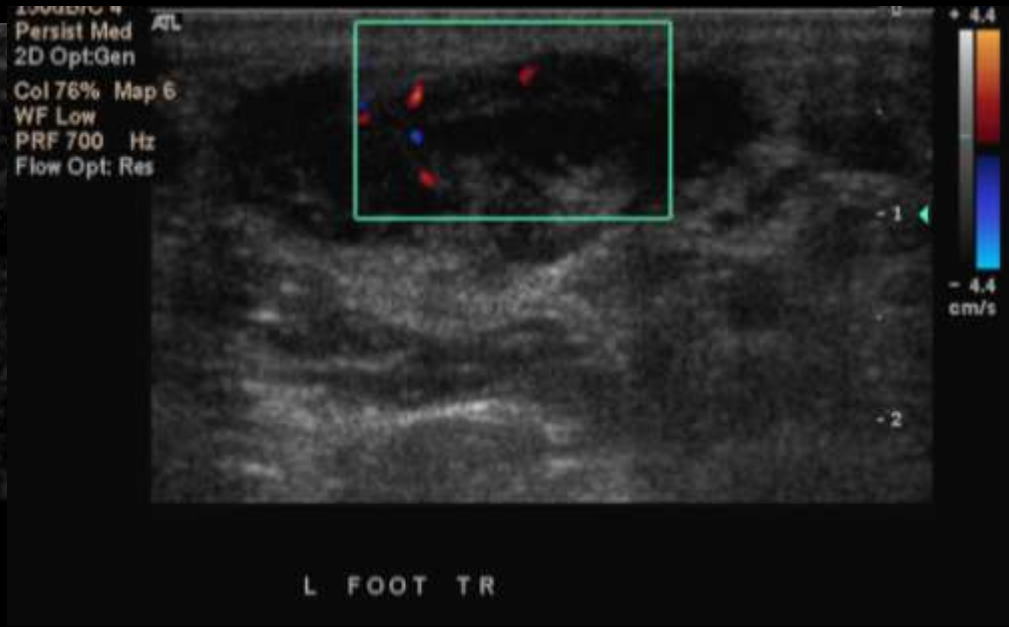


Plantar fibromatosis

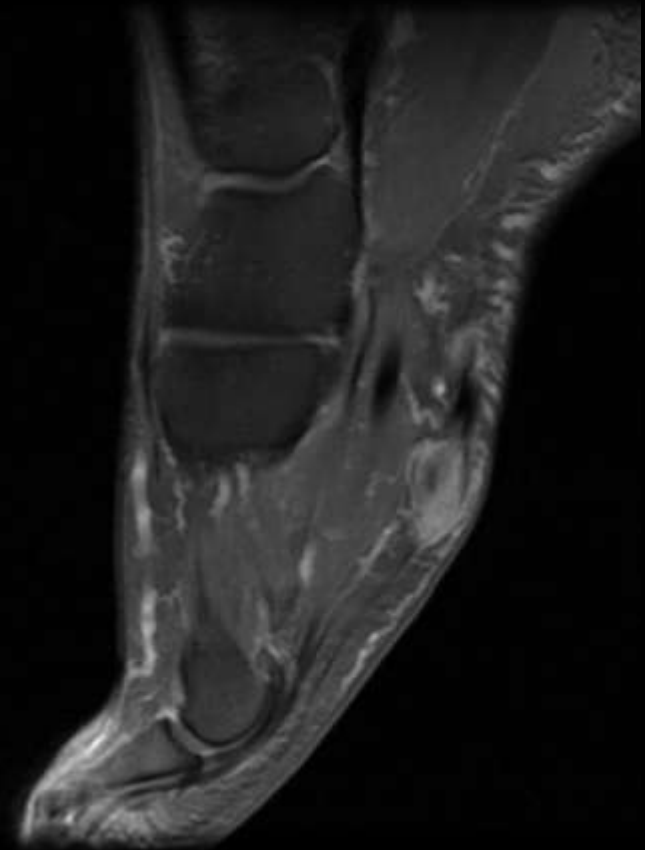


Plantar fibromatosis

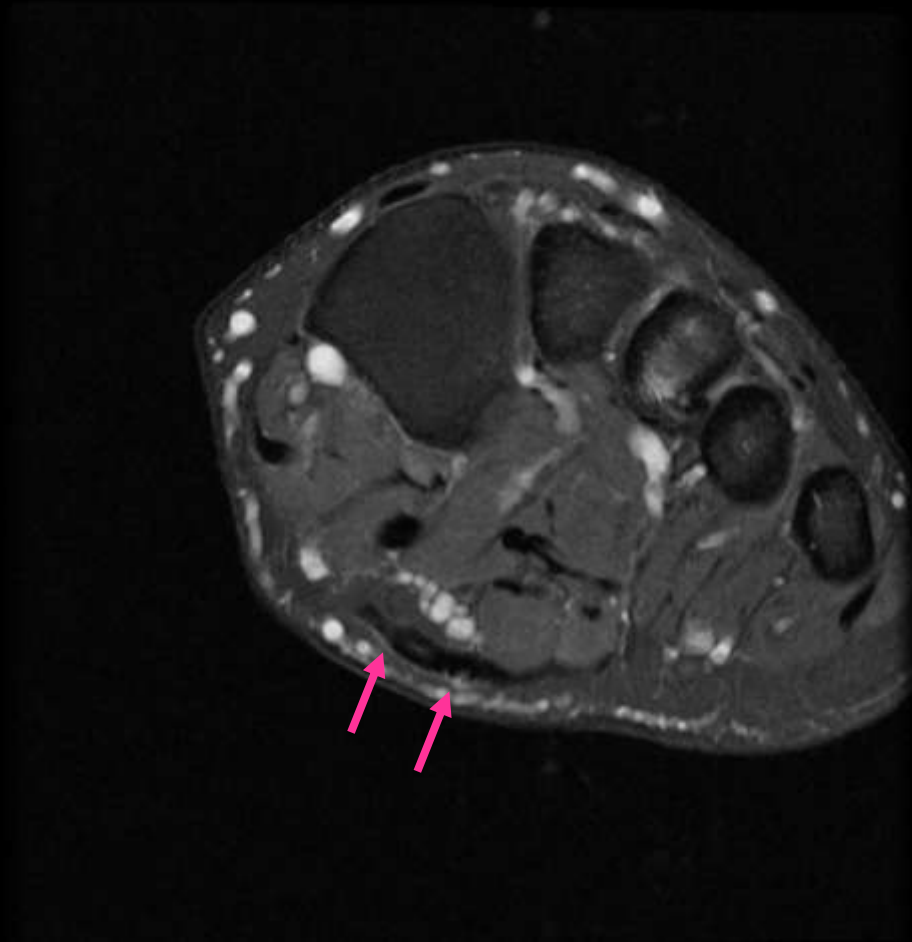
- 56 y.o. man with tender mass in arch of foot for 6 mo.



