Surgical Treatment of Femoroacetabular Impingement

Policy Number:
MM.06.014
Line(s) of Business:
HMO; PPO; QUEST Integration
Section:
Surgery
Place(s) of Service:
Outpatient

Original Effective Date:
10/01/2010
Current Effective Date:
07/27/2018

I. Description

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 before the onset of osteoarthritis (OA) 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

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 (e.g., 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, known as cam impingement and pincer impingement, 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.

Surgical Techniques for Treating FAI

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.

FAI in Association With SCFE

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 onset of a limp. SCFE occurs most frequently in children between the ages of 10 to

16. In a study of patients reaching skeletal maturity after being 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. 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 increased risk of adverse events.

REGULATORY STATUS

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

II. Criteria/Guidelines

Open or arthroscopic treatment of femoroacetabular impingement (FAI) is covered (subject to Limitations and Administrative Guidelines) when all of the following conditions have been met:

A. Age: Candidates should be skeletally mature with documented closure of growth plates (e.g., >15 of age).

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

C. Imaging:
   1. Morphology indicative of cam or pincer-type FAI, e.g., pistol-grip deformity, femoral head-neck offset with an alpha angle greater than 50°, a positive wall sign, acetabular retroversion (overcoverage with crossover sign), coxa profunda or protrusion, or damage of the acetabular rim; AND
   2. 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
   3. No evidence of advanced osteoarthritis, defined as Tonnis grade II or III, or joint space of less than 2 mm; AND
   4. No evidence of severe (Outerbridge grade IV) chondral damage.

III. Limitations

Treatment of FAI is not covered in all other situations.

IV. Administrative Guidelines

A. Precertification is not required. Documentation supporting the medical necessity should be legible, maintained in the patient's medical record and must be made available to HMSA upon request. HMSA reserves the right to perform retrospective review using the above criteria to validate if services rendered met payment determination criteria

B. Applicable CPT codes: CPT	Description
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

C. 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).

V. Scientific Background

This policy was created in 2009 and updated periodically using the MEDLINE database. The most recent literature update was performed throughMarch 8, 2018**.**

ADULTS WITH ASYMPTOMATIC FEMOROACETABULAR IMPINGEMENT
Currently, there are no studies providing evidence on the effect of femoroacetabular impingement (FAI) surgery on asymptomatic adults with FAI morphology for the prevention of osteoarthritis (OA). Indirect evidence consists of observational studies that demonstrate a relation between FAI and OA.

Observational Studies
In 2016, Oner et al 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 by Beck et al (2001) with Ganz as coauthor has described the potential relation between hip morphology and acetabular damage. In this report, a total of 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 et al 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. As of 2011, Reichenbach et al (with Ganz as coauthor) have reported that 1080 asymptomatic young men in the Sumiswald Cohort had undergone clinical examination and completed the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the EuroQoL health-related quality-of-life (QOL) questionnaire. Of these, 244 randomly selected subjects (mean age, 19.9 years) underwent magnetic resonance imaging (MRI) 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 (BMI), 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 2014 population-based cohort study by Thomas and colleagues found that subclinical deformities of the hip, including cam-type FAI, were significant predictors of radiographic OA and joint replacement in women. A cohort of 1003 women who underwent pelvis radiographs at years 2 and 20. At 20 years, blinded radiographic analysis was available for 670 hips (46%), of which 70 (11%) showed OA. Data on total hip replacement at the 20 year assessment was available for 1455 hips (99%), of which 40 (3%) had undergone replacement. Pincer-type FAI at year 2 was not significantly associated with radiographic OA. Cam-type FAI at year 2 of the study, determined by alpha angle and Gosvig's Triangular Index Height, was significantly associated with development of radiographic OA and THR. Each degree increase in alpha angle above 65˚ was associated with an increase in risk of 5% for radiographic OA and 4% for THR. This finding is limited by the low rate of participants having both baseline and follow-up radiographs.

