Washington State Health Care Authority

Safety and Efficacy of Femoroacetabular Impingement Syndrome Procedures

Assessing signals for update

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Safety and Efficacy of Femoroacetabular Impingement Syndrome Procedures: Assessing Signals for Update

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Previous Coverage Decision

A Health Technology Assessment titled: ***Hip Surgery Procedures for Treatment of Femoroacetabular Impingement Syndrome***, was originally released on August 26, 2011 by the Health Technology Clinical Committee. The Committee's Coverage Decision is summarized below.

Health Technology Background

The Hip Surgery for Femoroacetabular Impingement Syndrome (FAI) was selected and published in December 2010 to undergo an evidence review process. The evidence based technology assessment report indicates that FAI syndrome is a recently recognized diagnosis in primarily younger individuals where relatively minor abnormalities in the joint (orientation or morphology) are thought to cause friction/impingement and pain. It is theorized that FAI starts the breakdown of cartilage, leading to osteoarthritis. There are two types of FAI: cam impingement (nonspherical femoral head or abnormality at the head-neck junction) and pincer impingement (deep or retroverted acetabulum resulting in over coverage of the femoral head). Proponents believe that surgical correction of the impinging deformities will alleviate the symptoms and retard the progression of OA degeneration.

Hip surgery is an invasive procedure to correct FAI using either an open surgery or arthroscopic approach. The surgeon cuts off abnormal outgrowths of bone, removes damaged cartilage, and reshapes the femoral neck to ensure that there is sufficient clearance between the rim of the joint socket and the neck of the femur. Labral debridement and labral repair are surgical treatment options for treating damaged labral tissue when addressing FAI. After corrective surgery, avoidance of weight bearing for several weeks to months and rehabilitation is required. Surgery to correct FAI includes arthroscopy, open dislocation of the hip and arthroscopy combined with a mini-open approach. The purpose of the surgery is to remove abnormal outgrowths of bone and damaged cartilage, and to reshape the femoral neck to ensure that there is sufficient clearance between the rim of the acetabulum and the neck of the femur.

Health Technology Clinical Committee's Findings and Coverage Decision

Topic: Hip Surgery for Femoroacetabular Impingement Syndrome (FAI)

Meeting Date: September 16th, 2011

Final Adoption: November 18th, 2011

HTCC Coverage Determination

Hip Surgery for Femoroacetabular Impingement Syndrome (FAI) is **not** a covered benefit

1. Purpose of Report

The purpose of this literature update is to determine whether or not there is sufficient evidence published after the original report to conduct a re-review of this technology. The key questions included the following:

Key question 1
Is there a consistent or agreed upon case definition for FAI? What is the evidence of reliability and validity of these case definitions?

Key question 2
What are the expected treatment outcomes of hip surgery for FAI? Are there validated instruments related to hip surgery outcomes? Has clinically meaningful improvement in outcomes been defined for FAI?

Key question 3
What is the evidence of efficacy and effectiveness of hip surgery (open or arthroscopic) compared with no surgery for FAI?

Key question 4
What is the evidence of the safety of hip surgery for FAI compared with no surgery?

Key question 5
What is the evidence that hip surgery for FAI compared with no surgery has differential efficacy or safety issues in sub populations?

Key question 6
What evidence of cost implications and cost-effectiveness of hip surgery compared with no surgery exists for FAI?

2. Methods

2.1 Literature Searches

We conducted an electronic literature search for the period June 1, 2011 through November 30, 2014 using the identical search strategy used for the original report. This search included four main databases: PubMed, Medline, Cochrane Library, and EMBASE. Appendix A includes the search methodology for this topic.

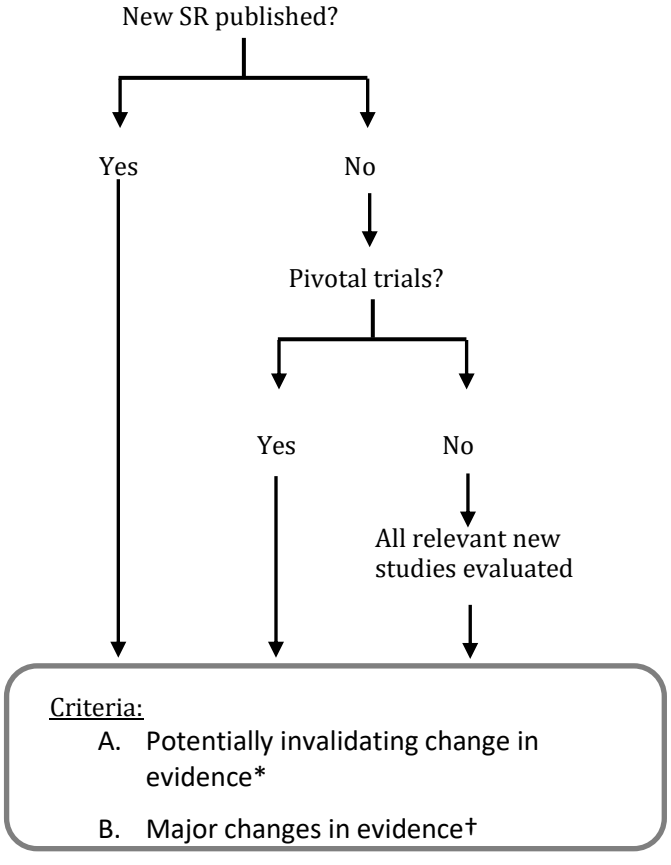
2.2 Study selection

In general, we used the same inclusion and exclusion criteria as the original HTA.

2.3 Compilation of Findings and Conclusions

For this assessment we constructed a summary table that included the key questions, the original conclusions, new sources of evidence, new findings, and conclusions based on available signals. To assess whether the conclusions might need updating, we used an algorithm based on a modification of the Ottawa method, Figure 1.

Figure 1. Algorithm of the modified Ottawa Method of Identifying Signals for SR Updates



*A-1. Opposing findings: Pivotal trial or SR including at least one new trial that characterized the treatment in terms opposite to those used earlier

A-2. Substantial harm: Pivotal trial or SR whose results called into question the use of the treatment based on evidence of harm or that did not proscribe use entirely but did potentially affect clinical decision making

A-3. Superior new treatment: Pivotal trial or SR whose results identified another treatment as significantly superior to the one evaluated in the original review, based on efficacy or harm.

†B-1. Important changes in effectiveness short of "opposing findings"

B-2. Clinically important expansion of treatment

B-3. Clinically important caveat

B-4. Opposing findings from discordant meta-analysis or nonpivotal trial

3. Results

3.1 Search

We identified 13 systematic reviews that addressed in part or in full key questions 1 through 5, Figure 2. There were no systematic reviews of cost-effectiveness (key question 6). We did identify 3 new cost-effectiveness studies that were included.

3.2 Identifying signals for re-review

Table 1 shows the original key questions, the conclusions of the original report, the new sources of evidence, the new findings, and the recommendations of Spectrum Research, Inc. (SRI) regarding the need for update.

