Systematic Review

The Management of Labral Tears and Femoroacetabular Impingement of the Hip in the Young, Active Patient

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Purpose: The purpose of this systematic review was to determine (1) the quality of the literature assessing outcomes after surgical treatment of labral tears and femoroacetabular impingement (FAI), (2) patient satisfaction after open or arthroscopic intervention, and (3) differences in outcome with open or arthroscopic approaches. **Methods:** 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. **Results:** Of the 19 articles with reported outcomes after surgery, none used a prospective study design and only 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 substantial pre-existing osteoarthritis. Arthroscopic treatment of labral tears is also effective, with 67% to 100% of patients being satisfied with their outcomes. **Conclusions:** The quality of literature reporting outcomes of surgical intervention for labral tears and FAI is limited. 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. **Level of Evidence:** Level IV, systematic review. **Key Words:** Femoroacetabular impingement—Labral tear—Surgical dislocation—Systematic review.

Acetabular labral tears have recently received increased attention as a cause of hip pain in young, athletic patients. Although previously thought to be a relatively uncommon injury, labral tears have been diagnosed with increasing frequency because of improvements in diagnostic imaging and clinical examination.[1-6] The acetabular labrum functions as a shock absorber and allows proper joint lubrication and pressure distribution to protect articular cartilage. Hydrostatic pressurization and joint lubrication are impaired in hips devoid of a labrum.[7-11] Several studies have recently found an association between acetabular labral tears and the early onset of osteoarthritis.[12-15] For this reason, treatment of labral tears in young and active patients is crucial for hip preservation.

Labral tears have been reported to result from acute hip trauma or overload injury due to acetabular dysplasia.[12,16-23] However, in the vast majority of young patients with hip pain, the etiology of these tears has been largely unrecognized. However, observations by Ganz and colleagues[13,24] have recently identified femoroacetabular impingement (FAI) as the predominant cause of labral tears in the nondysplastic hip.

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Structural abnormalities in the morphology of the hip can limit motion and result in repetitive impact of the proximal femoral neck against the acetabular labrum and its adjacent cartilage. Bony impingement can result from a decrease in femoral head-neck offset (cam effect), an overgrowth of the bony acetabulum (pincer effect), excessive acetabular retroversion, or a combination of these deformities. Bony impingement with range of motion, particularly with internal rotation and flexion, can compromise the labrum and adjacent soft tissues, ultimately resulting in irreversible damage to the articular cartilage and early-onset joint degeneration.[13,24] The cam effect causes damage to the anterosuperior acetabular cartilage and labrum by shearing from the nonspherical femoral head. In pincer impingement the labrum is crushed between the acetabulum and femoral neck, causing peripheral localized or circumferential labral degeneration. These recognized changes in the hip caused by FAI, including alterations to the labrum and cartilage, as well as fibrocystic degeneration at the head-neck junction, have all been associated with early-onset osteoarthritis of the young hip that was previously thought to be of idiopathic origin.[12-15]

Recognition of FAI as a cause of labral pathology and consequent hip degeneration has led to new treatment strategies aimed at earlier diagnosis and surgical correction. Open surgical dislocation of the hip, as described by Ganz and colleagues,[13,24-26] has played an important role in recognizing and treating FAI. Surgical dislocation allows for circumferential inspection of the acetabular rim, including the labrum, cartilage, and femoral head-neck junction, and simultaneously provides an opportunity to treat intracapsular pathology and restore normal joint clearance.

Arthroscopic treatment of hip pathology has grown in popularity during the last decade. Although it was initially met with some skepticism, advances in arthroscopic techniques have led to an expanding list of surgical applications, including treatment of symptomatic labral tears, capsular laxity and instability, FAI, chondral lesions, ligamentum teres injuries, and snapping hip syndrome.[18,27-37] Advantages include minimally invasive access to the hip joint, peripheral compartments, and associated soft tissues. Furthermore, arthroscopy allows for a dynamic intraoperative assessment and correction of FAI, and favorable early results have been reported in the literature.[27-47]

Despite an improved understanding of labral pathology and advances in surgical techniques, much is still unknown regarding patient outcomes after surgery. The literature is confounded by heterogeneous surgical techniques and patient populations, including those with acetabular dysplasia, pre-existing hip arthritis, or unrecognized FAI. Outcome analysis has been further limited by the lack of a validated assessment tool for nonarthritic hip pathology.

