
SPORTS HIP 16
www.sportshipsurgery.org
@WarwickOrtho
SPEAKER NOTES
Bryan Kelly
WARWICK orthopaedics

WARWICK orthopaedics

SPORTS INJURY CONFERENCES

SPORTS HIP 16

www.sportshipsurgery.org @WarwickOrtho

27TH & 28TH JUNE 2016

THE NATIONAL FOOTBALL CENTRE, ST GEORGE'S PARK

www.sports-surgery.org

COURSE CONVENOR



PROFESSOR DAMIAN GRIFFIN

PROFESSOR OF TRAUMA & ORTHOPAEDIC SURGERY

UNIVERSITY OF WARWICK

SPORTS HIP 2016 WAS SUPPORTED BY

Arthrex HELPING SURGEONS TREAT THEIR PATIENTS BETTER

DJO GLOBAL

bodyflow

stryker

Arthro Dynamik

Perform Part of Spire Healthcare

ÖSSUR

ZIMMER BIOMET Your progress. Our promise.

FUNCTION JIGSAW SPORTS INJURY MANAGEMENT

MicroPort Scientific Full Function. Faster.

SEMPRIS

Clinical Graphics See Beyond

Sybermedica

WARWICK orthopaedics
SPORTS INJURY CONFERENCES

SPORTS HIP 16

www.sportshipsurgery.org @WarwickOrtho

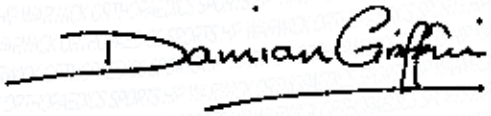
Dear Colleague,

The Sports Hip Conference will run again in 2018 as part of our portfolio of Sports Injury conferences. Some of you may have already attended the Sports Foot & Ankle, Sports Shoulder and and Sports Knee conferences. The dates for the next events will shortly be published on our website
www.sports-surgery.org

The key feature of these Sports Injury conferences is that we explore the latest ideas and most difficult problems in a relatively small group, guided by an expert international faculty.

Please do let us know if you have any thoughts about the meeting or any suggestions as to how we might develop it in the future.

With very best wishes.



PROFESSOR DAMIAN GRIFFIN
PROFESSOR OF TRAUMA & ORTHOPAEDIC SURGERY
UNIVERSITY OF WARWICK

WARWICK orthopaedics
SPORTS INJURY CONFERENCES
SPORTS HIP 16

Bryan Kelly



Dr. Bryan T. Kelly is a specialist in sports medicine injuries and arthroscopic and open surgical management of non-arthritic disorders around the hip. He has faculty appointments at New York Presbyterian's Weill Cornell Medical College as well as the Hospital for Special Surgery. He cares for several sports teams, serving as an Associate Team Physician for the New York Giants, and the New York Red Bull's MLS team, as well as team Consultant for hip injuries for the New Jersey Nets and several collegiate teams in the tri-state region.

After the completion of his residency at HSS in 2001, Bryan completed a two year fellowship at the Hospital for Special Surgery, specializing in Sports Medicine and Shoulder Surgery. He then completed a fellowship in Hip Sports Injuries and Arthroscopy at the University of Pittsburgh Medical Center, Center for Sports Medicine, under the direction of Dr. Marc J. Philippon, MD. Prior to starting his practice he also completed an AO International Traveling Fellowship where he spent time with Dr. Herbert Resch at the Landeskliniken Hospital in Salzburg, Austria. He has also spent time with Professor Reinhold Ganz and Dr. Michael Leunig in Bern and Zurich, Switzerland studying advanced techniques in open surgical management of hip injury and deformity through an AO Surgical Preceptorship.

Bryan currently serves as Co-Director for the Center for Hip Pain and Preservation at the Hospital for Special Surgery which is designed to provide multi-disciplinary care for patients at all levels with hip injuries. He has a broad range of both clinical and basic science research interests including the development of a clinical outcomes registry; biomechanical studies evaluating conflict patterns in femoroacetabular impingement and techniques in labral refixation; development of synthetic scaffolds for labral reconstruction and cartilage injuries in the hip; and the development of novel surgical techniques for managing soft tissue injuries around the hip joint. He has authored over 75 scientific publications, chapters, review articles, and books.

WARWICK orthopaedics
SPORTS INJURY CONFERENCES
SPORTS HIP 16

Session 1

HIP INSTABILITY

Iatrogenic instability: Capsulotomy, capsule repair and reconstruction

© Bryan Kelly 2016.
Permission must be obtained from the author before using any part of this presentation.

CONTACT THE AUTHOR

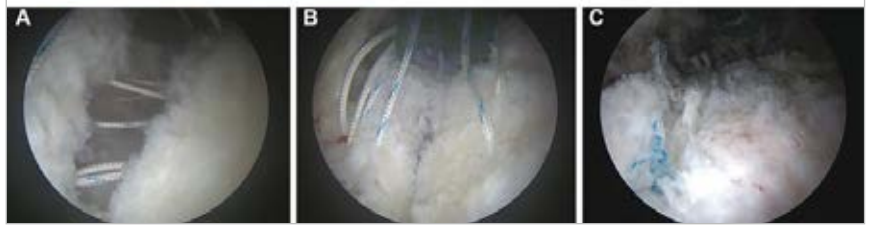
SPORTS MEDICINE AND HIP PRESERVATION

HOSPITAL FOR SPECIAL SURGERY

Iatrogenic Instability: Capsulotomy, capsule repair and reconstruction

Bryan T. Kelly, M.D.
Chief Sports Medicine Service
Hospital for Special Surgery
Professor of Orthopaedic Surgery
Weill Medical College of Cornell University

Warwick Orthopaedics
Sports Hip 2016
Tuesday, June 27th, 2016



SPORTS MEDICINE AND HIP PRESERVATION

Types of financial relationships and the companies with whom I have relationships are as follows:

A3 Surgical: Consultant; Shareholder
Arthrex: Consultant

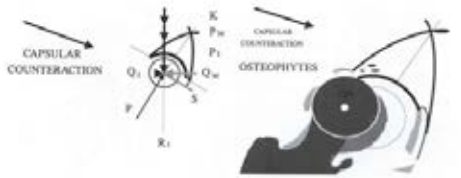
2

HOSPITAL FOR SPECIAL SURGERY

Hip Instability

Although an inherently stable joint, the labral-capsular complex of the hip is a dynamic structure that can lead to pain and instability.



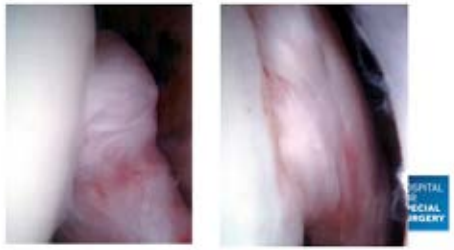


HOSPITAL FOR SPECIAL SURGERY

Anatomic Considerations – Soft Tissue

- Capsule
  - Iliofemoral resists anterior translation / ER
  - Ishiofemoral resists posterior translation / IR
- Ligamentum Teres
  - Tightens in ER

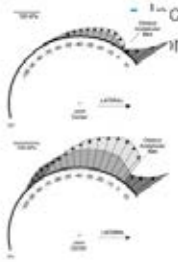




Anatomic Considerations - Labrum

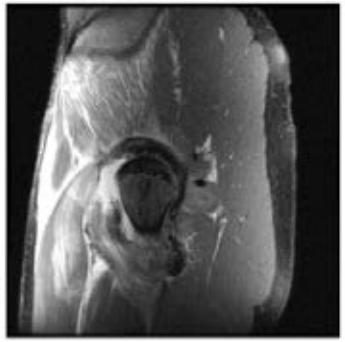
- Extension of Bony Acetabulum
- Suction Seal
  - *Ferguson et al 2000, 2001, 2003*
- Tear
  - Loss of Suction Seal
    - Synovial fluid "leak"
      - Decreased hydrostatic pressure
      - Increased cartilage compression





Spectrum of Hip Instability

- Traumatic Dislocations
- Traumatic Subluxations
- Impingement induced instability
- Generalized ligamentous laxity
- Collagen disorders
- Dysplasia
- ***Iatrogenic Instability***
  - ***Excessive Rim Resection***
  - ***Capsular Disruption / Excision***
  - ***Labral Debridement***



Iatrogenic: Hip Arthroscopy Alone

- Catastrophic Instability after Arthroscopy
- Dysplasia or Significant Retroversion
  - **Resection anteriorly = global instability**
  - **After capsulotomies / labral deb even without bony resections**
    - **Matsuda Arthroscopy 2009, Ranawat et al., JBJS 2009, Benali Arthroscopy 2009, Mei-Dan O Arthroscopy 2012, Jones et al, Hip Int 2009, Matsuda Arthroscopy 2012**



Iatrogenic: Open Surgery





Patient referred to Dr Clohisy after SHD done elsewhere resulted in instability

Biomechanical Evaluation of Capsulotomy, Capsulectomy, and Capsular Repair on Hip Rotation

Geoffrey D. Abrams, M.D., Michael A. Hart, B.S., Kaosu Takami, B.S., Christopher O. Bayne, M.D., Bryan T. Kelly, M.D., Alejandro A. Espinoza Orías, Ph.D., and Shane J. Nho, M.D., M.S.

