



IMAGING OF HAMSTRING AVULSION INJURIES: DIAGNOSTIC, PROGNOSTIC AND TREATMENT IMPLICATIONS

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AGENDA

- Patient presentation
- Regional anatomy
- Presentation and epidemiology
- Diagnostic imaging
- Implications for treatment
- Conclusion of patient presentation
- Imaging of chronic hamstring injuries



OUR PATIENT: HISTORY

- 76-year-old man presented to the emergency room with sharp pain in the right posterior thigh
 - Sudden onset while running
 - 2/10 at rest
 - 10/10 with any active movement
- No prior history of lower extremity injury



OUR PATIENT: EXAM

- Extremities:
 - Pelvis stable and non-tender
 - No swelling, overlying ecchymosis, or palpable defect in muscles/tendons of posterior thigh
 - Tenderness to palpation over right superior posterior thigh
 - Active contraction of right hamstring limited by pain

OUR PATIENT: PLAIN FILM

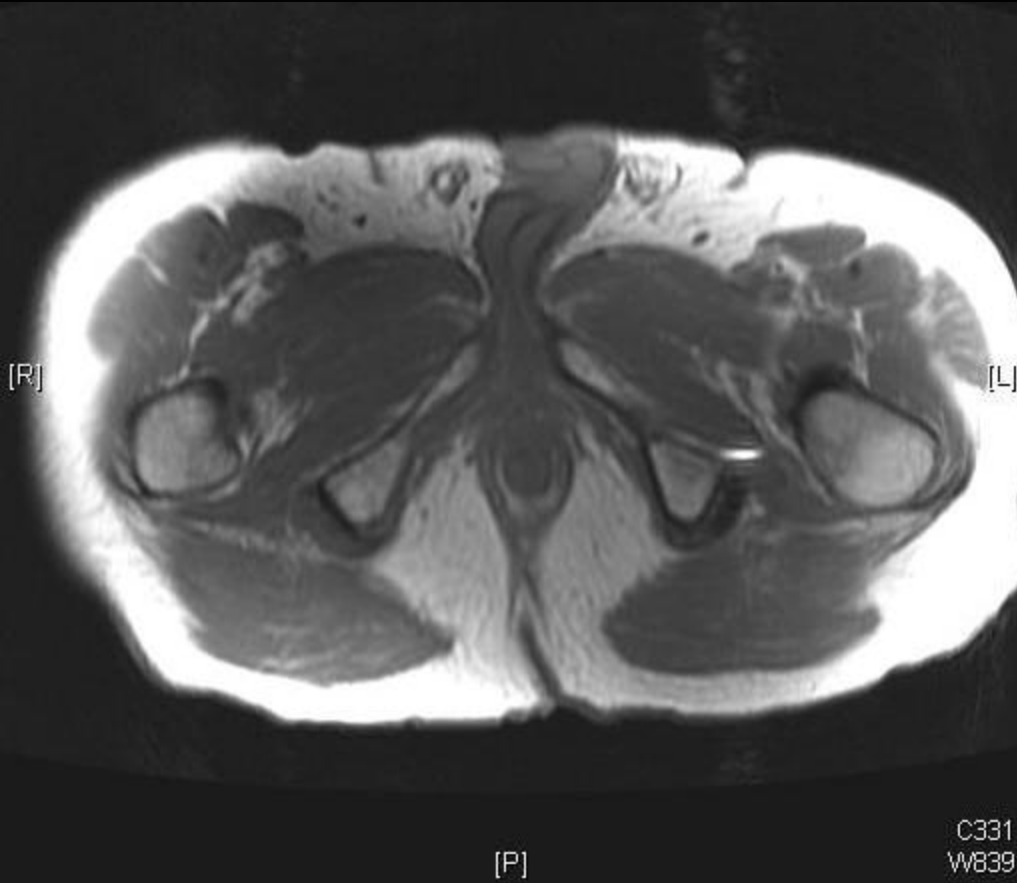




OUR PATIENT: FURTHER HISTORY

- Given the patient's history, there was high suspicion for a muscle tear
- An MRI was ordered for two days after the injury

