Kansas City

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Surgical Treatment of Femoroacetabular Impingement

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Policy

Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for the surgical treatment of femoroacetabular impingement (FAI) when it is determined to be medically necessary because the criteria shown below are met.

When Policy Topic is covered

Open or arthroscopic treatment of femoroacetabular impingement may be **medically necessary** when all of the following conditions have been met:

Age
- Candidates should be skeletally mature with documented closure of growth plates (e.g., 15 years or older).

Symptoms
- Moderate-to-severe hip pain that is worsened by flexion activities (e.g., squatting or prolonged sitting) that significantly limits activities; AND
- Unresponsive to conservative therapy for at least 3 months (including activity modifications, restriction of athletic pursuits and avoidance of symptomatic motion); AND
- Positive impingement sign on clinical examination (pain elicited with 90 degrees of flexion and internal rotation and adduction of the femur).

Imaging
- Morphology indicative of cam or pincer-type FAI, e.g., pistol-grip deformity, femoral head-neck offset with an alpha angle greater than 50 degrees, a positive wall sign, acetabular retroversion (overcoverage with crossover sign), coxa profunda or protrusion, or damage of the acetabular rim; AND
- High probability of a causal association between the FAI morphology and damage, e.g., a pistol-grip deformity with a tear of the acetabular labrum and articular cartilage damage in the anterosuperior quadrant; AND
- No evidence of advanced osteoarthritis, defined as Tonnis grade II or III, or joint space of less than 2 mm; AND
- No evidence of severe (Outerbridge grade IV) chondral damage.

When Policy Topic is not covered

Treatment of FAI is considered **investigational** in all other situations.

Considerations

If femoroacetabular impingement (FAI) morphology is identified, patients should be advised not to play aggressive sports. No more frequent than annual follow-up with magnetic resonance (MR) arthrography may be indicated for FAI morphology to evaluate cartilage changes before damage becomes severe. It should be noted that current imaging techniques limit the early identification of cartilage defects, whereas delay in the surgical correction of bony abnormalities may lead to disease progression to the point at which joint preservation is no longer appropriate. Confirmation of subtle FAI morphology may require 3-D computed tomography. Some clinicians may also use local anesthetic injection into the joint to assist in confirming FAI pathology.

Treatment of FAI should be restricted to centers experienced in treating this condition and staffed by surgeons adequately trained in techniques addressing FAI. Because of the differing benefits and risks of open and arthroscopic approaches, patients should make an informed choice between the procedures.

Some patients may require a second procedure if they have persistent or recurrent symptoms and meet the criteria for treatment of FAI. Published studies indicate that not all sources of impingement may have been identified prior to surgery, and those that had been identified may not have been adequately treated. The risk of needing an additional surgical procedure can be reduced by intraoperative assessment of impingement after bone debridement and reshaping.

Description of Procedure or Service

Populations	Interventions	Comparators	Outcomes
Individuals: • Who are adults with asymptomatic femoroacetabular impingement	Interventions of interest are: • Femoroacetabular impingement surgery	Comparators of interest are: • Observation	Relevant outcomes include: • Symptoms • Functional outcomes • Health status measures • Quality of life • Change in disease status
Individuals: • Who are adults with symptomatic femoroacetabular impingement	Interventions of interest are: • Femoroacetabular impingement surgery	Comparators of interest are: • Conservative management	Relevant outcomes include: • Symptoms • Functional outcomes • Health status measures • Quality of life • Change in disease status
Individuals: • Who are children ≤15 years of age with symptomatic femoroacetabular impingement	Interventions of interest are: • Femoroacetabular impingement surgery	Comparators of interest are: • Conservative management	Relevant outcomes include: • Symptoms • Functional outcomes • Health status measures • Quality of life • Change in disease status
Individuals: • Who are children ≤15 years of age	Interventions of interest are: • Femoroacetabular	Comparators of interest are: • Surgical repair	Relevant outcomes include: • Symptoms • Functional outcomes

with slipped capital femoral epiphysis–associated femoroacetabular impingement	impingement surgery	of slipped capital femoral epiphysis alone	• Health status measures • Quality of life • Change in disease status
Individuals: • With residual femoroacetabular impingement symptoms following primary surgery	Interventions of interest are: • Revision arthroscopic surgery	Comparators of interest are: • Conservative management	Relevant outcomes include: • Symptoms • Functional outcomes • Health status measures • Quality of life • Change in disease status

Femoroacetabular impingement (FAI) results from localized compression in the joint due to an anatomical mismatch between the head of the femur and the acetabulum. Symptoms of impingement typically occur in young to middle-aged adults prior to the onset of osteoarthritis but may be present in younger patients with developmental hip disorders. The objective of surgical treatment of FAI is to improve symptoms and reduce further damage to the joint.

For individuals who are asymptomatic adults with FAI who receive FAI surgery, there is no direct evidence that the surgical treatment will prevent the development of OA. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Indirect evidence consists of observational studies. In retrospective studies of patients with OA, the relevant outcomes were radiographic evidence of hip joint malformations. In prospective studies of patients with FAI, the relevant outcome is progression to OA. Several large observational studies (>1000 patients) as well as smaller studies have shown radiographic evidence of relationships between abnormal hip morphology and the development of OA. There have been no studies in which FAI surgery was performed on patients with FAI morphology but no symptoms. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who are symptomatic adults with FAI who receive FAI surgery, the evidence includes systematic reviews of large and small observational studies and 1 small RCT. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Open hip dislocation surgery and arthroscopic surgery are the most common surgical techniques performed on patients with FAI. Systematic reviews have evaluated open hip dislocation surgery and arthroscopic surgery, compared with no comparator, nonsurgical management, and other surgical techniques. Compared with nonsurgical management, all types of surgical techniques have resulted in significant improvements in functional outcomes, pain, and radiographic measurements. The reviews were limited when comparing surgical techniques to each other, because patient characteristics and outcome measurements were heterogeneous among studies. The evidence is sufficient to determine the technology results in a meaningful improvement in the net health outcome.

For individuals who children 15 years of age or younger with symptomatic FAI who receive FAI surgery, the evidence includes systematic reviews of small observational studies. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. While the studies reported improvements in pain and functional outcomes, the sample sizes were relatively small, with an average of 54 patients per study. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who are children 15 years of age or younger with slipped capital femoral epiphysis–associated FAI who receive FAI surgery, the evidence includes small observational studies (19-51 patients). Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. While most patients experienced symptom relief following FAI surgery, the surgery is invasive and complications (eg, nonunions) were reported. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have residual FAI symptoms following a primary surgery who receive revision arthroscopic surgery, the evidence includes systematic reviews of observational studies (>400 patients). Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Though the studies were low quality, consistent improvements in functional outcomes, pain relief, and patient satisfaction were reported. The evidence is sufficient to determine the technology results in a meaningful improvement in the net health outcome.