We performed a systematic review of the literature in an effort to address the following questions: (1) What is the quality of the literature evaluating outcomes after surgical management of hip labral pathology and FAI? (2) Does patient satisfaction correlate with a good result as determined by a validated outcomes instrument and/or the patient's ability to return to his or her preoperative level of activities? (3) Is treatment of a labral tear without attention to underlying FAI associated with inferior outcomes? (4) Are there significance differences in outcomes after open versus arthroscopic approaches to treat FAI and labral pathology? We hypothesized that arthroscopic techniques are as effective as open surgical techniques in achieving satisfactory clinical outcomes in the treatment of FAI and labral pathology.

METHODS

We searched the Medline, EMBASE, and Cochrane computerized literature databases for articles from January 1980 to May 2008 containing the following terms: FAI, hip, surgical dislocation, arthroscopy, labrum, labral tear, and outcome. All studies from the previously mentioned searches were reviewed. Reference lists from the articles were retrieved to identify any additional studies of interest. Studies were eligible for inclusion if they met the following criteria: (1) they were in English, (2) they had a level I, II, III, or IV study design according to *Arthroscopy* criteria, (3) labral tear and/or FAI was the major diagnosis, and (4) the labrum and/or FAI received an intervention. Studies were excluded if patients had concomitant severe, pre-existing hip osteoarthritis or severe acetabular dysplasia. One of us (A.B.) performed the initial search, after which all of us independently reviewed the selected studies.

We obtained 76 articles from Medline and 48 articles from EMBASE using the search criteria. Most of these articles were reviews of the topic or a described surgical technique and were excluded from further analysis. Nineteen articles that satisfied the inclusion criteria and provided an intervention with outcomes data remained.[25,32,38-51] Eighteen articles had a level IV design, and one had a level III design. No randomized, controlled studies or studies with a prospective study design were identified. Seven studies reported

outcomes after open surgical approaches,[25,38,48-51] and twelve reported outcomes after arthroscopic surgery.[32,39-47]

In the absence of a well-validated outcome instrument to evaluate patients with nonarthritic hip problems, leniency was given regarding outcome measure.[52] Of the 7 open surgical series, 3 used the Merle d'Aubigne outcomes instrument[25,49,50] and 1 used the Harris Hip Score (HHS).[51] In the Merle d'Aubigne grading system, pain, gait, and hip range of motion have a maximum possible score of 6 points each. The sum of the 3 individual scores produced the final clinical score, which was classified as excellent (18 points), very good (17 points), good (15 or 16 points), fair (13 or 14 points), or poor (<13 points). The HHS is a 100-point assessment tool (91 points for pain and function and 9 points for range of motion) typically used for patients with hip arthritis. The modified Harris Hip Score (MHHS) is more applicable to patients without significant osteoarthritis and eliminates scoring for deformity and range of motion from the original scale. A multiplier of 1.1 restores the 100-point score. MHHS scores are grouped according to Harris's original scheme (excellent, 90 to 100; good, 80 to 90; fair, 70 to 80; and poor, <70). Two studies used the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and University of California, Los Angeles (UCLA) validated outcomes instruments.[48] One study used only return-to-play outcomes in a small series of 5 professional athletes.[38]

Of the 12 arthroscopic series, 3 used the MHHS[39,45] and 3 used the WOMAC outcomes instrument.[40,41] Four studies solely used return-to-play outcomes. The 2 remaining studies used subjective questionnaires focusing on pain relief, improvement of mechanical symptoms, and patient satisfaction after surgery. In the study by Farjo et al.,[32] patients were asked questions regarding pain, mechanical symptoms, general activity level, ability to perform activities of daily living, work ability, and participation in sports. They were asked to compare their current symptoms and preoperative symptoms with regard to these areas on a scale ranging from 1 to 5 (where 1 indicates much worse; 3, the same; and 5, much better). If a patient had a 4 or 5 for each criterion, he or she was classified as having a good to excellent outcome; otherwise, the patient was classified as having a poor result.

In the open surgical series, sample sizes ranged from 5 to 52 patients, with a mean of 27 patients. The mean patient age was 33 years (range, 22 to 41 years). The mean duration of follow-up was 40 months. The primary diagnosis in all series was FAI and associated labral tears. The operative intervention in all but 1 subgroup of patients was an open surgical hip dislocation, labral debridement, and osteoplasty to restore normal joint clearance. One subgroup of patients in the series reported by Espinosa et al.[49] underwent surgical dislocation and labral refixation rather than only debridement at the tear.

