



Hip Arthroscopy Results in Similar Short-Term Function Compared to Total Hip Arthroplasty in Patients of Similar Demographic Profiles

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Purpose: To review short-term functional outcomes in patients who underwent hip arthroscopy and to compare their outcomes to those of a demographically similar cohort who underwent total hip arthroplasty (THA). **Methods:** Data were prospectively collected and retrospectively reviewed for patients undergoing hip arthroscopy (SCOPE) between April 2008 and October 2015. SCOPE patients were included if they were ≥ 35 years, had preoperative and postoperative 2-year follow-up, and had no prior hip condition or ipsilateral hip surgery. SCOPE patients were matched 1:1 to a demographically similar cohort of patients who underwent THA at our institution. Matching criteria included similar age (within 5 years), gender, and body mass index (within 5). SCOPE patients were assessed with modified Harris Hip Score (mHHS), non-arthritic hip score, and visual analogue scale (VAS). THA patients were assessed with mHHS, forgotten joint score, and VAS. **Results:** Sixty-seven patients were included in each cohort. Patients who underwent hip arthroscopy for management of labral tears achieved nearly equivalent mHHS, Health Survey Short Form (SF-12) Mental, SF-12 Physical, Veterans RAND 12 Item Health Survey (VR-12) Mental, VR-12 Physical scores at latest follow-up compared to demographically similar patients who underwent THA. There was no significant difference in mHHS scores (SCOPE = 82.9 ± 16.4 vs THA = 87.3 ± 15 , $P = .095$) between the 2 group groups. In addition, average patient satisfaction on a 10-point scale was 8.1 for the SCOPE cohort and 8.8 for the THA cohort ($P = .052$). **Conclusions:** Our results show that hip arthroscopy, when performed in patients with the appropriate indications, can lead to comparably excellent outcomes as total hip arthroplasty with significant pain relief at short term follow-up. **Level of Evidence:** Level III, retrospective cohort study.

Since its introduction, hip arthroscopy has evolved as a diagnostic and therapeutic procedure to treat various hip pathologies. Improvements in technology

have provided significant advancements in managing intra- and extra-articular disorders.^{1,2} As such, the past decade has seen a dramatic rise in the number of hip

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arthroscopies performed in the United States. Identifying optimal indications for arthroscopy has been of high interest within the academic community in an effort to curtail the explosion of case volume while providing high quality of care. Strict indications have resulted in favorable short- to mid-term outcomes in patients undergoing hip arthroscopy.³⁻⁵ Similarly, researchers have sought to identify factors that preclude benefit from hip arthroscopy, such as the severity of preoperative osteoarthritis (OA).^{6,7} In a review article by Domb et al.,⁷ the authors concluded that patients with a Tönnis grade ≥ 1 or joint space ≤ 2 mm are less likely to benefit from hip arthroscopy and are more likely to require subsequent conversion to total hip arthroplasty (THA).

The hip, as a ball-and-socket joint, has protective cartilage that may undergo irreversible damage in the progression to OA. This loss of articular cartilage can be painful, can lead to reduction in motion, and eventually can result in significant loss of hip function. Of all medical interventions performed in major medical centers, THA has the most predictable outcome as measured by pain relief, improved joint function, and high improvement in quality of life.^{8,9} Accordingly, THA has become the gold standard treatment option for end-stage OA. However, for milder forms of OA that are often well treated with hip arthroscopy, the question persists regarding whether it can produce similarly significant improvements in patient quality of life and function compared to THA. Furthermore, there are limited data comparing the outcomes and quality of life of demographically similar patients undergoing hip arthroscopy or THA.

We wanted to review short-term functional outcomes in patients who underwent hip arthroscopy and to compare their outcomes to those of a demographically similar cohort who underwent THA. The null hypothesis was that patients who underwent hip arthroscopy would have similar postoperative outcomes in comparison to patients who underwent THA.