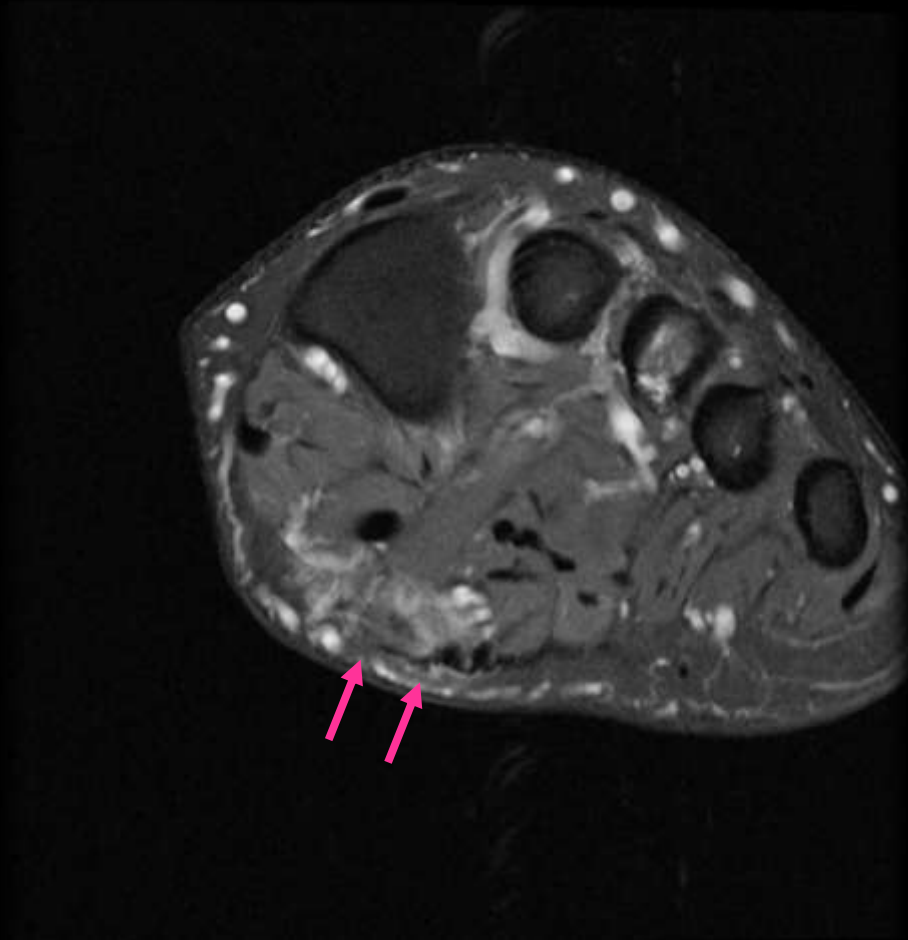
Plantar fibromatosis



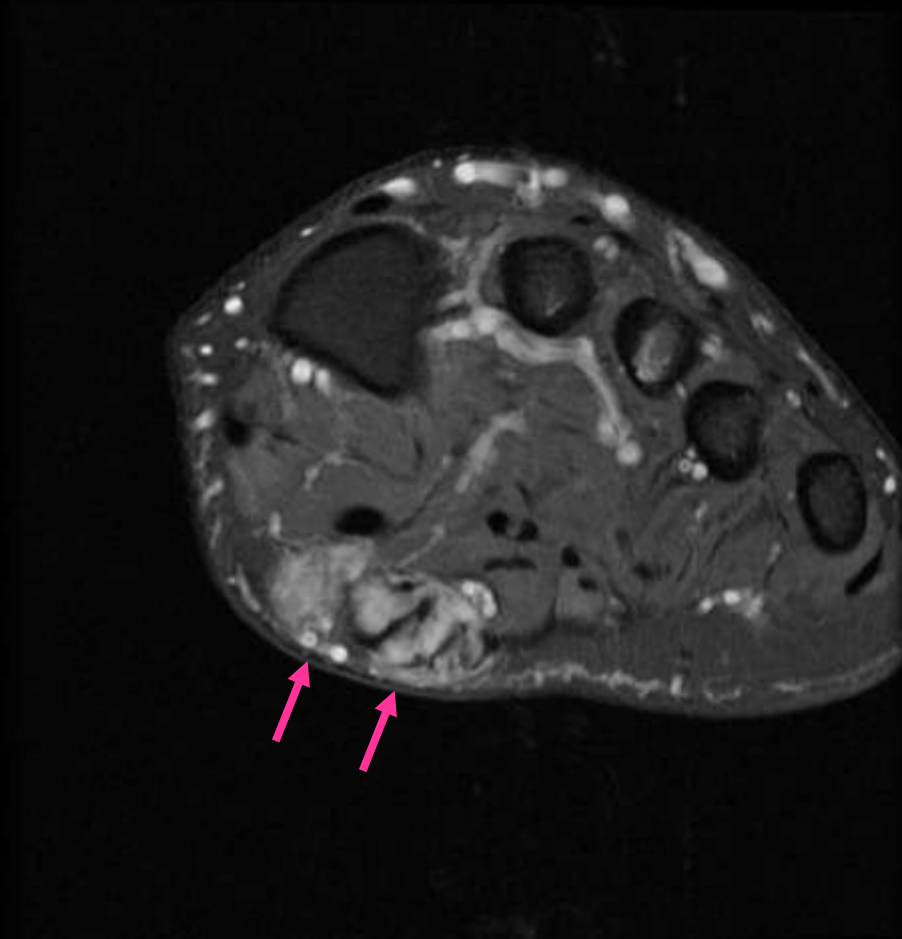
Plantar fibromatosis



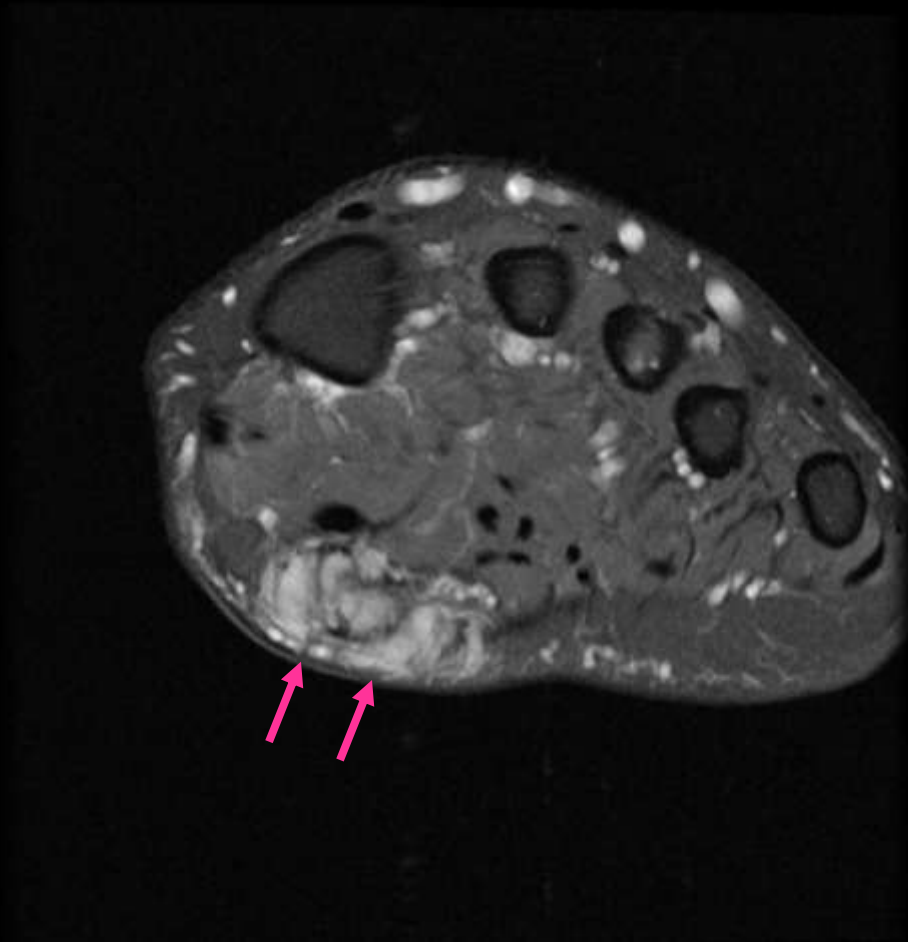
Plantar fibromatosis



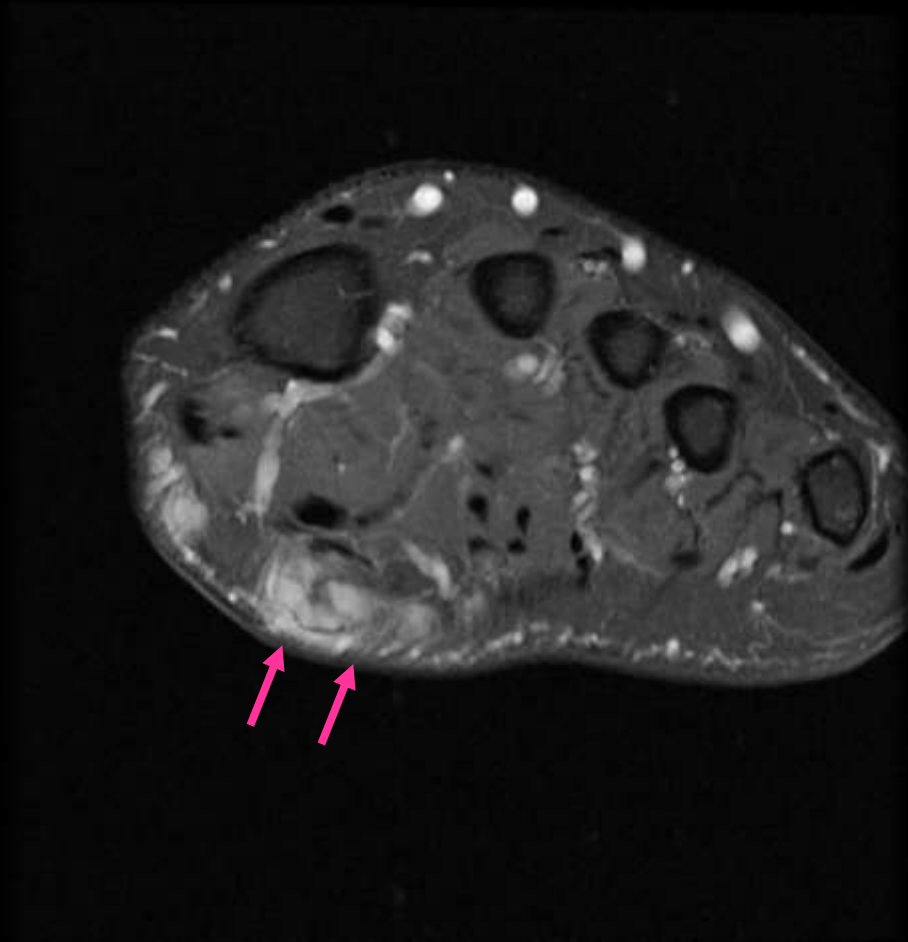
Plantar fibromatosis



Plantar fibromatosis

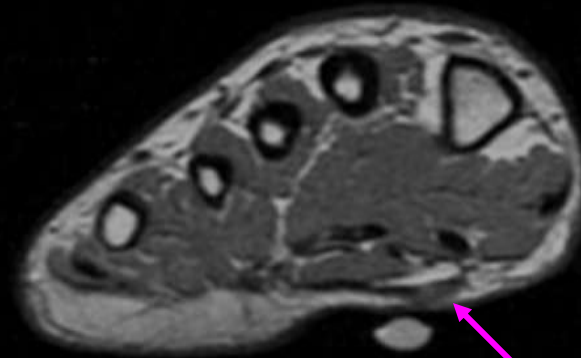
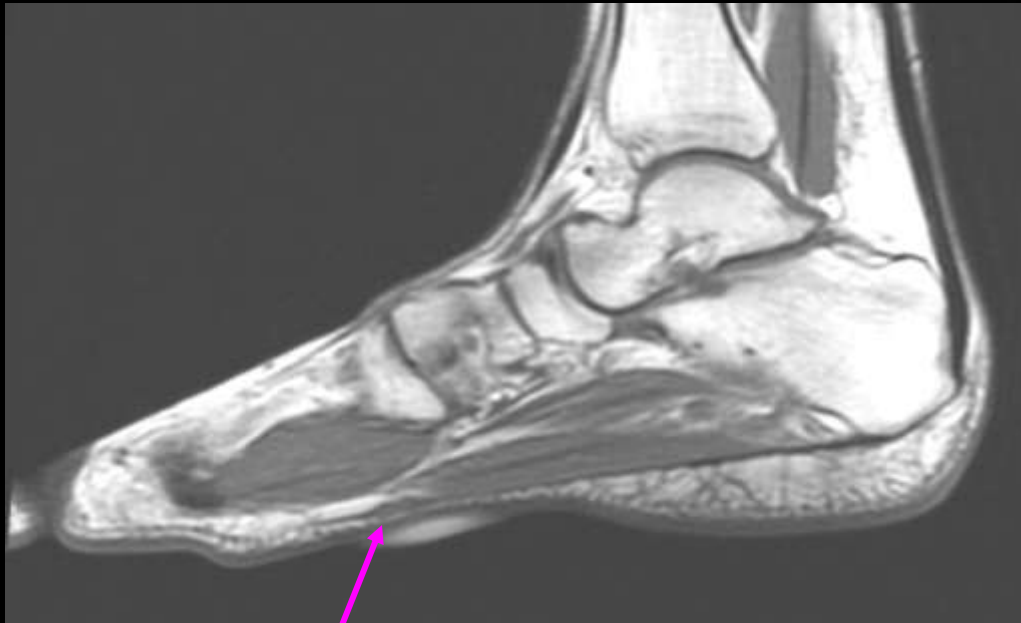


Plantar fibromatosis



Plantar fibromatosis

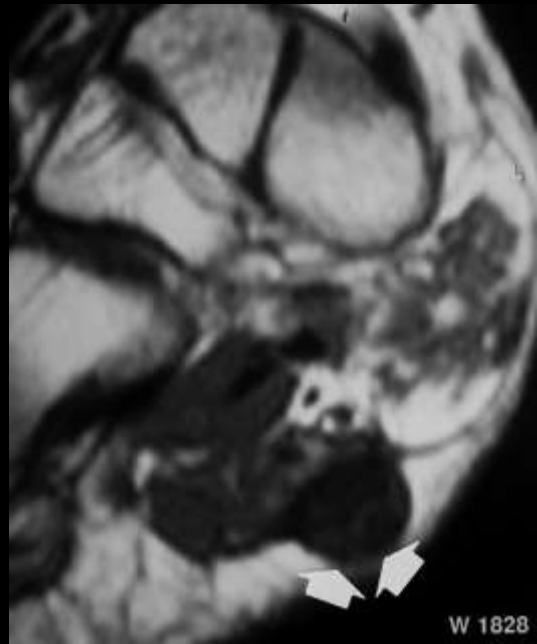
- 45 y.o. woman with pain and focal pea-sized bump on bottom of foot



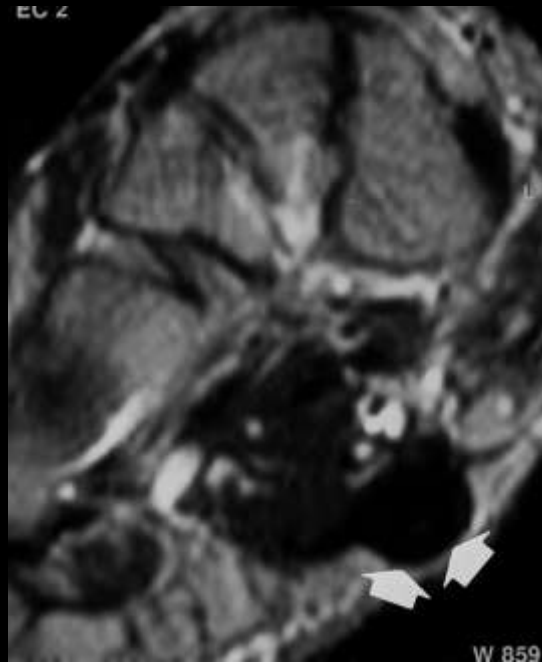
Plantar fibromatosis

- Treatment
- **Conservative:** orthopedic footwear
- **Surgery:** local excision
 - high rate of post-surgical recurrence