Arthroscopy: The Journal of Arthroscopic and Related Surgery 2015

- Purpose: To determine the effect of different types of capsulotomies on hip rotational biomechanical characteristics.
- **Conclusions: A T-capsulotomy showed significantly increased external rotation versus the intact and interportal capsulotomy states. The repaired T-capsulotomy restored the rotational profile back to the native state.**
- Clinical Relevance: *Many methods of capsular treatment during hip arthroscopy exist. Capsulotomy and capsulectomy do not restore the external rotation restraint of the hip back to its native state.*

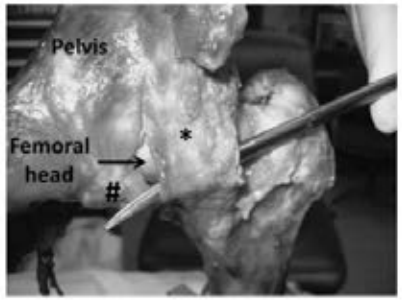


Biomechanics of the Hip Capsule and Capsule Management Strategies in Hip Arthroscopy

Jeffrey J. Nepple, MD and Matthew V. Smith, MD†*

Sports Medicine Arthroscopy Review 2015

- Recent advances in our understanding of the function of the hip capsule have clarified its importance to normal hip function and kinematics.
- The iliofemoral ligament is the primary stabilizing structure for controlling anterior translation and external rotation of the hip, and is violated by the arthroscopic interportal capsulotomy.
- *Microinstability of the hip occurring after surgical trauma remains a poorly defined clinical entity.*
- **Despite a lack of conclusive evidence-based indications, we recommend capsular repair** particularly in the settings of borderline hip dysplasia, hip hypermobility, connective tissue disorders, and traumatic or atraumatic instability.

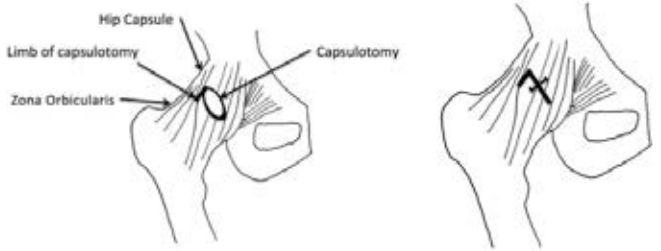


The Intracapsular Atraumatic Arthroscopic Technique for Closure of the Hip Capsule

Vipin Asopa, M.B.Ch.B., B.Sc., M.R.C.S., Ph.D., F.R.C.S.(Tr&Orth), and Parminder J. Singh, M.B.B.S., M.R.C.S., F.R.C.S.(Tr&Orth), M.S., F.R.A.C.S.

Arthroscopy: The Journal of Arthroscopic and Related Surgery 2014

- The hip joint capsule is a critical static stabilizer of the hip. During hip arthroscopy, the capsule is breached to gain exposure to treat femoroacetabular impingement lesions. There have been recent concerns regarding hip instability after hip arthroscopy, and relatively few techniques have been described for atraumatic arthroscopic closure of the hip capsule. **We describe an atraumatic, inside-out, 2-portal technique to repair the capsule.**



Hip Dislocation or Subluxation After Hip Arthroscopy: A Systematic Review

Neil L. Duplantier, M.D., Patrick C. McCulloch, M.D., Shane J. Nho, M.D., Richard C. Mather III, M.D., Brian D. Lewis, M.D., and Joshua D. Harris, M.D.

Arthroscopy: The Journal of Arthroscopic and Related Surgery 2016

- Purpose: To determine patient- and surgery-specific characteristics of patients sustaining post-arthroscopic hip dislocation or subluxation.
- Results: Ten articles with 11 patients were analyzed (mean patient age: 36.6 ˚ 12.3 years). **There were 9 hip dislocations and 2 subluxations.** Mean time between surgery and dislocation was 3.2 ˚ 4.0 months (range: recovery room to 14 months).
- Conclusions: **Post-arthroscopic hip instability was observed in patients with acetabular undercoverage (including iatrogenic resection), labral debridement, capsular insufficiency, or iliopsoas tenotomy.** Most dislocations were anterior, occurring with hip extension and external rotation.



Gross Instability After Hip Arthroscopy: An Analysis of Case Reports Evaluating Surgical and Patient Factors

Marco Yeung, M.D., Muzammil Memon, M.D.(Cand), Nicole Simunovic, M.Sc., Etienne Belzile, M.D., F.R.C.S.C., Marc J. Philippon, M.D., and Olufemi R. Ayeni, M.D., M.Sc., F.R.C.S.C.

Arthroscopy: The Journal of Arthroscopic and Related Surgery 2016

- Methods: A systematic search was performed in duplicate for studies investigating gross hip instability after hip arthroscopy up to October 2015.
- Results: **The systematic review identified 9 case reports investigating gross hip instability after hip arthroscopy (10 patients).** Anterior dislocation occurred in 66.7% of patients, and most injuries occurred with a low- energy mechanism.
- Conclusions: This systematic review discussed various patient, surgical, and postoperative risk factors of gross hip instability after arthroscopy**. Patient characteristics such as female gender, hip dysplasia, and ligamentous laxity may be risk factors for post-arthroscopy dislocation.** Similarly, surgical risk factors for iatrogenic hip instability may include unrepaired capsulotomies and iliopsoas debridement, although the role of capsular closure in iatrogenic instability is not clear. The influences of postoperative restrictions and protocols on dislocation are also unclear in the current literature. Surgeons should be cognizant of these risk factors when performing hip arthroscopy and be mindful that these factors appear to occur in combination.

Capsular Plication for Treatment of Iatrogenic Hip Instability

David M. Levy, M.D., Jeffrey Grzybowski, B.A., Michael J. Salata, M.D., Richard C. Mather III, M.D., Stephen K. Aoki, M.D., and Shane J. Nho, M.D., M.S.

Arthroscopy Techniques, 2015

- The most commonly reported reasons for persistent hip pain after hip arthroscopy are residual femoroacetabular impingement, dysplasia and dysplasia variants, or extra-articular impingement. There are some cases in which the underlying osseous pathomorphology has been appropriately treated, and the cause of persistent hip pain can be soft-tissue injuries such as chondrolabral tears or capsular abnormalities.
- **Capsular defects after hip arthroscopy may suggest an alteration of the biomechanical properties of the iliofemoral ligament and lead to iatrogenically induced hip instability.**
- **We describe the workup, examination under anesthesia, diagnostic arthroscopy, and technique of capsular plication for iatrogenic instability of the hip.**

Arthroscopic Capsular Repair for Symptomatic Hip Instability After Previous Hip Arthroscopic Surgery

James D. Wylie,* MD, MHS, James T. Beckmann,† MD, MS, Travis G. Maak,* MD, and Stephen K. Aoki,*‡ MD
Investigation performed at the Department of Orthopaedic Surgery, University of Utah, Salt Lake City, Utah, USA

AJSM Vol. 44, No. 1, 2016

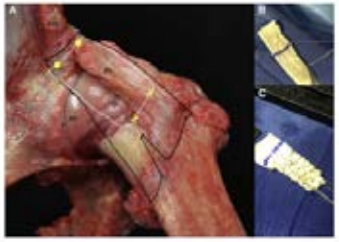
- Methods: In a cohort of approximately **1100 patients who underwent hip arthroscopic surgery, 33 patients (33 hips)** developed symptomatic instability requiring a revision surgery.
- Results: For the patients with a minimum 1-year follow-up after revision surgery all improved significantly. The results were similar when looking at only the patients with a minimum 2-year follow-up after revision surgery (n = 11; mean follow-up, 26.1 months); the mean mHHS (from 56.0 preoperatively to 91.5 at final follow-up; $P = .001$), HOS-ADL (from 68.3 to 89.9; $P = .009$), and HOS-Sports (from 35.7 to 87.9; $P = .001$) all improved significantly.
- Conclusion: **Revision hip arthroscopic surgery for capsular repair in patients with symptomatic instability after hip arthroscopic surgery provides good functional outcomes at a minimum of 1 and 2 years postoperatively.**

Arthroscopic Anterior Capsular Reconstruction of the Hip for Recurrent Instability

Omer Mei-Dan, M.D., Tigran Garabekyan, M.D., Mark McConkey, M.D., and Cecilia Pascual-Garrido, M.D.

Arthroscopy Techniques, 2015

- **Symptomatic anterior instability of the hip is typically iatrogenic in nature and poses a challenging problem for the orthopaedist.**
- With early recognition, capsular repair and plication are often effective in restoring stability. Capsular reconstruction may play an important role in restoring stability in these difficult cases.
- **We present an arthroscopic technique for iliofemoral ligament reconstruction, with Achilles tendon allograft, to address instability of the hip due to anterior capsular deficiency.**



Arthroscopic Capsule Reconstruction in the Hip Using Iliotibial Band Allograft

Christiano A. C. Trindade, M.D., Gregory A. Sawyer, M.D., Kiyokazu Fukui, M.D., Ph.D., Karen K. Briggs, M.P.H., and Marc J. Philippon, M.D.

Arthroscopy Techniques, 2015

- **Patients who do not undergo capsular closure or plication may continue to complain of hip pain and dysfunction postoperatively, likely because of microinstability or muscle invagination into the capsular defect, and high-resolution magnetic resonance imaging or magnetic resonance arthrography will identify the capsular defect.**
- **We describe our new surgical technique for arthroscopic hip capsular reconstruction using iliotibial band allograft.**

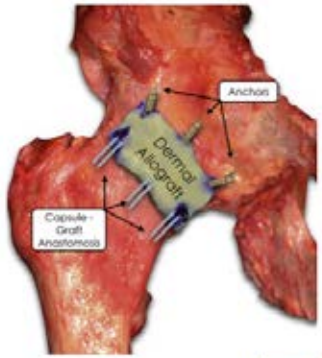


Hip Capsular Reconstruction Using Dermal Allograft

Jorge Chahla, M.D., Chase S. Dean, M.D., Eduardo Soares, M.D., William R. Mook, M.D., and Marc J. Philippon, M.D.