Figure 2. Flow chart showing results of literature search (KQ: Key Question)

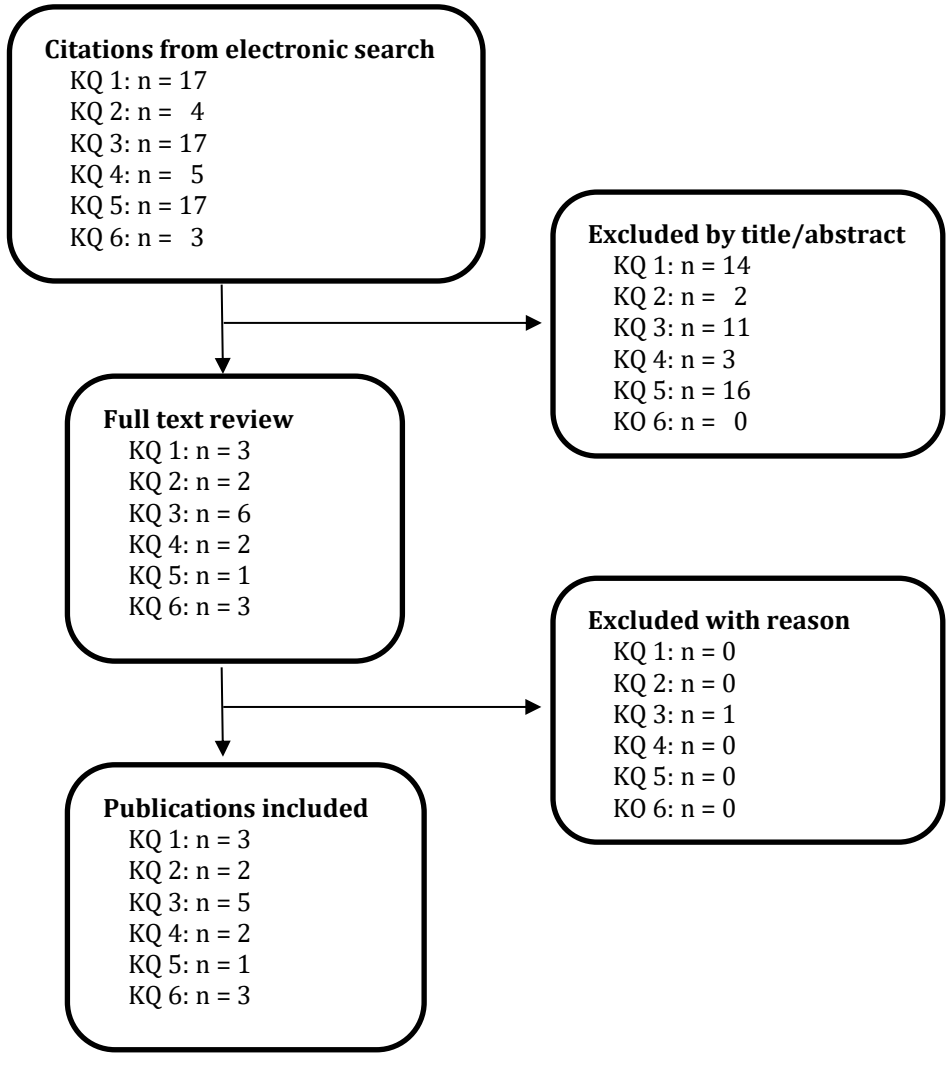


Table 1. FAI Summary Table

Key Question 1. Is there a consistent or agreed upon case definition for FAI? What is the evidence of reliability and validity of these case definitions?			
Conclusions from CER Executive Summary	**New Sources of Evidence**	**New Findings**	**Conclusion from SRI**
<u>Case definition</u> • The most consistent case definition of FAI (cam or mixed) as defined by inclusion/exclusion criteria in prospective studies of treatment effectiveness includes hip/groin pain, positive clinical impingement test, and an α-angle >50-55º • There is no evidence that the diagnosis of FAI can be obtained from clinical exam in one small study. One clinical test, the impingement sign, had a positive and negative predictive value of 86% and 79% in one study where the prevalence of FAI was 50%; however, in another study, the reliability of the impingement sign was only moderate. • Even though the α-angle showed moderate to high interobserver reliability in several studies, it had poor diagnostic value in identifying FAI. Other imaging tests assessing abnormalities of the femur and acetabulum had variable degrees of reliability, but no others were tested for diagnostic validity.	3 systematic reviews: (1) Tijssen et al. (2012)[1] (2) Ayeni et al. (2012)[2] (3) Ayeni et al. (2013)[3]	<u>Case definition</u> • A systematic review (Tijssen) of 21 studies evaluated 18 different physical tests for diagnostic accuracy and validity. Sensitivity and specificity for these diagnostic tests varied widely depending on the test and the reference standard used. The authors concluded that there is a wide range of physical diagnostic test that have been described. However, the quality of the studies is too low to provide conclusive recommendations for the clinician. • Two systematic reviews (Ayeni 2012, 2013) report a lack of consensus on clinical and radiographic indications for open or arthroscopic management of FAI	This section of the report is still valid and does not need updating.

Key Question 2: What are the expected treatment outcomes of hip surgery for FAI?			
Conclusions from CER Executive Summary	**New Sources of Evidence**	**New Findings**	**Conclusion from SRI**
Patient- and clinician reported outcomes • Seven hip outcomes measures were used commonly in FAI patients. Three have undergone psychometric analysis in FAI (HOS-D, M-WOMAC) or young hip-pain (HOS, NAHS) patient populations. • Only one, the Non-arthritic Hip Score (NAHS), of the three instruments was adequately tested for validity, and it was performed in a young hip-pain patient population. • Reliability was inadequately tested for all three instruments. • The MCID was defined to be 9 points for the ADL subscale and 6 points for the sports subscale of the HOS-D in FAI patients. The MCID has not been defined for any other outcome measures in FAI or young hip-pain patients.	2 systematic reviews: (1) Hetaimish et al. (2013)[4] (2) Harris-Hayes et al. (2013)[5]	Patient- and clinician reported outcomes • One systematic review (Hetaimish) evaluated 29 studies (2,816 patients) for consistency of reporting clinical and radiographic outcomes after arthroscopic management of FAI. With respect to clinician based outcomes, the Harris Hip Score and Non-arthritic Hips Scale were used the most frequently (45% and 28%, respectively). The authors concluded that there was significant variation in clinical outcomes after arthroscopic treatment of FAI. • One systematic review (Harris-Hayes) evaluated disease-specific patient reported outcomes in which content validity was ensured through input from patients of similar age, sex and activity level as those with FAI. They identified three outcomes, two which are new since the original report was written: – Copenhagen Hip and Groin Outcome Score (HAGOS) (new). – 33-item International Hip Outcome tool (iHOT-33) (new) – Non-arthritic Hip Score (NAHS in previous report) The authors conclude no conclusive evidence to support a single questionnaire for use in all patients with FAI, and that further investigation is needed into	This section of the report is still valid. However, there are at least two new outcomes that have been developed since the original report that may become more frequent in future studies of FAI.