 - adjunctive XRT sometimes used to prevent local recurrence

Is this a plantar fibroma?



T1



T2



Plantar
fascia
xanthoma

Plantar fascia xanthoma

- Usually bilateral and symmetric
- Dorsum of hands > Achilles > Plantar fascia
- Focal aponeurotic enlargement with heterogeneous signal intensity

Halifax, Nova Scotia, Canada

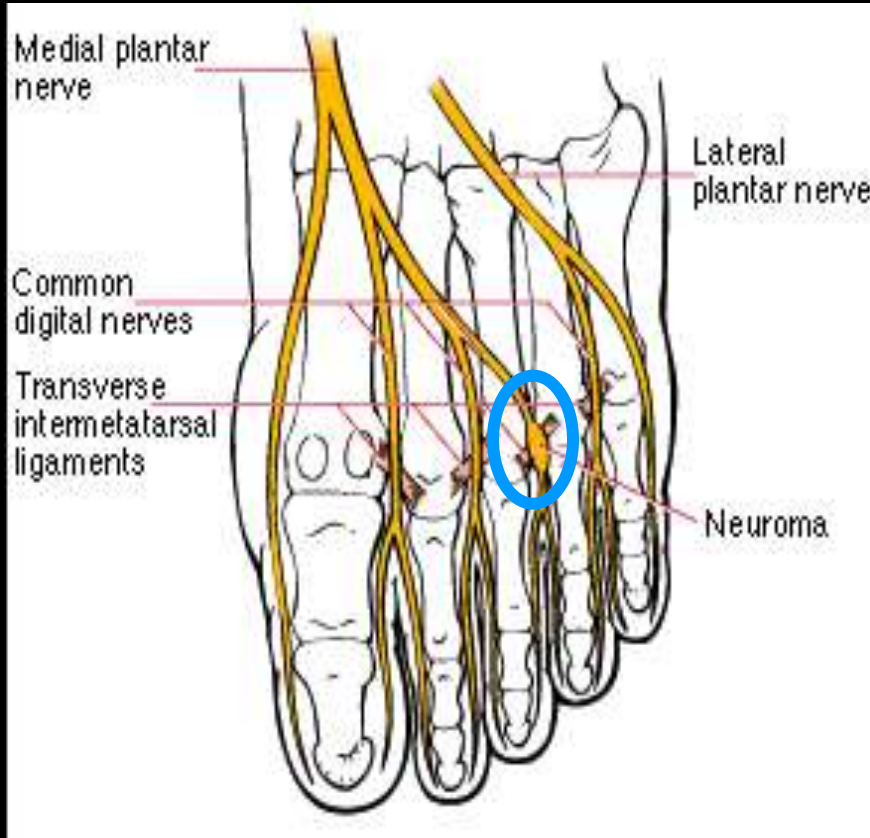




Morton's neuroma

- Originally described by Thomas Morton in 1876
- **Non-neoplastic lesion** - Perineural fibrosis involving and entrapping a plantar digital nerve
- May be common in asymptomatic patients
- Clinically manifests as forefoot pain, exacerbated with walking
- 80% women, commonly young & middle-aged

