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

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February 12, 2018

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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 Washington State Health Technology Clinical Committee. Additionally, an update signal assessment was published in December 29, 2014. The Committee's Coverage Decision for the original report is summarized below, followed by the main conclusions of the 2014 Signal Update review.

Health Technology Background

The Hip Surgery for Femoroacetabular Impingement Syndrome (FAI) topic was selected and published in December 2010 to undergo an evidence review process. The evidence based technology assessment report indicated 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 resects 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.

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.

Committee Findings
Having considered the evidence based technology assessment report and the written and oral comments, the committee identified the following key factors and health outcomes, and evidence related to those health outcomes and key factors:

(1) Evidence availability and technology features

The evidence based technology assessment report indicates:

- The evidence based technology assessment report stated that there are two types of FAI: cam impingement (non-spherical 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.
- The evidence based technology assessment report indicated that 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.
- The committee also reviewed information provided by the state agencies, and public members; and heard comments from the evidence reviewer, clinical expert, HTA program, agency medical directors and the public.

(2) Is the technology safe?

The committee discussed multiple key factors and health outcomes that were important for consideration in their overall decision on whether the technology is safe. Summary of committee considerations follows.

- The evidence based technology assessment reported that six comparative studies, 31 case-series and three case-reports were found that reported complications following surgical treatment for FAI in non- or recreational athletes. Altogether, 20 studies reported on arthroscopy, ten on open dislocation and seven on the mini-open procedure.
- The evidence based technology assessment report indicated reoperation for reasons other than a conversion to a total hip arthroplasty occurred 3.8% in patients undergoing arthroscopy, 4.4% in those receiving open dislocation and 8.7% in patients following a mini-open procedure. There was only one reported head-neck fracture (<0.1%) and no reports of AVN, osteonecrosis or trochanteric nonunion. Heterotopic ossification occurred in 2% to 3% of those receiving arthroscopy or mini-open, and 6% in those receiving open dislocation.
- The evidence based technology assessment report indicated 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. Three case-reports described an occurrence of extravasation of fluid into the abdomen/chest during arthroscopic treatment of FAI. In one case, the fluid extravasation resulted in

(3) Is the technology effective?

The committee discussed multiple key factors and health outcomes that were important for consideration in their overall decision on whether the technology is effective. Summary of committee considerations follows.

- *Hip surgery (open or arthroscopic) compared with no surgery for FAI:* The evidence based technology assessment report indicated that no randomized controlled trials (RCTs) comparing

surgery with conservative care for FAI or comparing different surgical treatments for FAI was found.

- *Hip surgery (open or arthroscopic) compared with no surgery for FAI:* The evidence based technology assessment report identified one study that retrospectively compared conservatively treated patients versus those receiving FAI surgery versus patients having a total hip arthroplasty in the short-term (<5 year follow-up). In addition, the report identified four comparative studies which investigated the effectiveness of various surgical treatments for FAI: labral debridement versus labral refixation (two studies) and osteoplasty versus no osteoplasty (two studies). The first study poorly describes the selection of patients so that it was not possible to tell how the treatment and control groups were obtained. The last four studies use historical controls. There was no evidence identified that one specific treatment resulted in better outcomes than another (surgery versus no surgery, labral debridement versus refixation, osteoplasty versus no osteoplasty).
- *Hip surgery (open or arthroscopic) compared with no surgery for FAI:* The evidence based technology assessment report identified 27 case series that reported on clinical outcomes following treatment for FAI in non- or recreational athletes. All studies report improvement in pain, patient-reported and clinician-reported hip outcomes scores, patient satisfaction and return to normal activities following FAI surgery.
- *Hip surgery (open or arthroscopic) compared with no surgery for FAI:* The evidence based technology assessment report stated that approximately 8% of patients diagnosed with FAI who undergo surgery in published series go on to have a total hip arthroplasty within 3 years. There are no long-term (≥10 years) data available to assess long-term effectiveness of FAI 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.
- *Hip surgery for FAI compared with no surgery:* The evidence based technology assessment reported six comparative studies, 31 case-series and three case-reports were found that reported complications following surgical treatment for FAI in non- or recreational athletes. Altogether, 20 studies reported on arthroscopy, ten on open dislocation and seven on the mini-open procedure.

(4) Special Populations?

- The evidence based technology assessment report indicated no studies were found comparing the differential effectiveness of surgery versus nonsurgical care in FAI patients. However, five studies were identified that looked at outcomes following surgical treatment for FAI in two subpopulations, those with varying degrees of osteoarthritis as assessed by the Tönnis grade and patients with varying degrees of chondral damage assessed during surgery.
- The evidence based technology assessment report indicated that outcomes following FAI surgery were consistently worse in patients with greater preoperative osteoarthritis compared with those with less osteoarthritis. In one study, the relative risk of a conversion to total hip arthroplasty (THA) in those with preoperative Tönnis grade 2–3 was 58 (95% CI: 8, 424) compared with Tönnis grade 0-1. There was no reported difference in outcomes in patients with varying degrees of chondral

(5) Is the technology cost-effective?

The committee discussed multiple key factors that were important for consideration in their overall decision on whether the technology has value and is cost-effective. Summary of committee considerations follows.

- The evidence based technology assessment report indicated no cost effectiveness, cost utility or costing studies were found on FAI surgery.

