## Medical Policy

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## Title:        Surgical Treatment of Femoroacetabular Impingement

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## DESCRIPTION

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 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.

## Background

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 (for example, 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. It has been proposed that impingement with damage to the labrum and/or acetabulum is a causative factor in the development of hip osteoarthritis and that as many as half of cases currently categorized as primary osteoarthritis may have an etiology of FAI.

Previously, access to the joint space was limited, and treatment primarily consisted of debridement and/or labral reattachment. 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 (the association between abnormal femoral head/neck morphology and early age onset of osteoarthritis had been described earlier by others) 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 adapted from the open approach by 2004. Arthroscopy requires specially designed instruments and is considered to be more technically difficult due to reduced visibility and limited access to the joint space. Advanced imaging techniques, including computed tomography (CT) and fluoroscopy, have been utilized to improve visualization of the 3-dimensional head/neck morphology during arthroscopy.

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. It is believed that if FAI presents with limitations in hip range of motion, compensatory patterns during athletic activity may lead to increased stresses involving the abdominal obliques, distal rectus abdominis, pubic symphysis, and adductor musculature. The condition is more common in men than in women and is associated with sports in which high speed twisting of the hip and pelvis occur (e.g., football, hockey). Under surgical exploration, a variety of musculotendinous defects, nerve entrapments, and inflammatory conditions have been observed. These defects are often discovered and repaired during open or minimally invasive exploratory laparoscopy. Surgery for athletic pubalgia has been performed concurrently with treatment of FAI or might be performed following FAI surgery if symptoms do not resolve.

The recognition and treatment of FAI has also brought attention to the possibility of cam-type FAI after slipped capital femoral epiphysis (SCFE). The standard treatment for SCFE is stabilization across the physis by in situ pinning, although it is not uncommon for patients with SCFE to develop premature osteoarthritis requiring total hip arthroplasty (THA) within 20 years. Treatments being evaluated 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. Therefore, early treatment to decrease impingement must be weighed against increased risk for adverse events including avascular necrosis in patients with SCFE.

It is known that surgical treatment of FAI pathology is less effective for pain reduction in patients with late stage osteoarthritis. In addition, delay in the surgical correction of bony abnormalities may lead to disease progression to the point at which joint preservation is no longer appropriate. 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 osteoarthritis, a future strategy to reduce the occurrence of idiopathic hip osteoarthritis could be early recognition and treatment of FAI before cartilage damage occurs.

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

   1.   Age
        a.   Candidates should be skeletally mature with documented closure of growth plates (e.g., ≥15).

   2.   Symptoms
        a.   Moderate-to-severe hip pain that is worsened by flexion activities (e.g., squatting or prolonged sitting) that significantly limits activities;

**AND**

b.   Unresponsive to conservative therapy for at least 3 months (including activity modifications, restriction of athletic pursuits, and avoidance of symptomatic motion);

**AND**

c.   Positive impingement sign on clinical examination (pain elicited with $90^{o}$ of flexion and internal rotation and adduction of the femur).

3.   Imaging

a.   Morphology indicative of cam or pincer-type FAI, e.g., pistol-grip deformity, femoral head-neck offset with an alpha angle greater than $50^{o}$, a positive wall sign, acetabular retroversion (overcoverage with crossover sign), coxa profunda or protrusion, or damage of the acetabular rim;
      **AND**

b.   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**

c.   No evidence of advanced osteoarthritis, defined as Tonnis grade II or III, or joint space of less than 2 mm;
      **AND**

d.   No evidence of severe (Outerbridge grade IV) chondral damage.

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


**Policy Guidelines**

If 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 3D CT. 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 before 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.

## RATIONALE

This policy was created in 2009 and updated periodically using the MEDLINE database. The most recent literature review was performed through April 2, 2014. The key issue for this policy is whether correction of femoroacetabular impingement (FAI) morphology with open or arthroscopic osteoplasty alters the development of symptomatic cartilage damage and hip osteoarthritis. Given the relatively recent recognition of FAI and development of interventional procedures, neither the natural history of FAI nor the effect of osteochondroplasty on the development of osteoarthritis is known. No randomized controlled trials (RCTs) were identified. Therefore, to evaluate the potential benefit of FAI with the evidence available at this time, studies were reviewed for the following:

- Evidence that FAI is an etiology of cartilage damage and hip osteoarthritis.
- Evidence for benefit of open or arthroscopic osteoplasty on pain and function in patients with FAI pathology. If there is benefit, what are the specific indications and the appropriate timing for surgical intervention?

