Survivorship Following Hip Arthroscopy: Lessons Learned from a Comprehensive Database

Joseph J. Ruzbarsky¹ · Rui Soares² · Adam Johannsen¹ · Marc J. Philippon^{1,2}

Published online: 6 May 2020
© Springer Science+Business Media, LLC, part of Springer Nature 2020

Abstract

Purpose of Review Hip arthroscopy and its indications continue to expand. Understanding the durability of hip arthroscopic procedures remains important not only for counseling patients, but also for determining the success of certain procedures or in certain populations. Survivorship is defined as the proportion of hip arthroscopy patients who have not yet gone on to periacetabular osteotomy (PAO), total hip arthroplasty (THA), and/or revision surgery. The purpose of this review is to summarize the recent literature pertaining to survivorship after certain hip arthroscopic procedures and certain special populations.

Recent Findings There is yet to be level 1 evidence published with relation to survivorship following hip arthroscopy. The best evidence in the recent literature is contained in just a few long-term prospective studies demonstrating good to excellent survivorship following hip arthroscopy for femoroacetabular impingement (FAI). Unfortunately, the follow-up for other conditions treated by hip arthroscopy is more limited.

Summary In summary, hip arthroscopy indications continue to expand. The most common indication for surgery is FAI, and its recently published long-term survivorship demonstrates excellent durability. Other hip arthroscopic procedures, including labral reconstruction, adjunctive procedures such as capsular closure, and special populations such as athletes, also demonstrate excellent survivorship in shorter term follow-up. Further prospective research is needed to further define survivorship of various hip conditions, associated procedures, and special populations commonly treated with hip arthroscopy.

Keywords Hip pain · Hip arthroscopy · Survivorship · Revision hip arthroscopy · Total hip arthroplasty · Femoroacetabular impingement

Introduction

There has been over a 700% increase in hip arthroscopy from 2003 to 2013 in England alone and this rate continues to rise in the developed world [1•]. Failure rates, defined as conversion to total hip arthroplasty (THA) or revision arthroscopy, have been reported to be anywhere from 1 to 50% [2••]. A large systematic review that included over 6000 patients and 92 studies reported a pooled reoperation rate of 6.3% with 2.9% of reoperations being conversions to THA [3].

Fortunately, although a tangible risk of conversion to THA exists, early retrospective data have not revealed an increased risk in complications of the eventual THA [4•].

As surgical volume increases and new techniques and refinements become popularized, it remains as important as ever to continue to closely monitor surgical outcomes. This includes survivorship to ensure such adaptations and refinements are improving patient care. The goal of this article is to provide the most recent updates in evidence-based medicine with regard to survivorship following hip arthroscopy. This review will focus primarily on articles published in the last 5 years. This timeframe was chosen since the indications and surgical techniques including labral repair/reconstruction and capsular management have evolved, and older studies may not be as relevant in terms of survivorship. Unfortunately, there is yet to be level 1 evidence pertaining to survivorship following hip arthroscopy; however, there are several recently published mediums to long-term follow-up studies reporting on patients using prospectively collected patient information, which provides high-quality evidence. Although survivorship

This article is part of the Topical Collection on *Outcomes Research in Orthopedics*

✉ Marc J. Philippon
drphilippon@sprivaail.org

¹ The Steadman Clinic and United States Coalition for the Prevention of Illness and Injury in Sport, Vail, CO, USA

² Steadman Philippon Research Institute, 181 W Meadow Dr, Ste 400, Vail, CO 81657, USA

is determined by several different endpoint variables such as recurrent surgery, conversion to total hip arthroplasty (THA), and periacetabular osteotomy (PAO), the review will detail which endpoint is used in each specific study. Furthermore, to improve comprehension and readability, the included studies will be best grouped according to length of follow-up, surgical indication, and specific population.

Femoroacetabular Impingement: Long-term Survivorship (Table 1)

Femoroacetabular impingement (FAI) is the most common indication for hip arthroscopy and, expectedly, it has the most evidence and longest term results pertaining to survivorship. In 2017, Menge et al. [5•] published the largest long-term study on hip arthroscopy. The authors reported on survivorship of labral debridement, when compared with repair for treatment of FAI with symptomatic labral tears, at a mean follow-up of greater than 10 years. Their cohorts included 79 patients who underwent labral repair and 75 who underwent labral debridement with a follow-up rate of 94%. The authors treated small labral tears or those with multiple cleavage planes insufficient for repair with debridement alone and repaired all others. At final follow-up, both groups demonstrated increased patient reported outcome measures (PROMs) from preoperatively to final follow-up; however, no differences in any PROMs were identified between the two groups. When controlling for microfracture, those patients undergoing labral debridement were at higher risk for conversion to THA at final follow-up. The overall survivorship when defined as conversion to THA at final follow-up was 66%. Independent risk factors associated with conversion to THA were determined to be increasing age (51 versus 31 years old), radiographic joint space less than 2 mm, and microfracture at the time of surgery.

A database study out of the UK [6] reviewed all hip arthroscopies performed under the National Health Service from 2005 to 2013. Data was available for 87.8% of patients. The mean patient age at the time of surgery was 38 years and the median follow-up was 2.4 years (range, 0.5–8.2 years). The authors only tracked conversion to THA as a survivorship outcome and reported a rate of 10.6%. Those who underwent a THA had an average older age 48 years versus 37 years. Males had an 87% survivorship at 8 years, while females had only an 80%.

Femoroacetabular Impingement: Medium-term Survivorship (Table 2)

Gupta et al. [7•] report on a large series of patients undergoing hip arthroscopy by a single surgeon. Indications were primary

hip arthroscopies for any reason excluding patients with Tonnis grades greater than 2, those with prior acetabular fractures, avascular necrosis (AVN), pigmented villonodular synovitis (PVNS), Legg-Calve-Perthes (LCP) disease, or Ehlers-Danlos syndrome. The most common indication for surgery was FAI. Surgical techniques and interventions performed varied but when indicated included bony resections, labral debridements/repairs/reconstructions, microfracture in the setting of full-thickness chondral defects, iliopsoas fractional lengthening in the setting of internal snapping hips, or greater trochanter bursectomy with or without abductor repairs in the setting of bursitis and abductor tears. Capsular closures were performed in all cases if indicated. Five hundred ninety-five patients were included with a minimum follow-up of 2 years. The average age was 38 years. Fifty-four patients (9.1%) underwent conversion to arthroplasty while 47 patients (7.7%) underwent revision arthroscopy most commonly for labral re-tearing. The total reported survivorship was 83.2%.