Arthroscopy Techniques 2016

- Hip arthroscopic procedures are increasing in number, complications related to the operation itself are starting to emerge.
- **The capsule has been recognized as an important static stabilizer for the hip, it has not been until recently that surgeons have realized the importance of its preservation and restoration.**
- Disruption of the capsule during arthroscopic procedures is a potential contributor to postoperative iatrogenic hip instability.
- **In cases of a symptomatic deficient capsule, a capsular reconstruction is mandatory because instability may lead to detrimental chondral and labral changes.** The purpose of this report was to describe our technique for arthroscopic hip capsular reconstruction using dermal allograft.



Influence of Capsular Repair Versus Unrepaired Capsulotomy on 2-Year Clinical Outcomes After Arthroscopic Hip Preservation Surgery

Benjamin G. Domb, M.D., Christine E. Stake, D.H.A., Zachary J. Finley, B.S., Tian Chen, Ph.D., and Brian D. Giordano, M.D.

Arthroscopy: The Journal of Arthroscopic and Related Surgery 2016

- Purpose: The primary objective of this study was to determine whether capsular management technique influences clinical outcomes at a minimum of 2 years after arthroscopic hip preservation surgery.
- Conclusions: **Arthroscopic capsular repair, used in conjunction with arthroscopic hip preservation surgery, appears to be safe and did not negatively influence clinical outcomes in this study. When confounding variables were controlled for, the use of capsular repair did not show clinically relevant superiority over the use of unrepaired capsulotomy.**

HOSPITAL FOR SPECIAL SURGERY

So…
Why Cut the Capsule?



The Challenge of Arthroscopic Treatment…

Can be difficult to interpret the anatomy / morphology of the cam lesion through a 70 degree arthroscope.

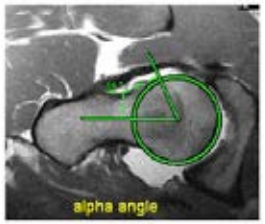
It is difficult to create a concavity around a sphere with limited global visualization.





Arthroscopic Management of FAI

- Failure to address bony impingement lesions of the hip are key factors in unsuccessful hip arthroscopy.
  - Philippon et al, *Revision Hip Arthroscopy*, AJSM, Vol. 35, No. 11;1918-21, 2007
  - Heyworth et al, *Radiologic and Intraoperative Findings in Revision Hip Arthroscopy*, Arthroscopy, Vol 23, No 12;1295-1302, 2007.





Arthroscopic Impingement Surgery Works IF:

1. Have a precise anatomic diagnosis

   Avoid excessive rim resection and complete cam resection

2. Have clear visualization

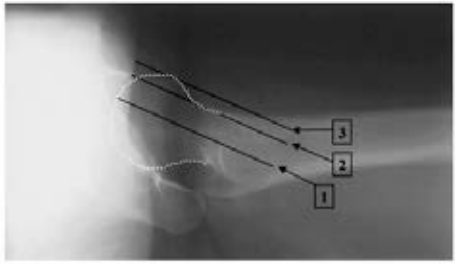
   Improved visualization with T-cut improves decompression

3. Be gentle with the soft tissue

   Repair the capsule completely

Point 1: Precise knowledge of the impingement morphology

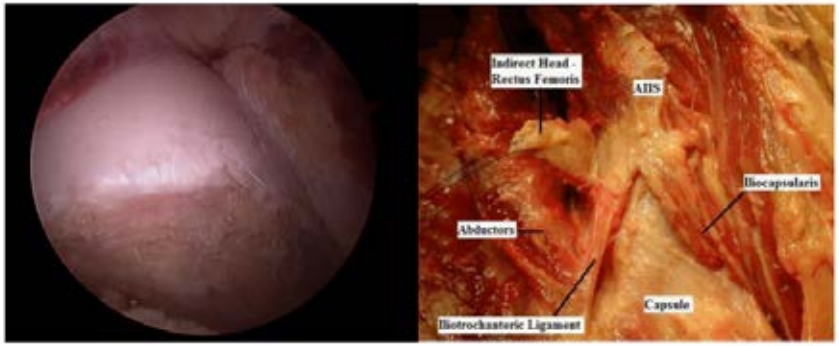




- Advanced three dimensional imaging and pre-operative planning can be helpful in some cases

Point 2: Clear Visualization

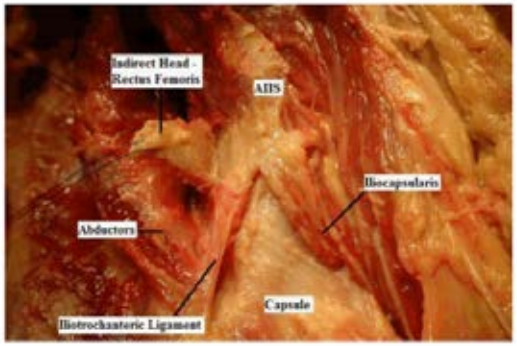
Visualization with selective, anatomic capsular cuts.



Point 3: Be gentle with the soft tissue.

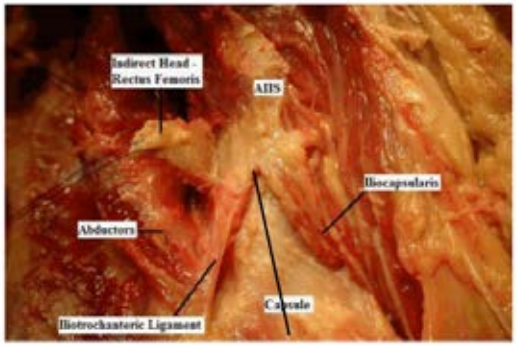
Know the capsular anatomy

Put it back the way you found it



Point 3: Be gentle with the soft tissue.

Carefully define the interval between the iliocapsularis and gluteus minimus prior to the T cut



Point 3: Be gentle with the soft tissue.

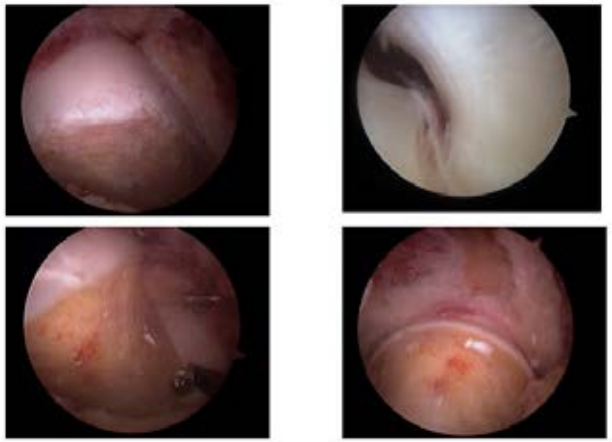
Cut all the way distal to the intertrochanteric line.

This allows you to visualize the distal extent of the Cam



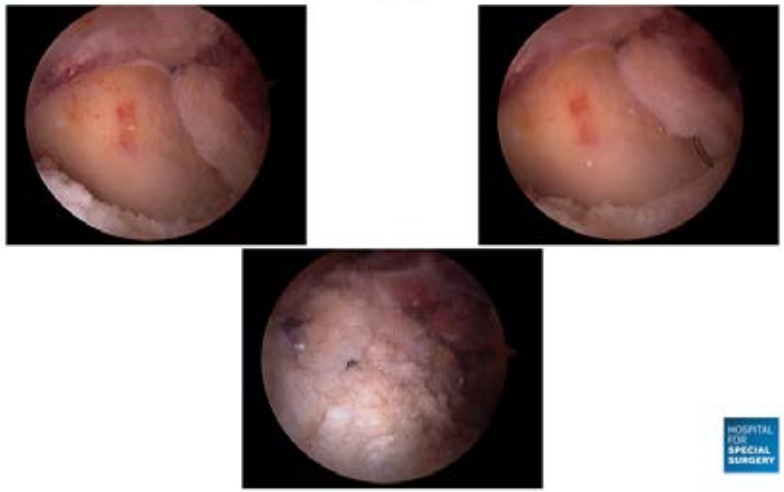
Point 3: Be gentle with the soft tissue.

Careful retraction of the capsular flaps allows for clear visualization from lateral synovial fold to medial synovial fold



Point 3: Be gentle with the soft tissue.

- Put the capsule back the way you found it

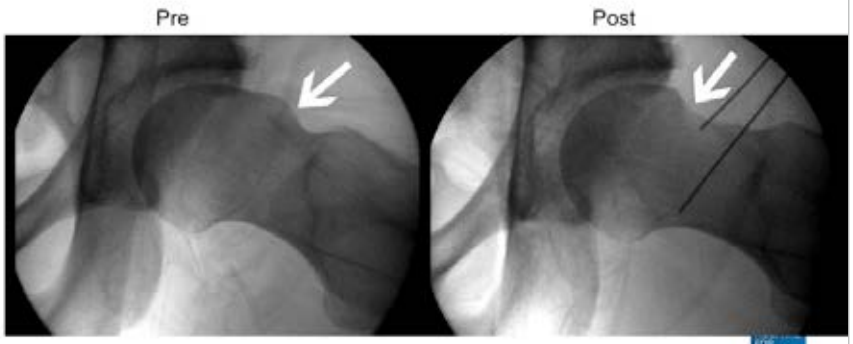


Point 3: Be gentle with the soft tissue.

- Close the T-cut with 3 – 4 sutures
- Close the interportal cut with 2 – 3 sutures



In appropriately selected patients, with strict adherence to careful technique, arthroscopic treatment of cam impingement with selective capsular cuts *with repair* can lead to successful outcomes without instability.