Background
Femoroacetabular Impingement
Femoroacetabular impingement (FAI) arises from an anatomic mismatch between the head of the femur and the acetabulum, causing compression of the labrum or articular cartilage during flexion. The mismatch can arise from subtle morphologic alterations in the anatomy or orientation of the ball-and-socket components (eg, a bony prominence at the head-neck junction or acetabular overcoverage), with articular cartilage damage initially occurring from abutment of the femoral neck against the acetabular rim, typically at the anterosuperior aspect of the acetabulum. Although hip joints can possess the morphologic features of FAI without symptoms, FAI may become pathologic with repetitive movement and/or increased force on the hip joint. High-demand activities may also result in pathologic impingement in hips with normal morphology.

Two types of impingement, cam and pincer, may occur alone or, more frequently, together. Cam impingement is associated with an asymmetric or nonspherical contour of the head or neck of the femur jamming against the acetabulum, resulting in cartilage damage and delamination (detachment from the subchondral bone). Deformity of the head/neck junction that looks like a pistol grip on radiographs is associated with damage to the anterosuperior area of the acetabulum. Symptomatic cam impingement is found most frequently in young male athletes. Pincer impingement is associated with overcoverage of the acetabulum and pinching of the labrum, with pain more typically beginning in

women of middle age. In cases of isolated pincer impingement, the damage may be limited to a narrow strip of the acetabular cartilage.

Epidemiologic and radiographic studies have found correlations between hip osteoarthritis (OA) and FAI lesions, supporting the theory that prolonged contact between the anatomically mismatched acetabulum and femur may lead not only to cam and pincer lesions, but eventually to further cartilage damage and subsequent joint deterioration. It is believed that osteoplasty of the impinging bone is needed to protect the cartilage from further damage and to preserve the natural joint. Therefore, if FAI morphology is shown to be an etiology of OA, a strategy to reduce the occurrence of idiopathic hip OA could be early recognition and treatment of FAI before cartilage damage and joint deterioration occurs.

An association between FAI and athletic pubalgia, sometimes called sports hernia, has been proposed. Athletic pubalgia is an umbrella term for a large variety of musculoskeletal injuries involving attachments and/or soft tissue support structures of the pubis (see evidence review 7.01.142 on the surgical treatment of athletic pubalgia).

Treatment
A technique for hip dislocation with open osteochondroplasty that preserved the femoral blood supply was reported by Ganz et al in 2001. Visualization of the entire joint with this procedure led to the identification and acceptance of FAI as an etiology of cartilage damage and the possibility of correcting the abnormal femoroacetabular morphology. Open osteochondroplasty of bony abnormalities and treatment of the symptomatic cartilage defect is considered the criterion standard for complex bony abnormalities. However, open osteochondroplasty is invasive, requiring transection of the greater trochanter (separation of the femoral head from the femoral shaft) and dislocation of the hip joint to provide full access to the femoral head and acetabulum. In addition to the general adverse effects of open surgical procedures, open osteochondroplasty with dislocation has been associated with nonunion and neurologic and soft tissue lesions.

Less invasive hip arthroscopy and an arthroscopy-assisted mini-approach were developed by 2004. Arthroscopy requires specially designed instruments and is considered technically more difficult due to reduced visibility and limited access to the joint space. Advanced imaging techniques, including computed tomography and fluoroscopy, have been used to improve visualization of the 3-dimensional head/neck morphology during arthroscopy.

FAI can also be a source of hip pain and decreased hip internal rotation in the pediatric population. When nonoperative management of FAI in children and adolescents is ineffective, surgical procedures may be indicated. Surgical techniques include arthroscopy, open hip dislocation, limited open with arthroscopy, and osteotomy.

Slipped Capital Femoral Epiphysis
Patients with slipped capital femoral epiphysis (SCFE) have a displaced femoral head in relation to the femoral neck within the confines of the acetabulum, which can result in hip pain, thigh pain, knee pain, and the onset of a limp. SCFE occurs most frequently in children between the ages of 10 to 16. Upon reaching skeletal maturity patients diagnosed with SCFE, 32% were found to have clinical signs of impingement. It is not uncommon for patients with SCFE to develop premature OA and require total hip arthroplasty within 20 years.

Treatment
The standard treatment for SCFE is stabilization across the physis by in situ pinning. Alternative treatments proposed for pediatric patients with SCFE-related FAI include osteoplasty without dislocation, or with the open dislocation technique described by Ganz. The Ganz technique (capital realignment with open dislocation) is technically demanding, with a steep learning curve and a high risk of complications, including avascular necrosis. Therefore, early treatment to decrease impingement must be weighed against the increased risk of adverse events.

Regulatory Status
Surgery for treatment of FAI is a procedure and, as such, is not subject to regulation by the U.S. Food and Drug Administration.

Rationale

This evidence review was created in April 2009 and has been updated regularly with searches of the MEDLINE database. The most recent literature update was performed through March 8, 2018.

Evidence reviews assess the clinical evidence to determine whether the use of a technology improves the net health outcome. Broadly defined, health outcomes are length of life, quality of life, and ability to function—including benefits and harms. Every clinical condition has specific outcomes that are important to patients and to managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of a technology, 2 domains are examined: the relevance and the quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial (RCT) is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate. RCTs are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types

of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

Adults with Asymptomatic Femoroacetabular Impingement
Currently, there are no studies providing evidence on the efficacy of femoroacetabular impingement (FAI) surgery for adults with asymptomatic FAI morphology for the prevention of osteoarthritis (OA). Indirect evidence consists of observational studies that demonstrate a relation between FAI and OA.

Observational Studies
Oner et al (2016) conducted a retrospective study to determine the prevalence of FAI as an etiologic factor for OA in the hip joint among patients who had undergone total hip arthroscopy (THA).[1] Radiographs of 1004 patients who had undergone THA between 2005 and 2010 were reviewed by 3 authors. Intra- and interobserver consistencies were calculated. The predisposing etiologic factor leading to end-stage degenerative hip disease was undetermined in 26 of the radiographs. Among the remaining 978 patients, 99 patients were diagnosed with FAI by all 3 reviewers, 83 with a cam-type FAI, and 16 with pincer-type FAI. Interobserver agreement was high, with a contingency coefficient between observers of 0.71 for the diagnosis of FAI.

A frequently cited paper by Beck et al (2005) with Ganz as coauthor has described the potential relation between hip morphology and acetabular damage.[2] In this report, 26 patients with pure pistol-grip deformity and 16 patients with isolated coxa profunda were identified from 302 hips treated for intra-articular pathology between 1996 and 2001. Among the 26 hips with isolated cam impingement on preoperative radiographs, all showed acetabular cartilage damage in the anterosuperior area of the acetabulum with separation between the acetabular cartilage and the labrum. In the 16 hips with isolated pincer impingement, the damage was located more circumferentially, usually including only a narrow strip of the acetabular cartilage. The report illustrated that, in carefully selected patients with early-stage OA and well-defined hip configurations, a strong association exists between specific hip morphology and the pattern of cartilage damage.