		their psychometric properties. Although all three have subscales, only the HAGOS and the NAHS have been validated for use as separate subscales.	
Key Question 3: What is the evidence of efficacy and effectiveness of hip surgery compared with no surgery for FAI?			
Conclusions from CER Executive Summary	**New Sources of Evidence**	**New Findings**	**Conclusion from SRI**
Efficacy • There are no data available to assess the short- or long-term efficacy of FAI surgery compared with no surgery	1 systematic review: (1) Wall et al. (2013)[6]	Efficacy • One systematic review (Wall), found no randomized or quasi-randomized controlled trials assessing surgical intervention compared with placebo treatment, non-operative treatment or no treatment in adults with FAI.	This section of the report is still valid and does not need updating.
Effectiveness (short term) • There is no evidence that one specific treatment resulted in better outcomes than another (surgery versus no surgery, labral debridement versus refixation, osteoplasty versus no osteoplasty). • Several case series report improvement in pain, patient reported and clinician reported hip outcome scores, patient satisfaction and return to normal activities following FAI surgery. However, whether this improvement is a result of the surgery, or the postoperative rehabilitation, or the change in activity subsequent to the surgery or placebo is not known. • Approximately 8% of patients diagnosed with FAI who undergo surgery in published	3 systematic reviews: (1) Ayeni et al. (2014)[7] (2) Tibor et al. (2012)[8] (3) Harris et al. (2013)[9]	Effectiveness (short term) • Two systematic reviews compared labral debridement to labral repair in FAI patients (Ayeni, Tibor). Ayeni et al. was more inclusive. Their review included 1 RCT and 5 non-randomized comparative studies. Three of the six studies (all done through arthroscopy) included the Modified Harris Hip Score (MHHS). Pooled analysis suggests that patients with labral repair have a slightly better MHHS compared with labral debridement. There was no meaningful difference in pain between labral repair and debridement in one study. Merle d'Aubigne scores were slightly better in the group with labral repair in another study. Overall level of evidence for these conclusions was LOW using GRADE as the evaluation tool. • We did not find studies comparing osteochondroplasty versus no osteochondroplasty in FAI patients receiving labral repair or debridement.	Though there is a suggestion that labral fixation may have slightly better MHHS scores than debridement, other outcomes have mixed results. This section of the report is still valid and does not need updating.

series go on to have a total hip arthroplasty within 3 years.		• One systematic review (Harris) combined 29 studies (83% case-series) to compare various forms of FAI treatment. They concluded surgery was better than non-operative care, with no consistent significant differences exhibited between open and arthroscopic techniques. They found mixed results with respect to labral repair versus debridement using a variety of outcomes.	
Key Question 3: What is the evidence of efficacy and effectiveness of hip surgery compared with no surgery for FAI? (continued)			
Conclusions from CER Executive Summary	**New Sources of Evidence**	**New Findings**	**Conclusion from SRI**
<u>Effectiveness (long term)</u> • There are no data available to assess long-term effectiveness of FAI surgery compared with no surgery. • There are no data yet published to test the hypothesis that FAI surgery prevents or delays hip osteoarthritis or the need for total hip arthroplasty.	1 systematic review: (1) Collins et al. (2014)[10]	<u>Effectiveness (long term)</u> • There are no data available to assess long-term effectiveness of FAI surgery compared with no surgery. • One systematic review assessed if prophylactic surgery for asymptomatic patients with radiographic evidence of FAI prevented early degenerative joint disease of the hip. No trials were identified that directly answered this question through 2013.	This section of the report is still valid and does not need updating.
Key Question 4: What is the evidence of the safety of hip surgery for FAI compared with no surgery?			
<u>Safety</u> • The risk of reoperation (other than conversion to THA) occurred in 4% (arthroscopy and open dislocation) and 9% of the patients (mini-open). • There was only one reported head-neck fracture (0.1%) and no reports of AVN, osteonecrosis or trochanteric nonunion.	2 systematic reviews: (1) Harris et al. (2013)[9] (2) Ayeni et al. (2014)[7]	<u>Safety</u> • In one systematic review of mostly case-series (Harris), the risk of reoperation (other than conversion to THA) occurred in 3% (arthroscopy), 41% (open dislocation) and 10% (mini-open) of patients. In a second systematic review (Ayeni), reoperation occurred in 3.1% of those receiving arthroscopy (debridement or repair).	This section of the report is still valid and does not need updating.

• Heterotopic ossification occurred in 2% to 3% of those receiving arthroscopy or mini-open, and 6% in those receiving open dislocation. • Neurological complications (nerve palsy, paresthesia, and neuropraxia) were rare in those receiving arthroscopy or open dislocation; however, they occurred in 22% of 258 hips undergoing a mini-open procedure. Most were transient in nature.		• Heterotopic ossification occurred in 15% of patients after open dislocation, 13% mini open, 3.3% arthroscopy and mini-open and <1% arthroscopy (Harris). • Temporary nerve palsy occurred in 4.6% after arthroscopic plus mini-open, 1.7% after arthroscopy, and <1% following open dislocation and mini-open (Harris).	
Key Question 5: What is the evidence that hip surgery for FAI compared with no surgery has differential efficacy or safety issues in sub populations?			
Conclusions from CER Executive Summary	**New Sources of Evidence**	**New Findings**	**Conclusion from SRI**
<u>Differential efficacy, effectiveness or safety</u> • We found no studies comparing the differential efficacy, effectiveness or safety of surgery versus nonsurgical care in FAI patients. • Outcomes following FAI surgery were consistently worse in patients with greater preoperative osteoarthritis compared with those with less osteoarthritis. • There was no reported difference in outcomes in patients with varying degrees of chondral damage assessed during surgery. • No data from other subpopulations were found.	1 systematic review: de Sa et al. (2014)[11]	<u>Differential efficacy, effectiveness or safety</u> • We found no studies comparing the differential efficacy, effectiveness or safety of surgery versus nonsurgical care in FAI patients. • One systematic review of 8 case-series in skeletally immature patients (10-19 years) reports improvement in pain, function and satisfaction after 1 year follow-up. No major complications were reported. Among those treated by arthroscopy, 3.7% required revision arthroscopy for lysis of adhesions. Among those treated with open dislocation, 1.2% developed heterotopic ossification.	This section of the report is still valid and does not need updating.

Key Question 6: What evidence of cost implications and cost-effectiveness of hip surgery compared with no surgery exists for FAI?			
<u>Cost-effectiveness</u> There were no cost-effectiveness, cost utility or costing studies found on FAI surgery.	3 studies: (1) Clement et al. (2014)[12] (2) Shearer et al. (2011)[13] (3) Diaz-Ledezma et al. (2013)[14]	<u>Cost-effectiveness</u> • 2 studies report cost-effectiveness of arthroscopy for FAI (Clement and Shearer). Both conclude that arthroscopy in patients without hip arthritis is cost-effective given limited data available and the assumptions of each study. • 1 study conducted a decision analysis comparing the benefits, opportunities, costs, and risk of open dislocation, arthroscopy and mini-open approaches. In a young active patient seen in the outpatient clinic with persistent hip pain after failed conservative treatment in the context of cam FAI without radiographic osteoarthritis, the mini-open approach was the best alternative.	There are new data that would update this section of the report. However, the findings from these studies don't meet the criteria that would trigger an updated report.

