Femoro-Acetabular Surgery for Hip Impingement Syndrome

Policy

*Please see amendment for Pennsylvania Medicaid at the end of this CPB.*

Aetna considers femoro-acetabular surgery, open or arthroscopic, for the treatment of hip impingement syndrome medically necessary for persons who fulfill all the following criteria:

- Diagnosis of definite femoro-acetabular impingement defined by appropriate imaging studies (X-rays, MRI or CT scans), showing cam impingement (alpha angle greater than 50 degrees), pincer impingement (acetabular retroversion or coxa profunda) (center edge angle greater than or equal to 40 degrees), or pistol grip deformity (nonspherical femoral head shape); and

- Moderate to severe symptoms typical of FAI (hip or groin pain that is worsened by flexion activities (e.g., squatting or prolonged sitting) that significantly limits activities, with duration of at least 6 months where diagnosis of FAI has been made as above; and

- Positive impingement sign with sudden pain on 90 degree hip flexion with adduction and internal rotation or extension and external rotation; and

- Failure to respond to all available conservative treatment options including activity modification (e.g., restriction of athletic pursuits and avoidance of symptomatic motion), pharmacological intervention (e.g., nonsteroidal anti-inflammatory drugs [NSAIDS]), injections of local anesthetics into the joint and physiotherapy; and

- Member is 15 years of age or older or skeletally mature (as indicated by epiphyseal closure); and
Absence of advanced osteoarthritis change on pre-operative Xray (Tonnis grade 2 or more) or severe cartilage injury (Outerbridge grade III or IV); and

Absence of joint space narrowing on plain radiograph of the pelvis. Joint space is not less than 2 mm wide anywhere along the sourcil; and

Member does not have generalized joint laxity especially in diseases connected with hypermobility of the joints, such as Marfan syndrome and Ehlers-Danlos syndrome; and

Member does not have osteogenesis imperfecta.

Aetna consider surgery for FAI impingement experimental and investigational for all other indications.

Aetna considers capsular plication experimental and investigational for the treatment of FAI because there is insufficient evidence regarding the effectiveness of this approach.

Aetna considers hip arthroscopy to repair a labral tear medically necessary for:

- traumatic labral tears causing mechanical symptoms; or
- an adjunct to FAI surgery.

Aetna considers hip arthroscopy to repair degenerative labral tears (e.g., due to early osteoarthritis) experimental and investigational.

Aetna considers labrum reconstruction experimental and investigational for the treatment of FAI because there is insufficient evidence regarding the effectiveness of this approach. Note: Labral reconstruction uses a graft to reconstruct the native labrum. This is distinct from a labral repair, which is to repair the torn tissue by sewing it back together and/or to its attachment site.

Aetna considers autologous osteochondral mosaicplasty in combination with femoral neck osteochondroplasty experimental and investigational for the treatment of FAI because there is insufficient evidence regarding the effectiveness of this approach.

Aetna considers the following procedures experimental and investigational when provided as an adjunct to FAI surgery because they have not been proven to improve the outcomes of FAI surgery:

- Anterior-inferior iliac spine decompression
- Debridement of trochanteric bursitis;
- Hip microfracture;
- Lesser trochanteric resection;
- Repair of partial gluteus medius tears (Note: repair of complete gluteus medius tears is considered medically necessary).

**Note:** Iliopsoas tendon release surgery and capsular release surgery are considered integral to the primary procedure and not separately reimbursable.

**Notes:** For purposes of this policy, Aetna will consider the official written report of complex imaging studies (e.g., CT, MRI, myelogram). If the operating surgeon disagrees with the official written report, the surgeon should document that disagreement. The surgeon should discuss the disagreement with the provider who did the official interpretation, and there should also be a written addendum to the official report indicating agreement or disagreement with the operating surgeon.

**Background**

Hip impingement syndrome, also known as femoro-acetabular impingement (FAI) syndrome, is a recently accepted pathological condition that primarily affects young and middle-aged adults. It is characterized by hip pain felt mainly in the groin, and can result in chronic pain and decreased range of motion in flexion and internal rotation. Femoroacetabular impingement (FAI) occurs as a result of friction in the hip joint caused by abnormal contact between the femoral head and the rim of the acetabulum (hip socket). Over time, the repetitive contact can cause damage to the articular or labral cartilage, which may lead to degenerative joint disease.

Femoro-acetabular impingement syndrome has been reported to be associated with progressive osteoarthritis of the hip. History, physical examination, as well as supportive radiographical findings including evidence of articular cartilage damage, acetabular labral tearing, and early-onset degenerative changes can aid in diagnosing this condition. Several pathological changes of the femur and acetabulum are known to predispose individuals to develop FAI syndrome.

The three types of FAI include excessive acetabular covering (pincer type), nonspherical femoral head (cam type) or a combination of the two. The two basic mechanisms of FAI are cam impingement (most common in young athletic males) and pincer impingement (most common in middle-aged women). This classification is based on the type of anatomical anomaly contributing to the impingement process. Cam Impingement is a type of impingement in which the femoral head is aspherical, which prevents it from rotating smoothly inside the acetabulum (i.e., femoral cause). Pincer Impingement is a type of impingement in which extra bone extends out over the normal rim of the acetabulum (i.e., acetabular cause). Cam impingement is the result
an abnormal morphology of the proximal femur, usually at the femoral head-neck junction; while pincer impingement is the result of an abnormal morphology or orientation of the acetabulum (Kassajian et al, 2007). These changes can be found on conventional radiography, magnetic resonance imaging (MRI) and computed tomography (CT) examinations (Beall et al, 2005; Bredella and Stoller, 2005).

Characteristic magnetic resonance arthrographic findings of cam FAI entail large alpha angles and cartilage lesions at the antero-superior position and osseous bump formation at the femoral neck (Pfirrmann et al, 2006). The alpha angle is a measurement of the hip ball (femoral head and neck junction) to determine how much cam impingement exists. The severity of the impingement increases along with the degree of the alpha angle.

Characteristic magnetic resonance arthrographic findings of pincer FAI include a deep acetabulum and postero-inferior cartilage lesions (Pfirrmann, et al., 2006). The term coxa profunda refers to a deep acetabulum with excessive acetabular coverage; also referred to as "deep socket." A center edge angle greater than or equal to 40 degrees has been found to be a reliable predictor of pincer impingement (Kutty, et al., 2012). The center edge angle is the angle formed by a vertical line and a line connecting the femoral head center with the lateral edge of the acetabulum. A normal center edge angle varies between 25º and 39º (Tannast, et al., 2007).

Management of individuals with FAI ranges from conservative therapies (e.g., modification of activities to reduce excessive motion and burden on the hip, the use of non-steroidal anti-inflammatory drugs, and discontinuation of activities associated with the painful hip movement) to surgery (e.g., peri-acetabular osteotomy, hip dislocation and debridement). Conservative measures, including physical therapy, restriction of activities, core strengthening, improvement of sensory-motor, and control and nonsteroidal anti-inflammatories are the mainstays of nonsurgical treatment (Samora, et al., 2011).

The main goal of surgical treatment for this condition is to improve the clearance for motion at the hip joint and lessen the femoral thrust against the acetabular rim. Surgical treatments for treating FAI include arthroscopic or open surgery and hip replacement. Arthroscopic surgery involves the insertion of an arthroscope and small surgical instruments through several small skin incisions into the joint for examination, shaving of bone spurs or removal of damaged cartilage as needed. Open surgery is performed when large defects are present. Hip replacement is necessary when no articular cartilage is present.

Surgical intervention usually focuses on improving the clearance for hip motion and alleviation of femoral abutment against the acetabular rim. Peri-acetabular osteotomy entails an incision over the front of the hip. With the aid of fluoroscopy, the surgeon cuts through the pelvic bones (i.e.,
ilium, ischium, and pubis) around the acetabulum to free it from its original position. When the surgeon is satisfied with the new location of the acetabulum (facing the right direction with good coverage), it is secured with 3 to 6 screws. From the same incision, the surgeon can also access the hip joint to debride extra bone from the head/neck as needed. Hip dislocation and debridement is usually performed through an incision over the side of hip where the surgeon can dislocate the hip after preserving the vascular supply to the head. After exposing the femoral head and acetabulum, the surgeon can debride extra bone that contributes to the impingement. After removal of bone and damaged tissue, the greater trochanter is re-attached to the femur with screws.

It has been suggested that the surgical trauma sustained during the open procedure for the treatment of FAI syndrome may make it difficult for high-level/professional athletes to return to professional sports. As a result, an arthroscopic approach to treat FAI syndrome has been developed (Philippon and Schenker, 2006).

The iliopsoas (or hip flexors) refer to the combination of the psoas major and the iliacus muscles at their inferior ends where they join together and form a common tendon that attaches onto the lesser trochanter of the thigh bone (femur). Iliopsoas impingement occurs when the muscle and tendon of the iliopsoas become inflamed and tight, causing an audible snap or click when the iliopsoas tendon moves over the labrum and femoral head. The tightness of the iliopsoas causes rubbing against the labral cartilage and may cause irritation, pain and tearing.

Iliopsoas tendon release (tenotomy) is a surgical procedure that may be performed to provide relief of tension by a partial release and lengthening of the tendon. This procedure can be performed in a natural hip or after total hip arthroplasty. A tenotomy is the total or partial severing of a tendon to allow lengthening.

Ayeni et al (2012) systematically reviewed the clinical literature to determine the consistently reported indications for arthroscopic management of femoroacetabular impingement (FAI). The indications for FAI surgery reported in the literature included a positive impingement sign, symptoms or pain for more than 6 months, and a series of positive special tests. Commonly reported radiographic indicators for arthroscopic FAI management included the following: results from a computed tomography scan or magnetic resonance imaging, cam or pincer lesions evident on anteroposterior and/or lateral radiographs, loss of sphericity of the femoral neck, acetabular retroversion, magnetic resonance arthrography, reduction in head-neck offset, an alpha angle greater than 50°, and coxa profunda.
Guidance on arthroscopic femoroacetabular surgery for hip impingement syndrome from the National Institute for Health and Clinical Excellence (NICE, 2011) found evidence is adequate for symptom relief in the short- and medium-term. The consultation documents stated, however, that additional research is needed on patient selection and long-term outcomes specifically related to the development of osteoarthritis. The Committee noted that the available evidence was from observational studies. The guidance stated that, while this was considered adequate for the present recommendation, further studies would be useful. The Committee stated that they recognized the difficulties of comparative research and acquisition of long-term data on this procedure. The guidance noted that the British Hip Society is establishing a registry for arthroscopic femoroacetabular surgery for hip impingement syndrome, and stated that clinicians should submit details of all patients undergoing femoroacetabular surgery for hip impingement syndrome to the registry once it is available. The guidance noted that a prime purpose of the registry is to provide data on the long-term outcomes of the procedure. The guidance also stated that it is important that both the registry and other studies report details of patient selection to allow clear understanding of these outcomes.

Matsuda et al (2011) performed a systematic evidence review to analyze the current approaches to the surgical management of symptomatic femoroacetabular impingement (FAI), including open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. A total of 18 peer-reviewed treatment outcome studies met the inclusion criteria with minimum 1-year follow-up of the surgical treatment of skeletal pathoanatomy and associated chondrolabral pathology in skeletally mature patients with FAI. There were 6 open surgical dislocation, 4 mini-open, and 8 arthroscopic studies, all with Levels of Evidence III or IV. The only prospective studies were in the arthroscopic category. Outcome data were extracted and analyzed with respect to surgical efficacy, failure rates, and complications. The authors concluded that the open dislocation, mini-open, and arthroscopic methods for treating symptomatic FAI are effective in improving pain and function in short-term to midterm studies and are relatively safe procedures. The authors said that the historical gold standard of 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 in some studies. The authors found that the arthroscopic method had surgical outcomes equal to or better than the other methods with a lower rate of major complications when performed by experienced surgeons. A critique of the systematic evidence review by Matsuda et al conducted by the Centre for Reviews and Dissemination (CRD, 2011) concluded that Matsuda et al’s conclusions should be treated with caution, given potential bias in the review process, inclusion of weak study designs, limited statistical data and wide variation in the included studies. The CRD noted that most studies of femoroacetabular surgery included in Matsuda et al’s systematic evidence review did not report confidence intervals and only one study provided power calculations and defined clinically
meaningful changes in outcomes. The CRD stated that, given that most studies of FAI surgery were case series and no explicit methods were used to assess studies for quality, potential for bias was substantial as differences in participants, interventions and outcomes made it difficult to interpret the clinical relevance and reliability of the results. The CRD noted that 3 different surgical options reviewed by Matsuda et al were compared indirectly in potentially different populations, which made it difficult to interpret the findings. The CRD (2011) concluded that given the potential biases in the review by Matsuda et al (searching, data extraction and quality assessment), inclusion of weak study designs, limited statistical data and wide variation in the included studies, Matsuda et al's conclusions should be treated with caution.

