Current Concepts in the Recognition and Treatment of Femoroacetabular Impingement

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Background

• Supervisor - Raleigh Orthopaedic Performance Center
• Practiced since 1996 in outpatient sports/ortho clinics
• S & C coach for MLS - Columbus Crew 2002-2006
• Owned my own training facility 2000-2010
• FMS certified, board certified orthopaedic clinical specialist (OCS), credentialed in dry needling
• Write for PFP Magazine
• PT consultant for Carolina Hurricanes
Objectives

- Review signs and symptoms of FAI
- Discuss relevant clinical tests and differential diagnosis
- Understand medical testing algorithm
- Cover surgical intervention including debridement, decompression, osteoplasty and labral repair
- Address non-surgical and post-op rehab treatment
- Provide return to play guidelines and current outcome data
Hip Anatomic Considerations

- Congruous, well-aligned surfaces
- "Good" coverage: not too little, not too much!
- Normal version: Ant. and Post. rims
- Symmetric, wide cartilage space

What is FAI?

- Refers to process by which a malformed hip joint secondarily leads to a breakdown of the intra-articular structures causing pain, dysfunction and premature arthritis
- Professor Reinhold Ganz & colleagues in Switzerland credited with concept of FAI as a cause of osteoarthritis
- Early onset of OA in 4th & 5th decade of life often attributed to this process

FAI

- Femoral-Aacetabular impingement occurs when the femoral neck and acetabular rim abut at the extremes of motion due to deformity of the femoral neck (CAM), acetabulum (Pincer), or both

Ganz et al. CORR 2003
Pincer Impingement

- Pincer - excessive prominence of the anterolateral rim of the acetabulum
  - Overgrowth issue
  - Retroversion
- With retroversion, the face of the acetabulum tilts slightly backward
- With hip flexion, the rim crushes the labrum against the femoral neck

Cam Impingement

- Cam - nonspherical femoral head rotating inside the acetabulum = cam effect
  - Sequelae of slipped capital femoral epiphysis (SCFE) where posterior displacement creates a prominence of anterior neck -> severe limit of IR
  - More subtle aspherical forms present & described as “pistol grip” deformity
- In flexion, the head rotates into the acetabulum creating a shear force on the anterolateral edge of the acetabulum

Articular pathology more prevalent with relative labral sparing
- Over time labrum will fail after advanced articular damage is present
- 3:1 predilection in men and often presents in young adulthood
Combined Impingement

- Cam & pincer lesions
- Either pattern may dominate or appear equally
- Rx choices may be impacted by degree and/or type of impingement
- Hip flexion, adduction & IR cause abutment

Labral Tears

- Clinical signs of FAI present in up to 95% of patients w/labral tear  
  Burnett et al. JBJS 2006
- Bony abnormality -> majority of labral tears
- Anterior-superior region is most common site for labral tear  
- Focal rotational instability - most common MOI is excessive hip ER leading to iliofemoral ligament laxity  
  Martin et al. JOSPT 2006, Schenker et al. Curr Opin Ortho. 2005
Hip Morphological Characteristics and Range of Internal Rotation in Femoroacetabular Impingement

- 30 patients (3 subgroups = impingement group, asymptomatic w/FAI radiographic features and healthy controls)
- Cam and hip anatomy analyzed along with IR in high flexion activity
- ROM avg. = 27.9 deg. (healthy), 21.1 deg. (asymptomatic) and 12.3 deg. (patients)
- Cam size, coverage, and femoral version appear to be predictive variables for ROM
- Decreased femoral anteversion and increased acetabular coverage also increase risk of FAI in sports/ADLs

Audenaert et al. AJSM 2012

Who is at Risk?

Computed Tomography Assessment of Hip Joints in Asymptomatic Individuals in Relation to Femoroacetabular Impingement

- 50 individuals (age 15-40) seen at hospital between 3/08 and 8/08 w/abdominal trauma or non-specific abdominal pain
- No known history of hip pain
- In 100 hips, 39% (31% female, 48% male) have at least 1 morphologic aspect predisposing to FAI
- 66% to 100% of findings bilateral
- High prevalence of bony characteristics that may lead to FAI in asymptomatic individuals

Kang et al. AJSM 2012

Femoroacetabular Impingement in Former High-Level Youth Soccer Players

- A-P and frog lateral radiographs in 50 former high-level soccer players and 50 controls (50 in each group all b/w ages 18-30)
- No Rx sought for hip disorders
- Hips w/alpha angles > 55 deg. deemed to have a cam deformity
- 15 of 25 males w/evidence of cam deformity compared with 14 male controls
- 9 of 25 females w/evidence of cam deformity compared to 8 control females
- Conclusion = No assoc. risk for FAI w/high level soccer

Johnson et al. AJSM 2012
**Prevalence of Cam-Type Morphology in Elite Ice Hockey Players**

Purpose of this study was to define the prevalence of cam and pincer radiographic deformity in elite ice hockey players.