**Natural History**

A frequently cited paper describing the relationship between hip morphology and acetabular damage is from the group of Ganz and Leunig, who had previously reported the open procedure with dislocation in 2001.(1) In this study, 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. Only hips with minor radiologic changes, with narrowing or osteophytes equivalent to an osteoarthrosis grade less than 1 according to the classification of Tonnis, were included. Excluded were hips with traumatic or post-traumatic conditions (n=37), avascular necrosis (n=14), and hips that had underdone previous surgery (n=7). Patients with incomplete or inadequate preoperative radiographs were also excluded. For the 26 hips that met the inclusion/exclusion criteria and showed 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 osteoarthritis and well-defined hip configurations, a strong association exists between specific hip morphology and the pattern of cartilage damage. The intent of the study was "to obtain unequivocal data" on the starting point of joint degeneration with FAI; damage in patients with more complex morphology was not described.

Population Studies. To address the gap in current knowledge, Ganz et al began a population-based natural history study in 2005 with a cohort of over 1000 young men to determine whether morphologic alterations are associated with an increased rate of early osteoarthritis. As of 2011, 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 qualityof- life (QOL) questionnaire.(2) Of these, 244 randomly selected subjects with a mean age of 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 asymptomatic men (27%). The primary outcome of labral lesions was found in a large proportion of subjects both with and without cam-type deformities; labral lesions were found 57 of 67 participants (85%) with a cam-type deformity and 118 of 177 participants (67%) without a deformity. Logistic regression models adjusted for age and body mass index (BMI) found an odds ratio (OR) 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 compared with those without in this cross-sectional study. As noted by the authors, longitudinal studies are needed to determine whether cam-type deformity is a risk factor for symptomatic hip osteoarthritis.

In 2010, Gosvig et al 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.(3) 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 osteoarthritis, 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 osteoarthritis (risk ratio [RR], 2.4 and 2.2, respectively).

The prevalence of a positive FAI impingement test was assessed in a population-based study of healthy 19-year-olds.(4) The study included questionnaires on medical and functional status, a clinical hip examination including the impingement test and hip range of motion, and 2 pelvic radiographs (anteriorposterior and frog-leg views). Of 1170 participants, 7.3% of men and 4.8% of women had positive impingement tests. Radiographic cam type findings were associated with positive tests in the men, but not women. A 2009 study from Asia reviewed records of 843 consecutive patients (978 hips) who underwent primary surgery for osteoarthritis or other diseases of the hip to determine the prevalence of FAI in this population.(5) Twenty-six patients (32 hips) were excluded due to insufficient radiographs or records, resulting in a study population of 817 patients (946 hips). The average age at the time of surgery was 54.8 years (range, 12-92 years). Most patients (73%) were diagnosed with osteoarthritis secondary to developmental dysplasia of the hip, another 12% had idiopathic osteonecrosis, and 1.7% had Legg-Calve-Perthes disease. Only 17 patients (1.8%) were considered to have had primary osteoarthritis. 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 osteoarthritis and 35% in the population with primary osteoarthritis.

Idiopathic Arthritis. Bardakos and Villar retrospectively examined progression of osteoarthritis 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 osteoarthritis (Tonnis grade 1 or 2) at baseline.(6) Radiographs taken at least 10

years apart showed progression of osteoarthritis 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 osteoarthritis in this small sample. A reduction of $1^o$ in the medial proximal angle increased the odds of the osteoarthritis progressing by 21 times, while osteoarthritis 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.

In another study, Tanzer and Noiseux reported that of 38 consecutive patients who were treated arthroscopically and who had a labral tear, 97% were found to have a pistol-grip deformity on preoperative radiographs.(7) These authors also reported that in 200 consecutive patients (200 hips) having primary total hip arthroplasty (THA), the underlying etiology of patients' arthritis was determined by their history and radiographic findings. All patients without a history or radiographic evidence of underlying hip disease were given the diagnosis of idiopathic hip arthritis. From the 125 cases diagnosed as idiopathic arthritis, 100% exhibited a pistol-grip deformity. Radiographs of the contralateral limb showed that 31% of patients had a healthy hip without a deformity or evidence of osteoarthritis, 14% had a deformity without evidence of arthritis, and 55% had a pistol-grip deformity and radiographic evidence of arthritis. A pistol-grip deformity was associated with arthritis later in life.

Kim et al reviewed outcomes of 43 patients (mean age, 40 years; range, 18-68 years) who had labral tears and early osteoarthritis (Tonnis grade 0 to 1, average Japanese Orthopedic Association [JOA] scores <1) and symptoms lasting 3 months or more who had been treated with debridement.(8) At an average 50 months' follow-up (12-96 months), 74% of patients had improved, with 11 showing no improvement. Blinded evaluation of preoperative radiographs and magnetic resonance (MR) arthrograms indicated that 42% of patients had FAI. When treated only with debridement, patients were less likely to improve if early stage osteoarthritis or FAI was present at the time of surgery. For example, on the JOA scale where 0 is severe pain to 3 is no pain, patients without either FAI or osteoarthritis scored 2.6 at follow-up, while patients with FAI scored 1.83, and those with both FAI and osteoarthritis scored 1.67.