Ganz and colleagues began a cross-sectional population-based natural history cohort in 2005 that included over 1000 young men to determine whether morphologic alterations are associated with an increased rate of early OA. Reichenbach et al (2011) reported on 1080 asymptomatic young men in the Sumiswald Cohort had undergone clinical examination and completed the Western Ontario and McMaster Universities Osteoarthritis Index and the EuroQoL health-related quality of life (QOL) questionnaire.[3] Of these, 244 randomly selected subjects (mean age, 19.9 years) underwent magnetic resonance imaging to evaluate cam-type deformities, labral lesions, cartilage thickness, and impingement pits. Definite cam-type deformities were detected in 67 (27%) asymptomatic men. Logistic regression models, adjusted for age and body mass index, found for patients with cam-type deformities odds ratios of 2.77 for labral

lesions, 2.91 for impingement pits, and 2.45 for labral deformities. Cartilage thickness was -0.19 mm lower in subjects with cam-type deformities.

A population-based cohort study by Thomas et al (2014) found that subclinical deformities of the hip, including cam-type FAI, were significant predictors of radiographic evidence of OA and total hip replacement (THR) in women.[4] A cohort of 1003 women underwent pelvis radiographs at years 2 and 20. At 20 years, blinded radiographic analysis was available for 670 (46%) hips, of which 70 (11%) showed OA. For THR (see evidence review 7.01.80), data at the 20-year assessment were available for 1455 (99%) hips, of which 40 (3%) had undergone replacement. Pincer-type FAI at year 2 was not significantly associated with radiographic evidence of OA. Cam-type FAI at year 2 was significantly associated with the development of radiographic OA and THR. Each degree increased in the alpha angle above 65° was associated with an increased risk of 5% for radiographic evidence of OA and 4% for THR. These findings were limited by the low rate of participants having both baseline and follow-up radiographs.

Gosvig et al (2010) published findings from a cross-sectional radiographic and questionnaire database of 4151 individuals from the Copenhagen Osteoarthritis study.[5] The study group consisted of 1332 men (mean age, 60.0 years; range, 22-90 years), and 2288 women (mean age, 60.8 years; range, 21-90 years). The hips were categorized as being without malformations or as having an abnormality consisting of a deep acetabular socket, a pistol-grip deformity, or a combination of the two based on radiographic criteria. Male and female prevalence of hip joint malformations was 71% and 36.6%, respectively. The prevalence of hip OA, radiographically defined, was 9.5% in men and 11.2% in women. A deep acetabular socket or a pistol-grip deformity was a significant risk factor in the development of hip OA (relative risk, 2.4 and 2.2, respectively).

A study by Takeyama et al (2009) from Asia reviewed records of 817 patients (946 hips) who underwent primary surgery for OA or other hip diseases to determine the prevalence of FAI.[6] Most (73%) patients were diagnosed with OA secondary to developmental hip dysplasia. Only 17 (1.8%) patients were considered to have had primary OA. Of these, 6 patients (average age, 63 years; range, 32-79 years) were determined to have FAI from preoperative radiographs, resulting in a possible etiology of FAI for 0.6% of the total population undergoing surgery for OA and 35% in the population with primary OA.

Bardakos and Villar (2009) retrospectively examined 43 patients (43 hips) younger than 55 years of age with a history of symptomatic idiopathic arthritis, who exhibited pistol-grip deformity of the femur and mild-to-moderate OA (Tonnis grade 1 or 2).[7] Radiographs showed progression of OA in two-thirds of the patients, with 12 receiving hip replacement or resurfacing after more than 10 years. Logistic regression analysis showed the medial proximal femoral angle and the posterior wall sign as significant independent predictors for progression of OA. A reduction of 1° in the medial proximal angle increased the odds of OA progression by 21 times, while hip OA with a positive posterior wall sign was 10 times more likely to progress than a hip that had a negative posterior wall sign. Of

note, one-third of the patients with a pistol-grip deformity did not progress rapidly within the assessment period.

Tanzer and Noiseux (2004) reported on 3 separate populations when investigating anterior hip impingement as a common etiology of hip disorders.[8] The 3 populations of interest were patients who had undergone hip arthroscopy for labral tears (n=38), patients who had undergone cheilectomy for anterior FAI (n=10), and patients who had THA due to idiopathic arthritis (n=200). Radiographic findings showed a pistol-grip deformity in 97% of the patients with labral tears and 100% of the patients with idiopathic arthritis.

Kim et al (2007) reviewed outcomes for 43 patients (mean age, 40 years; range, 18-68 years) with labral tears and early OA (Tonnis grade 0 to I; average Japanese Orthopedic Association scores, <1) and symptoms lasting 3 months or more who had been treated with débridement.[9] (The Japanese Orthopedic Association scale ranges from 0 [severe pain] to 3 [no pain].) At an average 50-month follow-up (range, 12-96 months), 74% of patients reported symptom improvement. Blinded evaluation of preoperative radiographs and magnetic resonance arthrograms indicated 42% of patients had FAI. Patients treated only with débridement were less likely to improve if early-stage OA or FAI was present at the time of surgery (Japanese Orthopedic Association score, 1.67). Patients without either FAI or OA scored 2.6 while patients with FAI scored 1.83.

Section Summary: Adults With Asymptomatic Femoroacetabular Impingement
There is no direct evidence that performing FAI surgery on asymptomatic adults with FAI morphology will prevent the development of OA. There is indirect evidence from retrospective studies that patients with cam-type impingement related to a pistol-grip deformity will experience labral damage, which can lead to the subsequent development of OA.

Adults with Symptomatic FAI
Surgical options for the treatment of adults with symptomatic FAI include: open, arthroscopic, mini-open, and mixed open/arthroscopic. The evidence for surgical treatment of FAI consists of systematic reviews of nonrandomized comparative studies and observational studies.

A Cochrane review by Wall et al (2014) evaluated surgery for the treatment of FAI, conducting a literature search for randomized and quasi-randomized trials assessing surgical intervention compared with placebo treatment, nonoperative treatment, or no treatment in adults with FAI.[10] No studies met these inclusion criteria. Four ongoing studies were identified at the time of publication (see NCT01893034 and NCT01623843 in the Ongoing and Unpublished Clinical Trials section).

A systematic review by Harris et al (2013) evaluating the treatment of FAI included literature through April 2013, identifying 29 studies (total N=2369 patients): 83% had level IV evidence (case series), 14% had level III (cohort),

and 3.4% had level I (RCT).[11] An arthroscopic approach was used in 59% of studies. Study interventions included nonoperative treatment, arthroscopy, surgical open dislocation, mixed open/arthroscopic, and mini-open. Both Nonarthritic Hip Score (NAHS) and modified Harris Hip Score (HHS) values improved significantly, regardless of the surgical procedure compared with nonsurgical management. Differences between surgical techniques could not be assessed due to heterogeneity across surgical groups and inconsistent outcome measures.

