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Research article

Results of hip arthroscopy in patients with MRI diagnosis of subchondral cysts—a case series

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ABSTRACT

The aim of this article is to examine the results of arthroscopic management of patients with labral pathology who have preoperative magnetic resonance images (MRIs) demonstrating subchondral cysts. This institution's database was searched for patients who underwent hip arthroscopy and had subchondral cysts on MRI and >2-year follow-up. Exclusion criteria included previous hip surgery, Tönnis grade >1, inflammatory arthritis, Perthes, slipped capital femoral epiphysis or abductor repair. Patient-reported outcome (PRO) scores including visual analog scale, modified Harris hip score (mHHS), non-arthritic hip score and hip outcome score sports-specific subscale (HOS-SSS) were gathered preoperatively, at 3 months, and annually thereafter. The change in PRO scores was compared with the minimally clinical important difference (MCID) to quantify improvement. Sixty-nine patients were eligible for this study, of which 65 (94%) had >2-year follow-up. All PROs were significantly improved at latest follow-up ($P < 0.001$). Mean patient satisfaction was 7.2. There was no correlation between Outerbridge grade III or IV cartilage damage noted during arthroscopy and subchondral femoral and acetabular cysts noted on MRI. Seventeen patients required reoperation [13 total hip arthroplasty (THAs) and 4 revision arthroscopies]. Patients with femoral subchondral cysts converted to THA 36% of the time. MCIDs for mHHS and HOS-SSS were surpassed by 63% and 68% of patients, respectively. Hip arthroscopies performed on patients with subchondral cysts present on preoperative MRI should be approached with caution. The rate of conversion to hip arthroplasty appears to be higher than that reported in the literature for patients who undergo arthroscopy without preoperative subchondral cysts. For patients who did not require hip arthroplasty or revision arthroscopy, patients demonstrated significant improvement in symptoms compared with the preoperative state.

INTRODUCTION

Hip arthroscopy has been shown to have a high success rate when performed on appropriate patients [1–6]. Patients with healthy cartilage that have notable cam, pincer, or mixed pathoanatomy with a concomitant labral tear have a favorable prognosis when addressed with hip arthroscopy. Hip impingement can lead to significant chondral damage as the head neck junction impacts the acetabular rim and causes both labral tearing and chondral injury. Although hip arthroscopy is very helpful in addressing the mechanical impingement and the secondary labral tear, chondral injury can be more difficult to manage.

Chondral damage at the time of arthroscopy has been shown to portend a poorer prognosis than if the articular surface is intact [7–9]. This has increased interest in being able to both treat the chondral damage as well as accurately identify it preoperatively. The identification of chondral damage can be done with radiographic analysis, standard magnetic resonance imaging (MRI), and special MRIs that target the health of the articular surface. On standard MRIs, physicians may appreciate the contour of the articular surface, but it can be difficult to tell the cartilage health with certainty. Many feel that subchondral cysts are a sign that the hip joint may be becoming arthritic [10].

Recently, it was shown that these cysts are associated with high-grade chondral defects [11]. Many hip surgeons use subchondral cysts as a contraindication for arthroscopic management of hip impingement.

The purpose of this study is to examine the results of arthroscopic management of patients with labral pathologies who have preoperative MRIs demonstrating subchondral cysts. The authors hypothesize that the results of hip arthroscopy will be favorable and that there will be an association between subchondral cysts on MRI and chondral damage in the acetabulum found on diagnostic arthroscopy.

METHODS

All hip arthroscopies conducted at this institution were prospectively entered into this institution's database and retrospectively reviewed for this study. Institutional review board (IRB) approval was received to conduct this study. Between February 2008 and March 2013, there were 1517 hip arthroscopies conducted at this institution by the senior author (B.G.D.). The database was searched for patients that had MRI findings of acetabular and/or femoral head subchondral cysts. Inclusion criteria consisted of >2-year follow-up and MRI findings of subchondral cysts in the acetabulum, femoral head, or both. Exclusion criteria consisted of previous surgery on the same hip, LCEA $\leq 20^{\circ}$, Tönnis grade >1, inflammatory arthritis, Perthes, slipped capital femoral epiphysis or a concomitant abductor repair.

