Outcomes of Hip Arthroscopy in Patients Aged 50 Years or Older Compared With a Matched-Pair Control of Patients Aged 30 Years or Younger

Benjamin G. Domb, M.D., Dror Linder, M.D., Zachary Finley, B.S., Itamar B. Botser, M.D., Austin Chen, M.D., Joseph Williamson, B.S., and Asheesh Gupta, M.D., M.P.H.

Purpose: Age has been suggested as a negative prognostic factor for hip arthroscopy. The purpose of this study was to compare patient characteristics and outcomes after hip arthroscopy in patients aged 50 years or older with a matched control group of patients aged 30 years or younger at a minimum postoperative follow-up of 2 years. **Methods:** Between September 2008 and March 2010, data were prospectively collected on all patients aged 50 years or older undergoing primary hip arthroscopy. Fifty-two patients met our inclusion and matching criteria, of whom all 52 (100%) were available for follow-up at a minimum of 2 years. This cohort was compared with a matched-pair control group of patients aged 30 years or younger who underwent similar procedures. **Results:** The mean age of the study group was 54.8 years (range, 50 to 69 years), and that of the control group was 20.3 years (range, 13 to 30 years). The groups were matched at a 1:1 ratio, including 18 male patients (34.6%) and 34 female patients (65.4%) in each group, with a mean follow-up period of 32 months (range, 24 to 54 months). In the younger control group, the score improvement from preoperatively to 2 years' follow-up was 62.9 to 84.2 for the modified Harris Hip Score, 60.5 to 84.2 for the Non-Arthritic Hip Score, 63.1 to 86.5 for the Hip Outcome Score—Activities of Daily Living, and 42.2 to 72.7 for the Hip Outcome Score—Sport-Specific Subscale. In the older study group, the score improvement from preoperatively to 2 years' follow-up was 61.2 to 82.2 for the modified Harris Hip Score, 59.9 to 80.4 for the Non-Arthritic Hip Score, 63.9 to 83 for the Hip Outcome Score—Activities of Daily Living, and 41.2 to 64.6 for the Hip Outcome Score—Sport-Specific Subscale. All improvements in both groups were statistically significant at the 2-year postoperative follow-up ($P < .001$). There was no significant difference for all patient-reported outcome (PRO) scores at final follow-up between both groups. When we compared the change in PRO scores (Δ) from preoperatively to 2 years postoperatively, there was no significant difference between both groups. The overall survivorship rate was 98.1% for the younger control group and 82.7% for the older study group. **Conclusions:** Survivors aged 50 years or older show similar improvement to patients aged 30 years or younger in PRO and patient satisfaction scores. The 2-year survivorship rate was 98.1% for the younger control group and 82.7% for the older study group. Therefore we believe that hip arthroscopy should be considered a valid treatment option when treating hip pain in patients aged 50 years or older with a Tönnis arthritic grade of 0 or 1. Older patients should be counseled on the possibility of later conversion to total hip arthroplasty. Future work may include development of a decision-making tool to assess for prognosis to better delineate the indications for hip arthroscopy in the older population. **Level of Evidence:** Level III, therapeutic case-control study.

From the American Hip Institute (B.G.D., D.L., Z.F., I.B.B., A.C., J.W., A.G.), Westmont; Hinsdale Orthopaedics (B.G.D.), Hinsdale; and Loyola University Stritch School of Medicine (B.G.D.), Chicago, Illinois, U.S.A.

The authors report the following potential conflict of interest or source of funding: B.G.D. receives support from Arthrex, MAKO Surgical, Pacira, American Hip Institute, Breg, MedWest, ATI, Orthomerica, DJO Global, Stryker. I.B.B. receives support from MAKO Surgical.

Received November 14, 2012; accepted August 28, 2014.

Address correspondence to Benjamin G. Domb, M.D., Hinsdale Orthopaedics, 1010 Executive Ct, Ste 250, Westmont, IL 60559, U.S.A. E-mail: drdomb@americanhipinstitute.org

0749-8063/12742/$36.00

http://dx.doi.org/10.1016/j.arthro.2014.08.030

Over the past decade, the arthroscopic management of hip pathologies in the young population has evolved because of improvements in instrumentation, surgical techniques, and diagnostic tools. However, limited information currently exists about outcomes after hip arthroscopy in the mature population.[1]

Most studies have shown that hip arthroscopy is less invasive than hip arthrotomy, has fewer complications, causes less pain, offers a quicker recovery time, and has lower morbidity.[2] Studies show that many pathologies, including but not limited to labral tears, chondral injuries, femoroacetabular impingement (FAI), and loose bodies, are indications appropriate for arthroscopic

intervention.[3] The treatment of labral tears and their associated disorders is crucial for hip preservation in young and active patients. Several studies have shown an association between labral tears and the early onset of osteoarthritis.[4,5] The presence of osteoarthritis negatively affects improvements in pain and function after hip arthroscopy and non-arthroplasty open hip surgery.[6]

Patient selection is an important consideration for preoperative planning. According to Byrd et al.,[7] the younger the patient, the more likely arthroscopy is to prolong the need for a total hip replacement.[8] In addition, the interval from the primary hip arthroscopy to subsequent total hip arthroplasty (THA) was found to be longer in patients younger than 55 years with minimal osteoarthritic changes.[9]

The purpose of this study was to compare patient characteristics and outcomes after hip arthroscopy in patients aged 50 years or older with a matched-pair control group of patients aged 30 years or younger at a minimum postoperative follow-up of 2 years. We hypothesized that a selected group of patients aged 50 years or older would benefit from hip arthroscopy at levels similar to a control group aged 30 years or younger.