Observational studies have demonstrated substantial improvements in symptoms with femoroacetabular surgery; however, observational studies may overestimate the actual degree of improvement from surgery. Studies of arthroscopy for shoulder impingement demonstrates the potential for observational studies to over-estimate the benefit of an orthopedic intervention, when compared to controlled clinical trials (compare Odenbring et al, 2008; Ketola et al, 2009). In addition, further research is needed on the structural variants that contribute to hip pain; one study failed to find an association in the community between one of the structural variants treated by arthroscopic hip surgery and hip joint pain (Gosvig et al, 2010; EMSCG, 2010).

The number of published studies of FAI surgery has increased exponentially over time. Haviv et al (2011) reviewed publications on FAI over the past decade, and found an exponential increase in numbers of publications on FAI over time; the authors found, however, that there has been no corresponding increase in the quality of published studies.

A number of studies have reported positive short- and mid-term outcomes. In a case-series study of 213 treated hips including 19 patients who underwent simultaneous inter-trochanteric osteotomy with a minimum follow-up of 2 years, Ganz and colleagues (2001) reported that most patients had an improved range of motion as well as a reduction in pain following surgical dislocation of the hip. In another case-series study (22 patients; 29 hips), Siebenrock et al (2003) examined if symptomatic anterior FAI due to acetabular retroversion can be treated effectively with a peri-acetabular osteotomy. Follow-up ranged from 24 months to 49 months (average of 30 months). These investigators reported that peri-acetabular osteotomy produced a good or excellent result in 26/29 (90 %) of hips. In a third case-series study, Murphy et al (2004) evaluated a group of 23 hips in 23 patients treated by surgical debridement for impingement: 22 patients were treated by full surgical dislocation and 1 patient was treated by relief of impingement without dislocation. Follow-up ranged from a minimum of 2 years to 12 years. These researchers reported that at 5.2 years' follow-up after debridement of the hip, 15/23 (65 %) of patients had functioning hips and had not required further surgery.
In a retrospective case series, Larson and Giveans (2008) assessed the early outcomes of arthroscopic management of FAI, reporting good to excellent results in 75 percent of patients. A total of 96 consecutive patients (100 hips) with radiographically documented FAI were treated with hip arthroscopy, labral debridement or repair/refixation, proximal femoral osteoplasty, or acetabular rim trimming (or some combination thereof). Outcomes were measured with the impingement test, modified Harris Hip Score, Short Form 12, and pain score on a visual analog scale (VAS) pre-operatively and post-operatively at 6 weeks, 3 months, and 6 months, as well as yearly thereafter. Pre-operative and post-operative radiographical alpha angles were measured to evaluate the adequacy of proximal femoral osteoplasty. There were 54 male and 42 female patients with up to 3 years’ follow-up (mean of 9.9 months). The mean age was 34.7 years. Isolated cam impingement was identified in 17 hips, pincer impingement was found in 28, and both types were noted in 55. Thirty hips underwent labral repair/refixation. A comparison of pre-operative scores with those obtained at most recent follow-up revealed a significant improvement (p < 0.001) for all outcomes measured: Harris Hip Score (60.8 versus 82.7), Short Form 12 (60.2 versus 77.7), VAS for pain (6.74 cm versus 1.88 cm), and positive impingement test (100 % versus 14 %). The alpha angle was also significantly improved after resection osteoplasty. Complications included heterotopic bone formation (6 hips) and a 24-hour partial sciatic nerve neurapraxia (1 hip). No hip went on to undergo repeat arthroscopy, and 3 hips have subsequently undergone total hip arthroplasty. The authors concluded that arthroscopic management of patients with FAI results in significant improvement in outcomes measures, with good to excellent results being observed in 75% of hips at a minimum 1-year follow-up. However, alteration in the natural progression to osteoarthritis and sustained pain relief as a result of arthroscopic management of FAI remain to be seen.

Ilizaliturri et al (2008) reported on short-term follow-up of an uncontrolled cohort of 19 patients with cam femoroacetabular impingement. The authors reported a modest improvement in Western Ontario and McMaster Universities Arthritis Index (WOMAC) score from preoperatively to 2 years post-operatively (mean of 82 points pre-operatively to mean of 89 points post-operatively). The authors conclude that "long-term follow-up is needed to fully understand the results of surgical intervention for the treatment of FAI".

In a preliminary report, Philippon et al (2008) reported on the treatment of FAI in the adolescent population. Between March 2005 and May 2006, a total of 16 patients (aged 16 years or younger) underwent hip arthroscopy for FAI. There were 14 females and 2 males, with 1 patient undergoing a bilateral procedure. Five patients had isolated pincer impingement, 2 had isolated cam impingement, and 9 had mixed pathology. All patients had labral pathology. Seven patients were treated with suture anchor repair of the labrum and 9 with partial labral debridement. Subjective data were collected from each patient during their initial visit and at follow-up after surgery. Subjective data included the modified Harris Hip score (MHHS), patient satisfaction,
and hip outcome score (HOS) activities of daily living (ADL), and sports subscales. The mean age at the time of arthroscopy was 15 years old (range of 11 to 16 years). The mean pre-operative MHHS was 55 (range of 33 to 70), HOS ADL was 58 (range of 38 to 75), and HOS sport score was 33 (range of 0 to 78). The mean time from injury to surgery was 10.6 months (range of 6 weeks to 30 months). The mean time to follow-up was 1.36 years (range of 1 to 2 years). The mean post-operative MHHS improved 35 points to 90 (range of 70 to 100; p = 0.005), post-operative HOS ADL improved 36 points to 94 (range of 74 to 100; p = 0.001), and post-operative HOS sport score improved 56 points to 89 (range of 58 to 100; p = 0.001). The mean patient satisfaction score was 9 (range of 9 to 10). The authors concluded that hip arthroscopy for FAI in the adolescent population produces excellent improvement in function and a high level of patient satisfaction in the short-term.

Philippon and colleagues (2009) reported the outcomes following hip arthroscopy for FAI with associated chondrolabral dysfunction. These investigators prospectively enrolled 122 patients who underwent arthroscopic surgery of the hip for FAI and met the inclusion criteria for this study. Patients with bilateral hip arthroscopy, avascular necrosis and previous hip surgery were excluded; 10 patients refused to participate, leaving 112 in the study (62 women and 50 men). The mean age of the patients was 40.6 years (95 % confidence interval (CI) 37.7 to 43.5). At arthroscopy, 23 patients underwent osteoplasty only for cam impingement, 3 underwent rim trimming only for pincer impingement, and 86 underwent both procedures for mixed-type impingement. The mean follow-up was 2.3 years (2.0 to 2.9). The mean MHHS improved from 58 to 84 (mean difference = 24 (95 % CI 19 to 28)) and the median patient satisfaction was 9 (1 to 10). Ten patients underwent total hip replacement at a mean of 16 months (8 to 26) after arthroscopy. The predictors of a better outcome were the pre-operative modified HHS (p = 0.018), joint space narrowing greater than or equal to 2 mm (p = 0.005), and repair of labral pathology instead of debridement (p = 0.032). The authors concluded that hip arthroscopy for FAI, accompanied by suitable rehabilitation, gives a good short-term outcome and high patient satisfaction.

Byrd and Jones (2009) prospectively assessed 200 patients (207 hips) who underwent arthroscopic correction of cam impingement from December 2003 to October 2007, using a MHHS. The minimum follow-up was 12 months (mean of 16 months; range of 12 to 24 months); no patients were lost to follow-up. The average age was 33 years with 138 men and 62 women. A total of 158 patients (163 hips) underwent correction of cam impingement (femoroplasty) alone while 42 patients (44 hips) underwent concomitant correction of pincer impingement. The average increase in MHHS was 20 points; 0.5 % converted to total hip arthroplasty. There were a 1.5 % complication rate. The authors stated that the short-term outcomes of arthroscopic treatment of cam-type FAI are comparable to published reports for open methods with the advantage of a less invasive approach.
Bardakos and Villar (2009) investigated the effect of several radiological parameters, each indicative of a structural aspect of the hip joint, on the progression of osteoarthritis. Pairs of plain antero-posterior pelvic radiographs, taken at least 10 years apart, of 43 patients (43 hips) with a pistol-grip deformity of the femur and mild (Tönnis grade 1) or moderate (Tönnis grade 2) osteoarthritis were reviewed. Of the 43 hips, 28 showed evidence of progression of osteoarthritis. There was no significant difference in the prevalence of progression between hips with initial Tönnis grade 1 or grade 2 osteoarthritis (p = 0.31). Comparison of the hips with and without progression of arthritis revealed a significant difference in the mean medial proximal femoral angle (81 degrees versus 87 degrees, p = 0.004) and the presence of the posterior wall sign (39 % versus 7 %, p = 0.02) only. A logistic regression model was constructed to predict the influence of these two variables in the development of osteoarthritis. Mild-to-moderate osteoarthritis in hips with a pistol-grip deformity will not progress rapidly in all patients. In one-third, progression will take more than 10 years to manifest, if ever. The individual geometry of the proximal femur and acetabulum partly influences this phenomenon. A hip with cam impingement is not always destined for end-stage arthritic degeneration.

Horisberger et al. (2010) prospectively followed a cohort of 105 hips (88 patients; 60 males, 28 females) who underwent arthroscopic surgery for symptomatic cam or mixed femoroacetabular impingement. At a minimum follow-up of 1.3 years (average, 2.3 years; range, 1.3 to 4.1 years), all clinical outcome measures improved. Nine patients (8.6%) underwent total hip arthroplasty during follow-up.

Gedouin et al (2010) reported on outcomes of arthroscopic surgery for hip impingement in 111 hips in 110 patients (78 male, 32 female; mean age of 31 years). A total of 65 patients showed no radiographic sign of osteoarthritis, and 36 showed grade-1 early osteoarthritis on the Tönnis scale. The investigators reported that mean WOMAC score rose from 60.3 pre-operatively to 83 (p < 0.001) at a mean 10 months' follow-up (range of 6 to 18 months); 77 % of patients were satisfied or very satisfied with their result. The investigators noted that patients with early osteoarthritis had significantly lower WOMAC and satisfaction scores than those free of osteoarthritis. Operative crossover to open surgery for femoroacetabular impingement occurred in one case. Five patients (4 %) had total hip replacement or resurfacing. There were 7 complications (6 %): 3 cases of heterotopic ossification, 1 of crural palsy, 1 of pudendal palsy, 1 of labium majus necrosis, and 1 non-displacement stress fracture of the femoral head/neck junction. There was no palsy of the territory of the lateral cutaneous nerve of the thigh.

The labrum is a ring of fibrocartilage (fibrous cartilage) around the edge of the articular (joint) surface of a bone. In a case series study, Philippon et al (2010) examined the indications for and outcomes of arthroscopic labral reconstruction in the hip by use of ilio-tibial band (ITB) autograft. Between August 2005 and May 2008, the senior author performed 95 arthroscopic labral
reconstructions using an ITB autograft in patients with advanced labral degeneration or deficiency. There were 47 patients (32 men, 15 women, mean age 37 years (range of 18 to 55 years)) who had undergone surgery at a minimum of 1 year previously and met the inclusion criteria. The mean time from the onset of symptoms to labral reconstruction was 36 months (range of 1 month to 12 years). Subsequent total hip arthroplasty was performed in 4 patients (9%). Follow-up was obtained in 37 of the remaining 43 patients. The mean time to follow-up was 18 months (range of 12 to 32 months). The mean modified Harris Hip Score (MHHS) improved from 62 (range of 35 to 92) pre-operatively to 85 (range of 53 to 100) post-operatively (p = 0.001). Median patient satisfaction was 8 out of 10 (range of 1 to 10). Patients who were treated within 1 year of injury had higher modified Harris Hip Scores than patients who waited longer than 1 year (93 versus 81, p = 0.03). The independent predictor of patient satisfaction with outcome after labral reconstruction was age. The authors concluded that these findings showed that patients who have labral deficiency or advanced labral degeneration had good outcomes and high patient satisfaction after arthroscopic intervention with acetabular labral reconstruction. Lower satisfaction was associated with joint space narrowing and increased age. Patients who waited longer than 1 year from the time of injury to surgery had lower function at follow-up than those treated in the 1st year. The study by Philippon et al (2010) was a case series that examined arthroscopic labral reconstruction in the hip by use of ilio-tibial band autograft in patients with advanced labral degeneration or deficiency. It is unclear how many of the studied cases involved hip impingement syndrome/femoro-acetabular syndrome.

