Identifying the Most Successful Procedures in Hip Arthroscopy

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abstract

Hip arthroscopy for femoral and acetabular pathologies has increased dramatically. However, there is little literature analyzing procedures as predictors of revision arthroscopy or arthroplasty. From February 2008 to November 2015, patients undergoing hip arthroscopy for a labral tear with minimum 2-year follow-up and between 18 and 60 years old were retrospectively reviewed. Those with previous surgeries, Tönnis grade greater than 1, and previous hip conditions were excluded. Follow-up was obtained for 1118 patients (1249 hips; 81.7%) with a mean age of 38.7 years (range, 18.0-60.0 years), mean body mass index of 26.4 kg/m^2 (range, 16.3-48.9 kg/m^2), and mean follow-up of 50.2 months (range, 24.0-111.9 months). A total of 122 (9.8%) patients converted to total hip arthroplasty (mean, 35.3 months; range, 1.4-95.2 months). Multivariate analysis for predictors of total hip arthroplasty found age at surgery (hazard ratio, 1.064/y; $P<.05$), body mass index (nonlinear; $P<.05$), labral debridement (HR, 1.558; $P=.03$), and notchplasty (HR, 2.128; $P<.05$), with trochanteric bursectomy (HR, 0.367; $P<.05$) identified as associated with higher survivorship. A total of 124 (9.9%) patients underwent revision hip arthroscopy at a mean of 21.7 months (range, 0.10-83.3 months). Multivariate analysis for predictors of revision surgery found workers' compensation (HR, 3.352; $P<.05$), capsular repair (HR, 1.950; $P<.05$), and femoral head microfracture (HR, 2.844; $P=.04$) to be significant, with age at date of surgery (HR, 0.973/y; $P<.05$) and femoral head chondroplasty (HR, 0.241; $P=.05$) associated with higher survivorship. Understanding risk factors for conversion to total hip arthroplasty or revision is paramount during discussions with patients. [*Orthopedics*. 2020;43(3):173-181.]

The use of hip arthroscopy has increased dramatically in recent years.[1] Common indications include femoroacetabular impingement (FAI) and labral tears as well as a variety of femoral and acetabular pathologies.[1,2] Instability from altered hip mechanics and FAI have been theorized to lead to labral and chondral degeneration. Arthroscopic treatments have been shown to be effective in reducing pain and increasing patient function via patient-reported outcome studies.[3] Thus, hip arthroscopy is posited to prevent the onset of early osteo-

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arthritis and delay the need for hip arthroplasty.[4] Recent research has focused on better understanding preoperative and intraoperative variables such as body mass index (BMI), radiographic parameters, and demographics to better predict patient outcomes while simultaneously reducing revision rates and conversion to total hip arthroplasty (THA).[5,6]

The most common reoperation procedure after hip arthroscopy is THA.[7] Patient factors known to be associated with an increased risk of failed hip arthroscopy include advanced age, preexisting degenerative changes within the joint, and dysplasia.[8,9] A recent population study by Schairer et al[9] identified more than 7000 patients who underwent hip arthroscopy and found that, on average, 12.4% of patients underwent THA within 2 years.[10] Their multivariate analysis of demographics and *International Classification of Diseases, Ninth Revision,* codes identified osteoarthritis (hazard ratio [HR], 2.30), obesity (HR, 2.43), high-volume institutions (HR, 0.76), and increasing age (HR, 5.48 for ages 40-49 y; 8.97 for ages 50-59 y; 14.33 for ages 60-69 y; and 9.70 for >70 y) as risk factors. Predictors of revision hip arthroscopy have been studied. They include female sex, age younger than 40 years, absence of labral repair, and low-volume centers.[7,11]

Most studies have used demographic, radiographic, and intraoperative data and *International Classification of Diseases, Ninth Revision,* codes as predictive indicators. However, few studies have incorporated procedural information into their models. The goal of this study, which involved a new analysis of a cohort that had been previously studied at the authors' institution,[12,13] was to conduct a multivariate analysis using 20 intraoperative procedural variables and 4 known demographic variables (age, sex, BMI, and workers' compensation status) to identify which procedures are associated with (1) conversion to THA and (2) revision hip arthroscopy.