A-P and frog-leg lateral radiographs on 137 elite ice hockey players were prospectively obtained during the 2014-2015 preseason entrance examinations. Participants included NHL roster/farm team members.

130 elite ice hockey players were included in the analysis. 180 (69.4%) hips met radiographic criteria for cam-type deformity. The prevalence in right and left hips was 89 (69.5%) and 91 (70.0%), respectively. 70 (60.8%) players demonstrated bilateral involvement.

Elite ice hockey players have a significantly higher prevalence of radiographic cam deformity in comparison to what has been reported for the general population.

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**Primary Sources of Hip Pain**

- **GI**
  - Athletic pubalgia, inguinal hernias, appendicitis
- **GU**
  - Kidney stone, nephritis
- **Gyn**
  - Ovarian cysts, PID, pregnancy
- **Neurological**
- **Musculoskeletal**
- **Psychological**

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**Coexistent Disorders**

- Lumbar spine disease (particularly in high speed rotational sports - baseball, golf)
- Athletic pubalgia (sports hernia or “core injury” as per Dr. Myers)
- Snapping IT Band - not commonly confused w/hip joint pain but may mimic instability
- Snapping iliotibial band is present in 10% of active population  Byrd Instr Course Lect. 2006
Differential Dx

- Muscle strains
- Contusion (hip pointer)
- Avulsion and apophysial injuries
- Hip dislocation/subluxation
- Proximal femur fractures
- Osteitis pubis
- Biceps femoris
- Developmental dysplasia
- Osteoarthritis
- FAI, labral tear, loose bodies
- Greater trochanteric bursitis
- Gluteus medius/minimus tear
- ITB syndrome
- Piriformis syndrome
- Abdominal (sports hernias and athletic pubalgia, inguinal hernias, appendicitis)

More Differential Dx

- Lumbar spine abnormalities
- SI joint pathology
- Avascular Necrosis
- SCFE
- Perthes disease
- Meralgia paresthetica
- Compression neuropathies
- Gynecologic (ovarian cysts, PID, pregnancy)
- Urologic (testicular, scrotal)
- Genitourinary (kidney stone, nephritis)

Evaluation: Intra-Articular or Extra-Articular?
Signs & Symptoms

- Onset may be gradual or athletes may have a precipitating episode
- Often mention non-specific sx’s of groin strain
- Complain of decreased flexibility
- Pain often in anterior groin radiating to medial thigh
- Mechanical sx’s often described as intermittent sharp stabbing pain & catching assoc. w/pivoting, turning twisting & lateral movement
- Max flexion painful as is rising from seated position

C Sign

Physical Exam

- Eval typically demonstrates hip irritability
- Remember: exam does not reproduce stress of physical activities
- Trademark of FAI is limited IR
- Altered morphology is usually present bilat.
- Many athletes may suffer decrease in IR but not suffer impingement
Observation

- Observe gait
- Standing posture
- Assess leg length and pelvis
- Determine if any local swelling is present
- Look for anteversion or retroversion

Physical Exam - AROM

Physical Exam

- Passive assessment - observe restrictions, excessive motion and pain in all planes
- MMT - assess hip flexion seated & supine, ext, IR/ER and ABD/ADD in anti-gravity positions
- Palpation - looking for soft tissue problems
- Special tests - Log roll, Impingement tests, FABER, Subspine (Scour) and Snapping iliopsoas
- Standing - DL/SL stance, marching, SFMA Lumbar ext/flex/rot, OH squat, SL squat
Log Roll Test

- Not sensitive, but most specific test for hip pathology (Byrd - Operative Hip Arthroscopy 2005)
- IR/ER does not stress surrounding structures

Log Roll Video

Impingement Test

- Flexion, ADD & IR
- May provoke pain in any irritable hip
- Highly sensitive, but low specificity for impingement
- Compare both sides
Impingement Video

