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SYMPOSIUM: ADVANCED HIP ARTHROSCOPY

Why Do Hip Arthroscopy Procedures Fail?

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Abstract

Background Despite the successes of hip arthroscopy, clinical failures do occur, and identifying risk factors for failure may facilitate refinement of surgical indications and treatment. Knowledge regarding the reasons for treatment failures may also improve surgical decision making.

Questions/purposes We (1) characterized patients whose symptoms recurred after hip arthroscopy necessitating a revision hip preservation procedure or hip arthroplasty, (2) determined the etiologies of failure, (3) and reported the profile of revision surgical procedures.

Methods In a prospective database of 1724 consecutive hip surgeries, we identified 58 patients (60 hips) with a history of failed hip arthroscopy. Thirty-seven patients (38 hips) underwent revision hip preservation and 21 (22) hip arthroplasty. Thirty-nine (67%) were female. Demographics, etiology of failure, and type of revision surgery were analyzed.

Results Patients treated with revision hip preservation were younger, had a lower BMI, and lower Tönnis osteoarthritis grade at the time of revision surgery compared to patients treated with hip arthroplasty. Common etiologies of failure were residual femoroacetabular impingement (68%) and acetabular dysplasia (24%) in patients treated with revision hip preservation and advanced osteoarthritis in patients treated with hip arthroplasty. The revision preservation procedures included arthroscopy in 16 (42%), arthroscopy with limited open capsulorraphy in two (5.3%), periacetabular osteotomy in nine (24%), and surgical dislocation in 12 (32%).

Conclusions Residual or unaddressed structural deformity of the hip and underlying osteoarthritis are commonly associated with failure after hip arthroscopy. Thorough patient evaluation with detailed characterization of structural hip anatomy and articular cartilage integrity are critical to the selection of proper surgical intervention and successful patient outcome.

Level of Evidence Level IV, prognostic study. See Instructions for Authors for a complete description of levels of evidence.

One of the authors certifies that he (JCC), or a member of his immediate family, has or may receive payments or benefits during the study period, an amount of less than USD 10,000 from Pivot Medical (Sunnyvale, CA, USA), an amount of less than USD 10,000 from Biomet, Inc (Warsaw, IN, USA), and an amount of USD 10,000 to USD 100,000 from Zimmer, Inc (Warsaw, IN, USA).
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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Introduction

The number of hip arthroscopies performed by American Board of Orthopaedic Surgery candidates increased 18-fold between 2003 and 2009 [8]. Multiple studies demonstrate successful treatment of labral tears, chondral defects, and ligamentum teres lesions with the arthroscopic approach

[3]. Recognition of femoroacetabular impingement (FAI) as an osseous deformity leading to hip pain in young adults has broadened the surgical indications to include resection of impingement lesions [9]. As with any surgical procedure, proper patient selection and precise surgical technique are critical to a successful outcome.

Despite the successes of hip arthroscopy, clinical failures do occur, and an attempt to identify risk factors for failure may facilitate refinement of surgical indications and treatment. Knowledge of the reasons for treatment failures may also improve surgical decision making. Two reports of failed hip arthroscopy revealed residual impingement as the most common cause of poor outcome, yet the studies only focused on patients undergoing revision hip arthroscopy [11, 17]. We analyzed a cohort of patients who failed hip arthroscopy and were treated with any revision hip procedure, including arthroscopy, osteotomy, or THA, to determine how they differed from the population of patients whose procedures were more successful. We included all revision procedures to provide a comprehensive description of failed hip arthroscopy procedures and the affected patient population. We (1) characterized the patients whose symptoms recurred after hip arthroscopy to such a degree that they returned for a revision hip preservation or hip arthroplasty procedure, (2) determined the etiologies of failure, (3) and reported the profile of revision surgical procedures.