In the arthroscopic surgical series, sample sizes ranged from 6 to 58 patients, with a mean of 30 patients. The mean age was 33 years (range, 24 to 41 years). The mean duration of follow-up was 26 months. The primary diagnosis in 8 series was symptomatic labral tears and/or FAI. The operative intervention was labral debridement and treatment of associated chondral injuries in 8 series. Four series addressed both the labrum and FAI with labral debridement and/or repair and osteoplasty.[41,44]

RESULTS

Open Surgical Series

A summary of the outcomes after open surgical dislocation for FAI and labral tears is shown in Table 1. The open surgical series collectively assessed outcomes in 197 patients with a mean follow-up of 40 months. A range of 65% to 94% good to excellent outcomes was reported. The failure rate, as defined by a dissatisfied patient and/or conversion to total hip arthroplasty, ranged from 4% to 30%.

Beck et al.[25] were the first to report midterm results of open surgical dislocation and osteoplasty for 19 patients with FAI. The mean duration of follow-up was 4.7 years. Outcomes were assessed by the Merle d'Aubigne hip score, radiographic progression of osteoarthritis as graded by Tönnis criteria, and failure requiring conversion to hip arthroplasty. All patients underwent femoral neck osteoplasty for cam impingement, and 6 underwent osteoplasty and rim resection for combined cam and pincer deformity. Lesions of the articular cartilage were seen in all but 1 case and were always adjacent to the labral lesion. Unstable cartilage flaps were debrided in 9 hips and combined with drilling in 3 cases. An additional intertrochanteric osteotomy to offload the damaged cartilage was performed in 5 cases. The Merle d'Aubigne hip score improved from 14.1 preoperatively to 16.5 postoperatively ($P < .015$).[25] Radiographic degeneration remained stable in 14 cases and actually improved in 3 patients. Five patients with failure because of residual pain and radiographic progression of osteoarthritis underwent conversion to total hip arthroplasty at a

TABLE 1. *Summary of Outcomes for Open Surgical Series*

Study	No. of Hips	Mean Age (yr)	Mean Duration of Follow-up (mo)	Procedure	Return to Play	Outcomes Data	Failures
Beck et al.[25] (2004)	19	36	57	Surgical dislocation, osteoplasty, labral debridement		70% good to excellent results	5/19 failures converted to THA
Bizzini et al.[38] (2007)	5	22	32	Surgical dislocation, osteoplasty, labral debridement	3/5 to professional level, 2/5 to minor league		
Murphy et al.[50] (2004)	23	35	60	Surgical dislocation, osteoplasty; 3 with associated IT osteotomy, 3 with associated PAO		65% good to excellent results	7/23 failures converted to THA
Peters and Erickson[51] (2006)	30	31	32	Surgical dislocation, osteoplasty, labral debridement		85% good to excellent results	4/8 with radiographic OA converted to THA
Beaulé et al.[48] (2007)	37	41	36	Surgical dislocation, osteoplasty, labral debridement	28/37 returned to preoperative level of activity	82% good to excellent results	6 dissatisfied with operative procedure
Espinosa et al.[49] (2006)	25 in group I and 35 in group II	30	24	Dislocation plus labral debridement (group I) or dislocation plus labral refixation (group II)		76% good or excellent results in group I and 94% good or excellent results in group II	4% poor results in group I and 6% moderate results in group II
May et al.[53] (2007)	5	40	26	Surgical dislocation or arthrotomy after failed arthroscopy, osteoplasty, and labral debridement/ repair		100% good to excellent results	1 symptomatic hardware removal

Abbreviations: THA, total hip arthroplasty; IT, intertrochanteric; PAO, periacetabular osteotomy.

mean of 3.1 years. All of these patients had either significant preoperative arthritis (Tönnis grade 2) or intraoperative findings of severe articular cartilage and/or labral degeneration. The authors concluded that surgical dislocation and osteoplasty were safe and effective in patients with FAI whose early degenerative changes were limited to Tönnis grade 1 with minimal articular cartilage damage.[25]

Bizzini et al.[38] reported outcomes after open surgical decompression of the hip in 5 professional hockey players with FAI. All patients underwent hip dislocation, osteoplasty, and labral debridement with peripheral refixation. The mean duration of follow-up was 32 months, and outcome measures were time to return of hip range of motion, core muscle strength, and return to competitive play. Hip range of motion was regained by a mean of 10 weeks, core strength reached preoperative levels by a mean of 8 months, and return to competitive play averaged 9.6 months. Three players returned to professional competition, and the remaining two returned to minor league play.[38]