Morton's neuroma



- Typically 3rd IMT space
- May be associated with IMT bursal fluid

Morton's neuroma

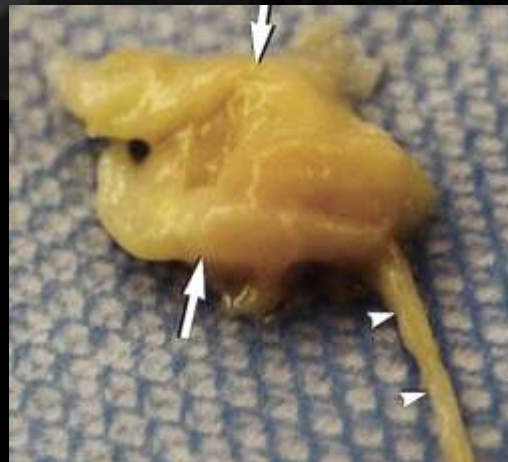
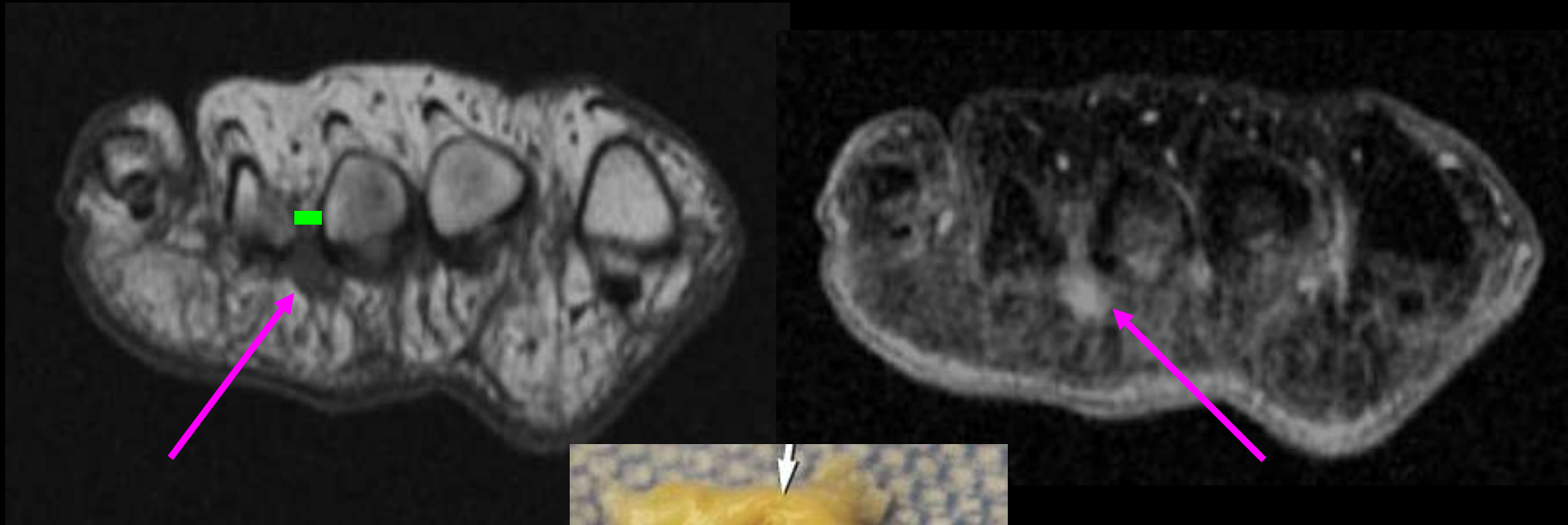
- MR Imaging

T1 weighted	Fluid sensitive	Post Gad
low signal *best sequence	variable, usually low may not be visible	variable, usually enhance

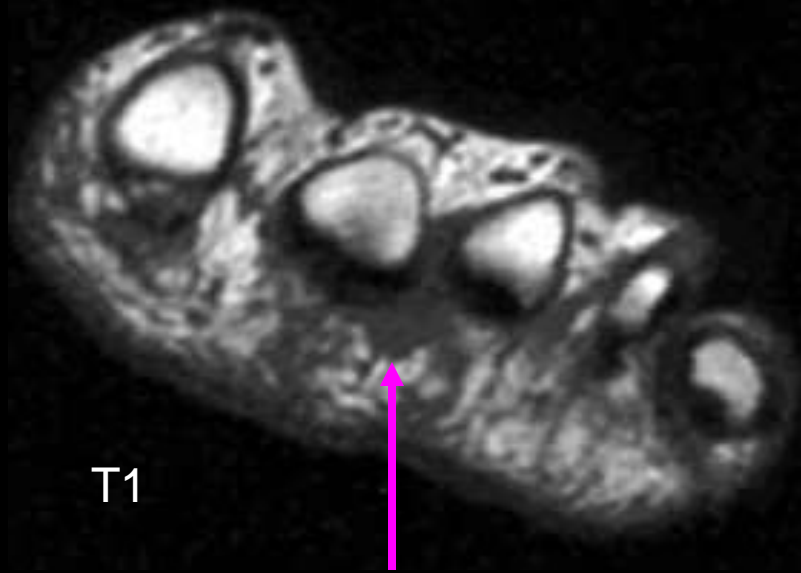
* Prone imaging may be more sensitive

Morton's neuroma

- 59 y.o. woman with plantar foot pain

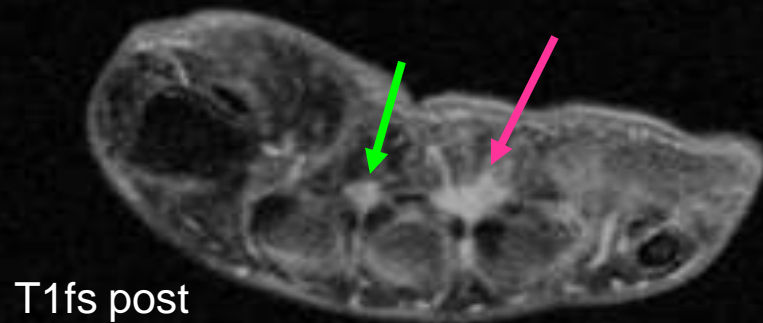
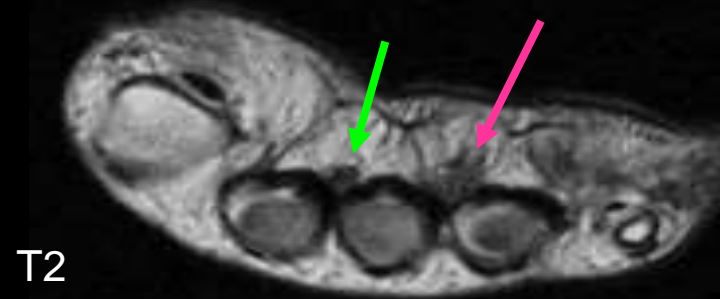
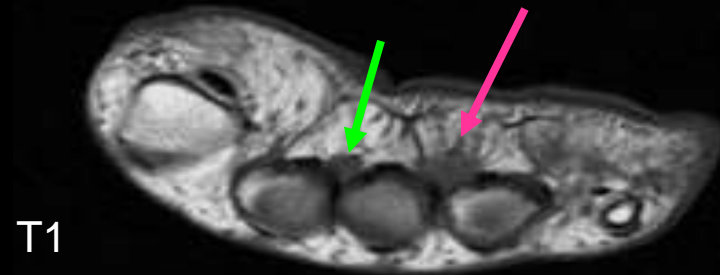
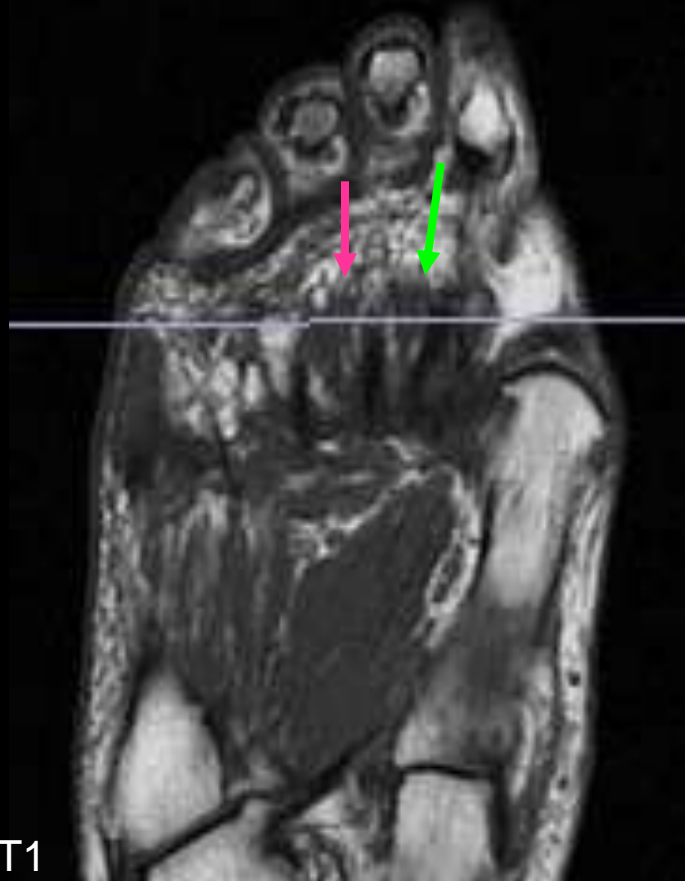