Patients and Methods

This study was approved by the Washington University Institutional Review Board. We queried the prospective database of the senior author (JCC) to identify all hip preservation or primary hip arthroplasties performed between March 2008 and May 2012. The search identified 1724 consecutive hips, including 820 hip preservation procedures and 904 primary THAs/hip surface replacement arthroplasties (SRAs). All patients enrolled in the database with a previous history of failed hip arthroscopy, performed either by the senior author or by another surgeon, were included in the study. Each of these patients subsequently went on to undergo a revision hip preservation procedure (hip arthroscopy, surgical hip dislocation, or periacetabular osteotomy [PAO]) or hip arthroplasty by the senior author. Fifty-eight patients (60 hips) met these criteria. All other patients were excluded. All patients underwent clinical and radiographic examination by the senior author and were subsequently indicated for revision hip preservation surgery or arthroplasty, including THA and SRA. Patient demographics and data regarding failed hip arthroscopy were obtained from the prospective database and a retrospective chart review of clinical records and operative reports when needed.

The cohort of 58 consecutive patients (60 hips) consisted of 19 males and 39 females, with an average age of 36 years (range, 15–71 years) and an average BMI of 26 kg/m^2 (range, 18–52 kg/m^2). The initial arthroscopy was performed by the senior author in 32 patients (53%), while the remaining 28 procedures (47%) were performed at outside facilities. Correction of osseous deformity was performed in 17 hips (28%) at the time of initial arthroscopy (Table 1). Revision hip preservation was performed in 38 hips (37 patients: seven male, 30 female) and arthroplasty was performed in 22 hips (21 patients: 12 male, nine female).

Preoperative radiographs were performed on all patients according to a standard protocol [4]. Standing AP pelvis and cross-table lateral radiographs were obtained in all patients treated with hip arthroplasty. In patients treated with revision hip preservation procedures, preoperative radiographs included a standing AP pelvis, false-profile, Dunn, and frog leg lateral views [5]. Tönnis grade, a measure of osteoarthritis, was determined for all hips preoperatively [5, 20]. All radiographic measurements were performed utilizing the digital radiograph measurement tool provided by the hospital imaging system (ClinDesk, Inc, St Louis, MO, USA). This system is not validated in the literature. One observer (GP), who was trained by the senior author, analyzed preoperative radiographs. A practice series of 20 radiographs were read and compared to an established reader to determine whether retraining was necessary. Reliability was established by having the primary observer (GP) read a series of 20 radiographs. Radiographs were read twice with a minimum of 1 week between readings. These values were compared to the same established reader to

Table 1. Procedures performed at primary hip arthroscopy in the two revision groups

Procedure	Number of hips	
	Hip preservation (n = 35)	Hip arthroplasty (n = 19)
Labral resection	16 (42%)	17 (90%)
Labral repair	15 (40%)	1 (5.2%)
Osteochondroplasty femoral head-neck junction	10 (26%)	3 (16%)
Partial synovectomy	8 (21%)	2 (11%)
Acetabular osteochondroplasty (rim trim)	4 (11%)	
Ligamentum teres débridement	5 (13%)	
Psoas lengthening	5 (13%)	
Capsulorraphy	2 (5.3%)	
Chondroplasty		15 (79%)
Microfracture		3 (16%)
Loose body removal		2 (11%)

determine both intra- and interobserver reliability. For continuous variables, agreement was assessed with intraclass coefficients. For categorical variables, Cohen's kappa and percent perfect were used. Intraobserver reliability of this observer ranged from moderate to excellent for all parameters tested, with the following kappa values: anterior center-edge angle (ACEA) = 0.99; acetabular index = 0.91; lateral center-edge angle (LCEA) = 0.96; alpha angle (frog) = 0.66; alpha angle (Dunn) = 0.76; and Tönnis grade = 0.54. Interobserver reliability of our observer included the following kappa values: ACEA = 0.91; acetabular index = 0.95; LCEA = 0.89; alpha angle (frog) = 0.38; alpha angle (Dunn) = 0.65; and Tönnis grade = 0.33.

Assessment of acetabular dysplasia was determined for all patients. The LCEA was measured on the AP radiograph as described by Wiberg [21]. Dysplasia was defined using a previously established threshold (LCEA < 20°). An LCEA of between 20° and 25° was considered borderline dysplasia and an LCEA of between 25° and 39° was considered normal. The Tönnis angle, also measured from the AP view, is an additional marker of dysplasia [20]. Normal Tönnis angle values range from 0° to 10°, with values of greater than 10° consistent with acetabular dysplasia. A final measure of dysplasia, the ACEA, was measured from the false-profile view on all patients with hip preservation utilizing the technique described by Lequesne and de Séze [14]. Values of between 20° and 35° were classified as normal and those of less than 20° as dysplastic [5].