Materials and Methods

Between February 2008 and November 2015, a total of 2889 patients underwent primary hip arthroscopies performed by a single fellowship-trained hip arthroscopist (B.G.D.) at a high-volume center. Data were collected prospectively and retrospectively reviewed. Patients undergoing primary hip arthroscopy for a symptomatic labral tear during the study period with a minimum of 2-year follow-up and age between 18 and 60 years were included. Those with Tönnis osteoarthritis of greater than grade 1, previous hip conditions such as Legg–Calvé–Perthes disease, avascular necrosis, and prior surgical intervention were excluded.

Patients in this study who underwent procedures that made up a small percentage of total surgeries were eliminated due to their dramatic effect on the statistical model. This turned out to be procedures that occurred in less than 1.9% of total surgeries, such as trochanteric micropuncture, piriformis release, pubic symphysectomy, femoral core decompression, sciatic neurolysis, cartilage repair, and hamstring repair.

All patients participated in the American Hip Institute Hip Preservation Registry. Although the current study represents a unique analysis, data for some of the patients may have been reported in other studies. All data collection received institutional review board approval. The authors collected 24 preoperative and intraoperative patient variables during the study period. These individual variables included age, sex, BMI, workers' compensation status, labral treatment, capsular management, ligamentum teres debridement, acetabuloplasty, femoroplasty, acetabular microfracture, trochanteric bursectomy, iliopsoas bursectomy, iliopsoas fractional lengthening, gluteus medius repair, synovectomy, notchplasty,[14] loose body removal, iliotibial (IT)-band release, femoral head microfracture, acetabular chondroplasty, femoral head chondroplasty, acetabular subchondral cyst decompression, femoral head subchondral cyst decompression, and subspine decompression.

Surgical Technique

The senior author (B.G.D.) performed all hip arthroscopies. The surgeries were performed with patients in the modified supine position using a minimum of 2 portals (standard anterolateral and mid-anterior) according to previously described surgical techniques.[15,16] After establishment of the portals and a standard inter-portal capsulotomy, a diagnostic arthroscopy was performed.

Bony pathology was corrected with the use of fluoroscopic guidance. An acetabuloplasty was performed for pincer impingement and femoral neck osteoplasty was performed for cam impingement. Capsular management was based on both preoperative and intraoperative factors. Preoperatively, all patients were assessed for generalized ligamentous laxity via the Beighton scoring system and range of motion characteristics, documented in comparison with the contralateral limb. Possible capsular plication procedures were planned for patients with excessive ligamentous laxity; however, ease of intraoperative limb distraction during hip arthroscopy was also taken into account. Patients deemed difficult to distract were managed with either a side-to-side capsulorrhaphy or capsular release procedures. Labral tears were managed with selective debridement to a stable rim or repaired when indicated. Labral reconstruction was performed if native tissue was of poor quality and degenerative in nature. If full-thickness cartilage damage was present, a microfracture was performed according to Steadman's technique.[17]

Rehabilitation Protocol

During the first 2 weeks after surgery, patients were placed in a hip brace that restricted range of motion to 0° to 90° of flexion at all times. In addition, patients had 20-lb flat-foot restrictions on the operative side for a minimum of 2 weeks if labral debridement or repair had been performed. Alternatively, if labral reconstruction, gluteus medius repair, or capsular plication in the setting of borderline dysplasia had been performed, the weight-bearing restrictions were extended for a total of 6 weeks. Following a microfracture procedure for articular cartilage injury, weight-bearing restrictions were further extended to 8 weeks. The authors' protocol included patients' beginning physical therapy on the first postoperative day to initiate range of motion. This was accomplished via a continuous passive motion device 4 hours daily or a stationary bike 2 hours daily.

End Points

Total hip arthroplasty, a hip-resurfacing procedure, or revision hip arthroscopy during the study period were defined as end points.

Statistical Analysis

The simultaneous evaluation of 20 procedures and 4 demographic variables vs the event rate was performed using a Cox proportional hazards regression model. Variable selection under this model was made using both best subset regression and minimum Akaike information criterion search using all 24 variables as candidates for retention into the model. Linearity between the (log) rate and age or (log) rate and BMI was assessed using restricted cubic splines. In addition, a binary recursive tree model was also investigated to identify the subset of simultaneously important predictors. For these multivariable models, Harrell's C-statistic is reported as a measure of accuracy and ranges from 0.50 (worst) to 1.0 (best-perfect accuracy).