Hevesi et al. [8•] report on a multicenter series of patients (including the previous series) undergoing hip arthroscopy with labral repair with a minimum of 5-year outcomes. Patients with labral debridement, labral reconstruction, and previous hip surgery were excluded from analysis. The series included 4 centers with 5 surgeons. Other than labral repairs, bony resections, psoas releases, and capsular closures were performed when clinically indicated. A total of 303 patients were included in the analysis. FAI was the most common indication for surgery. Total survivorship was 83.8% with 38 patients undergoing revision hip arthroscopy, 1 undergoing a PAO, and 9 undergoing arthroplasty.

Domb et al. [9•] reported on 64 hips who underwent the lead author's described labral base repair which represented a follow-up rate of 85.7%. In this study, the surgical technique included a transverse interportal capsulotomy in all cases. Additional procedures performed included acetabuloplasty, femoroplasty, ligament teres debridement, iliopsoas fractional lengthening, loose body removal, trochanteric bursectomy, microfracture, and gluteus medius repairs. Survivorship was 73.4% at final follow-up with 17.2% undergoing revision arthroscopy and 9.4% converted to THA.

Hufeland et al. [10•] report on a series of the senior author's first 50 patients undergoing hip arthroscopy for FAI. The operative technique within this cohort was relatively primitive with osteochondroplasty performed if indicated, no capsulotomy, and sometimes including a pincer resection with labral debridement. At an average follow-up of 66.3 months, an 88% follow-up rate was achieved. The authors did not mention the rate of revision arthroscopies but 5/44 (11.4%) underwent conversion to THA. Risk factors for conversion included older age and greater preoperative OA as measured by Kellgren and Lawrence (KL) score.

Chen et al. [11•] report on a single surgeon's experience with patients with FAI undergoing selective labral

Table 1 Summary femoroacetabular impingement: long-term survivorship

Study characteristics		Sample characteristics		Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Study (first author, year)	Arthroscopic intervention	Sample size	Sex					
Malviya (2015)	FAI	6395 (database)	Male, 2381 Female, 4014	38 years	2.4 years (0.5–8.2 years)	10.6% males, 87% at 8 years Females, 80% at 8 years	286 patients (4.5%) with mean 1.7 years 4 patients (0.06%) within 1 month	680 patients at mean of 1.4 years
Menge (2017)	FAI	79 labral repair or 75 labral debridement	Male debridement, 31 Female debridement, 44 Male repair, 49 Female repair, 30	Debridement, 41 Repair, 41	Greater than 10 years	66%	7 (4.5%), Two in debridement group and 5 in repair group	50 (34%) within 10 years

FAI femoroacetabular impingement; NR not reported; THA total hip arthroplasty

debridements. They chose to exclude patients with Outerbridge grade 4 wear, Tonnis grade > 2, workers' compensation claims, previous hip conditions, severe dysplasia (LCEA < 18°), or previous ipsilateral hip surgery from their analysis. Additionally, matching was performed on a subpopulation of 69 patients. These were matched 1:1 with patients undergoing labral repair based on several factors including age $\pm$ 5 years, body mass index (BMI) $\pm$ 5 kg/m², sex, and Seldes tear type. In the labral debridement cohort, 101 patients were included with follow-up of greater than 5 years which represented a follow-up rate of 80.8%. According to the authors, "patients with a stable labral base, at least 4 mm of the labral width, small focal tears with minimal intrasubstance involvement, and most importantly, enough stable labral tissue to maintain the suction-seal function were treated with (labral debridement) to remove any defects while maintaining as much of the stable labrum as possible." Additional procedures when indicated included bony resections, capsular repair, iliopsoas lengthening, trochanteric bursectomy, microfracture, and gluteus medius repair. As for survivorship in the full debridement cohort, 4% underwent revision arthroscopy and 13.9% were converted to THA for a cumulative survivorship of 82.1%. Risk factors for conversion to arthroplasty included greater age (average age 54 versus 42 years old at the time of surgery) and femoral head Outerbridge lesions > 2. In the matched cohort subgroup, there were no differences in rate of subsequent arthroscopy or arthroplasty.

Mild Osteoarthritis (Table 3)

Domb et al. [12••] report on their institution's series of patients with FAI and labral tears in addition to Tonnis grade 1 radiographic changes representing the first stages of osteoarthritis with a minimum follow-up of 5 years. Exclusion criteria included workers' compensation claims, Tonnis grade > 2, and previous hip conditions (ipsilateral surgery, SCFE, AVN, and dysplasia). Two hundred ninety-two total hips were included which represented a follow-up rate of 82%. A subgroup of 62 of these were matched 1:1 with patients with Tonnis grade 0 radiographic findings based upon age $\pm$ 5 years, BMI $\pm$ 5 kg/m², sex, type of labral treatment (repair, resection, selective debridement, and reconstruction), and type of capsular treatment (release versus closure). Additional procedures when indicated included bony resections, capsular repair, iliopsoas lengthening, trochanteric bursectomy, microfracture, and gluteus medius repair. Not unsurprisingly when defining survivorship as conversion to THA or revision hip arthroscopy, the total survivorship was lower in the Tonnis grade 1 cohort (69.4%) as compared with the Tonnis 0 cohort (88.4%).

