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

David Shulman, Harvard Medical School III

Gillian Lieberman, MD

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

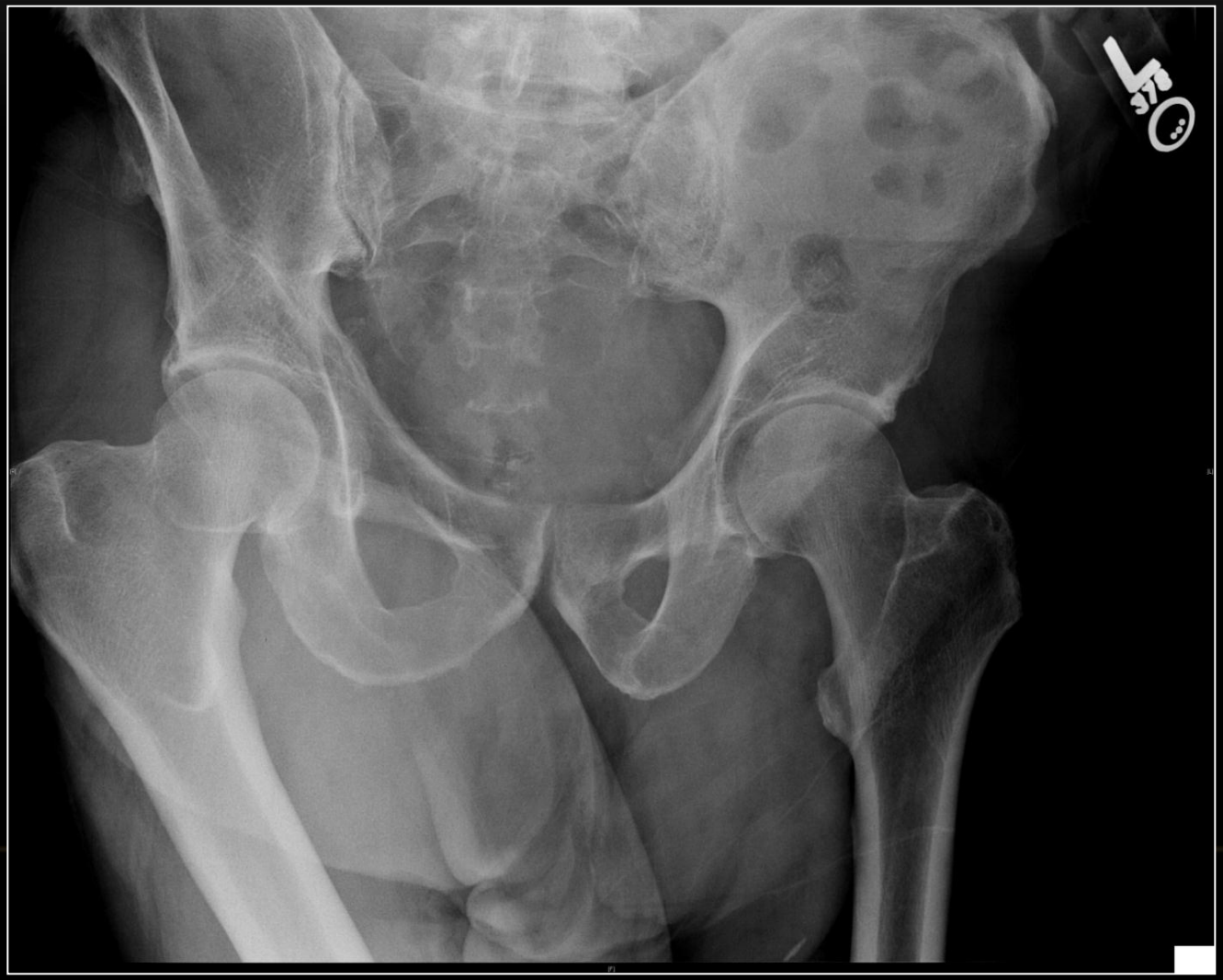
- 76-year-old man presented to the emergency room with sharp pain in the right posterior thigh
  - Sudden onset while running
  - 2/10 at rest
  - 10/10 with any active movement
- No prior history of lower extremity injury