In 2010, Gosvig and colleagues published findings from a cross-sectional radiographic and questionnaire database of 4151 individuals from the Copenhagen Osteoarthritis study. Subjects in this population-based cohort were selected according to a random Social Security number algorithm between 1991 and 1994. Excluding subjects with hip replacement surgery, Perthes disease, childhood hip disease, rheumatoid arthritis, radiographs with excessive rotation, or unreadable radiographs resulted in 3620 subjects who met the study criteria. The study group consisted of 1332 men with a mean age of 60.0 years (range, 22-90 years) and 2288 women with a mean age of 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 2 on the basis of radiographic criteria. The male and female prevalence of hip-joint malformations was 71% and 36.6%, respectively. The prevalence of hip OA, defined radiographically as a minimum joint-space width of 2 mm or less, was 9.5% in men and

11.2% in women. Although there was no significant increase in the reporting of deep groin pain in subjects with hip-joint malformations (p>0.13), a deep acetabular socket or pistol-grip deformity were significant risk factors in the development of hip OA (risk ratio, 2.4 and 2.2, respectively).

A 2009 study from Asia reviewed records of 817 patients (946 hips) who underwent primary surgery for OA or other diseases of the hip to determine the prevalence of FAI in this population. 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) 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 retrospectively examined progression of OA of 43 patients (43 hips) younger than 55 years of age with a history of symptomatic idiopathic arthritis, first seen no later than 1997, who exhibited pistol-grip deformity of the femur and mild-to-moderate OA (Tonnis grade 1 or 2) at baseline. Radiographs taken at least 10 years apart 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 the only significant independent predictors for progression of OA in this small sample. A reduction of 1° in the medial proximal angle increased the odds of the OA progressing by 21 times, while OA in a hip with a positive posterior wall sign (the center of the femoral head located lateral to the outline of the of the posterior acetabular rim) 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 in 100% of the patients with idiopathic arthritis.

Kim and colleagues reviewed outcomes of 43 patients (mean age, 40 years; range, 18–68 years) who had labral tears and early OA (Tonnis grade 0 to 1, average Japanese Orthopedic Association [JOA] scores <1) and symptoms lasting 3 months or more who had been treated with débridement. At an average 50 month follow-up (12–96 months), 74% of patients had improved, with 11 showing no improvement. Blinded evaluation of preoperative radiographs and magnetic resonance arthrograms (MRA) indicated that 42% of patients had FAI. The JOA scale ranges from 0 (severe pain) to 3 (no pain). Patients treated only with débridement were less likely to improve if early-stage OA or FAI was present at the time of surgery (JOA 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 OA from developing. 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 are: 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 2013 systematic review by Harris et al 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 (randomized controlled trial [RCT]). 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 (MHHS) values improved significantly, regardless of 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

In a 2008 systematic review, Bedi et al evaluated the management of labral tears and FAI. Seven of the 19 studies assessed were case series of patients with FAI treated with open hip dislocation. Several of these studies are briefly described next.

In 2004, Beck et al 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. 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 4- to 5-year follow-up, 5 (26%) patients had undergone THA, due to cartilage damage.

In 2006, Espinosa et al compared the effect of reattaching (n=35) or removing (n=25) the labrum during treatment for FAI. 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.

Also in 2006, Peters and Erickson reported on 29 patients (30 hips) in a prospective study with minimum 2-year follow-up. 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 studiesa small RCT and stand-alone observational studies

Systematic Reviews

In 2017, Kierkegaard et al published a systematic review and meta-analysis on patients with FAI who had undergone hip arthroscopy. 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 cohort, and 1 RCT. The RCT by Krych et al (2013) is described below in the next section. 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 used 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 report 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 of arthroscopic labral repair versus labral débridement was reported by Krych et al (2013). 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) compared with 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). A greater number of 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 changes in QOL in a prospective series of 612 patients treated by a single surgeon. 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 in 9%.