Table 2 Summary femoroacetabular impingement: medium-term survivorship

Study characteristics		Sample characteristics						
Study (first author, year)	Additional arthroscopic interventions	Sample size	Sex	Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Chen (2018)	N/A	101	Male, 26 Female, 75	44	5 years	82.10%	4 (4.0%)	14 (13.9%)
Domb (2018)	Transverse interportal capsulotomy	64	Male, 17 Female, 47	28.9	85.7	73.40%	17.20%	9.40%
Gupta (2016)	N/A	595	Male, 228 Female, 367	38 years	2 years	83.2% including revision arthroscopy	47 (7.7%)	54 (9.1%) THA or hip resurfacing procedure
Hevesi (2018)	Labral tears, chondral injuries, and FAI that had failed nonoperative management	303	Male, 101 Female, 202	32 years	5.7 years	83.80%	49 (16.2%)	7 THA, 2 hip resurfacing, 1 PAO alone, 1 revision arthroscopy followed by PAO

N/A not applicable; THA total hip arthroplasty; PAO periacetabular osteotomy

Capsular Closure (Table 4)

Management of the intraoperative capsulotomy has recently evolved both with regard to type and extent of capsulotomy, and also with regard to its closure. Recent evidence has still remains inconclusive regarding routine capsular closure [13•]. Capsular plication was the focus of a recently published large series from a single surgeon consisting of over 1000 patients undergoing hip arthroscopy for FAI [14•]. Surgical technique included labral debridement, repair, or reconstruction in addition to capsular closure. At a minimum of 2 years postoperatively, the follow-up rate was 86.6%. At final follow-up, 10.3% underwent revision arthroscopies and 6.4% underwent conversion to hip arthroplasty for a total survivorship of 83.3%.

Domb et al. [15•] performed a matched comparison study examining capsular closure, including patients with a minimum of 5-year follow-up who underwent labral repair surgery by a single surgeon. Minimum 5-year follow-up was obtained for 82.5% of patients. Surgical techniques included a transverse interportal capsulotomy in all cases in addition to an acetabuloplasty, femoroplasty, ligament teres debridement, iliopsoas fractional lengthening, loose body removal, trochanteric bursectomy, microfracture, and gluteus medius repairs. A subgroup of 65 patients who underwent capsular repair were matched 1:1 based upon age, gender, worker's compensation, body mass index, and acetabular coverage. As for survivorship, conversions to arthroplasty rates were 18.5% in the capsulotomy group versus 10.8% in the repair group. However, the rate of revision arthroscopy was the same in both groups (15.4%).

Nho et al. [2••] report on his experience with survivorship following hip arthroscopy for FAI with capsular closure. At a minimum 2-year follow-up, they report on an 80.5% follow-up rate of surgeries performed by a single surgeon using their institution's comprehensive database. These authors report an excellent overall survivorship of their cohort (96.4%) with failures defined as revision hip arthroscopy or conversions to THA. Risk factors for clinical failure included lower preoperative International Hip Outcome Tool score (iHOT), chronic preoperative pain, and chondromalacia seen at the time of arthroscopy.

Advanced Age (Table 5)

Age is a well-known risk factor for conversion to arthroplasty due to the obvious confounder of increased joint wear, but understanding which patients with advanced age that can experience durable benefits of hip arthroscopy remains a high priority and focus of recent research. Domb et al. [16] completed an interesting retrospective cohort study which compared a group of patients 50 years of age or older undergoing

Table 3 Summary of mild osteoarthritis

Study characteristics		Sample characteristics					
Study (first author, year)	Indication	Sample size	Sex		Age (years)	Follow-up (months)	Survivorship (conversion to THA)
Domb (2017)	FAI in the setting of mild osteoarthritis	292	Male	Tonnis Grade 0, 48 Male Tonnis Grade 1, 40 Female Tonnis Grade 0, 159 Female Tonnis Grade 1, 45	Tonnis Grade 0, 34.2 Tonnis Grade 1, 43.8	Tonnis Grade 0, 69.3 Tonnis Grade 1, 72.1	Tonnis Grade 0, 88.4% Tonnis Grade 1, 69.4%

FAI femoroacetabular impingement; THA total hip arthroplasty

hip arthroscopic treatment of FAI and compared survivorship and PROMs with a matched cohort aged 30 years or younger with a minimum of 2-year follow-up. In addition to the bony resections, all patients had either a labral repair or debridement, and the management of the capsulotomy was not mentioned. At final follow-up, there was no difference in PROMs but the authors did find that overall survivorship defined as revision hip arthroscopy or arthroplasty in the greater than 50-year-old cohort was 82.7% compared with 98.1% in the younger cohort.

Four years later, the same group published two additional studies focused on the topic of age and hip arthroscopy. In the first [17•], they focus on hip arthroscopy performed for FAI in patients older than 50 years old. This series included 94 patients who underwent bony resections for FAI in addition to a combination of labral repairs, debridements, reconstructions, or resections depending upon the senior author's discretion. There was no mention of treatment of the capsulotomy management. A total of 91.3% patients met the minimum of the 5-year follow-up threshold. The overall survivorship (only accounting for conversions to THA) was 72.3% with higher BMI, larger alpha angles (AA), smaller LCEA, Tonnis grades greater than 1, and femoral and acetabular Outerbridge grades greater than 2 as predictors of conversion to THA.

Several months later, the same group published the institution's experience in patients younger than 50 years old [18•]. Three hundred twenty-seven patients were available for minimum 5-year follow-up (80.3%). The mean age at surgery was 32.4 years. Thirty-eight hips (11.6%) went on to require repeat arthroscopy, while 25 (7.6%) converted to THA for a cumulative survivorship of 80.8%. Risk factors for undergoing revision hip arthroscopy included female sex, obesity, lower preoperative PROMs, and those not undergoing a capsular release. Risk factors for conversion to THA included BMI, greater age, Outerbridge grade 2 or greater on the acetabulum and/or femoral head, higher AAs, those having undergone a capsular release with labral debridement, and those with lower preoperative PROMs.

Capogna et al. [19•] report on their institution's experience of hip arthroscopy in the setting of FAI in a slightly older cohort of patients: those greater than 60 years old. At a minimum of 2-year follow-up, they report on 42/46 patients (91.3%). Labral repairs were performed in all cases and the authors did not mention capsular management. The overall survivorship defined as revision arthroscopy or THA was very high, 88.9%, with no reported specific risk factors for this conversion.