Morton's neuroma



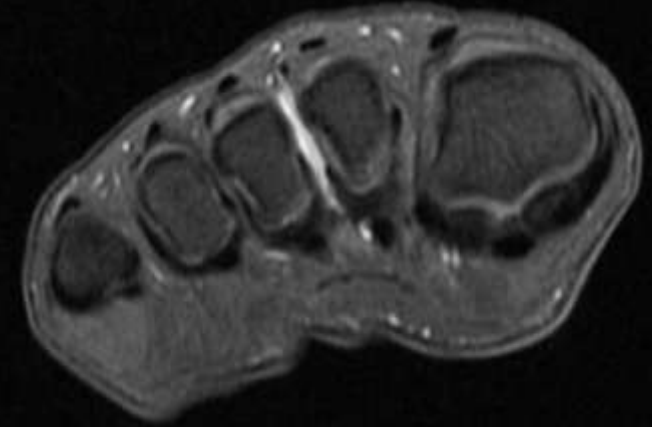
Morton's neuroma

- Forefoot pain

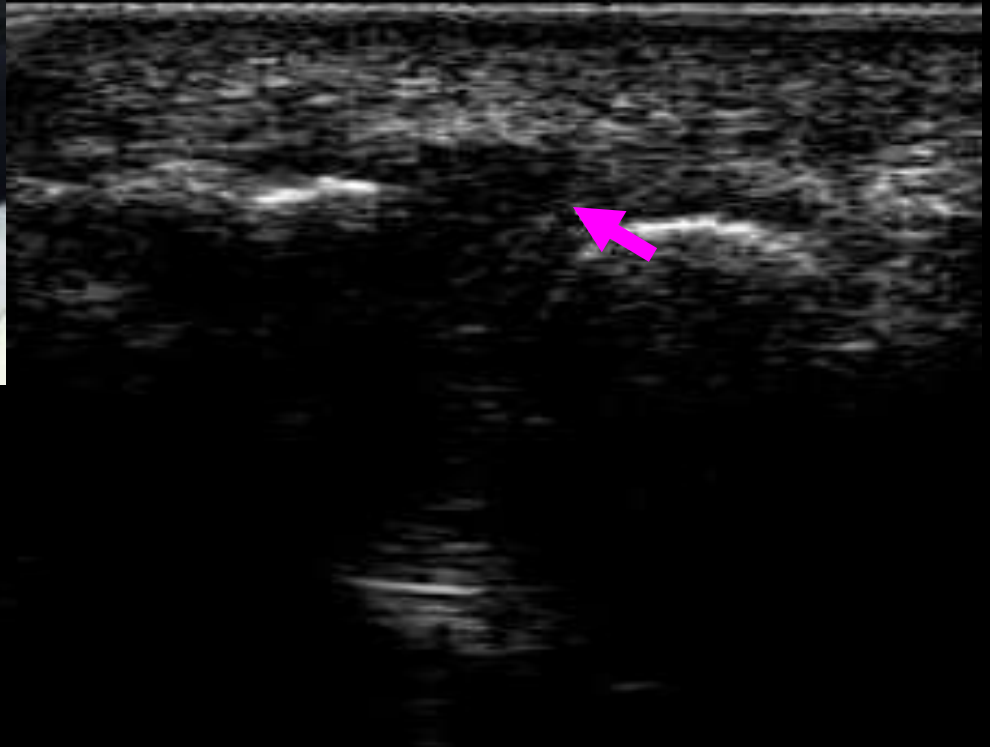


Morton's neuroma

- Small amount of bursal fluid in the first 3 IMT spaces is present in 67% of individuals
- Larger amount (> 3 mm) is suggestive of an associated Morton's neuroma



Morton's neuroma



Morton's neuroma

- Treatment
- **Conservative:** footwear modification, neuroma pads
- Steroid injection, ultrasound therapy
- **Surgery:** release of the IMT ligament for decompression, surgical resection of the neuroma with the involved nerve segment

Heel pad abnormalities

- Heel pain may arise from the fat pad itself
- Composed of columns of adipose tissue separated by fibrous septae. Serves as shock absorbing layer.
- Abnormalities:
 - rheumatoid nodules
 - heel pad inflammation
 - gout
 - peripheral nerve sheath tumours

Rheumatoid nodules

- Affect 20-30% of patients with RA, rarely affect seronegative pts.
- Occur in areas subjected to repetitive minor trauma – areas overlying osseous prominences
- May be painful
- May break down and get infected

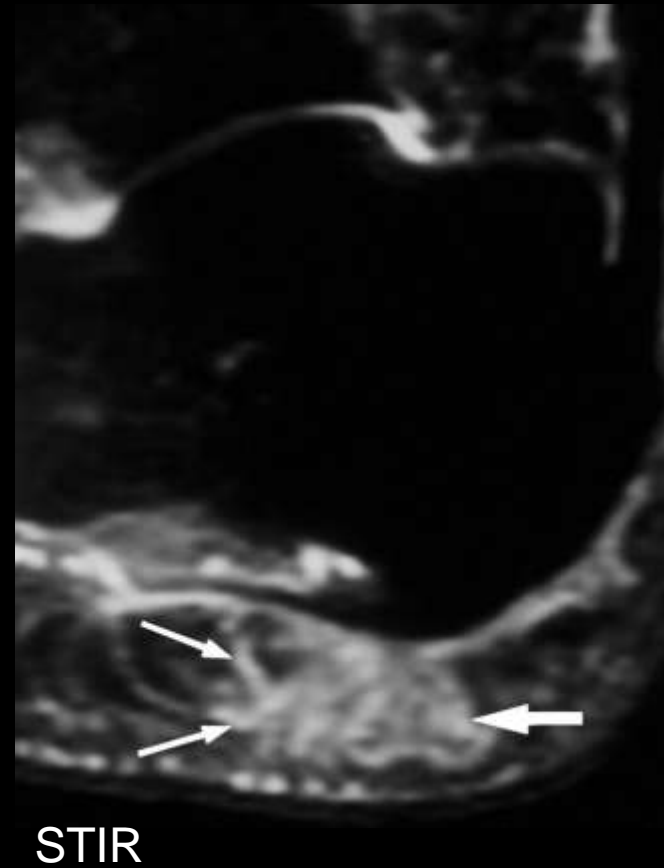
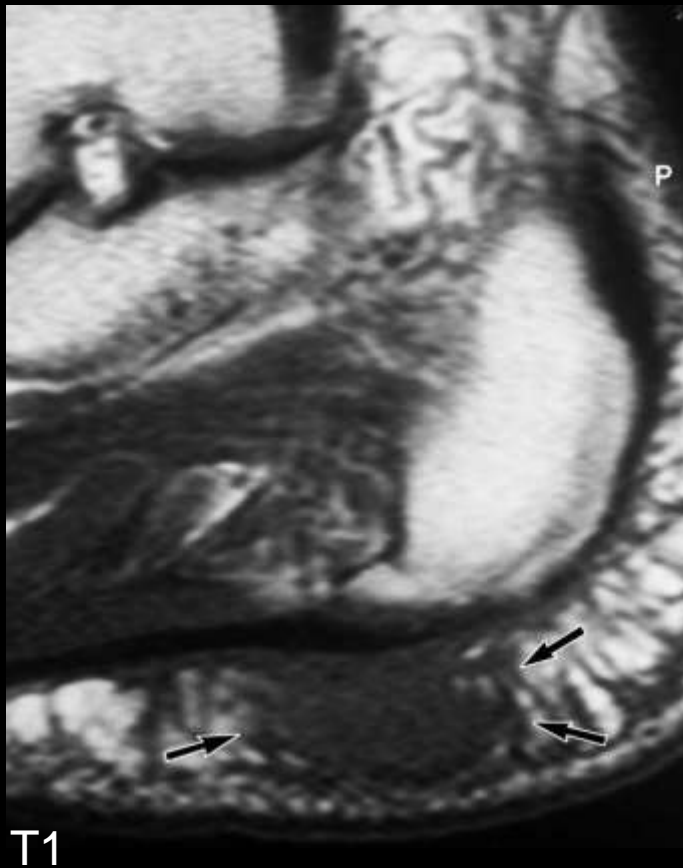
Rheumatoid nodules

- MR Imaging

T1 weighted	Fluid sensitive	Post Gad
Isointense to muscle	Intermediate to high signal	Variable - homogeneous, heterogeneous, peripheral