A controlled study of FAI surgery compared FAI surgery with resection of the torn labrum to FAI surgery with reattachment of the labrum to the acetabular rim (Espinosa et al, 2006). Espinosa and co-workers (2006) examined if labral re-fixation after treatment of FAI affects the clinical and radiographical results. These investigators retrospectively reviewed the clinical and radiographical results of 52 patients (60 hips) with FAI who underwent arthroscopy and surgical dislocation of the hip to allow trimming of the acetabular rim and femoral osteochondroplasty. In the first 25 hips, the torn labrum was resected (group 1); in the next 35 hips, the intact portion of the labrum was re-attached to the acetabular rim (group 2). At 1 and 2 years post-operatively, the Merle d'Aubigné clinical score and the Tönnis arthrosis classification system were used to compare the two groups. At 1-year follow-up, both groups showed a significant improvement in their clinical scores (mainly pain reduction) compared with their pre-operative values (p = 0.0003 for group 1 and p < 0.0001 for group 2). At 2-year follow-up, 28 % of the hips in group 1 (labral resection) had an excellent result, 48 % had a good result, 20 % had a moderate result, and 4 % had a poor result. In contrast, in group 2 (labral re-attachment), 80 % of the hips had an excellent result, 14 % had a good result, and 6 % had a moderate result. Comparison of the clinical scores between the two groups revealed significantly better outcomes for group 2 at 1-year (p = 0.0001) and 2-year (p = 0.01) follow-up. Radiographical signs of osteoarthritis were significantly more prevalent in group 1 than in group 2 at 1-year (p = 0.02) and at 2-year (p =
0.009) follow-up. The authors concluded that patients treated with labral re-fixation recovered earlier and had superior clinical and radiographical outcomes when compared with patients who had undergone resection of a torn labrum. These investigators noted that the results must be considered preliminary, but they recommend re-fixation of the intact portion of the labrum after trimming of the acetabular rim during surgical treatment of FAI. Furthermore, they stated that long-term follow-up will be needed to evaluate if use of this technique results in improved functional outcomes and a reduction in the prevalence of symptomatic osteoarthritis in affected patients.

Nho et al (2011) reported on a case series showing that arthroscopic treatment of femoroacetabular impingement in a mixed group of high-level athletes resulted in a significant improvement in hip functional outcome: 78% of athletes were able to return to play at 1 year and 73% of athletes were able to play at 2-year follow-up. High-level athletes who underwent arthroscopic treatment of femoroacetabular impingement (rim trimming, labral refixation or debridement, femoral osteochondroplasty) with a minimum of 1-year follow-up were retrospectively identified. All patients completed hip-specific outcome scores (Modified Harris Hip Score [MHHS] and Hip Outcome Score [HOS]) at baseline and most recent follow-up. Forty-seven patients with an average age of 22.8 ± 6.2 years met the study criteria with a mean follow-up of 27.0 ± 5.5 months. Thirty-three patients (70.2%) were available for follow-up. The level of competition was 27.7% varsity high school, 53.2% college, and 19.1% professional athletes. There were statistically significant improvements in the mean MHHS score (pre-operative, 68.6 ± 12.8; post-operative, 88.5 ± 17.7; p = 0.002) as well as the HOS score (pre-operative, 78.8 ± 11.3; post-operative, 91.4 ± 14.0; p = 0.03). There was a significant improvement in the alpha angle, with 76.4° ± 14.5°pre-operatively and 51.4° ± 11.7°post-operatively (p = 0.0003). Seventy-nine percent of patients were able to return to play after hip arthroscopy at a mean of 9.4 ± 4.7 months (range of 4 to 26 months); of those patients, 92.3% were able to return to the same level of competition. At 2-year follow-up, 73% of patients were able to return to play.

Byrd and Jones (2011) also found that most athletes treated with arthroscopic hip surgery were able to resume their activities. The authors reported on a case series of 200 patients identified who underwent arthroscopic management of FAI, participated in athletic activities, and had achieved minimum 1-year follow up. The authors stated that there was 100% follow-up at an average of 19 months (range of 12 to 60 months). A total of 116 athletes had achieved 2-year follow-up. For the entire cohort, the average age was 28.6 years (range of 11 to 60 years) with 148 males and 52 females. There were 159 cam, 31 combined, and 10 pincer lesions. There were 23 professional, 56 inter-collegiate, 24 high school, and 97 recreational athletes. The male:female ratio was 2.8:1 among cam lesions and 1:1 among pincer lesions. The median pre-operative score was 72 with a post-operative score of 96 and the median improvement was 20.5 points, which was statistically significant (p < 0.001). The authors reported that 95% percent of
professional athletes and 85% of inter-collegiate athletes were able to return to their previous level of competition. There were 5 transient neurapraxias (all resolved) and 1 minor heterotopic ossification. One athlete (0.5%) underwent conversion to total hip arthroplasty and 4 (2%) underwent repeat arthroscopy. For the group with minimum 2-year follow-up, the median improvement was 21 points with a post-operative score of 96.

Schilders et al (2011) reported that labral repairs achieved superior results to labral resection. The investigators reviewed 151 patients (156 hips) with FAI and labral tears who had been treated arthroscopically. These were subdivided into those who had undergone a labral repair (group 1) and those who had undergone resection of the labrum (group 2). In order to ensure the groups were suitably matched for comparison of treatment effects, patients with advanced degenerative changes (Tönnis grade greater than 2, lateral sourcil height less than 2 mm and Outerbridge grade 4 changes in the weight-bearing area of the femoral head) were excluded, leaving 96 patients (101 hips) in the study. At a mean follow-up of 2.44 years (2 to 4), the mean modified Harris hip score in the labral repair group (group 1, 69 hips) improved from 60.2 (24 to 85) pre-operatively to 93.6 (55 to 100), and in the labral resection group (group 2, 32 hips) from 62.8 (29 to 96) pre-operatively to 88.8 (35 to 100). The mean modified Harris hip score in the labral repair group was 7.3 points greater than in the resection group (p = 0.036, 95% confidence interval [CI]: 0.51 to 14.09). Labral detachments were found more frequently in the labral repair group and labral flap tears in the resection group. The investigators reported that no patient in the study group required a subsequent hip replacement during the period of follow-up. The investigators concluded that this study shows that patients without advanced degenerative changes in the hip can achieve significant improvement in their symptoms after arthroscopic treatment of femoroacetabular impingement. The authors stated that this evidence also suggests that labral repair, where appropriate, provides a superior result to labral resection.

There are limited data on the efficacy of FAI surgery in adolescents. Fabricant et al (2012) reported on a small, retrospective case series of FAI surgery in adolescents. The investigators retrospectively reviewed the records of 27 hips in 21 patients 19 years of age or younger who underwent arthroscopic treatment for FAI between 2007 and 2008. From the records the investigators extracted demographic data, operative details, complications, and pre-operative and post-operative MHHS and the HOS. The minimum follow-up was 1 year (average of 1.5 years; range of 1 to 2.5 years). The investigators reported that modified HHS improved by an average of 21 points, the activities of daily living subset of the HOS improved by an average of 16 points, and the sports outcome subset of the HOS improved by an average of 32 points. The investigators stated that all patients’ self-reported ability to engage in their pre-operative level of athletic competition improved. In 24 hips that underwent cam decompression, the mean
alpha-angle improved from $64^\circ \pm 16^\circ$ to $40^\circ \pm 5.3^\circ$ post-operatively. The investigators concluded that they found short-term improvements in HOS and HHS with no complications for arthroscopic treatment of FAI in our cohort of adolescent athletes.

There is emerging evidence of the efficacy of FAI surgery in older patients. Javed and O'Donnell (2011) reported on a small retrospective case series of FAI surgery in patients over 60 years of age. The investigators reviewed the clinical outcome of arthroscopic femoral osteochondroplasty for cam femoroacetabular impingement performed between August 2005 and March 2009 in a series of 40 patients over 60 years of age. The group comprised 26 men and 14 women with a mean age of 65 years (60 to 82). The mean follow-up was 30 months (12 to 54). The mean modified Harris hip score improved by 19.2 points (95 % CI: 13.6 to 24.9; p < 0.001) while the mean non-arthritic hip score improved by 15.0 points (95 % CI: 10.9 to 19.1, p < 0.001). Seven patients underwent total hip replacement after a mean interval of 12 months (6 to 24 months) at a mean age of 63 years (60 to 70). The investigators reported that the overall level of satisfaction was high with most patients indicating that they would undergo similar surgery in the future to the contralateral hip, if indicated. No serious complications occurred.

Phillipon et al (2012) reported on a case series of patients age 50 years and older who underwent hip arthroscopy for femoracetabular impingement. Between 2006 and 2008, prospectively collected data were retrieved from the authors database on 153 patients aged 50 years or older undergoing hip arthroscopy for FAI. Data collected included range of motion, MHHS, HOS for activities of daily living, HOS for sports, and Short Form 12 score. Survivors were defined as patients not requiring total hip replacement (THR). Survivorship was analyzed by use of the Kaplan-Meier method. The authors reported that THR was required after the arthroscopic treatment in 20 % of patients (31 of 153). At 3 years (with data available in 64 patients), patients with greater than 2 mm of joint space had survivorship of 90 % whereas those with 2 mm or less had survivorship of 57 % (p = 0.001). In the patients who did not require THR, the MHHS improved from 58 to 84. The HOS for activities of daily living improved from 66 to 87 (p = 0.001), and the HOS for sports improved from 42 to 72 (p = 0.001). The physical component of the Short Form 12 improved from 38 to 49 (p = 0.001), whereas the mental component did not change (54 pre-operatively v 53 post-operatively, p = 0.53). Median patient satisfaction was 9. The authors concluded that, on the basis of early results, patients with greater than 2 mm of joint space can expect improvement over pre-operative status in pain and function after hip arthroscopy for FAI. In patients aged 50 years or older with 2 mm of joint space or less and low pre-operative MHHSs, early conversion to THR was seen.

There is evidence that persons with advanced joint space narrowing do not improve with FAI surgery. Between September 2004 and April 2008, Larson et al (2011) treated 210 patients (227 hips) with FAI and a minimum 12-month follow-up (mean of 27 months). Group FAI consisted of
154 patients (169 hips) without radiographic joint space narrowing, whereas Group FAI-OA consisted of 56 patients (58 hips) with pre-operative radiographic joint space narrowing. The authors collected Harris hip scores (HHS), Short Form-12 (SF-12), and pain scores on a visual analog scale (VAS) pre-operatively and post-operatively. The authors reported that score improvements were better for Group FAI compared with Group FAI-OA. The overall failure rate was greater for Group FAI-OA (52 %) than for Group FAI (12 %). The authors found that, although patients with less than 50 % joint space narrowing or greater than 2 mm joint space remaining on pre-operative radiographs had improved scores throughout the study, they observed no score improvements at any time with advanced pre-operative joint space narrowing. The authors found that greater joint space narrowing, advanced MRI chondral grade, and longer duration of pre-operative symptoms predicted lower scores.

A number of reviews have evaluated the published data on FAI surgery, indicating positive results. A systematic evidence review (Stevens et al, 2010) judged the evidence for femoroacetabular surgery as fair quality. Wettstein and Dienst (2006) stated that the early results after hip arthroscopy for the treatment of FAI syndrome are very promising. Guanche and Bare (2006) stated that arthroscopic treatment of FAI syndrome caused by an abnormal head-neck offset improves symptoms, restores hip morphology, and may arrest the progression toward degenerative joint disease in some patients. They noted that early results showed that if debridement of the impinging lesion and injured labrum is performed in the setting of normal femoral and acetabular articular surfaces, the results are promising.