Methods

Patient Inclusion and Data Collection

During the study period, February 2008 to March 2010, data were collected prospectively on all patients undergoing primary hip arthroscopy by the senior surgeon (B.G.D.). The inclusion criteria were patients who underwent primary hip arthroscopy during the study period with a minimum of 2 years' follow-up with radiographs and patient-reported outcome (PRO) scores. The exclusion criteria were revision surgery, Tönnis grade greater than 1, previous hip conditions such as Legg-Calvé-Perthes disease, avascular necrosis, and prior surgical intervention (Table 1). The PRO scores reported included the modified Harris Hip Score (mHHS), the Non-Arthritic Hip Score (NAHS),[8] the Hip Outcome Score—Activities of Daily Living (HOS-ADL), and the Hip Outcome Score—Sport-Specific Subscale (HOS-SSS). These were collected preoperatively and at 3 months, 1 year, and 2 years postoperatively. All 4 questionnaires were used because it has been reported that there is no conclusive evidence for the use of a single PRO questionnaire for patients undergoing hip arthroscopy.[10,11] Pain was estimated on a visual analog scale (VAS) from 0 to 10 (10 being the worst), and satisfaction with surgery was rated on a scale from 0 to 10. Groups were divided based on age: 30 years or younger (control group) and 50 years or older (study group). The matched-pair control group was selected retrospectively at a 1:1 ratio based on matching criteria shown in Table 2.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Primary hip arthroscopy (no revisions)	Any previous hip condition (acetabular fracture, AVN, LCPD, fibromyalgia, Ehlers-Danlos syndrome, PVNS)
Agreement to participate in study	Tönnis grade >1
Minimum of 2 years' postoperative follow-up	Previous hip surgery

AVN, avascular necrosis; LCPD, Legg-Calvé-Perthes disease; PVNS, pigmented villonodular synovitis.

Physical Examination

A detailed physical examination was conducted on all hips before surgery, including assessment of passive range of motion and measurements of flexion, abduction, and internal and external rotation. Internal and external rotation was measured while the patient was in the supine position with both the hip and knee flexed at 90°. The anterior impingement test was considered positive if pain was elicited in forced flexion combined with internal rotation of the hip as described by Byrd.[12] The lateral impingement test was considered positive if symptoms were produced in forced abduction with external rotation. Evaluation of internal snapping of the iliopsoas tendon was performed as the hip was brought from a flexed, abducted, and externally rotated position into extension with internal rotation.[12] All physical examinations were performed and documented in degrees by the senior surgeon (B.G.D.) in a clinical setting.

Imaging

Plain radiographs included an anteroposterior pelvic view, Dunn view, cross-table lateral view, and false-profile view.[13-15] Measurements were made from these views including the Tönnis angle (acetabular inclination angle) using the method described in Jessel et al.,[16] lateral center-edge angle of Wiberg,[17] joint space at its lowest point,[15] ischial prominence size (in millimeters),[15] crossover sign,[18-20] alpha angle (Dunn view),[21] and offset (in millimeters).[22] Regarding the joint space, we analyzed the medial, central, and lateral areas. If any value was below 2 mm, then the patient was not considered a candidate for hip arthroscopy. The alpha angle was measured on the Dunn view[13] using the method described by Notzli et al.[23] for magnetic resonance imaging (MRI) and modified by

Table 2. Matching Criteria

Gender
Age within 5 yr
Tönnis grade 0 or 1
Crossover percentage <20% or crossover percentage >20%
Workers' Compensation claim
Labral procedure

Meyer et al.[14] Cam impingement was defined as an alpha angle greater than 55°. Hips classified as having pincer impingement had a crossover sign, coxa profunda, or protrusio acetabuli. The crossover sign size was quantified according to its percent from the superior edge of the acetabulum; for instance, crossover at the middle of the acetabulum was quantified as 50%. All of the measurements were performed by the same orthopaedic surgeon (B.G.D.) using a picture archiving and communication system. All radiographs were evaluated for arthritis and graded with the Tönnis classification of osteoarthritis.[15] MRI was obtained in all patients to evaluate for labral and articular cartilage injuries. Acetabular cartilage damage and labral tears were classified intraoperatively. Cartilage damage was classified according to the Outerbridge and Acetabular Labrum Articular Disruption classification systems.[24]

Surgical Procedure

The hip arthroscopies reported in this study were performed in a tertiary referral setting dedicated to hip arthroscopy and preservation. All were performed with patients in the modified supine position with a minimum of 2 portals (anterolateral and mid anterior).[14,25] The indications for surgery were predominantly labral tears with mechanical symptoms and failure of conservative treatment.