Methods

Patient Selection Criteria

Data were prospectively collected and retrospectively reviewed for all patients undergoing hip arthroscopy by B.G.D. between April 2008 and October 2015. All patients participated in the A.H.I. Hip Preservation Registry. All data collection received Institutional Review Board approval. Patients were considered for inclusion if they were ≥ 35 years old, if preoperative measurements and assessments indicated a diagnosis of a labral tear during this study period, and if they had preoperative and minimum 2-year follow-up scores recorded for the following patient-reported outcome (PRO) measures: modified Harris Hip Score (mHHS),

Non-Arthritic Hip Score, and Visual Analogue Scale (VAS) for pain. Patients were excluded for any of the following criteria: prior ipsilateral hip surgery, prior hip conditions such as Legg-Calve-Perthes disease, hip fractures, slipped capital femoral epiphysis, and avascular necrosis of the femoral head, active workers' compensation claim, duration of symptoms greater than one year, radiographic evidence of osteoarthritis (Tönnis >1 or joint space <2 mm), or grade 3 or 4 damage according to acetabular labrum articular disruption or Outerbridge classification systems. Additionally, to identify successful SCOPE patients, any patients who required a subsequent ipsilateral hip surgery were excluded from this analysis.

Hip arthroscopy patients who met the above-mentioned criteria comprised the SCOPE cohort. These patients were pair-matched to patients who underwent primary THA by the senior author during this same study period (THA cohort). For the THA cohort, the inclusion criterion was patients with minimum 2-year postoperative follow-up on the mHHS, the Forgotten Joint Score, and VAS scores. The exclusion criteria included the following: patients younger than 35 years old, patients who underwent concomitant gluteus medius repair, active worker's compensation patients, and patients who underwent hip resurfacing instead of THA. SCOPE patients were pair matched to THA patients with similar age (within 5 years), gender, and body mass index (BMI) (within 5).

Clinical and Radiographic Evaluation

Before each surgery, patients were evaluated by the senior author (B.G.D.) with a comprehensive physical examination. This examination included assessment of range of motion, gait, alignment, and strength. Furthermore, anterior, lateral, and posterior impingement tests were performed to assess femoroacetabular impingement.^{10,11}

All patients also underwent a preoperative and 2-week postoperative radiographic evaluation using the following views: upright and supine anterolateral pelvis, false-profile, and modified Dunn.¹²⁻¹⁵ All measurements were made using GE Healthcare's Picture Archiving and Communication System (GE-Healthcare, Chicago, IL, USA). The supine anteroposterior pelvis radiograph was used to assess (1) degree of osteoarthritis¹⁶ and (2) acetabular version, based on crossover and ischial spine signs.^{17,18} Acetabular inclination was assessed by measuring the lateral center-edge and anterior center-edge angles on the supine anteroposterior and false-profile radiographs, respectively.¹⁹⁻²¹ The modified Dunn view was used to measure the alpha angle and femoral offset.²² Preoperatively, all SCOPE patients also underwent magnetic resonance imaging (MRI) to confirm intra-articular pathology before surgical management. An MRI was

not completed for all THA patients because this form of preoperative assessment is not necessary for some THA patients.

Indications for Surgery

All patients attempted nonoperative management including physical therapy, injections, activity modification, or anti-inflammatory medications. Patients with severe hip osteoarthritis who were refractory to these measures for at least 3 months were recommended for THA. Similar to THA patients, those undergoing SCOPE also attempted a minimum of 3 months of nonoperative treatment.

Surgical Techniques

All arthroscopies were performed in the modified supine position. A minimum of 2 portals (midanterior and anterolateral) were created to access the joint. After interportal capsulotomy, a diagnostic arthroscopy was conducted to assess the femoral and acetabular cartilage, ligamentum teres, and labrum. Some patients in the study group were treated with ligamentum teres debridement using a radiofrequency tool. Acetabular and femoral head deformities were corrected using a burr under fluoroscopic guidance to reproduce normal anatomy. In some cases, patients who reported painful internal snapping were treated with iliopsoas fractional lengthening. The senior author performed a capsular plication in cases of capsular laxity.

Labral tears were classified using the Seldes system.²³ When possible, labral repairs were performed using a circumferential suture or labral base refixation techniques.²⁴ In some cases, selective labral debridement was conducted. Femoral head or acetabular microfracture was performed for full-thickness chondral lesions.