SCFE. Sink et al reported a retrospective review from 2 U.S. centers on 36 patients (39 hips) with stable SCFE who were treated with open surgical hip dislocation for chronic symptoms.(9) The degree of slip was considered to be mild in 8, moderate in 19, and severe in 11 patients, and 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 that were consistent with impingement. All but 1 patient had either labral or cartilage injury, with labral injury observed in 34 of 39 hips and cartilage injury in 33 or 39 hips (5 grade 1, 10 grade 2, 4 grade 3, 10 grade 4, and 4 grade 5); 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.

Dodds et al examined the prevalence of FAI in 36 patients (49 hips) who returned for clinical evaluation at an average 6 years after SCFE.(10) There was no difference in the grade of slip between those patients who were available for follow-up and the total cohort treated for SCFE. The average age at presentation was 12.2 years, and at the time of evaluation, all patients had

reached skeletal maturity. Postoperative radiographs were reviewed for the grade of slip, Southwick slip angle, Loder's classification of physeal stability, and the anterior head-neck offset (alpha) angle. Pain and impingement were found in 30% of the 30 hips with grade 1 slips, 25% of the 8 hips with grade 2 slips, and 0% of the 4 hips with grade 3 slips. None of the radiographic factors including the grade of slip was predictive of subsequent impingement; the alpha angle was the most influential variable in regression analysis (p=0.63). Together, these results indicate that it is difficult to predict which patients with SCFE will develop FAI but that all children should be followed into adulthood and monitored for impingement.

Athletic Pubalgia. The incidence of athletic pubalgia symptoms in professional athletes with symptomatic FAI was reported by Hammoud et al in 2012.(11) Of 38 professional athletes who underwent arthroscopic treatment for FAI, 32% had previously undergone surgery for athletic pubalgia. While none of the patients had returned to their previous level of play after isolated athletic pubalgia surgery, all 12 patients with treatment of both athletic pubalgia and FAI returned to professional competition. In another subset of 15 patients who presented with both athletic pubalgia and FAI, both sets of symptoms resolved after treatment of FAI alone.

SECTION SUMMARY
Evidence on the natural history and long-term effect of treatment is limited due to the relatively recent recognition of this condition. Overall, the retrospective evidence available indicates a relatively strong association between cam-type impingement related to a pistol-grip deformity, labral damage, and the subsequent development of osteoarthritis. The identification of patients with FAI morphology who will progress to osteoarthritis (and perhaps more importantly those who are unlikely to progress) is limited at this time, although some evidence from retrospective studies is beginning to emerge. An association between FAI and athletic pubalgia is also emerging.

**Treatment of FAI With Arthroscopic or Open Approaches**
Bedi et al performed a systematic review of the literature on labral tears and FAI, with a literature review conducted in May 2008.(12) Level I, II, III, or IV study designs were included if the patient population had a labral tear and/or FAI as the major diagnosis. Patients with severe preexisting osteoarthritis or acetabular dysplasia were excluded. Of the 19 studies included, only 1 met the criteria for level III basis of evidence. The studies reviewed suggested that 65% to 85% of patients will be satisfied with their outcome at a mean of 40 months after surgery. All series reported an increased incidence of failure among patients with substantial preexisting osteoarthritis. The authors concluded that the quality of literature reporting outcomes of surgical intervention for labral tears and FAI is limited. A systematic review that included literature through April 2013 identified 29 studies (2369 patients); 83% were level IV evidence (case series), 14% were level III (cohort), and 3.4% were level I (RCT).(13) An arthroscopic approach was used in 59% of studies. The larger case series, including those published after the literature search for the systematic review by Bedi et al are described next.