WARWICK orthopaedics
SPORTS INJURY CONFERENCES
SPORTS HIP 16

Session 4

HIP CARTILAGE

Treating a chondral defect: Microfracture or microdrilling?

© Bryan Kelly 2016.
Permission must be obtained from the author before using any part of this presentation.

CONTACT THE AUTHOR

SPORTS MEDICINE AND HIP PRESERVATION

HOSPITAL FOR SPECIAL SURGERY

Treating a chondral defect: Microfracture or microdrilling

Warwick Orthopaedics
Sports Hip 2016
Monday, June 27th, 2016

Bryan T. Kelly, M.D.
Chief Sports Medicine Service
Hospital for Special Surgery
Professor of Orthopaedic Surgery
Weill Medical College of Cornell University



SPORTS MEDICINE AND HIP PRESERVATION

Types of financial relationships and the companies with whom I have relationships are as follows:

A3 Surgical: Consultant; Shareholder
Arthrex: Consultant

2

HOSPITAL FOR SPECIAL SURGERY

Definition of Cartilage Injury?

- Radiographic Classification
  - Tonnis
  - Kellgren-Lawrence
- MRI Classification
- Arthroscopic Classification



Limitations of Radiographic Classifications

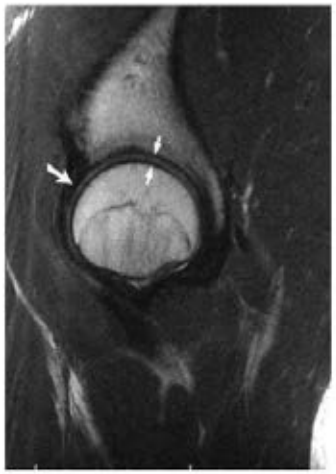
- Neither Validated
  - Reproducibility
  - Interobserver Reliability
  - Intraobserver
- Subjective Narrowing
  - Not byAmount
  - Just "Definite or Marked or Severe"





MRI Classifications

- Minz, Potter, et al
  - Grade 0: Intact articular cartilage;
  - *Grade 1: Chondral softening (high signal)*
  - Grade 2: Superficial ulceration, fissuring, or fibrillation involving less than 50% of the depth of the articular surface
  - Grade 3: Ulceration, fissuring, or fibrillation involving more than 50% of the depth of the articular cartilage
  - Grade 4: Full-thickness chondral wear with exposure of subchondral bone.



HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

MRI Classifications

- Minz, Potter, et al
  - Grade 0: Intact articular cartilage;
  - Grade 1: Chondral softening (high signal)
  - *Grade 2: Superficial ulceration, fissuring, or fibrillation involving less than 50% of the depth of the articular surface*
  - Grade 3: Ulceration, fissuring, or fibrillation involving more than 50% of the depth of the articular cartilage
  - Grade 4: Full-thickness chondral wear with exposure of subchondral bone.



HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

MRI Classification

- Minz, Potter, et al
  - Grade 0: Intact articular cartilage;
  - Grade 1: Chondral softening (high signal)
  - Grade 2: Superficial ulceration, fissuring, or fibrillation involving less than 50% of the depth of the articular surface
  - *Grade 3: Ulceration, fissuring, or fibrillation involving more than 50% of the depth of the articular cartilage*
  - Grade 4: Full-thickness chondral wear with exposure of subchondral bone.



HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

MRI Classifications

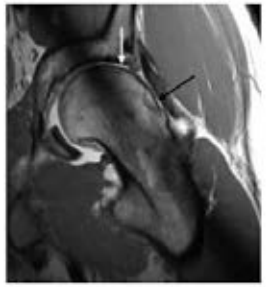
- Minz, Potter, et al
  - Grade 0: Intact articular cartilage;
  - Grade 1: Chondral softening (high signal)
  - Grade 2: Superficial ulceration, fissuring, or fibrillation involving less than 50% of the depth of the articular surface
  - Grade 3: Ulceration, fissuring, or fibrillation involving more than 50% of the depth of the articular cartilage
  - *Grade 4: Full-thickness chondral wear with exposure of subchondral bone.*

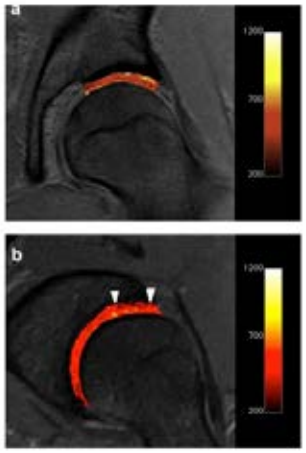


HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

Advanced Cartilage Imaging Techniques

- dGEMRIC
- T1 Rho, T2 mapping
- MRA (gad)



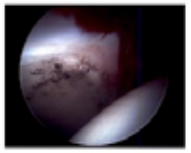


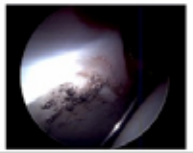
HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Arthroscopic Classifications

- Outerbridge
- ICRS
- Modified Noyes
- Beck Classification







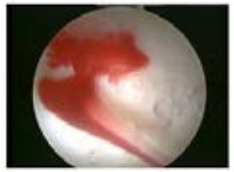
HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Literature

- *To date, the literature is limited regarding the effectiveness and utility of microfracture / microdrilling for chondral injuries within the femoro-acetabular joint.*







HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Indications and Outcomes for Microfracture as an Adjunct to Hip Arthroscopy for Treatment of Chondral Defects in Patients With Femoroacetabular Impingement: A Systematic Review

Austin E. MacDonald, M.D., Asheesh Bedi, M.D., Nolan S. Horner, M.D., Darren de SA, M.D., Nicole Simunovic, M.Sc., Marc J. Philippon, M.D., and Olufemi R. Ayeni, M.D., M.Sc., F.R.C.S.C.

Journal of Hip Preservation Surgery Vol. 3, No. 2, pp. 108–123

- Conclusions: **The outcomes reported in the literature after hip arthroscopy with microfracture for chondral defects are, in general, positive, with a very low percentage of patients requiring further surgery or experiencing complications.** The most common indication used in the literature for microfracture is a full-thickness, focal chondral defect (Outerbridge grade IV). The vast majority of literature recommends limited weight bearing after microfracture; however, there was significant variation among the specific rehabilitation protocols used. More research is needed to explore what indications and postoperative rehabilitation result in the best outcomes for patients.
- Level of Evidence: Level IV, systematic review of Level II, III, and IV studies.

HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Microfracture in the Hip

Results of a Matched-Cohort Controlled Study With 2-Year Follow-up

Benjamin G. Domb,*†‡ MD, Asheesh Gupta,† MD, MPH, Kevin F. Dunne,† BS, Chengcheng Gui,† BSE, Sivashankar Chandrasekaran,† MBBS, FRACS, and Parth Lodhia,† MD, FRCSC
Investigation performed at the American Hip Institute, Westmont, Illinois, USA

The American Journal of Sports Medicine, 2015

- **This study showed that patients undergoing microfracture during hip arthroscopy had equivalent PRO scores compared with the control group at 2 years postoperatively. The change in PRO scores from preoperatively to 2 years postoperatively was significantly lower in the microfracture group compared with the control group.** The VAS scores and satisfaction were inferior by 0.81 and 0.84 units, respectively, in the microfracture group compared with the control group, likely due to lack of full- thickness chondral defects in the latter. However, both groups showed significant improvement in all PRO scores after surgery, with no significant difference in final PRO scores.

A Matched-Pair Controlled Study of Microfracture of the Hip With Average 2-Year Follow-up: Do Full-Thickness Chondral Defects Portend an Inferior Prognosis in Hip Arthroscopy?

Benjamin G. Domb, M.D., John M. Redmond, M.D., Kevin F. Dunne, B.S., Christine E. Stake, M.A., and Asheesh Gupta, M.D., M.P.H.

Arthroscopy: The Journal of Arthroscopic and Related Surgery,
Vol -, No - (Month), 2015: pp 1-7

- Conclusions: **Our study found that patients undergoing microfracture during hip arthroscopy did not show a statistically significant difference in PRO scores when compared with a matched- pair control group at an average of 2 years of follow-up.** Both groups showed significant improvement in all PRO scores. Level of Evidence: Level III, matched case-control study.

Microfracture in the hip: a matched-control study with average 3-year follow-up

Parth Lodhia[1], Chengcheng Gui[1], Sivashankar Chandrasekaran[1], Carlos Suarez-Ahedo[1], S. Pavan Vemula[1] and Benjamin G. Domb[1,2,*]

Journal of Hip Preservation Surgery Vol. 0, No. 0, pp. 1–11, 2015

- **There was no significant difference (P > 0.05) in PRO scores preoperatively between the groups. Both groups dem- onstrated significant improvement (P < 0.05) in all post-operative PRO scores at all time points.** There was no statistic- ally significant difference (P > 0.05) in post-operative PRO scores between the microfracture and control groups, ex- cept for HOS-ADL and the visual analog scale (VAS) score, both of which were superior in the control group (P<0.05). Patient satisfaction was 6.9 for the microfracture group and 7.7 for the control group (P>0.05). Arthroscopic microfracture of the hip during treatment of labral tears results in favorable outcomes that are similar to the results arthroscopic treatment of labral tears in patients without full thickness chondral damage.

