

Ultrasound of Calf Injuries

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Disclosures

- Consultant: Bioclinica
- Contractor: POCUS PRO
- Book Royalties: Elsevier
- I now follow Nicki Minaj's cousin's friend in Trinidad on Twitter

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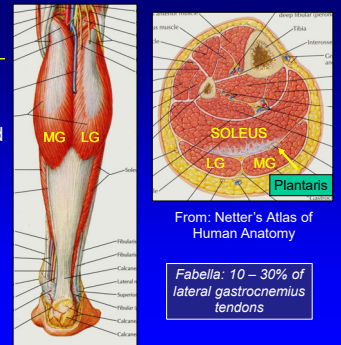
Reporting

- How is a tear described?
 - Given complex muscle anatomy
 - Tendon, aponeurosis, musculotendinous, etc.
 - Return to play
- Strain?
 - Unclear imaging definition
 - Clinical definition: non-specific term
 - Term should be avoided (use “tear” instead)

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Gastrocnemius

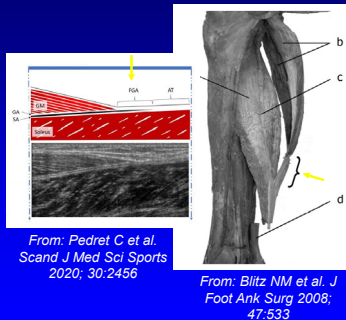
- Medial and lateral heads
- Origin: femur
- Insertion: calcaneus combined with soleus as Achilles tendon (triceps surae)
- Broad anterior or deep distal aponeurosis
- Fast twitch Type 2 fibers crossing 2 joints: injury prone



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Gastrocnemius

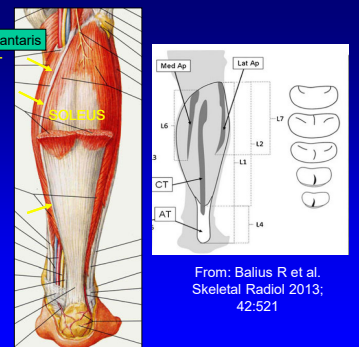
- Aponeurosis of gastrocnemius in contact with aponeurosis of soleus but not connected proximally
- Note “free gastrocnemius aponeurosis” (FGA) (yellow arrow) between gastrocnemius muscle and junction with soleus aponeurosis forming Achilles tendon (AT)



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Soleus

- Origin: tibia and fibula
- Insertion: calcaneus combined with gastrocnemius as Achilles tendon
- Central tendon
- Medial and lateral intramuscular aponeurosis
- Slow twitch Type 1 fibers crossing 1 joint: more resistant to injury



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Plantaris

- Origin: lateral femur
- Insertion: calcaneus
- Absent: 6 – 8% of population
- Small proximal muscle belly
- Tendon: between medial head of gastrocnemius and soleus muscle bellies
- Medial and anterior border of Achilles tendon

From: Netter's Atlas of Human Anatomy

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Gastrocnemius and Soleus

Yellow arrow: gastrocnemius aponeurosis
White arrow: soleus aponeurosis

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Gastrocnemius, Soleus, and Plantaris

Short Axis

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Plantaris

Short Axis

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Calf: injury

- Medial head of gastrocnemius: "tennis leg"
 - Most common in general population
- Lateral gastrocnemius: less common
- Soleus: common in Australian rules footballers¹
 - Especially proximal medial aponeurosis (56%)²
- Plantaris:
 - Isolated tear or combined with medial gastrocnemius
 - May be thickened with Achilles tendinosis³

¹Waterworth G et al. Skeletal Radiol 2017; 46:343
²Balius R et al. Skeletal Radiol 2013; 42:521
³Alfredson H. Br J Sports Med 45:1023

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Imaging: soleus muscle

- Ultrasound evaluation of soleus is limited
 - Deeper structure
- MRI more sensitive than ultrasound for minor injuries and early detection¹
 - Edema: subjective subtle increased echogenicity on ultrasound
 - MRI may detect asymptomatic findings²
 - Intramuscular injury: more likely to miss play³

¹Balius R et al. Skeletal Radiol 2014; 43:805
²Brennan JH et al. Skeletal Radiol 2020; 49:563
³Waterworth G et al. Skeletal Radiol 2017; 46:343

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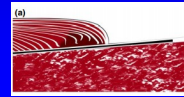
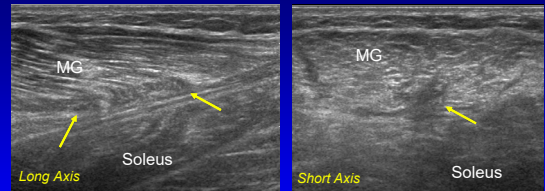
Ultrasound: gastrocnemius injury