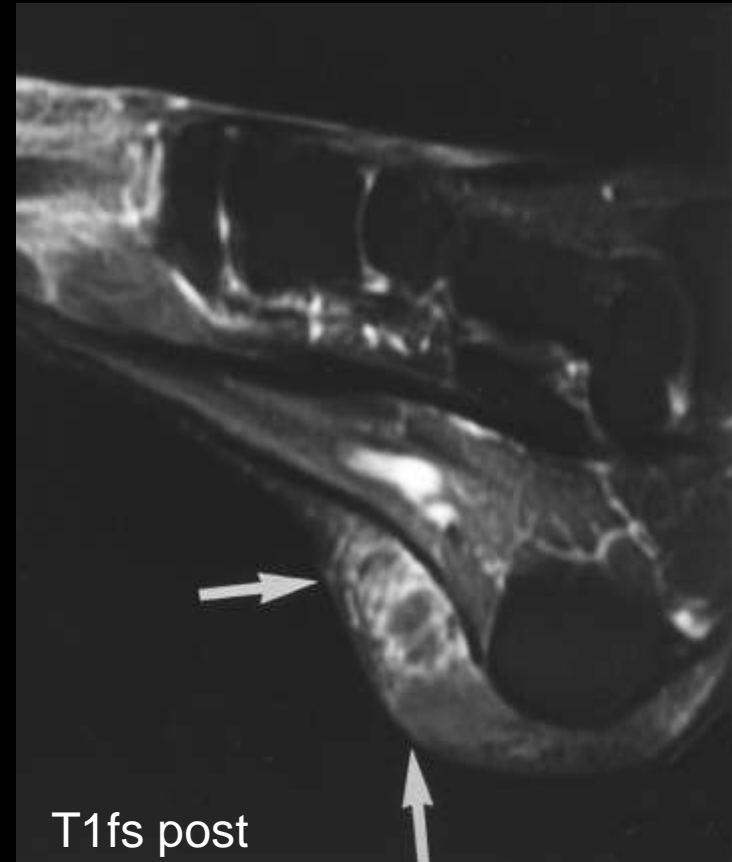
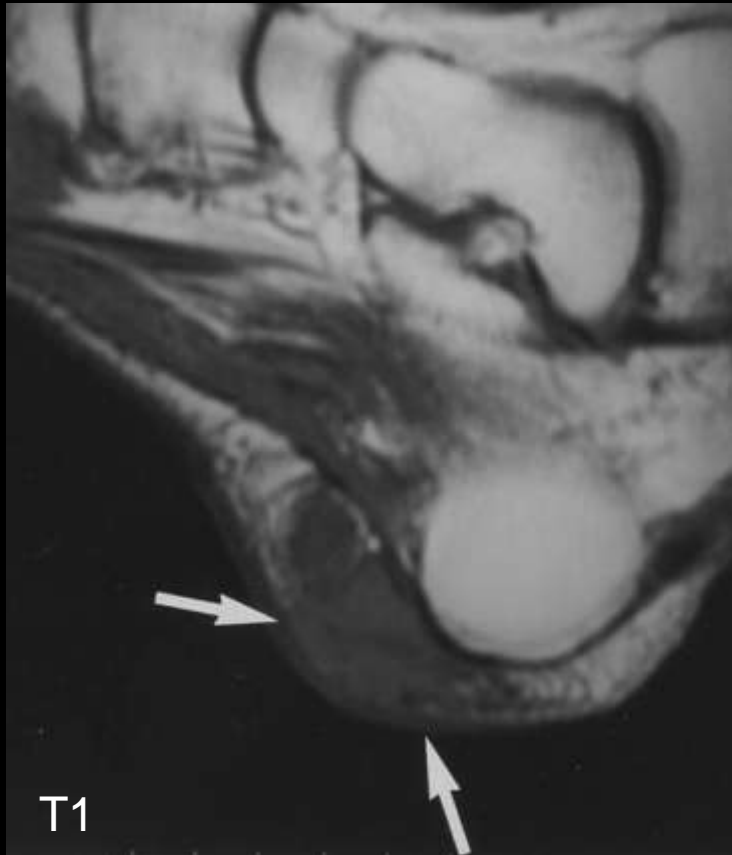
Rheumatoid nodules

- 70 y.o. man with longstanding RA



Rheumatoid nodules

- 45 y.o. woman with RA and heel swelling

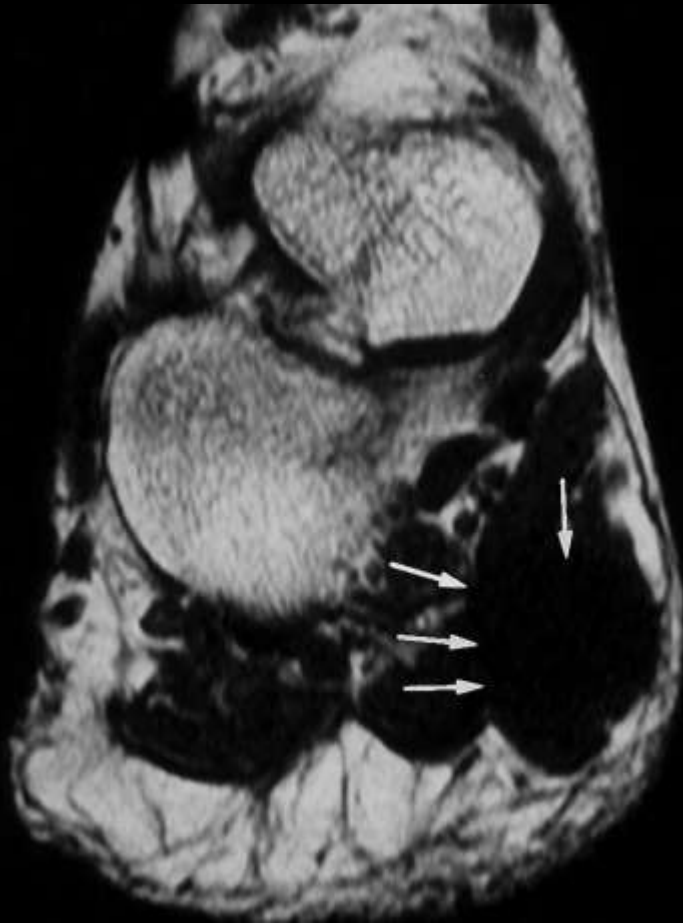


Heel pad inflammation

- Affects young pts as a result of sports injuries, obese elderly pts, truck drivers with stiff clutch pedals
- MRI: Edematous changes in the fat pad
- Treatment - conservative



Schwannoma



T1



T1 post

Hemangioma

- RARE in the plantar soft tissues, usually cavernous
- Can arise from many different tissues
 - skin, subcutaneous tissue, muscle, synovium

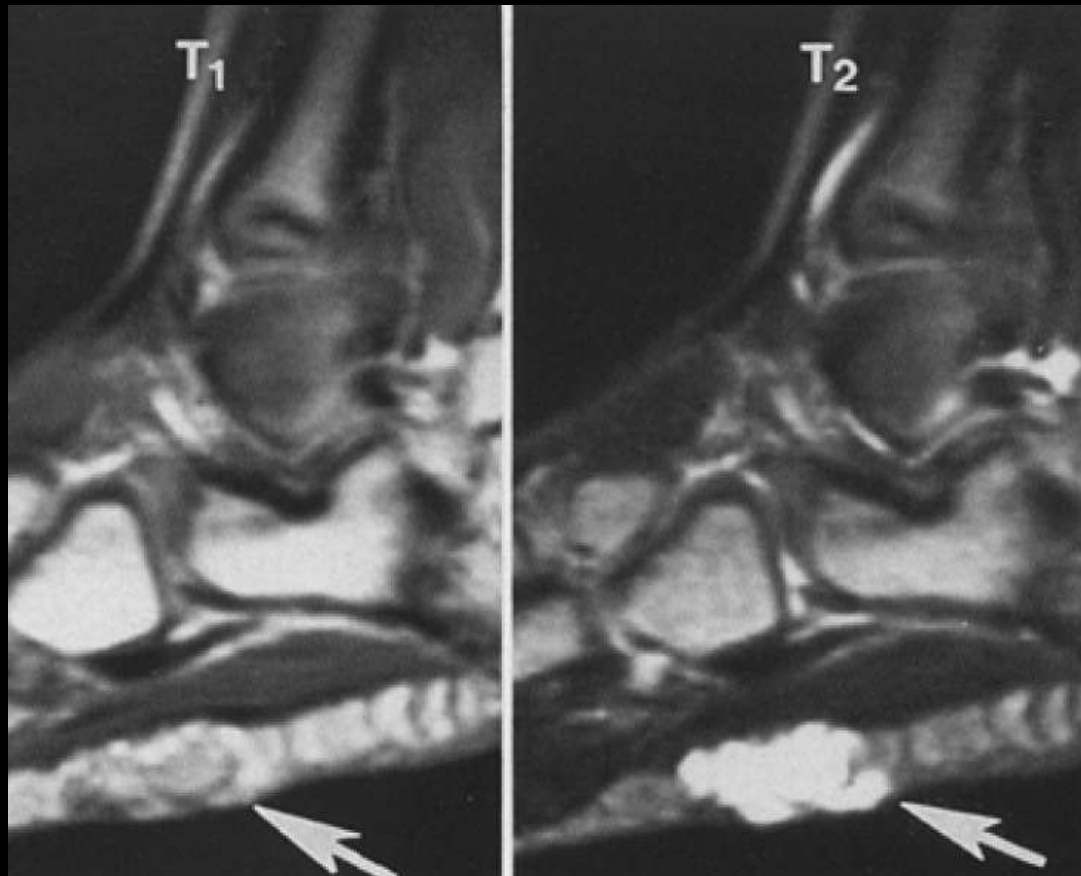
Hemangioma

- MR Imaging

T1 weighted	Fluid sensitive	Post Gad
low to intermediate variable amounts of high signal fat 50% have phleboliths	high signal septations due to vascular channels or fibrous septae	marked