(6) Medicare Decision and Expert Treatment Guidelines

Committee reviewed and discussed the expert guidelines as identified and reported in the technology assessment report.

- The Centers for Medicare and Medicaid Services have no national or local coverage determinations or policies regarding the surgical treatment of FAI syndrome.
- Guidelines – a search of the core sources and relevant specialty groups identified three guidelines.
    - National Institute for Health and Clinical Excellence (NICE), 2007: The National Institute for Health and Clinical Excellence (NICE), (which provides guidance on health technologies and clinical practice for the National Health Service in England and Wales) concluded in 2007 that current evidence on the efficacy and safety of both arthroscopic surgery for the treatment of FAI syndrome "does not appear adequate for these procedures to be used without special arrangements for consent and for audit or research"; further publications of safety and efficacy outcomes will be needed. NICE stated that only surgeons with specialist expertise in arthroscopic hip surgery should perform this procedure for FAI and that the natural history of FAI syndrome and the selection of patients for this procedure are uncertain; further research on these issues will be useful.
    - National Institute for Health and Clinical Excellence (NICE), 2011: In July 2011, NICE published an updated report on arthroscopy for FAI syndrome in the form of a rapid review of the medical literature and specialist opinion. The review is based on approximately 1126 patients from three non-randomized controlled trials, five case-series, and one case-report. Several short-comings in the available literature were addressed such as overall poor study quality, limited prospective data collection in case-series, variability of outcome assessment scales used and lack of validation of these scales, heterogeneity in treatments making comparison between studies difficult, and descriptions of hip impingement pathology/lesions not well defined in all studies. The specialists' concluded that "there is no proof yet that this procedure is efficacious, but the technique may have a place in preventing the development of osteoarthritis of the hip in some patients". They also stated that use of this procedure will become more widespread, but should remain with the confines of the specialist dealing with hip disorders in young adults.
    - National Institute for Health and Clinical Excellence (NICE), 2011: NICE published an updated guidance report on open surgery for FAI in July 2011 stating that "current evidence on the efficacy of open femoroacetabular surgery for hip impingement syndrome is adequate in terms of symptom relief in the short and medium term. With regard to safety, there are well recognized complications. Therefore this procedure may be used provided that normal

arrangements are in place for clinical governance, consent and audit with local review of outcomes.

Committee Decision

Based on the deliberations of key health outcomes, the committee decided that it had the most complete information: a comprehensive and current evidence report, public comments, and agency and state utilization information. The committee concluded that the current evidence on Femoroacetabular Impingement Syndrome (FAI) demonstrates that there is insufficient evidence to cover. The committee considered all the evidence and gave greatest weight to the evidence it determined, based on objective factors, to be the most valid and reliable. Based on these findings, the committee voted to not cover Femoroacetabular Impingement Syndrome (FAI).

Conclusions of the 2014 Signals for Update Assessment - FAI

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

1. Purpose of Report

A prior update report was completed in December 2014. The purpose of this update is to determine whether or not there is sufficient evidence published subsequent to the last signal assessment to conduct a re-review of this technology. The key questions from the original report are listed below. **For this signal update, updated searches were only performed for Key Questions 3-6.**

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? Have 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 August 1, 2014 through January 11, 2018 using identical search terms used for the original report for key questions 3 through 6. This search included three main databases: PubMed/Medline, Cochrane Library, and EMBASE. Additionally, we reviewed ClinicalTrials.gov for relevant ongoing studies. Appendix A reports the search methodology for this topic.

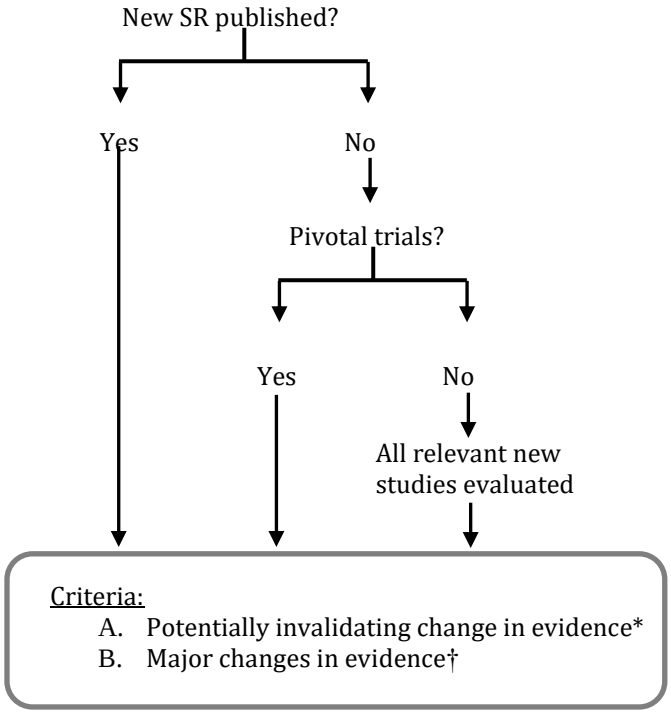
2.2 Study selection

We used the same inclusion and exclusion criteria as the original HTA and the 2014 Signal Update Review for Key Questions 3-6.

2.3 Compilation of Findings and Conclusions

For this assessment we constructed a summary table that included the key questions 3-6, the original conclusions, new sources of evidence, new findings, and new 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 Update



*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

From 121 citations returned from the updated search, 107 were excluded at title/abstract review. Of the 14 reviewed at full text, 6 systematic reviews that addressed in part or in full key questions 3 through 6, were retained (Figure 2). We identified no new cost-effectiveness studies for inclusion. A full list of excluded studies and the reasons for exclusions can be found in Appendix C.