OUR PATIENT: MRI - ISCHIAL TUBEROSITY



MRI Axial - T1 C-

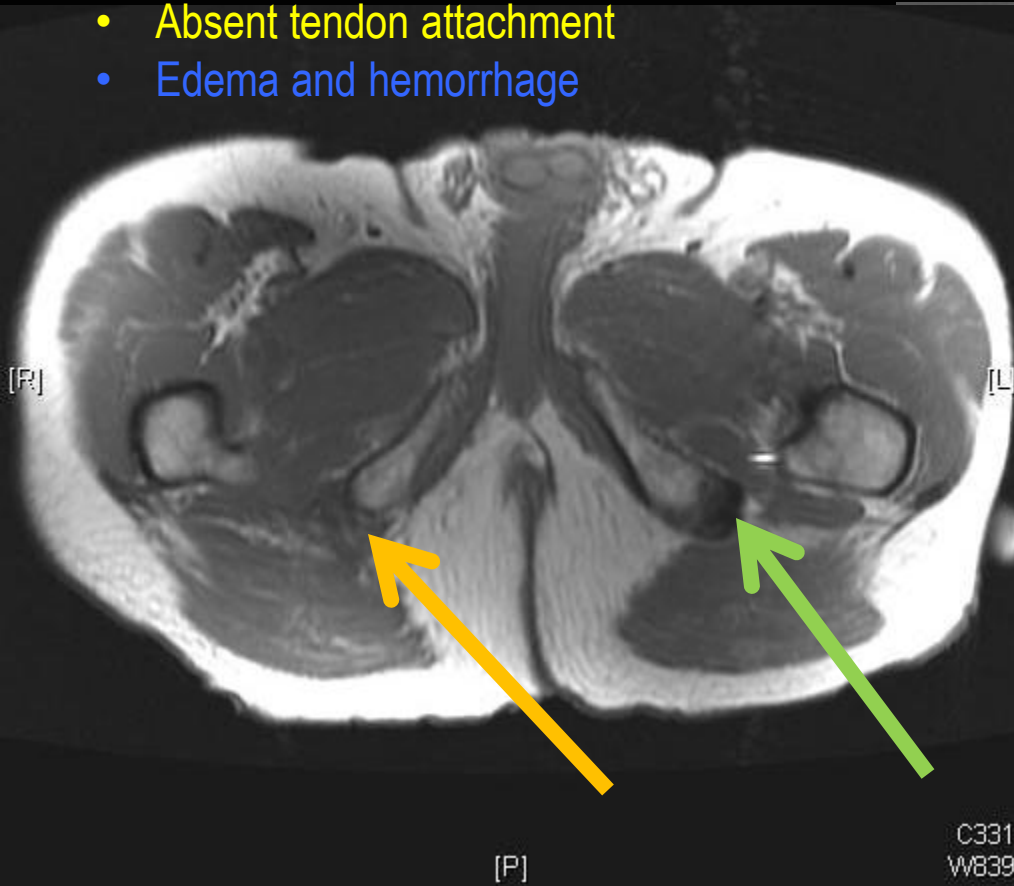


MRI Axial - T2 C-

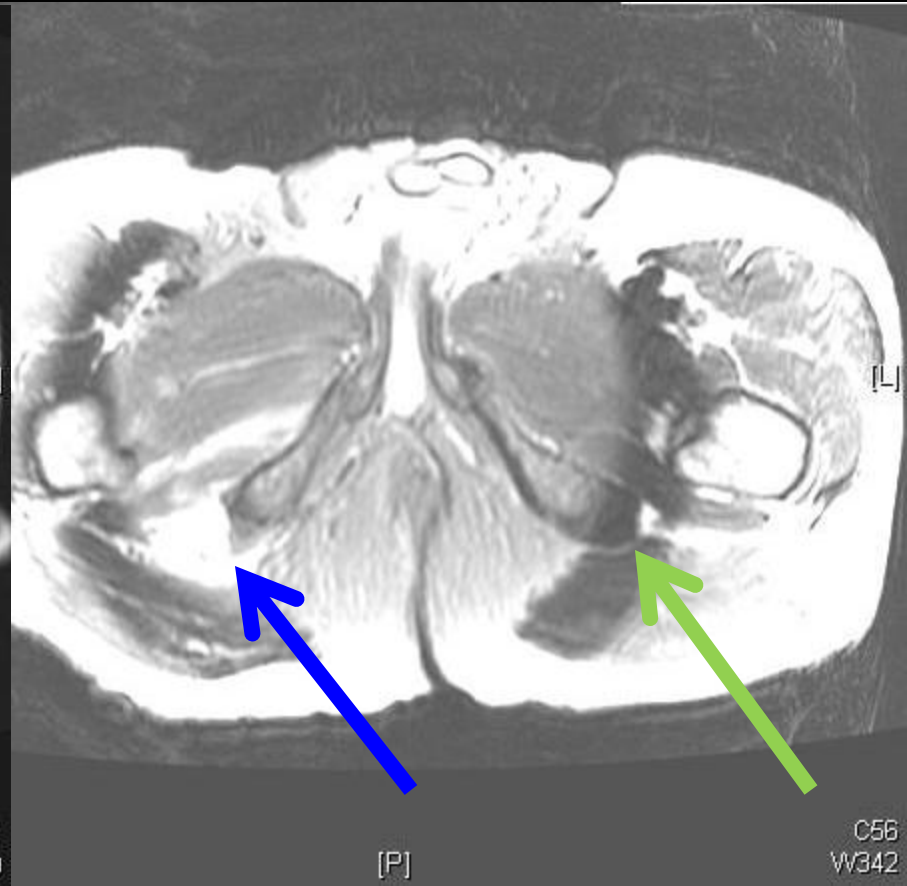
OUR PATIENT: MRI - BASE OF ISCHIAL TUBEROSITY