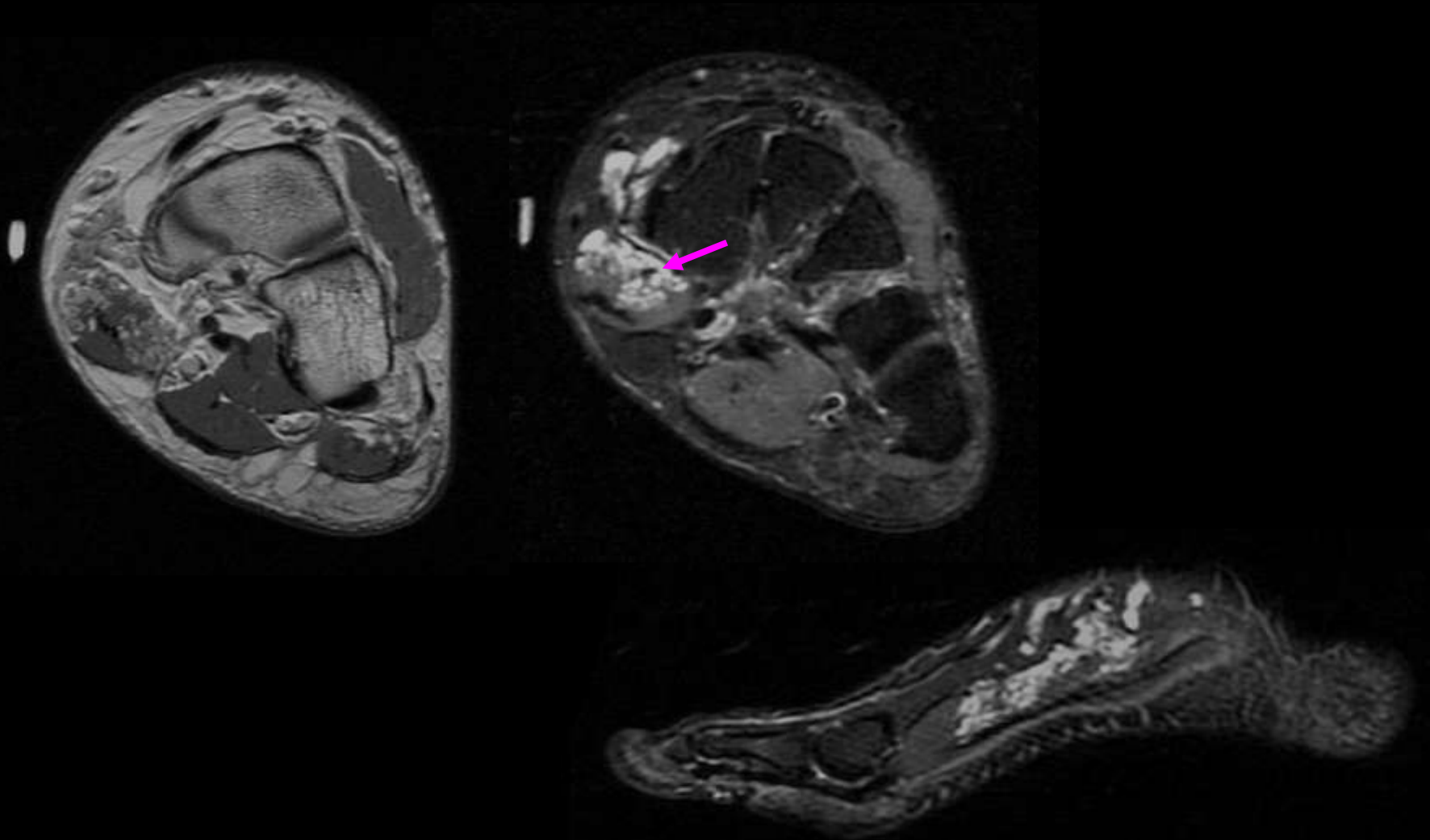
Hemangioma

- 6 y.o. boy with severe pain in the lateral aspect of his foot, exacerbated by wearing shoes.



Hemangioma

- 33 y.o. female with foot mass



Hemangioma

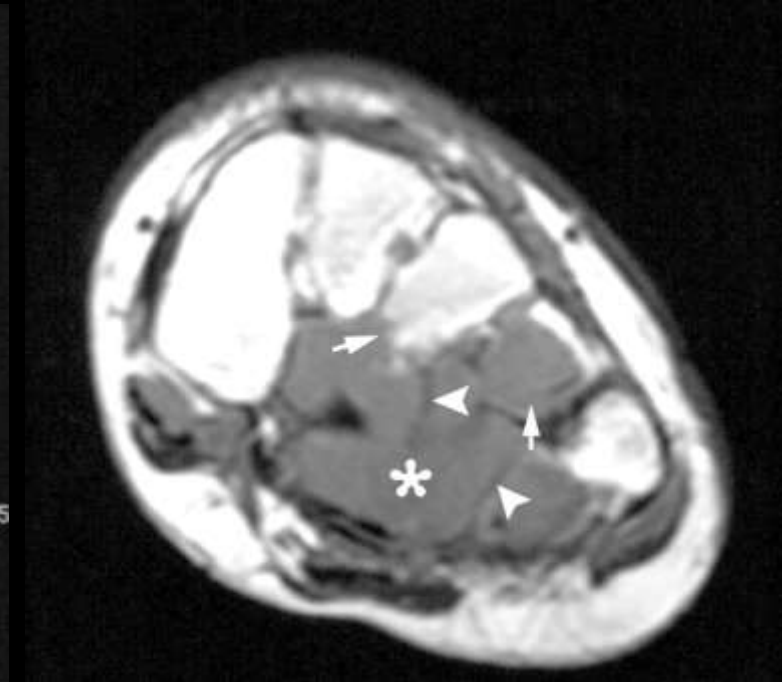
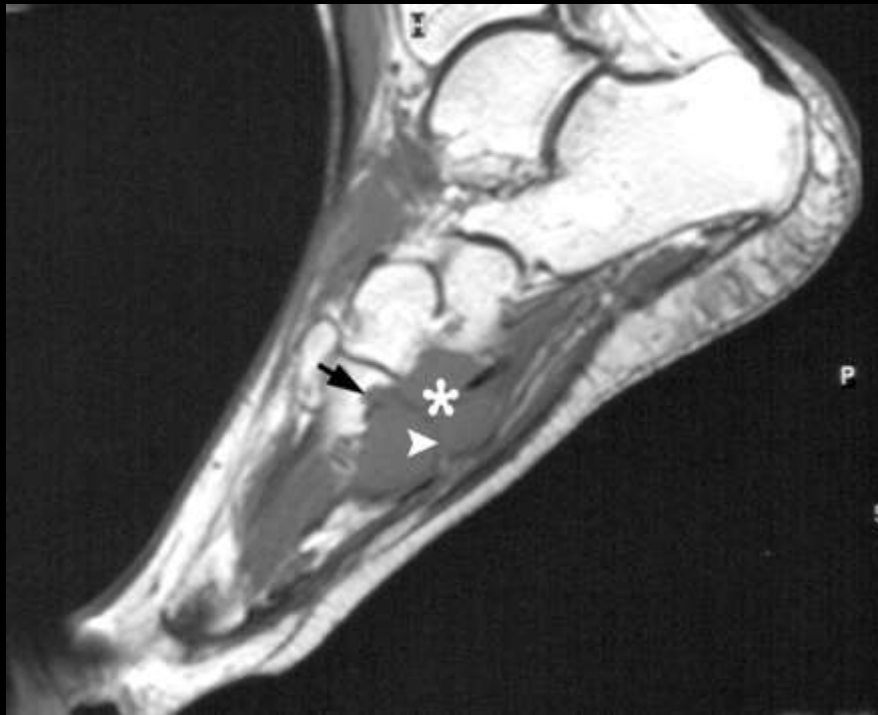
- Treatment
- Surgical resection, embolization, laser, XRT
- Biopsy usually non-diagnostic and can result in excess bleeding

Malignancies of the Plantar Soft Tissues

- RARE but they do occur
- Sarcomas – synovial sarcoma, dermatofibrosarcoma
- Synovial sarcomas
 - can remain quiescent for long periods of time
 - can be relatively small
 - can have well-defined margins and homogeneous appearance

Synovial sarcoma

- 29 y.o. woman with a 10 year hx of foot pain and treatment of plantar fasciitis without relief



TRIVIA

- What native of Halifax was nominated for Best Actress at the 2008 Oscars?