Chládek and Trc (2007) noted that in the case of primary surgery for FAI, short- and middle-term results so far obtained are promising, and forthcoming long-term results will show whether, and for how many years, this therapy is able to postpone the necessity of total hip arthroplasty. Standaert et al (2008) stated that although a connection between anatomical abnormalities of the hip and the development of osteoarthritis has been recognized for some time, there are limited data on the natural history of FAI and no long-term studies on the effect of surgical treatment. Samora et al (2011) concluded that the literature is replete with short-term evidence to support surgical treatment; however, there are currently no long-term prospective data or natural history studies examining the implications of FAI and effects of early intervention.

Longo et al (2010) completed a systematic computerized literature search on hip arthroscopy. The authors found that almost all studies reporting on the outcome of hip arthroscopy are of moderate scientific quality, and the evidence-based knowledge regarding results of hip arthroscopy arises from studies with a short-term follow-up period. The authors stated that the future of hip arthroscopy will require better visualization, access, instrumentation and implants.
with longer follow-up studies to prove its equivalence to or superiority over arthroscopy. The authors concluded that preliminary studies support the use of hip arthroscopy as an alternative to arthroscopy with an enormous therapeutic potential.

Beaule et al (2009) stated that FAI is a recognized cause of hip pain and osteoarthritis in young adults. The clinical presentation of this pathology is quite varied in terms of the underlying deformity, patient age, and the degree of cartilage damage. Open hip surgery with surgical dislocation is the gold standard for treating femoral deformities and the damaged acetabular labral complex; however, less invasive techniques such as hip arthroscopy and arthroscopy combined with limited anterior hip arthroscopy may provide comparable outcomes with less surgical morbidity. Unresolved issues include the indications for acetabular rim trimming with labral refixation in the presence of acetabular retroversion and/or delaminated acetabular cartilage. Other issues involve the use of arthroplasty in older patients and/or in those with significant cartilage damage. The authors concluded that surgery should be tailored to treat individual patient's abnormal hip morphology and should address the major underlying impinging deformities.

In a review on arthroscopic treatment of FAI, Tzaveas and Villar (2009) stated that FAI is a recently recognized pathological entity. Arthroscopic treatment, as a modern and minimally invasive technique, has become an attractive and promising treatment. Also, Larson and associates (2009) noted that improved techniques and longer-term outcomes studies will further define the optimal role of hip arthroscopy.

Macfarlane and Haddad (2010) noted the increasing number of studies of FAI in the published literature. The authors reviewed the etiology, pathophysiology, clinical features, diagnosis and treatment of FAI. Search terms included femoro-acetabular impingement, arthroscopic treatment, open treatment, etiology, pathophysiology. The search was limited to articles published in English. All articles were read in full by the authors and selected for inclusion based on relevance to the article. An increasing number of studies relating to FAI have been produced in the 10 years since its recognition. A range of clinical and radiological features have been described. Surgical management can be performed using a number of techniques, with promising results from various studies. Early treatment with open surgery has paved the way for less invasive and arthroscopic approaches, with short-to-medium term data reporting favorable functional results for arthroscopic treatment of FAI. Thus, the results of long-term studies are awaited.

Katz and Gomoll (2007) examined recent trends in the use of arthroscopic surgical techniques to address musculoskeletal problems. These investigators focused on arthroscopic approaches to problems of the hip, wrist, elbow and ankle. They noted that hip arthroscopy is permitting novel,
minimally invasive approaches to the management of FAI, labral tears, loose bodies and chondral lesions. Complications of arthroscopic procedures occur very rarely. However, they stated that virtually all the literature on arthroscopy outcomes comes from small uncontrolled studies.

In a review on the management of labral tears and FAI in young, active patients, Bedi and colleagues (2008) determined (i) the quality of the literature assessing outcomes after surgical treatment of labral tears and FAI, (ii) patient satisfaction after open or arthroscopic intervention, and (iii) differences in outcome with open or arthroscopic approaches. Computerized literature databases were searched to identify relevant articles from January 1980 to May 2008. Studies were eligible for inclusion if they had a level I, II, III, or IV study design and if the patient population had a labral tear and/or FAI as the major diagnosis. Patients with severe pre-existing osteoarthritis or acetabular dysplasia were excluded. Of the 19 articles with reported outcomes after surgery, none used a prospective study design and 1 met the criteria for level III basis of evidence. Open surgical dislocation with labral debridement and osteoplasty is successful, with a good correlation between patient satisfaction and favorable outcome scores. The studies reviewed support that 65 % to 85 % of patients will be satisfied with their outcome at a mean of 40 months after surgery. A common finding in all series, however, was an increased incidence of failure among patients with severe pre-existing osteoarthritis. Arthroscopic treatment of labral tears is also effective, with 67 % to 100 % of patients being satisfied with their outcomes. The authors found that, although open surgical dislocation with osteoplasty is the historical gold standard, the scientific data do not show that open techniques have outcomes superior to arthroscopic techniques.

In an evaluation of the aformented systematic evidence review by Bedi et al, the Centre for Reviews and Dissemination (2009) stated that the validity of the studies included in this systematic review was not assessed and the studies were of poor quality study design, so the reliability of their results is uncertain. The CRD concluded that Bedi et al's conclusions reflected the data presented, but the potential for various biases in the review made their reliability unclear.

A systematic evidence review prepared by the Health Care Insurance Board of the Netherlands (CVZ, 2010) found no prospective comparative studies of surgery for femoroacetabular hip impingement syndrome. The systematic evidence review noted that evidence consists largely of retrospective case-series, which are heterogeneous in terms of patient populations, treatment and outcomes.
Clohisy and colleagues (2010) performed a systematic review of the literature to (i) define the level of evidence regarding hip impingement surgery; (ii) determine whether the surgery relieves pain and improves function; (iii) identify the complications; and (iv) identify modifiable causes of failure (conversion to total hip arthroplasty). These investigators searched the literature between 1950 and 2009 for all studies reporting on surgical treatment of FAI. Studies with clinical outcome data and minimum 2-year follow-up were analyzed. A total of 11 studies met criteria for inclusion -- 9 were Level IV and 2 were Level III. Mean follow-up was 3.2 years; range of 2 to 5.2 years. Reduced pain and improvement in hip function were reported in all studies. Conversion to total hip arthroplasty was reported in 0 % to 26 % of cases. Major complications occurred in 0 % to 18 % of the procedures. Current evidence regarding FAI surgery is primarily Level IV and suggests the various surgical techniques are associated with pain relief and improved function in 68 to 96 % of patients over short-term follow-up. The authors stated that long-term follow-up is needed to determine survivorship and impact on osteoarthritis progression and natural history.

Ng et al (2010) also reviewed the published evidence on the surgical treatment of FAI. A total of 23 reports of case studies on the surgical treatment of FAI were identified and 1 systematic review was conducted. This review of 970 cases included 2 level III studies, and 20 level IV studies. One randomized controlled trial (level I study) (citing Espinosa et al, 2006) was found, comparing labral repair to labral debridement. The authors found that those patients with Outerbridge grade III or IV cartilage damage seen intra-operatively or with pre-operative radiographs showing greater than Tonnis grade I osteoarthritis appear to have worse outcomes with treatment for FAI. The authors found 2 studies that directly compared labral re-fixation with labral debridement; the authors stated that this evidence appears to support labral re-fixation. Although several studies reported post-operative osteoarthritis findings, the authors found that it is too soon to predict whether progression of osteoarthritis is delayed or halted.

A review by ARIF (2010) concluded that the main limitation with the data identified in reviews of femoroacetabular surgery for hip impingement syndrome was that it had been derived from retrospective case series, limiting the conclusions one can draw about the effectiveness of arthroscopic surgery for hip impingement and/or hip pain compared with any conventional approach overall and within any particular subgroups.

An assessment by Public Health Wales (Webb, 2010) found that the available evidence from systematic reviews is mainly of level III (case series) and level IV (expert opinion/formal consensus) type and is suggestive of short term improvements in outcomes with both open and arthroscopic surgical procedures. The assessment found that small prospective cohort studies also confirm outcome improvement. The assessment stated that most studies documented
decreased pain and improved function in the majority of patients with short term follow-up. However, long term follow up studies were not found. The assessment stated that predictors of treatment outcome and the efficacy of various surgical techniques need to be established in well-designed clinical trials.

A systematic evidence review commissioned by the Washington State Healthcare Authority (Dettori et al, 2011) found "no data to assess the short- or long-term efficacy of FAI surgery compared with no surgery". The assessment found "no evidence that one specific treatment resulted in better outcomes than another (surgery versus no surgery, labral debridement versus refixation, osteoplasty versus no osteoplasty)". The assessment identified several case series that reported improvement in pain, patient reported and clinician reported hip outcome scores, patient satisfaction and return to normal activities following FAI surgery. "However, whether this improvement is a result of the surgery, or the postoperative rehabilitation, or the change in activity subsequent to the surgery or placebo is not known". The assessment found "no data available to assess long-term effectiveness of FAI surgery compared with no surgery". The assessment stated that "there are no data yet published to test the hypothesis that FAI surgery prevents or delays hip osteoarthritis or the need for total hip arthroplasty". The Washington State Health Technology Clinical Committee (2011) concluded that the current evidence on surgery for femoroacetabular impingement syndrome demonstrates that there is insufficient evidence to cover. The committee stated that it considered all the evidence, including the comprehensive report, public comments, and utilization data, and gave greatest weight to the evidence it determined, based on objective factors, to be the most valid and reliable.

There is new emerging evidence of the long-term effectiveness of FAI surgery. Meftah et al (2011) reported on long-term outcomes of arthroscopic labral debridement. The investigators reported on fifty consecutive patients who underwent hip arthroscopy and labral debridement with a mean follow-up of 8.4 years. Patients' pre-operative Harris Hip Scores and co-existing pathologies such as FAI, dysplasia, or arthritis were recorded as variables. Post-operative Harris Hip Score and satisfaction at final follow-up were recorded as outcomes. The authors reported that good or excellent results were achieved in 62 % of cases (58 % in patients with untreated FAI and 19 % in patients with arthritis). Failures included 2 cases that were converted to total hip replacement (4.5 and 5.2 years after index procedure) due to advancement of arthritis and 1 case of repeat arthroscopy for cam decompression. Patients with no co-existing pathology had significantly higher satisfaction and Harris Hip Scores. The authors noted that almost all of the patients with low postoperative Harris Hip Scores had arthritic changes, and that arthritis had a significant correlation with low post-operative Harris Hip Scores and satisfaction. The authors found that co-existing pathology, especially arthritis and untreated FAI, can result in inferior
outcomes. The authors concluded that arthroscopic labral debridement of symptomatic tears in selected patients with no co-existing pathology can result in favorable long-term results. The authors found that arthritis is the strongest independent predictor of poor outcomes.

Previously published long-term data come from Byrd and Jones (2010), who investigated the response to hip arthroscopy in a consecutive series of patients with 10 years follow-up. Since 1993, the authors assessed all patients undergoing hip arthroscopy prospectively with a modified Harris hip score pre-operatively and then post-operatively at 3, 12, 24, 60, and 120 months. A cohort of 50 patients (52 hips) was identified who had achieved 10-year follow-up and represent the substance of this study. The authors reported that there was 100 % follow-up of these patients. The average age of the patients was 38 years (range of 14 to 84 years), with 27 males and 23 females. The median improvement was 25 points (pre-operative, 56 points; post-operative, 81 points). Fourteen patients were converted to total hip arthroplasty (THA) and 2 died. Four patients underwent repeat arthroscopy. There were 2 complications in 1 patient. The presence of arthritis at the time of the index procedure was an indicator of poor prognosis. The authors concluded that this study substantiates the long-term effectiveness of arthroscopy in the hip as treatment for various disorders, including labral pathology, chondral damage, synovitis, and loose bodies. The authors found that arthritis is an indicator of poor long-term outcomes with these reported methods.

In summary, there is currently sufficient evidence to support the short- and mid-term effectiveness of surgery (open or arthroscopic) for the treatment of individuals with FAI syndrome. However, there is a lack of evidence that surgical intervention slows the rate of progression to osteoarthritis of the hip in these patients.

A systematic review of the evidence for FAI surgery (Harris et al, 2013) found that study methodological quality, analyzed using Modified Coleman Methodology Score (MCMS), was poor.