Findings:

- Normal tendon attachment
- Absent tendon attachment
- Edema and hemorrhage



MRI Axial - T1 C-



MRI Axial - T2 C-

OUR PATIENT: MRI - 1 CM BELOW ISHCIAL TUBEROSITY



MRI Axial - T1 C-

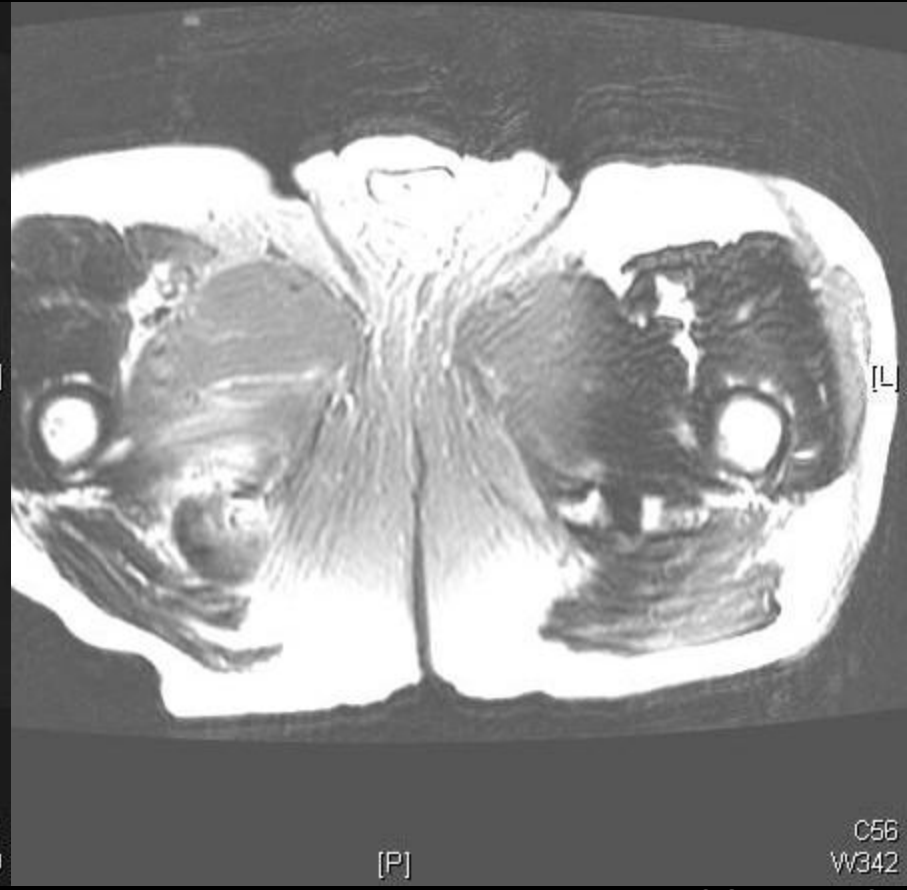