Intraoperative data, including the locations of the ligamentum teres, capsule, gluteus medius, femoral neck, and acetabular rim; the presence and size of labral tears; and the presence and location of articular cartilage lesions, were documented. The Outerbridge and Acetabular Labrum Articular Disruption classifications[24] were used to classify articular cartilage damage.

Bony pathology was corrected under fluoroscopic guidance. An acetabuloplasty was performed for pincer impingement, and a femoral neck osteoplasty was performed for cam impingement. Labral tears were repaired when possible; otherwise, they were selectively debrided until a stable labrum was achieved while preserving as much labrum as possible. Full-thickness cartilage damage was treated with debridement to create stable borders. Microfracture was performed according to the technique of Steadman and colleagues[26] in cases in which exposed bone was present after the bony decompression at the surgeon's discretion.

Rehabilitation Protocol

For the first 2 weeks, the patients are placed in a hip brace with limited range of motion from 0° to 90° of flexion at all times. Patients were limited to 20-lb flat-foot weight bearing with crutches for a minimum of 2 weeks. 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 hours per day or a stationary bike for 2 hours per day. At 2 weeks postoperatively, the brace was discontinued with an emphasis on range-of-motion exercises.

Surgical Outcome Measurement

All patients undergoing hip arthroscopy were assessed with the mHHS,[7] the NAHS,[27] and the HOS-ADL and HOS-SSS.[24,28,29] Patients were asked to estimate their pain using a VAS from 0 to 10, where 0 indicated no pain and 10 indicated the worst possible pain. Scores were recorded preoperatively, 3 months postoperatively, and then annually. We also calculated and compared the mean change in PRO scores from preoperatively to 2 years' follow-up (Δ) between the control and study groups. This allowed us to compare the magnitude of change taking into account possible different starting points preoperatively for both groups. Patients also rated their level of satisfaction after surgery, with 0 indicating not satisfied at all and 10 indicating extremely satisfied. The satisfaction scores of each group were compared at the last follow-up visit and according to the overall improvement of each score. Patient range of motion was also collected at each of the postoperative visits.

Statistical Analysis

An a priori power analysis was performed to estimate the number of cases needed. On the basis of a previous study, a difference of 10 points in mHHS results was considered significant.[30] Hence, with an estimated SD of 15, the effect size for the 2-tailed Student t test (Cohen's d) was 0.67; thus, to obtain a power of 80% or higher, with $P < .05$ and a 2-tailed hypothesis, the study required a minimum of 37 cases in each group to achieve statistical significance. A comparison of continuous variables between the study group and the matched-pair group was performed with a paired 2-tailed Student t test. Comparison of categorical values was performed with the χ^2 test. $P < .05$ was considered statistically significant. Descriptive statistics were performed using Microsoft Excel (Microsoft, Redmond, WA). Additional statistics were performed using IBM SPSS Statistics, version 20 (IBM, Armonk, NY).

Results

A total of 352 hip arthroscopies were performed during the study period. Seventy-four patients were aged 50 years or older during this time. At the time of review, 52 patients were available for 2-year follow-up in the study group. The majority of the patients were female patients (65.4%). The mean age was 54.8 years (range, 50 to 69 years) in the older study group and 20.3 years (range, 13 to 30 years) in the younger control group. The mean body mass index was 27.3 kg/m^2 in the study group and 22.8 kg/m^2 in the control group. Table 3 presents the demographic data for both groups.

Table 3. Demographic Data for Older Study Group and Younger Control Group

Demographic Data	Younger Control Group (n = 52)	Older Study Group (n = 52)	*P* Value
Female	34 (65.4%)	34 (65.4%)	>.99
BMI, kg/m^2	22.8	27.3	<.001*
Age, yr (range)	20.3 (13-30)	54.8 (50-69)	<.001*
Traction time, min	59.9	58.7	.81
Follow-up time, yr	2.76	2.73	.83
Right hip	28	26	.69

BMI, body mass index.
*Statistically significant.

Table 4 presents preoperative physical examination findings. Patients aged 50 years or older had significantly lower internal and external rotation ($P < .05$) compared with younger controls. Table 5 presents preoperative radiographic measurements of both groups. Interestingly, we found that the younger control group had significantly smaller central and lateral joint spaces compared with the older study group ($P < .05$). Table 6 describes all concomitant procedures performed for both groups. The older study group had significantly more femoroplasties, capsular releases, ligamentum teres debridements, and trochanteric bursectomies performed. The younger control group had significantly more iliopsoas fractional lengthening procedures, capsular plications, and synovectomies performed.