For the THA cohort, patients elected for either the direct anterior or the mini-posterior approach. After excision of soft tissue, the acetabulum was reamed, and the appropriate cup implant and liner were put into place. The femur was broached, and the stem and head components were impacted. In cases with MAKO robotic-arm assistance, cup positioning was facilitated with the robotic arm and computer system based on a preoperative CT scan. At closing, the surgical wound was irrigated with sterile solution, the capsule was repaired, and a Hemovac drain was placed.

Rehabilitation Protocol

After hip arthroscopy, patients wore a hip brace (Donjoy VersaROM, DJO Global, Carlsbad, CA) that restricted range of motion to 0° to 90° of flexion. Patients also used crutches with 20-pound flat-foot weightbearing restrictions on the operative side. If labral repair or debridement was performed, patients used a hip brace and crutches for a minimum of 2 weeks. In the case of

concomitant partial thickness (greater than 50%) and full-thickness gluteus medius repairs due to tears coincidentally identified on examination and MRI, patients used a hip brace and crutches for 6 and 8 weeks, respectively. Weightbearing was limited at this time to 20 pounds (9 kg) with a brace (DJO Global, Lewisville, TX) that limits hip flexion and extension to 90° and 0°, respectively. All patients began physical therapy on the first postoperative day with a continuous passive motion device. For the THA cohort, patients participated in home care for 1 to 2 weeks before transitioning to outpatient physical therapy for an additional 6 to 8 weeks to improve range of motion and strength.

Surgical Outcomes

Within 1 month of surgery, preoperative questionnaires were completed by all SCOPE patients to assess baseline pain and functioning. Additionally, SCOPE patients completed the mHHS, Non-Arthritic Hip Score, VAS, and satisfaction questionnaires postoperatively. Not all THA patients reported preoperative scores; however, all THA patients completed the mHHS, Forgotten Joint Score, VAS, and satisfaction questionnaires after surgery at 3 months, 1 year, and annually thereafter. Patient satisfaction was recorded on a 10-point scale. For both cohorts, postoperative assessment also included the Veterans RAND 12 Item Health Survey (VR-12) and the Health Survey Short Form (SF-12). The postoperative SCOPE assessment also included the International Hip Outcome Tool.

Statistical Analysis

All statistical analysis was performed using Microsoft Excel 2007 (Microsoft Corporation, Redmond, WA). Descriptive statistics were reported for demographic data, intraoperative procedures, and PROs. The Shapiro-Wilk test was used to assess normality and the *F*-test was used to test for equal variance. A *two*-tailed paired *t*-test was used to compare normally distributed data with equal variance, and the Wilcoxon signed-rank or Mann-Whitney tests were used to compare nonparametric data, depending on the size of the samples. A χ^2 analysis was conducted to detect differences between categorical data. A *P* value <.05 was considered statistically significant.

Results

Patient Selection and Match Results

Between April 2008 and October 2015, 2836 hip arthroscopies were conducted at our institution. There was a total of 1495 cases that were either not arthroscopy cases, did not have preoperative data, or were performed on patients under the age of 35 years. A total of 84 hips were eligible for the study, of which 76 (90.5%) had minimum 2 years' follow-up. Each SCOPE

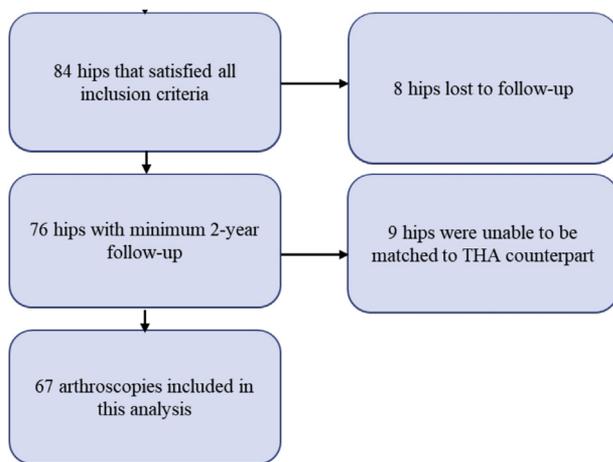


Figure 1. Patient selection flowchart.

patient was matched to a THA patient according to age, sex, and BMI, as described previously. Nine patients were unable to be matched, resulting in a 67-patient cohort. This selection process is outlined in Fig 1.