The senior author conducted a thorough hip exam on each patient at their initial clinic visit. Patients were evaluated in clinic for signs of labral tears resulting from hip impingement. If there were clinical signs or symptoms of a labral tear and impingement the patient was treated conservatively with physical therapy, activity modification, and non-steroidal anti-inflammatories for a minimum of 3 months. If the patient was still having significant pain and dysfunction in the hip with poor quality of life then a magnetic resonance arthrogram was performed to evaluate cartilage, labrum, and presence of subchondral cysts. If they had intra-articular pathology, as noted by exam and imaging, and failed conservative treatment for >3 months, surgical intervention was offered in the form of hip arthroscopy.

Clinical outcomes were measured with patient-reported outcomes (PROs), visual analog scale (VAS) for pain, and patient satisfaction. The PROs utilized were modified Harris hip score (mHHS), non-arthritic hip score (NAHS), and hip outcome score sports-specific subscale (HOS-SSS). All of these PROs have been shown to have good clinimetric support in the hip preservation population [12–18]. Patients were asked their level of satisfaction with surgery on a scale of 0–10, with zero being totally dis-satisfied and 10 being completely satisfied with surgery. Patients were surveyed preoperatively, at 3 months postoperatively, and annually thereafter. Patients that required total hip arthroplasty (THA) or revision surgery were noted in the institutions prospective database. In order to determine if based on their improvement in mHHS and HOS-SSS the patients felt an improvement the minimally clinical important difference was utilized (MCID) [18]. The number of patients who achieved the MCID was then compared between the femoral and acetabular cyst groups to determine if there was a difference.

Radiographs were taken preoperatively on every patient. These radiographs consisted of an anteroposterior view of the pelvis, false profile view, and a 45°Dunn view. These radiographs were utilized to calculate lateral center edge angle (LCEA), anterior center edge angle (ACEA), alpha angle, and Tönnis grade of osteoarthritis. An MRI was ordered for every patient prior to operative intervention. The purpose of the MRI was to evaluate the labrum, chondral surfaces, and presence of subchondral cysts. A cyst was considered to be any contained fluid within the weight-bearing portion of the subchondral bone of the acetabulum or femoral head. These were based on an MRI interpretation from a board certified radiologist. Femoral neck cysts (synovial herniation cysts) were not included, as their presence suggests nothing of the articular surface of the joint [19].

Operative technique

Patients were all placed in the supine position on an operative table with traction boot extensions. All operations were performed by the senior author (X.X.X.). The anterolateral and midanterior portals were utilized in every patient. If suture anchors were required, a distal lateral accessory portal was created. Diagnostic arthroscopy consisted of examination of the ligamentum teres, labrum, and cartilage of the femoral head and acetabulum. Labral tears were repaired if possible; if not possible, they were debrided to a stable rim of healthy tissue. Preoperative radiographs and intra-operative fluoroscopy were utilized for decisions regarding whether bone needed to be resected for cam and/or pincer lesions. When resection was warranted, fluoroscopy was utilized to ensure adequate resection was performed.

Rehabilitation

All patients were placed in a hip brace and instructed to be 20 pounds foot-flat weight-bearing on the operative extremity for 2 weeks postoperatively to protect against falls

Table I. Demographics and results of patients within this study's cohort

Demographics		
Total eligible	69	
F/U (>2 years)	65	94.2%
F/U time (months)	42 (23.1–89.7)	
Gender		
Male	41	63.1%
Female	24	36.9%
Surgical side		
Right	45	69.2%
Left	20	30.8%
BMI	27.1 (13.5–43.4)	
Age	43.6 (16.8–63.9)	
Patient satisfaction	7.23 (0–10)	
Future revision	4	6.2%
Time to revision (months)	30.4 (19.2–49.7)	
Conversion to THA	13	20.0%
Time to THA (months)	23.6 (3.5–59.7)	
Subchondral cyst type		
Acetabular	53	81.5%
Femoral	11	16.9%
Both	1	1.5%

THA, total hip arthroplasty; f/u, follow-up; BMI, body mass index.

as the patient recovered from surgery. If patients underwent a microfracture then 20 pound foot-flat weight-bearing for 8 weeks was enforced. Thereafter, patients were gradually allowed to return to weight-bearing as tolerated. All patients started physical therapy on the first postoperative day to initiate range of motion. This was accomplished by using a continuous passive motion machine for 4 h/day or using a stationary bicycle for 2 h/day.

Statistical analysis

All statistical analyses were performed using Microsoft Excel (excel citation?). Data were tested for normality using the Shapiro–Wilk test. PRO scores were compared pre-operatively to postoperatively using a two-tailed Student's *t*-test for normally distributed data and using the Mann–Whitney test for non-normally distributed data. Correlations of PROs to cyst being present on the femoral head or the acetabulum and, MCID rate to cyst location on femoral head or acetabulum, and cyst presence to Outerbridge grade in that location were all performed using a chi-squared test in order to determine the Phi value. P values < 0.05 were considered statistically significant.