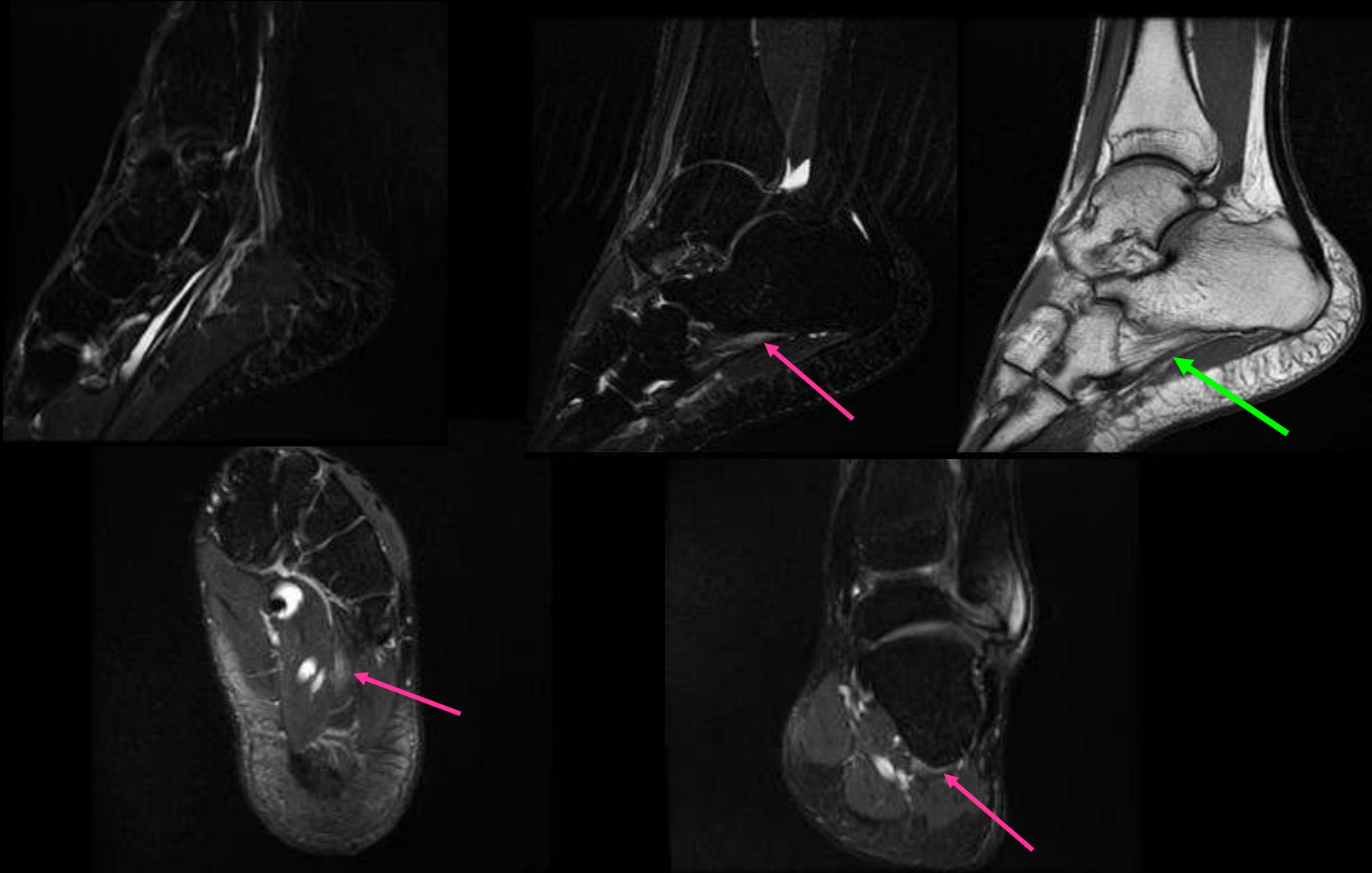


Ellen Page

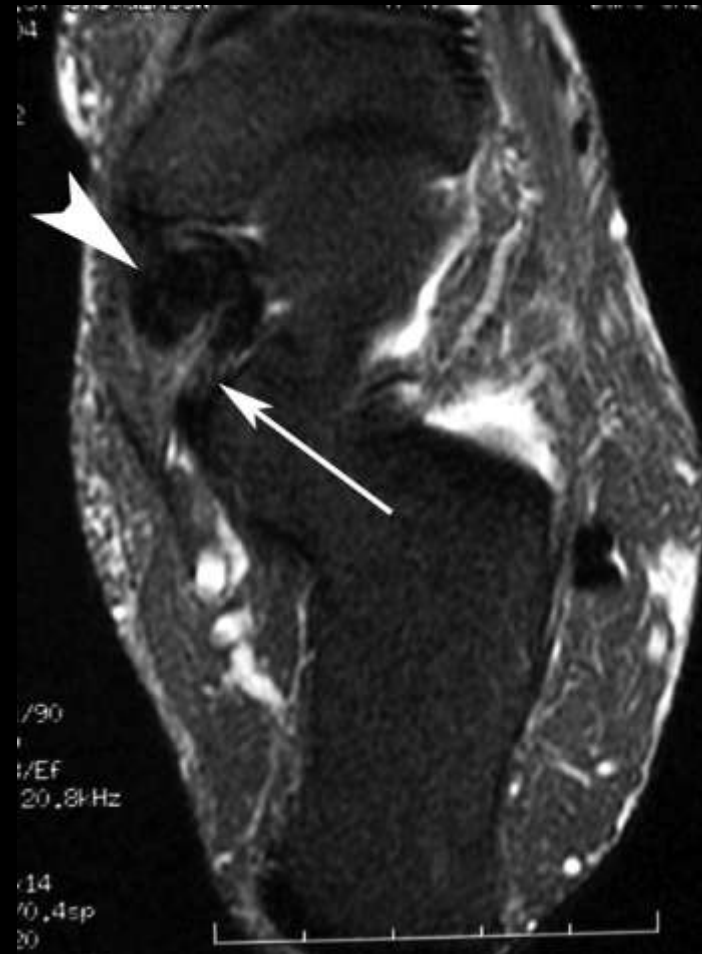
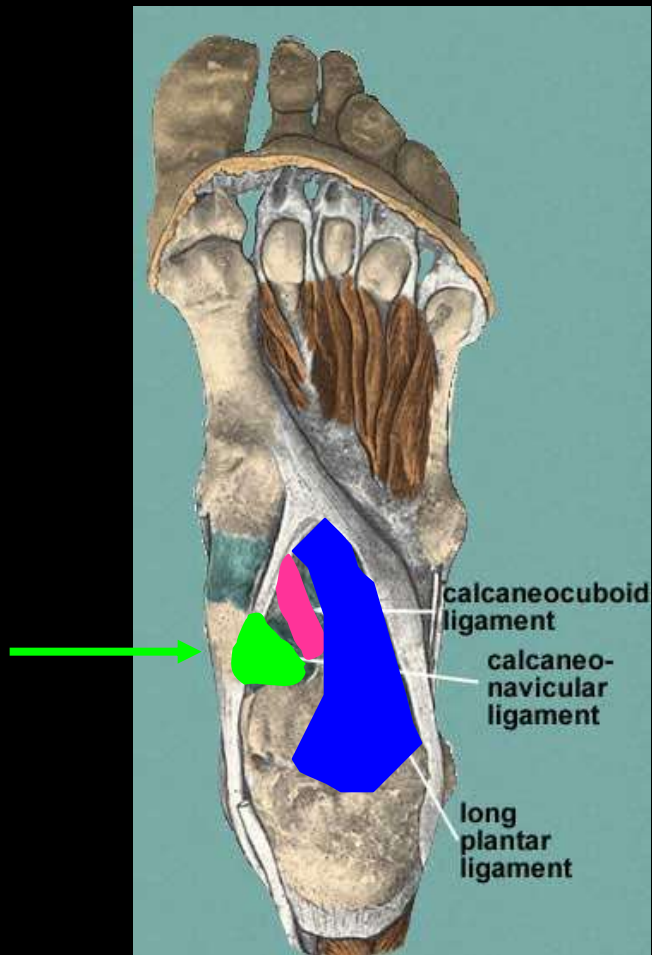
“Juno”

- Plantar ligament abnormalities

- 29 y.o. man with chronic ankle pain X 4 y



Anatomy Review



Spring ligament tears

- Typically a chronic degenerative process that occurs with TPT insufficiency
- The larger superomedial component is the greater contributor to hindfoot stability
- MR findings
 - abN calibre of the spring ligament
 - increased signal on fluid sensitive sequences
 - full thickness gap or wavy appearance
 - abN TPT
- Tear of the spring ligament warrants surgical repair

Spring ligament tear



Take Home Points

- When performing MRI of the foot, use a small FOV centered over the region of interest with a skin marker
- Reactive non-tumoral lesions are the most common abnormalities
- Malignant tumours are very rare but they do occur
 - Synovial sarcomas can remain quiescent for long periods of time and can have a non-aggressive appearance
- Evaluate the plantar ligaments

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