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

David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: PLAIN FILM



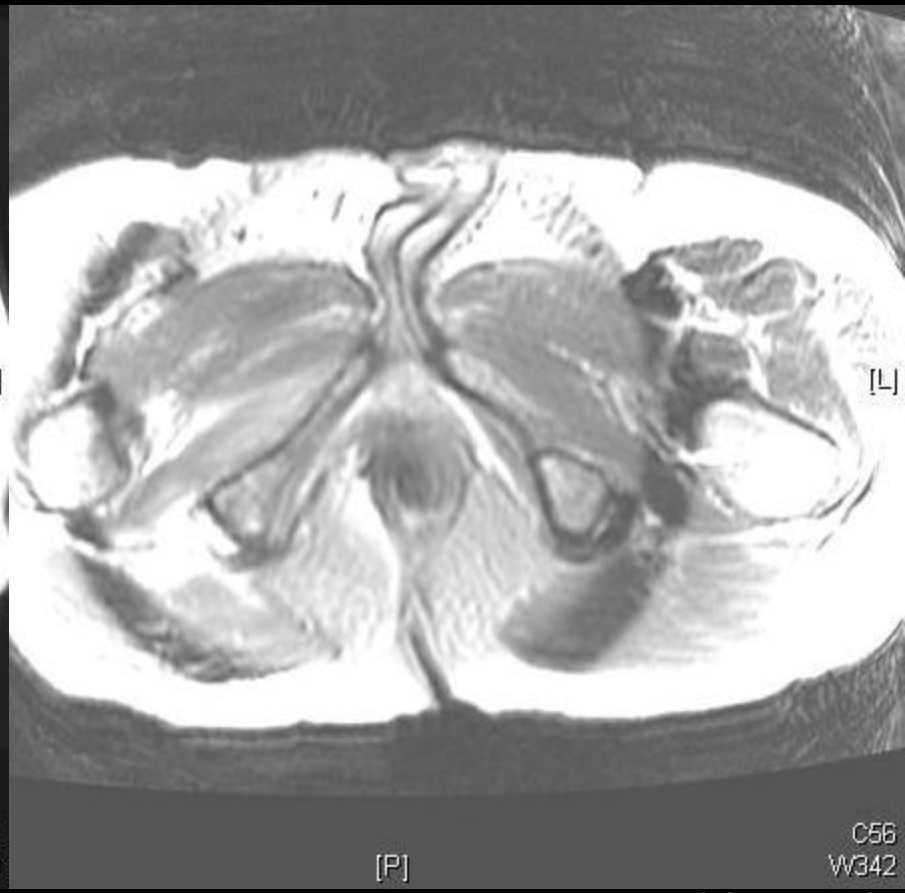
OUR PATIENT: FURTHER HISTORY

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