RESULTS

Between February 2008 and March 2013, there were 1517 hip arthroscopies performed at this institution. Of these hip arthroscopies, 69 were conducted on patients with pre-operative MRI findings of subchondral cysts. There were 65 patients (94%) that had complete 2-year follow-up with all PROs, VAS and patient satisfaction. The demographics of this cohort are noted in detail on Table I. There were 53 patients that were noted to have acetabular subchondral cysts, 11 who had femoral head subchondral cysts, and one that had subchondral cysts on both the femoral head and acetabulum. The procedures carried out at the time of hip arthroscopy are noted on Table II.

Patients demonstrated significant improvement in VAS (5.2–2.8), mHHS (64–76), NAHS (61–80), and HOS-SSS (41–63) ($P < 0.001$) (Figs 1 and 2). The average patient satisfaction was 7.2. There was no difference between the change in PROs between patients with femoral or acetabular cysts (Table III). There was an 80% survivorship with 13 patients that required conversion to a THA at an average of 24 months from the time of index operation. Of the 13 hip replacements, PRO, VAS, and satisfaction scores were complete on five of these patients prior to THA, which were included in the analysis of these metrics. The other eight patients were noted to have undergone THA, but their clinical scores could not be used as their >2-year scores were not documented prior to hip replacement. Femoral or acetabular cysts did not have a different rate of need for conversion to THA (Table IV). There were four patients (6.1%) that required revision arthroscopy, which was carried out at an average of 30 months from the time of surgery.

The MCID was exceeded by 63% of patients for mHHS, and 68% for HOS-SSS. These were then broken down into acetabular cysts, femoral cysts, and there was no statistical difference in achieving the MCID between these groups (Table V).

There was no correlation between subchondral cyst presence on MRI scan preoperatively and presence of Outerbridge grade III/IV cartilage damage at the time of diagnostic arthroscopy (see Table VI).

Table II. Procedures carried out at the time of arthroscopy

Procedures	N	%
Acetabuloplasty	43	66.2
Femoroplasty	55	84.6
Labral treatment		
Simple repair	25	38.5
Base repair	9	13.8
Debridement	31	47.7
Capsular treatment		
Repair/plication	14	21.5
Release	51	78.5
Notchplasty	10	15.4
Microfracture		
Femoral	0	0.0
Acetabular	15	23.1
Ligamentum teres treatment	36	55.4
Iliopsoas release	13	20.0
Iliopsoas bursectomy	1	1.5
Trochanteric bursectomy	2	3.1
Removal of loose body	12	18.5

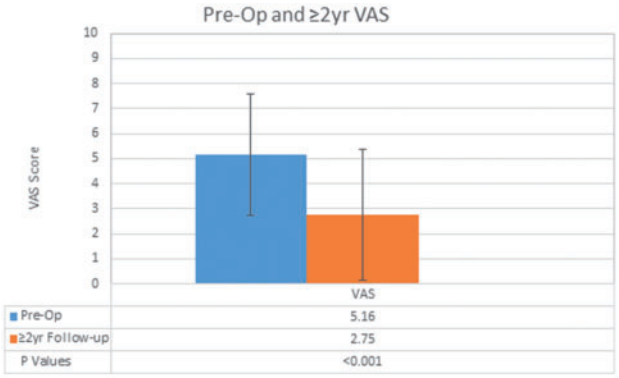

Fig. 1. Demonstrates the change from the preoperative to the postoperative setting with visual analog scale rating of pain (VAS).

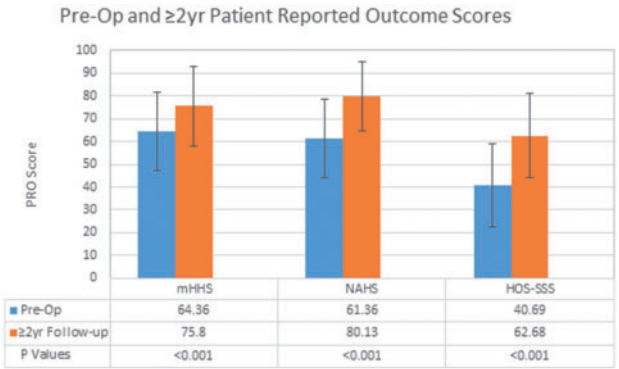

Fig. 2. Demonstrates the change in the various patient reported outcomes from preoperative setting (blue) to the postoperative setting (red). mHHS, modified Harris hip score; NAHS, non-arthritic hip score; HOS-SSS, hip outcome scores-sports specific subscale.