Table 4 Summary of capsular closure

Study characteristics		Sample characteristics					
Study (first author, year)	Arthroscopic intervention	Sample size	Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Domb (2014)	Capsular closure or repair	65	Unrepaired capsulotomy, 37.3 Repaired capsule, 36.8	Unrepaired capsulotomy, 75.7 Repaired capsule, 64.8	Unrepaired capsulotomy, 81.5% Repair group, 89.2%	Same for both groups, 15.4%	Unrepaired capsulotomy, 18.5% Repair group, 10.8%
Domb (2017)	Capsular plication	19 patients (21 hips)	22.9 years	68.8 months	NR	4 (19%)	0
Nho (2019)	NR	935	33.3 years	2 years	96.40%	23 (2.5%)	11 (1.2%)

NR not reported; THA total hip arthroplasty

Table 5 Summary of advanced age

Study characteristics		Sample characteristics				
Study (first author, year)	Arthroscopic intervention	Sample size	Sex	Age (years)	Follow-up (months)	Survivorship (conversion to THA)
Capogna (2016)	FAI to older age	42	Male, 8 Female, 34	65.8 years	2 year	88.90%
Domb (2015)	FAI to older age	52	Male, 18 Female, 34	Study group, 54.8 years Control group, 20.3 years	32 months	Stated on conversion to THA
Perets (2018)	Labral tears in older age	94	Male, 42 Female, 52	55.2 years	70.1 months	72.30%
Perets (2019)	FAI to older age	327 hips (295 patients)	Male, 108 Female, 219	32.4 years	5 years	80.80%
						Conversion to THA
						Older cohort (study group), 82.7%
						Control group, 98.1%
						2 (4.7%)
						Study group, 8 (15.4%)
						Control group, 2 (3.8%)
						4 (4.3%)
						26 (27.7%)
						25 (11.6%)

FAI femoroacetabular impingement; THA total hip arthroplasty

Labral Reconstruction (Table 6)

As of 2014, there has been very limited evidence for labral reconstruction. A systematic review [20] consisting of 5, mostly retrospective studies, tallied only 128 total patients. The cumulative survivorship in this cohort was 73.4%, which was defined as conversion to THA. The largest study contained in this systematic review was performed by Geyer et al. [21] This group reports on the senior author's experience with survivorship following labral reconstruction using iliotibial band (ITB) autograft at midterm follow-up. At 3–5 years, 76 hips were reported on from a prospectively collected database excluding elite athletes and patients under the age of 18 years old. At a mean follow-up of 49 months, survivorship, defined those hips not undergoing conversion to arthroplasty, was 76%.

Another large case series of labral reconstructions using ITB allografts was published in 2016 [22•]. This series contained 131 hips at a minimum of 2-year follow-up representing an 86.2% follow-up rate. Different than many of the other published literature on labral reconstructions, 99/142 patients had not had previous surgery but rather primary labral reconstructions. At final follow-up, 9.9% of the hips underwent conversion to arthroplasty while 3.8% had revision arthroscopies for a cumulative survivorship of 86.3% at 2 years. Those patients having failed labral reconstruction tended to have lower mHHS scores, lower Lower Extremity Function Scores, and higher Visual Analog Pain Scores at rest and with activity. Furthermore, those who previously underwent an open surgery were at higher risk for labral reconstruction failure.

Chandrasekaran et al. [23•] report on a small series of 22 patients who underwent labral reconstruction with semitendinosis allograft or gracilis autograft. One hundred percent of the cohort was available for follow-up after 2 years. One had undergone conversion to THA, while 2/22 underwent revision arthroscopies for an 86.4% survivorship.

A smaller case control study [24] compared labral resection with labral reconstruction using gracilis autograft at a minimum of 2-year follow-up. Eleven patients who underwent reconstruction were matched according to preoperative Non-Arthritis Hip Score with 22 patients who underwent labral resection. At final follow-up, 1/11 patients in the reconstruction cohort had undergone revision arthroscopy, while 3/22 in the resection cohort had undergone revision arthroscopy. No patients in either cohort had undergone conversion to THA.

Domb et al. [25••] performed a cohort study comparing arthroscopic hip labral reconstruction with a labral repair control group. Patients were included in the study if they underwent hip arthroscopy for segmental labral reconstruction in the setting of irreparable labral tear and FAI, with minimum 5-year follow-up for mHHS, NAHS, HOS-SSS, patient satisfaction, and VAS for pain. Patients were excluded with Tonnis

Table 6 Summary of labral reconstruction

Study characteristics		Sample characteristics		Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Study (first author, year)	Arthroscopic intervention	Sample size	Sex					
Ayeni (2014)	Labral reconstruction	128	Male, 60% Female, 40%	32.5 years	Mean range of 10 through 49 months	73.40%	NR	NR
Chandrasekaran (2015)	Labral reconstruction	22	Male, 8 Female, 14	32.2	29.1	86.40%	1/22 (4.5%)	2/22 (9.1%)
Domb (2013)	Labral reconstruction	Reconstruction, 11 Labral resection, 22	Male reconstruction, 7 Female reconstruction, 4 Male resection, 14 Female resection, 8	Reconstruction, 33 years Resection, 38.8 years	Reconstruction, 2.2 years Resection, 2.5 years 67.2 months	NR	Reconstruction, 1/11 (4.5%) Resection, 3/22 (13.6%)	0
Domb (2019)	Labral reconstruction	23	Male, 11 Female, 12	35.2 years	49 months	69.60%	4 (17.4%)	3 (13.0%)
Geyer (2013)	Labral reconstruction	76	Male, 42 Female, 33	38.5 years	49 months	76%	NR	NR
White (2016)	Labral reconstruction	131	Male, 54 Female, 69	39 years	2 years	86.30%	3.80%	9.90%

NR not reported; THA total hip arthroplasty

osteoarthritis grade > 1, prior hip conditions, or workers' compensation claims. A total of 23 patients were included in the study with a mean age of 35.2 years and mean follow-up of 67.2 months. Interestingly out of these 23 patients, 4 (17.4%) underwent revision hip arthroscopy and 3 (13.0%) underwent conversion to hip arthroplasty. Furthermore, this corresponds to an overall survivorship of 69.9%.

Revision Hip Arthroscopy (Table 7)

Ricciardi et al. [26•] reviewed all causes of revision surgery from their institution's prospective hip preservation registry. Over the time period reported, 92% of the surgeries were arthroscopic while 8% were open. The only patients excluded from the registry were those with previous diagnoses of LCP or SCFE. They reported on 147 revision cases. Patients at higher risk for revision included those with a younger age, female sex, and lower preoperative PROMs. One hundred sixteen patients (78.9%) underwent revision arthroscopy procedures. The most common reasons for revision included inadequately addressed FAI (74.8%), inadequately addressed extra-articular impingement (9.5%), or residual dysplasia (8.2%). Patients with AAs of greater than 50° were more likely to undergo revision procedures.