Murphy et al.[50] reported on 23 patients with FAI treated with open osteoplasty and labral debridement with follow-up ranging from 2 to 12 years. Of the patients, 10 had isolated cam-type impingement, 1 had isolated pincer impingement, and 12 had combined deformities. Three hips were treated by intertrochanteric osteotomy and four with periacetabular osteotomy in addition to the surgical dislocation to address additional deformities. Outcomes were assessed by Merle d'Aubigne hip score and failure requiring conversion to hip arthroplasty.[50] No data concerning return to preoperative sports competition were provided. Of the 23 patients, 15 continued to function well without additional surgery at final follow-up. One patient required subsequent hip arthroscopy for a torn labrum, and seven were converted to a total hip arthroplasty. Merle d'Aubigne scores improved from a mean of 13.2 ± 1.5 preoperatively to 16.9 ± 1.35 ($P < .0001$).[50] All 7 failures that were converted to hip arthroplasty had preoperative risk factors, including untreated acetabular dysplasia or osteoarthritis of Tönnis grade 2 or greater preoperatively.[50]

Peters and Erickson[51] recently presented a series of 30 hips treated with open surgical dislocation, osteoplasty, and labral debridement for FAI with a mean follow-up of 32 months. Isolated cam impingement was present in 14 hips, isolated pincer

impingement in 1, and combined impingement in 15. Outcomes were assessed by HHS, radiographic progression of osteoarthritis as graded by Tönnis, and failure requiring conversion to hip arthroplasty. Of the 30 cases, 16 had a labral tear or degeneration, 7 of which were treated with partial excision and 5 of which were repaired with partial detachment, debridement, and refixation with transosseous sutures. In 4 hips the damaged labrum was left untreated. Of the 30 cases, 26 had articular cartilage damage underlying the labrum at the anterosuperior quadrant; 20 of these had severe (Outerbridge grade III or IV) articular cartilage delamination. Of these cases, 10 were treated with resection of the cartilage flap. Microfracture of the lesion was performed in only 3 cases. In addition to surgical dislocation and osteoplasty, a relative femoral neck lengthening was performed in 5 patients by distal trochanteric advancement and residual medial greater trochanter debridement. The mean HHS improved from 70 to 87 points ($P < .0001$).[51] Four patients with residual pain and radiographic evidence of progressive arthrosis were converted to total hip arthroplasty. Three of these patients had an Outerbridge grade IV articular cartilage lesion of the acetabulum at the time of surgical exploration. The Tönnis grade of osteoarthritis did not change in 20 of 30 cases, and it progressed by 1 grade in 9 cases and by 2 grades in 1 case. Eight of the ten cases with radiographic progression had Outerbridge grade IV articular cartilage lesions noted intraoperatively. The study concluded that open surgical dislocation and osteoplasty comprised an effective technique for patients with FAI with minimal damage to the acetabular articular cartilage.[51]

Quality-of-life outcomes after open surgical dislocation and osteoplasty for FAI have recently been assessed by Beaulé et al.[48] All patients underwent surgical dislocation, head-neck junction osteoplasty, and partial debridement of a torn labrum. Damage to the acetabular articular cartilage was present in 28 cases, and 26 cases had moderate to severe (Beck type 4 or 5) defects. Only 2 patients underwent an associated acetabular rim resection for pincer impingement with debridement of delaminated cartilage and peripheral labral refixation. Outcomes of 37 procedures at a mean follow-up of 3.1 years were reported by use of the WOMAC, UCLA activity score, and Short Form 12 (SF-12) outcomes instruments. The mean WOMAC score improved from 61.2 ± 20 preoperatively to 81.4 ± 16 postoperatively ($P < .001$).[48] The mean UCLA activity score improved from 4.8 ± 1.9 to 7.5 ± 2.4 points ($P < .001$). The mean SF-12 physical and mental component scores improved from 37.3 ± 10.4 to 45.6 ± 10.5 points ($P < .001$) and from 46.4 ± 11.4 to 51.2 ± 11.3 points ($P = .031$), respectively. Six patients had an unsatisfactory outcome with no clinical improvement. Five of these patients had Beck type 4 damage to the acetabular cartilage at the time of the index operation. However, no correlation between cartilage damage and outcome was seen, because hips with favorable outcomes had type 4 or 5 cartilage lesions.[48]

Espinosa et al.[49] addressed the importance of labral preservation by retrospectively reviewing the outcomes of 2 cohorts of young patients treated with surgical dislocation and osteochondroplasty for FAI. In 25 patients the torn labrum was resected. In 35 patients the intact portion was preserved and reattached to the acetabular rim. Outcomes were assessed by the Merle d'Aubigne hip score and radiographic progression of arthrosis at 1 and 2 years postoperatively. No significant preoperative differences in age, gender, preoperative Merle d'Aubigne score, or radiographic arthrosis were identified between groups. In those patients treated with labral resection, the mean Merle d'Aubigne score improved from 12 points to 14 or 15 points at 1 year and 2 years. In those patients treated with labral reattachment, the mean Merle d'Aubigne score improved from 12 to 17 points at both 1 and 2 years.[49] Comparison showed significantly better outcomes with labral preservation at 1 year ($P = .0001$) and 2 years ($P = .01$) postoperatively. Radiographic progression of arthritis was more prevalent with labral resection compared with preservation at both 1 year ($P = .02$) and 2 years ($P = .009$) after surgery. However, no correlation between hip score and Tönnis grade was seen ($P = .4$). Although the surgery was effective in both groups, labral preservation over resection appeared to be favorable whenever possible.[49]