The baseline preoperative PRO scores were similar for both the control and study groups. The mean preoperative scores for both groups are presented in Table 7. In the younger control group, the score improvement from preoperatively to 2 years' follow-up was 62.9 to 84.2 for the mHHS, 60.5 to 84.2 for the NAHS, 63.1 to 86.5 for the HOS-ADL, and 42.2 to 72.7 for the HOS-SSS. In the older study group, the score improvement from preoperatively to 2 years' follow-up was 61.2 to 82.2 for the mHHS, 59.9 to 80.4 for the NAHS, 63.9 to 83 for the HOS-ADL, and 41.2 to 64.6 for the HOS-SSS. All improvements in both groups were statistically significant at the 2-year postoperative follow-up ($P < .001$) (Table 8). There was no significant difference for all PRO scores at final follow-up between both groups. When we compared the change in PRO scores (Δ) from preoperatively to 2 years postoperatively, there was no significant difference between both groups. Figure 1 shows the changes in the PRO scores for both the control and study groups.

Mean VAS pain scores were significantly lower for the older study group preoperatively. Both groups had a significant improvement in VAS scores. At the 2-year postoperative visit, VAS scores were not significantly different between groups (Fig 2). The postoperative patient satisfaction score at the 2-year time interval was 7.3 for the younger control group and 7.8 for the older study group, which was not significantly different.

Table 4. Preoperative Physical Examination Findings

Physical Examination	Age ≤30 yr (n = 52)	Age ≥50 yr (n = 52)	*P* Value
Anterior impingement	50 (96%)	45 (87%)	.16
Lateral impingement	28 (54%)	24 (46%)	.43
Posterior impingement	22 (42%)	13 (25%)	.06
Positive FABER	30 (58%)	28 (54%)	.69
External hip click	5 (9.6%)	3 (5.8%)	.71
Internal hip click	15 (29%)	5 (9.6%)	.01*
Range of motion			
Internal rotation	28.5°	20.2°	<.01*
External rotation	54.8°	48.8°	.03
Flexion	122.4°	118.4°	.19
Abduction	47.2°	44°	.08

FABER, flexion–abduction–external rotation.
*Statistically significant.

Table 5. Preoperative Radiographic Measurements

	Age ≤30 yr (n = 52)	Age ≥50 yr (n = 52)	*P* Value
Crossover %	9.4	8.5	.71
Lateral CEA	27.8°	27.2°	.7
Anterior CEA	29.3°	26.8°	.28
Acetabular inclination	5.14°	6.63°	.21
Alpha angle	56.7°	58.5°	.52
Medial joint space, mm	0.32	0.35	.26
Central joint space, mm	0.34	0.4	.001*
Lateral joint space, mm	0.37	0.43	<.01*

CEA, center-edge angle.
*Statistically significant.

Complications

One patient in both the control group and study group had a superficial wound infection that resolved

Table 6. Concomitant Procedures Performed for Older Study Group and Younger Control Group

Hip Procedure	Younger Control Group (n = 52)	Older Study Group (n = 52)	*P* Value
Acetabuloplasty	31 (60%)	26 (50%)	.32
Femoroplasty	26 (50%)	37 (71%)	.03*
Labral repair	28 (54%)	27 (52%)	.84
Ligamentum teres debridement	21 (40%)	34 (65%)	.01*
Capsular repair	25 (48%)	12 (23%)	<.01*
Capsular release	20 (38%)	40 (77%)	<.01*
Labral debridement	24 (46%)	25 (48%)	.84
Iliopsoas fractional lengthening	24 (46%)	4 (8%)	<.001*
Synovectomy	10 (19%)	4 (7.7%)	<.001*
Trochanteric bursectomy	0	16 (31%)	<.001*
Removal of loose body	2 (3.8%)	6 (11%)	.27
Acetabular notchplasty	0	4 (7.7%)	.13
Gluteus medius repair	0	3 (5.8%)	.24

*Statistically significant.

Table 7. Mean Preoperative Patient-Reported Outcome Scores

	Younger Control Group	Older Study Group	*P* Value
mHHS	62.9	61.2	.56
NAHS	60.5	59.9	.88
HOS-ADL	63.1	63.9	.84
HOS-SSS	42.2	42.2	.85

HOS-ADL, Hip Outcome Score-Activities of Daily Living; HOS-SSS, Hip Outcome Score—Sport-Specific Subscale; mHHS, Modified Harris Hip Score; NAHS, Non-Arthritic Hip Score.

with a course of oral antibiotics. One patient in the study group reported perineal numbness that resolved within 6 weeks. One patient in the study group had heterotopic ossification on postoperative radiographs that was asymptomatic. One patient in the study group had postoperative deep vein thrombosis that resolved with antithrombolytic drugs.