Clohisy et al (2013) stated that FAI surgery is at the development level, with only case series supporting the intervention. The authors stated that recently published systematic reviews of the literature indicate that the current evidence regarding FAI surgery primarily consists of level IV studies. These studies support the clinical efficacy of FAI surgery, with most patients reporting reduced pain, improved function, and a better quality of life after surgical intervention for symptomatic FAI. Similar to the data supporting many surgical interventions, these data have limitations, however, in that the study cohorts are relatively small, the surgical interventions are varied, and the follow-up duration is short- to midterm. The authors stated that, in the scheme of an ideal introduction of a new intervention, FAI surgery is at the development level, with only case series supporting the intervention. The authors stated that, to bolster the strength of clinical
Evidence regarding FAI surgery, larger clinical studies are needed to compare surgical and nonsurgical hip rehabilitation interventions, identify the predictive factors of treatment outcomes, and determine the long-term impact of FAI surgery on joint survivorship and disease modification, that is, the delay or prevention of secondary osteoarthritis.

The United Kingdom Feasibility study of a trial of Arthroscopic Surgery for Hip Impingement compared with Non-operative care (UK FASHIoN) is a large-scale multicenter pilot project funded by the Health Technology Assessment Programme, a division of the National Institute for Health Research (NIHR) of the National Health Service in the United Kingdom. The study began in March 2012, with a planned 18-month study period. The research team seeks to establish the feasibility of an RCT comparing hip arthroscopy with the so-called best nonsurgical care for symptomatic FAI.

Currently, there is insufficient evidence regarding the use of capsular plication as a treatment for FAI. Larson et al (2014) reported that capsular plication was a predictor of improved outcomes with revision arthroscopic surgery for residual FAI. The authors reviewed patients who underwent arthroscopic hip revision for residual FAI. The authors evaluated pathomorphological findings, intra-operative findings, and pre-operative and post-operative MHHS, SF-12, and pain on a VAS values. The authors compared outcomes after revision arthroscopic FAI correction with outcomes of a matched cohort who underwent primary arthroscopic FAI correction. A total of 79 patients (85 hips) with a mean age of 29.5 years underwent arthroscopic revision FAI correction (mean follow-up of 26 months). The labrum was debrided (27 hips), repaired (49 hips), or reconstructed (7 hips). Two labrums were stable and required no treatment. The authors compared results of revision arthroscopic FAI correction with those of 220 age- and sex-matched patients (237 hips) who underwent primary arthroscopic FAI correction (mean follow-up of 23 months). The mean improvement in outcome scores after revision FAI correction was 17.8 (MHHS), 12.5 (SF-12), and 1.4 (VAS) points compared with 23.4 (MHHS), 19.7 (SF-12), and 4.6 (VAS) points after primary arthroscopic FAI correction. The mean improvement was significantly better in the primary cohort compared with the revision cohort (p < 0.01 for MHHS, SF-12, and VAS values). Good/excellent results were achieved in 81.7 % of the primary cohort and 62.7 % of the revision cohort (p < 0.01). The authors reported that capsular plication (p = 0.032), greater post-operative head-neck offset (p = 0.024), subspine/anterior inferior iliac spine (AIIS) decompression (p = 0.014), and labral repair/reconstruction (p = 0.009) were significant predictors for better outcomes after revision surgery.

Bedi and colleagues (2011) noted that advances in the ability to treat various soft-tissue and osseous pathologic conditions of the hip arthroscopically have been predicated on an improved exposure of the pathology of the central, peripheral, and peri-trochanteric compartments. The management of the capsule is critical and must allow for an improved exposure without
compromising stability and kinematics of the hip. Described approaches have included capsulectomy, limited capsulotomy, extensile capsulotomy, capsular plication, and capsular shift. The selected approach must consider various factors, including symptomatic complaints, underlying hyper-laxity, specific mechanical pathology, and surgical expertise. Universally using a single technique without consideration of the complex mechanical and anatomic factors unique to each patient may result in incomplete treatment of the patho-anatomy or iatrogenic instability.

Domb et al (2013) critically evaluated the available literature exploring the role of the hip joint capsule in the normal state (stable) and pathologic states (instability or stiffness). Furthermore, these researchers examined the various ways that arthroscopic hip surgeons address the capsule intra-operatively: (i) capsulotomy or capsulectomy without closure, (ii) capsulotomy with closure, and (iii) capsular plication. Two independent reviewers performed a systematic review of the literature using PubMed and the reference lists of related articles by means of defined search terms. Relevant studies were included if these criteria were met: (i) written in English, (ii) Levels of Evidence I to V, (iii) focus on capsule and its role in hip stability, and (iv) human studies and reviews. Articles were excluded if they evaluated (i) total hip arthroplasty constructs using bony procedures or prosthetic revision, (ii) developmental dysplasia of the hip where re-orientation osteotomies were used, (iii) syndromic instability, and (iv) traumatic instability with associated bony injury. By use of the search method described, a total of 5,085 publications were reviewed, of which 47 met appropriate criteria for inclusion in this review. Within this selection group, there were multiple publications that specifically addressed more than 1 of the inclusion criteria. Relevant literature was organized into the following areas: (i) capsular anatomy, biomechanics, and physiology; (ii) the role of the capsule in total hip arthroplasty stability; (iii) the role of the capsule in native hip stability; and (iv) atraumatic instability and capsulorrhaphy. The authors concluded that as the capsule-ligamentous stabilizers of the hip continue to be studied, and their role defined, arthroscopic hip surgeons should become facile with arthroscopic repair or plication techniques to restore proper capsular integrity and tension when indicated.

In a cohort study, Skendzel et al (2014) determined if patients with narrow joint spaces had inferior outcomes at a post-operative minimum of 5 years and if they had a higher conversion rate to THA. The hypothesis was that patients with less than or equal to 2-mm joint spaces would report inferior outcomes and that patients with greater than 2-mm joint spaces would have improved survivorship (no conversion to THA). Between March 2005 and January 2008, prospectively collected data were analyzed for patients older than 18 years of age undergoing hip arthroscopic surgery for FAI. Radiographic measurements of joint space were collected, and hips were grouped as having preserved (greater than 2 mm) or limited (less than or equal to 2 mm) joint space. Outcome measures included the WOMAC, MHHS, HOS for ADL and sports-
specific (HOS-ADL) and HOS-SS), and SF-12. There were 559 patients in this study, 466 (83 %) were contacted: 54 patients with limited joint spaces (86 %) converted to THA, while only 63 patients with preserved joint spaces (16 %) converted to THA. The mean survival time for patients with preserved joint spaces was 88 months (95 % CI: 85 to 91 months), and the mean survival time for patients with limited joint spaces was 40.0 months (95 % CI: 33.7 to 46.3 months) (p = 0.0001). Complete follow-up outcome data were available on 323 patients, none of whom had THA, with a mean follow-up of 73 months. The mean post-operative HOS for ADL and sports were significantly better in patients with preserved joint spaces (82 versus 62 [p = 0.012] and 77 versus 47 [p = 0.003], respectively) compared with those with limited joint spaces at a mean of 73 months post-operatively (range of 60 to 97 months). The authors concluded that hip arthroscopic surgery for FAI resulted in significantly better outcomes and activity levels at minimum 5-year follow-up in patients with preserved joint spaces. Hips with limited joint spaces converted to THA earlier than did those with preserved joint spaces.

Frank et al (2014) noted that hip capsular management after hip arthroscopic surgery for FAI is controversial. These researchers compared the clinical outcomes of patients undergoing hip arthroscopic surgery for FAI with T-capsulotomy with partial capsular repair (PR; closed vertical incision, open interportal incision) versus complete capsular repair (CR; full closure of both incisions). The hypothesis was that there would be improved clinical outcomes in patients undergoing CR compared with those undergoing PR. Consecutive patients undergoing hip arthroscopic surgery for FAI by a single fellowship-trained surgeon from January 2011 to January 2012 were prospectively collected and analyzed. Inclusion criteria included all patients between ages 16 and 65 years with physical examination and radiographic findings consistent with symptomatic FAI, with a minimum 2-year follow-up. For analysis, patients were matched according to sex and age ± 2 years. Primary clinical outcomes were measured via the HOS-ADL and HOS-SS subscales, the MHHS, patient satisfaction (measured on a VAS), and clinical improvement at baseline, 6 months, 1 year, and 2 years. Statistical analysis was performed utilizing Student paired and unpaired t-tests, with p < 0.05 considered significant. A total of 64 patients were included in the study, with 32 patients (12 males, 20 females) in each group. The average follow-up was 29.9 ± 2.6 months. There were no significant demographic differences between the groups. The CR group demonstrated significantly superior outcomes in the HOS-SS at 6 months (PR: 63.8 ± 31.1 versus CR: 72.2 ± 16.1; p = 0.039), 1 year (PR: 72.7 ± 14.7 versus CR: 82.5 ± 10.7; p = 0.006), and 2.5 years (PR: 83.6 ± 9.6 versus CR: 87.3 ± 8.3; p < 0.0001) after surgery. Patient satisfaction at final follow-up was significantly better in the CR group (PR: 8.4 ± 1.0 versus CR: 8.6 ± 1.1; p = 0.025). Both groups demonstrated significant improvements in the HOS-ADL (PR: 64.6 ± 17.0 to 90.7 ± 8.4 [p < 0.0001]; CR: 66.1 ± 15.7 to 92.1 ± 7.9 [p < 0.0001]) and HOS-SS (PR: 39.4 ± 23.9 to 83.6 ± 9.6 [p < 0.0001]; CR: 39.1 ± 24.2 to 87.3 ± 8.3 [p < 0.0001]) at final follow-up. There were no significant differences between the groups in the HOS-ADL at any time-point. There were no significant differences in the
MHHS between the groups at final follow-up (PR: 82.5 ± 5.0 versus CR: 83.0 ± 4.4; p = 0.364). The overall revision rate was 6.25%; all patients (n = 4) who required revision arthroscopic surgery were in the PR group (13% of 32 patients), while no patients in the CR group required revision surgery. The authors concluded that while significant improvements were seen at 6 months, 1 year, and 2.5 years of follow-up regardless of the closure technique, patients who underwent CR of the hip capsule demonstrated superior sport-specific outcomes compared with those undergoing PR. There was a 13% revision rate in the PR group, but no patients in the CR group required revision surgery. They stated that while longer term outcome studies are needed to determine if these results are maintained over time, these data suggested improved outcomes after CR compared with PR at 2.5 years after hip arthroscopic surgery for FAI.

This study provided Level 3 evidence. The authors stated that “This study had several limitations, including its retrospective nature and relatively short-term follow-up period of 29.9 months. In addition, the outcome instruments utilized in this study, including the MHHS and HOS, represent limitations to this study. The MHHS is limited because of its ceiling effects, as it was initially designed as a disease specific score for hip osteoarthritis. Although a validated hip-specific outcome instrument, the HOS is limited, as it is a patient-reported outcome score but not patient derived. The authors currently use validated hip-specific outcome scores such as the International Hip Outcome Tool (iHOT-12, iHOT-33); however, these data were not used at the time of data collection for the present study. The other potential limitation is that PR was performed initially, and then the senior author (S.J.N.) transitioned to CR, which may suggest an improvement in the overall surgical technique. The transition happened over a relatively short period of time, and no other variables were introduced in the surgical technique. As noted by multiple authors, the suggested learning curve for competency in hip arthroscopic surgery is 30 cases, and as the senior author had performed over 500 hip arthroscopic procedures before the initiation of this study, a learning curve was likely not a relevant factor in the overall outcomes found in this study. The patient characteristics and procedures performed were similar in both groups, including operative duration, and the only difference was the status of the closure. As noted, over this time period, patients were only included in the study after meeting strict inclusion/exclusion criteria, with the goal of eliminating variables that may have confounded the results; however, this may have resulted in selection bias. This study also had several strengths, including the use of age- and sex-matched study groups, the use of multiple validated hip-specific outcome scores, and the use of both 6-month and 1-year data for all patients, allowing for comparisons and trending of outcomes over time. Overall, this is the first study to directly compare partial capsular closure to complete capsular closure after hip arthroscopic surgery for FAI in age- and sex-matched cohorts. Utilizing these preliminary short-term outcome data, the authors recommend performing complete capsular closure in all appropriate patients undergoing hip arthroscopic surgery for FAI. Future long-term studies are needed to determine if these results are maintained over time”.
Labral Reconstruction for the Treatment of Femoro-Acetabular Impingement Syndrome

Boykin and colleagues (2013) stated that FAI has been well characterized as a cause of hip pain and resultant damage to the acetabular labrum. It has become increasingly clear that an intact labrum is essential for normal joint mechanics, hip stability, and preservation of the articular cartilage. Elite athletes with a hypoplastic or irreparable labrum present a difficult clinical challenge. In a case-series study, these researchers assessed clinical outcomes and determined if elite athletes are able to return to a high level of function and sport after labral reconstruction. They performed a retrospective review of a prospectively collected registry identified 21 elite athletes (23 hips) with an average age of 28.0 years (range of 19 to 41 years) who underwent an arthroscopic ilio-tibial band labral reconstruction. Concomitant procedures included femoral and acetabular osteoplasty in all patients and micro-fracture in 9 of 23 hips. Clinical outcomes were assessed with the MHHS, HOS, the SF-12, and patient satisfaction (on a scale from 1 to 10). Return to play was determined, as well as level of return to play, based on sport-specific statistics. Two patients progressed to arthroplasty. There were 2 revisions in this group of patients, both for lysis of capsulo-labral adhesions in which the graft was found to be well integrated at the time of surgery. The rate of return to play was 85.7 % (18/21), with 81 % (17/21) returning to a similar level. Subjective follow-up was obtained from 17 of the remaining 19 patients (89 %), with an average follow-up of 41.4 months (range of 20 to 74 months). The average MHHS improved from 67 to 84 (p = 0.026) and the average HOS Sport sub-score from 56 to 77 (p = 0.009). The overall median patient satisfaction with outcome was 8.2 (range of 3 to 10). The authors concluded that arthroscopic labral reconstruction using an ipsilateral ilio-tibial band autograft provided good short-term clinical outcomes, high patient satisfaction, and a satisfactory level of return to play in a select group of elite athletes. This was a small (n = 21), retrospective study with short-term (average of 41.4 months) results. Level of Evidence = IV.