A small series of open surgical dislocation and osteoplasty after failed arthroscopic labral debridement was recently reported by May et al.[53] Five patients presented with persistent hip pain at a mean of 13.6 months after hip arthroscopy and labral debridement. All patients underwent open surgical dislocation or anterior arthrotomy and chondro-osteoplasty of the femoral head-neck junction and reported significant symptomatic improvement at a mean of 16.3 months after surgery. The mean UCLA hip score improved as follows: pain, from 3 (range, 1 to 6) to 7 (range, 6 to 9) ($P = .01$);

TABLE 2. *Summary of Outcomes for Arthroscopic Surgical Series*

Study	No. of Hips	Mean Age (yr)	Mean Duration of Follow-up (mo)	Procedure	Return to Play	Outcomes	Data Failures
Byrd and Jones[39] (2000)	44	29	26	Arthroscopy, labral debridement, loose body removal		93% good to excellent results	1 case of meralgia paresthetica
Guanche and Sikka[40] (2005)	8	36	14	Arthroscopy, labral debridement	8/8 return to preinjury level of competition		
McCarthy et al.[42] (2003)	13	24	18	Arthroscopy, labral debridement		92% good to excellent results	1 failure with recurrent symptoms
Philippon et al.[44] (2007)	45	31	20	Arthroscopy, osteoplasty, labral debridement/ repair, microfracture	42/45 return to preinjury professional athletics	78% still active in professional sports at 20 months' follow-up	3 failures with progressive OA
Saw and Villar[47] (2004)	6			Arthroscopy, labral debridement	5/6 return to professional soccer		
Ilizaliturri et al.[41] (2007)	14	31	30	Arthroscopy, osteoplasty, labral debridement, microfracture		Mean WOMAC increased from 77 to 88; improved ROM in all patients with SCFE and LCP disease	No AVN, infection, fractures
Santori and Villar[46] (2000)	58	37	42	Arthroscopy, labral debridement		67% good to excellent results	33% dissatisfied with procedure
Potter et al.[45] (2005)	33	35	26	Arthroscopy, labral debridement		68% good to excellent results in nondisability patients, 39% good to excellent results in disability patients	
Farjo et al.[32] (1999)	28	41	34	Arthroscopy, labral debridement		71% good to excellent results if no preoperative OA, 21% good to excellent results in patients with OA preoperatively	8 failures requiring conversion to THA
O'Leary et al.[43] (2001)	22	34		Arthroscopy, labral debridement		90% good to excellent results	1 conversion to THA 1 yr s/p arthroscopy
Larson and Giveans[54] (2008)	100	35	10	Arthroscopy, osteoplasty, labral debridement		90% good to excellent results	6 cases of heterotopic ossification, 1 sciatic neurapraxia; 3 failures with conversion to THA
Ilizaliturri et al.[55] (2008)	19	34	24	Arthroscopy, osteoplasty, labral debridement/ repair		84% good to excellent results	2 patients with preoperative arthritis with lower WOMAC scores postoperatively

Abbreviations: OA, osteoarthritis; ROM, range-of-motion; SCFE, slipped capital femoral epiphysis; LCP, Legg-Calve-Perthes; AVN, avascular necrosis; THA, total hip arthroplasty; S/P, status post.

walking, from 8 to 9.2 (range, 8 to 10) ($P = .07$); function, from 5.8 (range, 1 to 8) to 8 (range, 4 to 10) ($P = .01$); and activity, from 6 (range, 2 to 10) to 7 (range, 4 to 10) ($P = .03$). There were no postoperative complications, although 1 patient required symptomatic hardware removal.[53]

Arthroscopic Surgical Series

A summary of the outcomes of hip arthroscopy for FAI and/or labral tears is shown in Table 2. The arthroscopic surgical series collectively assessed outcomes in 271 patients with a mean follow-up of 26

months. A range of 67% to 93% good to excellent outcomes was reported. The failure rate, as defined by a dissatisfied patient and/or conversion to total hip arthroplasty, ranged from 1% to 33%. Of the 10 surgical series, only 2 reported outcomes after both labral debridement and osteoplasty to address the underlying bony impingement. On the other hand, all 6 open surgical series presented outcomes after combined labral debridement and osteoplasty procedures.