MRI Axial - T2 C- PACS-BIDMC

OUR PATIENT: MRI - 2 CM BELOW ISCHIAL TUBEROSITY

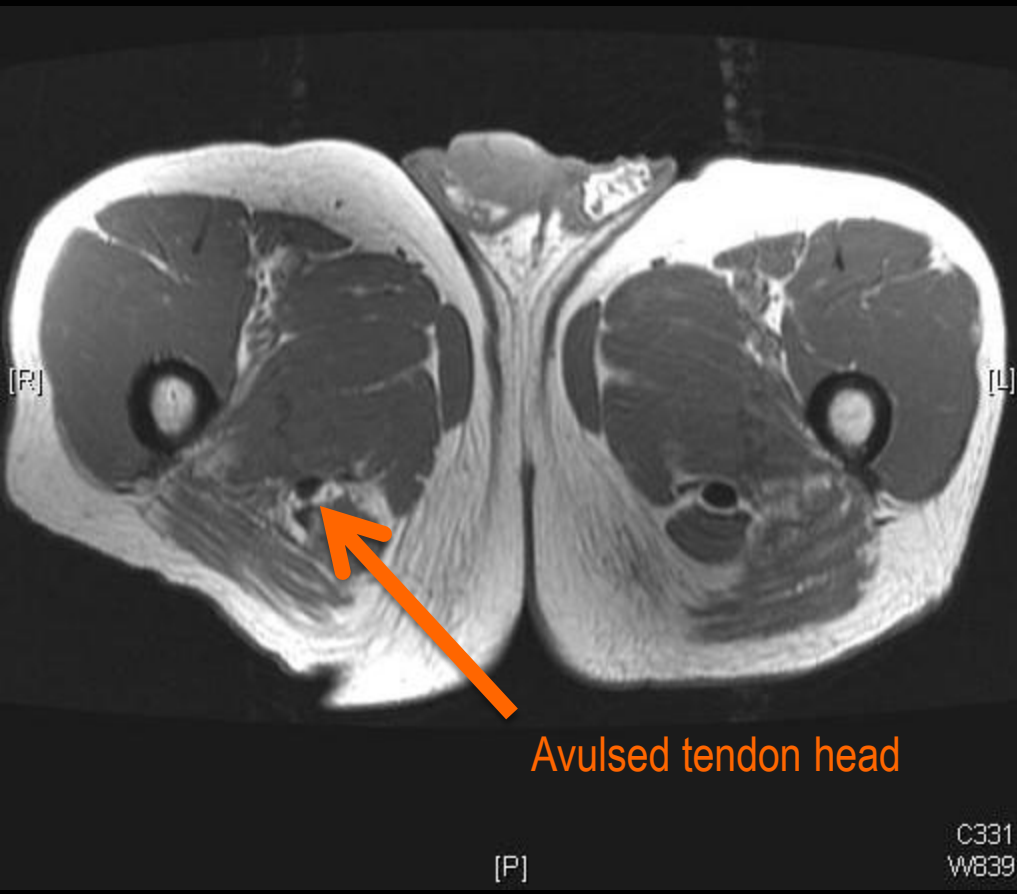


MRI Axial - T1 C-

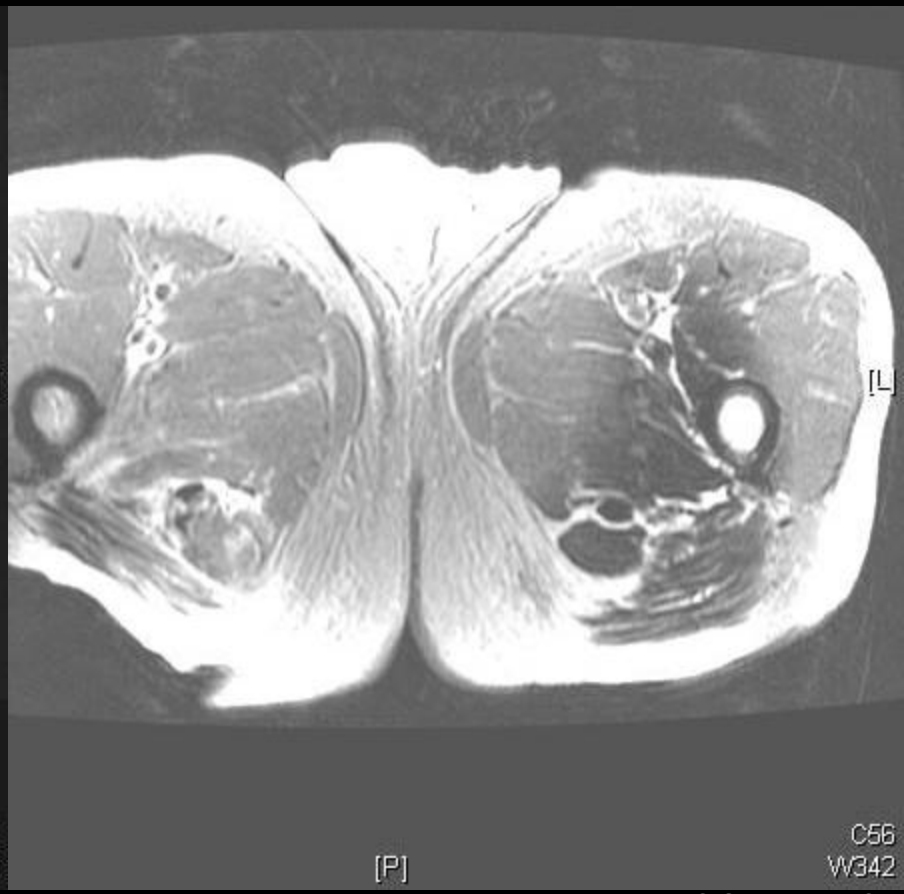


MRI Axial - T2 C- PACS-BIDMC