3.3 Current ongoing clinical trials

We identified four ongoing clinical trials, Table 2. One will test whether osteochondroplasty will provide improved clinical results versus arthroscopic lavage. Three will test whether arthroscopic surgery in FAI patients will result in better clinical outcomes compared with non-operative care that includes physical therapy.

Table 2. Characteristics of current ongoing studies registered in clinical trials.gov assessing the efficacy of FAI treatment.

Study Author NCT ID Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
Ayeni NCT: 01623843 Completion: 2017	To determine whether surgical correction of hip impingement morphology via arthroscopic osteochondroplasty (shaving of bone) will provide improved clinical results (decreased pain and improved function) in adult patients with FAI compared to arthroscopic lavage (washing out of painful inflammation debris) and treating obvious damage of the hip joint.	Inclusion Criteria: 1. Adult men or women ages 18 to 50 years 2. Hip pain for greater than 6 weeks with no relief from non-operative means (physiotherapy, non-steroidal anti-inflammatory medication, rest) 3. CAM or Mixed Type FAI as diagnosed on x-rays and magnetic resonance imaging (MRI) or magnetic resonance arthrogram (MRA) 4. Temporary relief from an intra-articular hip injection 5. Informed consent from participant 6. Ability to speak, understand and read in the language of the clinical site Exclusion Criteria: 1. Previous inclusion in a study involving FAI 2. Evidence of hip dysplasia (centre edge angle less than 20) 3. Presence of advanced hip osteoarthritis (Tonnis Grade 2 or 3) 4. Previous trauma to the affected hip 5. Previous surgery on the affected hip 6. Isolated Pincer lesion 7. Immunosuppressive medication use 8. Chronic pain syndromes 9. Significant medical co-morbidities (requiring daily assistance for ADLs 10. History of paediatric hip disease (Legg-Calve-Perthes; SCFE)	Intervention: Osteochondroplasty Control: Arthroscopic Lavage	Primary: Pain (VAS) Secondary: • HRQoL (SF-12) • Function (HOS, iHOT-12) • Health utility (EQ-5D) • Sexual and urinary function (IIEF, FSFI, ICIQ- MLUTS, ICIQ-FLUTS) • Complications/AE

Study Author NCT ID Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
		11. Ongoing litigation or compensation claims secondary to hip problems 12. Any other reasons given to exclude the patient		
Glyn-Jones NCT: 01893034 Completion: 2017	To compare the effectiveness of arthroscopic surgery versus physical therapy and activity modification for the treatment of FAI.	Inclusion Criteria: 1. Adult men or women ages 18 to 60 years 2. Symptomatic patients 3. Clinical and radiological evidence of FAI 4. Competent to consent Exclusion Criteria: 1. Prior hip surgery 2. Established osteoarthritis (Kellgren-Lawrence ≥ 2) 3. Hip dysplasia (Centre-Edge angle < 20 degrees on radiograph 4. Completion of physical therapy program targeting FAI within the past year 5. Comorbidities that mean surgical intervention is not possible/safe 6. Contraindication to MRI 7. Pregnancy	Intervention: Arthroscopic surgery Control: Conservative management	Primary: • Hip Outcome Score Secondary: • Patient reported outcome measures • Morphological and physiological MRI ○ Morphological parameters ○ Measures of osteoarthrits
Naudie NCT: 01621360 Completion: 2014	To determine if patients with FAI who undergo arthroscopic hip surgery experience similar outcomes at 2 years post-operative with respect to physical function, pain, and health related quality of life, compared to similar patients who receive conservative management, including medication and physical therapy.	Inclusion Criteria: 1. Adult men or women ages 18 to 60 years 2. Patients with FAI of the hip 3. Grade 1, 2 or 3 radiographic severity of osteoarthritis as defined by the Tonnis classification scale Exclusion Criteria: 1. Identified isolated labral tear 2. Inflammatory or post-infectious arthritis 3. Previous arthroscopic treatment for hip osteoarthritis 4. Previous major hip trauma 5. Tonnis grade 4 osteoarthritis in two compartments in persons over 60 years of age 6. Patients with a major neurologic deficit, serious medical illness (life expectancy less than 2 years or high intraoperative risk) or	Intervention: Arthroscopic surgery Control: Conservative management	Primary: • Hip Outcome Score Secondary: • Non-arthritic hip score (NAHS) • Modified Harris Hip Score • SF-12 • Range of motion

Study Author NCT ID Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
		those who are unable to provide informed consent or who are deemed unlikely to comply with follow-up		
Mansell NCT: 01993615 Completion: 2016	To compare the outcomes for patients that receive two different treatments used for FAI. The programs are 1) a 6-week supervised physical therapy program and 2) arthroscopic surgery.	Inclusion Criteria: 1. Adult men or women ages 18 to 65 years 2. Tricare beneficiaries 3. Diagnosis of FAI and/or labral pathology confirmed by a combination of the following: • Pain at anterior hip or groin • Pain with hip flexion • Positive FADIR test • Patient reported relief of pain after intra-articular injection 4. Surgical candidate for hip arthroscopy defined by both: • No less than 2 mm of joint space based on imaging (CT scan, radiographs, and MR arthrogram) • Positive crossover sign and/or alpha angle >50^{o} based on imaging (CT scan, radiographs, and MR arthrogram) 5. Failed 6 weeks of conservative management Exclusion Criteria: 1. Pregnancy 2. Has other concurrent systemic disease that may affect the condition (cancer, rheumatoid arthritis, or other systemic arthralgia/arthritis) 3. Has had surgery on the same hip that will be analyzed in the study 4. Diagnosis of hip osteoarthritis is more likely 5. Clearing the lumbar spine reproduces the patient's hip symptoms	Intervention: Arthroscopic surgery Control: Physical therapy	Primary: • Hip Outcome Score • International Hip Outcome Score (iHOT33) Secondary: • Global Rating of Change (GROC) • Self-Motivation Inventory • Pain Catastrophizing Scale (PCS)

Study Author NCT ID Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
		6. Plans to move/relocate out of the local area within 6 months 7. Pending litigation for their hip condition 8. Unable to give formal consent to participate in the study		

4. Conclusions

4.1. There are several systematic reviews that include new literature on FAI since the publication of the HTA. From a review of these systematic reviews, there are no opposing findings or important changes in results for key questions 1-5. Furthermore, there continues to be no randomized controlled trials of efficacy of surgical treatment of FAI compared with non-operative treatment, or whether osteochondroplasty improves outcomes compared with no osteochondroplasty.

4.2. There are no studies to evaluate the efficacy of surgical intervention in reducing hip osteoarthritis in patients with a diagnosis of FAI.