Philippon et al (2012) evaluated outcomes following arthroscopic treatment for FAI in 153 consecutive patients ages 50 years or older. Mean age of patients was 57 years (range, 50-77 years). The prospective database included range of motion, MHHS, 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 MHHS 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 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.

In 2012, Palmer et al reported on a prospective 3-year follow-up of 201 procedures for cam-type FAI with a Tonnis grade of 1 or less. 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 cm2, 60% underwent hip replacement at a mean of 21.7 months (range, 2-29 months).

Javed and O'Donnell (2011) reported arthroscopic treatment for cam-type FAI in 40 patients older than 60 years of age (mean, 65 years; range, 60-82 years). MHHS 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 MHHS 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). 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 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 lower HHS.

A 2010 study by Horisberger et al reported on outcomes for 20 patients who showed generalized severe cartilage lesions during intraoperative arthroscopic assessment for FAI. Nine hips had Tonnis grade I OA, 6 had grade II, and 5 had grade III OA. 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 III 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 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. Of the 100 patients available for follow-up, 90 (90%) improved from an average MHSS 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. 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 10-month follow-up (3 months to 3 years) for 96 patients (100 hips) who presented with FAI and underwent arthroscopy. 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 heterotopic bone formation. VAS 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

In 2016, Zhang et al published a systematic review of studies comparing the efficacy and safety of hip arthroscopy with open surgical dislocation for the treatment of FAI. 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 MHHS and HOS scales for ADLs and sports were equivalent between the groups. Complications were also similar between the 2 groups, though reoperation rates were significantly lower in patients undergoing arthroscopy (RR=0.4; 95% CI, 0.17 to 0.95).

In 2016, Nwachukwu et al published a systematic review and meta-analysis comparing open with arthroscopic surgical techniques for the treatment of FAI. 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 mean follow-up of 58 months from the open surgery studies and from 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 are limited by outcome instrument heterogeneity. Both surgical techniques demonstrated favorable outcomes using their respective measuring systems.

Several systematic reviews comparing open and arthroscopic surgery for FAI have been identified. Matsuda et al (2011) included 18 level III or IV studies (controlled cohort or case series) with a minimum 1-year follow-up. There were 6 studies on open surgical dislocation, 4 on mini-open procedures, and 8 arthroscopic studies. All 3 approaches were found to be effective in reducing pain and improving function in short-term to mid-term studies. Open dislocation surgery had a comparatively high major complication rate primarily because of trochanteric osteotomy-related issues. The mini-open method showed comparable efficacy but a 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. 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 in 2013. 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 (WOMAC, 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 a matched-pair comparison of open and arthroscopic treatment of FAI. 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 , diagnosis of FAI, 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 higher in the arthroscopic group. There was no significant difference between groups in the MHHS, HOS ADLs scale, or VAS for pain.

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). 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 treatment of FAI was reported by Laude et al (2009) for 97 patients (100 hips). 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 increased 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 for the treatment of adults with FAI consists of systematic reviews of observational studies and 1 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 two case series published after one of the systematic reviews. The systematic reviews, a case series in one of the systematic reviews, and the 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. 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.

The 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. 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 the 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 2013 multicenter prospective study of arthroscopic treatment for cam-type FAI in 34 skeletally immature adolescents with open growth plates (41 hips). 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.

In 2017, Guindani et al 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 instituion. 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: MHHS, NAHS, and SF-12. No significant improvements were found in sphericity deviation score or on α angles (both anteroposterior and Lauenstein views).

Nwachukwu et al (2017) reviewed an institutional hip preservation registry of patients with FAI who underwent hip arthroscopy. 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 two case series. All studies reported favorable outcomes in pain reduction and functional improvements, but all studies had relatively small sample sizes and lacked sufficiently long follow-up. No serious adverse events were reported.

ADOLESCENTS AND 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

In 2017, Guindani et al published results for patients less than 18 years of age undergoing surgical dislocation for several indications. 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 α angles (both anteroposterior and Lauenstein views). No significant improvements were found in MHHS, SF-12, or sphericity deviation scores.