Patient Demographics

Demographic data are depicted in Table 1. There were no differences between groups in laterality of surgery, gender, age, or BMI ($P > .05$). There was a significant difference between the SCOPE and THA cohorts in follow-up duration, with the average follow-up for SCOPE and THA patients being 65 months and 42.6 months, respectively ($P < .001$).

Intraoperative Findings and Procedures

Intraoperative diagnostic data collected for the SCOPE cohort are presented in Table 2, whereas Table 3 illustrates frequency data of various arthroscopic procedures performed on these patients. Nearly all cases (97.0%) were confirmed to have a labral tear classified by a Seldes I, II, or I & II tear. No patients underwent labral reconstruction; most (58.2%) underwent repair, whereas 28 patients (41.8%) were treated with selective debridement. No patients underwent acetabular or femoral head microfracture.

Surgical Outcomes

Table 4 contains the patient-reported outcome scores measured preoperatively and at minimum 2 years after surgery. The outcome measures listed are those that were common between the 2 groups: mHHS, VAS, VR-12, SF-12, and patient satisfaction (Figs 2-4). Both groups demonstrated significant improvement from preoperative to latest follow-up ($P < .001$). Average patient satisfaction on a 10-point scale was 8.1 for the SCOPE cohort and 8.8 for the THA cohort. This difference approached but did not reach statistical significance ($P = .052$). The two groups also reached nearly equivalent functional status for the following outcome measures: mHHS, SF-12 Mental, SF-12 Physical, VR-12 Mental, VR-12 Physical or patient satisfaction ($P > .05$) (Table 4). Patients in the THA cohort had significantly lower preoperative mHHS scores ($P < .001$). As such, there was also a significant difference between the groups' mHHS improvements from before to after surgery ($P < .001$), despite patients having similar post-operative scores. THA patients reported significantly less pain ($P < .001$) than SCOPE patients at latest follow-up.

Discussion

In summary, the results of this study showed that there was no significant difference between the SCOPE and THA groups in latest scores for any of the following outcome measures: mHHS, SF-12 Mental, SF-12 Physical, VR-12 Mental, VR-12 Physical or patient satisfaction ($P > .05$). Although both groups experienced statistically significant decreases in VAS pain ratings from preoperative to latest follow-up, THA patients demonstrated a lower mean follow-up VAS compared to the SCOPE cohort.

Two broad categories have been associated with improved survivorship after hip arthroscopy: surgeon factors and patient factors. Surgeon factors primarily include technical skill and proficiency, given the relative newness of the procedure. However, an additional (and possibly just as important) surgeon factor to consider is diagnostic acumen, which results in the appropriate patients being selected for surgery. These

Table 1. Demographics of Patient Cohort

	Scope	THA	<i>P</i> Value
Hips included in study			
Left	31 (46.3%)	34 (50.7%)	0.730
Right	36 (53.7%)	33 (49.3%)	
Sex			
Male	21 (31.3%)	21 (31.3%)	> 0.999
Female	46 (68.7%)	46 (68.7%)	
Age at surgery (years, mean, SD, range)	47.6 ± 7.7 (35.8 – 70.7)	48.7 ± 7.2 (34.9 – 69.8)	0.230
BMI (kg/m ² , mean, SD, range)	26.0 ± 5.1 (18.9 – 42.4)	26.8 ± 4.8 (18.9 – 42.1)	0.264
Follow-up time (months, mean, SD, range)	65.0 ± 20.2 (24.9 – 113.1)	42.6 ± 16.4 (24 – 77.1)	< 0.001

SCOPE, arthroscopy; THA, total hip arthroplasty; BMI, body mass index.