4.3. There are a number of recent studies, mostly non-randomized studies, which compare labral repair with labral debridement in FAI patients. These studies suggest that labral repair may result in better outcome. However, the evidence base for this is low.

4.4. There are 4 ongoing randomized controlled trials in patients with FAI. Three will help to answer the question of surgical versus non-surgical treatment, and one will help to answer the question of the efficacy of osteochondroplasty. These studies are due to be completed in 2014 (n=1), 2016 (n=1) and 2017 (n=2).

4.5. Three studies on cost effectiveness of surgical intervention have been published since the original HTA. Two conclude that hip arthroscopy could be cost effective in non-arthritic patients depending on the accuracy of assumptions. One concludes that the mini-open approach may be more cost effective than open dislocation or arthroscopy. These new reports don't meet the criteria that would trigger an updated report.

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APPENDIX A. SEARCH STRATEGIES

Below is the search strategy for PubMed. Parallel strategies were used to search other electronic databases listed below. Keyword searches were conducted in the other listed resources.

Key Question 1

1.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”
2.	SENSITIVITY[TIAB] OR SPECIFICITY[TIAB] OR PREDICT*[TIAB] OR "Reproducibility of Results"[Mesh] OR RELIAB*[TI] OR VALID* OR INTERTEST* OR INTEROBSERV* OR INTRATEST* OR INTRAOBSERV* OR INTERRAT* OR INTRARAT* OR “Validation Studies" [Publication Type] OR "Reproducibility of Results"[Mesh]
3.	PROSPECTIV*
4.	#1 AND #2 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)
5.	#1 AND #3 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)

Key Question 2

6.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”
7.	"Merle d'Aubigné" OR “HARRIS HIP SCORE” OR “Western Ontario and McMaster Universities Osteoarthritis Index” OR WOMAC OR “NON ARTHRITIC HIP SCORE” OR “NONARTHRITIC HIP SCORE” OR “HIP OUTCOME SCORE” OR “OUTCOME SCORE”
8.	"Reproducibility of Results"[Mesh] OR RELIAB*[TI] OR VALID* OR INTERTEST* OR INTEROBSERV* OR INTRATEST* OR INTRAOBSERV* OR INTERRAT* OR INTRARAT*) OR “Validation Studies" [Publication Type]) OR "Reproducibility of Results"[Mesh]
9.	#6 AND #7 AND #8 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)

Key Question 3, 5

10.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”
11.	"Research Design/classification"[Mesh] OR "Research Design/epidemiology"[Mesh] OR "Research Design/methods"[Mesh] OR "Comparative Study" [Publication Type] OR "Clinical Trial" [Publication Type] OR RANDOM*[TIAB] OR "Treatment Outcome”]
12.	#10 AND #11 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)

Key Question 4

13.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”
14.	"Reoperation"[Mesh] OR "Femur Head Necrosis"[Mesh] OR "Arthroplasty, Replacement, Hip"[Mesh] OR REOPERATION REATTACHMENT OR AVN OR AVASCULAR NECROSIS OR TOTAL HIP OR TOTAL JOINT OR ARTHROPLASTY OR INFECTION* OR DEATH OR COMPLICATION* OR ADVERSE EVENT OR "Intraoperative Complications"[Mesh] OR SCIATIC* OR NERVE OR NEURO* OR FRACTURE* OR INTRAABDOM* OR CARDIAC ARREST OR THROMBO* OR EMBOL* OR INSTABILITY
15.	#13 AND #14 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)

Key Question 6

16.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”
17.	COST[TIAB] OR "Cost-Benefit Analysis"[Mesh] OR DECISION ANALYSIS [TIAB]
18.	#16 AND #17 (LIMIT ENGLISH)

Parallel strategies were used to search the Cochrane Library and others listed below. Keyword searches were conducted in the other listed resources.

Electronic Database Searches

The following databases have been searched for relevant information:

Agency for Healthcare Research and Quality (AHRQ)
Cochrane Database of Systematic Reviews (through November 2014, Issue 11)
Database of Reviews of Effectiveness (Cochrane Library) (through November 2014, Issue 11)
EMBASE (June 1, 2009 – November 30, 2014)
PubMed (June 1, 2009 – November 30, 2014)
Informational Network of Agencies for Health Technology Assessment (INAHTA)
HSTAT (Health Services/Technology Assessment Text)

APPENDIX B. SYSTEMATIC REVIEWS EXCLUDED AT FULL TEST REVIEW

Citation	Reason for exclusion
Ayeni OR, Alradwan H, de Sa D, Philippon MJ. The hip labrum reconstruction: indications and outcomes--a systematic review. *Knee Surg Sports Traumatol Arthrosc* 2014; **22(**4): 737-43.	Non comparative study

APPENDIX C. ANNOTATED BIBLIOGRAPHY

Key Question 1

- Ayeni, O. R., et al. (2013). "Surgical indications for treatment for femoroacetabular impingement with surgical hip dislocation." Knee Surg Sports Traumatol Arthrosc 21(7): 1676-1683.

PURPOSE: There is a lack of detailed information about the indications of surgical treatment for femoroacetabular impingement (FAI), particularly using open surgical dislocation. The purpose of this review was to systematically review the reported indications for surgical dislocation of the hip for FAI. METHODS: Two databases (MEDLINE and EMBASE) were screened for clinical studies involving the treatment for FAI with surgical hip dislocation. We conducted a full-text review and the references for each included paper were hand-searched for other eligible studies. Papers published until September 2011 were included in this review. Two individuals reviewed all identified studies independently, and any disagreement was resolved through consensus. RESULTS: Fifteen studies met the eligibility criteria, which included a total of 822 patients. We identified a lack of consensus for clinical and radiographic indications for surgical hip dislocation to treat FAI. The most common clinical indications reported were clinical symptoms such as hip pain in 10 papers (67 %), a positive impingement sign in 9 papers (60 %), painful/reduced range of motion in 9 papers (60 %), activity-related groin pain in 4 papers (27 %), and non-responsive to non-operative treatment in 4 papers (27 %). The most commonly reported radiographic indicators for surgical hip dislocation were a variety of impingement findings from radiographs in all 15 included papers (100 %), a combination of radiographs and MRA in 5 papers (33 %) or radiographs and MRI in 3 papers (20 %). CONCLUSIONS: These results showed that that there was an inconsistency between the clinical and radiographic indications for surgical hip dislocation as a treatment for femoroacetabular impingement. This review suggests that there is a need for the development of standardized clinical and radiological criteria that serve as guidelines for surgical treatment for FAI. LEVEL OF EVIDENCE: Systematic review, Level IV.

- Ayeni, O. R., et al. (2012). "Surgical indications for arthroscopic management of femoroacetabular impingement." Arthroscopy 28(8): 1170-1179.