DISCUSSION

This is the largest cohort in the literature to have investigated the results of hip arthroscopy in patients that have subchondral cysts noted on preoperative MRI scan and were treated with hip arthroscopy. This study demonstrated an 80% survival rate at >2-year follow-up with 13 patients requiring THA, and 6% revision arthroscopy rate. It was noted that patients with femoral cysts had a 36% conversion rate to THA as compared with 17% in the acetabular cyst group. Patients demonstrated significant improvement in all PRO scores and VAS from the preoperative state, with a patient satisfaction of 7.2.

The conversion rate of 20% in this group to THA is significantly >3% quoted in a recent review article examining >6000 hips with >2-year follow-up [20]. The rate of conversion to THA was very high in the patients with femoral cysts (36%). All the patients in this study had Tönnis grade one or less osteoarthritis and had failed conservative management for >3 months prior to surgical intervention. This makes treatment decisions difficult, because the patient's radiographic workup does not justify a hip replacement, but they are still experiencing pain that affects activities of daily living and are not responding to conservative management. The patients in this cohort that did not convert to THA did demonstrate significant improvement in PRO scores from their preoperative state.

Krych *et al.* [11] recently conducted a study examining a matched cohort of 34 patients with either marrow edema and/or subchondral cysts. These patients had worse PROs at final follow-up than a matched cohort without subchondral cysts or edema. All subchondral cysts in their study were correlated with Outerbridge grade III or IV lesions at the time of arthroscopy. The current study's results are slightly different, in that cysts were correlated with high-grade Outerbridge chondral defects in only 18% of femoral cysts and 59% of acetabular cysts. Krych *et al.* had only 5%

Table III. Various demographic variables for patients with femoral and acetabular cysts

Demographics	*Acetabular*	*femoral head*	P *value*	*Both*
Total eligible	57	11		1
F/U (>2 years)	53	11		1
F/U time (months)	39.7 (4.8–89.7)	31.3 (3.0–75.8)		3.9
Gender				
Male	34	6	0.7336	1
Female	19	5		0
Surgical side				
Right	40	5		1
Left	13	6		0
BMI	27.2 (13.5–43.4)	27.1 (19.2–35.6)	0.809	30.4
Age	43.5 (16.8–61.3)	43.4 (19.0–63.9)	0.7	56.9
Future revision	3	1		0
Time to revision (months)	32.9 (19.2–49.7)	22.9		
Conversion to THA	9	4		0
Time to THA (months)	26.6 (3.5–59.3)	15.7 (9.9–20.9)		
Patient satisfaction (0–10)	7.2 (0–10)	7.6 (0–10)		8
Patient reported outcome scores				
Δ mHHS	11.1 (±23.6)	13.4 (±22.9)	0.81	15.8
Δ NAHS	19.8 (±19.6)	11.1 (±17.5)	0.27	21.25
Δ HOS-SSS	21.3 (±30.1)	20.6 (±46.9)	0.96	55.5
Δ VAS	−2.6 (±3.2)	−1.4 (±3.4)	0.37	0

F/u, follow-up; BMI, body mass index; THA, total hip arthroplasty; mHHS, modified harris hip score; NAHS, non-arthritic hip score; HOS-SSS, hip outcome score-sports specific subscale; VAS, visual analog score.

Table IV. Number of total hips done on patients with acetabular and femoral cysts

	Number total hips	P *value*
Acetabular cysts	9 (15.5%)	0.14
Femoral head cysts	4 (33.3%)	

Table V. Number of patients that exceeded the MCID for acetabular and femoral cyst groups

MCID	*Acetabular cyst*	*Femoral head cyst*	P *value*
mHHS	30 (61.2%)	6 (75%)	0.45
HOS-SSS	35 (71.4%)	4 (50%)	0.22

conversion to hip arthroplasty, as compared with 20% in the current study. The current study only investigated patients with subchondral cysts and not patients with just bone marrow edema, which may suggest that cysts may be a precursor to arthritic change in the joint, that may not always be macroscopic Outerbridge grade III and IV damage, but may be damage at the molecular level to the cartilage that may cause impending joint decline in some cases.