OUR PATIENT: MRI - 4 CM BELOW THE ISCHIAL TUBEROSITY



MRI Axial - T1 C-

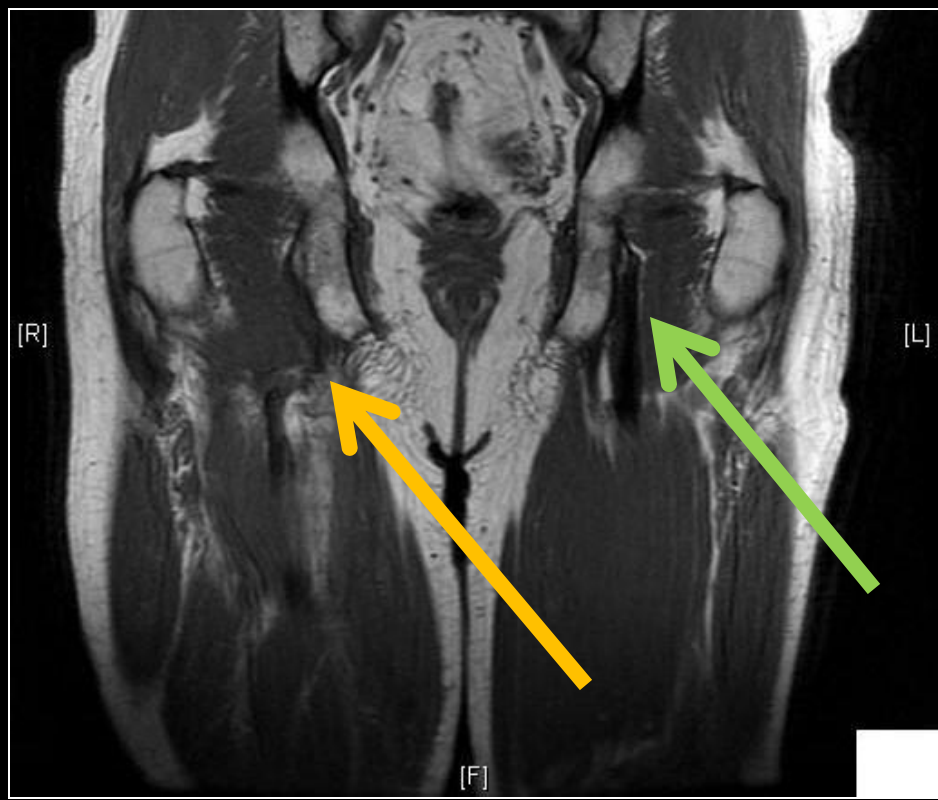


MRI Axial - T2 C- PACS-BIDMC

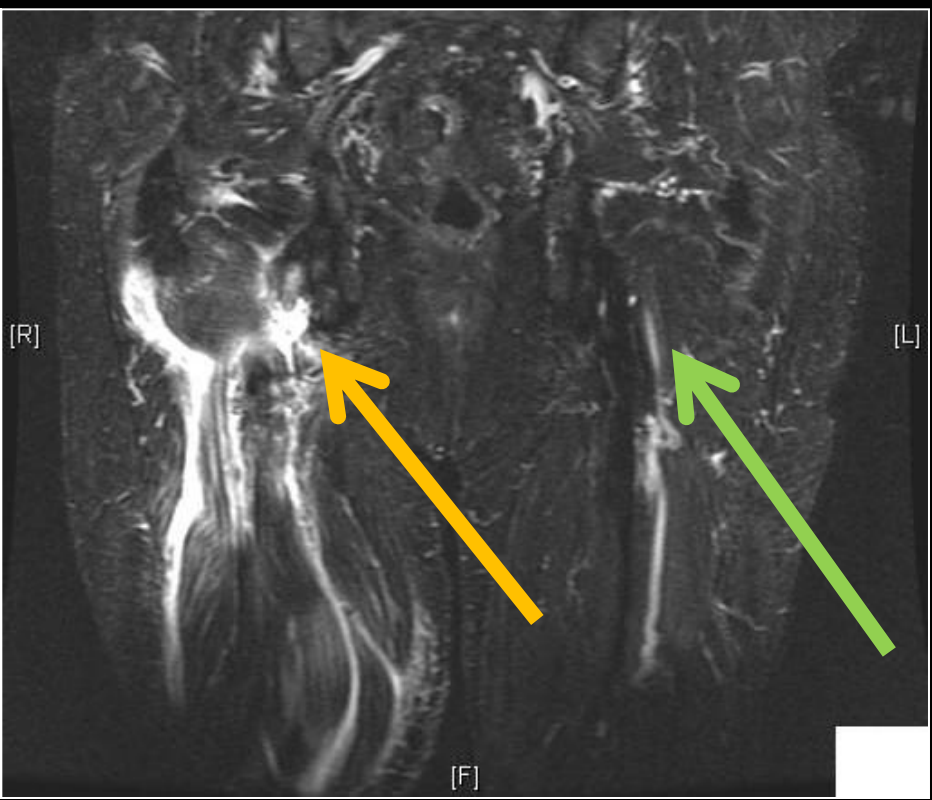
OUR PATIENT: MRI CORONAL

Findings:

- Normal tendon attachment
- Avulsed tendon

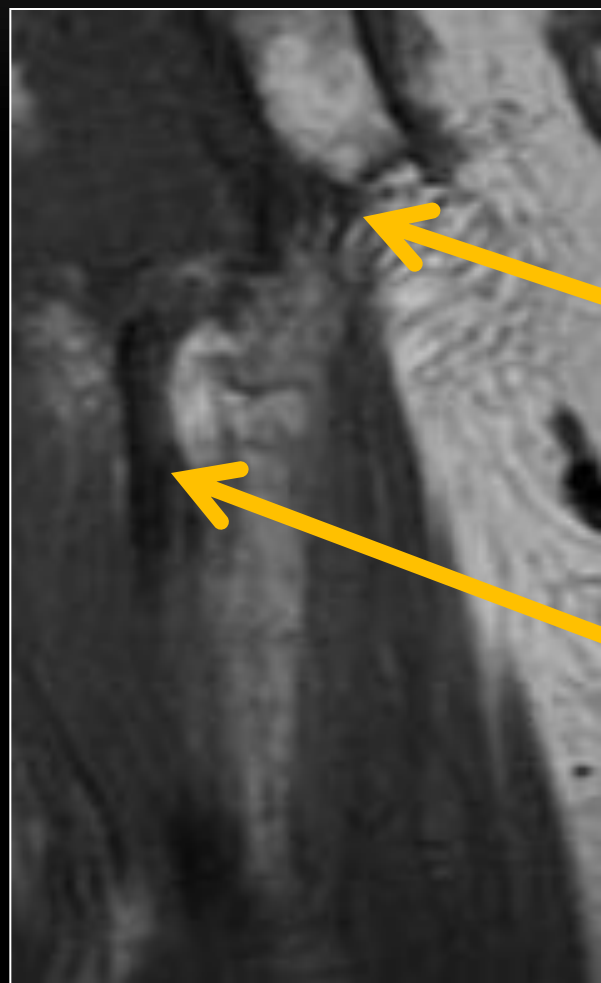


MRI Coronal - T1 C-



MRI Coronal – STIR C-
PACS-BIDMC

OUR PATIENT: MRI - EXPANDED



MRI Coronal - T1 C-

Ischial tuberosity

Tendon



MRI Coronal - STIR C- PACS-BIDMC



DIFFERENTIAL DIAGNOSIS

Posterior thigh pain

- Hamstring strain
- Ischial tuberosity disease
- Hamstring enthesopathy
- Hamstring syndrome
- Referred pain
- Hamstring contusion
- Myositis ossificans
- Bursitis
- Ligament strain
- Posterior compartment syndrome
- Sciatic nerve pain
- Bone tumor
- Sacroiliitis
- Claudication

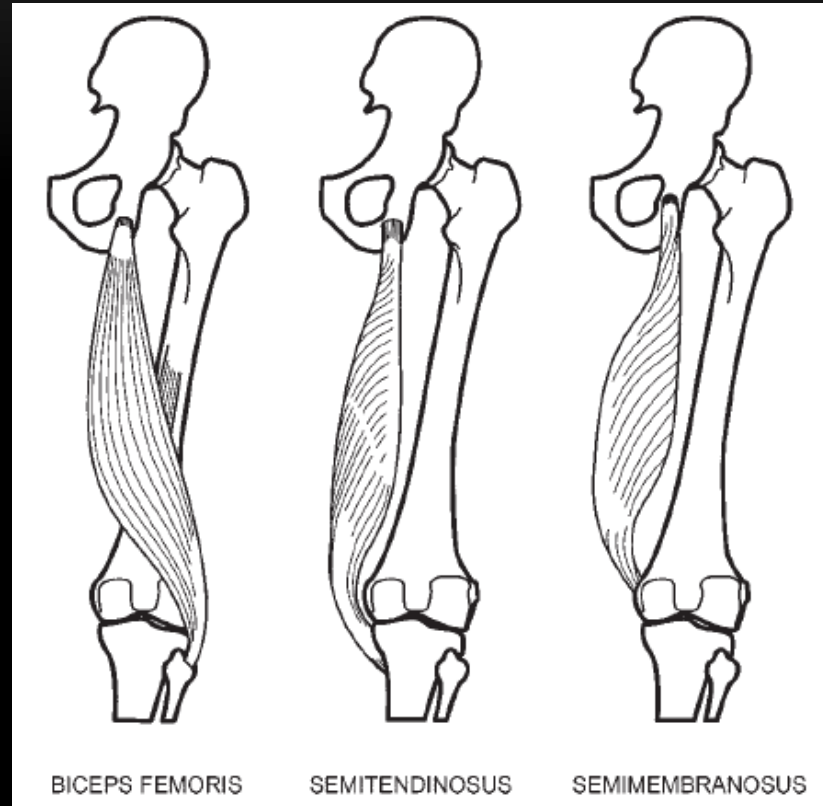
Radiologic differential for hamstring muscle complex injury

- Hamstring strain
- Hamstring avulsion/tear w/ or w/o ischial tuberosity involvement



