FAI: Imaging Modalities and Dynamic Imaging Software

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Acceptance of Hip Arthroscopy & FAI

• Public
• Payors
• Orthopaedic Community
• Patient Base

Significant questions remain . . . especially in the realm of impingement-related surgery

Reoperation: FAI remains a clinical diagnosis
Practice Evolution

- Correlation of morphology, pathology, and clinical symptoms
- Gender assessment and differentiation
- Static → Dynamic Analysis

**GOAL:** Treating the patient and using imaging to support that treatment

Imaging Choices

- Plain Films
- Fluoroscopy
- Computed Tomography
- Magnetic Resonance
- Ultrasound
- Bone Scintigraphy

How do we extract more from our imaging?

- Change field of view
- Improve resolution
- Adjuvants/Enhancers (i.e., contrast, dGEMRIC)
- Anatomic reconstruction 3-D
- Time based analysis 4-D
FAI: a possible cause of labral injury
Modified from Lavigne et al. 2004

Radiographic Studies
Plain Films 4 Views
- Supine AP Pelvis
- Cross Table Lateral
- Frog Leg Lateral
- False Profile
  - Weight bearing view
  - Anterior CE Angle
  - Occult joint space narrowing

Radiographic Studies
Plain Films
- Osteoarthritis
- Dysplasia
- Femoroacetabular Impingement (FAI)
- Acute Fractures
Surface area of the femoral head covered by acetabulum

Surface area of the acetabulum covering the femoral head

Tonnis angle
Moderate Correlation
Other AP Metrics
No Correlation

False Profile View:
Anterior Center Edge Angle

> 20°

IFACE ≥ 20 degrees; be careful
Adult dysplasia

Crowe Classification
- I
- II
- III

Supine AP Pelvis
Pincer Impingement: Retroversion

- Retroversion Signs
  1) Cross Over
  2) Ischial Spine

Supine AP Pelvis
Pincer Impingement: Profunda

- Profunda Signs
  1) LCE > 35
  2) Center of FH medial to posterior wall
  3) Based of acetabulum medial to ilioischial line
Pincer
Femoral Head and Neck Junction Injury

Alpha Angle >55 degrees
Cam Impingement

False Profile View:
Weight Bearing

Joint Space Ratio Test
A/B
If A/B > 1, then OK
If A/B < 1, then not OK
If A/B = 1, then not OK

If B = 0, then consider Inflammatory (Coxa Profunda)
If C = 0, then consider Inflammatory (Coxa Profunda)
False Profile
Left Hip

Subtle Signs of Grade IV

Portable CT
Intraop Cotyloid Space

Sabre Tooth Sign

What about CT Scans?

• Benefits
  – 3D Reconstruction
  – May assist in evaluation of dysplasia
  – May benefit from version assessment of femur and acetabulum

• Risks
  – Significant radiation to pelvis
  – Static image of dynamic problem
**Intraoperative CT Scanning**

**MRI**
Preference is Noncontrasted 3T Dedicated Hip Scan

- Avoids unnecessary pain
- Avoids additional expense
- Avoids iatrogenic T2 signal

**MRI Arthrogram**
CAM Triad:
1) Head-Neck Jx Abnormality
2) AnteroSup Chondral Abnormality
3) AnteroSup Labral Tear

Karakatsanis et al. Radiology 2005
MRI FAI:
Pincer Groove & Callous

MRI Arthrograph

Labral Tear Triad
1) Loss of triangular shape
2) Discontinuity from rim
3) Heterogeneity of signal

MRI FAI Cyst
Paralabral Cyst
Labral Tear
MRI 3D Recon

MRI Recon Limits:
1) Slice Thickness
2) Cost
3) Time

Role of Bone Scan

Osteoid Osteoma
Spondylolysis

Evaluation of Pediatric and Adolescent FAI
MRI Special Considerations

- Difficulty with skeletally immature imaging of hip
  - Reference point
  - Imaging may require sedation

- Morphology is a moving (growing) target until 25 yrs

Post Collapse AVN 14 y/o with Sickle Cell

SCFE Impinging Screw: Iatrogenic FAI 7 years of hip pain

Cross Table Lateral Terminal Flexion Limit

Reference: Howse EA Arthrosc Tech 2014
Benefits of 4-D Templating

• Surgeon controlled parameters
• Inputs reflect clinical evaluation and limitations
• Concomitant bony pathology can be assessed

Input & Calibration: 3D Map
CT Scan: Protocol Pelvis & Distal Femurs
Software and Surgeon Calibration
4D Simulated Preop & Postop

Benefits of 4-D Templating
Report: Recommended Resection

4D Analysis: Ideal Scenarios

• Suspected bony impingement
• Revision case work
• Unusual anatomy or atypical examination
  – Physiologic outliers
Limits of 4-D Templating

• No exact roadmap: needs surgeon input
• Physiologic motion in one patient may not be the same in another.
• Templating remains sensitive but limited validation and specificity

One still needs to think!

Summary

• FAI is a clinical diagnosis supported by radiology
• Multidimensional imaging may be needed
• Future efforts in dynamic imaging will assist in diagnosis, treatment, and outcomes

Thank You!