Soft Tissue and Osseous Lesions of the Hip

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Osseous Anatomy

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Gluteus Minimus

Gluteus Medius Main Tendon
Gluteus Medius
Lateral Component

Clinical Significance
• Statistically significant association between trochanteric pain syndrome and peritrochanteric T2 abnormality and abductor tendinopathy

Rotator Cuff Tear of the Hip
• First reported in the orthopaedic literature
• Initially felt to be asymptomatic lesions
• Involves gluteus medius or gluteus minimus tendons avulsion at insertion to greater trochanter
• Treatment can include reattachment of tendon

Rotator Cuff Tear of the Hip
• Atrophy of gluteus medius and minimus
• Irregularity at greater trochanter

Gluteus Minimus – Partial Tear

Gluteus Minimus - Avulsion
Gluteus Minimus - Avulsion

Active 55 year old woman with right hip pain

Secondary Signs of Abductor Tendon Abnormalities

- Trochanteric enthesopathy > 2mm is associated with abductor tendon abnormalities
  Steinart, et al., Radiology. 2010; 257(3): 754-763

Gluteus Minimus Rupture with Atrophy

Pfirrmann, et al., Radiology 2005 235: 969-976

Rotator Cuff Tears in THR

- Soft tissue lesions important causes of hip pain s/p THR (especially with transgluteal approach)
- Patients present with hip pain and abductor weakness
- Of 39 symptomatic patients
  - 22 gluteus minimus defects
  - 24 gluteus medius defects
- Pathology included
  - Tears
  - Graft tear
  - Tendon change
  - Atrophy/muscle

Pfirrmann, et al., Radiology 2005 235: 969-976
Normal Appearance of Gluteal Attachment after THR

Gluteus Medius and Minimus Pathology in Total Hip Replacement
- Cause for "clinical" failure of THR

S/P Total Hip Replacement with Aching Pain

Metal-on-Metal
- Large diameter MoM THA (>36mm) offer potential advantage of less wear than small diameter heads and reduced risk of dislocations
  - However ultimate failure rate is implant specific
  - For instance, ASR XL implant (DePuy Orthopaedics) was recalled by manufacturer due to high failure rates

Adverse Reaction to Metal Debris (ARMD)
- Umbrella term used to describe heterogeneous group of diseases leading to joint failure
- High female predisposition
- Pain and large sterile effusion are common to most definitions
- Various clinical presentations, histologic findings, and degree of aggressiveness described


Adverse Reaction to Metal Debris (ARMD)
- Cystic and solid masses associated with resurfacing devices
- True incidence? But our data shows up to 69% of hips (both sx and axa) have this findings
- Histologic appearance of periprosthetic soft tissues around MoM failed implant
- Unclear if this cause or reaction

Pseudotumor
- Can be associated with periprosthetic osteolysis

ALVAL
- Aseptic Lymphocyte Dominated Vasculitis Associated Lesion

Granulomas
**Dull Aching S/P Metal on Metal THR**
C3 Complication (Tendon Avulsion)

**Findings that Correlate with ALVAL**
- Fluid collection with dark pseudocapsule
- Osteolysis
- High volumes of synovitis
- Intramuscular edema
- Extracapsular disease

*Dark pseudocapsule sign is sequence dependent!!!*

Hayter, et al., AJR 2012;199(4):884-93
Petscavage, et al., Proceedings of Society of Skeletal Radiology, 3/19/2012

**Findings that Correlate with ALVAL**
Synovitis

**Take Home Points**
- Be familiar with basic means to reduce metallic susceptibility artifacts
- Be aware of complications in orthopedic hardware
- In the setting of the MOM THR, evaluate for fluid collection and tissue necrosis

**Proximal Hamstring Attachment Complex**
Facets of the Ischial Tuberosity

- Superolateral or oblique facet
  - Semimembranosus
- Inferomedial or horizontal facet
  - Semitendinosus
  - Biceps femoris

**Superolateral Facet of Ischial Tuberosity**
Inferomedial Facet of Ischial Tuberosity

Proximal Hamstring Attachment Complex Anatomy

34 year old playing sports and heard pop

Hamstring Avulsion

van der Made, et al., Knee Surg Sports Traumatol Arthrosc. 2013 Nov Epub Ahead of Print


Quadratus Femoris

- **Origin:** Superolateral Border of Ischial Tuberosity
- **Insertion:** Linea Quadrata (Posterior Aspect of Intertrochanteric Crest)
- **Action:** Laterally Rotates, Adducts Femur
- **Innervation:** Nerve to Quadratus Femoris (L4-S1)

Quadratus Femoris Impingement

- Chronic symptoms and narrowing between ischial tuberosity and lesser trochanter (< 2 cm)
- Cases of edema centered at muscle belly, not MT junction, with edema in adjacent fat
- Inability to distinguish low-grade muscle strain from impingement induced edema
- Need for clinical correlation in these scenarios


Quadratus Femoris Evaluation

A – Ischiofemoral space
- Narrowest distance between lateral cortex ischial tuberosity and medial cortex lesser trochanter

B – Quadratus femoris space
- Narrowest space for passage of quadratus femoris delimited by superolateral surface of hamstring and posteromedial surface of iliofemoral tendon or lesser trochanter

Torriani, et al., AJR. 2009; 193(1): 186-190

Ischiofemoral Impingement

- Hip MR examination reports over a 7 year period retrospectively reviewed
- 10 subjects, all women, mean age 53 years