FABER Test

- Flex/ABD/ER
- Stresses anterior hip
- Often indicative of labral pathology
- Pain vs. tightness

FABER Video
Subspine Test

- Forced flexion in supine
- Downward long axis pressure applied through femur
- Scour test may be used as well

Subspine Video

Snapping Iliopsoas

- Start position is in Flex/ABD/ER
- Move into Ext & IR
- Snapping usually occurs as hip moves into Ext & IR
Snapping Iliopsoas Video

The Interrater Reliability of 4 Clinical Tests Used to Assess Individuals With Musculoskeletal Hip Pain

- MD & PT assess 70 patients (age range 18-76) with various diagnoses
  - 4 tests - Log roll, FABER, impingement test and > trochanter tenderness
  - The kappa values for the FABER test, log roll test, and assessment of greater trochanteric tenderness were greater than 0.40 (fair level of agreement) at a 95% confidence level
  - The flexion-internal rotation-adduction impingement test had a high prevalence index (0.76), with a higher proportion of positive tests
  - Implication = FABER, log roll and assessment for > trochanter tenderness are clinically acceptable

Martin & Sekiya JOSPT 2008

Imaging

- X-Rays
  - Well centered A-P & frog-lateral view to pick up FAI, dysplasia, fractures
  - Look for crossover sign (pincer lesion)
  - Detect os acetabulum
  - Alpha angle used to determine severity of cam lesions
MRI
- Sensitivity is good, but ability to detect articular cartilage is poor.
  - Byrd/Jones AJSM 2004
- Anterior subchondral edema indicative of significant articular pathology
- Paralabral cysts are common with labral tears
- Subchondral cysts more indicative of articular pathology
- Useful in picking up muscle strains/tears, labral tears and cartilage injuries

MRA (Gadolinium arthrography w/MRI)
- Greater sensitivity detecting intra-articular problems (e.g. labral tears)
  - Byrd/Jones AJSM 2004
- A normal separation b/w labrum and acetabular rim (cleft) is present with contrast and should not be interpreted as tear
- Biggest benefit is concomitant injection of long-lasting anesthetic -> pain relief is suggestive of intra-articular pathology
Optimal Imaging?

- Byrd prefers precontrast and postcontrast images
- MRA disadvantages include: inability to see effusion & may obscure subchondral signal change in the bone
- MRI & MRA often unable to detect os acetabulum or joint space narrowing
- CT better at showing bone architecture
- Keep in mind 2D images may poorly quantify cam lesions, so 3D CT ideal

Injections

- 90% accuracy of determining intra-articular etiology of hip pain
- Patients with intra-articular pathology have improved outcomes with arthroscopy
- If no relief from injection: must look for another source of pain

Non-operative Rx

- Work to eliminate neuromuscular imbalances
- Improve mobility
- STM techniques (ART, deep tissue, rolling)
- Strengthen the core and hips
Non-operative Rx

- Manual therapy and strengthening
- Blood flow restriction training
- Dry needling
- Laser

Myofascial Treatment for Patients With Acetabular Labral Tears: A Single-Subject Research Design Study

- 4 consecutive patients (all female 18-52 y/o)
- Inclusion criteria: ant. acetabular labral tear confirmed by MR arthrogram, 50% or more pain in posterolateral hip and palpation of ropy, dense or nodular tissues in the posterolateral hip muscles
- ART 1-3x/week up to 8 weeks as well as stretching & strengthening
- Muscles targeted: TFL, hip abductors & external rotators
- All 4 had clinically meaningful & statistically significant improvement in pain and hip related function

Cashman et al. JOSPT 2014

Self MFR
Hip Ins & Outs (Video)

Non-operative Rx

- Pain guides activity level & exercise
- Consider loaded vs. unloaded rehab
- Minimize deep flexion initially (esp. deep squats and lunges) & control IR/adduction
- Gluteus medius function commonly impaired w/hip pathology  
- Emphasize pelvic, core and hip stability with activation of gluteus medius

Non-operative RX

- Limited information with respect to Rx of labral tear  
  Austin et al. JOSPT 2008
- Interventions aimed at normalizing hip alignment and correcting joint mvmt
- Use of hip strapping device to reduce frontal plane (adduction) and transverse plane (IR) hip motion was found to reduce pain and improve function in a female patient with FAI
  Austin et al. JOSPT 2008
Rehab Ex’s

DL Bridge (Video)

DL Bridge w/Knee Ext (Video)