Acetabular Retrograde Drilling: A New Arthroscopic Technique for Treatment of Chondral Lesions Grade 1 and 2 in Patients with Femoroacetabular Impingement

Dante Parodi[1*], Joaquin Lara[2], Maria Jesus Haydar[3], Carlos Tobar[4]
[1]Department of Orthopedics and Traumatology, Hip and Pelvis unit, Fundacion Medica San Cristobal, Santiago, Chile
[2]Department of Orthopedics and Traumatology, German Clinic of Santiago, Avenida Vitacura 5951, Santiago de Chile, Región Metropolitana, Chile
[3]Department of Orthopedics and Traumatology, Austral University of Chile, Chile
[4]Department of Orthopedics and Traumatology, German Clinic of Santiago, Avenida Vitacura 5951, Santiago de Chile, Región Metropolitana, Chile

Orthop Muscular Syst 4: 193. 2015

- **Surgical Technique:** Through anterior and anterolateral arthroscopic portals, acetabular retrograde drilling is performed from the capsular side of the acetabular rim, to the cartilage detachment zone, without interrupting the indemnity of the articular cartilage surface.
- **Conclusion:** *Acetabular retrograde drilling is a new arthroscopic treatment alternative for acetabular chondral lesions grade 1 and 2 associated with femoroacetabular impingement. Is technically simple, inexpensive, reproductible and does not interfere with rehabilitation.*



Figure 3A: Schematic drawings of the surgical technique of arthroscopic retrograde drilling.

The biology and clinical evidence of microfracture in hip preservation surgery

Chadwick John Green[1,*], Aswin Beck[2], David Wood[2] and Ming H Zheng[2]

Journal of Hip Preservation Surgery Vol. 3, No. 2, pp. 108–123

- **The use of microfracture in hip arthroscopy is increasing dramatically. However, recent reports raise concerns not only about the lack of evidence to support the clinical use of microfracture, but also about the potential harm caused by violation of the subchondral bone plate.**
- The biology and pathology of the microfracture technique were described based on observations in translational models and the clinical evidence for hip microfracture was reviewed systematically. The clinical outcomes in patients undergoing microfracture were the same as those not undergoing microfracture. However, the overall clinical evidence quality is poor in hips.

The biology and clinical evidence of microfracture in hip preservation surgery

Chadwick John Green[1,*], Aswin Beck[2], David Wood[2] and Ming H Zheng[2]

Journal of Hip Preservation Surgery Vol. 3, No. 2, pp. 108–123

- This review identified only one study with Level III evidence, while most studies were Level IV. There were no randomized trials available for review.
  - **Repair tissue is primarily of fibrocartilaginous nature.**
  - **Reconstitution of the subchondral bone is often incomplete and associated with poor quality repair tissue and faster degeneration.**
  - **Subchondral bone cyst formation is associated with microfracture, likely secondary to subchondral bone plate disruption and a combination of pressurized synovial fluid and inflammatory mediators moving from the joint into the bone.**
  - **There is a lack of clinical efficacy evidence for patients undergoing microfracture.**
  - **There is evidence of bone cyst formation following microfracture in animal studies, which may accelerate joint degeneration.**
  - **Bone cyst formation following microfracture has not been studied adequately in humans.**

THE BONE & JOINT JOURNAL

Sustained five-year benefit of autologous matrix-induced chondrogenesis for femoral acetabular impingement-induced chondral lesions compared with microfracture treatment

A. Fontana,
L. de Girolamo

From COF Lanzo Hospital, Lanzo d'Intelvi, Italy

Journal of Bone and Joint, Vol. 97-B, No. 5, MAY 2015

- Acetabular grade III and IV chondral lesions measuring between 2 cm2 and 8 cm2 in 147 patients were treated by MFx in 77 and AMIC in 70. The outcome was assessed using the modified Harris hip score at six months and one, two, three, four and five years post- operatively. The outcome in both groups was significantly improved at six months and one year post-operatively. During the subsequent four years the outcome in the MFx group slowly deteriorated, whereas that in the AMIC group remained stable. Six patients in the MFx group subsequently required total hip arthroplasty, compared with none in the AMIC group
- **We conclude that the short-term clinical outcome improves in patients with acetabular chondral damage following both MFx and AMIC. However, the AMIC group had better and more durable improvement, particularly in patients with large (≥ 4 cm2) lesions.**

Microfracture: Literature

- *If we extrapolate from the knee literature, indications for microfracture of the hip are likely similar and include focal and contained lesions, typically less than 2 to 4 cm in size.*



Microfracture: Indications?

- *Chondral injuries with full thickness loss of articular cartilage in weight-bearing areas and unstable cartilage flaps overlying intact subchondral bone.*





HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Indications?

- Other considerations
  - patient age
  - activity level
  - ability to comply with the postoperative rehabilitation protocol.

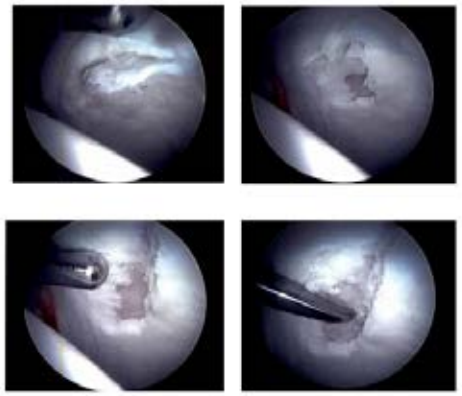




HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Indications?

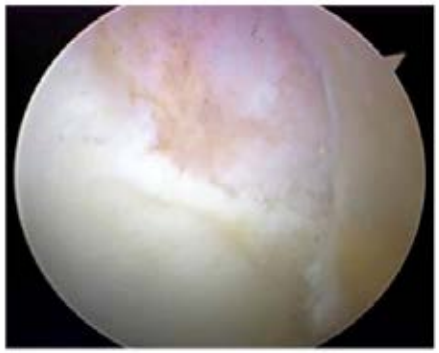
- Most commonly performed in cases of cam impingement where there is associated focal chondral damage on the acetabular side due to transition zone delamination.
- Less commonly used for chondral defects on the femoral head.



HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Technical Considerations

- The same technical considerations for microfracture of the knee should be applied to microfracture in the hip including:
  - debridement of all remaining unstable cartilage from the exposed bone.



HOSPITAL FOR **SPECIAL SURGERY** CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Technical Considerations

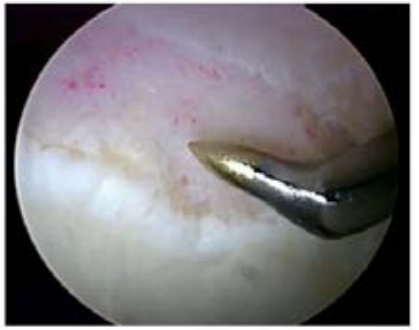
- Meticulous preparation of the defect through the creation of a smooth, perpendicular, shouldered border.



HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

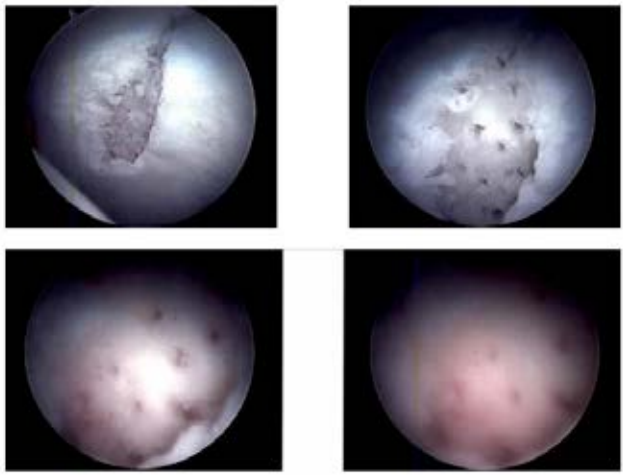
Microfracture: Technical Considerations

- Removal of the calcified cartilage layer; and maintenance of the subchondral plate.
- After preparation of the bed, angled arthroscopic awls are used to penetrate the microfracture holes deep to the subchondral bone.



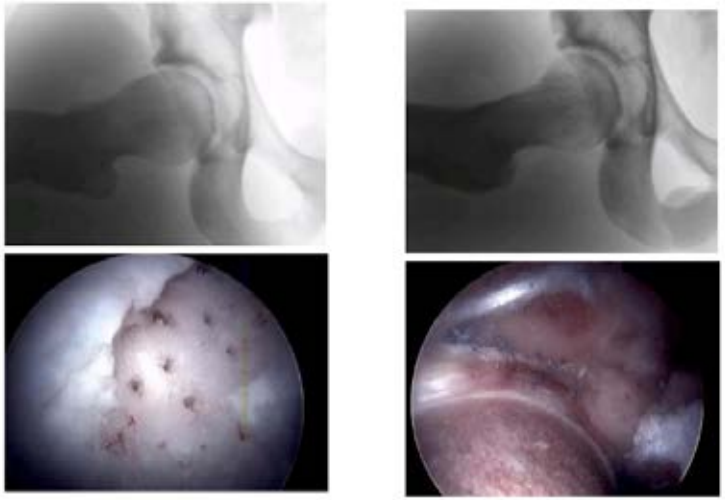
HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Microfracture



HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Treatment of associated pathology

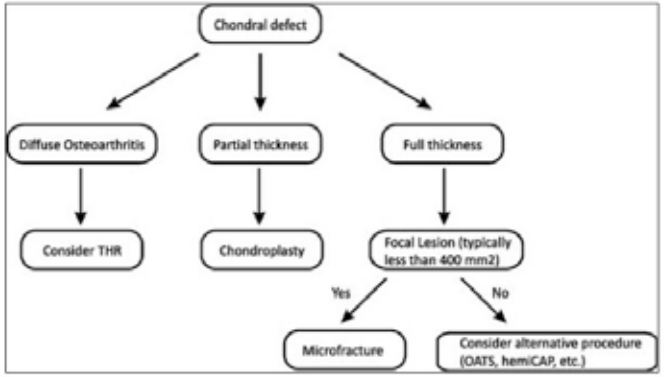


HOSPITAL FOR SPECIAL SURGERY CENTER FOR HIP PAIN AND PRESERVATION

Microfracture: Summary

- Prospective literature on the efficacy of microfracture techniques for the treatment of focal chondral defects in the hip compared to alternative treatment options or no treatment of the cartilage are currently very limited in the literature
- Recommendations regarding the use of this technique are largely based upon extrapolation of data from the knee literature.