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 Aggregate Analytics, Inc. (AAI) regarding the need for update. Table 2 shows updated information on currently ongoing trials assessing arthroscopic surgery versus non-surgical interventions. Appendix B details data abstraction and summaries for included systematic reviews and recent comparative studies. Appendix C includes a list of Systematic Reviews excluded at full-text review.

Figure 2. Flow chart showing results of literature search

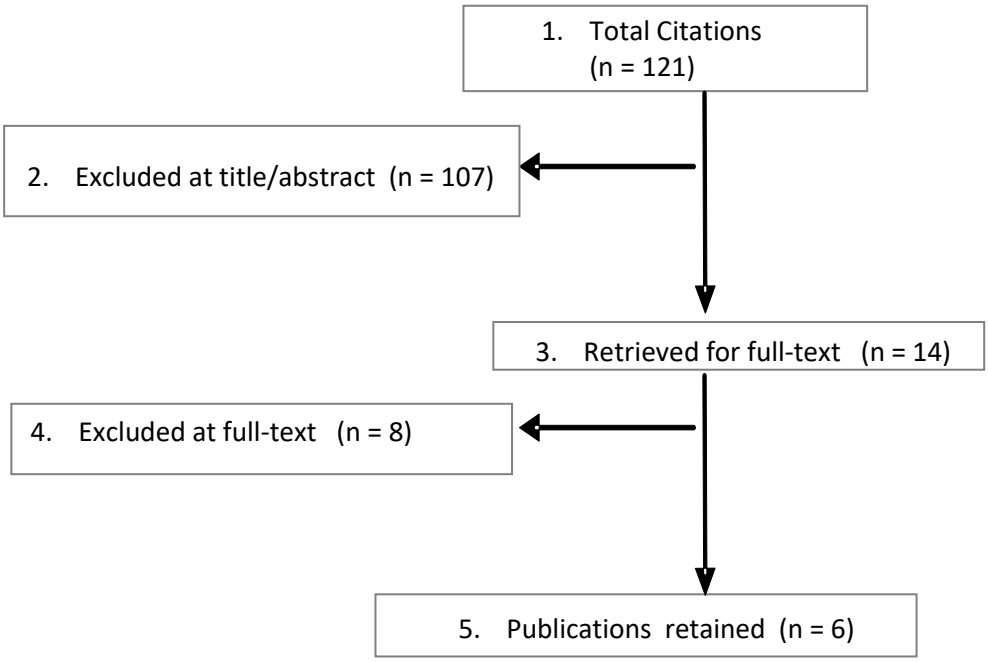


Table 1. Summary Table of Key Questions 1-6

Conclusions from CER Executive Summary	Conclusions from 2014 Signal Update	New Sources of Evidence	New Findings	Conclusion from AAI
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?				
Case definition • 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 □-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.	This section of the report is still valid and does not need updating	Not sought for 2018 update	N/A	N/A
Key Question 2: What are the expected treatment outcomes of hip surgery for FAI?				
Patient- and clinician reported outcomes • Seven hip outcomes measures were used commonly in FAI patients. Three have undergone psychometric analysis in FAI	This section of the report is still valid. However, there are at least two new outcomes that have been developed since	Not sought for 2018 update	N/A	N/A

Conclusions from CER Executive Summary	Conclusions from 2014 Signal Update	New Sources of Evidence	New Findings	Conclusion from AAI
(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.	the original report that may become more frequent in future studies of FAI.			
Key Question 3: What is the evidence of efficacy and effectiveness of hip surgery compared with no surgery for FAI?				
Efficacy • There are no data available to assess the short- or long-term efficacy of FAI surgery compared with no surgery	This section of the report is still valid and does not need updating.	**Systematic Review:** Wall 2014[5] Fairley 2016[1]	Efficacy • One Cochrane systematic review (Wall 2014) found no randomized or quasi-randomized trials that compared surgical intervention with no surgery; review did not compare surgical interventions with other surgical interventions. • Another systematic review (Fairley 2016) primarily reviewing cohort studies, found no studies comparing surgical and non-surgical treatment, and no overarching conclusions regarding the relative efficacy of one surgical approach over another were made. No quantitative analyses were provided.	This section of the report remains 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).	Though there is a suggestion that labral fixation may have slightly better MHHS scores than debridement, other outcomes have mixed	**Systematic Reviews:** Forster-Horvath 2016[2] Kierkegaard 2017[4]	Effectiveness (short-term) • There is no evidence comparing outcomes between surgery and no surgery from two systematic reviews. • One systematic review (Forster-Horvath 2016) indirectly compared surgical interventions (labral	Comparisons between surgical interventions were indirect. This section of the report remains valid and does not need updating.