Overall risk was estimated using the Kaplan–Meier ("survival curve") method. Event rates per 1000 person-months of follow-up were reported along with the HR for each of the 24 potential predictors, including the 20 procedures.

Table 1

Patient Demographics

Characteristic	Value
Sex, male:female, No.	471:778
Laterality, right:left, No.	672:577
Age at surgery, mean±SD (range), y	38.7±11.4 (18.0-60.0)
Body mass index, mean±SD (range), kg/m^2	26.4±5.3 (16.3-48.9)
Workers' compensation, No.	108 (8.7%)
Follow-up, mean±SD (range), mo	50.2±21.0 (24.0-111.9)
Revision arthroscopy, No.	124 (9.9%)
Time to revision, mean±SD (range), mo	21.7±17.4 (0.10-83.3)
Conversion to total hip arthroplasty, No.	122 (9.8%)
Time to total hip arthroplasty, mean±SD (range), mo	35.3±24.3 (1.4-95.2)

Results

Demographics

Of the 2889 hip arthroscopies conducted during the study period, 1521 met inclusion criteria and were eligible for follow-up. Of the 1521 eligible hips, follow-up was obtained for 1118 patients (1249 hips; 81.7%). Of these patients, 471 (37.7%) were male and 778 (62.3%) were female. The patient cohort had a mean age of 38.7 years (range, 18.0-60.0 years) and a mean BMI of 26.4 kg/m^2 (range, 16.3-48.9 kg/m^2). A total of 108 (8.7%) patients had workers' compensation status (**Table 1**). Mean follow-up for the cohort was 50.2 months (range, 24.0-111.9 months). One hundred twenty-two (9.8%) patients converted to THA at a mean of 35.3 months (range, 1.4-95.2 months). One hundred twenty-four (9.9%) patients underwent revision hip arthroscopy at a mean of 21.7 months (range, 0.10-83.3 months).

Table 2

Intraoperative Findings

Finding	No.
Seldes-defined labral tear	
Type 1	440 (35.2%)
Type 2	359 (28.8%)
Combined types 1 and 2	450 (36.0%)
Acetabular labrum articular disruption grade	
0	143 (11.5%)
1	339 (27.1%)
2	361 (28.9%)
3	309 (24.7%)
4	97 (7.8%)
Acetabular Outerbridge grade	
0	179 (14.3%)
1	356 (28.5%)
2	325 (26.0%)
3	230 (18.4%)
4	159 (12.8%)
Femoral head Outerbridge grade	
0	994 (79.6%)
1	13 (1.0%)
2	81 (6.5%)
3	90 (7.2%)
4	71 (5.7%)

Intraoperative Findings and Procedures

Each arthroscopic surgery began with a diagnostic arthroscopy to assess the chondral health of the operative hip (**Table 2**). Most of the patients in this study had a femoral head Outerbridge grade of 0 (79.6%). Following the diagnostic arthroscopy, the treating surgeon often performed several concomitant procedures for reported painful hip symptoms and to restore normal anatomy (**Table 3**). All patients underwent labral treatment for their labral tears. In this study, 806 (64.5%) patients underwent simple repair, 362 (29.0%) patients received a

Table 3

Intraoperative Procedures

Procedure	No. (%)
Labral treatment	
Simple repair	806 (64.5%)
Reconstruction	56 (4.5%)
Resection	25 (2.0%)
Debridement	362 (29.0%)
Capsular treatment	
Release	622 (49.8%)
Repair	617 (49.4%)
None	10 (0.8%)
Ligamentum teres debridement	391 (31.3%)
Femoroplasty	1073 (85.9%)
Acetabuloplasty	895 (71.7%)
Iliopsoas fractional lengthening	481 (38.5%)
Iliopsoas bursectomy	259 (20.7%)
Loose body removal	188 (15.1%)
Trochanteric bursectomy	158 (12.7%)
Acetabular chondroplasty	155 (12.4%)
Acetabular microfracture	137 (11.0%)
Synovectomy	118 (9.5%)
Notchplasty	105 (8.4%)
Femoral head chondroplasty	58 (4.6%)
Femoral head subchondral cyst decompression	57 (4.6%)
Gluteus medius repair	53 (4.2%)
Acetabular subchondral cyst decompression	48 (3.8%)
Iliotibial-band release	30 (2.4%)
Subspine decompression	27 (2.2%)
Femoral head microfracture	24 (1.9%)

labral debridement, 25 (2.0%) patients underwent labral resection, and 56 (4.5%) patients underwent labral reconstruction. Capsular treatment was uniformly split between release (49.8%) and plication (49.4%) procedures. In addition to these more prevalent procedures, procedures such as IT-band release, subspine (anterior inferior iliac spine) decompression, and femoral head microfracture were performed with much less frequency.