Microfracture Algorithm?



Chondral Lesions of the Hip: Microfracture and Chondroplasty.
Yen, Yi-Meng; MD, PhD; Kocher, Mininder; MD, MPH
Sports Medicine & Arthroscopy Review. 18(2):83-89, June 2010.

The Role of Microfracture in my Practice?

- Rarely use it on the acetabulum.
- Very rarely / never on the femoral head.
- Conditions when I will consider it:
  - Small, isolated, full thickness chondral defects in the transition zone cartilage secondary to cam lesion.
  - Beck stage 4 or 5
  - Size less than 3 cm^2
  - Stable shoulders
  - Healthly remaining cartilage
  - Complete treatment of cam lesion

Where are we now?

Clear

- Structural deformities (FAI) can lead to hip damage
- Impingement surgery can relieve pain
- Treatment success depends upon bony correction
- ***Treatment success depends on cartilage damage***

Less clear:

- Natural course of untreated FAI
- Impact of surgery on natural course (OA prevention)
- Role of conservative management
- ***Impact of treatment of cartilage lesions***

Where do we go from here?

- Improve Techniques
  - It is not just poking holes in the bone.
  - Angle of penetration of the awl is problematic.
- Several questions remain
  - What is the healing potential?
  - What are the appropriate indications?
  - Are other cartilage restoration procedures applicable?
  - Is there any effect on outcome with microfracture?
  - Is there a difference between microfracture use on the acetabulum versus the femoral head?

How do we get there?

- Prospective, randomized studies
  - Inclusion criteria:
    - isolated lesions on the acetabulum
    - stable shoulders
    - Beck 4 or 5
    - No other significant cartilage lesion
    - Size less than 3 cm^2
  - Group 1: Microfracture
  - Group 2: No microfracture
- Continue to improve sensitivity of cartilage imaging
- Improve instrumentation to better facilitate microfracture techniques







Thank You

WARWICK orthopaedics
SPORTS INJURY CONFERENCES
SPORTS HIP 16

Session 7

FEMOROACETABULAR IMPINGEMENT 1: HOT TOPICS

What happened to 3D surgical planning and surgical navigation?

© Bryan Kelly 2016.
Permission must be obtained from the author before using any part of this presentation.

CONTACT THE AUTHOR

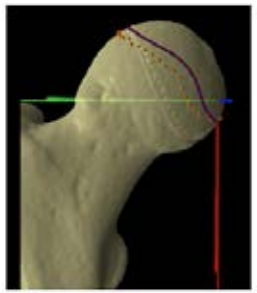
SPORTS MEDICINE AND HIP PRESERVATION

HOSPITAL FOR SPECIAL SURGERY

What happened to 3D surgical planning and surgical navigation?

Warwick Orthopaedics
Sports Hip 2016
Tuesday, June 28th, 2016

Bryan T. Kelly, M.D.
Chief Sports Medicine Service
Hospital for Special Surgery
Professor of Orthopaedic Surgery
Weill Medical College of Cornell University



SPORTS MEDICINE AND HIP PRESERVATION

Types of financial relationships and the companies with whom I have relationships are as follows:

A3 Surgical: Consultant; Shareholder
Arthrex: Consultant

- Morphological variants (pathomorphology) associated with secondary joint damage (i.e., FAI) incompletely understood
  - Pincer & cam impingement represent simplistic mechanisms to explain observations on secondary damage



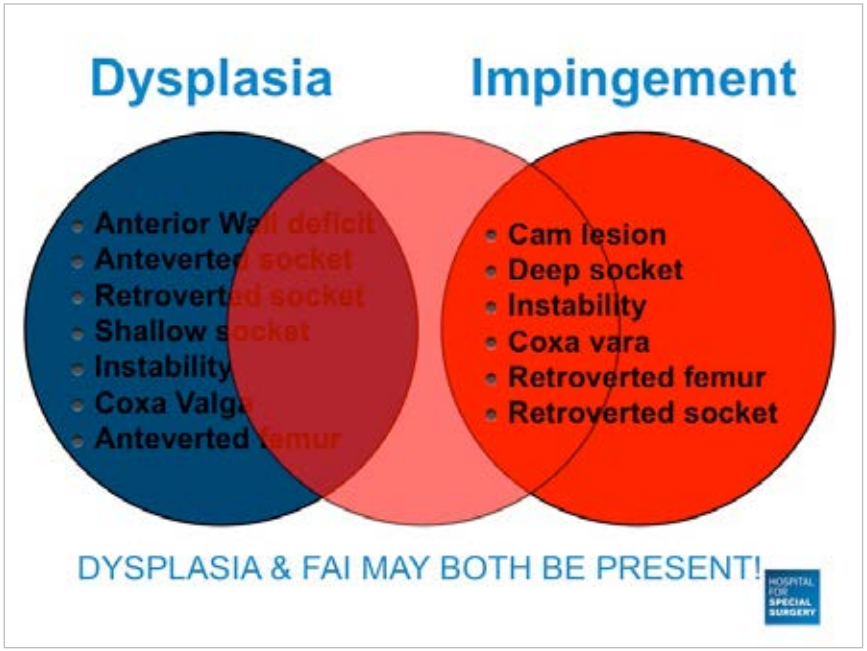
HOSPITAL FOR SPECIAL SURGERY

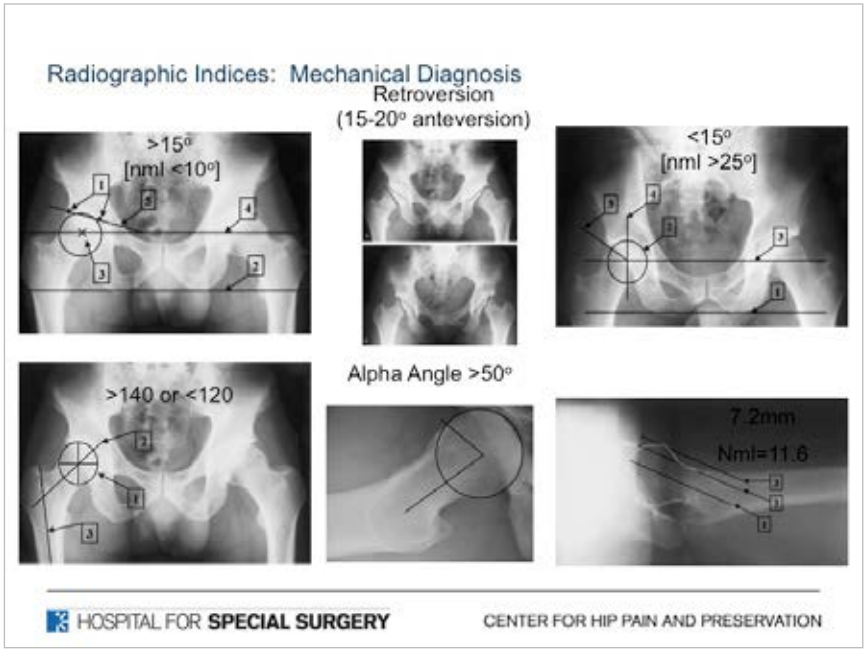
- **Dynamic Impingement**
- **CAM lesion**
- **Pincer lesion**
  - **Cranial Retroversion**
  - **Global Retroversion**
  - **Profunda**
  - **Protrusio**
- **Femoral Retroversion**
- **Femoral Varus**

- **Static Overload**
- **Lateral Acetabular Undercoverage**
- **Anterior Acetabular Undercoverage**
- **Femoral Anteversion**
- **Femoral Valgus**

Preoperative recognition of the mechanical conflict is very difficult…

Can Computer Navigation Help?