Byrd and Jones[39] presented outcomes for a series of 44 athletes who underwent arthroscopy for hip pathology. Thirteen patients were elite or professional athletes. The mean duration of follow-up was 26 months. Most of the patients had labral tears (n = 27) or chondral damage (n = 23). Labral tears and cartilage flaps were debrided, but FAI was not addressed. Outcomes were assessed by use of the MHHS, which improved from a mean preoperative value of 57 to 92 postoperatively. Although no statistical significance was shown, younger patients appeared to have more favorable outcomes. In addition, labral tears of traumatic origin appeared to fare better than those of more insidious onset.[39]

Guanche and Sikka[40] reported the outcomes of 8 elite running athletes who underwent hip arthroscopy and debridement of symptomatic labral tears. All patients underwent debridement of anterosuperior labral tears, and 6 underwent additional debridement of associated articular cartilage lesions. No osteoplasty for FAI was performed. The mean duration of follow-up was 14 months. Outcomes were assessed by the ability to return to play and the WOMAC score. Preoperative baseline scores, however, were not reported. The mean WOMAC score was 94, and all patients were able to return to their preinjury competition levels by final follow-up.[40]

McCarthy et al.[42] reported outcomes of hip arthroscopy for labral tears in elite athletes. They treated 13 hips in 10 patients: 7 professional hockey players, 1 football player, 1 baseball player, and 1 golfer. Eleven hips had debridement of anterior labral tears, and two had debridement of anterior and posterior tears. Four patients had untreated associated chondral lesions adjacent to the labral tears. The mean duration of follow-up was 18 months. Outcomes were measured by return to play and subjective assessment by the surgeon. All patients were able to return to their preinjury level of competition, and 12 of 13 cases were subjectively graded as having good or excellent outcomes.[42]

Outcomes after an arthroscopic approach to labral tears and FAI in professional athletes were recently reported by Philippon et al.[44] Forty-five athletes were followed up for a mean of 1.6 years postoperatively. Outcomes were assessed by ability to return to professional level of play. Eleven athletes had previously undergone hip arthroscopy for treatment of labral or chondral lesions. Of the athletes, 22 underwent decompression for an isolated cam lesion, 3 for an isolated pincer lesion, and 21 for mixed deformity. All patients had labral tears; 25 patients underwent labral repair with suture anchors, 12 had intrasubstance labral repairs, and 5 had labral debridement.[44] Two patients were labral deficient from previous arthroscopic debridement and underwent labral grafting by use of an iliotibial band autograft. Acetabular and femoral head chondral defects were routinely managed with either chondroplasty or microfracture in most cases. Of the athletes, 42 (93%) were able to return to professional sports. The 3 patients who were unable to return to this level of professional athletics were all found to have extensive osteoarthritis changes intraoperatively. Thirty-five athletes remained active in professional sports at a mean of 1.6 years after the index procedure.[44]

Saw and Villar[47] presented a small series of professional soccer players who underwent hip arthroscopy and debridement for symptomatic labral tears. All players had anterior, traumatic longitudinal labral tears with articular chondral defects. The labrum was resected to a stable margin, and no additional interventions for FAI were performed. The only outcome reported was return to play, with 5 of 6 athletes being able to return to professional competition at a mean of 12 months after surgery.[47]

Outcomes for arthroscopic decompression of FAI due to pediatric hip disorders have recently been reported. The cause of deformity was a slipped femoral epiphysis in 8 cases, Legg-Calve-Perthes disease in 4 cases, and developmental dysplasia in 2 cases.[41] All patients underwent osteoplasty for cam deformity, with 1 treated for combined cam and pincer impingement. All patients had anterior labral tears and adjacent articular cartilage delamination and were treated with partial resection of labral tissue and cartilage flaps and microfracture of exposed bone. Outcomes were assessed with the WOMAC activity score, with the mean score improving from 77.7 preoperatively to 87.4 postoperatively ($P = .0001$). No radiographic progression of osteoarthritis was noted.[41]

Santori and Villar[46] retrospectively reported on 58 patients who underwent arthroscopic labral debridement for symptomatic tears refractory to nonoperative management. No assessment or treatment of FAI was

performed. Although patients with severe chondral or osteoarthritic damage were excluded, 28 of 58 patients had moderate chondral damage of the acetabulum or femoral head. The mean duration of follow-up was 3.5 years. Outcomes were assessed with the HHS, which improved from a mean of 49.6 to 73.6 at final follow-up. No correlation between chondral damage and outcome scores was seen.[46]