Open Surgery

A systematic review by Bedi et al (2008) evaluated the management of labral tears and FAI.[12] Seven of the 19 studies assessed were case series of patients with FAI treated with open hip dislocation. Several of these studies are described next.

Beck et al (2004) reported on 19 of 22 patients (average age, 36 years; range, 21-52 years) with confirmed clinical, radiographic, and magnetic resonance arthrographic diagnosis of FAI, treated with surgical dislocation of the hip.[13] Follow-up duration was at least 4 years. All had labral damage, and 18 had acetabular damage. Using the Merle d'Aubigné hip score, 13 of the hips were rated excellent to good and pain scores improved from 2.9 to 5.1. By the 4- to 5-year follow-up, 5 (26%) patients had undergone THA, due to cartilage damage.

Espinosa et al (2006) compared the effect of reattaching (n=35) or removing (n=25) the labrum during treatment for FAI.[14] Patients were 20 to 40 years of age and had no prior surgery; all had preoperative evidence of acetabular damage. Independent evaluations at 2-year follow-up indicated improved Merle d'Aubigné scores for both groups. The study also reported a reduction in OA progression.

Peters and Erickson (2006) reported on 29 patients (30 hips) in a prospective study with minimum 2-year follow-up.[15] The specific diagnoses were primary FAI in 25 patients (26 hips), Legg-Calve-Perthes disease (n=3), and slipped capital femoral epiphysis (SCFE; n=1). The average age of the patients was 31 years (range, 16-51 years). Twenty-nine of the 30 hips had cam-type impingement (n=14) or mixed cam and pincer-type impingement (n=15). The Harris Hip Score (HSS) improved from 70 at baseline to 87 at an average 32-month follow-up. No progression to OA was observed in 68% of patients. There was nonunion in 8 (27%) hips; 5 (17%) hips were expected to convert to THA due to progressive pain, and 4 (13%) had progressed to OA. Radiographic signs of progression of OA and clinical failure requiring conversion to THA were seen only in patients with severe damage to the acetabular articular cartilage.

Arthroscopic Surgery

The evidence on arthroscopic surgery for FAI consists of a systematic review of observational studies, a small RCT, and stand-alone observational studies.

Systematic Reviews

Kierkegaard et al (2017) published a systematic review and meta-analysis of patients with FAI who had undergone hip arthroscopy.[16] Outcomes were pain,

activities of daily living (ADLs), and sports function. Databases were searched through September 2015. Nineteen studies were included in the meta-analysis (15 case series, 3 cohorts, 1 RCT). The RCT by Krych et al (2013) is described in the next section.[17] The total number of patients included in the 19 studies was 2322 (mean age, 36 years; range, 18-57 years) and 42% were women. Weighted mean differences between pre- and postoperative outcomes were evaluated in the meta-analysis. Detectable pain reduction was achieved in less than 3 months and maintained through 5 years. Improved ADLs were evident between 3 and 6 months and maintained through at least 3 years of follow-up. Sports function improvements were detected between 6 and 12 months after arthroscopy and were maintained through follow-up over several years. Patients who received FAI continued to have some pain postsurgery.

Minkara et al (2018) published a systematic review and meta-analysis analyzing risk factors and outcomes after patients with FAI had undergone hip arthroscopy.[18] Reviewers identified 29 relevant articles that included 1911 patients (1981 hips). Reviewers conducted a meta-analysis assessing return to play, revision rate, surgical and nonsurgical complications, change in α-angle, intraoperative bone resection, and patient-reported outcome measures after hip arthroscopy in FAI. However, all but 2 studies (1 RCT, 1 prospective cohort) in the meta-analysis were case series. Reviewers also sought to identify risk factors associated with intervention success and/or failure. The data on reoperation and complication rates are most relevant. The cumulative risk of reoperation after hip arthroscopy, including revision surgery or subsequent THA, was 5.5% (95% CI, 3.6% to 7.5%). For patients requiring a secondary procedure, 77% underwent THA, and 13% required revision arthroscopy. A single study was the source for 19% of patients requiring a second procedure, which assessed hip arthroscopy exclusively among patients who were 50 years of age and older (mean, 57 years; range, 50-77 years). The risk of clinically reported complications was 1.7% (95% CI, 0.9% to 2.5%) The most frequent complication was heterotopic ossification, followed by transient neurapraxia, typically of the lateral femoral cutaneous nerve and sciatic nerve.

Randomized Controlled Trials
The single RCT compared arthroscopic labral repair with labral débridement; it was reported by Krych et al (2013).[17] This nonblinded RCT included 36 females with pincer-type or combined-type FAI. At a mean 32-month follow-up (range, 12-48 months), both treatment groups showed significant improvements in the Hip Outcome Score (HOS) vs baseline. Compared with the débridement group, the arthroscopic repair group had better outcomes on the HOS ADLs scale (91.2 vs 80.9) and HOS sports scale (88.7 vs 76.3). Most patients in the arthroscopic repair group also rated their hip function as normal or nearly normal (94% vs 78%).

Observational Studies
Lund et al (2017) used data from the Danish Hip Arthroscopy Registry to report on outcomes for 1835 patients treated with 2054 FAI procedures between 2012 and 2015.[19] At 1- and 2-year follow-ups, patient-related outcome measures (PROM) were: the European Quality of Life assessment, the Copenhagen Hip and Groin

Outcome Score; the Hip Sports Activity Scale; and a numeric rating scale for pain. Although statistically significant improvements in all PROM scores were reported at one-year follow-up, there were no improvements in these measures between 1 and 2 years, with the exception of mean numeric rating scale pain scores for walking (preoperative, 49; 1 year, 27; 2 year, 22; p<0.05; 95% CI not reported). The authors concluded that patients with FAI could generally expect to see reductions in pain and improvements in QOL postsurgery.

Malviya et al (2012) reported on reported on changes in QOL in a prospective series of 612 patients treated by a single surgeon.[20] Patients ranged in age from 14 to 75 years (mean, 36.7). At 1-year follow-up, QOL scores on the Rosser Index improved by at least 1 grade in 76.6% of patients, remained unchanged in 14.4%, and decreased 9%.

Philippon et al (2012) evaluated outcomes following arthroscopic treatment for FAI in 153 consecutive patients ages 50 years or older.[21] Mean age of patients was 57 years (range, 50-77 years). The prospective database included range of motion, modified HHS, HOS ADLs scale, HOS sports scale, and 12-Item Short-Form Health Survey (SF-12) score preoperatively and at 6 months postsurgery. Questionnaires were then mailed annually. THA was required after arthroscopy for FAI in 20% of patients at a mean of 1.6 years (range, 3 months to 4 years). In patients who did not require THA, the modified HHS improved from 58 to 84, HOS ADLs scale improved from 66 to 87, and HOS sports scale improved from 42 to 72. The Physical Component Summary (PCS) of the SF-12 improved from 38 to 49, with no change in the Mental Component Summary. Survivorship, defined as not requiring a hip replacement, was 92% at 1 year, 84% at 2 years, and 80% at 3 years. For the 64 patients who had available data at 3 years, patients with a joint space greater than 2 mm preoperatively had survivorship rate of 90%, whereas those with a joint space 2 mm or less had survivorship rate of 57%. Logistic regression modeling, adjusted for age and days from injury to surgery, identified a joint space of 2 mm or less and a preoperative MHHS of less than 50 as risk factors for hip replacement.