Sink et al (2010) reported on a retrospective review from 2 U.S. centers evaluating 36 patients (39 hips) with stable SCFE who were treated with open surgical hip dislocation for chronic symptoms. 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 retrospective review 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. 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.

The same U.S. institution reported in 2006 on 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. 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 of 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 ARTHROCOPIC SURGERY

The evidence for revision arthroscopic surgery to treat patients with residual FAI consists of 2 systematic reviews published in 2015, as well as an observational study on patients 18 years of age or younger, published after the reviews.

Systematic Reviews

In 2015, Sardana et al published a systematic review on revision hip arthroscopy, searching for articles through July 2014. Three prospective case-control studies and 3 retrospective chart reviews, providing information on 448 hips, were included in the review. 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 resulted in improved functional outcomes (33.6% improvement in HHS) and pain relief. Reviewers noted that the studies were low quality (level III and IV).

The 2015 systematic review, by Cvetanovich et al, evaluated revision hip arthroscopy. The review included 5 studies, with a total of 348 revision hip arthroscopies. 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%). Revision hip arthroscopy resulted in improved functional outcomes, as measured by the HHS (WMD, 56.8 preoperative vs 72.0 at mean 22.4-month follow-up; p=0.01), NAHS, HOS, and SF-12.

Observational Study

A 2016 case-control study by Newman et al compared outcomes after revision hip arthroscopy with outcomes after primary hip arthroscopy among patients 18 years of age and younger. 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 a minimum of 2 years. There were no significant differences between groups in HOS ADLs scale and SF-12 PCS. However, the primary arthroscopic surgery group had significantly higher scores in HOS sports scale, HHS, and patient satisfaction.

Gwathmey et al (2017) reported on outcomes for 186 patients (190 hips) who underwent revision hip arthroscopy. 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 consistent 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

Femoroacetabular impingement (FAI) results from localized compression in the joint due to an anatomic mismatch between the head of the femur and the acetabulum. Symptoms of impingement typically occur in young to middle-aged adults before the onset of osteoarthritis (OA) but may be present in younger patients with developmental hip disorders. The objective of surgical treatment of FAI is to provide symptom relief 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.

ONGOING AND UNPUBLISHED CLINICAL TRIALS

Some ongoing and unpublished trials that might influence this policy are listed in Table 1.

Table 1. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
Ongoing			
NCT01623843	Femoroacetabular Impingement RandomiSed Controlled Trial (FIRST)	220	June 2017
NCT01893034	A Randomised Controlled Trial of Surgical Versus Non-surgical Treatment of Femoroacetabular Impingement - Trial for Femoroacetabular Impingement Treatment (FAIT)	120	July 2017
NCT02306525	Outcome after Arthroscopic Treatment of Patients in Horsens and Aarhus with Femoroacetabular Impingement: the HAFAI Cohort	90	Dec 2017
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

SUPPLEMENTAL INFORMATION

Clinical Input Received through 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 through 2 physician specialty societies (3 reviewers) and 2 academic medical centers while this policy was under review in 2009. All 5 inputs supported open or arthroscopic surgery for FAI as an appropriate treatment for selected patients when conservative treatment has failed.

Practice Guidelines and Position Statements

National Institute for Health and Care Excellence
In 2011, the U.K.'s National Institute for Health and Clinical Excellence (NICE) issued revised guidance on arthroscopic femoroacetabular surgery for hip impingement syndrome. NICE considers current evidence on the efficacy of arthroscopic femoroacetabular surgery for hip impingement syndrome to be adequate in terms of symptom relief in the short and medium term.

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

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

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

VI. Important Reminder

The purpose of this Medical Policy is to provide a guide to coverage. This Medical Policy is not intended to dictate to providers how to practice medicine. Nothing in this Medical Policy is intended to discourage or prohibit providing other medical advice or treatment deemed appropriate by the treating physician.

Benefit determinations are subject to applicable member contract language. To the extent there are any conflicts between these guidelines and the contract language, the contract language will control.