Until 2014, there was limited survivorship data on revision hip arthroscopies in the published literature. In one of the first midterm series, Aprato et al. [27] reported on the senior author's experience with revision hip arthroscopies. A total of 63/74 (85%) patients were available for a minimum of 3-year follow-up. Five underwent repeat arthroscopy and another 5 underwent conversion to arthroplasty for a total survivorship of 53/63 (84%).

Larson et al. [28] performed the first matched cohort study comparing revision arthroscopic FAI correction with primary FAI surgery based on age, labral repair versus debridement, FAI classification, and degree of degenerative changes without further manipulation. Eighty-five hips in the intervention arm were compared with 237 hips in the control arm. At a mean follow-up of 26 months for their revision cohort, they reported no conversion to THA and did not report on revision arthroscopies or reoperations in their control arm.

Newman et al. [29••] performed a matched cohort analysis comparing those patients having undergone revision hip arthroscopy with those having undergone primary hip arthroscopy from the same prospective database. In total, 246 patients undergoing revision hip arthroscopy were included (this was excluding professional athletes, those who underwent prior open surgery, or those who did not speak English), and these were matched by age, sex, and month of surgery with 492 patients who underwent primary hip arthroscopy for FAI by the same senior surgeon. Of the revision cohort, 183 patients had 1 prior surgery, 45 patients had 2 prior surgeries, and

Table 7 Summary of revision hip arthroscopy

Study characteristics		Sample characteristics						
Study (first author, year)	Arthroscopic intervention	Sample size	Sex	Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Aprato (2012)	Revision hip arthroscopy	63	Male, 27 Female, 36	37 years	3 years	53/63 (84%)	5/63 (7.9%)	5/63 (7.9%)
Gupta (2015)	Revision hip arthroscopy	70	Male, 31 Female, 39	36.35 years	27.99 months	85.70%	100%	10 (14.3%)
Larson (2014)	Revision hip arthroscopy	79 (85 hips)	Male, 35 Female, 44	29.5 years	26 months	NR	No significant differences	No significant differences
Newman (2016)	Revision hip arthroscopy	Primary cohort, 49 Revision cohort, 246	Male primary cohort, 202 Female primary cohort, 290 Male revision cohort, 101 Female revision cohort, 145	Primary cohort, 33.4 Revision cohort, 32.1	Primary cohort, 44 months Revision cohort, 43 months	Primary cohort, 90% Revision cohort, 94%	Primary cohort, 8% Revision cohort, 2%	Primary cohort, 11/492 (2%) Revision cohort, 10/246 (4%)

NR not reported; THA total hip arthroplasty

18 patients had three or more prior surgeries. Only 36% of the primary surgeries were performed by the senior author. Revision procedures included lysis of adhesions, $\pm$ labral repair or reconstruction, $\pm$ femoral osteoplasty, and/or rim trimming. As for survivorship, future surgery was 10% of the primary cohort and 6% of the revision cohort with hip arthroscopy reported in 8% of the primary cohort and 2% of the revision cohort. Interestingly, the rate of conversion to arthroplasty was different between the two cohorts. In the revision cohort, 11/492 (2%) versus 10/246 (4%) in the primary cohort underwent conversion to THA.

Gupta et al. [30••] performed a retrospective case series comparing clinical outcomes and pain and patient satisfaction after undergoing revision hip arthroscopy with a minimum of 2-year follow-up. In total, there were 87 patients that underwent revision arthroscopy during the study period but only 70 patients were included in the study. Patients were included if they had revision hip arthroscopic surgeries or more than one prior hip arthroscopy to the index revision arthroscopy. Patients were excluded by the authors if they had previous hip conditions such as acetabular fracture, avascular necrosis, Legg-Calve-Perthes disease, Ehlers-Danlos

syndrome, pigmented villonodular synovitis, or radiographic findings of Tonnis grade 2 or higher. The mean age was 36.35 years and the mean follow-up was 27.99 months. Overall, 10 patients (14.3%) underwent conversion to arthroplasty, thereby demonstrating, an 85.7% survivorship.

Special Populations

Athletes (Table 8)

Perets et al. [31••] report their series on high school, collegiate, or professional athletes who underwent hip arthroscopy. They report on 66/77 patients (85.7% follow-up) who were able to meet the minimum 5-year follow-up threshold. They excluded patients who had Tonnis grades of greater than 1, no preoperative PROMs, prior hip conditions (LCP, SCFE, AVN, or hip fractures), hip dysplasia (LCEA $< 18^\circ$), and prior ipsilateral hip surgery. Surgical techniques performed when indicated included bony resections, labral debridements/repairs/reconstructions, microfracture in the setting of full-thickness chondral defects, iliopsoas fractional lengthening in the setting

Table 8 Summary of special populations

Study characteristics		Sample characteristics						
Study (first author, year)	Population	Sample size	Sex	Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Perets (2018)	Athletes	66	Male, 19 Female, 47	21.4 years	67.8 months	84.80%	10/66 (15.2%)	0

THA total hip arthroplasty

Table 9 Summary of FAI mild dysplasia

Study characteristics		Sample characteristics						
Study (first author, year)	Population	Sample Size	Sex	Age (years)	Follow-up (months)	Survivorship (conversion to THA)	Revision arthroscopy	Conversion to THA
Fukui (2015)	Borderline dysplasia	100 (102 hips)	Male, 50 Female, 50	35 years	2 years	81.30%	12/102 (failed arthroscopy) 11.8%	7/102 (6.9%)
Hevesi (2018)	Borderline dysplasia	Dysplasia (LCEA < 25), 48 Controls (LCEA > 25), 96	Male dysplasia, 21 Female dysplasia, 27 Male controls, 47 Female controls, 49	Dysplasia age, 31.8 Control age, 31.4	5.7 years	Dysplasia overall survivorship 83% (78.1% control group)	Dysplasia, 6 (12.5%) Control, 18 (18.8%)	Dysplasia, 1 (2.1%) Control, 3 (3.1%)
Domb (2018)	Borderline dysplasia	19 (21 hips)	Male, 2 Female, 17	22.9	68.8 months	81%	19%	N/A

LCEA lateral center-edge angle; THA total hip arthroplasty

of internal snapping hips, or greater trochanter bursectomy with or without abductor repairs if clinically indicated. Capsular closures were performed in all cases if indicated. The most common treatment was labral repairs, which were performed in 75.8%. They report that 71% of the athletes returned to at least their previous level of sport following the procedure. As for survivorship, 10/66 hips required a secondary hip arthroscopy (15.2%) and none underwent conversion to THA for a total survivorship of 84.8%.