Several systematic reviews comparing open and arthroscopic surgery for FAI have been identified.(14-16) Matsuda et al included 18 level III or IV studies (controlled cohort or case series) with a minimum 1-year follow-up.(14) 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 improving pain and function in shortterm to midterm 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 included 26 level II to IV articles totaling 1462 hips in 1409 patients.(15) Of these, 900 hips were treated arthroscopically, 304 with the open dislocation method, and 258 by the mini-open method. The mean time from onset of symptoms to surgery was 28 months. Overall complication rates were found to be 1.7% for the arthroscopic group, 9.2% for the open surgical dislocation group, and 16% for the combined approach group. For a 2012 review by Papalia et al, 31 studies (1713 patients) were identified that reported clinical, functional, and imaging outcomes after open or arthroscopic treatment of FAI.(16)

A direct comparison of arthroscopic and open treatment of FAI was reported by Zingg et al in 2013.(17) Of 200 patients with FAI who were invited to participate in this prospective study, 10 patients agreed to be randomly allocated to arthroscopy or open surgical hip dislocation, and 28 patients agreed to participate in the study but selected their preferred treatment. The open and arthroscopic groups were generally comparable at baseline. Arthroscopic treatment of FAI resulted in a shorter hospital stay (3 vs 5 days) and less time off work. The Harris Hip Score (HHS) was improved compared with open treatment at 6 weeks, 3 months, and 12 months. Overall, pain scores (WOMAC and visual analog scale [VAS]) were lower with arthroscopy, reaching statistical significance on about half of the time points. Compared with the open surgical approach, arthroscopy resulted in morphologic over-corrections at the head-neck junction.

Domb et al reported a matched-pair comparison of open vs arthroscopic treatment of FAI.(18) Patients chose the procedure 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, gender, 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, the improvements in in the Hip Outcome Score (HOS) Sport-Specific subscale (42.8 vs 23.5) and Non-Arthritic Hip Score (94.2 vs 85.7) were significantly higher in the arthroscopic group. There was no significant difference between the groups in the modified HHS, HOS-activities of daily living, or VAS for pain.

ARTHROSCOPIC APPROACH
At the time this policy was created, there were 4 prospective/consecutive case series with at least 100 patients/hips and 1 controlled cohort study. Literature updates have identified additional large series with longer follow-up.

The largest prospective series is by Malviya et al, who reported on changes in QOL for 612 patients who were treated by a single surgeon.(19) Patients ranged in age from 14 to 75 years (mean, 36.7). At 1 year after surgery, QOL scores on the Rosser Index improved by at least 1 grade in 76.6% of patients, were unchanged in 14.4%, and decreased in 9%. Byrd and Jones 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.(20) The average age of the patients was 33 (range not reported), with symptoms averaging 32 months and no sign of advanced osteoarthritis. At an average of 16 months (range, 12–24 months) after treatment, patients showed an average 20-point improvement (-17-60) on the 91-point MHHS. Eighty-three percent of patients were considered to be improved by the procedure.

In 2012, Palmer et al reported prospective 3-year follow-up on 201 procedures for cam-type FAI with a Tonnis grade of 1 or less.(21) The mean duration of symptoms before surgery was 59 months. At followup, the Nonarthritic Hip Score (NAHS) improved from a mean of 56.1 to 78.2 and 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 period compared with patients who did not undergo arthroplasty, and patients with pincer resection had poorer results (NAHS improvement, 16.1) compared to patients with only cam-type FAI (NAHS improvement, 23.9). Of the 93 patients who were able to return for a final postoperative radiograph, 91 (97.8%) had no change in the 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 who were 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).

Philippon et al reported 2.3 year follow-up (range, 2-2.9 years) on 100 of 209 prospectively enrolled consecutive patients who underwent hip arthroscopy for disabling pain.(22) Patients were included in the study report (n=122) if they underwent arthroscopic treatment for FAI and chondrolabral dysfunction and did not have bilateral hip arthroscopy, avascular necrosis, or previous surgery. Of the 100 patients available for follow-up, 90 (90%) improved from an average score of 58 to 84 on the MHHS, 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. Larson and Giveans reported 10-month follow-up (3 months to 3 years) from a consecutive series of 96 patients (100 hips) who presented with FAI.(23) The average age was 35 (range, 16-64 years). Following FAI treatment, the impingement test was reported to be better in 86% of patients, with good to excellent results in 75% of patients. Three patients (3%) 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.

Revision Surgery. Two case series were identified on revision arthroscopic treatment of FAI.(24,25) Philippon et al reported on 37 revisions of previous hip arthroscopies by the senior author (51%) or referred from other centers.(24) Radiographic evaluation showed evidence of impingement in 36 of 37 patients that was either not addressed (60%) or inadequately addressed (32%) at the time of the index procedure. Five of the revisions (14%) required repeat revision or total hip replacement and were considered failures. Average 1-year follow-up on 27 of 32 hips that did not fail revision showed improvement (mean, 77; range, 36-100) on the MHHS. Heyworth et al identified 24 revisions (23 patients) of a total of 450 patients who underwent a hip arthroscopy at their institution.(25) The mean interval between the primary hip arthroscopy and recurrence of symptoms was 6 months (range, 0-39 months). Radiographic evaluation showed evidence of bony impingement in 19 cases (79%). Of these, 10 had only soft tissue repair during the primary procedure, and 9 had débridement of bone; 7 of the 9 were considered to be inadequate. Although the revision rate for arthroscopic FAI cannot be determined from the data provided, the authors commented that even when bony lesions are fully recognized, there may be a tendency to insufficiently address them surgically. Revision arthroscopy was also reported in 16 patients for the treatment of adhesions following open surgical hip dislocation for FAI.(26)