REGIONAL ANATOMY

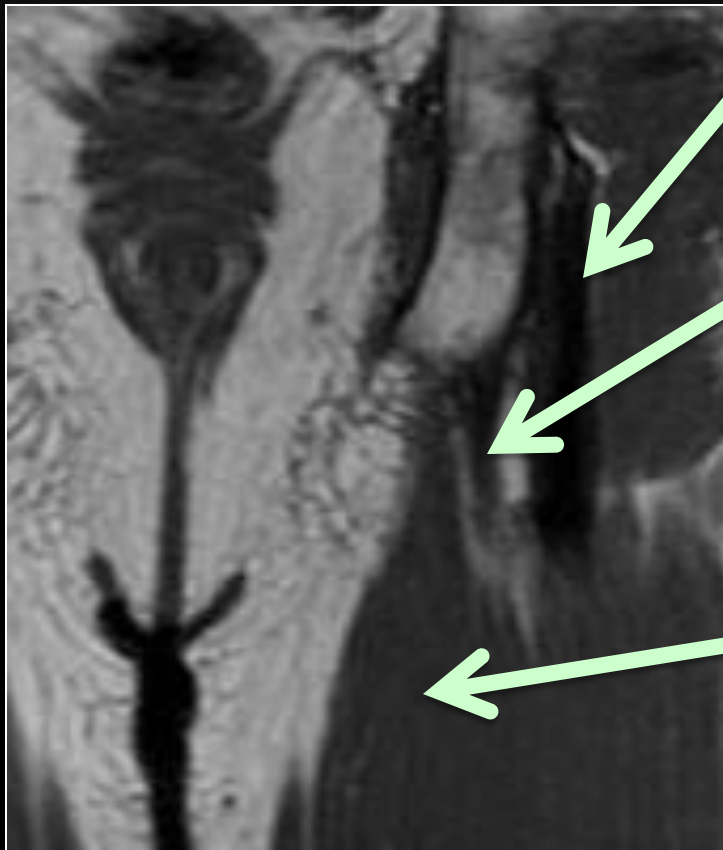
- Flex the knee and extend the hip
- The hamstring muscles cross two joints, predisposing to strains and tears
- Decelerates the leg during running and walking



Koulouris G, Connell D. Hamstring muscle complex: an imaging review. *Radiographics*. 2005 May-Jun;25(3):571-86. Review. Erratum in: *Radiographics*. 2005 Sep-Oct;25(5):1436.



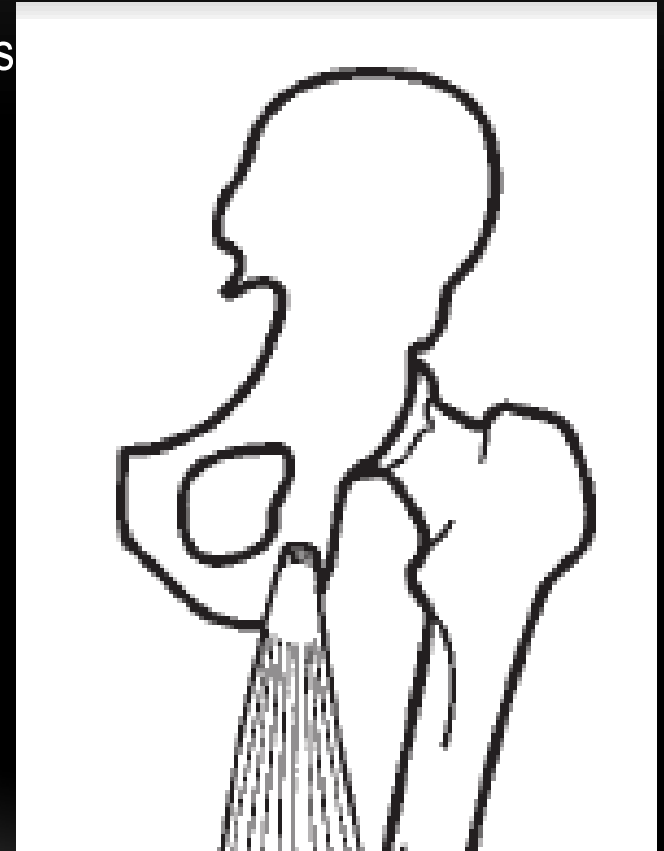
REGIONAL ANATOMY – TENDON ATTACHMENTS



Semimembranosus
Tendon

Conjoint
Tendon

Muscle body



PACS-BIDMC



PRESENTATION AND EPIDEMIOLOGY

- **History**
 - Sudden onset
 - Feeling of a “pop”
 - Pain is exacerbated by movement of the leg
- **Epidemiology and risk factors**
 - Adolescents - Avulsion of the ischial tuberosity is more common
 - Adults - Involvement of the muscle-tendon junction
 - Elderly – Tendon involvement most common
 - Poor flexibility and muscle weakness relative to the quadriceps
 - Sports related – Waterskiing, sprinting, playing soccer and football



IMAGING HAMSTRING AVULSIONS: GOALS

- Diagnosis
- Prognosis
- Determine surgical candidacy



IMAGING HAMSTRING AVULSIONS: MODALITIES

- **X-ray**
 - Often first study in practice
 - May help identify bony abnormalities and joint abnormalities
- **Ultrasound**
 - Most sensitive early for moderate to severe injuries
 - Slightly more sensitive than MRI in the first two weeks, but declines as fluid resolves¹
 - US may be most sensitive in adolescents²
- **MRI**
 - Improved characterization of the injury
 - More prognostic information
 - Useful for following injury resolution