- Type 1: myoaponeurotic injury (no intermuscular hematoma)
- Type 2: aponeurotic injury (most common)
 - 2A: <50% width; 2B: >50% width
- Type 3: free gastrocnemius aponeurosis injury
 - Longest return to play
- Type 4: mixed type 2 and 3
- **Worse prognosis:** intermuscular hematoma and asynchronous gastrocnemius-soleus movement (with plantar flexion)

Pedret C et al. Scand J Med Sci Sports 2020; 30:2456

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Medial Head of Gastrocnemius Tear: Type 1 Injury

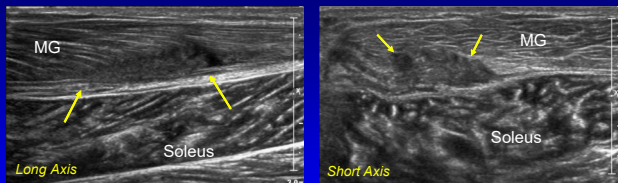


Note: isolated muscle abnormality (myoaponeurosis injury)

Illustrations from: Pedret C et al. Scand J Med Sci Sports 2020; 30:2456

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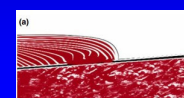
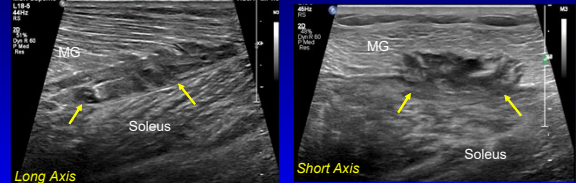
Medial Head of Gastrocnemius Tear: Type 2A Injury



Note: muscle abnormality (myoaponeurosis injury) and adjacent gastrocnemius aponeurosis discontinuity and <50% involvement (short axis)

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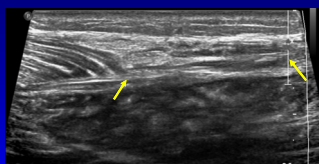
Medial Head of Gastrocnemius Tear: Type 2B Injury



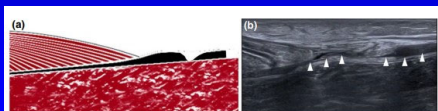
Note: muscle abnormality (myoaponeurosis injury) and adjacent gastrocnemius aponeurosis discontinuity and >50% involvement (short axis)

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Medial Head Gastrocnemius Tear: Type 3 Injury



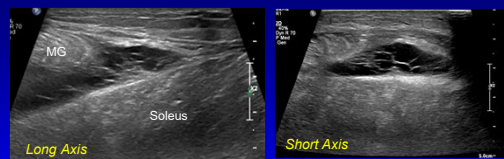
Note: injury to free gastrocnemius aponeurosis



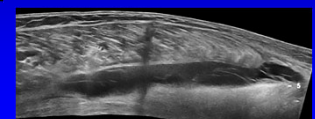
From: Pedret C et al. Scand J Med Sci Sports 2020; 30:2456

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Medial Head Gastrocnemius Tear: Type 4 Injury