Clinical Endpoints

Regarding conversion to THA or a hip-resurfacing procedure, 1 patient in the control group and 9 patients in the study group underwent THA during the study period, giving conversion rates of 1.9% and 17.3%, respectively ($P < .01$). The indication for most of the patients who underwent THA or a resurfacing procedure was refractory pain with progression of arthritis and joint space narrowing on radiographs. Eight patients in the control group and 2 patients in the study group underwent revision hip arthroscopy during the study period, giving revision rates of 15.4% and 3.8%, respectively ($P = .05$). All revisions were performed for recurrent pain postoperatively with evidence of labral tears on MRI. The overall patient satisfaction score after revision was 6.1 for the control group and 8.5 for the older study group. Patients not requiring THA after primary arthroscopy were defined as survivors. The 2-year survivorship rate was 98.1% for the younger control group and 82.7% for the older study group.

Discussion

Since the introduction of FAI in 2003 by Ganz et al.,[31] numerous studies have reported the outcomes of surgical intervention in the young and active population. It has been shown that hip arthroscopy in the presence of osteoarthritis has a poorer prognosis with variable failure rates reported: Larson et al.[6] reported a 52% failure rate in patients undergoing hip arthroscopy for FAI. In contrast, Haviv and O'Donnell[9] reported a rate of only 16%. In both studies it was also suggested that advanced age might be a cause for early failure. Today, as the average age increases and the awareness of maintaining an active lifestyle is growing, we encounter older patients who are athletically active and wish to remain so for as long as possible.

Table 8. Patient-Reported Outcome Scores

			Preoperative				3 mo Postoperatively				1 yr Postoperatively				2 yr Postoperatively			
Outcomes	Group	No. of Patients	Mean	95% CI	SD	*P* Value	Mean	95% CI	SD	*P* Value	Mean	95% CI	SD	*P* Value	Mean	95% CI	SD	*P* Value
mHHS	Control	52	62.9 (32-96)	4.59	16.5	.56	84.3 (37-100)	9.17	17.2	.02*	83.7 (43-100)	8.64	16.8	.32	84.2 (24-100)	10.18	19.1	.58
	Study	52	61.2 (30-85)	3.70	13.3		74.7 (43-100)	10.45	17.3		78.8 (37-100)	9.72	18.9		82.2 (44-100)	8.06	16.2	
	Δ in Control						22.3		19.1	.04*	22.3		18.9	.64	21.3		21.4	.65
	Δ in Study						13.7		17.5		19.8		21.7		21		18.6	
NAHS	Control	52	60.5 (11-94)	5.79	20.8	.88	83.5 (19-100)	8.89	19	.02*	82.2 (44-99)	7.47	15.5	.23	84.2 (20-100)	9.47	17.1	.27
	Study	52	59.9 (10-90)	4.76	17.1		73.4 (31-99)	9.10	17.7		76.3 (34-100)	10.03	19.5		80.4 (40-100)	7.86	16.3	
	Δ in Control						22.4		22.6	.14	23.4		21.2	.19	23.5		23.3	.35
	Δ in Study						15.7		15.6		14.6		26.9		20.4		20.2	
HOS-ADL	Control	52	63.1 (23-96)	6.26	22.5	.84	86.1 (42-100)	7.05	15.9	.05	84.8 (31-100)	9.64	17.4	.53	86.5 (22-100)	9.15	17.8	.36
	Study	52	63.9 (22-97)	5.40	19.4		79 (42-100)	7.81	16.2		81.7 (35-100)	10.60	19.9		83 (40-100)	9.06	18.8	
	Δ in Control						24.9		21.9	.07	22.7		20.3	.56	23.4		24	.95
	Δ in Study						16.4		17.6		19.2		24.1		19.6		22.1	
HOS-SSS	Control	52	42.2 (5-94)	7.35	26.4	.85	64.3 (5-100)	12.28	30.4	.43	70.1 (6-100)	10.42	27.9	.66	72.7 (5-100)	11.51	29.1	.19
	Study	52	41.2 (10-100)	7.32	26.3		58.6 (10-100)	13.17	32.6		66.7 (6-100)	10.60	29.4		64.6 (3-100)	10.80	28.4	
	Δ in Control						26.8		27.6	.09	29.2		31.2	.73	30.3		31.2	.44
	Δ in Study						15.5		29.8		25.8		40.3		23.9		33.7	

CI, confidence interval; HOS-ADL, Hip Outcome Score-Activities of Daily Living; HOS-SSS, Hip Outcome Score—Sport-Specific Subscale; mHHS, Modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; SD, standard deviation.
*Statistically significant.