Potter et al.[45] evaluated outcomes of hip arthroscopy and labral debridement for symptomatic labral tears in active-duty soldiers. Thirty-three patients were followed up for a mean of 26 months postoperatively. Associated FAI was not addressed. Eight patients had evidence of mild or moderate osteoarthritis on plain radiographs, although none had severe osteoarthritis by subjective review. Ten patients had associated Outerbridge grade III chondral defects. Outcomes were assessed by the MHHS and Short Form 36 (SF-36) questionnaire. Overall, only 39% of patients had a good or excellent outcome (>80 points) according to the MHHS. Good correlation between MHHS and SF-36 outcome scores was observed. When groups were subdivided by disability evaluation, the MHHS, SF-36 subscales, and patient satisfaction scores were all significantly better in the nondisabled population. There was no difference in outcome based on variations in patient age or chondromalacia status.[45]

Farjo et al.[32] presented a retrospective series of 28 patients who underwent isolated arthroscopic debridement of labral tears. The mean duration of follow-up was 34 months. Plain radiographs were subjectively evaluated preoperatively, and they showed arthritis or dysplasia in 14 patients. No assessment or treatment of FAI was performed. Outcomes were assessed by a nonvalidated outcomes questionnaire assessing pain relief, mechanical symptoms, activity level, work ability, and participation in sports. Thirteen good and fifteen poor results were reported; failure requiring conversion to total hip arthroplasty was also reported. A correlation between radiographic changes of osteoarthritis or intraoperative detection of chondral lesions and poor outcomes was noted ($P = .008$ and $P = .003$, respectively). Six patients underwent conversion to total hip arthroplasty at a mean of 14 months after the index procedure.[32]

A series of short-term clinical outcomes after arthroscopic management of FAI was recently reported by Larson and Giveans.[54] Arthroscopy or labral debridement or repair, as well and femoral and/or acetabular osteoplasty, was performed in 100 hips in 96 patients (mean age, 34.7 years). Patients with Tönnis grade 3 or 4 degenerative changes were excluded. 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. Outcomes were assessed with the MHHS, SF-12, and visual analog pain scale at a mean of 9.9 months postoperatively (range, 3 to 36 months). A comparison of preoperative scores with those obtained at the most final follow-up evaluations showed a significant improvement ($P < .001$) for all outcomes measured: HHS (60.8 *v* 82.7), SF-12 (60.2 *v* 77.7), visual analog score for pain (6.74 cm *v* 1.88 cm), and positive impingement test (100% *v* 14%). Complications included heterotopic bone formation (6 hips) and a sciatic nerve neurapraxia (1 hip). There were 3 failures that subsequently underwent total hip arthroplasty by the time of final follow-up.[54]

Intermediate follow-up outcomes after arthroscopic treatment of cam-type impingement was recently reported by Ilizaliturri et al.[55] They treated 19 patients (mean age, 34 years) with arthroscopic osteoplasty (n = 19) and partial anterior labrectomy (n = 15), and patients were followed up for a minimum of 2 years. The mean preoperative WOMAC score was 82 points (SD, 9; range, 50 to 90). The mean WOMAC score at 2-year follow-up was 89 points (SD, 9; range, 60 to 96). Two of the cases with osteoarthritis had lower WOMAC scores from the preoperative status to their last follow-up; it decreased from 87 to 83 points in one patient and from 79 to 74 points in the other. The mean increase in score for the rest of the series (16 cases) was 8 points. Mechanical symptoms were resolved in all 16 patients in whom the WOMAC score improved.[55]

DISCUSSION

Improved attention to careful examination of the hip in combination with advances in magnetic resonance imaging have substantially improved our ability to detect early degenerative changes previously not detected on conventional radiographs.[1-5,43] In particular, labral tears have been diagnosed with increasing frequency and have been recognized to be 1 of the factors contributing to osteoarthritis of the hip.[14,15,22] Recent work by Ganz et al.[26] identified morphologic abnormalities of the proximal femur and acetabulum and secondary impingement to be responsible for labral damage and the subsequent irreversible injury to articular cartilage. This recognition of FAI as a common cause of early hip degeneration has led to new open

and arthroscopic surgical strategies aimed at early diagnosis and hip preservation.

Although these advances in surgical technique are novel and exciting, it is imperative that our indications and expectations for surgery are substantiated by objective results. Assessment of surgical outcomes has historically been confounded by variable surgical indications, techniques, and patient populations. Therefore we have performed this systematic review of the literature in an effort to define and critique the objective outcomes data on the surgical management of labral tears and FAI.