Torriani, et al., AJR. 2009; 193(1): 186-190

**Table 1:** Results of Statistical Analyses of Nine Affected Subjects (12 Hips) and 10 Control Subjects (11 Hips)

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Affected Subjects (mm)</th>
<th>Control Subjects (mm)</th>
<th>p</th>
<th>Cut-off</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischiofemoral space</td>
<td>13±5</td>
<td>22±8</td>
<td>0.002</td>
<td>0.17</td>
<td>83</td>
<td>82</td>
</tr>
<tr>
<td>Quadratus femoris</td>
<td>7±3</td>
<td>12±4</td>
<td>0.002</td>
<td>0.18</td>
<td>83</td>
<td>82</td>
</tr>
</tbody>
</table>

Note — Ischiofemoral space is smallest distance between lateral cortex of ischial tuberosity and medial cortex of lesser trochanter. Quadratus femoris space is smallest distance between superolateral surface of hamstring tendons and posterior medial surface of iliofemoral tendon or lesser trochanter. Measurements are given in mm.

Ischiofemoral Impingement

**Role of Pelvic Morphology**

- Increased Femoral Neck in IFI patient on left/ Normal Control Right

Bredella, et al., Skeletal Radiol. 2014 November Epub ahead of Print

**Osteochondroma Narrowing IFS**

Images Courtesy Hilary Umans, OCAD
**Quadratus Femoris Partial Tear**

- Rare Cause of Groin or Gluteal Pain
- W>M, Young, R>L (Small Series)
- Can Be Confused with Hamstring Injury
- Obturator Externus Injury
- Best Visualized on Sagittal Images Posterior to Lesser Trochanter (Comma Shape)
- Difficult Assessment in Coronal Plane
  - Not always included on FOV
  - Muscle long axis parallel to Coronal Plane


**Quadratus Femoris Partial Tear**

- 55 year old woman with hip pain

**Quadratus Femoris Partial Tear**

- 84 year old man s/p fall


**Osseous Abnormalities**

- Fracture
  - Fatigue
  - Insufficiency
- AVN
- Bone marrow edema
  - Infection
  - Transient Osteoporosis of the Hip
  - Regional Migratory Osteoporosis

**Insufficiency Fracture**

- Osteoporosis
- XRT
- Paget
- Fibrous Dysplasia
- Rheumatoid Arthritis
84 yo woman with bilateral hip pain

- Link between prolonged bisphosphonate therapy and atypical femur fractures
- Bisphosphonate may suppress bone turnover
- Results in skeletal microdamage accumulation
Imaging Findings

- Fractures located .5 – 18.3 cm below lesser trochanter
  - 79% < or = 5 cm below trochanter
- Medial beak (85%) and varus angulation
- “Skirt” of focal buttressing at lateral cortex
- Increased propensity for bilateral involvement (12/22)
- All women aged 50-81 years
- On alendronate therapy minimum 4 years up to 14 years

MR Imaging Findings

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Take Home Points

- High association of bilateral involvement with limited symptoms indicate screening of both hips
- Subset of fractures occur well below the lesser trochanter – be sure entire femur is evaluated
- MR findings can be subtle and focused at endosteum
**Stress Fracture**

- Amorphous
  - Ill-defined marrow abnormality
  - May represent early phase of fatigue fx
  - Chronic comminution in insufficiency fx
- Linear
  - Band low signal intensity on all sequences
  - Surrounded by marrow edema
  - Perpendicular to cortex and major trabeculae
  - Less commonly longitudinal

**Stress Fracture Grading System**

- Grade 0
  - Normal
- Grade I
  - Subtle periosteal edema noted on fluid sensitive sequences
- Grade II
  - Periosteal and marrow edema noted on fluid sensitive
  - +/- changes on T1-weighted images
- Grade III
  - Periosteal and marrow changes on T1-weighted and fluid sensitive
- Grade IV
  - Visible fracture line

Hwang, et al., AJR 2005; 185: 166-173
Adductor Stress Syndrome
“Thigh Splints”
- Repetitive avulsive stress at adductor longus and brevis insertions
- Leads to traction periostitis
- Syndrome (traction periostitis) represents early stage along continuum:
  - Periosteal edema
  - Marrow edema
  - Cortical stress fracture

Adductor Avulsive Syndrome
- Fracture
- Early osteonecrosis
- Infection
- Transient “Osteoporosis” of the Hip
- Radiation therapy

Differential Diagnosis of Bone Marrow Edema
- Fracture
- Early osteonecrosis
- Infection
- Transient “Osteoporosis” of the Hip
- Radiation therapy

Septic Joint with Osteomyelitis

Plain Film Correlation
7/98 at time of MR
6/98
**Rapidly Destructive OA**
- Also called rapidly destructive coxarthrosis
- Unknown etiology
  - Ischemic necrosis
  - Prostaglandins

**Transient “Osteoporosis” of the Hip**
- Unknown etiology
- Self-limited condition
- Middle-aged, male predominance
- Third trimester pregnancy
- Predilection left hip
- Synonyms
  - Idiopathic bone marrow edema
  - Transient painful marrow edema
  - Regional migratory “osteoporosis”
  - Algodystrophy

**Objective Identification of Hip Osteopenia**
- Prominent tensile and compressive trabeculae
- Accentuation of Ward’s triangle

**Transient “Osteoporosis” MR Findings**
- Geographic loss of signal in femoral head on T1-W images
- Signal abnl extends to IT line
- High signal on T2-W and STIR images
- Femoral head contour normal
Transient Painful Marrow Edema

• ? Role of insufficiency fracture

Insufficiency Fractures of the Hip

• Non-traumatic flattened lesions in the superolateral aspect of the femoral head
• No predisposing factors (other than osteopenia)
• DDX: transient painful marrow edema, osteonecrosis


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