FAI in the Setting of Mild Hip Dysplasia (Table 9)

Hip arthroscopy remains controversial in the setting of hip dysplasia. Severe cases ($LCEA \leq 18^\circ$) of dysplasia associated with a labral tear typically undergo a staged or concurrent hip arthroscopy with PAO. Fukui et al. [32] report on a series of 102 hips with borderline dysplasia defined as a lateral center-edge angle of $20\text{--}25^\circ$ with a minimum of 2 years of clinical follow-up. As for survivorship, 12/102 failed hip arthroscopy with 7 undergoing a subsequent arthroscopy and undergoing conversion to THA.

Hevesi et al. [33••] report midterm follow-up on a matched cohort of patients undergoing hip arthroscopy with labral repair and dysplasia defined as a LCEA of less than 25° . These patients underwent surgery from 2 centers by three surgeons and were matched with nondysplastic controls by age, sex, laterality, BMI, Tonnis grade, and capsular repair per a 1:2 matching algorithm. Surgically, all patients underwent a labral repair, some underwent iliopsoas release for internal snapping hip, and capsular repair was not routinely performed. The cohorts included 48 patients with dysplasia who were matched with 96 controls. In the dysplasia group, the mean LCEA was 21.6° (versus 32° in the control cohort) and the mean follow-up was 5.7 years. At this follow-up period, the overall survivorship was 83.3% (versus 78.1% in the control cohort) with 6 undergoing revision arthroscopy, 2 undergoing PAOs, and 1 undergoing a THA. BMI < 30 was determined to be a risk factor for failure of the dysplasia group. When subgrouping severe dysplasia, defined as LCEA of $< 20^\circ$, and comparing that with borderline dysplasia (LCEA $20\text{--}25^\circ$), the authors found no differences or risk factors between these two subgroups.

Finally, Domb et al. [34] reported on their 5-year follow-up of patients undergoing hip arthroscopy for borderline dysplasia, defined as a LCEA from $18\text{--}25^\circ$. At final follow-up, 19/25 patients were available representing an 84% follow-up rate. At the time of surgery, all patients underwent a labral repair with a described capsular shift using 4–6 sutures. Overall survivorship was 81% at final follow-up with 19% undergoing revision hip arthroscopies.

Conclusion

Long-term survivorship for uncomplicated FAI remains near 80%. It remains to be seen how modern modifications of previous techniques, including labral reconstruction, modern labral repair techniques, and capsular closure, will influence the survivorship in coming years but the current shorter term results from these interventions remain promising. Recently, initiated randomized controlled trials [35–37] will eventually increase the level of evidence for these and other arthroscopic hip techniques.

Compliance with Ethical Standards

Conflict of Interest Joseph Ruzbarsky, Rui Soares, and Adam Johannsen declare that they have no conflict of interest. Marc J. Philippon reports royalties from Bledsoe, ConMed Linvatec, DonJoy, Arthrex, Arthrosurface SLACK Inc., Elsevier, Smith & Nephew Endoscopy, Consultancy fees from Smith & Nephew and MIS, Stockholder of Arthrosurface, MIS, Vail Valley Medical Center-Governing, Ownership of ProofPoint Biologics, TSC DME Company, TSC Imaging MJP Innovations, LLC, and research support from the National Institute of Health, National Institute of Arthritis and Musculoskeletal and Skin Diseases, National Institute of Aging, U.S. Department of Defense, Smith & Nephew Endoscopy, Ossur, Arthrex, and Siemens.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