This Medical Policy has been developed through consideration of the medical necessity criteria under Hawaii's Patients' Bill of Rights and Responsibilities Act (Hawaii Revised Statutes § 432E-1.4), generally accepted standards of medical practice, and review of medical literature and government approval status. HMSA has determined that services not covered under this Medical Policy will not be medically necessary under Hawaii law in most cases. If a treating physician disagrees with HMSA's determination as to medical necessity in a given case, the physician may request that HMSA reconsider the application of the medical necessity criteria to the case at issue in light of any supporting documentation.

VII. References

1. Oner A, Koksal A, Sofu H, et al. The prevalence of femoroacetabular impingement as an aetiologic factor for end-stage degenerative osteoarthritis of the hip joint: analysis of 1,000 cases. Hip Int. Mar-Apr 2016;26(2):164-168.
2. Beck M, Kalhor M, Leunig M, et al. Hip morphology influences the pattern of damage to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. J Bone Joint Surg Br. 2005; 87(7):1012-1018.
3. Reichenbach S, Leunig M, Werlen S, et al. Association between cam-type deformities and magnetic resonance imaging-detected structural hip damage: a cross-sectional study in young men. Arthritis Rheum. 2011; 63(12):4023-4030.
4. Thomas GE, Palmer AJ, Batra RN, et al. Subclinical deformities of the hip are significant predictors of radiographic osteoarthritis and joint replacement in women. A 20 year longitudinal cohort study. Osteoarthritis Cartilage. Oct 2014;22(10):1504-1510.
5. Gosvig KK, Jacobsen S, Sonne-Holm S, et al. Prevalence of malformations of the hip joint and their relationship to sex, groin pain, and risk of osteoarthritis: a population-based survey. J Bone Joint Surg Am. 2010; 92(5):1162-1169.
6. Takeyama A, Naito M, Shiramizu K, et al. Prevalence of femoroacetabular impingement in Asian patients with osteoarthritis of the hip. Int Orthop. Oct 2009; 33(5):1229-1232.
7. Bardakos NV, Villar RN. Predictors of progression of osteoarthritis in femoroacetabular impingement: a radiological study with a minimum of ten years follow-up. J Bone Joint Surg Br. Feb 2009; 91(2):162-169.
8. Tanzer M, Noiseux N. Osseous abnormalities and early osteoarthritis: the role of hip impingement. Clin Orthop Relat Res. Dec 2004; (429):170-177.
9. Kim KC, Hwang DS, Lee CH, et al. Influence of femoroacetabular impingement on results of hip arthroscopy in patients with early osteoarthritis. Clin Orthop Relat Res. Mar 2007; 456:128-132.
10. Wall PD, Brown JS, Parsons N, et al. Surgery for treating hip impingement (femoroacetabular impingement). Cochrane Database Syst Rev. 2014;9:CD010796.
11. Harris JD, Erickson BJ, Bush-Joseph CA, et al. Treatment of femoroacetabular impingement: a systematic review. Curr Rev Musculoskelet Med. Sep 2013; 6(3):207-218.
12. Bedi A, Chen N, Robertson W, et al. The management of labral tears and femoroacetabular impingement of the hip in the young, active patient. Arthroscopy. Oct 2008; 24(10):1135-1145.
13. Beck M, Leunig M, Parvizi J, et al. Anterior femoroacetabular impingement: part II. Midterm results of surgical treatment. Clin Orthop Relat Res. Jan 2004; (418):67-73.
14. Espinosa N, Rothenfluh DA, Beck M, et al. Treatment of femoro-acetabular impingement: preliminary results of labral refixation. J Bone Joint Surg Am. May 2006; 88(5):925-935.
15. Peters CL, Erickson JA. Treatment of femoro-acetabular impingement with surgical dislocation and debridement in young adults. J Bone Joint Surg Am. Aug 2006; 88(8):1735-1741.
16. Kierkegaard S, Langeskov-Christensen M, Lund B, et al. Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis. Br J Sports Med. Apr 2017;51(7):572-579.