Assessment of radiographic signs of FAI was also performed on all patients. Cam impingement was characterized by measurement of the alpha angle on the AP, frog leg lateral, and Dunn radiographic views as described by Nötzli et al. [16]. An alpha angle of greater than 60° on any view was considered consistent with a pathologic decrease in femoral head-neck offset. Pincer impingement was defined as an LCEA of greater than 39°, an ACEA of greater than 35°, and a Tönnis angle of less than 0° [5].

The senior author also prospectively documented intraoperative findings noted at the time of revision hip preservation surgery. We used a standardized intraoperative data sheet established for the hip preservation registry (adapted from the surgical data collection forms of the Academic Network of Conservational Hip Outcomes Research [ANCHOR] Study Group) for collection (supplemental materials are available with the online version of CORR®). The articular cartilage of the acetabulum, femoral head, and femoral head-neck junction were assessed for signs of chondral damage. If present, the location was recorded and the degree of damage classified. The acetabular labrum was also inspected for damage and classified accordingly. Finally, the femoral head-neck junction was inspected for the presence of an osteochondral prominence and/or impingement trough, and the location of the deformity/defect was documented.

We analyzed comparisons of categorical values using the Fisher exact test. Analysis of quantitative data was performed using Student's t-test [1]. Statistical analysis was performed using Microsoft® Excel® software (Microsoft Corp, Redmond, WA, USA).

Results

The patients who underwent revision hip preservation were younger (mean ± SD age: 28 ± 10 years versus 50 ± 7 years; $p < 0.005$) and had a lower mean BMI (25 ± 6 kg/m^2 versus 28 ± 4.5 kg/m^2; $p = 0.034$) than those treated with hip arthroplasty. There were also more females in the hip preservation group (79% versus 41%; $p = 0.009$). The mean interval between arthroscopy and secondary procedure was similar between groups (hip preservation: 25 months; range, 2.9–84 months; arthroplasty: 31 months; range, 1.9–70 months; $p = 0.246$).

Residual or unaddressed FAI was the most common cause of failed hip arthroscopy. The etiologies of failure as assigned by the treating surgeon included FAI (26), acetabular dysplasia (nine), soft tissue laxity (two), osteoarthritis (22), and other (one) (Fig. 1). In the 26 patients with FAI and nine patients with dysplasia, radiographic evidence of osseous abnormality was noted (Table 2). Excessive joint laxity was found to be the primary abnormality in two patients. Both were found to have generalized joint hypermobility as defined by the Brighton criteria [10] and had excessive external rotation motion, with the hip positioned in extension, without a distinct soft tissue end point. Finally, one patient showed no evidence of structural deformity. Secondary osteoarthritis was believed to be the primary cause of failure in the remaining 22 patients. Preoperative radiographs (at the time of revision surgery) demonstrated moderate to severe osteoarthritis in 77% of these hips (Tönnis Grade 2 or 3). The remaining hips had MR arthrographic evidence of diffuse full-thickness articular cartilage loss. In addition to arthritis, evidence of FAI was found in 16 hips (73%) and signs of acetabular dysplasia in six hips (27%) (Table 2).

The majority (63%) of patients who failed hip arthroscopy were managed with a repeat hip preservation procedure including repeat arthroscopy (37%), surgical hip dislocation (32%), and PAO (24%); however, the remaining 22 patients (37%) underwent hip arthroplasty. Fourteen hips with FAI (12 cam, one combined, and one pincer) were managed with revision arthroscopy (Table 3). Twelve