- 1.• Palmer AJR, Malak TT, Broomfield J, Holton J, Majkowski L, Thomas GER, et al. Past and projected temporal trends in arthroscopic hip surgery in England between 2002 and 2013. *BMJ Open Sport Exerc Med*. 2016;2(1):e000082 **This article is a database study that queried hip arthroscopies performed in the National Health Service hospitals in England performed between the years 2002–2013. They found that the number of hip arthroscopies increased by 727% during that 11 year period. They found that females undergo the majority of hip arthroscopies and that the prevalence of hip arthroscopies varies by region.**
- 2.•• Nho SJ, Beck EC, Nwachukwu BU, Cvetanovich GL, Neal WH, Harris JD, et al. Survivorship and outcome of hip arthroscopy for femoroacetabular impingement syndrome performed with modern surgical techniques. *Am J Sports Med*. 2019;47(7):1662–9 **This article reports on a single surgeon's experience with hip arthroscopy for FAI with capsular closure. At a minimum 2-year follow-up, they report an excellent overall survivorship of their cohort (96.4%). Risk factors for clinical failure included lower preoperative International Hip Outcome Tool score (iHOT), chronic preoperative pain, and chondromalacia seen at the time of arthroscopy. Tonnis grades > 1, workers' compensation cases, and increase BMI were all predictors of inferior clinical outcomes.**
3. Harris JD, McCormick FM, Abrams GD, Gupta AK, Ellis TJ, Bach BR, et al. Complications and reoperations during and after hip arthroscopy: a systematic review of 92 studies and more than 6000 patients. *Arthrosc J Arthrosc Relat Surg*. 2013;29(3):589–95.
- 4.• Haynes JA, Xiong A, Nepple JJ, An T, Nunley RM, Clohisy JC. Does previous hip arthroscopy affect the clinical outcomes of total hip arthroplasty? *Orthop J Sport Med*. 2019;7(3):1–5 **These authors report on clinical outcomes in primary total hip arthroplasty between patients with and without prior hip arthroscopy. Fifty-eight patients undergoing primary THA with history of ipsilateral hip arthroscopy were compared and matched in a 1:2 manner to 116 hips undergoing primary THA without history of hip arthroscopy. A mean follow-up of 42 months determined. The authors concluded that prior hip arthroscopy did not affect the clinical outcome of a subsequent THA.**
- 5.•• Menge TJ, Briggs KK, Dorman GJ, McNamara SC, Philippon MJ. Survivorship and outcomes 10 years following hip arthroscopy for femoroacetabular impingement. *J Bone Joint Surg*. 2017;99(12):997–1004 **The authors reported on long-term survivorship of labral debridement, when compared with repair for treatment of FAI with symptomatic labral tears. For the combined cohort consisting of 154 patients, at a mean follow-up of greater than 10 years, the overall survivorship when defined as conversion to THA at final follow-up was 66%. Independent risk factors associated with conversion to THA were determined to be increasing age (51 versus 31 years old), radiographic joint space less than 2 mm, and microfracture at the time of surgery.**
6. Malviya A, Raza A, Jameson S, James P, Reed MR, Partington PF. Complications and survival analyses of hip arthroscopies performed in the national health service in England: a review of 6395 cases. *Arthrosc J Arthrosc Relat Surg*. 2015;31(5):836–842. 26.
- 7.• Gupta A, Redmond JM, Stake CE, Dunne KF, Domb BG. Does primary hip arthroscopy result in improved clinical outcomes? *Am J Sports Med*. 2016;44(1):74–82 **The authors report on a large case series of patients who underwent hip arthroscopy. Five hundred ninety-five patients were included in the study with a minimum of 2-year follow-up. The surgical techniques used by the author included labral debridements/repairs/reconstructions, microfractures, bony resections, iliopsoas fractional lengthening, and greater trochanteric bursectomies. Forty-seven patients underwent revision arthroscopy while 54 patients underwent conversion to arthroplasty. The article concludes that patients who had primary hip arthroscopy for all procedures showed excellent clinical outcomes and improved patient satisfaction scores at short-term follow-up.**
- 8.•• Hevesi M, Krych AJ, Johnson NR, Redmond JM, Hartigan DE, Levy BA, et al. Multicenter analysis of midterm clinical outcomes of arthroscopic labral repair in the hip: minimum 5-year follow-up. *Am J Sports Med*. 2018;46(3):280–7 **This study reports on a 303 patients from 4 high volume centers undergoing hip arthroscopy with labral repair for a multitude of origins with a minimum of 5-year outcomes. FAI was the most common indication for surgery. Total survivorship was 83.8% with 38 patients undergoing revision hip arthroscopy, 1 undergoing a PAO, and 9 undergoing arthroplasty. Patients with a BMI > 30, age > 35 years, and Tonnis grades 2+ had lower patient reported outcome measures.**
- 9.• Domb BG, Yuen LC, Ortiz-Declet V, Litrenta J, Perets I, Chen AW. Arthroscopic labral base repair in the hip: 5-year minimum clinical outcomes. *Am J Sports Med*. 2017;45(12):2882–90 **This article reports on a case series of patients being evaluated for clinical outcomes in a labral repair cohort with a minimum of 5-year follow-up. A total of 60/70 (85.7%) patients were available for follow-up. Out of the 60 patients, 64 hips were assessed. The surgical techniques included in the article were a transverse**