17. Krych AJ, Thompson M, Knutson Z, et al. Arthroscopic labral repair versus selective labral debridement in female patients with femoroacetabular impingement: a prospective randomized study. Arthroscopy, Jan 2013; 29(1):46-53.
18. Minkara AA, Westermann RW, Rosneck J, et al. Systematic review and meta-analysis of outcomes after hip arthroscopy in femoroacetabular impingement. Am J Sports Med. Jan 1 2018:363546517749475. PMID 29373805
19. Lund B, Mygind-Klavsen B, Gronbech Nielsen T, et al. Danish Hip Arthroscopy Registry (DHAR): the outcome of patients with femoroacetabular impingement (FAI). J Hip Preserv Surg. Jul 2017;4(2):170-177. PMID 28630739
20. Malviya A, Stafford GH, Villar RN. Impact of arthroscopy of the hip for femoroacetabular impingement on quality of life at a mean follow-up of 3.2 years. J Bone Joint Surg Br. Apr 2012; 94(4):466-470.
21. Philippon MJ, Schroder ESBG, Briggs KK. Hip arthroscopy for femoroacetabular impingement in patients aged 50 years or older. Arthroscopy. Jan 2012; 28(1):59-65.
22. Palmer DH, Ganesh V, Comfort T, et al. Midterm outcomes in patients with cam femoroacetabular impingement treated arthroscopically. Arthroscopy. Nov 2012; 28(11):1671-1681.
23. Javed A, O'Donnell JM. Arthroscopic femoral osteochondroplasty for cam femoroacetabular impingement in patients over 60 years of age. J Bone Joint Surg Br. Mar 2011; 93(3):326-331
24. Larson CM, Giveans MR, Taylor M. Does arthroscopic FAI correction improve function with radiographic arthritis? Clin Orthop Relat Res. Jun 2011; 469(6):1667-1676.
25. Horisberger M, Brunner A, Herzog RF. Arthroscopic treatment of femoral acetabular impingement in patients with preoperative generalized degenerative changes. Arthroscopy. May 2010; 26(5):623-629.
26. Philippon MJ, Briggs KK, Yen YM, et al. Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: minimum two-year follow-up. J Bone Joint Surg Br. Jan 2009; 91(1):16-23.
27. Byrd JW, Jones KS. Arthroscopic femoroplasty in the management of cam-type femoroacetabular impingement. Clin Orthop Relat Res. Mar 2009; 467(3):739-746.
28. Larson CM, Giveans MR. Arthroscopic management of femoroacetabular impingement: early outcomes measures. Arthroscopy. May 2008; 24(5):540-546.
29. Zhang D, Chen L, Wang G. Hip arthroscopy versus open surgical dislocation for femoroacetabular impingement: A systematic review and meta-analysis. Medicine (Baltimore). Oct 2016;95(41):e5122.
30. Nwachukwu BU, Rebolledo BJ, McCormick F, et al. Arthroscopic versus open treatment of femoroacetabular impingement: a systematic review of medium- to long-term outcomes. Am J Sports Med. Apr 2016;44(4):1062-1068.
31. Matsuda DK, Carlisle JC, Arthurs SC, et al. Comparative systematic review of the open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. Arthroscopy. Feb 2011; 27(2):252-269
32. Botser IB, Smith TW, Jr., Nasser R, et al. Open surgical dislocation versus arthroscopy for femoroacetabular impingement: a comparison of clinical outcomes. Arthroscopy. Feb 2011; 27(2):270-278.