Poor outcomes following arthroscopic treatment of FAI in patients with arthritis have been reported. Larson et al 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).(27) Although both groups had improved scores throughout 12-month follow-up, outcomes were better for patients without osteoarthritis than for patients with osteoarthritis. Patients with advanced preoperative joint space narrowing (n=22) showed no improvement after treatment for FAI. At 3-year follow-up, the mean HHS score was 88 for the group without osteoarthritis and 67 for the group with osteoarthritis. The failure rate at the last follow-up, defined as a MHHS less than 70 or conversion to hip arthroplasty, was 12% for patients without osteoarthritis, 33% for hips with mild to moderate preoperative joint space narrowing (<50% joint space narrowing or >2 mm joint space), and 82% failure rate 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 MRI, and greater duration of symptoms preoperatively were independent predictors for lower HHSs. Another study reported outcomes from 20 patients (of a series of 150) who showed generalized severe cartilage lesions during intraoperative arthroscopic assessment for FAI.(28) Nine hips had Tonnis grade I osteoarthritis, 6 had grade II, and 5 had grade III osteoarthritis. At a mean follow-up of 3 years, 10 patients (50%) had undergone, or planned to undergo, total hip replacement. Preoperatively, 5 of the 10 hips had Tonnis grade III osteoarthritis. Another 2 patients had a poor result at latest follow-up but were not yet willing to undergo THA. The mean time between the 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 does not have any effect beyond the short-term pain relief resulting from debridement.

Selection for Age. Philippon et al evaluated outcomes following arthroscopic treatment of FAI in 153 consecutive patients aged 50 years or older.(29) The mean age of the patients was 57 years (range, 50-77 years). The prospective database included range of motion, MHHS, HOS for activities of daily living, HOS for sports, and SF-12 score preoperatively and at 6-months after surgery. 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 the patients who did not require THA, the MHHS improved from 58 to 84, HOS for activities of daily living improved from 66 to 87, and HOS for sports improved from 42 to 72. The physical component of the SF-12 improved from 38 to 49, with no change in the mental component. 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 data available at 3 years, patients with greater than 2 mm of joint space preoperatively had survivorship of 90%, whereas those with 2 mm or less of joint space had survivorship of 57%. Logistic regression modeling adjusted for age and days from injury to surgery identified joint space of 2 mm or less and preoperative MHHS of less than 50 as risk factors for hip replacement.

Javed and O'Donnell reported arthroscopic treatment of cam-type FAI in 40 patients older than 60 years of age (mean, 65 years; range, 60-82).(30) Patients were excluded from this retrospective study if they had Tonnis grade 2 or 3 osteoarthritis, pincer FAI, bilateral cam FAI, inflammatory or metabolic hip disease, hip dysplasia, Perthes disease, and history of fracture of the hip or previous surgery on the hip. Forty patients fulfilled the inclusion/exclusion criteria of a total of 1693 hip arthroscopies (2.4%) performed at their institution. In 17 patients, there was no arthroscopic evidence of osteoarthritis in the hip; 23 had a variable degree of chondral loss from the acetabulum and/or femoral head. The MHHS and the nonarthritic hip score were collected preoperatively and at 2, 6, 26, and 52 weeks postoperatively, and then on an annual basis. Follow-up was performed for a mean of 30 months (range, 12-54 months). The mean MHHS

improved by 19.2 points (from 60.5 to 79.7), and the mean nonarthritic hip score improved by 15 points (62.1-77.2). Of this selected group of 40 patients with unilateral cam impingement, Tonnis grade 1 or less osteoarthritis, and a mean age of 63 years (range, 60-70), 7 (17.5%) underwent total hip replacement at a mean interval of 12 months. All but 1 had evidence of severe synovitis, 4 of the 7 patients had grade 3 chondral loss from both the acetabulum and femoral head, while 3 had a grade 3 lesion of the acetabular cartilage. No fractures of the femoral neck occurred during the follow-up period.

Arthroscopic treatment for cam type FAI in adolescents with open growth plates was reported in 2012-2013.(31) At a mean follow-up of 14 months (range, 1-2 years), prospectively collected data showed improvement on the MHHS from 77.39 to 94.15 and on the NAHS from 76.34 to 93.18. Of the 34 consecutive patients included in the study, 78.1% returned to full sporting activity. No complications (e.g., avascular necrosis, SCFE, fracture, growth plate arrest) were observed.