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: MRI - ISCHIAL TUBEROSITY

MRI Axial - T1 C-



MRI Axial - T2 C-

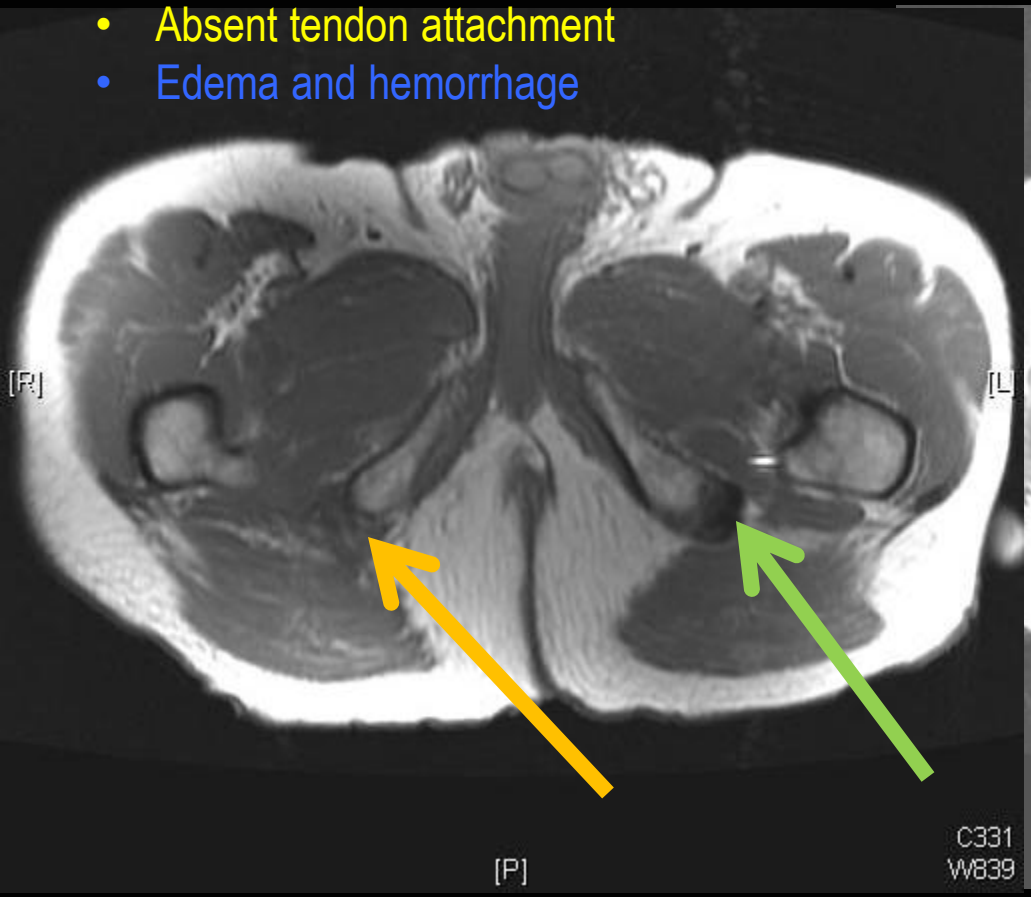
PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

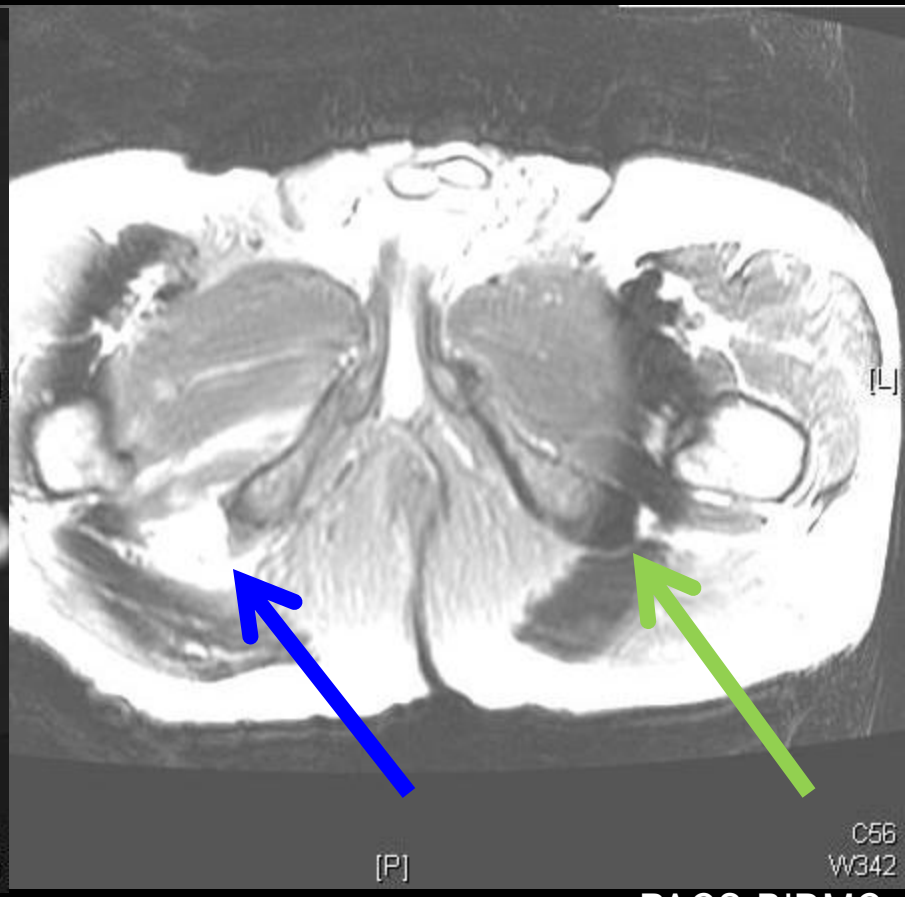
OUR PATIENT: MRI - BASE OF ISCHIAL TUBEROSITY