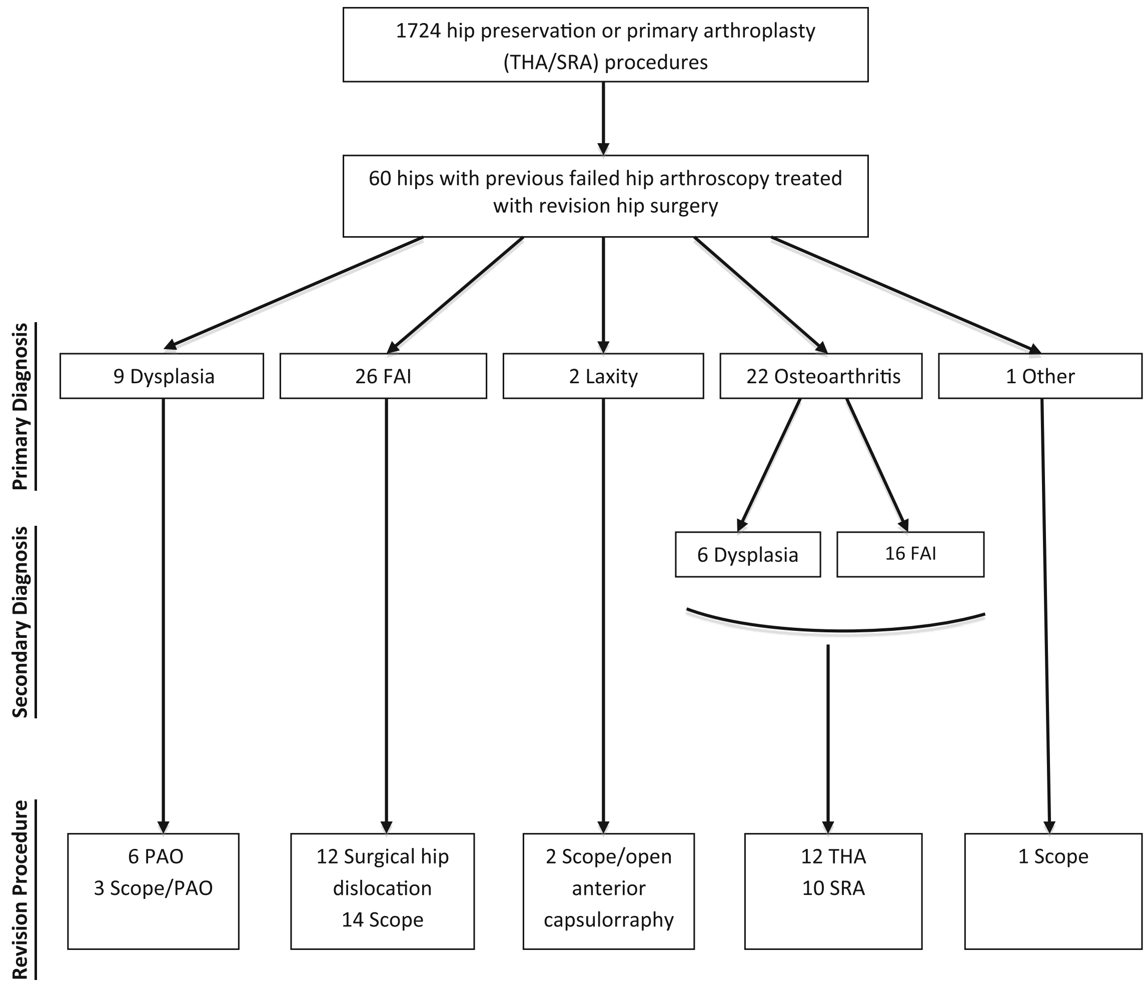

Fig. 1 A flowchart shows preoperative diagnoses and revision procedures after failed hip arthroscopy.

hips with FAI were managed with surgical hip dislocation (seven combined, five cam). All nine hips with dysplasia were treated with acetabular reorientation via the Bernese PAO [19]. A concomitant osteochondroplasty of the femoral head-neck junction was also performed in all patients at the time of PAO [7]. Combined arthroscopy and PAO was performed in three patients [18]. Arthroscopic labral repair was performed in three, acetabular microfracture in one, and acetabular chondroplasty in one. Both patients with excessive laxity were treated with repeat arthroscopy followed by open anterior arthrotomy and capsulorraphy, and the single patient without structural deformity was treated with lysis of adhesions, acetabular chondroplasty, and labral repair. Intraoperative assessment of patients treated with revision hip preservation surgery revealed evidence of continued pathology, including chondral and labral damage in 88% and 86%, respectively (Table 4). In patients treated with arthroplasty, THA was performed in 12 (54%) and SRA in 10 (45%).