MIXED OPEN/ARTHROSCOPIC APPROACH
A mixed open/arthroscopic approach for treatment of FAI was reported by Laude et al in 97 patients (100 hips).(32) This technique allows direct visualization of the anterior femoral head-neck junction without dislocation. The average age of the patients was 33 (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. In 8 of these patients, the damaged part of the labrum was removed, and in 6 patients, osteochondroplasty of the head was performed to improve the groove at the head-neck junction. Another patient had heterotopic ossification. Eleven hips (12%) required THA at a mean of 40 months (range, 5-75 months). In the THA group, the acetabular lesions were deeper (10.9 mm vs 6 mm), and a higher percentage of Beck grade 5 was found (54% vs 7%). The best results were observed in patients younger than 40 years with a Tonnis grade of 0.

OPEN APPROACH
Seven case series of patients with FAI treated with the open approach and dislocation were identified in the systematic review by Bedi et al.(12) Two studies reported on 5 patients, and 5 studies reported results from 19 to 52 patients, with follow-up ranging from 24 to 60 months. The 5 studies are briefly described here.

Beck et al reported outcomes from 19 patients (average age, 36 years; range, 21-52 years) of 22 who had been selected from their database with confirmed clinical, radiographic, and MR arthrography diagnosis of FAI, had been treated with surgical dislocation of the hip, and had at least 4 years of followup.(33) Three patients were excluded based on a history of prior intra-articular surgery of the involved hip. Of the remaining 19, all had labral damage, and 18 had acetabular damage. By 4 to 5 years' follow-up, 5 patients (26%) had undergone THA, with the failures associated with cartilage damage. Thirteen patients (68%) were reported to have had good to excellent outcomes.

Another study selected 52 of 141 consecutive patients to compare the effect of reattaching or removing the labrum during treatment for FAI.(34) Patients were selected for age (20-40 years) and no prior surgery; all had preoperative evidence of acetabular damage. Patients were excluded from the study because of incomplete clinical or radiographic documentation (n=48),

open growth plates (n=4), age older than 40 years (n=29), previous hip surgery (n=7), or participation in professional athletic activity (n=1). Independent evaluations of 2-year follow-up indicated improved Merle d'Aubigne scores for both groups, from a baseline of 12 to 15 in the group in which the labrum was resected and from 12 to 17 in the group where the labrum was reattached. The study also found a reduction in progression to osteoarthritis when the labrum was reattached.

Peters and Erickson reported on 29 patients (30 hips) in a prospective protocol with minimum 2-years' follow-up.(35) The specific diagnoses were primary femoroacetabular impingement in 25 patients (26 hips), Legg-Calve-Perthes disease (n=3), and SCFE (n=1). The average age of the patients was 31 years (range, 16-51 years). Twenty-nine of the 30 hips had either cam-type impingement (n=14), or mixed cam and pincer-type impingement (n=15). Eighteen hips were reported to have had severe cartilage damage that was not seen on MR arthrography. The HHS improved from 70 at baseline to 87 at an average 32- months' follow-up. No progression to osteoarthritis was observed in 68% of patients. There was nonunion in 8 hips (27%); 5 hips (17%) were expected to convert to THA due to progressive pain, and 4 (13%) had progression to osteoarthritis. Radiographic signs of progression of osteoarthritis and clinical failure requiring conversion to THA were seen only in patients with severe damage to the acetabular-articular cartilage. Two additional retrospective studies (n=23 and 34) that included patients with severe cartilage damage reported that 50% to 70% of patients improved and 30% to 50% failed (either no improvement or underwent subsequent THA) following open osteochondroplasty with dislocation.(36,37)

Slipped Capital Femoral Epiphysis. Several studies have been identified from specialized centers on the treatment of symptomatic FAI in children with developmental hip disorders. The largest series on SCFE was a joint retrospective review from the Swiss group of Ganz and Leunig (n=30), together with the Children's Hospital of Boston (n=10), with 1- to 8-year follow-up on 40 patients (between 9 and 18 years of age) with moderate to severe SCFE who were treated by capital realignment with surgical dislocation.(38) The primary aim of the article was to determine whether this capital realignment technique was feasible and repeatable and would restore hip anatomy and function while avoiding osteonecrosis. Dislocation was not performed in SCFE with a slip angle of less than 30°, in which trimming of the anterior metaphysis was considered sufficient to restore the anterior offset without weakening the femoral neck. 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. Stability and the duration of symptoms of SCFE (1 day to 3 years) were associated with the severity of acetabular cartilage damage observed at the time of surgery.