SL Bridge Progression (Video)
Treatment: Goals of Surgical Intervention

- Diagnostic evaluation of cartilage and labral injury
- Treat cartilage and labrum
- Address underlying sources of impingement (acetabulum, femur, iliopsoas)

- Average time from injury to accurate diagnosis 21 months
- Average of 3.3 providers seen before definitive treatment
Open Hip Surgery

- Pro: Gold standard, technically reproducible, muscle splitting exposure, allows excellent visualization
- Con: Open incision, increased risk of neurovascular injury, infection, adhesions, trochanteric osteotomy

Hip Arthroscopy

- Less invasive
- Technically demanding
- Immediate rehab
- Minimal pain
- Best way to confirm capsular laxity, FAI and labral tear

Surgical Videos
Philippon Rehab Snippets
Non-Microfracture Procedure

- No flexion restriction
- ABD 0-45 for 2 weeks
- No ER for 17 days
- Ext to 0 deg for 21 days
- No IR or ADD limit
- 20# FFWB for 3 weeks, 50% wk 3-4 then wean
- Brace 21 days from 0-105 degrees w/walking
- Avoid sitting at 90 deg hip flexion for 2 weeks

Post-op Rehab (Repair)
0-4 Weeks

- PWB with crutches
- STM, scar massage, modalities PRN
- Circumduction (day 1 for 10 min CW/CCW per Philippon)
- Hip PROM as tol, but no ER > 20 degrees
- Stool rotations, log rolling for IR
- Faber Slides (day 18 per Philippon)
- Hip isometrics (no flexion) & core training
- Bike immediately (up to 2x/day as tol)
- Isotonics (except flexion) in weeks 3-4

Circumduction (Video)
Stool Rotations (Video)
Faber Slides (Video)
Post-op Rehab (Repair)  
4-8 Weeks

- WBAT
- Progress to full ROM including ER
- Advance PRE's (including hip flexion)
- More CKC exercise/proprioception ex's
- Progress core as tol (e.g. Pilates)

ER Fall Outs (Video)

Post-op Rehab (Repair)  
8-12 Weeks

- FWB
- ROM should be full & painless
- Advance LE PRE's (single leg)
- Continue core training
- Introduce low level impact activities (mini-tramp jog, shuttle, single leg sticks)
Rehabilitation Exercise Progression for
the Gluteus Medius Muscle With
Consideration for Iliopsoas Tendinitis
An In Vivo Electromyography Study

- Phase I (initial 4 or 8 weeks)
  - Resisted TKE (prone), Resisted knee flex (prone), and DL bridges
- Phase II (next 4 weeks)
  - Resisted hip extension, stool hip rotations, S/L hip ABD with wall slides and clamshells
- Phase III (final 4 weeks)
  - Prone heel squeeze, S/L ABD w/IR, S/L ABD w/ER and SL bridge
  - Closed chain ex's

Philippon et al. AJSM 2011

IR Mobility Assessment

Post-op Rehab (Repair) 12-20 Weeks

- Begin straight ahead running
- Plyometric training
- Agility and sport specific drills
- Increase fitness (energy system specific)
- Continue strengthening
- Functional testing
Complications

- Iliopsoas tendinitis
- Stiffness
- Weakness
- Neuropraxia
- Limited sports participation

Return to Play

- FMS
- Y-Balance
- Hop testing
- Movement assessment

LQ Y-Balance Video
Femoroacetabular Impingement in Athletes, Part II: Treatment and Outcomes

- 172 FAI cases in athletes with 1 year F/U
  - Avg. age w/cam impingement = 29 and man:woman ratio of 2.7:1
  - Avg age w/pincer lesion = 32 and man:woman ratio of 1.2:1
  - Avg. Mod. Harris Hip Score improvement = 22 points (71 to 93)
  - 89% of pro athletes and 90% of collegiate athletes return to previous level of competition

Byrd J Sports Health 2010

Arthroscopic Labral Repair and Treatment of Femoroacetabular Impingement in Professional Hockey Players

- 28 NHL players undergo arthroscopic labral repair and treatment for FAI (3/05 - 12/07)
  - Avg. age at time of surgery = 27
  - 11 L and 17 R hips with 9 defensemen, 12 offensive players and 7 goaltenders
  - Avg. return to skating/hockey drills = 3.4 months
  - Avg. Mod Harris Hip Score increased from 70-95
  - 2 players had re-injury and additional surgery