Palmer et al (2012) reported on a prospective 3-year follow-up of 201 procedures for cam-type FAI with a Tonnis grade 1 or less.[22] Mean duration of symptoms before surgery was 59 months. At follow-up, NAHS improved from a mean of 56.1 to 78.2 and visual analog scale (VAS) for pain improved from 6.8 to 2.7. There was a higher incidence of grade 4 acetabular chondral defect in the 12 patients who required hip arthroplasty during the follow-up compared with patients who did not undergo arthroplasty, and patients with pincer resection had poorer results (NAHS improvement, 16.1) compared with patients with only cam-type FAI (NAHS improvement, 23.9). Of the 93 patients who returned for a final postoperative radiograph, 91 (97.8%) had no change in Tonnis grade. Subgroup analyses of patients who were 20 or younger and 60 or older showed no significant effect of age. Among the 48 patients excluded from this study due to acetabular chondral defects greater than 1.5 cm^2, 60% underwent hip replacement at a mean of 21.7 months (range, 2-29 months).

Javed and O'Donnell (2011) reported on arthroscopic treatment for cam-type FAI in 40 patients older than 60 years of age (mean, 65 years; range, 60-82 years).[23] The modified HHS and NAHS data were collected preoperatively and at 2, 6, 26, and 52 weeks postoperatively, and then annually. Mean follow-up was 30 months (range, 12-54 months). Mean modified HHS improved by 19.2 points and mean NAHS improved by 15 points. Of this select group of 40 patients with unilateral cam impingement, Tonnis grade 1 or less OA, and a mean age of 63 years (range, 60-70 years), 7 (17.5%) underwent THR at a mean interval of 12 months.

Larson et al (2011) conducted a retrospective comparison of outcomes from arthroscopic treatment of 154 patients (169 hips) without joint space narrowing (Tonnis grade 0 to 1) and 56 patients (58 hips) with preoperative radiographic evidence of joint space narrowing (Tonnis grade 2 or 3).[24] Although both groups had improved scores through 12 months of follow-up, outcomes were better for patients without OA. Patients with advanced preoperative joint space narrowing (n=22) showed no improvement postsurgery. At the 3-year follow-up, mean HHS was 88 for the group without OA and 67 for the group with OA. The surgical failure rate at the last follow-up, defined as an MHHS of less than 70 or conversion to THA, was 12% for patients without OA, 33% for hips with mild-to-moderate preoperative joint space narrowing (<50% joint space narrowing or >2 mm joint space), and 82% for hips with advanced preoperative joint space narrowing (>50% joint space narrowing or ≤2 mm joint space). Multiple linear regression analysis revealed that increasing radiographic joint space narrowing, chondral grade on magnetic resonance imaging, and longer duration of symptoms preoperatively were independent predictors for a lower HHS.

Horisberger et al (2010) reported on outcomes for 20 patients who showed generalized severe cartilage lesions during intraoperative arthroscopic assessment for FAI.[25] Nine hips had Tonnis grade 1 OA, 6 had grade 2, and 5 had grade 3. At a mean follow-up of 3 years, 10 (50%) patients had undergone or planned to undergo, THA. Preoperatively, 5 of the 10 hips had Tonnis grade 3 OA. Another 2 patients had a poor result at latest follow-up but were unwilling to undergo THA. Mean time between index surgery and THA was 1.4 years (range, 0.4-2.2 years). The authors concluded that, in patients with generalized chondral lesions, arthroscopic treatment of FAI did not have any effect beyond the short-term pain relief resulting from débridement.

Philippon et al (2009) reported on 2.3-year follow-up (range, 2-2.9 years) on 100 of 209 prospectively enrolled consecutive patients who had hip arthroscopy for disabling pain.[26] Of the 100 patients available for follow-up, 90 (90%) improved from an average modified HSS score of 58 to 84, and 10 (10%) required THA at a mean of 16 months. Patients with a joint space of less than 2 mm were 39 times more likely to progress to THA.

Byrd and Jones (2009) provided a brief report on 200 patients (207 hips) from a consecutive group of 220 patients (227 hips) who had been treated with arthroscopy for FAI.[27] Average age was 33 years (range not reported), with symptoms averaging 32 months and no sign of advanced OA. At an average of 16

months (range, 12-24 months) posttreatment, patients showed an average 20-point improvement (range, -17 to 60) on the 91-point MHHS. Eighty-three percent of patients were considered to be improved by the procedure.

Larson and Giveans (2008) reported on 10-month follow-up (3 months to 3 years) for 96 patients (100 hips) who presented with FAI and underwent arthroscopy.[28] The average age was 35 years (range, 16-64 years). Following FAI treatment, the impingement test was reported to be improved in 86% of patients, with good-to-excellent results in 75% of patients. Three (3%) patients required THA, and 6 had a heterotopic bone formation. VAS score for pain improved from 6.7 at baseline to 1.9 at follow-up. Scores on the SF-12 improved from 60 to 78.

Open Surgery vs Arthroscopic Surgery

Systematic Reviews
Zhang et al (2016) published a systematic review of studies comparing the efficacy and safety of hip arthroscopy with open surgical dislocation for the treatment of FAI.[29] Five comparative studies published through August 2016 were included, evaluating a total of 352 hips. All studies were considered good or high quality based on the Newcastle-Ottawa Scale. Length of follow-up among the studies ranged from 12 to 25 months. At the 3-month follow-up, patients undergoing open dislocation experienced significant improvements in alpha angle (-4.45; 95% CI, -8.22 to -0.67) compared with patients undergoing arthroscopy, while patients undergoing arthroscopy reported significantly better NAHS (16.58; 95% CI, 9.54 to 23.61) compared with patients undergoing open dislocation. At 12-month follow-up, NAHS remained significantly better in the arthroscopy group, though the modified HHS and HOS scales for ADLs and sports were equivalent between groups. Complications were also similar between groups, though reoperation rates were significantly lower in patients undergoing arthroscopy (relative risk, 0.4; 95% CI, 0.17 to 0.95).