In a cohort study, Domb et al (2014) compared the clinical outcomes of arthroscopic labral reconstruction (RECON) with those of arthroscopic segmental labral resection (RESEC) in patients with FAI of the hip. Between April 2010 and March 2011, all prospectively gathered data for patients with FAI who underwent arthroscopic acetabular labral reconstruction or segmental resection with a minimum 2-year follow-up were reviewed. A total of 11 cases in the RECON group were matched to 22 cases in the RESEC group according to the preoperative Non-Arthritic Hip Score (NAHS) and sex. The patient-reported outcome scores (PROs) used included the NAHS, the HOS, and the MHHS. Statistical analyses were performed to compare the change in PROs in both groups. There was no statistically significant difference between groups regarding the pre-operative NAHS (p = 0.697), any of the other pre-operative PROs, or demographic and radiographic data. The mean change in the NAHS was 24.8 ± 16.0 in the RECON group and 12.5 ± 16.0 in the RESEC group. The mean change in the HOS-activities of daily living (HOS-ADL) was 21.7 ± 16.5 in the RECON group and 9.5 ± 15.5 in the RESEC group. Comparison of
the amount of change between groups showed greater improvement in the NAHS and HOS-ADL for the RECON group (p = 0.046 and 0.045, respectively). There was no statistically significant difference in the mean changes in the rest of the PROs, although there were trends in all in favor of the RECON group. All PROs in both groups showed a statistically significant improvement at follow-up compared with pre-operative levels. The authors concluded that arthroscopic labral reconstruction is an effective and safe procedure that provided good short-term clinical outcomes in hips with insufficient and non-functional labra in the setting of FAI. Again, this was a small (n = 11) study with short-term (minimum of 2 years) results. Level of Evidence = III.

In a systemic review, Ayeni et al (2014) explored and identified the reported indications and outcomes in patients who undergo labral reconstruction of the hip joint. The electronic databases Embase, Medline, and PubMed were searched for all available dates up to July 2013. Further hand search of the reference sections of the included studies was done. Two reviewers searched, screened, and evaluated the included studies for data quality using the Methodological Index for Non-Randomized Studies (MINORS) Scale. Data were also abstracted in duplicate, and agreement and descriptive statistics were presented. There were 5 eligible studies (3 case series, 1 prospective cohort, and 1 retrospective chart review) with a total of 128 patients, and an average 11/16 quality on the MINORS score included in this review. All patients were diagnosed with FAI and underwent labral reconstruction; 94 patients were assessed at follow-up (73.4 % survivorship) between a reported mean range of 10 and 49 months. There was variability between the studies with regard to the graft types utilized (ilio-tibial band, Gracilis tendon, Ligamentum teres), surgical approaches [open (18.7 %) versus arthroscopic (81.3 %)], and the reported outcome measures. Overall, improvement was observed in the PROs and functional scores (MHHS, HOS, UCLA, NASH, and SF-12). The failure rate or conversion to THA rate in all available patients was 20 %. The most common indication for labrum reconstruction was a young, active patient with minimal arthritis and non-salvageable or deficient labrum. Other indications included instability, pain, and hypotrophic dysfunctional labrum. The authors concluded that based on the current available evidence, hip labrum reconstruction is a new technique that shows short-term improvement in PROs and functional scores post-operatively. The main indication for reconstruction was a deficient labrum due to previous surgical excision or irreparable tears in young patients with no significant arthritis. They stated that long-term follow-up results with higher quality studies are still lacking based on this review.

White et al (2016) presented minimum 2-year outcomes in patients who underwent a modified technique for arthroscopic labral reconstruction using ilio-tibial band allograft tissue and a front-to-back fixation. From April 2011 to July 2012, all consecutive arthroscopic labral reconstruction patients were included in this Institutional Review Board-approved, prospective case-series study. Inclusion criteria were arthroscopic ilio-tibial band allograft labral reconstruction performed by a single surgeon, age greaterthan or equal to 16 years at the time of arthroscopy, and a
minimum of 2 years of follow-up. Patients completed subjective questionnaires both pre-operatively and post-operatively, including MHHS, the Lower Extremity Function Score (LEFS), VAS pain scores, and patient satisfaction. A modified front-to-back fixation technique for labral reconstruction was used. A total of 152 hips (142 patients) met the inclusion criteria for this study; 131 hips (86.2 %) had complete follow-up at a minimum of 2 years, and 21 hips (13.8 %) were lost to follow-up or had incomplete data during the study period; 70 hips had concomitant procedures performed; 27 microfracture, 30 chondroplasty, 26 psoas release, 5 os acetabuli resection, and 3 Ganz osteotomy. Overall, 18 hips (13.7 %) required revision procedures at a mean of 17 months (range of 1 to 37) after the labral reconstruction. In the remaining 113 hips, there was significant improvement in all outcome measures from pre-operative to most recent follow-up (p < 0.0001). The mean MHHS improved by 34 points (p < 0.0001), and the mean LEFS improved by 27 points (p < 0.0001). The mean VAS pain score improved by 3 points at rest (p < 0.0001), 4 points with average pain with daily activities (p < 0.0001), and 5 points with sport (p < 0.0001). Patients reported an overall satisfaction of 9 (range of 1 to 10). The authors concluded that arthroscopic ilio-tibial band allograft labral reconstruction of the hip showed promising outcomes at minimum 2-year follow-up. Level of Evidence = IV.

Khan et al (2016) provided a comprehensive review and summary of the research published in Arthroscopy: The Journal of Arthroscopic and Related Surgery and The American Journal of Sports Medicine (AJSM) related to hip arthroscopy for FAI. A comprehensive review was conducted in duplicate of Arthroscopy and AJSM from February 2012 to February 2015 for all articles related to FAI, and a quality assessment was completed for all included studies. Clinical outcomes were dichotomized into short-term (less than 6 months) and mid-term (less than 24 months) outcomes, and values were pooled when possible. These researchers identified 60 studies in Arthroscopy and 44 studies in AJSM, primarily from North America (78.8 %), that predominantly assessed clinical outcomes after arthroscopic hip surgery (46.1 %); 71 % of Arthroscopy studies and 20.5 % of AJSM studies were Level IV evidence. The MHHS was used by 81.5 % of included studies. Pooled weighted mean MHHS values after arthroscopic surgery for FAI showed improvements at the mid-term from 60.5 points (range of 56.6 to 83.6) to 80.5 points (range of 72.1 to 98.0) out of a possible 100 points. Pooled weighted outcomes for labral repair showed mean MHHS improvements from 63.8 points (range of 62.5 to 69.0) pre-operatively to 86.9 points (range of 85.5 to 89.9) up to 24 months post-operatively. The authors concluded that the is comprehensive review of research published in Arthroscopy and AJSM over the past 3 years identified a number of key findings. Arthroscopic intervention resulted in improvements in functional outcomes at both the short-term and mid-term for patients with symptomatic FAI in the absence of significant existing degenerative changes. They stated that labral repair may result in improvements over labral debridement. The most commonly used
outcome score was the MHHS for objective assessment of surgical success. They stated that there is a need for continued focus on improvement of methodological quality and reporting of research pertaining to FAI.

Autologous Osteochondral Mosaicplasty in Combination with Femoral Neck Osteochondroplasty

Gungor et al (2015) stated that although FAI syndrome is included in the etiology of lesions involving the acetabular labrum and acetabular cartilage, it is one of many possible reasons behind osteochondral lesions in the femoral head. These researchers presented clinical findings and outcomes of 2 cases with osteochondral defects and cam type impingement of femoral head. Both cases underwent autologous osteochondral mosaicplasty along with femoral osteochondroplasty following controlled hip dislocation. Harris hip scores improved significantly post-operatively and MRI showed an adequate graft union and formation of a healthy chondral surface at the final assessment. The authors concluded that autologous osteochondral mosaicplasty of parafoveal region defects and femoral neck osteochondroplasty combination may be an effective treatment method for young patients with FAI syndrome. These preliminary findings need to be validated by well-designed studies.

Capsular Plication

Capsular plication is an arthroscopic procedure that involves suturing the ligaments around the joint for greater hip stability.

Wada et al (2012) stated that Kabuki syndrome is characterized by distinctive facial features, skeletal anomalies, persisting fingertip pads with dermatoglyphic abnormalities, post-natal growth deficiency and mental retardation. These investigators reviewed their results in the operative treatment of hip dislocations in patients with Kabuki syndrome. Between 2001 and 2009, a total of 7 dislocated hips (3 unilateral and 2 bilateral hips) in 5 patients (all girls) were operatively treated at the authors institution. The operative treatment consists of open reduction, femoral derotation varus osteotomy, pelvic osteotomy (Salter in 1 and incomplete peri-acetabular osteotomy in 6 hips) and capsular plication. The age of the patients at the time of surgery ranged from 2.4 to 5.7 years, with an average of 3.6 years. The follow-up post-operative period ranged from 3.2 to 6.3 years, with an average of 5.0 years. At the final follow-up, all patients reported no click and no pain, and showed well-contained hips by radiographs. All 7 hips were graded as Severin class I to II. One patient presented as having habitual dislocation of the hip 4.4 years after surgery. Computed tomographic (CT) scans revealed posterior acetabular wall deficiency, which was not corrected by the antero-laterally directed Salter osteotomy. The incomplete peri-acetabular osteotomy provided sufficient postero-lateral coverage of the
acetabulum. The authors concluded that operative treatment combining open reduction, femoral derotation varus and incomplete peri-acetabular osteotomies, and capsular plication provided successful results in patients with Kabuki syndrome who had the characteristics of hip instability such as ligamentous laxity, muscular hypotonia and posterior acetabular wall deficiency.

