"Femoroacetabular Impingement: Is it a Morphology or a Pathology?"

I. Introduction
   a. Femoroacetabular Impingement: what is it?
      i. The theoretical concept of bony impingement as a mechanism for the future development of hip pathology, particularly osteoarthritis (OA), was first described by Murray in 1965.¹
      ii. The direct observation of FAI as a potential mechanical cause of hip OA was introduced by Ganz et al. in 2001² by differentiating it from other visible deformities such as acetabular dysplasia and femoral head tilt.
      iii. Distinct types of FAI (cam and pincer) have been described.
         1. Cam FAI: the jamming of a malshaped femoral head (nonspherical with insufficient head/neck offset) into the acetabulum during forceful flexion and internal rotation.³,⁴
         2. Pincer FAI: the result of linear contact between the acetabular rim and the femoral head-neck junction due to an acetabulum that is functionally excessive (deep or maloriented).²
         3. These anatomic variants (cam and pincer) were first described as pistol-grip or tilt deformities, respectively.¹
      iv. Definitions⁵-⁷
   b. Current scope of care
      i. Innovation of surgical procedures for FAI was first introduced and pioneered by Myers, Eijer and Ganz⁸ who surgically treated FAI by open dislocation in 4 patients previously treated with periacetabular osteotomy. The resection of the non-spherical head associated with FAI was later found possible to treat by arthroscopy.⁹
      ii. Technical developments have undergone rapid progression since the surgery was first pioneered in 1999. This has led to more widespread use of hip arthroscopy and a heightened confidence that the technique is preferable to past surgical and current non-surgical techniques and a sense that the procedure can be utilized for more and more patients.
      iii. Surgical rates for correction of FAI have escalated, despite limited evidence to support a cause and effect relationship between FAI and hip pain.¹⁰-¹²
      iv. 18-fold increase in FAI surgery occurred between 1999 to 2009,¹³ and this rate has most recently been further accelerated towards a tipping point by high-volume surgeons in North America and Europe.¹⁴
      v. Conservative care evidence is lacking.¹⁵
REFERENCES

II. Hip Morphology

• For this presentation – *Hip morphology* will be operationally defined as the bony adaptations that happen to the human coxofemoral joint across the lifespan. Specifically, will be discussing the hip morphology changes related to the development of a cam or pincer impingement.
  o Sex, genetics and physical activity appear to influence whether or not a cam deformity develops. The prevalence of cam deformity may be as high as 89% in athletes participating in activities that result in impact loading of the hip as compared to only 9% in non-athletic controls.\(^1\)
  o Loading during sports or activity does influence hip morphology\(^2,3\), however, many variables (age, gender, sport, volume, intensity, etc.) must be examined in a rigorous scientific manner in order to determine how exactly hip morphology occurs and if/when the prevention of cam or pincer CAM prevention needs to be considered.\(^4\)

**Correlation doesn’t mean Causation**

• A significant association between cam deformity at baseline and the risk of developing hip OA and/or undergoing total hip replacement (THR) within 2–20 years of follow-up has been demonstrated in a few prospective studies with small sample sizes.\(^5-7\) The idea is that this morphology might gradually lead to hip OA. However, to date, there is no evidence available from multiple large prospective studies regarding whether the magnitude of the effect of these cam deformities on hip OA differs according to sex, body mass index (BMI), ethnicity, and age.\(^8,9\)

• Another form of femoroacetabular impingement (FAI), pincer impingement, results from localized acetabular overcoverage of the femur, which is called a pincer deformity. Pincer deformity is proposed to compress the labrum and increase stresses on the underlying acetabular rim in the area of acetabular overcoverage during terminal motion of the hip. Retrospective and cross-sectional studies showed conflicting results regarding the association between pincer deformity and hip OA\(^10\), and 2 recent prospective studies demonstrated no association between pincer deformity and the risk of hip OA or THR.\(^6,7\)

**Potential flaws in using hip morphology as a reason to drive interventions (both surgical or non-surgical)**

• From the Warwick Consensus Statement\(^11\): “The panel was unable to recommend precise diagnostic values for any of the common measures to define cam or pincer morphology in routine clinical practice. This is because we recognized that impingement is the result of a complex interaction, during motion, between the acetabulum and femoral neck. We agreed that the depth, orientation and rim of the acetabulum, and the head–neck profile, neck angle and torsion of the proximal femur all vary in the general population.”\(^11\)
• Patient factors, including mental health, activity level, sex, and smoking, may be more predictive of baseline hip pain and function than are intra-articular findings (labral or articular cartilage damage) during hip arthroscopy for FAIS. Future studies evaluating patient outcomes after surgery for FAIS should consider adjusting for these identified patient factors to accurately interpret the effect of treatment on patient-reported outcomes after surgery.¹²

• Overmedicalization / Overtreatment: Diagnostic imaging evidence of FAIS was the most commonly reported criterion for surgery. Only 56% of included studies utilized the combination of symptoms, clinical signs and diagnostic imaging for diagnosis of FAIS as suggested by the Warwick Agreement,¹¹ and only 44% of studies had failed non-surgical treatment (and 18% a failed trial of physiotherapy) as a criterion for surgery.¹³

References:

III. FAI as pathology

a. Definitions:

b. Why FAI is a pathology?
   i. Theoretical, mechanical framework from FAI to OA described by R. Ganz in early 2000s [1,2]
   ii. Cam lesions increases risk for OA [3-5]
      1. These concepts, in part, have been substantiated by large epidemiological cohorts showing large cam lesions are associated with future OA and OA progression [3-5]
      2. However…
         a. Not all individuals with cam lesions develop OA [3-6] and,
         b. there is no confirmed pathomechanical or pathophysiological link to clarify how the altered joint mechanics associated with FAI may lead to incident OA
   iii. FAI is commonly associated with chondral and labral lesions – both highly prevalent in FAI – and risk factors for future degenerative joint disease
   iv. In the ‘right’ conditions, FAI can cause supraphysiologic stress to the labrum and adjacent cartilage [2,7]
      1. Altered mechanics are implicated in the pathogenesis of OA [8], and particularly so in hip OA [9]
      2. Magnitude, orientation, and rate of loading are all implicated in articular changes [10]
         a. Cam lesions contribute to high acetabular stresses [11], possibly through altered orientation
      3. FAIS preferentially effects active young adults who participate in sports requiring end range hip movement under high loads (ie. cutting, pivoting, kicking)
   v. Altered whole body mechanics, either pre-existing or as a compensation, may also contribute to mechanistic link between FAI and OA.
      1. FAI is now considered a movement-related disorder and now syndrome, FAIS [12]
      2. Altered movement is common in FAIS [13-17] and may be more disrupted in those with worse cartilage health [14,18,19]
3. Altered movement persists after surgical treatment of bony morphology [13,15], making movement-based interventions a high priority for future clinical trials [16]


IV. Question and Answer
V. Case presentation
VI. Question and Answer; Wrap Up

Michael P. Reiman, PT, DPT, OCS, SCS, ATC, FAAOMPT, CSCS.

Mike is an associate professor of physical therapy at Duke University Medical Center. As a clinician Dr. Reiman has over 20 years of experience in assessing, rehabilitating, and training clients at various levels of ability. He received his doctoral degree in physical therapy from MGH Institute of Health Professions. In addition to his certifications as an athletic trainer and strength and conditioning specialist, Dr. Reiman is a manual therapy fellow through the American Academy of Orthopaedic and Manual Physical Therapists, a USA Weightlifting level 1 coach, and a USA Track and Field level 1 coach. Mike has written the most comprehensive orthopedic and sports related examination book and has co-written the only textbook on functional testing, as well as book on clinical biomechanics. He has written over 10 book chapters on orthopedic examination/intervention and training. He has also written over 40 peer-reviewed articles in sports and currently serves on the editorial board, and is a reviewer for, multiple orthopedic and sports related journals. Dr. Reiman presents on and researches various areas of assessment and treatment methods in orthopaedic and sports medicine. He is the current Sports Section Hip SIG Chair for the APTA. He continues to practice clinically on various sports and orthopedic-related injuries. He is a member of
the American Physical Therapy Association, National Athletic Trainers’ Association, National Strength and Conditioning Association, USA Weightlifting Association, and USA Track and Field Association.

APTA # 48122

**Stephanie Di Stasi, PT, PhD, OCS**, is an Assistant Professor in the Division of Physical Therapy at The Ohio State University (OSU) and a Research Scientist for OSU’s Wexner Medical Center Sports Medicine Research Institute. She earned her Master of Science in Physical Therapy from Springfield College and maintains part-time clinical work treating sports and orthopaedic populations. Dr. Di Stasi received her PhD in Biomechanics and Movement Science from the University of Delaware in 2011 and completed post-doctoral work in Sports Medicine at OSU. Dr. Di Stasi’s current research focuses on the mechanisms of disability and joint disease in individuals following lower extremity injury and surgery in order to inform targeted treatment strategies. Her work on outcomes following hip arthroscopy has been funded by the National Center for Advancing Translational Sciences, the Foundation for Physical Therapy, the Sports Physical Therapy Section of the APTA, and OSU’s Center for Clinical and Translational Science. Dr. Di Stasi is a member of the American Physical Therapy Association (Research, Sports and Orthopaedics sections), American Society of Biomechanics, and International Society for Hip Arthroscopy.

APTA number: 332548

**J.W. Matheson, PT, DPT, OCS, SCS, CSCS**

Dr. Matheson is a 1996 graduate of the Mayo Clinic of Health Sciences. J.W. is a 2001 graduate of the first public APTA Credentialed Sports Physical Therapy residency at Gundersen Health Sports Medicine in Onalaska, WI. He is both a board-certified specialist in sports physical therapy and a board-certified specialist in orthopaedic physical therapy. J.W. completed his transitional DPT degree from the Massachusetts General Hospital Institute of Health Professions in 2005.

Dr. Matheson has worked in a variety of clinical and academic settings as a clinician, researcher, adjunct faculty member, consultant, and practice owner. He is currently President and Clinic Director of Catalyst Sports Medicine. This is a private outpatient physical therapy practice and sports performance center located in Hudson, Wisconsin. J.W. is an active member of the American Physical Therapy Association (APTA) and serves on several legislative and research committees locally and nationally.

APTA # - 185687