Findings:

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



MRI Axial - T1 C-



MRI Axial - T2 C-

PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: MRI - 1 CM BELOW ISHCIAL TUBEROSITY

MRI Axial - T1 C-

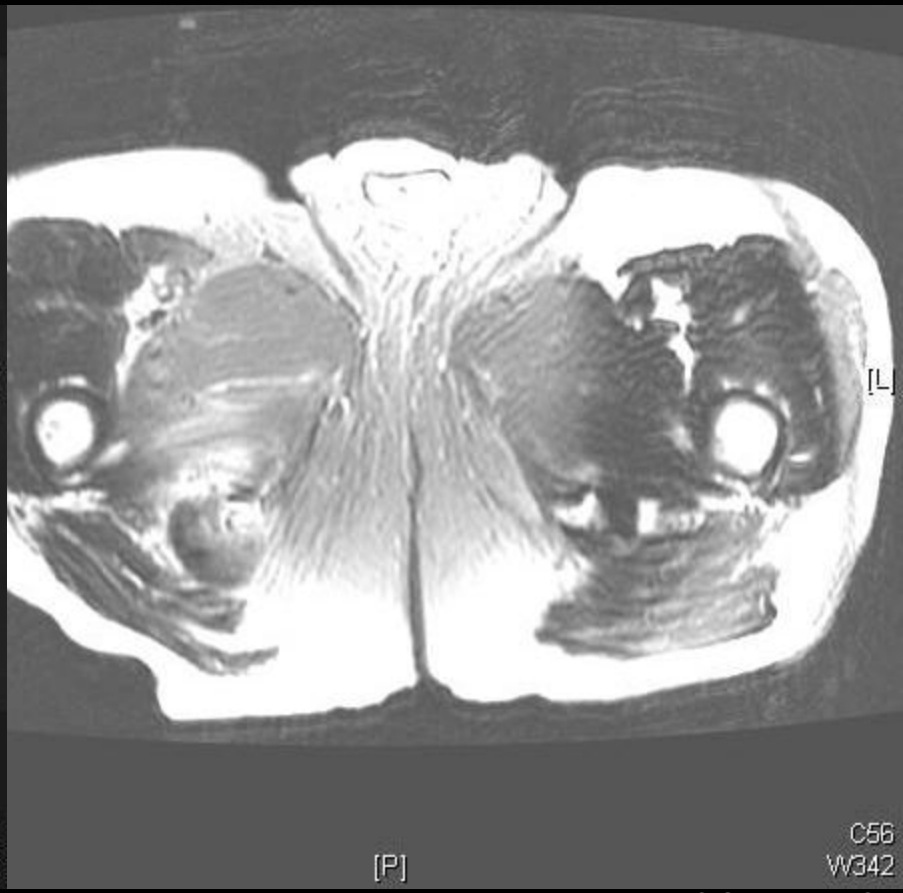
MRI Axial - T2 C-

PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: MRI - 2 CM BELOW ISCHIAL TUBEROSITY