Nwachukwu et al (2016) published a systematic review and meta-analysis comparing open with arthroscopic surgical techniques for the treatment of FAI.[30] The literature search included studies published through October 2014, which had a mean follow-up of at least 3 years. Sixteen studies met inclusion criteria—9 open surgical hip dislocation studies and 7 hip arthroscopy studies. Pooled cohort analyses were conducted on data from 600 hips with a mean follow-up of 58 months from the open surgery studies and 1484 hips with a mean follow-up of 51 months from the arthroscopy studies. Conversion to THA was the outcome end point, with an overall survival rate of 93% for patients undergoing open surgery and 90.5% for patients undergoing arthroscopy (p=0.06). Scores on the SF-12 were significantly better among patients undergoing arthroscopy. Direct comparisons of other outcomes were limited by outcome instrument heterogeneity. Both surgical techniques demonstrated favorable outcomes using their respective measuring systems.

Several other systematic reviews comparing open with arthroscopic surgery for FAI have been identified.[31-33] Matsuda et al (2011) included 18 level III or IV

studies (controlled cohort or case series) with a minimum 1-year follow-up.[31] Selected were 6 studies on open surgical dislocation, 4 on mini-open procedures, and 8 arthroscopic studies. All 3 approaches were effective in reducing pain and improving function in short-term to mid-term studies. Open dislocation surgery had a comparatively higher major complication rate primarily because of trochanteric osteotomy-related issues. The mini-open method showed comparable efficacy but significant incidence of iatrogenic injury to the lateral femoral cutaneous nerve. Botser et al (2011) included 26 level II to IV articles totaling 1462 hips in 1409 patients.[32] Of these, 900 hips were treated arthroscopically, 304 with the open dislocation method, and 258 by the mini-open method. Mean time from onset of symptoms to surgery was 28 months. Overall complication rates were 1.7% for the arthroscopic group, 9.2% for the open surgical dislocation group, and 16% for the combined approach group.

Observational Studies
A direct comparison of arthroscopic and open treatment of FAI was reported by Zingg et al (2013).[34] Of 200 patients with FAI invited to participate in this prospective study, 10 patients agreed to be randomized to arthroscopy or to open surgical hip dislocation, and 28 patients agreed to participate if permitted to select their preferred treatment. The open and arthroscopic groups were generally comparable at baseline. Arthroscopic treatment of FAI resulted in a shorter hospital stay (3 days vs 5 days) and less time off work. HHS was improved with arthroscopy compared with open treatment at 6 weeks, 3 months, and 12 months. Overall, pain scores (Western Ontario and McMaster Universities Osteoarthritis Index, VAS) were lower with arthroscopy, with statistically significant results for about half of the time points. Compared with the open surgical approach, arthroscopy resulted in morphologic overcorrections at the head-neck-junction.

Domb et al (2013) reported on a matched-pair comparison of open and arthroscopic treatment of FAI.[35] Patients chose their treatment approach after discussion of the advantages and disadvantages of each approach. Ten patients who chose the open procedure were matched with 20 patients from a larger cohort of 785 patients who underwent arthroscopic treatment of FAI during the same period. Patients were matched for age, sex, FAI diagnosis, and worker's compensation status. The 2 groups had similar preoperative scores, and both groups showed significant improvements postoperatively. At 2-year follow-up, improvements in HOS sports scale (42.8 vs 23.5) and NAHS (94.2 vs 85.7) were significantly greater in the arthroscopic group. There was no significant difference between groups in the MHHS, HOS ADLs scale, or VAS pain scores.

Mini-Open and Mixed Open/Arthroscopic Approaches
The evidence for mixed-open and open/arthroscopic approaches for the treatment of FAI consists of observational studies. This technique permits direct visualization of the anterior femoral head-neck junction without dislocation.

Observational Studies
A study of the mini-open surgical technique performed on 118 patients with FAI was described by Chiron et al (2012).[36] Fifty-eight percent had cam-type

impingement, and 42% had mixed-type impingement. Average follow-up was 2.2 years. NAHS, internal rotation, and alpha angles significantly improved following surgery. Eight revisions were performed, 2 patients experienced residual pain and eventually underwent TKA, and 2 progressed rapidly to OA.

A mixed open/arthroscopic approach for the treatment of FAI was reported by Laude et al (2009) for 97 patients (100 hips).[37] The average age of patients was 33 years (range, 16-56 years). Ninety-one (94%) were available for follow-up at an average 58 months (range, 29-104 months). Scores on the NAHS improved from 55 at baseline to 84 at the last follow-up. One patient had a femoral neck fracture, 3 weeks postoperatively, and 13 (14%) required revision due to persistent pain. Eleven (12%) hips required THA at a mean of 40 months (range, 5-75 months). The best results were observed in patients younger than 40 years with Tonnis grade 0.

Section Summary: Adults With Symptomatic FAI

The evidence for the use of open dislocation for the treatment of adults with FAI consists of systematic reviews of observational studies. The evidence for the use of arthroscopy to treat adults with FAI consists of systematic reviews of observational studies and a small nonblinded RCT. Comparisons of open dislocation and arthroscopy have shown that both procedures successfully reduce pain and improve functional outcomes, with arthroscopy showing more favorable satisfaction ratings. Although the evidence is mostly observational, cumulatively, the studies have reported on thousands of patients and outcomes have been positive.

Adolescents and CHILDREN WITH SYMPTOMATIC FAI

The evidence for the surgical management of adolescents and children with symptomatic FAI consists of a systematic review of observational studies and another of case series as well as 2 case series published after one of the systematic reviews. The systematic reviews, a case series in one of the systematic reviews, and case series published after the systematic review are described below.

Systematic Reviews

Oduwole et al (2017) reviewed 15 case series identified in a literature search from 2005 to 2016 that reported on the efficacy of surgical management in patients with FAI secondary to slipped capital femoral epiphysis.[38] A total of 261 patients (266 hips) underwent both arthroscopic and open procedures (arthroscopic osteochondroplasty, 85 patients [88 hips]; surgical hip dislocation, 131 patients [133 hips; open osteotomy, 45 patients [45 hips]). Mean alpha angle corrections observed for arthroscopy were 32.14°; for surgical hip dislocation, 41.45°; and for open osteotomy, 6.0° (p<0.05). Surgical hip dislocation resulted in the most improved correction of the alpha angle.

A systematic review by de Sa et al (2015) conducted a literature search through April 2014 and identified 6 case series and 2 conference abstracts (total N=388 children and adolescents) on surgical treatment for FAI.[39] The mean number of

hips per study was 54 (range, 17-108). Meta-analysis could not be performed due to the inconsistency of outcome measures across studies. Patients' ages ranged from 11 to 19.9 years. The main indication for surgery was confirmed diagnosis of FAI, with persistent pain despite nonoperative interventions. Most patients were treated with hip arthroscopy (81% arthroscopic, 19% open). Mean follow-up was 23.4 months. All studies reported significant reductions in pain and improvements function. Satisfaction rates were 84% to 100% for arthroscopy and 79% for open dislocation. There were no reports of iatrogenic femoral neck fracture, instability/dislocation, acute SCFE, avascular necrosis, premature physeal closure, and proximal femoral growth arrest.