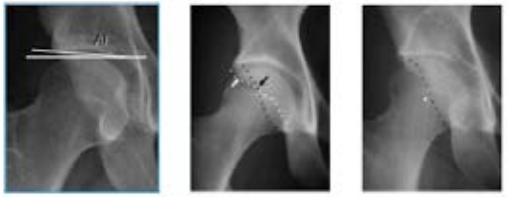


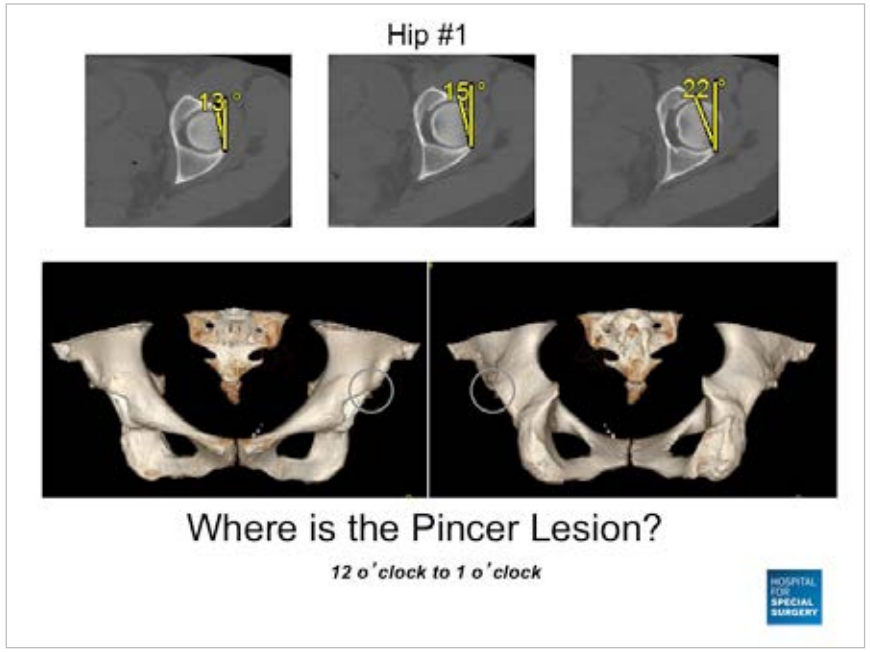


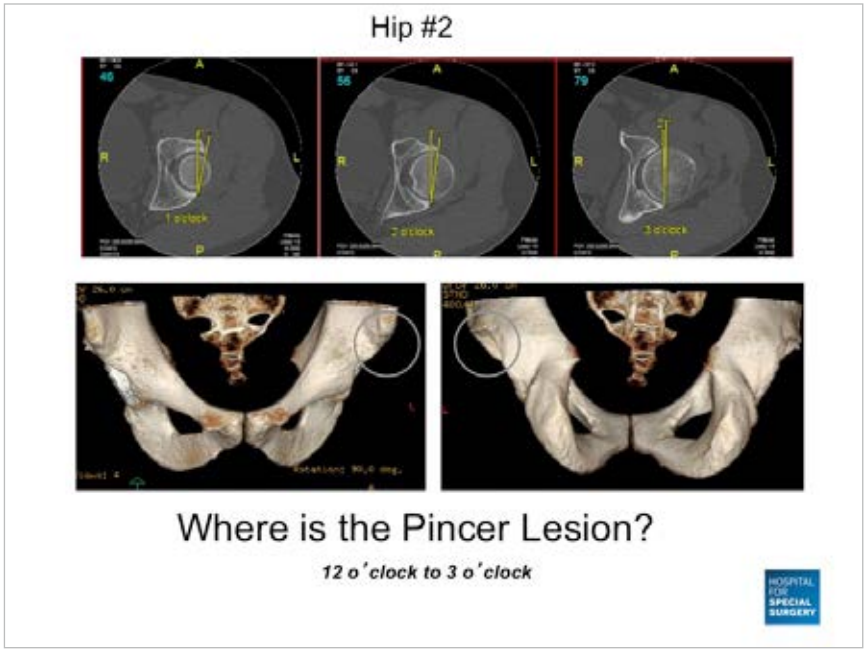
- Radiographic indices represent poor two-dimensional interpretations of complex anatomy
  - **Volume of femoral head coverage by acetabulum** poorly reflected by CE angles (i.e., lateral CE angle of Wiberg; anterior CE angle on false profile view) or parameters of profunda/protrusio

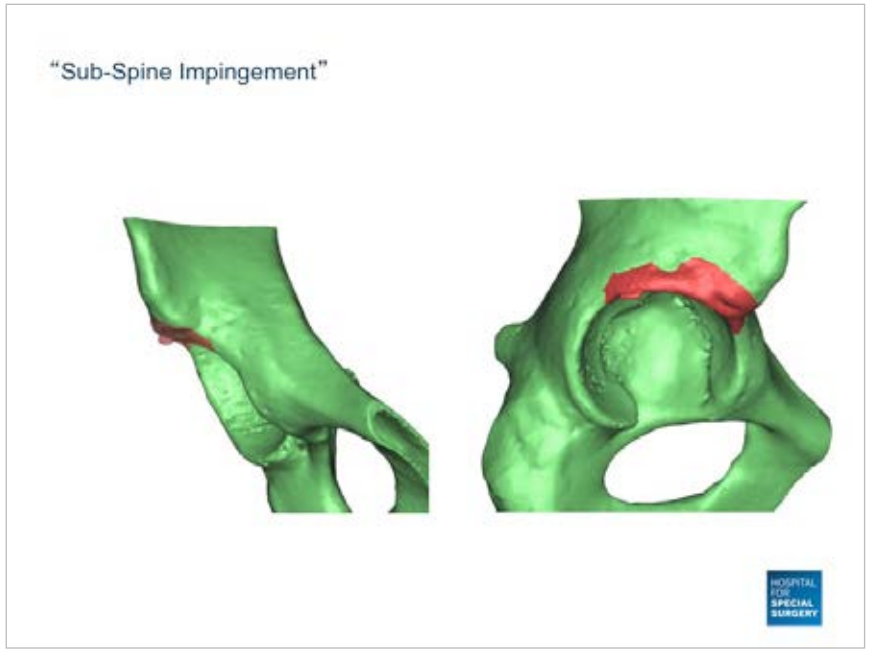


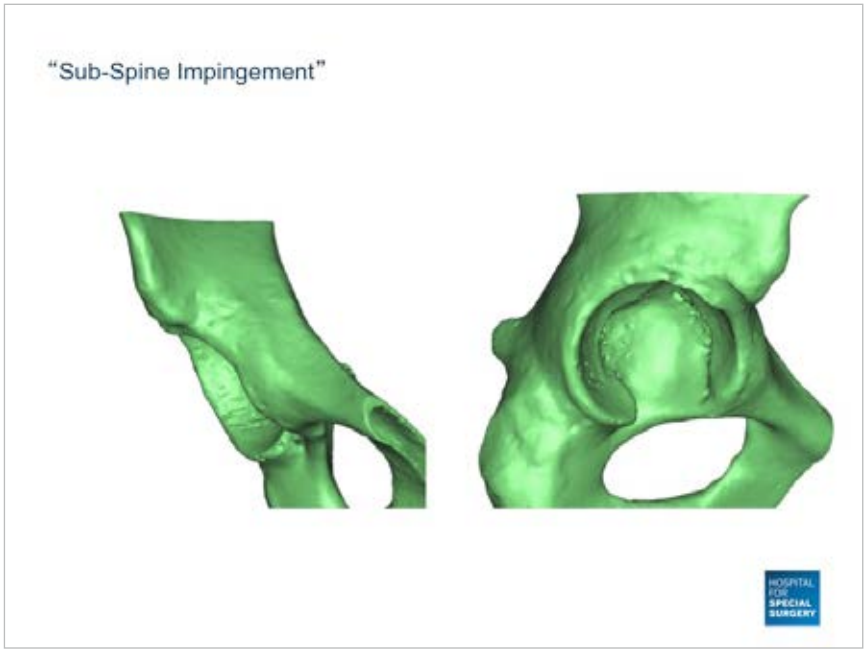
- Radiographic indices represent poor two-dimensional interpretations of complex anatomy
  - **Acetabular orientation & morphology** poorly reflected by various indices including acetabular index , Tonnis angle, crossover and posterior wall signs



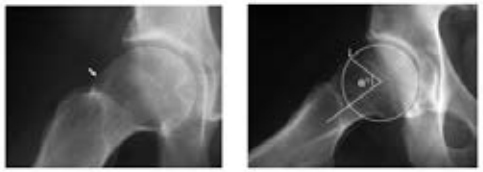

Hip #1
13°
15°
22°
Where is the Pincer Lesion?
12 o'clock to 1 o'clock


Hip #2
Where is the Pincer Lesion?
12 o'clock to 3 o'clock


"Sub-Spine Impingement"

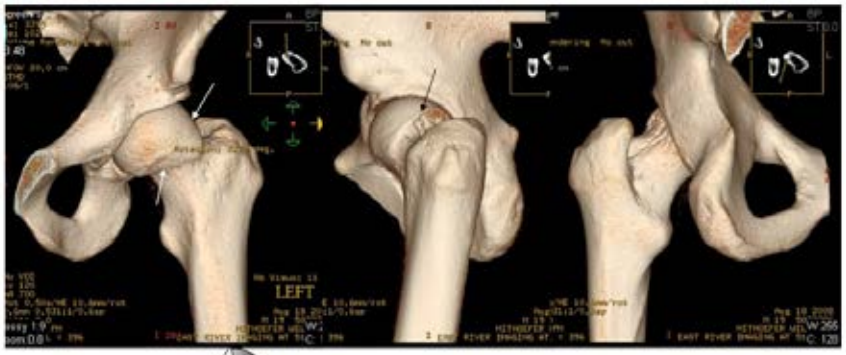

"Sub-Spine Impingement"

- Radiographic indices represent poor two-dimensional interpretations of complex anatomy
  - **Sphericity of femoral head** poorly reflected by Alpha angle, which indicates only one point
    - Does not reflect morphology of proximal femoral anatomy



What is the alpha angle?
Where is the Cam Lesion?
What are the associated deformities?