Domb et al (2013) noted that the role of hip arthroscopy in the treatment of patients with dysplasia is unclear because of the spectrum of dysplasia that exists. Patients with borderline dysplasia are generally not candidates for peri-acetabular osteotomy because of the invasive nature of the procedure. However, arthroscopy in dysplasia has had mixed results and has the potential to exacerbate instability. These researchers hypothesized that patients with borderline dysplasia will demonstrate post-operative improvement, high satisfaction rates, and low re-operation rates after a surgical approach that includes arthroscopic labral repair augmented by capsular plication with inferior shift. Between April 2008 and November 2010, patients less than 40 years old who underwent hip arthroscopy for symptomatic intra-articular hip disorders, with a lateral center-edge (CE) angle greater than or equal to 18° and less than or equal to 25°, were included in this study. Patients with Tonnis grade 2 or greater, severe hip dysplasia (CE less than or equal to 17°), and Legg-Calvé-Perthes disease were excluded. Patient-reported outcome scores, including the modified Harris Hip Score (mHHS), non-arthritic hip score (NAHS), hip outcome score-sport-specific subscale (HOS-SSS), hip outcome score-activity of daily living (HOS-ADL), and visual analog scale (VAS) for pain were obtained in all patients pre-operatively and at 1, 2, and 3 years post-operatively. Revision surgery and complications were recorded for each group. A total of 26 patients met the criteria to be included in the study. Of these, 22 (85 %) patients were available for follow-up. The mean (± standard deviation) length of follow-up for this cohort was 27.5 ± 5.5 months (range of 17 to 39) and the average age was 20 years (range of 14 to 39). The mean lateral CE angle was 22.2° (range of 18° to 25°) and the mean Tonnis angle was 5.8° (range of 0° to 17°). There was significant improvement in all patient-reported outcome scores (mHHS, NAHS, HOS-SSS, and HOS-ADL) (p < 0.0001). There was a significant improvement in VAS scores from 5.8 to 2.9 (p < 0.0001). Overall patient satisfaction was 8.4 out of 10; 17 patients had good/excellent results (77 %); 2 patients required revision arthroscopy. The authors concluded that patients with borderline dysplasia have often fallen into a gray area between arthroscopy and peri-acetabular osteotomy, and viable treatment options have remained scarce. They stated that the current study demonstrated favorable results at 2-year follow-up for an arthroscopic approach that includes labral repair augmented by capsular plication with inferior shift.

Peterlein et al (2013) stated that the treatment of hip instability in patients with Down syndrome is challenging. These investigators have performed different pelvic osteotomies and corrections at the proximal femur for this indication. This retrospective study was conducted to evaluate the clinical and radiological outcome of each intervention. All in all, 166 patients with Down
syndrome were treated at the authors’ orthopedic department in the observation period. Problems related to the hip joint were diagnosed in 63 of those patients. Only patients who underwent surgery were included in this study. The charts and X-rays of these 31 patients were evaluated with respect to the following parameters: incidence of the hip problem, concomitant diseases, temporal progress, kind of operation method and date, duration of stay in the hospital, after-care, follow-on surgery related to complications, AC angle, CE angle, ACM angle, CCD angle, index of migration according to Reimers, classification of Bauer and Kerschbauer and general morphology of the femoral head. The group was compared with an age-matched group of 21 patients with hip dysplasia. Those patients underwent the same sort of operation in the same year. In the Morbus Down group, these researchers performed surgery for preservation of the hip in 49 cases. This included 13 osteotomies according to Chiari, 11 triple osteotomies according to Tonnis, 10 corrections by femoral varus derotation osteotomy, 8 pelvic osteotomies according to Pemberton, 5 pelvic osteotomies according to Salter and 2 open reductions of the hip. With respect to the moment of surgery, these researchers detected 3 peaks of age. There was no difference in course of disease and quantity of complications between the groups.

Satisfactory results concerning clinical and radiological outcome were achieved predominantly by complete re-directional acetabular osteotomies; 50 % of the patients who were solely treated by femoral varus derotation osteotomy needed follow-on surgery in the form of pelvic osteotomy. Comparison of pre-operative and post-operative range of motion (ROM) of the hip joint between groups detected capsular insufficiency, increased ligamentous laxity and muscular hypotonia in patients with Down syndrome. Comparison of pelvic radiographs demonstrated significant improvement concerning measured angles in both groups. Pre-operative values with respect to AC angle and CE angle were demonstrated to be lower in the hip dysplasia group (p < 0.01); whereas values for ACM angle were comparable between groups. The authors concluded that hypermobility and secondary dislocation of the hip joint is a common problem in patients with Down syndrome, which often requires surgical intervention at an early stage. According to the authors’ data and clinical results, they suggested a complete re-directional acetabular osteotomy in combination with capsular plication for treatment of this challenging condition.

Rosenbaum et al (2013) reported on the case of a 24-year old military policeman underwent arthroscopic femoral neck osteoplasty and labral repair of his right hip following failed conservative management of femoro-acetabular impingement (FAI). His post-operative course was complicated by recurring posterior instability of his right hip initially presenting as a posterior dislocation on post-operative day 19. Iatrogenic disruption of the hip’s static stabilizers in the setting of underlying coxa valga was the likely culprit. Although anterior dislocation following hip arthroscopy has been described, posterior dislocation has not. Further, these investigators identified a successful and less-invasive approach to the treatment of this complication, in the
form of a spica cast. Prior cases pertaining to post-arthroscopy hip instability have only described operative interventions, such as capsular repair and plication, as effective revision procedures.

Uchida et al (2014) noted that in addition to the underlying shallow acetabular deformity, a patient with hip dysplasia has a greater risk of development of a labral tear, a cam lesion, and capsular laxity. This combination of abnormalities exacerbates joint instability, ultimately leading to osteoarthritis. Unsurprisingly, only repairing the acetabular labrum remains controversial, and the outcome is unpredictable. In this technical note, with video, these researchers demonstrated an entirely endoscopic approach for simultaneously repairing the most common mechanical abnormalities found in moderate hip dysplasia: labral repair, cam osteochondroplasty, capsular plication, and shelf acetabuloplasty using an autologous iliac bone graft.

Chandrasekaran et al (2015) stated that atraumatic instability or micro-instability of the hip is a recognized cause of groin pain and hip instability. Risk factors include female sex, ligamentous laxity, and borderline dysplasia. Arthroscopically, the joint may distract easily, and there may be associated ligamentum teres tears and laxity of the capsule on manual probing. The use of arthroscopic capsular plication in this cohort of patients has shown good to excellent results. Biomechanically, a capsular plication aims to create an imbrication and inferior shift of the capsule to augment the screw-home mechanism of the capsule-ligamentous structures and thereby improve stability in extension and external rotation. These investigators detailed the step-by-step surgical technique of arthroscopic capsular plication, in addition to the indications, pearls, and pitfalls of the technique.

Larson et al (2015) presented outcomes in a series of patients with Ehlers-Danlos syndrome (EDS)-hypermobility type who underwent hip arthroscopy for associated hip pain and extreme capsular laxity. A retrospective chart review identified 16 hips with confirmed EDS -- hypermobility type that underwent hip arthroscopy for continued pain and capsular laxity. All patients had complaints of "giving way" and pain, an easily distractible hip with manual traction under fluoroscopy, and a patulous capsule at the time of surgery. No patient had osseous evidence of acetabular hip dysplasia or prior confirmed hip dislocation. Outcomes were evaluated pre-operatively and post-operatively with the mHHS, the 12-Item Short Form Health Survey (SF-12), and a VAS for pain. Evidence of symptomatic FAI was found in 15 hips (93.8%). The 16th hip had subjective giving way with a positive anterior impingement test and was easily distractible, had a labral tear, and had a patulous capsule at the time of surgery. The mean follow-up period was 44.61 months (range of 12 to 99). The mean pre-operative lateral CE angle was 31.8° (range of 25° to 44°), and the mean Tonnis angle was 3.6° (range of -2° to 8°). Mean femoral version measured on CT scans was 19.2° (range of -7.9° to 31.0°). Of the hips, 13 underwent primary arthroscopy and 3 underwent revision. All hips underwent hip arthroscopy
with an inter-portal capsular cut only and arthroscopic capsular plication. There were 13 labral repairs, 2 labral debridements, 8 rim resections, 15 femoral resections, 2 psoas tenotomies, and 1 micro-fracture. Improved stability with an inability to distract the hip with manual traction under fluoroscopy was noted in all hips after plication. The mean alpha angle pre-operatively was 58.7° on antero-posterior radiographs and 63.6° on lateral radiographs compared with 47.4° and 46.1°, respectively, post-operatively. There were significant improvements for all outcomes (mHHS, p = 0.002; SF-12 score, p = 0.027; and VAS score, p = 0.0004). The mean mHHS, SF-12 score, and VAS score were 45.6 points, 62.4 points, and 6.5 points, respectively, pre-operatively compared with 88.5 points, 79.3 points, and 1.6 points, respectively, at a mean follow-up of 45 months. No EDS patients were lost to follow-up or excluded from analysis. The mean improvement in mHHS from pre-operatively to post-operatively was 42.9 points, and there were no iatrogenic dislocations. One patient underwent further revision arthroscopy for recurrent pain, subjective giving way, and capsular laxity. The authors concluded that FAI and extreme capsular laxity can be seen in the setting of EDS. Although increased femoral version was common, acetabular dysplasia was not common in this study. They stated that meticulous capsular plication, arthroscopic correction of FAI when present, and labral preservation led to dramatic improvements in outcomes and subjective stability without any iatrogenic dislocations in this potentially challenging patient population.

Levy et al (2015) stated that the most commonly reported reasons for persistent hip pain after hip arthroscopy are residual FAI, dysplasia and dysplasia variants, or extra-articular impingement. There are some cases in which the underlying osseous pathomorphology has been appropriately treated, and the cause of persistent hip pain can be soft-tissue injuries such as chondrolabral tears or capsular abnormalities. Capsular defects after hip arthroscopy may suggest an alteration of the biomechanical properties of the ilio-femoral ligament and lead to iatrogenically induced hip instability. There are a growing number of biomechanical and clinical studies showing the importance of capsular management during hip arthroscopy. The authors described the work-up, examination under anesthesia, diagnostic arthroscopy, and technique of capsular plication for iatrogenic instability of the hip.

Mei-Dan et al (2015) noted that symptomatic anterior instability of the hip is typically iatrogenic in nature and poses a challenging problem for the orthopedist. With early recognition, capsular repair and plication are often effective in restoring stability. Cases involving multiple instability episodes or those with delayed presentation, however, may have patulous and deficient capsular tissue precluding successful capsulorrhaphy. Capsular reconstruction may play an important role in restoring stability in these difficult cases. The authors presented an arthroscopic technique for ilio-femoral ligament reconstruction, with Achilles tendon allograft, to address instability of the hip due to anterior capsular deficiency.
There is inadequate evidence that microfracture improves the outcomes of FAI surgery. An editorial (Lubowitz, et al., 2016) commenting on a systematic review of microfracture with FAI surgery noted that we are unable to determine from these studies whether improvements in pain are due to the microfracture or the FAI surgery.

Hip arthroscopy may be necessary for a traumatic labral tear that is causing mechanical symptoms (e.g., unstable tear in good quality labrum, such as may occur in a younger patient with traumatic etiology). However, degenerative tears are usually a sign of early osteoarthritis and there is a lack of adequate evidence that arthroscopic repair of degenerative tears improves clinical outcomes. Most peer-reviewed published medical literature regarding repair of torn labrum are in the context of hip impingement. There are a few studies of isolated repair of torn labrum in patients with dysplasia and bony impingement, and these are mostly case series (level IV evidence). In an evidence review, Haddad, et al. (2014) stated that “It seems logical to repair an unstable tear in a good quality labrum with good potential to heal in order potentially to preserve its physiological function. A degenerative labrum on the other hand may be the source of discomfort and its preservation may result in persistent pain and the added risk of failure of reattachment. The results of the present study do not support routine refixation for all labral tears.”

Anterior-Inferior Iliac Spine Decompression during Femoro-Acetabular Impingement Surgery

Sharfman and colleagues (2016) stated that the anterior inferior iliac spine (AIIS) has variable morphology that correlates with hip ROM. Sub-spinal impingement is an extra-capsular cause for FAI and is clinically significant because it results in decreased ROM and groin pain with flexion-based activity. In symptomatic patients with AIIS extension to or below the acetabular rim, AIIS decompression is considered part of an FAI corrective procedure. A consistent exposed bony area on the anterior and infero-medial aspect of the AIIS serves as a “safe zone” of resection allowing for decompression with preservation of the origin of the rectus femoris tendon. This surgical note described a technique for AIIS decompression. The goal for low AIIS osteoplasty is to resect the AIIS to 2 burr widths (using a 5.5-mm burr) above the acetabular rim, achieving an 11-mm clearance, creating a type I AIIS. The resultant flat anterior acetabular surface between the most antero-inferior prominent point of the AIIS and the acetabular rim allows for free movement of the hip joint without impingement. Careful execution of AIIS decompression can alleviate clinical symptoms of FAI and restore function to the hip joint. However, there is limited evidence regarding the effectiveness of anterior inferior iliac spine decompression.
Bohnsack (2018) examined the clinical value of complete arthroscopic decompression of the impinging sub-spinal soft tissues and resection of the hypertrophic bone formation between the anterior hip capsule and AIIS or decompression of a hypertrophic AIIS. Indications were painful anterior hip impingement and decreased hip flexion following a hypertrophic osseous sub-spinal deformation. Contra-indications were no clinical symptoms or decreased anterior hip function despite radiological osseous sub-spinal hip impingement. Surgical technique involved was hip arthroscopy in supine position on an extension table. Treatment of possible intra-articular hip pathologies in the central or peripheral compartment. Arthroscopic visualization of the hypertrophic impinging soft tissues below the AIIS and decompression using a shaver or radio-frequency (RF) device. Complete arthroscopic resection of the hypertrophic AIIS parts and the osseous sub-spinal deformation using a high speed burr under fluoroscopic control. Post-operative management entailed early functional rehabilitation with full weight-bearing and unlimited hip motion; 3 weeks ossification prophylaxis and 8 weeks of limitation for jumping and running sports activities. The authors concluded that there are no comparative studies or medium- and long-term study results in the literature for arthroscopic AIIS decompression. However, currently published case series showed an improvement of the determined scores.