Observational Studies

Included in the de Sa systematic review was a multicenter prospective study by Tran et al (2013) who assessed arthroscopic treatment for cam-type FAI in 34 skeletally immature adolescents with open growth plates (41 hips).[40] At a mean follow-up of 14 months (range, 1-2 years), MHHS improved from 77.39 to 94.15 and NAHS improved from 76.34 to 93.18. Return to full sporting activity was reported by 78% of patients. No complications (eg, avascular necrosis, SCFE, fracture, growth plate arrest) were observed.

Guindani et al (2017) published results from patients less than 18 years of age who were retrospectively identified as having undergone surgical dislocation for several indications at a single institution.[41] Among the 51 patients (53 hips) in the study, 18 (34%) hips had a diagnosis of FAI. Patients with FAI reported significant improvements in the following pre- and postmeasurements: modified HHS, NAHS, and SF-12. No significant improvements were found in sphericity deviation score or on alpha angles (both anteroposterior and Lauenstein views).

Nwachukwu et al (2017) reviewed an institutional hip preservation registry of patients with FAI who underwent hip arthroscopy.[42] The authors sought to define the minimal clinically important difference) and the substantial clinical benefit for adolescents undergoing hip arthroscopy. Data from 47 adolescents (68.1% female; mean age, 16.5 years) were obtained on the patients' modified HHS, the HOS, and the international Hip Outcome Tool. Overall adolescent patients reported a minimal clinically important difference for the various patient-related outcomes but not substantial clinical benefit. The authors discussed the potential limitations of patient-related outcomes for adolescents compared with adults. They noted that adolescents might have higher expectations and greater physical activity demands that influence their scores.

Section Summary: Adolescents and Children With Symptomatic FAI

The evidence consists of a systematic review of observational studies and another of case series as well as 2 case series. All studies reported favorable outcomes in pain reduction and functional improvements, but all had relatively small sample sizes and lacked sufficiently long follow-up. No serious adverse events were reported.

CHILDREN WITH SCFE-ASSOCIATED FAI
The evidence for the use of FAI surgery to treat children with SCFE-associated FAI consists of observational studies.

Observational Studies
Guindani et al (2017) published results for patients less than 18 years of age undergoing surgical dislocation for several indications.[41] Among the 51 patients (53 hips) in the study, 13 (24%) hips had the diagnosis of SCFE. Mean age at surgery for the whole population was 14 years and mean follow-up was 3 years. Outcomes postsurgery differed by indication. SCFE patients reported significant improvements in the following pre- and postmeasurements: NAHS and on alpha angles (both anteroposterior and Lauenstein views). No significant improvements were found in modified HHS, SF-12, or sphericity deviation scores.

Sink et al (2010) retrospectively reviewed data from 2 U.S. centers evaluating 36 patients (39 hips) with stable SCFE who were treated with open surgical hip dislocation for chronic symptoms.[43] The average time between in situ pinning and surgical hip dislocation was 20 months (range, 6-48 months). Most patients had partial or complete relief of symptoms immediately after initial pinning followed by a recurrence of symptoms consistent with impingement. All but 1 patient had either a labral or a cartilage injury, with labral injury observed in 34 of 39 hips and cartilage injury in 33 or 39 hips; the average depth of cartilage damage was 5 mm (range, 2-10 mm). There was no correlation between slip severity or duration of symptoms and the type of cartilage injury.

Ziebarth et al (2009) with Ganz as coauthor conducted a joint 2-center retrospective review that assessed data from their Swiss institution (n=30) and a children hospital in Boston (n=10). Follow-up was 1 to 8 years for patients between 9 and 18 years of age with moderate-to-severe SCFE who were treated with surgical dislocation.[44] No patients from either institution developed osteonecrosis, infection, deep venous thrombosis, or nerve palsies. Three patients developed delayed unions; none developed nonunions. Five patients required additional surgery for heterotopic ossification (n=1), residual impingement (n=1), or breakage of screw or wire fixation (n=3). The short-term postoperative clinical outcomes were found to be near normal, with similar scores between the operative and nonoperative hips.

As reported by Spencer et al (2006, the same U.S. institution evaluated 19 patients (age range, 12-43 years) who underwent femoral neck osteoplasty (n=13) or osteoplasty with intertrochanteric osteotomy (n=6) via Ganz-type surgical dislocation.[45] Of 12 patients with a history of SCFE (age range, 12-38 years), 9 were reported improved symptom control at 8- to 25-month follow-up. Of the 7 patients (age range, 17-43 years) without SCFE who underwent open surgical dislocation for pistol-grip deformities, 5 reported worse symptoms or minimal relief. Outcomes for patients with a chondral flap were worse than for patients without a chondral flap.

Section Summary: Children With SCFE-Associated FAI

The evidence for the use of FAI surgical management for children with SCFE-associated FAI consists of observational studies. Currently, there is no method to determine which children with SCFE will develop FAI. While most patients experienced symptom relief following FAI surgery, the surgery is invasive, and complications (eg, delayed union) have been reported.

REVISION ARTHROSCOPIC SURGERY

The evidence for revision arthroscopic surgery to treat patients with residual FAI consists of systematic reviews as well as observational studies, published after those reviews.

Systematic Reviews

Sardana et al (2015) published a systematic review on revision hip arthroscopy, considering articles published through July 2014.[46] Three prospective case-control studies and 3 retrospective chart reviews, providing information on 448 hips, were selected. The most common indications for revision surgery were residual FAI, labral tears, and chondral lesions. The mean interval between index and revision procedures was 25.6 months (range, 20.5-36 months). Patients most often requiring revision surgery were women (60%) and younger patients (mean age, 33.4 years). Revision hip arthroscopy improved functional outcomes (33.6% improvement in HHS) and pain relief. Reviewers noted that the studies were low quality (level III and IV).

A systematic review by Cvetanovich et al (2015) evaluated revision hip arthroscopy.[47] Reviewers included 5 studies, with a total of 348 revision hip arthroscopies. The mean age of patients was 31.4 years, and 60% were female. The mean interval between index and revision procedures was 27.8 months. The most common indication for revision surgery was residual FAI (81%). At a mean of 22.4-month follow-up, revision hip arthroscopy resulted in improved functional outcomes, as measured by the HHS (weighted mean difference, 56.8 preoperative vs 72.0; p=0.01), NAHS, HOS, and SF-12.

Observational Studies

A case-control study by Newman et al (2016) compared outcomes after revision hip arthroscopy with outcomes after primary hip arthroscopy among patients 18 years of age and younger.[48] Each patient in the revision hip arthroscopic surgery group (n=42) was matched with 2 patients undergoing primary hip arthroscopic surgery (n=84). Outcomes included the HOS ADLs and sports scales, HSS, and SF-12 PCS scores. Follow-up was conducted for at least 2 years. There were no significant differences between groups in HOS ADLs scale and SF-12 PCS scores. However, the primary arthroscopic surgery group had significantly higher scores on HOS sports scale, HHS, and patient satisfaction.