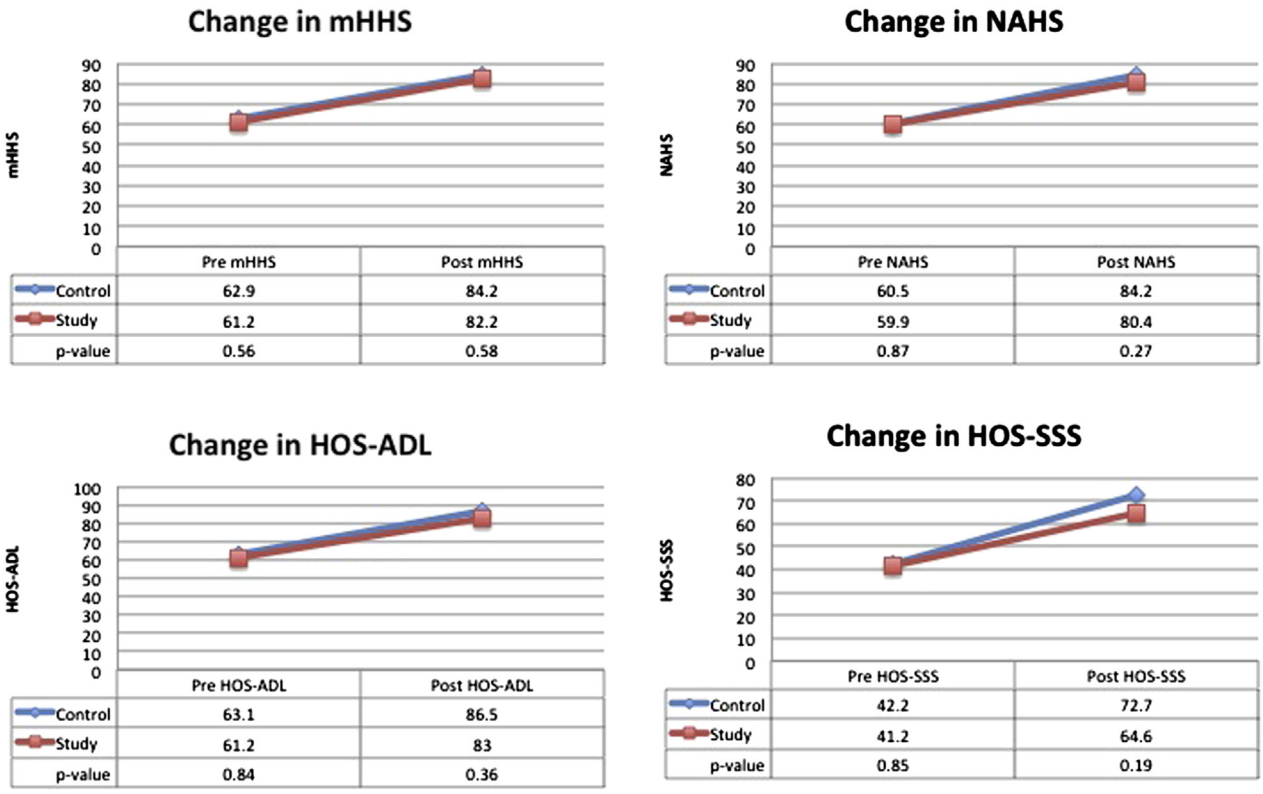

Fig 1. Change in patient-reported outcome scores from preoperatively (Pre) to 2 years postoperatively (Post). (HOS-ADL, Hip Outcome Score—Activities of Daily Living; HOS-SSS, Hip Outcome Score—Sport-Specific Subscale; mHHS, Modified Harris Hip Score; NAHS, Non-Arthritic Hip Score.)

To our knowledge, 2 studies have addressed the issue of hip arthroscopy in the middle-aged population: Philippon et al.[1] showed improvement in hip scores in patients aged 50 years or older. They reported that the mHHS improved from 58 to 84 and HOS-ADL improved from 66 to 87. Javed and O'Donnell[32] showed the mHHS to increase by 19.2 points and the NAHS to increase by 15 points in patients older than 60 years. Neither of these studies compared the results of the study group with a matched-pair younger control group.

Recently, Ben Tov et al.[33] evaluated the clinical and functional outcomes of patients older than 50 years who underwent acetabular labral repairs. Similarly, they found that the mHHS improved from 62.5 to 87.2 in patients with a Tönnis grade of 0 or 1. McCormick et al.[25] evaluated the influence of age and arthritis on hip arthroscopy for labral tears. They found that the presence of osteoarthritic changes at the time of arthroscopy was predictive of worse outcome scores compared with the nonarthritic cohort. In addition, age younger than 40 years was predictive of good to excellent results (odds ratio, 7; 95% confidence interval, 2.9 to 16.9; $P < .0001$). In our study we did not find a difference in PRO scores between the older and control groups. This may be because we do not routinely operate on patients with a Tönnis grade of 2 or higher.

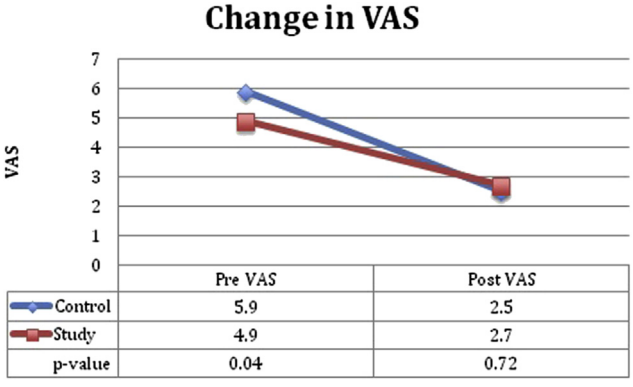

Fig 2. Change in visual analog scale (VAS) score from preoperatively (Pre) to postoperatively (Post).