Discussion

The limits of hip arthroscopy continue to be defined. Despite successful outcomes in many patients, failures do occur and have only recently been critically evaluated. In a cohort of patients who failed hip arthroscopy and were treated with any revision hip procedure, we therefore (1) characterized the patients who failed hip arthroscopy, (2) determined the etiology of failure, and (3) reported the profile of revision surgical procedures after failed arthroscopy.

There are limitations of this study. The preoperative diagnosis and details regarding the initial arthroscopic procedure were not available for all patients because many procedures were performed at outside institutions. Additionally, we only reported data relevant to failed arthroscopic procedures. A control group of clinically successful procedures has not been analyzed. A single surgeon (senior author) performed patient assessment,

Table 2. Prerevision diagnoses and radiographic measurements

Revision procedure	Preoperative diagnosis	Alpha angle (°)	p value	Acetabular index	p value	Anterior center-edge angle (°)	p value	Lateral center-edge angle (°)	p value	Tönnis Grade 2 or 3 (%)	p value
Hip preservation	FAI	61 ± 16	0.912	7 ± 6	< 0.005	28 ± 12	0.047	26 ± 8	< 0.005	11.4	< 0.005
	Dysplasia	62 ± 16		15 ± 7		19 ± 9		14 ± 8			
Hip arthroplasty	FAI	80 ± 20	0.079	3 ± 5	< 0.005			28 ± 7	0.023	77.3	
	Dysplasia	61 ± 22		14 ± 2				20 ± 6			

Values are expressed as mean ± SD; FAI = femoroacetabular impingement.

Table 3. Additional procedures performed at revision hip surgery

Revision procedure	Additional procedures	Number of hips
Hip arthroscopy (n = 20*)	Osteochondroplasty femoral head-neck junction	18 (90%)
	Osteochondroplasty acetabulum (rim trim)	2 (10%)
	Labral repair	8 (40%)
	Partial labral resection	7 (35%)
	Ligamentum teres débridement	6 (30%)
Surgical hip dislocation (n = 12)	Osteochondroplasty femoral head-neck junction	12 (100%)
	Labral repair	8 (67%)
	Osteochondroplasty acetabulum (rim trim)	7 (58%)
	Relative femoral neck lengthening	2 (17%)
	Labral reconstruction	2 (17%)
	Trochanteric advancement	2 (17%)

* Includes three patients with combined hip arthroscopy and periacetabular osteotomy and two patients with combined hip arthroscopy and anterior open capsulorrhaphy.

Table 4. Intraoperative findings at the time of revision hip preservation surgery

Location	Finding	Number of hips
Articular cartilage acetabulum	Visualized	32 (84%)
	Normal	1 (3.1%)
	Chondromalacia	12 (37%)
	Debonding	8 (25%)
	Cleavage	4 (12%)
	Focal defect	3 (9%)
Articular cartilage femoral head	Visualized	34 (90%)
	Normal	22 (65%)
	Chondromalacia	7 (21%)
	Cleavage	3 (9%)
	Focal defect	2 (6%)
Femoral head-neck junction	Visualized	38 (100%)
	Prominence	
	Total	32 (84%)
	Anterolateral	30 (34%)
	Anteromedial	20 (63%)
	Posterolateral	6 (19%)
	Posteromedial	2 (7%)
Labrum	Visualized	35 (92%)
	Normal	4 (11%)
	Damaged	31 (89%)
	Anterior	29 (94%)
	Superolateral	25 (81%)
	Posterior	8 (26%)

indications for surgery, disease classification, and revision procedure selection; therefore, the biases of this surgeon are present in these data. For example, the senior author used surgical dislocation for revision surgery in 12 or 26 hips with FAI, while other surgeons may favor arthroscopy. Different surgeons may have distinct diagnostic and treatment preferences. Nevertheless, the senior author does have substantial expertise in the diagnosis and treatment of hip disorders, and the diagnoses and treatments selected for this cohort are based on established parameters and concepts [4, 6, 15]. Finally, postrevision outcome was not included in this study as the current duration of followup is inadequate to draw conclusions; therefore, the efficacy of the revision procedure is unknown. The results of revision procedures are beyond the scope of this study but will be the focus of future investigations.