Gwathmey et al (2017) reported on outcomes for 186 patients (190 hips) who underwent revision hip arthroscopy.[49] All patients (mean age, 32.7 years; range 14-64 years) had undergone at least 1 prior hip arthroscopy (range, 1-6) and were prospectively assessed using the modified HHS at both baseline and 3, 12,

24 and 60 months postsurgery. FAI was treated in 79 revision cases. The mean improvement in the modified HHS for the FAI correction as the primary procedure was 27.4 months (mean follow-up, 44.7 months). The overall improvement for FAI correction revision was 21.9 points (mean follow-up, 43.5 months).

Section Summary: Revision Arthroscopic Surgery
The evidence for revision arthroscopic surgery for patients with residual FAI symptoms consists of 2 systematic reviews of observational studies. The observational studies, although low quality, showed consistently favorable functional outcomes following revision surgery. The evidence for revision arthroscopic surgery for children consists of 1 observational study. Results have shown that children receiving revision surgery have functional outcomes comparable to children receiving primary arthroscopic surgery.

Summary of Evidence
For individuals who are adults with asymptomatic FAI who receive FAI surgery, there is no direct evidence that the surgical treatment will prevent the development of OA. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Indirect evidence consists of observational studies. In retrospective studies of patients with OA, the relevant outcomes were radiographic evidence of hip joint malformations. In prospective studies of patients with FAI, the relevant outcome is progression to OA. Several large observational studies (>1000 patients), as well as smaller studies, have shown radiographic evidence of relationships between abnormal hip morphology and the development of OA. There have been no studies in which FAI surgery was performed on patients with FAI morphology but no symptoms. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who are adults with symptomatic FAI who receive FAI surgery, the evidence includes systematic reviews of large and small observational studies and a small RCT. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Open hip dislocation surgery and arthroscopic surgery are the most common surgical techniques performed on patients with FAI. Systematic reviews have evaluated open hip dislocation surgery and arthroscopic surgery, compared with no comparator, nonsurgical management, and other surgical techniques. Compared with nonsurgical management, all types of surgical techniques have resulted in significant improvements in functional outcomes, pain, and radiographic measurements. The reviews were limited when comparing surgical techniques with each other because patient characteristics and outcome measurements were heterogeneous among studies. The evidence is sufficient to determine the technology results in a meaningful improvement in the net health outcome.

For individuals who are children 15 years of age or younger with symptomatic FAI who receive FAI surgery, the evidence includes systematic reviews evaluating small observational studies and case series. Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease

status. While the studies reported reductions in pain and improvements in functional outcomes, the sample sizes were relatively small, with an average of 54 patients per study. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who are children 15 years of age or younger with slipped capital femoral epiphysis–associated FAI who receive FAI surgery, the evidence includes small observational studies (range, 19-51 patients). Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. While most patients experienced symptom relief following FAI surgery, the surgery is invasive and complications (eg, nonunions) were reported. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have residual FAI symptoms following a primary surgery who receive revision arthroscopic surgery, the evidence includes systematic reviews of observational studies (>400 patients). Relevant outcomes are symptoms, functional outcomes, health status measures, quality of life, and change in disease status. Though the studies were of low quality, consistent improvements in functional outcomes, pain relief, and patient satisfaction were reported, in some cases beyond 3 years. The evidence is sufficient to determine the technology results in a meaningful improvement in the net health outcome.

Supplemental Information

Clinical Input From Physician Specialty Societies and Academic Medical Centers
While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to requests, input was received from 2 physician specialty societies (3 reviewers) and 2 academic medical centers while this policy was under review in 2009. All input supported the use of open or arthroscopic surgery as an appropriate treatment for femoroacetabular impingement in selected patients when conservative treatment has failed.

Practice Guidelines and Position Statements

National Institute for Health and Care Excellence
In 2011, the National Institute for Health and Care Excellence (NICE) issued guidance on arthroscopic femoroacetabular surgery for hip impingement syndrome.[50] NICE considered the evidence on the efficacy of arthroscopic femoroacetabular surgery for hip impingement syndrome to be adequate for symptom relief in the short and medium term.

NICE's 2011 guidance on open femoroacetabular surgery for hip impingement syndrome indicated that evidence for this procedure was adequate for symptom relief in the short and medium term.[51] This guidance replaced IPG203.

U.S. Preventive Services Task Force Recommendations
Not applicable.

Medicare National Coverage
There is no national coverage determination. In the absence of a national coverage determination, coverage decisions are left to the discretion of local Medicare carriers.

Ongoing and Unpublished Clinical Trials
Currently unpublished trials that might influence this review are listed in Table 1.

Table 1. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
Ongoing			
NCT01893034	A Randomised Controlled Trial of Surgical Versus Non-surgical Treatment of Femoroacetabular Impingement - Trial for Femoroacetabular Impingement Treatment (FAIT)	120	Jul 2017 (ongoing)
NCT02306525	Outcome after Arthroscopic Treatment of Patients in Horsens and Aarhus with Femoroacetabular Impingement: the HAFAI Cohort	90	Dec 2017 (ongoing)
NCT01623843	Femoroacetabular Impingement RandomiSed Controlled Trial (FIRST)	220	Dec 2019
NCT02692807	Arthroscopic Surgical Procedures Versus Sham Surgery for Patients with Femoroacetabular Impingement and/or Labral Tears: a Multicenter, International, Double-Blinded, Randomized Controlled Trial (HIPARTI)	140	Dec 2035

NCT: national clinical trial.

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Billing Coding/Physician Documentation Information

29914	Arthroscopy, hip, surgical; with femoroplasty (i.e., treatment of cam lesion)
29915	Arthroscopy, hip, surgical; with acetabuloplasty (i.e., treatment of pincer lesion)
29916	Arthroscopy, hip, surgical; with labral repair

ICD-10 Codes

M24.151-M24.159	Other articular cartilage disorders, hip, code range
M24.851-M24.859	Other specific joint derangements of hip, not elsewhere classified code range
M25.551-M25.559	Pain in hip code range
M25.851-M25.859	Other specified joint disorders code range
M94.251-M94.259	Chondromalacia, hip, code range
S79.811A-S79.929S	Other specified or unspecified injuries of hip and thigh code range

There are no specific CPT codes for the open treatment of FAI. The procedure might be coded using code 27299 (unlisted procedure, pelvis or hip joint).

Additional Policy Key Words

N/A

Policy Implementation/Update Information

11/1/09	New policy. May be considered medically necessary.
11/1/10	No policy statement changes.
1/1/11	Coding updated.
11/1/11	No policy statement changes.
11/1/12	No policy statement changes.

11/1/13 Policy statement revised regarding age restrictions. Age restriction on older adults removed; age restriction on pediatric patients clarified.
11/1/14 No policy statement changes.
11/1/15 No policy statement changes.
11/1/16 No policy statement changes.
11/1/17 No policy statement changes.
11/1/18 No policy statement changes.