Table 2. Intraoperative Findings for Arthroscopy Patients

	Scope
Seldes	
0	0 (0.0%)
I	19 (28.4%)
II	27 (40.3%)
I & II	21 (31.3%)
ALAD	
0	4 (6.0%)
1	26 (38.8%)
2	37 (55.2%)
3	0 (0.0%)
4	0 (0.0%)
Outerbridge (Acetabulum)	
0	2 (3.0%)
1	31 (46.3%)
2	34 (50.7%)
3	0 (0.0%)
4	0 (0.0%)
Outerbridge (Femoral Head)	
0	60 (89.6%)
1	0 (0.0%)
2	7 (10.4%)
3	0 (0.0%)
4	0 (0.0%)
LT Percentile Class (Domb)	
0 – 0%	25 (37.3%)
1 – 0 - <50%	26 (38.8%)
2 – 50 - <100%	15 (22.4%)
3 – 100%	1 (1.5%)
LT Villar Class	
0 – No Tear	25 (37.3%)
1 – Complete Tear	1 (1.5%)
2 – Partial Tear	28 (41.8%)
3 – Degenerative Tear	13 (19.4%)

Scope, arthroscopy; ALAD, acetabular labrum articular disruption; LT, ligamentum teres.

factors intuitively improve with case volume, as surgeons ascend the steep learning curve of hip arthroscopy.²⁵⁻²⁸ Patient factors associated with improved survivorship after hip arthroscopy include younger age, duration of symptoms less than 1 year, absence of preoperative arthritis, absence of prior hip arthroscopy, and preservation of labral function.^{6,25,29,30} Optimization of the above categories—surgeon factors and patient factors—is critical to enhance survivorship after hip arthroscopy and to sustain improvement in patient-reported outcome scores.²⁵

This study aimed to evaluate hip arthroscopy performed under optimal conditions. As such, our analysis considered arthroscopy patients without any signs of advanced OA who (1) underwent surgery at a dedicated hip preservation center and (2) did not require a subsequent ipsilateral hip surgery. Through a pair-matched study design, we compared these patients' outcomes to THA outcomes. Hip arthroscopy is a newer procedure performed on a generally younger population; yet, our results and comparison to THA show that it leads to excellent short-term outcomes. As expected,

the THA cohort—suffering from extreme limitations in function and severely decreased quality of life—averaged significantly lower preoperative mHHS scores (6.4 vs 60.4) and significantly greater preoperative-to-latest improvement compared to the SCOPE cohort. Similarly, although both groups experienced statistically significant decreases in post-operative VAS pain scores, the THA cohort reported greater overall improvement in pain than the SCOPE cohort. These findings were related to a study by Niehaus et al.³¹ showing that patients undergoing THA may have a shorter recover time than those undergoing hip arthroscopy; this may be related to the decreased mean VAS seen in our study. Again, these results were expected given the debilitating nature of end-stage OA.

Although most patients improved significantly after arthroscopy, an important consideration of the arthroscopist is the possibility of treatment failure and its implications on future THA. A recent review by Rosinsky et al.³² evaluated patients undergoing THA after prior hip arthroscopy and demonstrated similar short-term outcomes compared to patients undergoing primary THA. In relevance to the present study, we may suspect that the hip arthroscopy patients with less-favorable outcomes may still benefit favorably from THA in the future, if necessary. However, the sample size to perform such a subgroup analysis may not be clinically meaningful, but it may be worth conducting a separate study to identify patients in the “gray area” who may unpredictably benefit from either hip arthroscopy or THA.

One of the main strengths of our study is that it is one of the earliest to compare hip arthroscopy outcomes to those after total hip replacement at short-term follow-up. This study also has a strict and rigorous matched-pair controlled design, which analyzed prospectively collected data in a cohort comparison. Additionally, this study used multiple tools to assess PROs, addressing the

Table 3. Surgical Procedure for Arthroscopy Patients

	Scope
Labral treatment	
Debridement	28 (41.8%)
Repair	39 (58.2%)
Reconstruction	0 (0.0%)
Capsular treatment	
Repair	24 (35.8%)
Release	43 (64.2%)
Acetabuloplasty	44 (65.7%)
Femoroplasty	49 (73.1%)
Acetabular microfracture	0 (0.0%)
Femoral head microfracture	0 (0.0%)
Ligamentum teres debridement	35 (52.2%)
Iliopsoas fractional lengthening	16 (23.9%)
Trochanteric bursectomy	16 (23.9%)
Gluteus medius repair	6 (9.0%)

Scope, arthroscopy.

