Hip: Orthopaedic Perspectives

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Disclosures

• I have no relevant financial disclosures

• I am not a radiologist
Purpose

• Hip conditions from the perspective of the treating Orthopaedic surgeon
• What they are
• Why they are bad
• How I use imaging
• What they look like on the inside
Why do we care?

- Osteoarthritis (OA)
- OA of the hip is usually caused by a mechanically based abnormality
  - Perthes, SCFE, DDH, FAI
- Mechanical abnormalities are often correctable
- Joint preserving procedures are effective if they correct the mechanical problem *IN TIME.*
The normal hip (Anatomic)

- Congruous, well aligned surfaces
- Good coverage
- Normal version
- Symmetric cartilage space
- Thin, horizontal sorcil
The normal hip (Mechanical)

- Stable
- Mobile
- Articular cartilage loads
  - 2MPa pressure
  - Compressive loads
Hip Mechanics

TOO STABLE (IMPINGMENT)  << SWEET SPOT >>  UNSTABLE (DYSPLASIA)
Common Developmental Hip Conditions

- FAI
- Acetabular Dysplasia
- Legg Calves Perthes

Where I utilize advanced imaging
Clinical Presentation of Hip Pain

• History
  – Anterior groin/thigh pain
  – Worse with flexion
  – Buttock pain
  – “C” sign

• Exam
  – Impingement sign
    • 90° flexion +IR+ adduction
Imaging Guides Hip Treatment

- Plain radiographs
  - AP pelvis
    - Coccyx symphysis relationship
    - Frog/Dunn lateral
    - False profile
- MRI arthrogram
  - Hip – NOT PELVIS
  - Double oblique (axial oblique)
  - Radial
  - Perfusion
- CT scan
  - Femoral and acetabular version
Radiographic Evaluation

- Plain Radiographs
  - Well rotated AP
  - Frog/Dunn lateral
  - False profile

- Looking for
  - Center edge angles
  - Acetabular version (cross over sign and posterior wall sign)
  - Impingement cysts (herniation pits)
  - Protrusio (ilioischial line)
  - Pistol grip femur
  - Arthritic changes
Well Rotated

Distance from the pubic symphysis to the tip of the coccyx should be 1-3 cm

Obturator foramina should be symmetric in appearance
Frog

Impingement cyst
Frog

Decreased offset
Crossover sign/Posterior wall sign/Ischial spine sign (Pincer)
MRI

- MRI arthrogram
  - Sphericity of femoral head
  - Head-neck offset ($\alpha$ angle)
  - Impingement cysts
  - Ossification of acetabular rim
  - Labral tears
  - Chondral lesions
Axial Oblique MRI

Degenerative Labrum
Radial MRI
CT Scan

• Axial slices
  – Acetabular version
  – Femoral version

• 3D reconstruction
  – Cam lesions
FAI

• Simple Definition:
  – Abnormal contact between the proximal femur and acetabulum

• 2 types
  – Cam
  – Pincer
  – Combined

• Patterns of damage unique to type
In pediatrics FAI is often disguised
Cam
Imaging in FAI

- Better understand the anatomy
- Cam or Pincer
  - Cam – where is the lesion
- Pincer – focal or global
- Is preservation surgery worth while?
- Use this to decide best surgical approach
Nonsurgical Treatment

• Activity modification
• NSAIDS
• Ineffective long term
  – Anatomic deformity
Surgical Treatment Options

• Depends on the nature of the impingement
  – Cam
    • Localized
    • Diffuse
  – Pincer
    • Anterior over-coverage
    • Acetabular retroversion

• Arthroscopy
• Surgical Dislocation
• Anteverting Periacetabular osteotomy
Case Examples

- Idiopathic Cam FAI
- Cam FAI due to SCFE
- Focal Pincer FAI
- Pincer FAI due to acetabular retroversion

- What imaging studies I order and what I want to know from you
- Treatment
  - How the inside looks compared to pre-op imaging
Idiopathic Cam FAI

• 16 year old male left hip pain while playing soccer

• Positive impingement test
Cam FAI

- What I order
  - AP, frog pelvis
Cam FAI

- MRI arthrogram
  - What I want to know
    - Labral tear?
    - Where is the cam lesion?
    - How extensive is the cam lesion?
    - Is there any acetabular cartilage delamination?
Cam FAI
Cam FAI
Cam FAI

• My interpretation:
  – Focal idiopathic appearing Cam lesion
  – No labral tear
  – Healthy articular cartilage

• Arthroscopic femoral osteochondroplasty
Cam FAI due to SCFE

• 15 y.o. male previously treated for right SCFE
• Continued right hip pain with walking and sports
• Right hip internal rotation of -30°
• Positive impingement sign
Cam FAI due to SCFE