PURPOSE: The clinical literature was systematically reviewed to determine the consistently reported indications for arthroscopic management of femoroacetabular impingement (FAI). METHODS: Two databases (Medline and EMBASE) were screened for clinical studies involving the arthroscopic surgical management of FAI. A full-text review of eligible studies was conducted, and the references were searched. Articles published from 1980 until June 2011 were included, and the inclusion criteria were as follows: studies of human patients of all ages and genders with FAI, studies with a minimum of 6 months of patient follow-up, and studies reporting clinical outcome data. A quality assessment of the included articles was conducted. RESULTS: We included 20 articles in this review, involving a total of 1,368 patients. We identified a lack of consensus on clinical and radiographic indications for the arthroscopic management of FAI. The indications varied from a positive impingement sign (45%) and symptoms or pain for more than 6 months (35%) to a series of positive special tests (25%). Commonly reported radiographic indicators for arthroscopic FAI management included the following: results from a computed tomography scan or magnetic resonance imaging (60%), cam or pincer lesions evident on anteroposterior and/or lateral radiographs (50%), loss of sphericity of the femoral neck (30%), acetabular retroversion (30%), magnetic resonance arthrography (25%), reduction in head-neck offset (25%), an alpha angle greater than 50 degrees (25%), and coxa profunda (25%). CONCLUSIONS: We found that there was great inconsistency

among the indications for arthroscopic management of FAI. Clinical and radiographic indices remain largely unvalidated. This review highlights the need for more consistent reporting of surgical indications for the arthroscopic management of FAI. Future research should explore what combination of clinical and radiographic indications should be best used to determine arthroscopic FAI management. LEVEL OF EVIDENCE: Level IV, systematic review of Level II to IV studies.

- Tijssen, M., et al. (2012). "Diagnostics of femoroacetabular impingement and labral pathology of the hip: a systematic review of the accuracy and validity of physical tests." Arthroscopy 28(6): 860-871.

PURPOSE: Femoroacetabular impingement (FAI) and labral pathology have been recognized as causative factors for hip pain. The clinical diagnosis is now based on MRI-A (magnetic resonance imaging-arthrogram) because the physical diagnostic tests available are diverse and information on diagnostic accuracy and validity is lacking. The purpose of this systematic review was to identify the diagnostic accuracy and validity of physical tests that are used to assess FAI and labral pathology of the hip joint. METHODS: We performed a computerized literature search using PubMed, Medline, Web of Science, PEDro, the Cochrane Library, and CINAHL (Cumulative Index to Nursing and Allied Health Literature) (through EBSCO). Studies describing tests and diagnostic accuracy studies were included. All included studies were assessed by the Levels of Evidence for Primary Research Questions list. All diagnostic accuracy studies were assessed by the QUADAS (Quality Assessment of Diagnostic Accuracy Studies) score. RESULTS: We included 21 studies in which 18 different tests were described. For 11 of these tests, diagnostic accuracy figures were presented. Sensitivity was examined for all tests. Other diagnostic accuracy figures were often lacking, and when available, these were low. All articles describing tests had Level IV or V evidence. All diagnostic accuracy studies, except 1, had Level II or III evidence. Three articles had a good QUADAS score. CONCLUSIONS: In previous studies a wide range of physical diagnostic tests have been described. Little is known about the diagnostic accuracy and validity of these tests, and if available, these figures were low. The quality of the studies investigating these tests is too low to provide a conclusive recommendation for the clinician. Thus, currently, no physical tests are available that can reliably confirm or discard the diagnoses of FAI and/or labral pathology of the hip in clinical practice. LEVEL OF EVIDENCE: Level III, systematic review of Level III studies.

Key Question #2

- Harris-Hayes, M., et al. (2013). "Clinical outcomes assessment in clinical trials to assess treatment of femoroacetabular impingement: use of patient-reported outcome measures." J Am Acad Orthop Surg 21 Suppl 1: S39-46.

Patient-reported outcome measures are an important component of outcomes assessment in clinical trials to assess the treatment of femoroacetabular impingement (FAI). This review of disease-specific measures and instruments used to assess the generic quality of life and physical activity levels of patients with FAI found no conclusive evidence to support a single disease-specific questionnaire. Using a systematic review of study methodology, the Copenhagen Hip and Groin Outcome Score and the 33-item International Hip Outcome Tool scored the best. Nevertheless, both of these instruments were developed recently and have not been established in the literature. Although currently used generic and activity-level measures have limitations, as well, they should be considered, depending on the specific goals of the study. Additional research is needed to assess the properties of these measures fully when used to evaluate patients with FAI.

- Hetaimish, B. M., et al. (2013). "Consistency of reported outcomes after arthroscopic management of femoroacetabular impingement." Arthroscopy 29(4): 780-787.

PURPOSE: The purpose of this systematic review is to evaluate the consistency of the reporting of clinical and radiographic outcomes after arthroscopic management of femoroacetabular impingement (FAI). METHODS: Two databases (Medline and EMBASE) were screened for clinical studies involving the arthroscopic management of FAI. A full-text review of eligible studies was conducted, and the references were searched. Inclusion and exclusion criteria were applied to the searched studies, and a quality assessment was completed for included studies. RESULTS: We identified 29 eligible studies involving 2,816 patients. There was a lack of consensus with regard to reported outcomes (clinical and radiographic) after arthroscopic treatment of FAI. Clinical outcomes reported include the Harris Hip Score (45%) and the Non-Arthritic Hip Scale (28%), range of motion (34%), pain scores (24%), and patient satisfaction (28%). The most commonly reported radiographic outcomes included the alpha angle (38%), head-neck offset (14%), and degenerative changes (21%). CONCLUSIONS: There is significant variation in reported clinical and radiographic outcomes after arthroscopic treatment of FAI. This study highlights the need for consistent outcome reporting after arthroscopic FAI surgery. LEVEL OF EVIDENCE: Level IV, systematic review of Level II, III, and IV studies.

Key Question #3-4

- Wall, P. D., et al. (2014). "Surgery for treating hip impingement (femoroacetabular impingement)." Cochrane Database Syst Rev 9: CD010796.

BACKGROUND: Surgery is sometimes recommended for femoroacetabular impingement where non-operative interventions have failed. OBJECTIVES: To determine the benefits and safety of surgery for femoroacetabular impingement. SEARCH METHODS: We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (2013, Issue 11); MEDLINE (Ovid) (1946 to 19 November 2013); and EMBASE (Ovid) (1980 to 19 November 2013) for studies, unrestricted by language. SELECTION CRITERIA: Randomised and quasi-randomised clinical trials assessing surgical intervention compared with placebo treatment, non-operative treatment or no treatment in adults with femoroacetabular impingement. DATA COLLECTION AND ANALYSIS: Two authors independently selected trials for inclusion, assessed risk of bias and extracted data. MAIN RESULTS: There were no studies that met the inclusion criteria, with 11 studies that were excluded following detailed review. There were four ongoing studies identified that may meet the inclusion criteria when they are completed; the results from these ongoing studies may begin to become available within the next five years. Three of the four ongoing studies are comparing hip arthroscopy versus non-operative care. The fourth study is comparing hip arthroscopy versus a sham arthroscopic hip procedure. All of the ongoing studies are recording at least one of our preferred clinical outcome measures for benefit and safety. AUTHORS' CONCLUSIONS: There is no high quality evidence examining the effectiveness of surgery for femoroacetabular impingement. There are four ongoing studies, which may provide evidence for the benefit and safety of this type of surgery in the future.