Philippon et al. AJSM 2010

Outcomes After the Arthroscopic Treatment of Femoroacetabular Impingement in a Mixed Group of High-Level Athletes

- 47 high-level athletes (avg. age 22.8 +/- 6.2) w/mean F/U of 27 +/- 5.5 months
  - 33 (70.2%) available for F/U
  - 27.7% varsity, 53.2% college & 19.1% pros
  - 79% athletes able to return to play (mean of 9.4 +/- 4.7 months (range 4-26 months)
  - Of this group, 92.3% @ same level of competition
  - 73% able to play at 2 year F/U

Nho et al. AJSM 2011
Arthroscopic Management of Femoroacetabular Impingement in Athletes

- Cohort of 200 patients undergoing hip arthroscopy at 1 institution (participated in sports and achieved min. 1 year F/U)
  - Avg. age 28.6, 148 males and 52 females
  - 159 cam, 31 combined and 10 pincer lesions
  - Median pre-op Harris Hip Score 72 and post-op 96
  - 95% of pro athletes and 85% of collegiate athletes returned to previous level of competition
  - 5 transient neurapraxias (all resolved), 1 minor HTO, 1 conversion to THA, and 4 had repeat arthroscopy

Byrd and Jones AJSM 2011

Return to play after hip arthroscopy with microfracture in elite athletes.

McDonald JE, Herzog MM, Philippon MJ - Arthroscopy 2013

- Elite male athletes who underwent hip arthroscopy between 1999 and 2010
- Inclusion criteria were hip arthroscopy w/treatment of labrum, FAI, cartilage, ligamentum teres, capsule, and/or loose body removal
- 77% (30 of 39) of athletes in the microfracture treatment group and 84% (79 of 94) in the control group returned to play
- No detectable statistically significant difference in return to play rate after hip arthroscopy with microfracture and hip arthroscopy without microfracture

Efficacy of Surgery for Femoroacetabular Impingement

A Systematic Review

- 23 reports of case studies on surgical treatment of FAI
  - Current literature has 4 questions to answer:
    1. Does Rx succeed in improving symptoms?
    2. Which subset of patients should Rx for FAI be avoided?
    3. Is labral refixation superior to simple resection?
    4. Does Rx alter the natural progression of OA in this group of typically young patients?

Ng et al. AJSM 2010
Efficacy of Surgery for Femoroacetabular Impingement

A Systematic Review

- Review of 970 cases including 1 level II trial, 2 level III studies and 20 level IV studies
  - All studies demonstrate improvement
  - Up to 30% will eventually require THA and FAI procedure best in those w/o advanced OA or chondral damage
  - Only 2 studies compared refixation and debridement - early evidence supports fixation
  - Too early to predict if progression of OA is delayed

Ng et al. AJSM 2010

Sports and Activity Levels After Open Surgical Treatment of Femoroacetabular Impingement

- Retrospective study included 153 patients (mean age, 30.0 years; 40.5% female) with 192 hips treated. Sports behavior and satisfaction were determined at a mean follow-up of 58.4 months w/use of a questionnaire.
- 126 patients who were regularly active in sports before surgery, 107 (85%) were so at follow-up.
- Nineteen patients (12.4%) stopped participating in regular sports, and 8 (5.2%) commenced w/sports after the operation
- Of all patients, 75% were satisfied with their sports ability, and 25% were not
- Activity levels are significantly higher in male patients, but this does not yield higher satisfaction rates

Naal et al. AJSM 2014

Femoroacetabular Impingement in Adolescent Athletes

Outcomes of Arthroscopic Management

- 104 consecutive athletes (116 hips) younger than 18 years who underwent arthroscopic correction of symptomatic FAI with a minimum 2-year follow-up
  - Average follow-up was 38 months (range, 24-120 months), and average patient age was 16 years (range, 12-17 years), with 47 male and 57 female patients. There were 67 combined, 33 cam, and 16 pincer lesions
  - The average improvement on the mHHS was 25 points (average score: 69 preoperatively, 94 postoperatively
  - 87% of athletes were able to return to sport
FAI Conclusion

- Bony morphology is common in young athletes
- Dx can be elusive and early intervention is best for return to function
- Clinical exam must be thorough and followed by proper imaging
- Addressing mobility and improving lumbopelvic stability and gluteus medius strength should be focus of Rx
- Avoid temptation to push too hard too fast

Questions

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