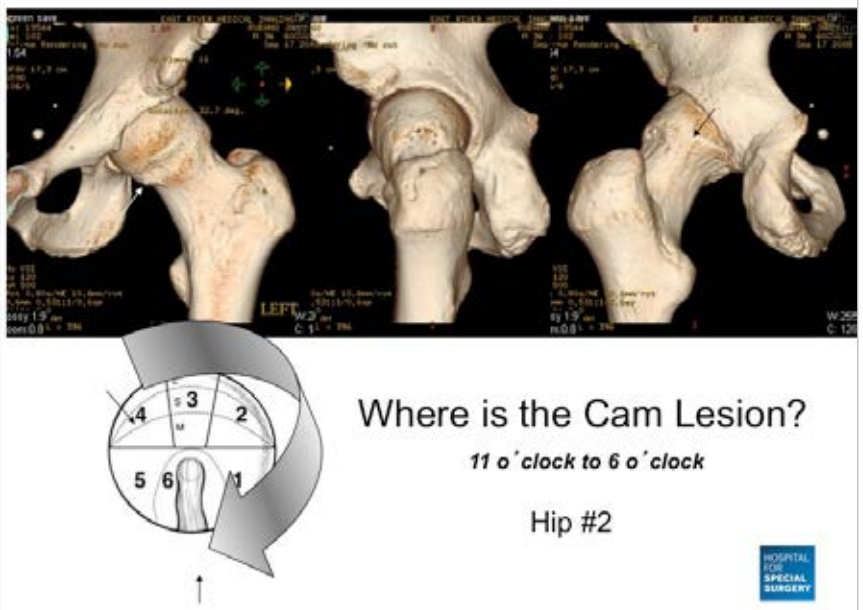




Where is the Cam Lesion?

1 o´clock to 4 o´clock

Hip #1



Where is the Cam Lesion?

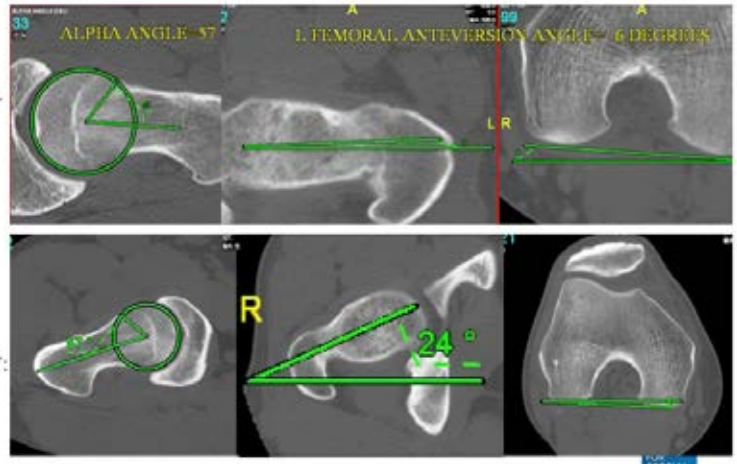
11 o´clock to 6 o´clock

Hip #2

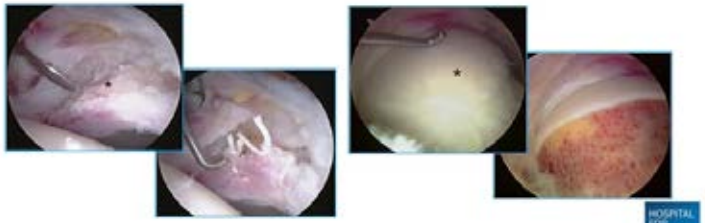
Other Mechanical Factors

Hip #1:
Alpha: 57°
AV: -6°

Hip #2:
Alpha: 57°
AV: 21°



- Not everyone needs the same anatomy or correction
  - When can you just correct pincer or cam and when must both be addressed?
  - How much correction?



- Not everyone needs the same anatomy or correction
  - No standard anatomic form to be recreated with arthroscopic intervention
  - Correction titrated to specific demands of individual's joint

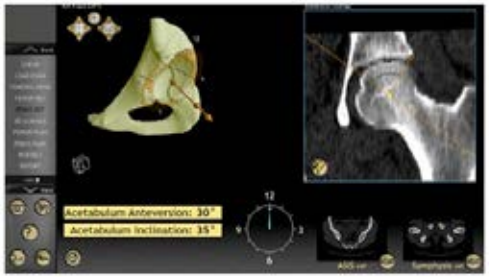




Is there a role for computer navigation and modeling?

- CT-based, computer modeling can localize regions of anticipated mechanical impingement in symptomatic patients with hip pain.
  - **Complex mechanics hard to predict critical lesions of impingement**
  - **What correction is kinematically important?**
- Computer modeling can guide resection to optimize improvement in hip kinematics and ROM
  - **Avoid typical under-resection**
  - **Avoid overzealous resection → iatrogenic dysplasia**

Computer Software System





Three-dimensional virtual simulation and evaluation of the femoroacetabular impingement based on "black bone" MRA

Florian Radetzki · B. Saul · A. Hagel · T. Mendel · T. Döring · K. S. Delank · D. Wohlrab · D. Stoevesandt

Arch Orthop Trauma Surg, 2015

- **Magnetic resonance arthrography (MRA) is used to virtually verify the range of motion (ROM) of the hip. It enables the evaluation of FAI and the preoperative simulation of adequate surgical manoeuvres.**
- Each MRI was completed on a 3.0 T system using a flexible transmit/receive surface body coil with the patient in the supine position. The virtual colliding regions were visualised for verification and simulation of osseous trimming.
- Information about damage to the cartilage and labrum, "black bone" MRA was used to generate extremely precise 3D reconstructions of the hip joint to automatically calculate the preoperative osseous ROM. Furthermore, the acetabular and femoral locations of the impingement zone were individually visualised and quantified.
- The described procedure is a useful tool for the preoperative investigation of impinging hips. It enables appropriate planning of required surgical interventions.

Pros, Cons, and Future Possibilities for Use of Computer Navigation in Hip Arthroscopy

Eric P. Tannenbaum, MD, James R. Ross, MD, and Asheesh Bedi, MD

Sports Medicine Arthroscopy Review, 2014

- **Although these technologies have shown potential for increasing surgical precision in treating femoroacetabular impingement, they are not without limitations, including an inability to factor in soft-tissue structures and an incompatibility with dysplastic and arthritic hips.** Future studies must be conducted to determine whether these systems result in improved clinical outcomes.



Pros, Cons, and Future Possibilities for Use of Computer Navigation in Hip Arthroscopy

Eric P. Tannenbaum, MD, James R. Ross, MD, and Asheesh Bedi, MD

Sports Medicine Arthroscopy Review, 2014

TABLE 1. Pearls of Computer-assisted Hip Arthroscopy

Five fundamental benefits outlined by Specht and Koval[52]
Geometric precision of size and location of bony pathoanatomy
Reproducibility
Perfect "memory"
Lack of fatigue
Insensitivity to radiation
Provides a 3D dynamic model to plan for accurate surgical resection
Potential for improved intraoperative visualization
Potential for decreased intraoperative time

TABLE 2. Pitfalls of Computer-assisted Hip Arthroscopy

No proof of improved clinical outcomes
Expensive costs associated with the computer navigation systems
Steep learning curve
Inability of computer systems to factor in concurrent soft-tissue pathology
Limited to only concentric hips (cannot use in dysplastic hips)

Three-dimensional Imaging and Computer Navigation in Planning for Hip Preservation Surgery

Andrew W. Kuhn, BA, James R. Ross, MD,† and Asheesh Bedi, MD**

Sports Medicine Arthroscopy Review, 2014

- Hip arthroscopy is technically demanding, requiring a steep and slow learning curve.14,15
- Visualization and awareness of spatial orientation is difficult when navigating the hip joint due to its depth in the body, surrounding anatomic and neurovascular structures, and regional viewing through multiple arthroscopic portals.
- **Poor visualization of the hip could potentially lead to complications due to inadequate or excessive recontouring of the impeding bony morphology. Patients with FAI have a complex 3-dimensional (3D) anatomy within the hip joint.**
- Traditionally, surgeons have relied on 2-dimensional (2D) imaging to preoperatively assess the offending lesion and hip joint, before evaluating the dynamic impingement arthroscopically or by means of intraoperative fluoroscopy.

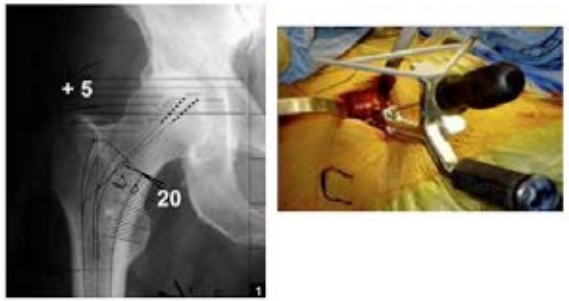
Residual Deformity Is the Most Common Reason for Revision Hip Arthroscopy: A Three-dimensional CT Study

James R. Ross MD, Christopher M. Larson MD, Olusanjo Adeoyo MD, Bryan T. Kelly MD, Asheesh Bedi MD

CORR, 2015

- The purposes of this study were to (1) define the three-dimensional (3-D) morphology of hips with residual symptoms before revision femoroacetabular impingement (FAI) surgery; (2) determine the limitation in range of motion (ROM) in these patients using dynamic, computer-assisted, 3-D analysis; and (3) compare these measures with a cohort of patients who underwent suc- cessful arthroscopic surgery for FAI by a high-volume hip arthroscopist.
- **Conclusions: We found marked radiographic evidence of incomplete correction of deformity in patients with residual symptoms compared with patients with successful results with residual deformity present in the large majority of patients (45 of 50 [90%]) undergoing residual FAI surgery. We recommend careful attention to full 3-D resection of impinging structures.**

- The most challenging questions remain when, what, where and how much correction to be performed



- The most challenging questions remain when, what, where and how much correction to be performed
  - Software planning is the Template for surgical correction in the hip that will answer this questions
  - Computer navigation becomes a simple technical/ technological exercise (intraoperative Jigs) to accomplish the solution determined by the Planning



Thank You

HOSPITAL FOR SPECIAL SURGERY