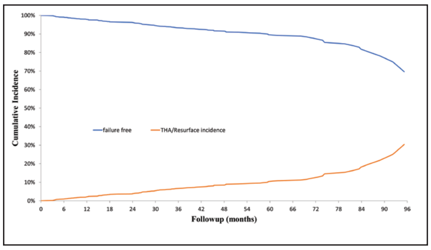

Figure 1: The cumulative incidence curve for total hip arthroplasty (THA) after hip arthroscopy for labral treatment.

Multivariate Analysis—THA

Figure 1, generated using the Kaplan–Meier method, shows the overall cumulative event incidence/risk for this cohort. At 48 months, the median follow-up time, the estimated THA/resurface incidence was 8.3%. A proportional hazards model was fit to discern the best variable(s) for predicting a patient's conversion to either THA or resurfacing. Of the 24 potential predictors, 5 were identified as simultaneously significant: age at date of surgery ($P<.05$), BMI ($P<.05$), labral debridement ($P=.03$), trochanteric bursectomy ($P<.05$), and notchplasty ($P<.05$), with trochanteric bursectomy (HR, 0.367; $P<.05$) identified as associated with higher survivorship. The remaining 19 variables did not increase the accuracy of the model or account for a significantly increased amount of the variation in the event rate, which, in this study, was conversion to either THA or a resurfacing procedure. These 5 variables provided a C-statistic of 0.773, compared with a C-statistic of 0.780 when all 24 variables were included in the model.

Table 4 presents the final results based on a Cox model for conversion to THA, including HRs for the 5 most predictive variables. For age, the HR of 1.06 implies that, controlling for the other 4 variables in the model, the event rate increased 6.0% for every 1-year increase in age. The HR of 2.13 for notchplasty implies that, controlling for the other variables, the event rate was 2.13 times higher for those with notchplasty compared with those without notchplasty. The HR of 0.37 for trochanteric bursectomy implies that, controlling for all else, the event rate for those with trochanteric bursectomy was 63% lower than that for those without trochanteric bursectomy. Finally, the HR of 1.56 for labral debridement suggests that, when controlling for all other variables, those patients who underwent this procedure had a conversion to THA that was 1.56 times higher than that of those who received labral repair, labral reconstruction, or labral resection.

Controlling for the other variables, the association of BMI with HR was nonlinear. **Figure 2** demonstrates that the HR increased as BMI increased until BMI of 33 kg/m^2, when the HR was 1.48 (relative to the mean BMI of 26.4 kg/m^2). After this, the HR decreased slightly.

Multivariate Analysis—Revision

Following the analysis of the variables associated with conversion to THA, a multivariate analysis was performed to elucidate the study population's incidence of revision arthroscopy. At the median follow-up of 42 months, the estimated incidence of revision surgery was 9.4%. **Figure 3** shows the overall cumulative event incidence.

Similar to the THA analysis discussed above, a proportional hazards model was conducted to uncover the best variable(s) for predicting a patient's receiving a second arthroscopy. Age at date of surgery ($P<.05$), workers' compensation ($P<.05$), capsular management repair ($P<.05$), femoral head chondroplasty ($P=.05$), and femoral head microfracture ($P=.04$) were identified as simultaneously significant, with age at date of surgery (HR, 0.973/y; $P<.05$) and femoral head chondroplasty (HR, 0.241; *P*=.05) associated with higher survivorship. The C-statistic for the authors' revision model was 0.678, compared with a C-statistic of 0.699 when all variables were included in the model. Thus, the 5 variables found to be significant comprised the majority of the impact in revision factor likelihood as their cumulative score nearly matched that of all of the others combined.