From the same U.S. institution was a 2006 report of 19 patients (age range, 12-43 years) who underwent either femoral neck osteoplasty (n=13) or osteoplasty with intertrochanteric osteotomy (n=6) via Ganztype surgical dislocation.(39) Of 12 patients with a history of SCFE (age range, 12-38 years), 9 were found to be improved at 8 to 25 months' follow-up. Of the 7 patients (age range, 17-43 years) without SCFE who underwent open surgical dislocation for pistol-grip deformities, 5 had worse symptoms or minimal relief. Outcomes for patients with a chondral flap were worse than for patients without a chondral flap. For example, function scores on WOMAC

improved from a baseline of 26 to 10 in patients without a chondral flap but did not improve (25 to 24) in patients with chondral flap damage.

**Labral Repair**
Systematic reviews have found low-quality evidence in favor of labral repair over labral debridement.(40,41) For example, a 2014 systematic review identified 1 RCT (described next) and 5 observational studies with a total of 490 patients that met the review inclusion criteria.(41) Five studies used an arthroscopic approach and 2 used an open approach. None of the studies included in the review were of high quality. With follow-up to 3 years, 4 of the 6 studies reported that labral repair resulted in significantly greater postoperative improvements in functional scores (MHHS, nonarthritic hip, hip outcome, and Merle d'Aubigne scores) compared with labral débridement. Pooled data from 3 studies that reported the MHHS showed a clinically important difference of 7.4 points favoring labral repair.

The single RCT of labral repair versus labral debridement was reported by Krych et al in 2013.(42) This nonblinded RCT included 36 female patients with pincer-type or combined-type FAI. At a mean 32-month follow-up (range, 12-48 months), both groups showed significant improvement in the HOS compared with baseline. Compared with the débridement group, the repair group had better outcomes on activities of daily living HOS (91.2 vs 80.9) and sports HOS (88.7 vs 76.3). A greater number of patients in the repair group rated their hip function as normal or nearly normal (94% vs 78%).

Bardakos et al compared results from 24 patients treated with osteochondroplasty for cam impingement (after 2004) with 47 patients who showed cam impingement but had only the labrum repaired (between 2000 and 2004).(43) The cohorts were matched for age (27-46 years) and for follow-up of 1 year. The number of patients who did not meet the selection criteria was not reported. There was a trend (p=0.11) for improved MHHS outcomes (excellent, good, fair, poor) in patients who were treated for impingement in addition to labral repair in this small study. Post hoc analysis of the percentage of patients in the excellent/good category showed significant improvement for the FAI-treated patients over historical controls (83% vs 60%, respectively; p=0.043). Results of this study should be interpreted cautiously due to multiple potential sources of bias, including selection bias, limited follow-up, and the small sample size.

**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.

**<u>SUMMARY</u>**
Five prospective/consecutive case series with more than 100 hips/patients treated for femoroacetabular impingement (FAI) have been identified. These studies show a 20-point

improvement on the modified Harris Hip Score (MHHS) at short- to mid-term follow-up, indicating a change from marked pain with a serious limitation of activities preoperatively to mild pain after treatment, or from moderate pain with some limitations of ordinary activity or work to slight or no pain after treatment. Given that the arthroscopic procedure was developed around 2004, long-term follow-up is limited.

What can be ascertained from the current literature:
- Not all patients with FAI morphology will have FAI pathology.
- There is a high association between FAI pathology and idiopathic osteoarthritis, but this may represent a small proportion of the total cases of hip osteoarthritis.
- Patients may present with hip pain that can be diagnosed as FAI by a combination of clinical evaluation, radiographs, and magnetic resonance (MR) arthrography.
- In cases in which there is a positive impingement test result, anterosuperior labral, or acetabular damage identified on MR arthrography and a pistol-grip morphology identified on imaging, there is a very high probability that the acetabular damage is caused by impingement of the femoral head-neck junction against the acetabular rim. FAI can be verified intraoperatively.
- Repair of the labrum alone can improve symptoms in the short term. It is reasonable to expect that debridement/osteoplasty of the bump or bone spur would reduce continued abrasion in the long term. Some studies, albeit of low quality, support this view.
- Treatment of FAI is most effective in younger patients without osteoarthritis (Tonnis grade 0 or I) or severe cartilage damage. Although osteoarthritis can be identified with plain film radiographs, articular damage is not always identified with current imaging techniques.
- There is a high probability that symptoms in patients with osteoarthritis (Tonnis grade II or III, or joint space of less than 2 mm) or severe cartilage damage (Outerbridge grade IV) will not improve following osteoplasty. These patients may require total hip arthroplasty (THA) for progressing pain within 5 years.
- In large case series, arthroscopic treatment of FAI in young to middle-age patients without osteoarthritis and showing mild to moderate cartilage damage results in 75% to 85% of patients improved.
- Smaller case series suggest that open treatment of FAI in young to middle-age patients with moderate to severe cartilage damage results in 50% to 70% of patients improved. Nonunion has been reported to occur in 27% of patients following the transection of the great trochanter with hip dislocation.