MRI Axial - T1 C-

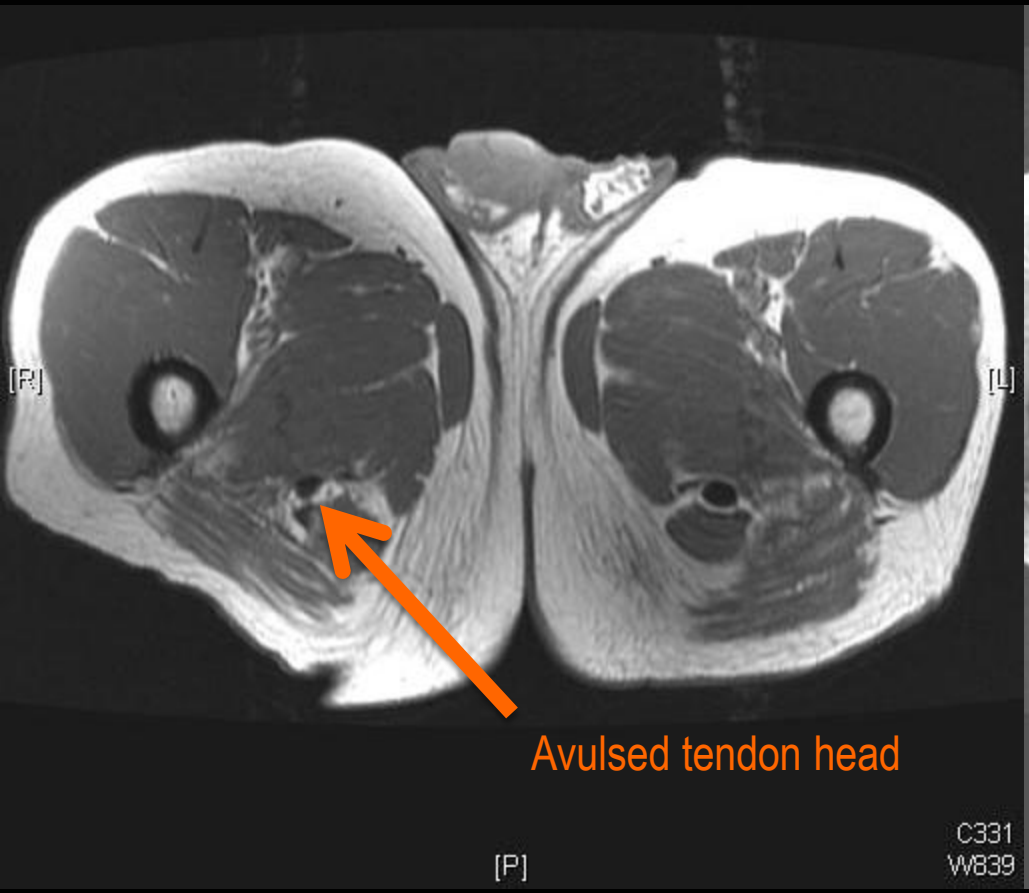


MRI Axial - T2 C-

PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: MRI - 4 CM BELOW THE ISCHIAL TUBEROSITY



MRI Axial - T1 C-

MRI Axial - T2 C-

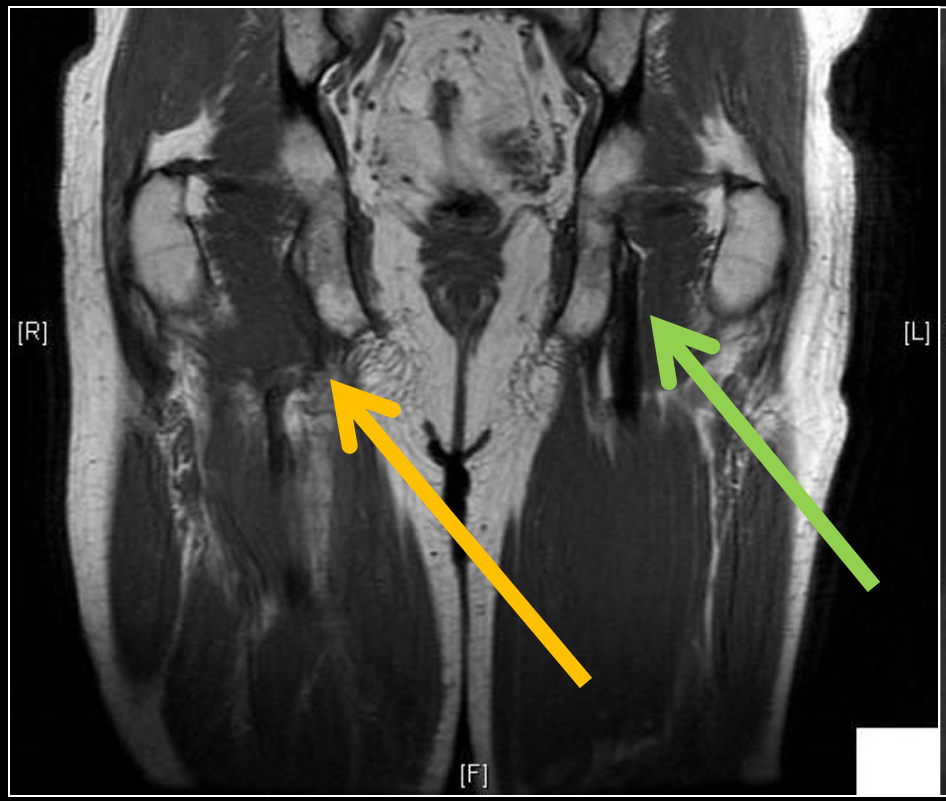
PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