Conclusions from CER Executive Summary	Conclusions from 2014 Signal Update	New Sources of Evidence	New Findings	Conclusion from AAI
• 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 series go on to have a total hip arthroplasty within 3 years.	results. This section of the report is still valid and does not need updating.		debridement/segmental resection and labral reconstruction) using evidence primarily from case series. No quantitative synthesis was reported. Authors concluded that clinical outcomes were comparable for labral debridement/segmental resection and labral reconstruction. One available comparative study reported a significantly greater mean change (improved function) in the Non-Arthritic Hip Score (P = 0.046) and Hip Outcome Score-Activities of Daily Living (P = 0.045) favoring labral reconstruction over labral debridement/ segmental resection. • One systematic review (Kierkegaard 2017) found hip pain reduction and Activities of Daily Living Function improvements between 3 and 6 months post-arthroscopic surgery, and sport function improvements between 6 and 12 months post-surgery. The overall low level of evidence (primarily case series) and lack of comparative studies indicate that further evidence is needed to determine comparative effectiveness.	
Key Question 3: What is the evidence of efficacy and effectiveness of hip surgery compared with no surgery for FAI? (continued)				
<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.	This section of the report is still valid and does not need updating.	**Systematic Review:** Kierkegaard 2017[4]	• There are no data available to assess long-term effectiveness of FAI surgery compared with no surgery. • One systematic review of primarily case series (Kierkegaard 2017) found that in hip pain reduction, and improvements in ADL function and sport function were evident at least up to 3 years after hip arthroscopy in patients with FAI, however, authors that report lower average scores after hip arthroscopy than patient's healthy counterparts indicated residual mild hip pain and/or impaired hip function during ADL and sport. The overall low level of evidence (primarily case-series) and lack of	This section of the report remains valid and does not need updating.

Conclusions from CER Executive Summary	Conclusions from 2014 Signal Update	New Sources of Evidence	New Findings	Conclusion from AAI
			comparative studies indicate that further evidence is needed to determine relative effectiveness.	
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. • 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.	This section of the report is still valid and does not need updating.	**Systematic Reviews:** Zhang 2016[6] Forster-Horvath 2016[2]	<u>Safety</u> • One systematic review (Zhang 2016) found a higher risk of reoperation (relative risk: 0.40, 95% CI: 0.17–0.95, P= 0.04) for open surgical dislocation than for hip arthroscopy across four cohort studies (n=292 hips). No statistical difference in complications between arthroscopy and open surgical dislocation was found. • One systematic review (Forster-Horvath 2016) mostly reviewing case series found an overall range of conversion to hip arthroplasty of 0% to 30% across debridement and refixation groups. Patients who underwent labral debridement/ segmental resection were not found to transition to Total Hip Arthroplasty more frequently than those who underwent labral reconstruction.	This section of the report remains valid and does not need updating.
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?				
<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.	This section of the report is still valid and does not need updating.	**Systematic Review:** Griffin 2017[3]	• We found no studies comparing the differential efficacy, effectiveness or safety of surgery versus nonsurgical care in FAI patients. • Study designs were not conducive to evaluation of differential efficacy, effectiveness or safety of surgery intervention versus another surgical interventions; only information on subpopulations was available. • One systematic review (Griffin 2017) reviewing cohort studies and case series concluded that hip arthroscopy was safe and efficacious procedure across studies among patients older than 40 who	This section of the report remains valid and does not need updating.

Conclusions from CER Executive Summary	Conclusions from 2014 Signal Update	New Sources of Evidence	New Findings	Conclusion from AAI
• 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.			did not have significant underlying degenerative changes. Authors do not report on comparative effectiveness of arthroscopy versus other treatment options. • Overall reoperation rate (excluding conversion to arthroplasty) was 2.3% (arthroscopy) among adults older than 40. This review found an overall complication rate of 5.1% (8/157) of patients across five studies (cohort studies and case series). Complications included: 1 deep venous thrombosis, 1 case of heterotopic ossification (HO), 1 superficial wound infection resolved with oral antibiotics, 1 deep wound infection, 3 cases of psoas tendinitis, and 2 cases of transient sensory neurapraxia (perineum and foot).	
Key Question 6: What evidence of cost implications and cost-effectiveness of hip surgery compared with no surgery exists for FAI?				
Cost-effectiveness There were no cost-effectiveness, cost utility or costing studies found on FAI surgery.	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.	No new sources of evidence.	• We found no additional cost-effectiveness, cost utility or costing studies that would change the conclusions of the previous signal update	This section of the report remains valid and does not need updating.

3.3 Current ongoing clinical trials

We identified one additional ongoing clinical trial registered since the 2014 signal update report, Table 2. Along with the details of the additional trial, the status of the other four trials has been updated. No analyses of the four trials were identified.