What cannot be ascertained from the literature:
- It is not known which patients with FAI morphology are most likely to progress to osteoarthritis. The progression of pincer impingement with damage initially restricted to the labrum may follow a different time course than cam-type impingement.
- It is not known whether treatment of FAI will reduce the occurrence of osteoarthritis.

Based on the (1) intraoperatively established relationship between FAI morphology and damage to the acetabulum, (2) consistent improvement in symptoms reported in large prospective case series, and (3) the potential for continued and irreparable cartilage damage if FAI pathology is not addressed, it may be considered medically necessary to debride the bone at the same time that the labrum and/or articular cartilage is being repaired when specific criteria are met. This conclusion is supported by clinical input from physician specialty societies and academic medical

centers. Because of the differing benefits and risks of open and arthroscopic approaches, patients should make an informed choice.

The evidence is insufficient to permit conclusions concerning the effect of this procedure on the development of osteoarthritis. Therefore, treatment of FAI morphology in the absence of symptoms is considered investigational.

Due to the unclear balance of risks and benefits, questions regarding whether, when, and how to treat symptomatic FAI in children with slipped capital femoral epiphysis (SCFE) are difficult. Although the impact of not treating FAI is established, there is limited evidence on treatment outcomes in pediatric patients. The open dislocation procedure is technically demanding with a high risk of serious complications and has not been shown to be safe and effective outside of a few highly specialized centers. In addition, questions remain concerning selection criteria and the appropriate timing and approach for FAI treatment in patients with developmental hip disorders. In a 2009 review of SCFE, surgeons from Children's Hospital Boston considered subcapital correction osteotomy with surgical dislocation to be an emerging treatment, stating that, "Currently, we recommend that this type of treatment should be restricted to few select specialized centers until the availability of long-term results and outcome. Also, this type of treatment has a steep learning curve, and it is advised to learn this surgical technique at a specialized center."(44) Because this approach has not been shown to be safe and effective outside of a few specialized centers, surgical treatment of FAI in pediatric patients is considered investigational.

**Practice Guidelines and Position Statements**
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.(45) 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. There are well-recognized complications, and NICE recommends that this procedure may be used provided that normal arrangements are in place for clinical governance, consent and audit with local review of outcomes. Clinicians in the U.K. should submit details of all patients undergoing this procedure to a new register for arthroscopic femoroacetabular surgery for hip impingement syndrome from the British Hip Society to provide information about long-term outcomes. In addition, arthroscopic femoroacetabular surgery for hip impingement syndrome should only be carried out by surgeons with specialist expertise in arthroscopic hip surgery. This interventional procedure guidance (IPG 408) replaces IPG 213 from 2007.

2011 Guidance from NICE on open femoroacetabular surgery for hip impingement syndrome indicates that evidence for this procedure is adequate in terms of symptom relief in the short and medium term.(46) This replaces interventional procedure guidance 203. Open femoroacetabular surgery for hip impingement syndrome involves major surgery with the potential for serious complications. Therefore, NICE recommends that this procedure should only be undertaken by surgeons who are well-trained and highly experienced in this type of procedure and that normal arrangements be in place for clinical governance, consent and audit with local review of outcomes. Clinicians are advised to submit details of all patients undergoing this procedure to the register of the British Hip Society once it is available.

## CODING

The following codes for treatment and procedures applicable to this policy are included below for informational purposes.  Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

CPT/HCPCS
27299     Unlisted procedure, pelvis or hip joint
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-9 Diagnoses
719.45    Pain in joint, pelvic region and thigh
719.85    Other specified disorders of pelvic joint
719.95    Unspecified disorder of joint of pelvic region and thigh

ICD-10 Diagnoses (Effective October 1, 2015)
M24.151    Other articular cartilage disorders, right hip
M24.152    Other articular cartilage disorders, left hip
M24.851    Other specific joint derangements of right hip, not elsewhere classified
M24.852    Other specific joint derangements of left hip, not elsewhere classified
M25.551    Pain in right hip
M25.552    Pain in left hip
M25.851    Other specified joint disorders, right hip
M25.851    Other specified joint disorders, left hip
M25.251    Chondromalacia, right hip
M25.252    Chondromalacia, left hip

## REVISIONS

| 11-14-2014 | Policy added to the bcbsks.com web site on 10-15-2014. Effective 11-14-2014, 30 days after posting. |
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