Table 4. Patient outcomes for patients that underwent arthroscopy and total hip arthroplasty

	Scope	THA	P Value
mHHS (mean, SD)			
Pre-op	60.4 ± 14.7 (15 – 92)	37.0 ± 21.1 (0 – 59)	<0.001
Post-op	82.9 ± 16.4 (40 – 100)	87.3 ± 15 (45 – 100)	0.095
Pre-op vs Post-op P-value	< 0.001	< 0.001	
Delta	22.5 ± 16.9 (-25 – 60.4)	90.8 ± 8.5 (74.9 – 100)	<0.001
PASS (n, %)	51 (76.1%)	56 (83.6%)	0.389
VAS (mean, SD)			
Pre-op	5.7 ± 2.2 (0 – 10)	6.4 ± 3.6 (0 – 10)	0.209
Post-op	2.5 ± 2.6 (0 – 8.6)	1.3 ± 1.9 (0 – 8)	<0.001
Pre-op vs Post-op P-value	< 0.001	0.002	
Delta	-3.2 ± 2.9 (-9 – 2.1)	-6.3 ± 3.7 (-10 – 0)	<0.001
SF-12 Mental (mean, SD)	55.5 ± 7.2 (26.7 – 67.2)	54.9 ± 8.3 (17.8 – 67.4)	0.704
SF-12 Physical (mean, SD)	45.8 ± 10.4 (18.3 – 58)	48.6 ± 9.2 (18.9 – 57.9)	0.147
VR-12 Mental (mean, SD)	59.4 ± 7.2 (31.1 – 67.7)	58.2 ± 9.2 (22 – 67.2)	0.659
VR-12 Physical (mean, SD)	47.5 ± 9.9 (20.3 – 59.1)	50 ± 8.3 (19.5 – 59.4)	0.186
Patient Satisfaction (mean, SD)	8.1 ± 2.5 (0 – 10)	8.8 ± 2 (2 – 10)	0.052

Scope, arthroscopy; THA, total hip arthroplasty; mHHS, modified Harris Hip Score; VAS, visual analog scale; SF-12, 12-Item Short Form Survey; VR-12, Veterans RAND 12 Item Health Survey.

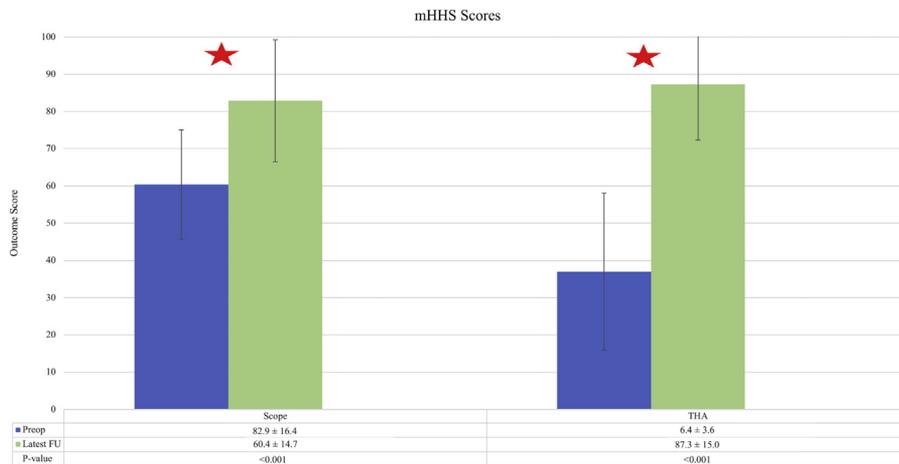
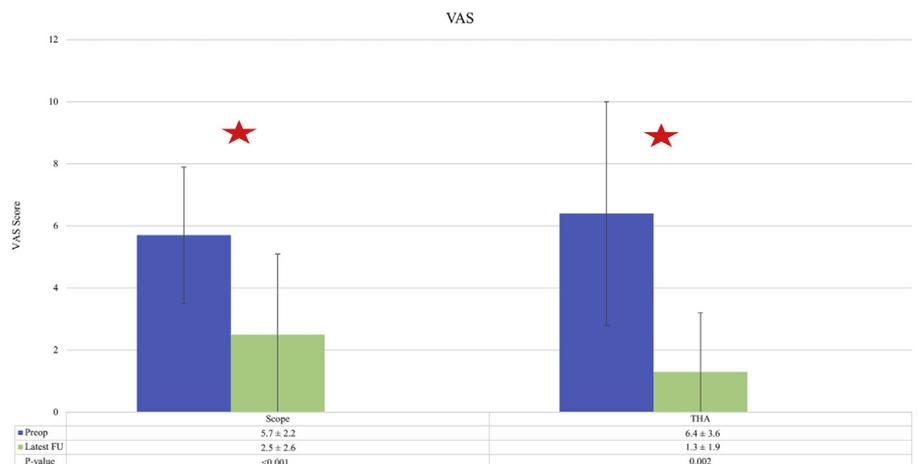