The newly identified trial will compare arthroscopic surgery with sham surgery (diagnostic arthroscopy). One previously identified trial will test whether osteochondroplasty will provide improved clinical results versus arthroscopic lavage, while the other 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
New Ongoing Trial Identified Since 2014 Report				
Risberg NCT: 02692807 Last Update: May 16, 2017 Completion: currently recruiting, completion unknown	The primary aim of this study is to determine the efficacy of hip arthroscopic surgery compared to a sham surgery (diagnostic arthroscopy only) for patients with symptomatic and radiological findings related to impingement (FAI) and/or labral tears using a randomized controlled design (HIPARTI Study: Primary aim and the main paper: primary end point: iHOT 1 year follow-up)).	Inclusion Criteria: 1. Adult men or women ages 18 to 65 years 2. hip pain during daily and/or sporting activities; 3. intra-articular hip pain with radiological signs of FAI and/or labral tears eligible for hip arthroscopy (to be determined in a pragmatic fashion by the surgeon based on clinical examination and imaging 4. the patient is able to give written informed consent and to participate fully in the interventions and follow-up procedures Exclusion Criteria: 1. pain that is not confirmed by physical examination of the hip 2. evidence of preexisting osteoarthritis, defined as Tonnis grade >1, or less than 3mm superior joint space width on AP pelvic radiograph 3. center edge angle on radiograph <25°; (v) previous known hip pathology such as Perthes' disease, slipped upper femoral epiphysis or avascular necrosis 4. previous hip injury such as acetabular fracture, hip dislocation or femoral neck fracture 5. previous hip surgery 6. medical conditions complicating surgery (ASA 3); (ix) inflammatory joint disease (RA, Bechterew etc) 7. physical inability to undertake testing procedures; expected lack of compliance such as cognitive impairment, drug abuse or similar; inability to understand the written and spoken language of the treatment centre; contra-indications to placebo surgery, which will include large loose body, chondral flap >1cm2 detached at 3 sides, complete labral radial flap tear and labral bucket-handle tear with complete avulsion >1.5cm long	Intervention: Arthroscopic surgery Control: Sham Surgery (Diagnostic Arthroscopy)	Primary: • International Hip Outcome Tool (IHOT-33) Secondary: • Expectations of Surgery Questionnaire • Hip Dysfunction and Osteoarthritis (HOOS) • Arthritis Self-Efficacy Scale (ASES) • Tampa Scale of Kinesiophobia Fear of Movement Questionnaire • Hip Sports Activity Scale (HSAS) • Work place Activity Limitation Survey (WALS) • Patient Specific Functional Scale • Measures of hip physical impairment • Hip Muscle Strength • Single Leg Squat Performance • Total Hip Replacement

Study Author, NCT ID, Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
Status of Trials Identified in Previous Report				
Ayeni NCT: 01623843 Last Update: June 7, 2017 Completion: unknown	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) 11. Ongoing litigation or compensation claims secondary to hip problems 12. Any other reasons given to exclude the patient	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
Glyn-Jones NCT: 01893034 Last Update: December 3, 2013 Completion: Unknown	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 $\geq$ 2) 3. Hip dysplasia (Centre-Edge angle < 20 degrees on radiograph	Intervention: Arthroscopic surgery Control: Conservative management	Primary: • Hip Outcome Score Secondary: • Patient reported outcome measures • Morphological and physiological MRI

Study Author, NCT ID, Completion date	Purpose	Inclusion/exclusion	Intervention	Outcomes
		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		○ Morphological parameters ○ Measures of osteoarthrits
Naudie NCT: 01621360 Last Update: February 8, 2013 Completion: Unpublished	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 those who are unable to provide informed consent or who are deemed unlikely to comply with follow-up	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
Mansell NCT: 01993615 Last Update: December 20, 2016 Completion: Recruitment Completed	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	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
		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 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 no new systematic reviews that include new studies that compare surgical interventions with non-surgical interventions for the treatment of FAI since the publication of the HTA or previous signal update report. (Criteria A-1, A-3, B-1-4)

4.2. There are no new comparative studies to evaluate the efficacy of surgical intervention in reducing hip osteoarthritis in patients with a diagnosis of FAI. (Criteria A-1, A-3, B-1-4)

4.3. There are a number of recent non-randomized studies that indirectly compare labral repair with labral debridement in FAI patients. Although some suggest that labral repair may result in better outcome, the evidence base for this is low and does not meet the criteria that would trigger an updated report. (Criteria A-1, A-3, B-1-4)

4.4. One systematic review reviewing five cohort studies found a higher risk of reoperation for open surgical dislocation than for hip arthroscopy across four studies and 292 hips. No statistical difference in complications between arthroscopy and open surgical dislocation was found. Another systematic review, primarily reviewing case series, found an overall range of conversion to hip arthroplasty of 0% to 30% for both debridement and refixation groups. New safety evidence does not meet the criteria that would trigger an updated report. (Criterion A-2)

4.5. Although one new systematic review described outcomes for arthroscopic treatment of FAI in people over 40, the evidence does not meet criteria that would trigger an updated report. (Criteria A-1, A-3, B-1-4)

4.6. We identified no new cost-effectiveness, cost utility or costing studies that would change the conclusions of the previous signal update. (Criteria B-1-3)

4.7. One new ongoing trial was identified that is in the process of recruiting patients. No published data or completion timelines are evident from the four ongoing trials identified in the previous signal update.

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5. Wall PD, Brown JS, Parsons N, Buchbinder R, Costa ML, Griffin D. Surgery for treating hip impingement (femoroacetabular impingement). The Cochrane database of systematic reviews 2014:Cd010796.
6. Zhang D, Chen L, Wang G. Hip arthroscopy versus open surgical dislocation for femoroacetabular impingement: A systematic review and meta-analysis. Medicine 2016;95:e5122.

APPENDIX A. SEARCH STRATEGIES

Below is the search strategy for PubMed (August 1, 2014 – January, 11 2018). Parallel strategies were used to search other electronic databases listed below together with the search dates. Keyword searches were conducted in the other listed resources. Updated searches for Key Questions 1 and 2 were not conducted.