• What I order
  – AP, frog pelvis
  – No MRI b/c screws

• Treatment – surgical dislocation of the hip vs hip arthroscopy
Cam FAI due to SCFE
Cam FAI due to SCFE
Cam FAI due to SCFE - scope
Pincer FAI due to focal anterior over-coverage

• 16 y.o. female complains of right hip pain worse with exercise

• Shows “c-sign”

• Positive impingement sign

• What I order
  – AP, frog pelvis, false profile
  – MRI arthrogram
Pincer FAI due to focal anterior over-coverage
Pincer FAI due to focal anterior over-coverage
Pincer FAI due to focal anterior over-coverage
Pincer FAI due to acetabular retroversion

• 16 year old male with right hip pain with sitting and activities
• Baseball catcher – can’t play
• What I ordered
  – AP, frog pelvis, false profile
  – 3D CT
Pincer FAI due to acetabular retroversion
Anteverting (Reverse) Periacetabular Osteotomy
Acetabular Dysplasia

- Insufficient bony coverage anterior and lateral
- Cartilage contact pressure >10MPa
- Shear forces
Pathomechanics of DDH

- Loading at the acetabular rim
  - Labral hypertrophy
  - Labral tear
  - Loss of suction seal
  - Cartilage delamination
  - Rim fracture
What I order

• Radiography
  – AP/frog pelvis
  – False profile
  – Abduction internal rotation view
• MRI (Arthrogram)
  – Labrum
  – Cartilage
Radiographic Assessment

- Normal CEA >20°
- Normal sorcil tilt <10°
- Congruency on AIR
- Arthrosis (Tonnis grade)
- Shenton’s line
Anterior CEA 10°

Congruent on AIR
MRI

• What I want to know:
  – Labral tear?
  – Often have labral pathology
    • Most do not need to be directly addressed
  – Detached vs intra-substance tear
  – Articular cartilage degeneration?
Best Indications for joint preserving osteotomy

- Young, active patient
- Symptomatic hip dysplasia
- CEA < 20°
- Congruent joint
- Minimal arthrosis
Principles of pelvic osteotomy

- **Goals**
  - Change mechanical environment
  - Improve coverage
  - Improve congruity
  - Improve stability
  - Take load off of rim
  - Convert force from shear
  - Prevent/delay arthrosis

Kralj, 2005
Periacetabular Osteotomy

1. Incomplete ischial cut
2. Superior ramus cut
3. Iliac cut
4. Posterior column cut

• Fluoroscopic guidance
• Elite level gymnast
• 6 years of right hip pain
  – recently worsened
  – Pain located in groin, catches
• I order AP, frog pelvis
Femoral Head OCD lesion

• What I need to know
  – Size of the lesion
    • >/< 20mm
    • Allograft vs OATS
  – Remainder of cartilage
  – Labral tear
  – Acetabular rim
Assessment and Plan

1. Right Acetabular Dysplasia
2. Right labral detachment with rim fracture
3. Right femoral head OCD

1. Surgical Dislocation with labral repair
2. Fresh Allograft to femoral head OCD
3. Periacetabular Osteotomy
• 17 year old female

• Right groin pain

• Suddenly worse 6 months ago
Acetabular Dysplasia with Rim Fracture

- MRI
  - How big is the fracture?
    - Repair vs debride
  - How much articular surface?
  - Is the cartilage intact?
  - How is the remainder of the cartilage?
Labrum

Articular cartilage

22mm
• Diagnosis
  – Severe Acetabular Dysplasia
  – Large anterior-lateral acetabular rim fracture

• Plan
  – Arthroscopic reduction and fixation of fracture
  – Periacetabular osteotomy
Labrum
Acetabular cartilage
Labrum
Labrum
Labrum
Labrum
Legg Calves Perthes

• Idiopathic AVN of the capital epiphysis
• For some reason the head loses its blood supply and dies
• Femoral head becomes flattened
Goal of treatment

• Maintain sphericity and congruency
  – Radiographic
  – Stulberg system

Prevent arthritis
Classification – Lateral Pillar

- Lateral pillar A - No change
- Lateral pillar B - >50% height maintained
- Lateral pillar B/C Border
- Lateral pillar C - <50% height maintained

Problem: Classified late
Perthes – Evolving Understanding

• Early treatment is important
  – Joseph – odds ratio of maintaining sphericity 16.58 times higher if treated in early stages
  – Axer
  – Heikinnen
  – Hoikka
  – Lack
Waldenstrom stages of disease and treatment goals

Medial surgery

Stage II a

Stage II b
Radiographs: when to intervene

• Radiographs
  – AP, frog pelvis

• What I want to know
  – Waldenstrom stage
  – 2A/2B
Who will benefit from intervention?

- Perfusion (subtraction) MRI
- Quantifies perfusion in early fragmentation
- Predicts which will fragment
- Guides treatment
Imaging Guiding Treatment
Treatment

- 6-10 year old
- Waldenstrom 2a
- >50% perfusion deficit
Thank you