- Ayeni, O. R., et al. (2014). "Surgical management of labral tears during femoroacetabular impingement surgery: a systematic review." Knee Surg Sports Traumatol Arthrosc 22(4): 756-762.

PURPOSE: This systematic review explored reported outcomes addressing femoroacetabular impingement (FAI), specifically those comparing labral debridement to labral repair. In addition, the quality of the evidence was evaluated for the purposes of making treatment recommendations. METHODS: Three databases (MEDLINE, EMBASE, and PubMed) were searched for comparative studies involving labral repair

and debridement during FAI surgery. Two reviewers conducted a title, abstract, and full-text review of eligible studies and the references of these studies. Inclusion and exclusion criteria were applied to the searched studies, data were extracted, and a quality assessment was completed for included studies. RESULTS: Six eligible studies involving 490 patients were identified. The most commonly reported outcome measure was the modified Harris hip score (MHHS) (50 %). All studies reported that labral repair had greater postoperative improvements in functional scores (modified Harris hip, non-arthritic hip, hip outcome, and Merle d'Aubigne scores) compared to labral debridement. Five studies reported statistically significant improvements with labral repair. MHHS were pooled to demonstrate a clinically important difference in favor of labral repair by 7.4 points in three studies. The mean individual study quality can be considered fair. However, the overall quality of the body of evidence in this review is rated as low according to GRADE guidelines. CONCLUSIONS: This review demonstrates a reporting of better clinical outcomes with labral repair compared to labral debridement in all studies with five of six studies reporting statistically significant improvements (of repair over debridement). However, given the lack of high quality evidence and associated limitations in study design, these results should be interpreted with caution. Consequently, definitive treatment recommendations require further investigation with well-conducted clinical trials. This systematic review enables the discussion of best evidence practice for the surgical managing of a labral tear associated with FAI. LEVEL OF EVIDENCE: III.

- Tibor, L. M. and M. Leunig (2012). "Labral Resection or Preservation During FAI Treatment? A Systematic Review." HSS J 8(3): 225-229.

BACKGROUND: Open and arthroscopic treatment of femoroacetabular impingement and resultant labral pathology has increased significantly over the past decade. Although the functional importance of the labrum and the labral seal has been established in biomechanical studies, good clinical results have been reported for both labral debridement and labral refixation. QUESTIONS/PURPOSES: The purpose of this paper is to summarize existing literature on the surgical treatment of labral pathology to provide treatment recommendations and direct future research. A systematic review was performed with the following research question in mind: Does preservation of the hip labrum improve outcomes as compared to labral debridement for the treatment of labral pathology? METHODS: The MEDLINE database was searched for level I, II, or III articles in English or German comparing labral debridement to labral refixation. Five studies were included in the analysis. RESULTS: Good short-term results were reported for both groups. Three out of five papers report improved outcomes after labral refixation as compared to labral debridement. CONCLUSIONS: In short-term follow-up, labral refixation appears to have slightly better outcomes than labral debridement. Studies with prospectively defined cohorts and longer follow-up are, however, necessary to provide definitive recommendations for labral treatment.

- Harris, J. D., et al. (2013). "Treatment of femoroacetabular impingement: a systematic review." Curr Rev Musculoskelet Med 6(3): 207-218.

The purpose of this review is to determine if there is a difference in outcomes after: (1) nonsurgical vs surgical treatment of FAI; (2a) surgical dislocation with greater trochanteric osteotomy, (2b) anterior mini-open, (2c) arthroscopic plus mini-open, and (2d) arthroscopic surgery for FAI; (3) difference in complication and re-operation rates; and (4a) labral refixation and (4b) labral debridement for labral injuries. A systematic review of multiple databases was performed after PROSPERO registration and using PRISMA guidelines. Level I-IV evidence clinical studies with minimum 2-year follow-up were included. Data were compared using 2-sample and 2-proportion Z-test calculators. Study methodological quality was analyzed using Modified Coleman Methodology Score (MCMS). Recommendations were made using SORT (Strength Of Recommendation Taxonomy). Twenty-nine studies were included (2369 subjects; 2507 hips).

MCMS was poor. Mean subject age was 34.4+/-8.4 years and mean follow-up was 3.1+/-0.9 years. Statistically significant differences were observed following both nonsurgical and surgical treatment, with greater ($P < 0.05$) improvements following surgery (SORT B), without consistent significant differences observed between different surgical techniques (SORT C). There was a greater ($P < 0.05$) reoperation and complication rate following surgical dislocation vs mini-open and arthroscopic techniques (SORT A). Clinical outcomes were significantly better ($P < 0.05$) following labral refixation vs debridement (SORT B). Outcomes of operative treatment of femoroacetabular impingement are significantly better than nonsurgical management. Surgical treatment significantly improves outcomes, with no consistent significant differences exhibited between open and arthroscopic techniques. Open surgical dislocation has significantly greater reoperation and complication rates vs mini-open and arthroscopic techniques. Outcomes of labral refixation are significantly better than debridement in patients with labral injuries.

- Collins, J. A., et al. (2014). "Is prophylactic surgery for femoroacetabular impingement indicated? A systematic review." Am J Sports Med 42(12): 3009-3015.

BACKGROUND: This is a systematic review to determine if prophylactic surgical intervention for asymptomatic patients with radiographic evidence of femoroacetabular impingement (FAI) is warranted to prevent early degenerative joint disease of the hip. METHODS: A systematic search was performed from 1965 to 2013 in PubMed and EMBASE. Inclusion criteria were prospective or retrospective studies comparing skeletally mature asymptomatic patients with radiographic evidence of FAI treated with prophylactic hip arthroscopic surgery versus nonoperative management. A total of 840 references were identified from the searches. After detailed eligibility screening, none of the references met the eligibility criteria. RESULTS: No trials were identified that met the criteria for inclusion in the review. CONCLUSION: There is a lack of available evidence to support surgical intervention for the treatment of FAI in asymptomatic patients. This article attempts to address this dilemma by reviewing the available literature to answer several questions that would indirectly address the topic. First, what is the prevalence of FAI in the asymptomatic population? Second, what is the natural history of FAI if left untreated? Upon reviewing these issues, the authors' conclusion parallels that of the systematic review: Current evidence does not support prophylactic surgery for asymptomatic FAI in the vast majority of cases. However, limited evidence suggests that asymptomatic patients who have previously undergone total hip arthroplasty for FAI-induced osteoarthritis of the contralateral hip are at a significantly increased risk for early degenerative joint disease. Further research is needed to better clarify surgical indications.

Key Question #5

- de Sa, D., et al. (2014). "Femoroacetabular Impingement in Skeletally Immature Patients: A Systematic Review Examining Indications, Outcomes, and Complications of Open and Arthroscopic Treatment." Arthroscopy.