33. Papalia R, Del Buono A, Franceschi F, et al. Femoroacetabular impingement syndrome management: arthroscopy or open surgery? Int Orthop. May 2012; 36(5):903-914.
34. Zingg PO, Ulbrich EJ, Buehler TC, et al. Surgical hip dislocation versus hip arthroscopy for femoroacetabular impingement: clinical and morphological short-term results. Arch Orthop Trauma Surg. Jan 2013; 133(1):69-79.
35. Domb BG, Stake CE, Botser IB, et al. Surgical dislocation of the hip versus arthroscopic treatment of femoroacetabular impingement: a prospective matched-pair study with average 2-year follow-up. Arthroscopy. Sep 2013; 29(9):1506-1513.
36. Chiron P, Espie A, Reina N, et al. Surgery for femoroacetabular impingement using a minimally invasive anterolateral approach: analysis of 118 cases at 2.2-year follow-up. Orthop Traumatol Surg Res. Feb 2012;98(1):30-38.
37. Laude F, Sariali E, Nogier A. Femoroacetabular impingement treatment using arthroscopy and anterior approach. Clin Orthop Relat Res. Mar 2009; 467(3):747-752.
38. de Sa D, Cargnelli S, Catapano M, et al. Femoroacetabular impingement in skeletally immature patients: a systematic review examining indications, outcomes, and complications of open and arthroscopic treatment. Arthroscopy. Feb 2015;31(2):373-384.
39. Tran P, Pritchard M, O'Donnell J. Outcome of arthroscopic treatment for cam type femoroacetabular impingement in adolescents. ANZ J Surg. Sep 3 2013; 83(5):382-386.
40. Guindani N, Eberhardt O, Wirth T, et al. Surgical dislocation for pediatric and adolescent hip deformity: clinical and radiographical results at 3 years follow-up. Arch Orthop Trauma Surg. Apr 2017;137(4):471-479.
41. Nwachukwu BU, Chang B, Kahlenberg CA, et al. Arthroscopic treatment of femoroacetabular impingement in adolescents provides clinically significant outcome improvement. Arthroscopy. Oct 2017;33(10):1812-1818. PMID 28623078
42. Sink EL, Zaltz I, Heare T, et al. Acetabular cartilage and labral damage observed during surgical hip dislocation for stable slipped capital femoral epiphysis. J Pediatr Orthop. Jan-Feb 2010;30(1):26-30.
43. Ziebarth K, Zilkens C, Spencer S, et al. Capital realignment for moderate and severe SCFE using a modified Dunn procedure. Clin Orthop Relat Res. Mar 2009; 467(3):704-716.
44. Spencer S, Millis MB, Kim YJ. Early results of treatment of hip impingement syndrome in slipped capital femoral epiphysis and pistol grip deformity of the femoral head-neck junction using the surgical dislocation technique. J Pediatr Orthop. May-Jun 2006; 26(3):281-285.
45. Sardana V, Philippon MJ, de Sa D, et al. Revision hip arthroscopy indications and outcomes: a systematic review. Arthroscopy. Oct 2015;31(10):2047-2055.
46. Cvetanovich GL, Harris JD, Erickson BJ, et al. Revision hip arthroscopy: a systematic review of diagnoses, operative findings, and outcomes. Arthroscopy. Jul 2015;31(7):1382-1390.
47. Newman JT, Briggs KK, McNamara SC, et al. Outcomes after revision hip arthroscopic surgery in adolescent patients compared with a matched cohort undergoing primary arthroscopic surgery. Am J Sports Med. Dec 2016;44(12):3063-3069.
48. Gwathmey FW, Jones KS, Thomas Byrd JW. Revision hip arthroscopy: findings and outcomes. J Hip Preserv Surg. Dec 2017;4(4):318-323. PMID 29250340
49. National Institute for Health and Clinical Excellence (NICE). Arthroscopic femoro-acetabular surgery for hip impingement syndrome. IPG 408. 2011; http://www.nice.org.uk/guidance/ipg408. Accessed March, 16, 2017.

50. National Institute for Health and Care Excellence (NICE). Open femoro-acetabular surgery for hip impingement syndrome (IPG403). 2011; http://guidance.nice.org.uk/IPG403. Accessed March, 16, 2017.
51. Blue Cross Blue Shield Association. Medical Policy Reference Manual: Surgical Treatment of Femoroacetabular Impingement #7.01.118. Reviewed April 2018.