Key Question 1

	Search Terms
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) AND English 9

Key Question 2

	Search Terms
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

	Search Terms	Number of Articles
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”	2,586
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”]	3,474,807
12.	#10 AND #11 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)	97

Key Question 4

	Search Terms	Number of Articles
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”	2,586
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	850,549
15.	#13 AND #14 AND SYSTEMATIC REVIEW (LIMIT ENGLISH)	82

Key Question 6

	Search Terms	Number of Articles
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”	2,016
17.	COST[TIAB] OR "Cost-Benefit Analysis"[Mesh] OR DECISION ANALYSIS [TIAB]	98,867
18.	#16 AND #17 (LIMIT ENGLISH)	12

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) (August 1, 2014 through January, 11 2018)

Cochrane Database of Systematic Reviews (August 1, 2014 through January, 11 2018, Issue 1)

Database of Abstracts of Reviews of Effects (DARE - Cochrane Library) (August 1, 2014 through January, 11 2018 Issue 1)

Informational Network of Agencies for Health Technology Assessment (INAHTA) (Database Inception through January, 11 2018)

EMBASE (August 1, 2014 through January, 11 2018)

PubMed (August 1, 2014 through January, 11 2018)

APPENDIX B. SUMMARY OF INCLUDED STUDIES

Appendix Table B1. Summary of Included Systematic Reviews

Assessment Search dates	Purpose	Condition	Treatment vs. comparators	Primary Outcomes	Evidence- base Used	Primary Conclusions
Fairley et al. 2016 Systematic Review *Jan 2000 to July 2015*	The optimal therapy for femoroacetabular impingement (FAI) is unclear. The aim of this systematic review was to examine the evidence for surgical and non-surgical treatment of FAI on symptom and structural outcomes.	Femoroacetabular impingement (FAI)	Surgical and non-surgical treatment, Open Surgery vs. arthroscopy, Different arthroscopic techniques with each other, Different open surgical techniques with each other	Symptoms assessed by validated tools, hip bone shape (radiographic measures, joint degeneration, or progression to joint replacement	18 studies (16 cohort studies, 2 RCTs)	Although evidence supports improvement in symptoms after surgery in FAI, no studies have compared surgical and non-surgical treatment. Therefore no conclusion regarding the relative efficacy of one approach over the other can be made. Surgery improves alpha angle but whether this alters the risk of development or progression of hip OA is unknown. This review highlights the lack of evidence for use of surgery in FAI. Given that hip geometry may be modified by non-surgical factors, clarifying the role of non-surgical approaches vs surgery for the management of FAI is warranted.
Forster-Horvath et al. 2016[2] Systematic Review *Database inception through April 2016*	To perform a systematic review comparing outcomes of labral debridement/segmental resection with labral reconstruction as part of a comprehensive treatment strategy for femoroacetabular impingement.	Femoroacetabular impingement (FAI)	Acetabular Labral Debridement/Segmental Resection vs. Reconstruction		20 studies (12 case series or case-control studies, 1 RCT, 7 cohort studies)	**Results:** After an exhaustive search of the available literature, 20 publications were included. Twelve studies explored outcomes after labral debridement/resection in a total of 400 hips, whereas 7 studies reported on outcomes after labral reconstruction in a total of 275 hips. One additional matched-pair control study compared labral resection (22 hips) with reconstruction (11 hips). The surgical intervention was a revision in 0% to 100% for group 1 versus 5% to 55% for group 2. A direct anterior approach was not performed in group 2, and cam-type impingement appeared to make up a larger percentage of group 1. The Tönnis grade ranged from 0 to 1 for group 1

Assessment Search dates	Purpose	Condition	Treatment vs. comparators	Primary Outcomes	Evidence- base Used	Primary Conclusions
						versus 0.3 to 1.1 for group 2. Joint replacements were performed in 0% to 30% and 0% to 25%, respectively. The modified Harris Hip Score was the most widely used patient-reported outcome measure and suggested that labral reconstruction was not inferior to labral debridement/segmental resection. Clinical outcomes after labral debridement/segmental resection versus labral reconstruction were found to be comparable. In the setting of unsalvageable labral pathology, labral reconstruction was used more frequently as a revision option whereas debridement may be more commonly used in the index setting. **Reoperation:** Of the patients, 0% to 25% underwent conversion to THA. Outcomes after revision labral treatment in the setting of FAI have consistently been shown to be inferior to those of primary surgical procedures in the literature. There were more patients in group 2 who underwent labral reconstruction as a revision procedure. Therefore, these patients may have exhibited more extensive chondral wear, capsular scarring, or injury, and compensatory myotendinous adaptations or neurogenic pain modulation may have developed through the chronicity of their hip disease. A sophisticated labral procedure may have been inadequate to resolve these layered challenges.

Assessment Search dates	Purpose	Condition	Treatment vs. comparators	Primary Outcomes	Evidence- base Used	Primary Conclusions
						Conversion: Overall, for both groups, the range of conversion to hip arthroplasty was 0% to 30%. Because one study did not stratify the type of labral procedure (debridement/ segmental resection vs refixation), it is difficult to make precise conclusions on the THA conversion rate. Nonetheless, patients who underwent labral debridement/ segmental resection were not found to transition to THA more frequently than those who underwent labral reconstruction.
Griffin et al. 2017[3] Systematic Review *Database inception to June 2016*	To review the outcomes of hip arthroscopy in older adults and identify factors associated with treatment failures.	Femoroacetabular impingement (FAI)	Noncomparative	Patient-reported Outcomes (validated), Quality of Life, Range of Motion, Reoperation, Complications	8 studies (3 cohort studies and 5 case series)	**Complications:** Overall complication rate of 5.1% (8/157 patients) across five studies. 1 deep venous thrombosis, 1 case of heterotopic ossification (HO), 1 superficial wound infection resolved with oral antibiotics, 1 deep wound infection, 3 cases of psoas tendinitis, and 2 cases of transient sensory neurapraxia (perineum and foot). **Reoperation:** Seven of 8 studies reported reoperation rates. Excluding conversion to arthroplasty, the rate of reoperation was 2.3% (8/351 patients). The majority of reoperations were repeat hip arthroscopy for continued pain and/or labral tear identified on postoperative MRI. There were 3 additional reoperations: 1 for excision of HO, 1 irrigation and debridement for deep wound infection, and 1 lysis of adhesions. When including arthroplasty, the total reoperation rate increased to 20.8%.