Regarding age, the HR of 0.973 suggested that, controlling for the other 4 variables in the model, the event rate decreased 2.7% for every 1-year increase in age. The HR of 3.35 for workers' compensation status meant that the event rate was more than 3 times higher for those with workers' compensation status compared with those without workers' compensation status when controlling for the other variables. The HR of 1.95 for capsular management (repair) implied that, controlling for all else, the revision surgery rate in this category was approximately twice as high as that for patients who underwent a capsular release or capsulotomy. The femoral head chondroplasty HR of 0.24 indicated that those patients who underwent this procedure had a 76% lower revision rate than those who did not. Finally, an HR of 2.84 for femoral head microfracture proposed that, when controlling for all other variables, those patients who underwent this procedure had a revision surgery event rate almost 3 times higher than that of those who did not. **Table 5** contains complete Cox model results.

Table 4

Multivariable Cox Model for Conversion to Total Hip Arthroplasty

Variable	Hazard Ratio	Lower Confidence Interval	Upper Confidence Interval	*P*
Age (per year)	1.06	1.04	1.09	<.01
Trochanteric bursectomy	0.37	0.19	0.72	<.01
Notchplasty	2.13	1.32	3.40	<.01
Labral treatment (relative to repair)				
Debridement	1.56	1.05	2.32	.03
Reconstruction	1.74	0.74	4.06	.20
Resection	1.87	0.79	4.42	.15

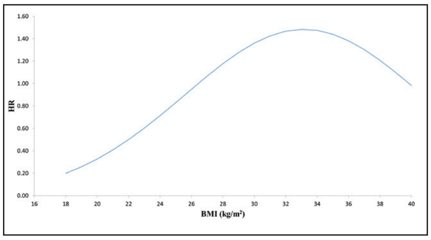

Figure 2: Multivariable model–based hazard ratio (HR) curve for total hip arthroplasty conversion surgery based on patient body mass index (BMI) following hip arthroscopy, controlling for age, trochanteric bursectomy, notchplasty, and labral treatment (Table 4).

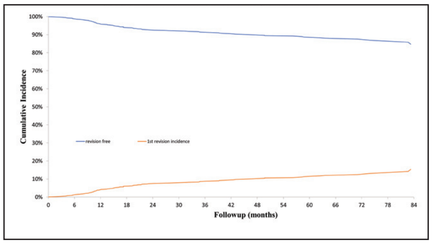

Figure 3: The cumulative incidence curve for revision surgery after hip arthroscopy for labral treatment.

Discussion

Hip arthroscopy has been shown to be effective in treating symptomatic labral tears, borderline dysplasia, and FAI.[4,18] Several studies have analyzed demographic and radiographic variables to predict outcomes, likelihood of revision arthroscopy, and conversion to THA.[5,7,9-11,19-22] However, to the current authors' knowledge, no study has analyzed intraoperative procedures as predictive variables. This multivariate model analyzed 20 procedural variables to assess predictability for conversion to THA or revision arthroscopy. When examining the THA model, the authors found the absence of trochanteric bursectomy, the presence of notchplasty, and the presence of labral debridement to be predictive procedural variables and increasing age and BMI to be predictive demographic variables. Their model for predictors of revision arthroscopy found capsular repair, the absence of femoral head chondroplasty, and the presence of femoral head microfracture to be procedural predictors of revision arthroscopy and decreasing age and workers' compensation status to be predictive demographic variables.

This patient cohort had a conversion to THA rate of 9.8% (122 cases) at a mean follow-up of 50.2 months. Several studies have examined risk factors for conversion to THA after hip arthroscopy. Herrmann et al[22] identified a joint space of less than 2 mm and a Kellgren–Lawrence grade of 3 as risk factors for THA.[18,23] The current study did not directly measure joint space or Kellgren–Lawrence grade; however, the authors did identify the necessity of notchplasty as a risk factor (HR, 2.13). Notchplasty is used to eliminate osteophytes within the acetabular fossa.[14] These osteophytes create a rough surface for central acetabular impingement and therefore damage the articular surface of the femoral head. Thus, patients experiencing hip pain with acetabular osteophytes may already have corresponding underlying chondral damage and a narrowed joint space predisposing them to the need for future THA.