PURPOSE: Improvements in physical examination and radiographic appreciation of symptomatic femoroacetabular impingement (FAI) has increased the focus on early diagnosis and treatment in an adolescent population. This systematic review aimed to establish specific indications, outcomes, and complications of surgical management of adolescent FAI. METHODS: The Medline, Embase, and PubMed online databases were searched from inception until April 21, 2014, for English-language studies that addressed open and/or arthroscopic treatment of FAI in patients aged 10 to 19 years inclusively. The studies were systematically screened and data abstracted in duplicate, with qualitative findings presented. RESULTS: There were 6 eligible case series (4 with arthroscopic and 2 with open technique) and 2 conference abstracts examining 388 patients in total (435 hips), 81% of which were treated with hip

arthroscopy. Overall, patients were followed up for a mean of 23.4 months postoperatively (range, 3 to 75 months). The main indication for surgery was a confirmed diagnosis of FAI with persistent pain and impaired function refractory to nonoperative interventions (activity modification, intra-articular injections, and so on). Specific contraindications included Tonnis grade 2, 3, or 4 chondral changes and acetabular dysplasia. All studies reported significant improvements in patient pain, function (e.g., no patients were "abnormally" or "severely abnormally" impaired), and satisfaction rates (84% to 100% with arthroscopic technique v 79% with open technique). Improvements also were observed in range of motion and alpha angle correction, as well as across a variety of patient-reported functional scores, with all but 7 of 388 patients (1.8%) returning to activity/sport. No major complications were reported, with only 13 of 354 hips (3.7%) treated by arthroscopy requiring revision arthroscopy for lysis of adhesions and 1 of 81 open surgical dislocation hips (1%) having asymptomatic heterotopic ossification not requiring additional management. No cases of avascular necrosis, physeal arrest or growth disturbance, or iatrogenic deformity were reported. CONCLUSIONS: Both arthroscopic and open surgical dislocation approaches for the treatment of adolescent FAI appear to be safe and effective options for patients with persistent pain and limited function after an appropriate trial of nonoperative therapy. LEVEL OF EVIDENCE: Level IV, systematic review of Level IV studies.

Key Question #6

- Clement, N. D., et al. (2014). "Hip arthroscopy for femoroacetabular impingement: a health economic analysis." Hip Int 24(5): 457-464.

There has been a significant increase in use of hip arthroscopy for femoroacetabular impingement over the last 10 years. However, some care providers in the United Kingdom are not commissioning such an intervention due to cost constraints and lack of published cost effectiveness studies. A cost analysis for a prospective cohort of 58 patients undergoing hip arthroscopy for femoroacetabular impingement was performed. The short form 12 six dimension health utility score (SF12-6D) was used. This was recorded preoperatively and one year after surgery. Three time points (one, two, and 10 years) from operation were used to calculate the quality-adjusted-life-years (QALYs) gained. Predicted need for conversion to total hip replacement and diminishing gain with time (5% per year) was incorporated into the two- and 10-year models. The Scottish Tariff was used to assign the cost of surgery. The number of QALYs gained one year after surgery was 0.159, which equated to a cost per QALY of pound19,335. This cost decreased to pound10,118 per QALY gained at two years, and further still to pound2,677 per QALY gained at 10 years. Multivariable regression analysis found that a worse preoperative SF12-6D was an independent predictor of greater QALYs gained one year after surgery ($R(2) = 0.51$, $p<0.001$). At no point in time, from one year onwards, does hip arthroscopy for femoroacetabular impingement cost more than pound20,000 per QALY, making it a cost-effective intervention according to the National Institute for Health and Clinical Excellence.

- Diaz-Ledezma, C. and J. Parvizi (2013). "Surgical approaches for cam femoroacetabular impingement: the use of multicriteria decision analysis." Clin Orthop Relat Res 471(8): 2509-2516.

BACKGROUND: Currently, three surgical approaches are available for the treatment of cam femoroacetabular impingement (FAI), namely surgical hip dislocation (SHD), hip arthroscopy (HA), and the miniopen anterior approach of the hip (MO). Although previous systematic reviews have compared these different approaches, an overall assessment of their performance is not available. QUESTIONS/PURPOSES: We therefore executed a multidimensional structured comparison considering the benefits, opportunities, costs, and risk (BOCR) of the different approaches using multicriteria decision analysis (MCDA). METHODS:

A MCDA using analytic hierarchical process (AHP) was conducted to compare SHD, HA, and MO in terms of BOCR on the basis of available evidence, institutional experience, costs, and our understanding of pathophysiology of FAI. A preclinical decision-making model was created for cam FAI to establish the surgical approach that better accomplishes our objectives regarding the surgical treatment. A total score of an alternative's utility and sensitivity analysis was established using commercially available AHP software. RESULTS: The AHP model based on BOCR showed that MO is the best surgical approach for cam FAI (normalized score: 0.38) followed by HA (normalized score: 0.36) and SHD (normalized score: 0.25). The sensitivity analysis showed that HA would turn into the best alternative if the variable risks account for more than 61.8% of the priority during decision-making. In any other decision-making scenario, MO remains as the best alternative. CONCLUSIONS: Using a recognized method for decision-making, this study provides supportive data for the use of MO approach as our preferred surgical approach for cam FAI. The latter is predominantly derived from the lower cost of this approach. Our data may be considered a proxy performance measurement for surgical approaches in cam FAI.

- Shearer, D. W., et al. (2012). "Is hip arthroscopy cost-effective for femoroacetabular impingement?" Clin Orthop Relat Res 470(4): 1079-1089.

BACKGROUND: The impact of hip arthroscopy on health-related quality of life (HRQoL) among younger patients with symptomatic femoroacetabular impingement (FAI) is unknown, but with increasing recognition of the condition there is likely to be increasing demand for arthroscopy. QUESTIONS/PURPOSES: We describe an approach to determine the incremental cost-effectiveness of hip arthroscopy compared with observation in patients with FAI; we also identified variables that influence its cost-effectiveness. PATIENTS AND METHODS: We constructed a Markov model including possible health states for 36-year-old patients with FAI using decision analysis software and compared two strategies: (1) observation and (2) hip arthroscopy, followed by THA with disease progression. We estimated the ratio of the incremental cost to the incremental benefit (reflected by HRQoL) of both strategies. We identified studies reporting Harris hip scores and complications after arthroscopy to estimate health state preferences and their probabilities. We performed sensitivity analyses on 30 input variables over a plausible range of estimates to determine the influence of uncertainty on the ICER with particular emphasis on the magnitude and duration of benefit. RESULTS: Among patients with FAI but no radiographic evidence of arthritis, the estimated ICER of hip arthroscopy was $21,700/QALY while the ICER for patients with preoperative arthritis was $79,500/QALY. Alteration of the natural history of arthritis by hip arthroscopy improved the ICER to $19,200/QALY and resulted in cost savings if THA was not performed until at least 16 years after arthroscopy. CONCLUSIONS: Although limited by available data, our model suggests hip arthroscopy in patients with FAI without arthritis may result in a favorable ICER compared with other health interventions considered cost-effective. Further studies of hip arthroscopy are needed to determine the impact on quality of life, duration of symptomatic relief, and the effect on the need for subsequent THA.