The MCID score was utilized in this study to demonstrate how many patients had a perceivable improvement

Table VI. Correlation between Outerbridge grade III/IV cartilage damage on diagnostic arthroscopy and subchondral cysts presence in that same location

	High Outerbridge grade (3,4)	*Phi*	P *value*
Acetabular Outerbridge		0.123	0.2804
Acetabular cyst	38 (58.5%)		
No acetabular cyst	9 (52.5%)		
Femoral Outerbridge		0.0611	0.594
Fermoral head cyst	2 (18.1%)		
No femoral head cyst	8 (12.3%)		

in their PRO scores from the preoperative state. MCID for mHHS was surpassed by 63% of patients and 68% of patients for the HOS-SSS. There was no significant difference between femoral and acetabular cysts and number of patients who surpassed MCID. The average satisfaction was 7.2, which suggests that patients were satisfied with their surgical intervention.

Although this study did demonstrate a higher rate of conversion to hip arthroplasty, it did indicate a significant improvement from baseline with PROs and VAS. A recent study examined MRIs of asymptomatic individuals with an average age of 37, and found that 73% of these patients had some abnormal findings [21]. Of these, 16% were subchondral cysts. This brings up the possibility that not all cysts are symptomatic and should not preclude surgical treatment in all patients whom have failed conservative management.

It is important for surgeons to be able to adequately determine who has a higher likelihood of poor results after operative intervention. In the case of hip arthroscopy there are several predictive factors of poor outcomes. These include obesity, cartilage damage, poor dgemeric indices, dysplasia, joint space narrowing, age, and high Tönnis grade [7, 9, 22–30]. This study demonstrates that subchondral cysts may imply either macroscopic or microscopic level of damage to the overlying cartilage that may increase the likelihood of a hip arthroplasty at some point, but can get some improvement in the interim. This is important for setting patient expectations preoperatively.

Subchondral cysts were followed with MRI in patients that underwent peri-acetabular osteotomy for dysplasia [31]. That study noted an overall decrease in the cyst volume at 2 years after PAO. They concluded cyst reabsorption occurred secondary to offloading the previously overloaded portion of the joint. In the current study, the senior author assumes that as the cause of damage to the joint is offloaded by addressing known hip pathology, these cysts will resorb or decrease in size with time. So there would be a reasonable likelihood of success as long as the patients do not already have full thickness damage to the articular surface. Using emerging MRI technology, such as dgemeric, for assessment of the cartilage prior to surgical intervention may be a way to better predict which patients may convert to THA and which patients will benefit more from arthroscopic surgery in patients with subchondral cysts.

This study is the largest study in the literature to date that has examined clinical outcomes of hip arthroscopy in patients with preoperative subchondral cysts noted on MRI. All patients had >2-year outcome, and the follow-up was 94%. This study utilized three different PROs with high clinimetric validity as well as VAS and a rating of patient satisfaction to demonstrate patient outcomes to help quantify results.

LIMITATIONS

The limitations of this study include the lack of a comparison group and its retrospective nature. There were 13 patients that underwent THA. Eight of these patients did not have >2-year clinical follow-up with PROs, VAS, and patient satisfaction prior to undergoing the hip arthroplasty, and so their numbers are not included in the final analysis of these hip scores. If these scores could have been included they likely would have decreased the final average PROs, VAS, and patient satisfaction scores in this cohort. Five of the total hip replacement patients did have scores on prior to hip replacement and were included in PRO, VAS and satisfaction calculations. All hip arthroplasty patients were discussed in the results as an end point procedure.

CONCLUSION

Hip arthroscopies performed on patients with subchondral cysts present on preoperative MRI should be approached

with caution. The rate of conversion to hip arthroplasty appears to be higher than that reported in the literature for patients who undergo arthroscopy without preoperative subchondral cysts. For patients who did not require hip arthroplasty or revision arthroscopy, patients demonstrated significant improvement in symptoms compared with the preoperative state.

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CONFLICT OF INTEREST STATEMENT

Hartigan: paid consultant for Arthrex. **Domb:** Dr. Domb reports personal fees and other from Arthrex, other from Breg, other from ATI, personal fees and other from Pacira, personal fees and other from Stryker, personal fees from Orthomerica, personal fees from DJO Global, personal fees from Amplitude, personal fees from Medacta, outside the submitted work; and Dr. Domb is a boardmember for the American Hip Institute, which funds research and is the institute where our studies are performed. Dr. Domb is also a boardmember at the AANA Learning Center Committee and Arthroscopy Journal.-none of these are pertinent to this study. **Yuen:** no conflict of interest. **Perets:** no conflict of interest.

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