McCarthy et al[20] identified increased acetabular Outerbridge grade, femoral Outerbridge grade, and sex as risk factors

Table 5

Multivariable Cox Model for Revision Surgery

Variable	Hazard Ratio	Lower Confidence Interval	Upper Confidence Interval	*P*
Age (per year)	0.97	0.96	0.99	.02
Workers' compensation	3.35	2.09	5.38	<.01
Capsular management (relative to release)				
Repair	1.95	1.31	2.91	<.01
None	1.19	0.16	8.70	.86
Femoral head chondroplasty	0.24	0.06	0.98	.05
Femoral head microfracture	2.84	1.03	7.82	.04

for conversion to THA and found labral tears to have no influence. Redmond et al[21] found increasing age, lower preoperative scores, decreased femoral anteversion, revision surgery, increased femoral Outerbridge grade, performance of acetabuloplasty, and lack of performance of femoral osteoplasty to be risk factors for THA.[10,22] The current study also found increasing age at the time of surgery to be a risk factor (HR, 1.064) for conversion to THA. The current study differs in that the authors did not find acetabuloplasty or femoral osteoplasty to be significant risk factors for THA, when controlling for other significant factors. However, they did find the presence of trochanteric bursectomy and labral repair to be negative predictors for THA. Arthroscopic trochanteric bursectomy is used to treat recalcitrant trochanteric bursitis and leads to good results.[24] Thus, if patients undergoing hip arthroscopy are experiencing symptoms from inflamed bursa and trochanteric bursitis, then symptomatic relief with bursectomy should prevent a missed abductor injury or inflammatory bursitis that could continue an antalgic or altered gait. The current study also identified labral repair as a negative predictor of THA when compared with labral debridement (HR, 1.558; *P*=.0290 for debridement). Labral reconstruction (HR, 1.740; *P*=.204) and labral resection (HR, 1.870; *P*=.154) were not statistically significant relative to repair, but they were in the direction of higher risk. This is similar to a study conducted by Degen et al,[25] but differs from predictive studies conducted by McCarthy et al,[20] Redmond et al,[21] and Menge et al,[24] perhaps due to their smaller cohorts of 106, 792, and 145, patients, respectively. The current study appears to be unique for having found labral debridement to be a predictor for conversion to THA, whereas numerous studies comparing patient outcomes of labral repair vs debridement have had mixed results.

Kester et al[10] examined 3957 patients in the New York State Planning database and found that age older than 60 years, index procedure performed by a low-volume surgeon, female sex, and obesity (BMI >30 kg/m^2) were risk factors for THA. Perets et al[26] conducted a study of obese patients (BMI >30 kg/m^2) matched to non-obese patients at a minimum of 5 years and found that obese patients had a twofold increased risk of conversion to THA. This contrasts with a prior study from the same group that found no difference in conversion rates at minimum 2-year follow-up, indicating the deleterious effect of obesity beyond the short term.[27] The current model found the association of BMI to be non-linear. **Figure 2** shows that the HR for the authors' conversion to THA model increased as BMI increased until BMI was 33 kg/m^2 (HR, 1.48). After this, the HR decreased slightly. This may have been due to activity levels decreasing after BMI reached a certain point.

In the current cohort, 124 patients (9.9%) underwent revision surgery at a mean of 21.7 months. Numerous studies have examined risk factors for revision arthroscopy after primary hip arthroscopy.[10,11,25,28-30] Like previous studies, the current revision cohort was younger (mean age, 35.25 years) and female (70.8%). Degen et al[25] analyzed 7836 patients from The Statewide Planning and Research Cooperative System database in New York and found revision arthroscopy for 311 patients (3.8%) at a mean of 1.7 years. Regression analysis of this cohort revealed that age older than 50 years and osteoarthritis were significant risk factors. Labral repair and high-volume centers were associated with a lower reoperation rate. The current study found age to have a small but decreasing effect as a risk factor for revision arthroscopy (HR, 0.973/y), consistent with several previous studies.[8,29,31] The current authors postulated that residual intra- or extra-articular pathology suggesting subtle bony deformities or multiple pathologies causing hip pain led patients to present to their clinic at a younger age. Studies have shown that patients with workers' compensation claims have inferior outcomes; however, the current study showed that workers' compensation was a risk factor for revision surgery as well (HR, 3.352).[32,33]

Prior authors have concluded that persistent intra-articular pathology, including FAI, is a leading cause of revision in up to 95% of cases.[29] The multivariate analysis of the current study found femoral head chondroplasty, to eliminate osteochondral lesions on the femoral head, to be a negative predictor for revision arthroscopy (HR, 0.241). The authors' institution uses the femoral head Outerbridge grade to assess chondral lesions. Although this study did not incorporate non-procedural data into the model, a chondroplasty is generally performed for Outerbridge grades 3 and 4 where there is fissuring to the level of subchondral bone, or subchondral bone is exposed. This is done to decrease the possibly of chondral injury propagation. Patients with an Outerbridge grade of 3 or 4 made up 12.9% of the cohort.