1. Connell DA, Schneider-Kolsky ME, Hoving JL, Malara F, Buchbinder R, Koulouris G, Burke F, Bass C. Longitudinal study comparing sonographic and MRI assessments of acute and healing hamstring injuries. *AJR Am J Roentgenol.* 2004
2. Lazović D, Wegner U, Peters G, Gossé F. Ultrasound for diagnosis of apophyseal injuries. *Knee Surg Sports Traumatol Arthrosc.* 1996;3(4):234-7

RADIOLOGIC FINDINGS ON X-RAY



Ischial tuberosity avulsion



RADIOLOGIC FINDINGS ON US

- Heterogeneity of the HMC tendons
- Surrounding edema
- Separation of conjoint and semimembranous tendons from the ischial tuberosity
- Can look for movement of the muscle tendon complex



RADIOLOGIC FINDINGS ON US: EXAMPLES



Ultrasound imaging showing a partial tear of the HMC (arrow) near the insertion point on the ischial tuberosity (*). Fluid can be seen tracking under the tendon complex (curved arrow).



Ultrasound imaging showing a normal HMC (arrow) near the insertion point on the ischial tuberosity (*). Superior to the insertion the HCM is difficult to separate from the sacrotuberous ligament (curved arrow).

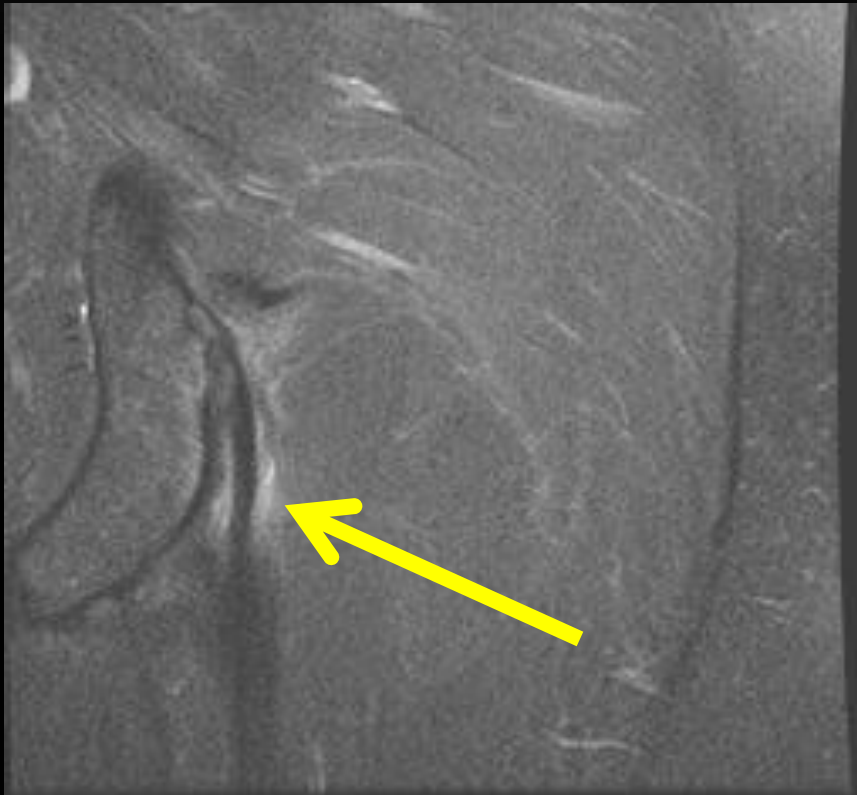


RADIOLOGIC FINDINGS ON MRI

- Tendons are low-intensity on MR
 - Loss of low-intensity signal between tendons and bone may be visible on T1
 - Intervening edema between tendons and bone will be evident on T2
- On T2 imaging fluid may be seen tracking down the posterior compartment around the hamstrings.
- May be able to assess sciatic nerve integrity



RADIOLOGIC FINDINGS ON MRI: PARTIAL TEAR



- Partial tear
- Tendon is largely intact
- Subtle high-intensity edema around tendon

Courtesy of Dr. James Wu



TREATMENT

- Most evidence comes from small case studies
- No definitive guidelines for surgical vs. non-surgical management
- Most patient's do well with non-operative management
- Elite athletes may benefit from surgical management
- Avulsion of the ischial tuberosity in adolescents may warrant surgical correction

OUR PATIENT: CONCLUSION

- The orthopedic surgeon decided to treat non-operatively
- The patient is currently undergoing physical therapy



COMPLICATIONS OF HAMSTRING AVULSIONS

- Re-injury
- Sciatic nerve irritation
- **Myositis Ossificans**
- “Hamstring syndrome”





CONCLUSIONS

- Hamstring injuries are a common musculoskeletal problem
- The choice to image should be based on the history and physical examination
- Imaging modality may be patient specific and depend on the availability of technology
- US and MRI are the two most sensitive technologies
- US is operator dependent, most sensitive early and best for moderate to severe injuries
- MRI provides overall assessment of the injury, surgical characterization and the potential for long-term monitoring



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