Fig 2. Preoperative and postoperative modified Harris Hip Score (mHHS) scores for the SCOPE and total hip arthroplasty (THA) groups. FU, follow-up. *Red star* denotes statistical significance.

Fig 3. Preoperative and postoperative pain on a Visual Analog Scale (VAS) for the SCOPE and total hip arthroplasty (THA) groups. FU, follow-up. *Red star* denotes statistical significance.



2 Year PROs

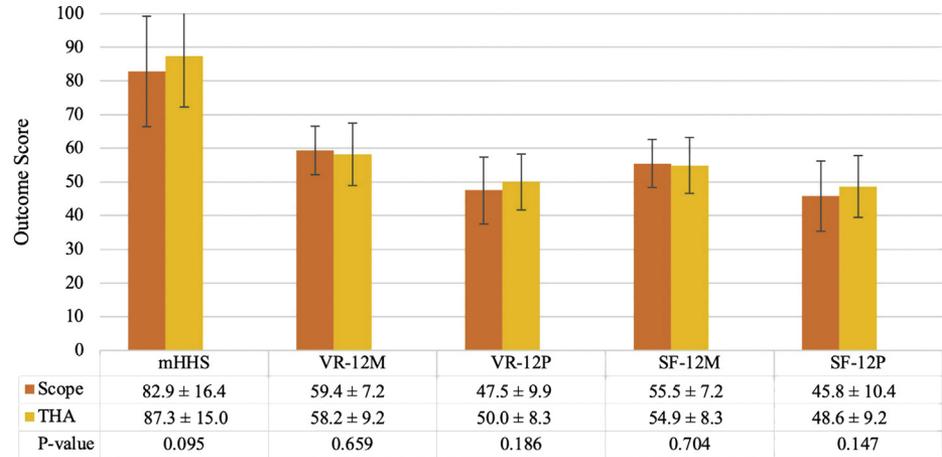


Fig 4. Scores for modified Harris Hip Score (mHHS), Veterans RAND 12 Item Health Survey Mental (VR-12 M), Veterans RAND 12 Item Health Survey Physical (VR-12 P), 12-Item Short Form Survey Mental (SF-12 M) and 12-Item Short Form Survey Physical (SF-12 P) at minimum 2-year follow-up.

psychometric evidence that no single PRO is adequate to assess the effects of hip surgery. Additionally, both the preservation and arthroplasty registries were treated by the same, high-volume surgeon, which limits surgeon-based variability in our outcomes.

Limitations

There are several limitations of this study. We used strict exclusion criteria to identify the optimal candidates for arthroscopy, resulting in only a small fraction (2%) of all hip arthroscopies performed at our institution being included in this study. A power analysis using postoperative VAS scores and a standardized deviation of 2 determined that 44 patients in each group would be required to achieve 80% power. Although our study was adequately powered for its intention, we acknowledge the small sample size in the present study. Additionally, the mean follow-up average significantly differed between the SCOPE and THA patients (65 months and 42.6 months, respectively [$P < .001$]). Another limitation is that some patients who underwent arthroscopy had gluteus medius tears identified and treated as a result of findings on clinical examination that correlated with routine preoperative MRI, as opposed to those undergoing THA. Of note, patients undergoing primary THA may have examination findings of gluteus medius injuries but do not routinely undergo MRI to assess for them. Finally, hip arthroscopy and hip arthroplasty have different surgical indications; thus preoperative functional status differed between the two groups.

Conclusions

Our results show that hip arthroscopy, when performed in patients with the appropriate indications, can lead to comparably excellent outcomes as total hip

arthroplasty with significant pain relief at short-term follow-up.

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