In our study we have found that at a minimum of 2 years' follow-up, patients aged 50 years or older had a 2-year survivorship rate of 82.7%. Survivors had improvement in the mHHS of 21 compared with improvement of 21.3 for the group aged 30 years or younger, whereas the HOS-ADL improved by 19.6 in the group aged 50 years or older and by 23.4 in the control group. The difference between the older group and the younger group was not statistically significant. The VAS score decreased from 4.9 to 2.7 in the older group and from 5.9 to 2.5 in the younger group. The satisfaction score was 7.8 in the older group and 7.3 in the younger group.

Our results support our hypothesis that the patients aged 50 years or older may benefit as much as the group aged 30 years or younger. These results should encourage surgeons to consider recommending the described treatment option for their patients; however, the issue of predicting survivorship in these patients needs to be addressed with future studies. Philippon et al.[1] suggested using joint space width to predict survivorship and recommended not performing hip-preservation surgery in patients who have a joint space below 2 mm. At our institution, we do not perform hip arthroscopy in patients with a Tönnis grade of 2 or higher or in patients with a joint space of less than 2 mm. However, neither joint space nor Tönnis grade assesses the cartilage integrity directly; rather, they offer an indirect assessment of the cartilage. Finding a better tool to assess the cartilage quality may be important in the future; this will help increase the percentage of patients achieving long-term improvement from hip-preservation procedures (survivors) in this patient population.

Limitations

All surgical procedures were performed at a dedicated hip-preservation referral center, and extrapolation of results from one center to another may present challenges. There were differences in the concomitant pathologies and procedures performed between the groups. We acknowledge the potential for selection bias; however, the difference in adjunctive procedures reflects the different frequencies of secondary diagnoses between younger and older patients with labral tears. Although labral tear was the primary diagnosis for all patients, trochanteric pathology was more common in the older population whereas internal snapping was more common in the younger group. This may be because of an increase in tendinopathic degenerative changes in the older patients resulting in lateral-sided hip pain in the setting of trochanteric bursitis. In younger patients with more mobility in their joints, hyperactivity of the dynamic hip stabilizers, such as the iliopsoas muscle, may be more likely to develop. This has been theorized to cause internal snapping. The small size of the study and the short follow-up period preclude definite conclusions on the likelihood of progression to THA. However, the results in the survivors in the older cohort were comparable with those in the younger control group. Midterm and long-term studies are currently under way at our institution to learn the extent to which clinical outcomes will deteriorate with time.

Conclusions

Survivors aged 50 years or older show similar improvement to patients aged 30 years or younger in PRO and patient satisfaction scores. The 2-year survivorship rate was 98.1% for the younger control group and 82.7% for the older study group. Therefore we believe that hip arthroscopy should be considered a valid treatment option when treating hip pain in patients aged 50 years or older with a Tönnis arthritic grade of 0 or 1. Older patients should be counseled on the possibility of later conversion to THA. Future work may include development of a decision-making tool to assess for prognosis to better delineate the indications for hip arthroscopy in the older population.

References

1. Philippon MJ, Schroder ESBG, Briggs KK. Hip arthroscopy for femoroacetabular impingement in patients aged 50 years or older. *Arthroscopy* 2012;28:59-65.
2. Botser IB, Smith TW Jr, Nasser R, Domb BG. Open surgical dislocation versus arthroscopy for femoroacetabular impingement: A comparison of clinical outcomes. *Arthroscopy* 2011;27:270-278.
3. Stevens MS, Legay DA, Glazebrook MA, Amirault D. The evidence for hip arthroscopy: Grading the current indications. *Arthroscopy* 2010;26:1370-1383.
4. Neumann G, Mendicuti AD, Zou KH, et al. Prevalence of labral tears and cartilage loss in patients with mechanical symptoms of the hip: Evaluation using MR arthrography. *Osteoarthritis Cartilage* 2007;15:909-917.
5. Shindle MK, Voos JE, Nho SJ, Heyworth BE, Kelly BT. Arthroscopic management of labral tears in the hip. *J Bone Joint Surg Am* 2008;90:2-19 (suppl 4).
6. Larson CM, Giveans MR, Taylor M. Does arthroscopic FAI correction improve function with radiographic arthritis? *Clin Orthop Relat Res* 2011;469:1667-1676.
7. Byrd JW, Jones KS. Prospective analysis of hip arthroscopy with 2-year follow-up. *Arthroscopy* 2000;16:578-587.
8. Christensen CP, Althausen PL, Mittleman MA, Lee JA, McCarthy JC. The nonarthritic hip score: Reliable and validated. *Clin Orthop Relat Res* 2003;406:75-83.
9. Haviv B, O'Donnell J. The incidence of total hip arthroplasty after hip arthroscopy in osteoarthritic patients. *Sports Med Arthrosc Rehabil Ther Technol* 2010;2:18.
10. Lodhia P, Slobogean GP, Noonan VK, Gilbart MK. Patient-reported outcome instruments for femoroacetabular impingement and hip labral pathology: A systematic review of the clinimetric evidence. *Arthroscopy* 2011;27:279-286.
11. Tijssen M, van Cingel R, van Melick N, de Visser E. Patient-reported outcome questionnaires for hip arthroscopy: A systematic review of the psychometric evidence. *BMC Musculoskelet Disord* 2011;12:117.
12. Byrd JW. Evaluation of the hip: History and physical examination. *N Am J Sports Phys Ther* 2007;2:231-240.
13. Dunn DM. Anteversion of the neck of the femur; a method of measurement. *J Bone Joint Surg Br* 1952;34:181-186.
14. Meyer DC, Beck M, Ellis T, Ganz R, Leunig M. Comparison of six radiographic projections to assess femoral head/neck asphericity. *Clin Orthop Relat Res* 2006;445:181-185.
15. Tönnis D, Heinecke A. Acetabular and femoral anteversion: Relationship with osteoarthritis of the hip. *J Bone Joint Surg Am* 1999;81:1747-1770.