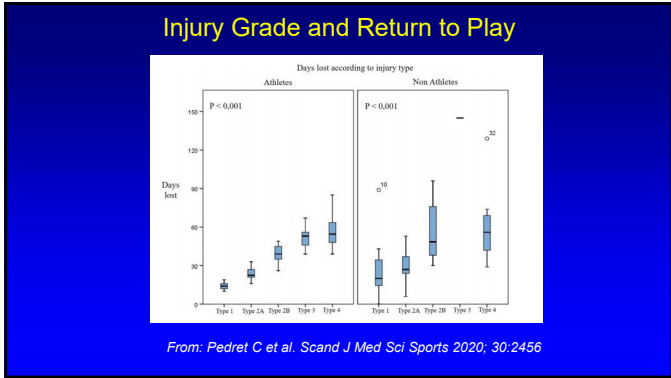


Note: mixed Types 2 and 3 injury

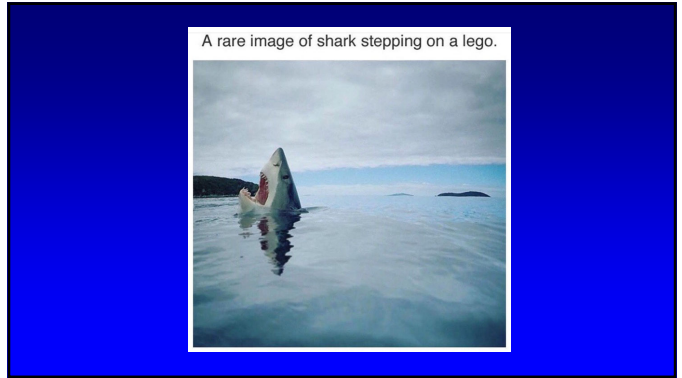


From: Pedret C et al. Scand J Med Sci Sports 2020; 30:2456

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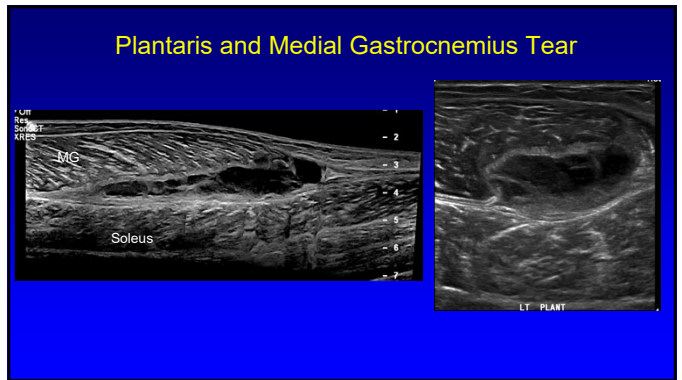
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Plantaris Tendon: tear

- Between medial gastrocnemius & soleus muscle bellies
- Hypoechoic fluid: tubular
 - *Mid-calf level
- Plantaris tendon fiber disruption
- Normal gastrocnemius muscle and aponeurosis

Leekam RN et al. AJR 1999; 172:185

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Soleus Injuries

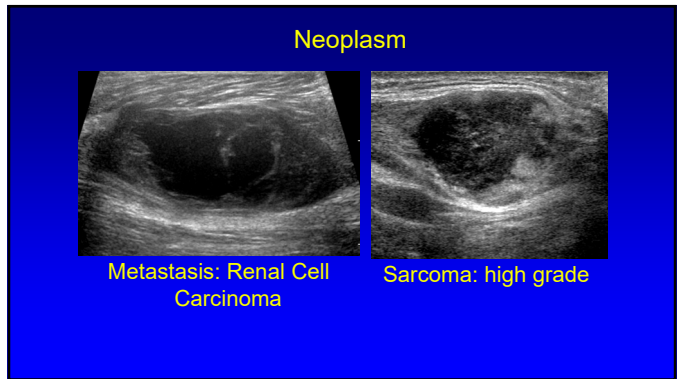
- Ultrasound limited
- Use MRI
- Consider British Athletic Muscle Injury Classification
- Caution: intramuscular hematoma differential diagnosis includes neoplasm

Myofascial Tear

Hematoma

From: Balus R et al. Skeletal Radiol 2014; 43:805

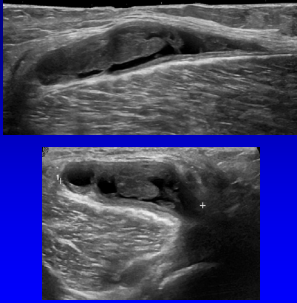
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Baker cyst: rupture

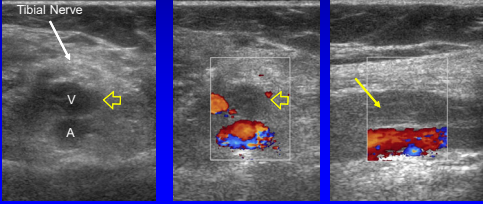
- Calf symptoms
- Superficial to medial gastrocnemius
- Rarely intramuscular
- May extend to Achilles
- Look for communicating "neck"



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Deep Venous Thrombosis

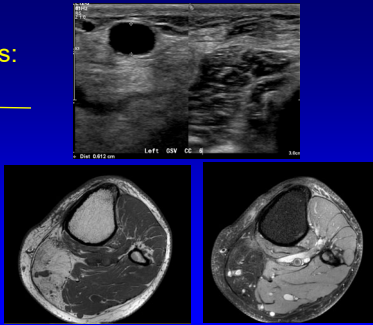
- Hypoechoic thrombus
- Not compressible
- No flow



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Medial Gastrocnemius: fatty infiltration

- Focal: prior injury
- Diffuse:
 - Denervation
 - Pseudohypertrophy
- Variable: idiopathic



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Take Home Points

- Gastrocnemius:
 - 5 injury types
 - Poor prognosis: intermuscular hematoma with asynchronous motion between soleus and gastrocnemius
- Plantaris: proximal tubular fluid collection
- Soleus injury: need MRI

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Syllabus on line and other educational material:
www.jacobsonmskus.com
 Twitter handle: @jjacobsn

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