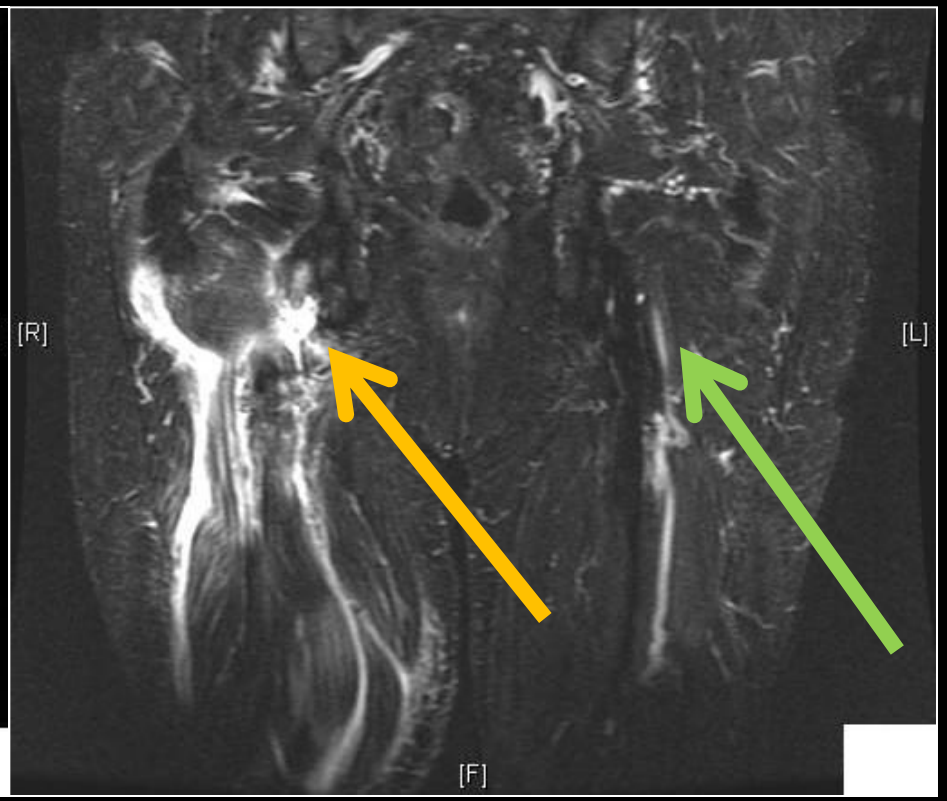
OUR PATIENT: MRI CORONAL

Findings:

- Normal tendon attachment
- Avulsed tendon



MRI Coronal - T1 C-



MRI Coronal – STIR C-

PACS-BIDMC

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

OUR PATIENT: MRI - EXPANDED

Ischial tuberosity

Tendon

MRI Coronal - T1 C-

MRI Coronal – STIR C-

PACS-BIDMC

DIFFERENTIAL DIAGNOSIS

Posterior thigh pain

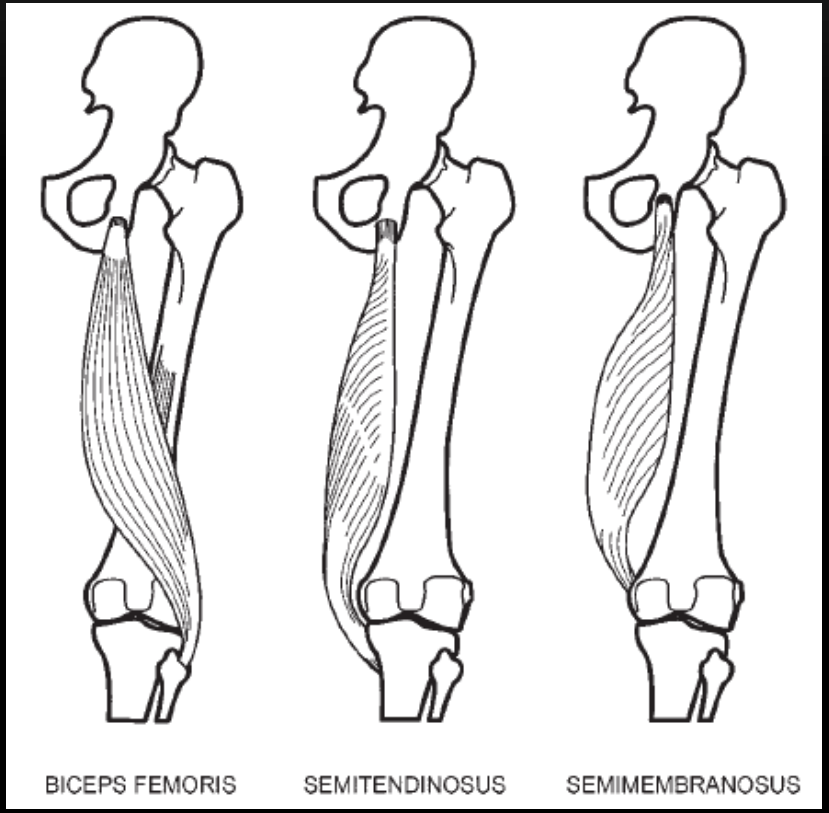
- Hamstring strain
- Ischial tuberosity disease
- Hamstring enthesopathy
- Hamstring syndrome
- Referred pain
- Hamstring contusion
- Myositis ossificans
- Bursitis
- Ligament strain
- Posterior compartment syndrome
- Sciatic nerve pain
- Bone tumor
- Sacroiliitis
- Claudication

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

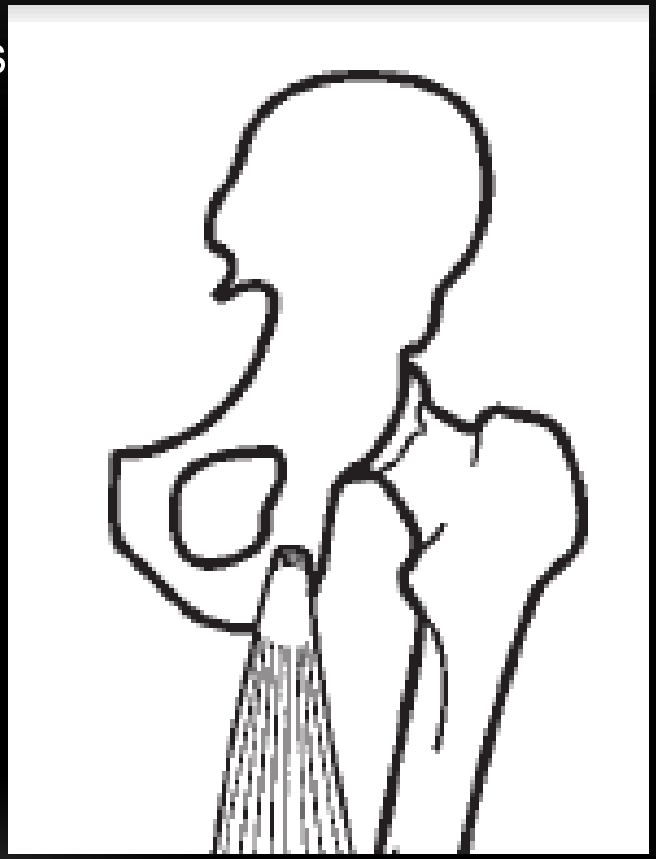


Koulouris G, Connell D. Hamstring muscle complex: an imaging review. Radiographics. 2005 May-Jun;25(3):571-86. Review. Erratum in: Radiographics. 2005 Sep-Oct;25(5):1436.

Beth Israel Deaconess Medical Center
David Shulman, 2013
Gillian Lieberman, MD

REGIONAL ANATOMY – TENDON ATTACHMENTS

PACS-BIDMC



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.

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 quadraceps
  - Sports related – Waterskiing, sprinting, playing soccer and football

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.