Effective use of intraoperative radiographs can be helpful for identifying subtle bony morphology. Restoration of normal anatomy is imperative to reduce FAI and intra-articular impingement to prevent reinjury, including labral tears. In some cases, intraoperative chondral lesions may be severe, and microfracture may be performed during the primary surgery with the intention of stimulating type 1 collagen scar formation, which can act as a buffer for the articulating joint line. Microfracture has been associated with high rates of revision arthroscopy and THA.[34-36] The current model identified microfracture of the femoral head as a risk factor for revision hip arthroscopy (HR, 2.844) but did not associate femoral head microfracture with THA. An explanation for this finding may be twofold. First, if microfracture was performed along the femoral head, presumably the overall health of the joint was deemed amenable to hip preservation. Therefore, the attempt to form scar cartilage over a smaller, ideally less than 1 cm^2, region is made to salvage the native joint line, thereby prolonging the need for total joint arthroplasty. In other words, the procedure is working as designed and delaying the need for THA in the setting of chondral damage. If, however, the joint was deemed un-salvageable, then microfracture would not be performed and a future procedure for that particular hip would likely be reconstruction. Capsular treatment comparing repair, plication, or no treatment has been debated extensively with mixed results.[37,38] The current study found capsular repair to be a risk factor for revision arthroscopy (HR, 1.950). The advancements in capsular techniques (ie, capsular plication in an effort to manage various intra- and extra-articular pathologies such as borderline dysplasia and generalized ligamentous laxity) have been implemented extensively in this cohort because the authors' institution is a major referral center for patients who have failed conservative and nonoperative management. Additionally, this cohort was treated by a single surgeon specializing in complex hip preservation, and capsular techniques are often implemented to augment both dynamic and static instability states such as chondro-labral deficiency borderline hip dysplasia and iliopsoas pathology. This study's findings underscore the importance of the capsular ligaments as a static stabilizer of the hip and highlight the concerns of proper management, in an individualized manner. No two hips are the same. Both preoperative and intraoperative characteristics need to be factored into capsular management. Capsular repair as a risk factor for revision arthroscopy may be explained by the need for expanding indications of capsular plication, thereby reducing the incidence of possible postoperative microinstability, or even simple refinement of side-to-side repair techniques.

This study had several limitations. First, the authors focused exclusively on procedures as predictors of surgical end points (conversion to THA or revision arthroscopy). A more comprehensive model would include radiographic variables, demographic information, intraoperative findings, and outcome scores. The authors believe that their findings add insight into procedural predictors that can be used to set expectations during patient discussions in both the pre- and the postoperative setting. In this model, a patient undergoing notchplasty was more likely to convert to THA. This does not imply that surgeons should abstain from performing notchplasty; rather, it is an indication that extensive chondral damage on the articular surface has perhaps already occurred. Second, mean follow-up for the current cohort was 50.2 months. This should ideally be longer when looking for predictors of conversion to THA and revision. However, this model can be used as an early predictor for revision or conversion to THA. Third, the models were not completely predictive. When the 5 statistically significant variables were included and when all 24 variables were included, the THA model had a C-statistic of 0.773 and 0.780, respectively, and the revision model had a C-statistic of 0.678 and 0.699, respectively. Therefore, factors that the authors were unable to identify and incorporate into their model play a large role in predicting conversion to THA or revision arthroscopy. Fourth, this cohort represented a nonuniform group of patients undergoing hip arthroscopy. The authors attempted to use exclusion criteria and statistical methods to create more uniformity. A more focused model may assist in the predictive value for an individual patient's circumstances.

Conclusion

Twenty procedural variables were analyzed to assess conversion to THA or revision arthroscopy. This multivariate model found notchplasty and labral debridement to be predictive of THA and trochanteric bursectomy to be associated with increased survivorship, whereas capsular repair, absence of femoral head chondroplasty, and presence of femoral head microfracture were shown to be predictive for revision arthroscopy with age at time of surgery and femoral head chondroplasty associated with increased survivorship. Numerous factors affect the outcomes of hip arthroscopy. Understanding the risk factors for conversion to THA or revision is paramount during discussions with patients.

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