Assessment Search dates	Purpose	Condition	Treatment vs. comparators	Primary Outcomes	Evidence- base Used	Primary Conclusions
Kierkegaard et al. 2017[4] Systematic Review *Database inception to Sept 2015*	To investigate pain, activities of daily living (ADL) function, sport function, quality of life and satisfaction at different time points after hip arthroscopy in patients with femoroacetabular impingement (FAI).	Femoroacetabular impingement (FAI)	Noncomparative	Preoperative and postoperative hip pain and/or hip function during ADL and sport and/or quality of life and/or postoperative satisfaction absolute scores	26 studies (primarily 22 case series, 3 cohort studies, 1 RCT – comparative studies included comparisons of revision surgery versus surgery)	Clinically relevant pain and ADL function improvements were first reported between 3 and 6 months, and sport function improvements between 6 months and 1 year after surgery. It is not clear when quality of life improvements were first achieved. On average, residual mild pain and ADL and sport function scores lower than their healthy counterparts were reported by patients following surgery. Postoperative patient satisfaction ranged from 68% to 100%. **Function and Pain:** In patients with FAI, hip pain reduction and ADL function improvements may be achieved between 3 and 6 months after surgery, while sport function improvements occurs between 6 months and 1 year after hip arthroscopy. Hip pain, ADL and sport function improvements are evident at least up to 3 years after hip arthroscopy in patients with FAI. Average scores from patients indicate residual mild hip pain and/or hip function during ADL and sport lower than their healthy counterparts after hip arthroscopy. In patients with FAI, hip pain reduction and ADL function improvements may be achieved between 3 and 6 months after surgery, while sport function improvements occurs between 6 months and 1 year after hip arthroscopy. Hip pain, ADL and sport function improvements are evident at least up to 3 years after hip arthroscopy in patients with FAI. Average scores from patients indicate residual mild hip pain and/or hip function during ADL and sport lower than their healthy counterparts after hip arthroscopy.

Assessment Search dates	Purpose	Condition	Treatment vs. comparators	Primary Outcomes	Evidence- base Used	Primary Conclusions
Wall et al. 2014[5] Cochrane Review *Database inception to Nov 2013*	To determine the benefits and safety of surgery for femoroacetabular impingement.	Femoroacetabular impingement (FAI)	Operative treatment for FAI versus placebo, no treatment or non-operative treatment	Proportion of participants with 30% or more reduction in pain, preferred pain measures, hip function measures, Quality of Life, Participant global assessment of treatment success, the adverse events	0 randomized or quasi-randomized included	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.
Zhang et al. 2016[6] Systematic Review *Database inception to Aug 2016*	This meta-analysis aims to evaluate the efficacy and safety of hip arthroscopy versus open surgical dislocation for treating femoroacetabular impingement (FAI) through published clinical trials	Femoroacetabular impingement (FAI)	hip arthroscopy versus open surgical dislocation	Alpha angle improvement, Nonarthritic Hip Scores (NAHS), modified Harrison Hip Score (mHHS), Hip Outcome Score-Activities of Daily Living (HOS-ADL), Hip Outcome Score-Sport Specific Subscale (HOS-SSS), reoperation rates, complications	5 cohort studies	Hip arthroscopy resulted in higher NAHS and lower reoperation rates, but had less improvement in alpha angle in patients with cam osteoplasty, than open surgical dislocation. **Reoperation Rate**: Data reporting on reoperation rate are described in 4 studies that included a total of 292 hips. This meta-analysis demonstrated that more additional operations were required after open surgical dislocation than after hip arthroscopy (relative risk [RR]: 0.40, 95% CI: 0.17–0.95, P= 0.04, I2=0%; Fig. 4A). **Complications:** Data reporting on complications are described in 2 studies that included a total of 61 hips. This meta-analysis demonstrated no statistical difference in complications between hip arthroscopy and open surgical dislocation (RR: 0.76, 95% CI: 0.12–4.63, P= 0.76, I2=0%; Fig. 4B).