In our prospective database of patients undergoing either hip preservation surgery or hip arthroplasty, 60 hips were identified with a history of previous failed hip arthroscopy. The majority of patients were female. The average time to revision after failed hip arthroscopy was similar between our series (25.8 months) and those reported by Heyworth et al. [11] (25.6 months) and Philippon et al. [17] (20.5 months). While our arthroplasty cohort was older, the average age of patients undergoing revision hip preservation in our series was also similar to those present in the literature [11, 17]. In comparing these two cohorts, the revision preservation patients were younger and had a lower BMI than those treated with arthroscopy.

Residual or unaddressed structural deformity of the hip can lead to failure of hip arthroscopy. In 38 hips with recurrent symptoms and minimal to no signs of osteoarthritis, we found a primary deformity of FAI in 68% and acetabular dysplasia in 24%. In these hips, the need for revision hip preservation surgery was believed to be related to residual structural deformity. The remaining 22 hips had moderate to severe osteoarthritis at the time of revision surgery. Given the lag time of 31.6 months between arthroscopy and the need for hip arthroplasty, it is likely that advanced articular cartilage disease at the time of arthroscopy contributed to these failures. This conclusion is further supported by the high incidence of restorative cartilage procedures performed in the arthroplasty cohort at the time of index hip arthroscopy (Table 1). Arthroscopic chondroplasty or microfracture of the acetabulum or femoral head was performed in 18 hips (81%) later managed with hip arthroplasty (Table 1). Our results are consistent with those reported in the literature. In a report by Heyworth et al. [11], osseous impingement was present in 79% of patients (19 of 24 hips) undergoing revision hip arthroscopy and believed to be the most common cause of failed hip arthroscopy. In another series, by Philippon et al. [17], of 37 patients with recurrent symptoms after hip arthroscopy, revision arthroscopy was performed to address FAI in 72% of patients. In 12% of these patients, an attempt at correction of osseous deformity had been previously performed.

We classified our patients with failed hip arthroscopy into two cohorts, those treated with revision hip preservation and those treated with hip arthroplasty. Revision procedures performed included both preservation and reconstruction. Current literature evaluating failure of hip arthroscopy is limited to reports in which the revision procedures were performed utilizing arthroscopy alone [11, 17]. To our knowledge, ours is the first study to report on a cohort of patients in whom revision procedures encompassed not only repeat arthroscopy but also open hip preservation techniques and joint reconstruction procedures. In 53% of patients in our series, an open joint preservation procedure, including PAO (23.4%), surgical hip dislocation (31.5%), and anterior capsulorraphy (5.2%), was selected to address all underlying pathology. This serves to highlight the application of open surgical procedures in the setting of failed arthroscopic surgery. While the limitations of arthroscopic decompression of impingement lesions is highly variable and dependent on the experience and expertise of the treating surgeon, open techniques can be considered in complex disease patterns, including hips with residual childhood deformities (Legg-Calvé-Perthes and slipped capital femoral epiphysis) and nonfocal FAI disease patterns with posterolateral head-neck deformities and circumferential acetabular deformities. In our cohort of patients undergoing revision surgery for FAI, 22.7% were found to have evidence of decreased femoral head-neck offset posterolaterally, a position that is difficult to access arthroscopically [2]. Symptomatic dysplasia was present in nearly ¼ of patients, and while repair of associated labral disease is possible via an arthroscopic approach, management of the underlying structural deformity requires acetabular reorientation. Successful treatment of dysplasia with PAO after a previously failed hip arthroscopy has been reported [12]. The use of arthroplasty after failed arthroscopy in our cohort of patients with evidence of osteoarthritis is consistent with the literature documenting poor results of hip arthroscopy in patients with underlying osteoarthritis [13].

Given the rapidly rising rate of hip arthroscopy, it is imperative we define the benefits and limitations of this evolving surgical technique so that we can minimize the number of failed procedures [8]. Specifically, preoperative radiographs should be scrutinized for evidence of structural deformity. When present, deformity correction should be considered and the optimal surgical technique to address the identified lesion should be determined. When necessary, open procedures, such as surgical hip dislocation and PAO, should be considered for the treatment of complex FAI and acetabular dysplasia, respectively. Finally, the benefit of hip arthroscopy in the setting of moderate to severe degenerative disease appears to be limited and nonoperative management should be considered in these patients until arthroplasty is needed.

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