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 resolves[1]
  - US may be most sensitive in adolescents[2]
- **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

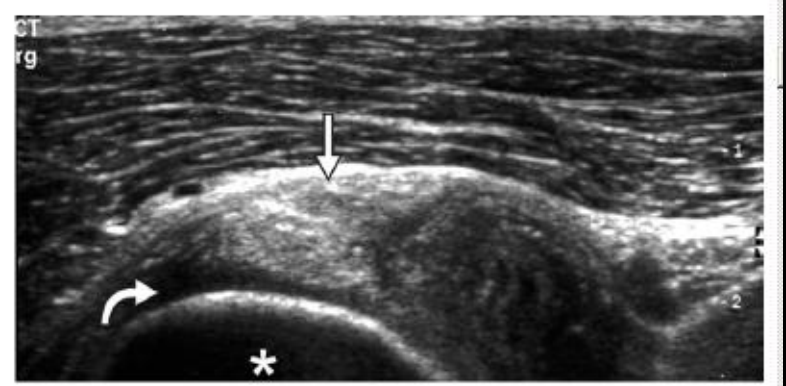
Gidwani S, Bircher MD. Avulsion injuries of the hamstring origin - a series of 12 patients and management algorithm. Ann R Coll Surg Engl. 2007 May;89(4):394-9.

RADIOLOGIC FINDINGS ON US

- Heterogenetity 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

A



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).

B

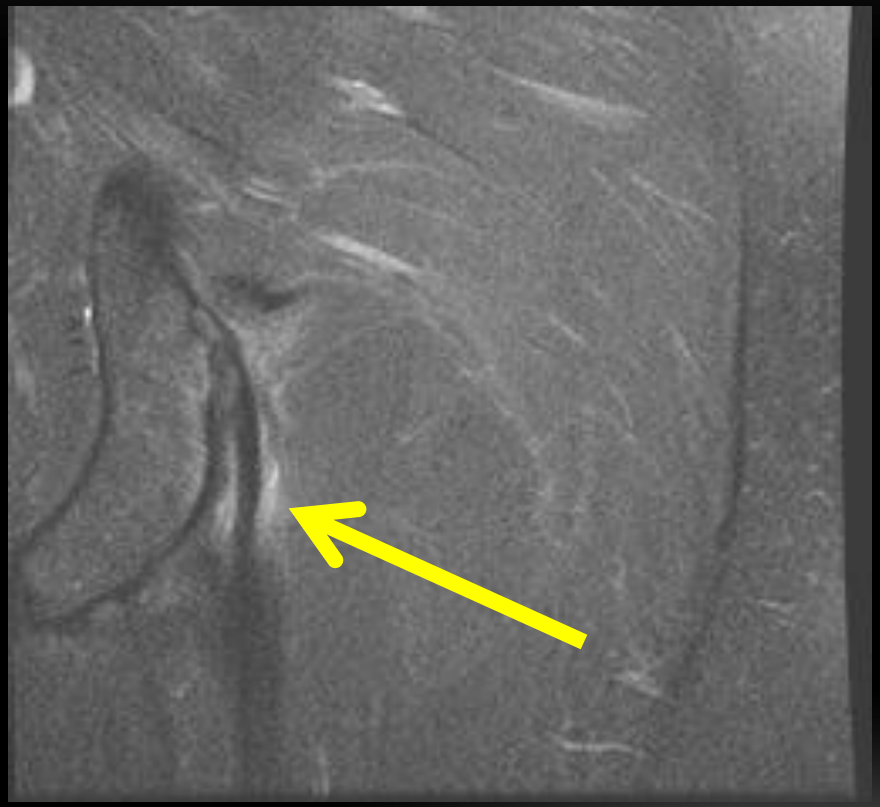
Ultrasound imaging showing a normal HMC (arrow) near the insertion point on the ischial tuberosity (*). Superior to the insertion the HCM is difficult to separate from the sacrotuberous ligament (curved arrow).

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.

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

David Shulman, 2013
Gillian Lieberman, MD

COMPLICATIONS OF HAMSTRING AVULSIONS

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

Personal collection

MRI – sagital – T1

MRI – coronal – T2 FS

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

ACKNOWLEDGMENTS

- Dr. Gillian Lieberman
- Claire Odom
- Dr. Jim Wu
- My family
- Roshan Sethi, HMS III