Appendix Table B2. Summary of Comparative Studies Published after 2014 in Included Systematic Reviews

Author, N, *Study Type*	Treatment vs. comparators	Author Conclusions
Domb et l. 2014 (n=23) *prospective matched-pair cohort*	Segmental labral resection vs. reconstruction	Arthroscopic labral reconstruction is an effective and safe procedure that provides good short-term clinical outcomes in hips with insufficient and nonfunctional labra in the setting of FAI. There was no statistically significant difference between groups regarding the preoperative NAHS (P = .697), any of the other preoperative PROs, or demographic and radiographic data. The mean change in the NAHS was 24.8 ± 16.0 in the RECON group and 12.5 ± 16.0 in the RESEC group. The mean change in the HOS–activities of daily living (HOS-ADL) was 21.7 ± 16.5 in the RECON group and 9.5 ± 15.5 in the RESEC group. Comparison of the amount of change between groups showed greater improvement in the NAHS and HOS-ADL for the RECON group (P = .046 and .045, respectively). There was no statistically significant difference in the mean changes in the rest of the PROs, although there were trends in all in favor of the RECON group. All PROs in both groups showed a statistically significant improvement at follow-up compared with preoperative levels. Chondral Lesion: NR OA (Tonnis Grade): 0 in 15, 1 in 7 Complications: SSI in 2, adhesive capsulitis in 1 Reoperations: 3 rearthroscopies (9-36 mo)
Larson et al. 2014 (n=90) **Matched-pair cohort**	Revision hip arthroscopy vs. primary hip arthroscopy	Arthroscopic hip revision surgery for residual FAI yielded significantly improved outcome measures, but these were inferior to those after primary arthroscopic FAI corrective surgery. Improved femoral head-neck offset after cam decompression, identification and treatment of subspine/AIIS impingement, labral preservation/reconstruction, and capsular preservation/plication may be paramount to achieve satisfactory outcomes.
Skendzel et al. 2014 (n=323) n=323 *Prospective Cohort*	labral repair vs labral debridement	Significant improvement in outcome scores with surgical intervention, with better results seen in some parameters with labral repair compared with debridement.
Frank et al. 2014 (n=64) *Cohort study*	T-capsulotomy with partial capsular repair vs. complete capsular repair	While significant improvements were seen at 6 months, 1 year, and 2.5 years of follow-up regardless of the closure technique, patients who underwent CR of the hip capsule demonstrated superior sport-specific outcomes compared with those undergoing PR. There was a 13% revision rate in the PR group, but no patients in the CR group required revision surgery. While longer term outcome studies are needed to determine if these results are maintained over time, these data suggest improved

Author, N, *Study Type*	Treatment vs. comparators	Author Conclusions
		outcomes after CR compared with PR at 2.5 years after hip arthroscopic surgery for FAI.
Redmond et al. 2015 (n=174) *Cohort study*	arthroscopic acetabuloplasty and labral refixation without labral detachment vs. with labral detachment	Treatment of pincer- and combined-type impingement with arthroscopic acetabuloplasty and labral refixation without detachment, when possible, resulted in similar patient outcomes compared with acetabuloplasty with labral detachment. We may conclude that in cases where the chondrolabral junction remains intact, acetabuloplasty and labral refixation without detachment is a viable option.
Botser et al. 2014 (n=23) *Prospective Cohort*	surgical hip dislocation vs hip arthroscopy	Improvement in both groups with no significant between group differences.

APPENDIX C. SYSTEMATIC REVIEWS EXCLUDED AT FULL TEXT REVIEW

Citation	Reason for exclusion
Casartelli NC, Leunig M, Maffiuletti NA, Bizzini M. Return to sport after hip surgery for femoroacetabular impingement: a systematic review. Br J Sports Med. 2015 Apr 3:bjsports-2014.	Search strategy only extends thru Oct 2014
de Sa D, Horner NS, MacDonald A, Simunovic N, Slobogean G, Philippon MJ, Belzile EL, Karlsson J, Ayeni OR. Evaluating healthcare resource utilization and outcomes for surgical hip dislocation and hip arthroscopy for femoroacetabular impingement. Knee surgery, sports traumatology, arthroscopy: official journal of the ESSKA. 2016 Dec;24(12):3943.	Not a formal economic analysis
Gillespie JA, Patil SR, Meek RD. Clinical outcome scores for arthroscopic femoral osteochondroplasty in femoroacetabular impingement: a quantitative systematic review. Scottish medical journal. 2015 Feb;60(1):13-22.	Lack of new evidence not captured in previous HTA, Signal Update or newer included reviews.
Gupta A, Redmond JM, Hammarstedt JE, Schwindel L, Domb BG. Safety measures in hip arthroscopy and their efficacy in minimizing complications: a systematic review of the evidence. Arthroscopy. 2014 Oct 1;30(10):1342-8.	Search strategy only extends through 2013
Horner NS, Vikas K, MacDonald AE, Naendrup JH, Simunovic N, Ayeni OR. Femoral neck fractures as a complication of hip arthroscopy: a systematic review. Journal of hip preservation surgery. 2017 Jan 9;4(1):9-17.	Patient population composed of less than 80% FAI
Levy DM, Kuhns BD, Chahal J, Philippon MJ, Kelly BT, Nho SJ. Hip arthroscopy outcomes with respect to patient acceptable symptomatic state and minimal clinically important difference. Arthroscopy. 2016 Sep 1;32(9):1877-86.	Patient population composed of less than 80% FAI
Nakano N, Lisenda L, Jones TL, Loveday DT, Khanduja V. Complications following arthroscopic surgery of the hip: a systematic review of 36 761 cases. Bone Joint J. 2017 Dec 1;99(12):1577-83.	Patient population composed of less than 80% FAI
Weber AE, Harris JD, Nho SJ. Complications in Hip Arthroscopy: A Systematic Review and Strategies for Prevention. Sports medicine and arthroscopy review 2015;23:187-93.	Patient population composed of less than 80% FAI