16. Jessel RH, Zurakowski D, Zilkens C, Burstein D, Gray ML, Kim YJ. Radiographic and patient factors associated with pre-radiographic osteoarthritis in hip dysplasia. *J Bone Joint Surg Am* 2009;91:1120-1129.
17. Wiberg G. Shelf operation in congenital dysplasia of the acetabulum and in subluxation and dislocation of the hip. *J Bone Joint Surg Am* 1953;35:65-80.
18. Jamali AA, Mladenov K, Meyer DC, et al. Anteroposterior pelvic radiographs to assess acetabular retroversion: High validity of the "cross-over-sign." *J Orthop Res* 2007;25:758-765.
19. Siebenrock KA, Schoeniger R, Ganz R. Anterior femoro-acetabular impingement due to acetabular retroversion. Treatment with periacetabular osteotomy. *J Bone Joint Surg Am* 2003;85:278-286.
20. Werner CM, Copeland CE, Ruckstuhl T, et al. Radiographic markers of acetabular retroversion: Correlation of the cross-over sign, ischial spine sign and posterior wall sign. *Acta Orthop Belg* 2010;76:166-173.
21. Barton C, Salineros MJ, Rakhra KS, Beaule PE. Validity of the alpha angle measurement on plain radiographs in the evaluation of cam-type femoroacetabular impingement. *Clin Orthop Relat Res* 2011;469:464-469.
22. Eijer H, Leunig M, Mohamed N, Ganz R. Cross-table lateral radiographs for screening of anterior femoral head-neck offset in patients with femoroacetabular impingement. *Hip Int* 2001;11:37-41.
23. Notzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. *J Bone Joint Surg Br* 2002;84:556-560.
24. Martin RL, Philippon MJ. Evidence of reliability and responsiveness for the Hip Outcome Score. *Arthroscopy* 2008;24:676-682.
25. McCormick F, Nwachukwu BU, Alpaugh K, Martin SD. Predictors of hip arthroscopy outcomes for labral tears at minimum 2-year follow-up: The influence of age and arthritis. *Arthroscopy* 2012;28:1359-1364.
26. Crawford K, Philippon MJ, Sekiya JK, Rodkey WG, Steadman JR. Microfracture of the hip in athletes. *Clin Sports Med* 2006;25:327-335, x.
27. Callaghan JJ, Rosenberg AG, Rubash HE, eds. *The adult hip*. Ed 2. Philadelphia: Lippincott Williams & Wilkins, 2007.
28. Martin RL, Kelly BT, Philippon MJ. Evidence of validity for the hip outcome score. *Arthroscopy* 2006;22:1304-1311.
29. Martin RL, Philippon MJ. Evidence of validity for the hip outcome score in hip arthroscopy. *Arthroscopy* 2007;23:822-826.
30. Larson CM, Giveans MR, Stone RM. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: Mean 3.5-year follow-up. *Am J Sports Med* 2012;40:1015-1021.
31. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: A cause for osteoarthritis of the hip. *Clin Orthop Relat Res* 2003;417:112-120.
32. Javed A, O'Donnell JM. Arthroscopic femoral osteochondroplasty for cam femoroacetabular impingement in patients over 60 years of age. *J Bone Joint Surg Br* 2011;93:326-331.
33. Ben Tov T, Amar E, Shapira A, Steinberg E, Atoun E, Rath E. Clinical and functional outcome after acetabular labral repair in patients aged older than 50 years. *Arthroscopy* 2014;30:305-310.