Michal and associates (2018) evaluated the clinical outcomes after arthroscopic sub-spinal decompression in patients with hip impingement symptoms and low AIIS, and assessed the presence of low anterior inferior iliac spine on the pre-operative radiographs of patients with established sub-spinal impingement diagnosed intra-operatively. Retrospective analysis of patients who underwent arthroscopic sub-spinal decompression has been performed. The indications for surgery were FAI, or sub-spinal impingement. Pre-operative radiographs were assessed for anterior inferior iliac spine type. Intra-operative diagnosis of low anterior inferior iliac spine was based on the level of anterior inferior iliac spine extension relative to the acetabulum and the presence of reciprocal labral and chondral lesions. In patients where low anterior inferior iliac spine was not diagnosed on pre-operative radiographs, the pre-operative radiographs were re-read retrospectively to assess missed signs of low anterior inferior iliac spine. A total of 34 patients underwent arthroscopic sub-spinal decompression between 2012 and 2015. They were followed for a median of 25 months (13 to 37 months). Intra-operatively, grade 2 anterior inferior iliac spine was found in 27 patients and grade 3 anterior inferior iliac spine was found in 7 patients; MHHS, HOS, and HOSS scores increased from median (range) pre-operative scores of 55 (11 to 90), 48 (20 to 91) and 20 (0 to 80) to 95 (27 to 100), 94 (30 to 100) and 91 (5 to 100), respectively (p < 0.0001, p = 0.001, p < 0.0001, respectively). Pre-operative diagnosis of low AIIS was made in 6/34 patients via AP radiographs. On retrospective analysis of pre-operative radiographs, signs of low AIIS were still not observed in 21/34 (61.8 %) patients. The authors concluded that arthroscopic sub-spinal decompression of low AIIS yielded significantly improved outcome measures and high patient satisfaction at a minimum of 13 months follow-up. Low AIIS was often under-diagnosed on AP pelvis and lateral frog.
Radiographs and if left untreated, may result in unresolved symptoms and failed procedure. This was a retrospective study with small sample size (n = 34) and short-term follow-up (13 months). Level of Evidence: IV.

Tateishi and co-workers (2018) evaluated the additional effect of AIIS decompression on knee extensor and hip flexor strength and compared functional outcomes after arthroscopic FAI correction with and without AIIS decompression. A total of 60 patients who underwent arthroscopic FAI correction surgery were divided into 2 groups matched for AIIS morphology: 31 patients who underwent arthroscopic FAI surgery only (without AIIS decompression) (FAI group) (AIIS Type I; n = 5, Type II; n = 26, Type III; n = 0) and 29 patients who underwent arthroscopic FAI surgery with AIIS decompression (AIIS group) (AIIS Type I; n = 5, Type II; n = 24, Type III; n = 0). Knee extensor and hip flexor strength were evaluated pre-operatively and at 6 months after surgery; PRO scores using MHHS, NAHS and iHOT-12 were obtained pre-operatively and at 6 months after surgery. In the AIIS group, there was no significant difference between knee extensor strength pre- and post-operatively (non-significant). In the AIIS group, hip flexor strength was significantly improved post-operatively compared to pre-operative measures (p < 0.05). In the FAI group, there were no significant improvements regarding muscle strength (non-significant). While there were no significant differences of pre-operative and post-operative MHHS and NAHS between both groups (MHHS; non-significant, NAHS; non-significant), the mean post-operative iHOT-12 in the FAI group was inferior to that in the AIIS group. (p < 0.01).

The revision surgery rate for the AIIS group was significantly lower compared with that in the FAI group (p < 0.05). The authors concluded that anterior inferior iliac spine decompression, as a part of an arthroscopic FAI corrective procedure, had a lower revision surgery rate and did not compromise knee extensor and hip flexor strength, and it improved clinical outcomes comparable to FAI correction without AIIS decompression. They stated that AIIS decompression for FAI correction improved post-operative PRO scores without altering the muscle strength of hip flexor and knee extensor. Level of Evidence: III.

The authors stated that this study had several drawbacks. This was a retrospective study with all the inherent limitations of such a study design. There were many cases in which rehabilitation follow-up was limited in the authors’ hospital because many surgery cases have come over from all over the country. Selection bias existed in this study because a number of patients were excluded, as they were seen at clinic sites where dynamometer testing was not performed. In addition, the sample size was relatively small (n = 29 for patients who underwent arthroscopic FAI surgery with AIIS decompression) and the follow-up was short term (6 months). These researchers stated that further studies are needed to evaluate the longer-term effects of various surgical procedures on hip function and muscle strength in a larger number of patients. It was unclear as to whether the addition of an AIIS decompression had an effect on the ultimate outcome other than the muscle strength measures noted previously. Post-operative
inflammation of the origin of the direct head of the rectus femoris may theoretically exist and affect patient function as well. Imaging studies, such as MRI, may be necessary to examine the effect of AIIS decompression on the origin of the rectus femoris. Finally, it was difficult to distinguish whether the most important cause of revision was due to AIIS impingement or residual FAI.

Computer-Assisted Hip Arthroscopic Surgery for Femoro-Acetabular Impingement

Kobayashi and colleagues (2018) noted that precise osteochondroplasty is key for success in hip arthroscopic surgery, especially for FAI caused by cam or pincer morphology. In this Technical Note, these researchers presented computer-assisted hip arthroscopic surgery for FAI, including pre-operative planning by virtual osteochondroplasty and intra-operative computer navigation assistance. The important concept of this technique is that navigation assistance for osteochondroplasty is based on planning made by computer simulation analysis. The navigation assistance allows surgeons to perform neither too much nor too little osteochondroplasty. Specifically, computer simulation was used to identify the impingement point. Virtual osteochondroplasty was then performed to determine the maneuvers that would improve ROM. Thereafter, the planning data were transported to a CT-based computer navigation system that directly provided intra-operative assistance. The authors concluded that computer-assisted technology including pre-operative simulation, virtual osteochondroplasty planning, and intra-operative navigation assistance may promote precise hip arthroscopic surgery for FAI.

The authors stated that there are several limitations, risks, and disadvantages in the clinical application of computer-assisted techniques. First, radiation exposure by CT is considerable, although CT evaluation may be needed for a diagnosis of FAI morphology in detail regardless of computer-assisted techniques application. In addition, surgeons need certain time and fluoroscopic guides for the navigation registration process. Furthermore, it should be noted that surgeons need additional skin incision for setting the navigation device in the distal femur. They must take notice of interference between the femur and navigation device, which possibly induces the error of the navigation system. The appropriateness of pre-operative planning should be considered. Furthermore, surgeons need to validate the accuracy of the navigation system itself compared with the pre-operative planned model.

Appendix

Arthroscopic hip surgery may be medically necessary for the following additional indications:

- Acute fractures of the femoral head or acetabulum; or
- Malunion of a previous intraarticular fracture; or
- Persons with chronic (3 or more months duration), persistent hip pain or dysfunction due to avascular necrosis or loose bodies; or
- Limited synovectomy for chronic inflammatory arthritides (e.g., rheumatoid arthritis, psoriatic arthritis, Lyme arthritis), benign neoplastic disorders (e.g., osteochondromatosis and pigmented villonodular synovitis), recurrent hemarthrosis (e.g., hemophilia), or septic arthritis; or
- Ligamentum teres injuries; or
- Synovial biopsy.

**Note:** Aetna considers psoas tendon release an integral part of femoroacetabular impingement syndrome surgery.

**Tönnis Classification of Osteoarthritis by Radiographic Changes**

Grade 0: No signs of OA

Grade 1: Increased sclerosis, slight joint space narrowing, no or slight loss of head sphericity

Grade 2: Small cysts, moderate joint space narrowing, moderate loss of head sphericity

Grade 3: Large cysts, severe joint space narrowing, severe deformity of the head

**Outerbridge classification**

Grade 0: normal cartilage;
Grade I: cartilage with softening and swelling;
Grade II: a partial-thickness defect with fissures on the surface that do not reach subchondral bone or exceed 1.5 cm in diameter;
Grade III: fissuring to the level of subchondral bone in an area with a diameter more than 1.5 cm;
Grade IV: exposed subchondral bone.

**CPT Codes / HCPCS Codes / ICD-10 Codes**

*Information in the [brackets] below has been added for clarification purposes. Codes requiring a 7th character are represented by "+".*

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><strong>CPT codes covered if selection criteria are met:</strong></td>
</tr>
<tr>
<td>29862</td>
<td>Arthroscopy, hip, surgical; with debridement/shaving of articular cartilage (chondroplasty), abrasion arthroplasty, and/or resection of labrum</td>
</tr>
<tr>
<td>29914</td>
<td>Arthroscopy, hip, surgical; with femoroplasty (ie, treatment of cam lesion)</td>
</tr>
<tr>
<td>Code</td>
<td>Code Description</td>
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</tr>
<tr>
<td>29915</td>
<td>Arthroscopy, hip, surgical; with acetabuloplasty (ie, treatment of pincer lesion)</td>
</tr>
<tr>
<td>29916</td>
<td>Arthroscopy, hip, surgical; with labral repair</td>
</tr>
</tbody>
</table>

CPT codes not covered for indications listed in the CPB:

- iliopectas tendon release surgery, capsular plication, labrum reconstruction, autologous osteochondral mosaicplasty in combination with femoral neck osteochondroplasty, debridement of trochanteric bursitis, hip microfracture, gluteus medius repair, lesser trochanteric resection, and capsular release surgery - no specific code

<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
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<tbody>
<tr>
<td>29863</td>
<td>Arthroscopy, hip, surgical; with synovectomy [not covered for debridement of trochanteric bursitis as an adjunct to FAI surgery]</td>
</tr>
</tbody>
</table>

ICD-10 codes covered if selection criteria are met:

- M24.151 - M24.159 Other articular cartilage disorders, hip [hip impingement syndrome]
- M24.551 - M24.559 Contracture, hip [hip impingement syndrome]
- M24.851 - M24.859 Other specific joint derangements of hip, not elsewhere classified [hip impingement syndrome]
- M25.151 - M25.159 Fistula, hip [hip impingement syndrome]
- M25.551 - M25.559 Pain in hip [hip impingement syndrome]
- M25.651 - M25.659 Stiffness of hip, not elsewhere classified [hip impingement syndrome]
- M25.9 Joint disorder [hip impingement syndrome]
- R26.2 Difficulty in walking, not elsewhere classified [hip impingement syndrome]
- S73.001+ - S73.199+ Dislocation and sprain of joint and ligament of hip [hip impingement syndrome]

ICD-10 codes not covered for indications listed in the CPB (not all-inclusive):

- M16.0 - M16.9 Osteoarthritis of hip [advanced osteoarthritis]
- M13.151 - M13.159 Monoarthritis not elsewhere classified, hip
- M13.851 - M13.859 Other specified arthritis, hip
- Q78.0 Osteogenesis imperfecta
- Q79.6 Ehlers-Danlos syndrome
- Q87.40 - Q87.43 Marfan's syndrome
The above policy is based on the following references:


86. MacDonald AE, Bedi A, Horner NS, et al. Indications and outcomes for microfracture as an adjunct to hip arthroscopy for treatment of chondral defects in patients with ...


AETNA BETTER HEALTH® OF PENNSYLVANIA

Amendment to
Aetna Clinical Policy Bulletin Number: 0736
Femoro-Acetabular Surgery for Hip Impingement Syndrome

There are no amendments for Medicaid.