Our review has shown the quality of the literature evaluating outcomes after surgical intervention to be limited for both open and arthroscopic approaches. Of the 16 articles with reported outcomes after surgery, none used a level I or II study design and only 1 met the criteria for level III basis of evidence. A vast majority were small, retrospective case series with level IV evidence. Only 9 of 16 studies used a validated outcomes instrument (Merle d'Aubigne score in 3, HHS or MHHS in 3, and WOMAC score in 3). Furthermore, these outcome tools were not consistent or specifically designed to assess young patients with nonarthritic, intra-articular hip problems. Although both groups had suboptimal data, the arthroscopic literature was particularly limited, with only 4 of 10 series using a validated outcomes instrument and 4 studies reporting return-to-play data alone. The literature is also limited by the availability of only short-term results, with the mean duration of follow-up ranging from approximately 2 to 3 years.

In all 6 series of patients undergoing open surgical dislocation, the selected treatment addressed both the labral tear and underlying bony impingement.[25,38,48-51] Only 2 of the 10 arthroscopic case series, however, identified and addressed the underlying FAI as part of the surgical procedure.[41,44] As a result, our ability to accurately compare the arthroscopic outcomes with those of open surgical procedures is limited. However, on the basis of the available data, it does not appear that the clinical outcomes of the open techniques are superior to those of arthroscopic techniques in addressing labral tears and FAI.

In the arthroscopic series the limited short-term outcomes suggest that there is not a significant difference in outcomes scores or failure rate after isolated intervention for a labral tear compared with treatment of the tear and underlying FAI.[32,39-47] However, this conclusion must be interpreted with significant caution because the consequences of residual bony impingement and secondary hip degeneration are likely to become more apparent at midterm and long-term evaluation. A 2007 study by Philippon et al.[56] supports this concern. They reported on 37 patients requiring revision hip arthroscopy for persistent pain at a mean of 21 months after the index procedure. Of the 37 cases, 36 had radiographic evidence of FAI at the time of revision surgery that was not addressed or was inadequately addressed at the index procedure. The mean MHHS improved from 53 points at prerevision evaluation to 77 at a mean of 13 months postoperatively. The increased time between index arthroscopy and revision and the presence of osteoarthritis were identified as negative prognostic factors.[56] The authors concluded that the treatment of underlying bony abnormalities is essential to the success of arthroscopic surgery for hip labral pathology. Data from our own experience with revision hip arthroscopy have yielded similar conclusions.[57] Unaddressed or undertreated impingement lesions were found in 19 of 24 revision cases (5 cam, 11 pincer, and 3 combined), with corresponding findings identified on imaging studies in each case. A tight psoas tendon and corresponding labral impingement lesion were identified by arthroscopic visualization in 7 of 24 cases, for which partial psoas tendon release was performed.[57]

Open surgical dislocation with labral debridement and osteoplasty is successful, with a good correlation between patient satisfaction and favorable outcomes as defined by the HHS or Merle d'Aubigne score.[25,48-51] The studies reviewed support that 65% to 85% of patients will be satisfied with their outcomes at a mean of 40 months after surgery. However, a common finding in all series was an increased incidence of failure among patients with substantial pre-existing osteoarthritis.[25,38,48-51,58]

Arthroscopic treatment of labral tears is also effective, with at least 67%, and as many as 100%, of patients being satisfied with their outcomes. Satisfied patients were able to return to their preinjury level of athletic competition and achieved good results according to WOMAC or HHS scores. Patients treated arthroscopically for a labral tear and associated FAI also did well, with as many as 93% of patients being able to return to sports and 78% being able to remain active at 1.5 years after surgery. Although some studies suggested that patients with associated chondral lesions fared worse than patients with isolated labral tears, larger series were unable to detect a correlation between chondral injury and clinical outcomes.[32,39-47] In addition, the volume and quality of outcomes literature are insufficient to conclude superior short-term outcomes when both the labral tear and underlying

impingement were surgically addressed compared with treatment of the labral tear alone.

Improvements in study design, including prospective data collection and consistent use of validated outcomes instruments, will be essential to provide a greater level of evidence in documenting surgical treatment of labral tears and their associated abnormalities. This, along with implementation of new outcomes instruments focused on young patients with nonarthritic hip problems, will allow further differentiation of the success of variable surgical techniques and approaches to this problem.[52] In addition, it will allow us to provide objective guidelines for patient selection and procedures that will help to optimize our clinical outcomes.

CONCLUSIONS

The quality of the literature assessing clinical outcomes after open or arthroscopic treatment of FAI and labral pathology is limited. On the basis of the studies published to date, our hypothesis that arthroscopic techniques are as effective as open surgical techniques in achieving satisfactory clinical outcomes in the treatment of FAI and labral pathology was supported. 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.

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