- interportal capsulotomy in all cases, acetabuloplasty, femoroplasty, iliopsoas fractional lengthening, ligament teres debridement, loose body removal, microfracture, gluteus medius repair, and trochanteric bursectomy. A total of 17.2% patients underwent revision arthroscopy and 9.4% converted to THA. The authors concluded that arthroscopic labral repair continued to be a successful procedure at a minimum of 5-year follow-up.
10. Hufeland M, Krüger D, Haas NP, Perka C, Schröder JH. Arthroscopic treatment of femoroacetabular impingement shows persistent clinical improvement in the mid-term. *Arch Orthop Trauma Surg.* 2016;136(5):687–91 **These authors report on the senior author's first 50 patients undergoing hip arthroscopy for FAI. The operative technique included an osteochondroplasty, if indicated, no capsulotomy, and sometimes a pincer resection with labral debridement. At an average follow-up of 66.3 months, an 88% follow-up rate was achieved. Risk factors for conversion included older age and greater preoperative OA as measured by Kellgren and Lawrence (KL) score.**
 11. Chen AW, Yuen LC, Ortiz-Declet V, Litrenta J, Maldonado DR, Domb BG. Selective debridement with labral preservation using narrow indications in the hip: minimum 5-year outcomes with a matched-pair labral repair control group. *Am J Sports Med.* 2018;46(3):297–304 **This article reports on patients with FAI undergoing selective debridements with labral preservation at a minimum 5-year follow-up. This cohort study focused on collecting data on patients who underwent hip arthroscopy surgery between February 2008 and September 2011. One hundred twenty-five hips were eligible for inclusion but only 101 patients were included with follow-up greater than 5 years representing a follow-up rate of 80.8%. The full debridement group had 4% of patients undergoing revision arthroscopy and 13.9% converting to THA. A matched cohort subgroup showed no differences in rate of subsequent revision arthroscopy or conversion to arthroplasty.**
 12. Domb BG, Chaharbachshi EO, Rybalko D, Close MR, Litrenta J, Perets I. Outcomes of hip arthroscopic surgery in patients with Tönnis grade 1 osteoarthritis at a minimum 5-year follow-up: a matched-pair comparison with a Tönnis grade 0 control group. *Am J Sports Med.* 2017;45(10):2294–302 **This article reports on a cohort study analyzing patients who underwent hip arthroscopy for FAI and labral tears between February 2008 and April 2011 with a minimum 5-year follow-up. Patients also had Tönnis grade 1 radiographic changes representing the first stages of osteoarthritis. A total of 292/356 hips were included in the study. A subgroup of 65 patients were also paired 1:1 with patients with Tönnis grade 0 radiographic findings based upon age, BMI, type of labral, and capsular treatment. The authors found that arthroscopic treatment of labral tears and FAI in patients with Tönnis grade 1 had good results at a minimum 5-year follow-up.**
 13. Westermann RW, Bessette MC, Lynch TS, Rosneck J. Does closure of the capsule impact outcomes in hip arthroscopy? A systematic review of comparative studies. *Iowa Orthop J.* 2018;38:93–9 **This article is a systematic review focusing on capsular closure in the setting of hip arthroscopy. Four total databases were searched for primary articles, and the search strategy yielded 7 total studies which underwent analysis. They found that in two studies reporting on revision hip arthroscopy, routine capsular closure improved outcomes, whereas the evidence was mixed in primary cases.**
 14. Domb BG, Martin TJ, Gui C, Chandrasekaran S, Suarez-Ahedo C, Lodhia P. Predictors of clinical outcomes after hip arthroscopy: a prospective analysis of 1038 patients with 2-year follow-up. *Am J Sports Med.* 2018;46(6):1324–30 **The authors report on this case-control study in a cohort of 1038 patients who underwent hip arthroscopy between February 2008 and June 2012. The mean age and follow-up time were 36.4 years and 30.1 months respectively. The authors report favorable clinical outcomes in a large cohort of hip arthroscopies with a minimum of 2 year follow-up.**
 15. Domb BG, Chaharbachshi EO, Perets I, Walsh JP, Yuen LC, Ashberg LJ. Patient-reported outcomes of capsular repair versus capsulotomy in patients undergoing hip arthroscopy: minimum 5-year follow-up—a matched comparison study. *Arthrosc J Arthrosc Relat Surg.* 2018;34(3):853–863.e1 **The authors describe a retrospective comparative study examining capsular closure who have undergone labral repair surgery at a minimum of 5-year follow-up. Five-year follow-up was obtained for 82.5% of patients. This equates to 287 out of 348 hips that met inclusion criteria. Sixty-five patients who underwent capsular repair were matched 1:1 ratio with 65 patients with release based on age, gender, worker's compensation, BMI, and acetabular coverage. Conversions to arthroplasty based on the capsulotomy group and repair group were determined to be 18.5% and 10.8%, respectively. As far as revision arthroscopy, the rate was the same for both groups at 15.4%. The authors found that patients undergoing hip arthroscopy or have minimal to no osteoarthritis have significant short-term outcomes in situations of whether the capsule is closed or unrepaired.**
 16. Domb BG, Linder D, Finley Z, Botser IB, Chen A, Williamson J, et al. Outcomes of hip arthroscopy in patients aged 50 years or older compared with a matched-pair control of patients aged 30 years or younger. *Arthrosc J Arthrosc Relat Surg.* 2015;31(3):231–8.
 17. Perets I, Chaharbachshi EO, Mu B, Ashberg L, Battaglia MR, Yuen LC, et al. Hip arthroscopy in patients ages 50 years or older: minimum 5-year outcomes, survivorship, and risk factors for conversion to total hip replacement. *Arthrosc J Arthrosc Relat Surg.* 2018;34(11):3001–9 **This article focuses on a single institution's experience with hip arthroscopy performed for FAI in 94 patients older than 50 years old. The overall survivorship (only accounting for conversions to THA) was 72.3%. Higher BMI, larger alpha angles (AA), smaller LCEA, Tönnis grades greater than 1, and femoral and acetabular Outerbridge grades greater than 2 were found to be predictors of conversion to THA.**
 18. Perets I, Chaharbachshi EO, Shapira J, Ashberg L, Mu BH, Domb BG. Hip arthroscopy for femoroacetabular impingement and labral tears in patients younger than 50 years: minimum five-year outcomes, survivorship, and risk factors for reoperations. *J Am Acad Orthop Surg.* 2019;27(4):e173–83 **This study reports on a single center's experience with hip arthroscopy for FAI in 327 patients younger than 50 years old with a minimum of 5-year follow-up. Thirty-eight hips (11.6%) went on to require repeat arthroscopy, while 25 (7.6%) converted to THA for a cumulative survivorship of 80.8%. Risk factors for undergoing revision hip arthroscopy included female sex, obesity, lower preoperative PROMs, and those not undergoing a capsular release. Risk factors for conversion to THA included BMI, greater age, Outerbridge grade 2 or greater on the acetabulum and/or femoral head, higher AAs, those having undergone a capsular release with labral debridement, and those with lower preoperative PROMs.**
 19. Capogna BM, Ryan MK, Begly JP, Chenard KE, Mahure SA, Youm T. Clinical outcomes of hip arthroscopy in patients 60 or older: a minimum of 2-year follow-up. *Arthrosc J Arthrosc Relat Surg.* 2016;32(12):2505–10 **The authors present prospectively collected data on survivorship and clinical outcomes of patients that were aged 60 years and older who underwent hip arthroscopy for hip pain. 42 patients were included in the study with a mean age of 65.8 years. Five (11.9%) of the 42 patients met failure criteria as needing revision surgery or converting to total hip arthroplasty. Three patients underwent conversion to total hip arthroplasty (7.1%) and two patients (4.7%)**

- underwent revision arthroscopy for recurrent symptoms or labral pathology. The authors concluded that in patients aged 60 or older, with Tonnis grade 0 or 1 on initial plain radiographs, hip arthroscopy for the treatment of hip pathology lead to improved early outcomes on mHHS and NAHS.
20. Ayeni OR, Alradwan H, de Sa D, Philippon MJ. The hip labrum reconstruction: indications and outcomes—a systematic review. *Knee Surg Sport Traumatol Arthrosc.* 2014;22(4):737–43.
 21. Geyer MR, Philippon MJ, Fagrellius TS, Briggs KK. Acetabular labral reconstruction with an iliotibial band autograft: outcome and survivorship analysis at minimum 3-year follow-up. *Am J Sports Med.* 2013;41(8):1750–6.
 22. White BJ, Stapleford AB, Hawkes TK, Finger MJ, Herzog MM. Allograft use in arthroscopic labral reconstruction of the hip with front-to-back fixation technique: minimum 2-year follow-up. *Arthrosc J Arthrosc Relat Surg.* 2016;32(1):26–32 **This article reports on a series of 131 hips at a minimum of 2-year follow-up. Different than many of the other published literature on labral reconstructions, 99 patients had not had previous surgery but rather primary labral reconstructions. At final follow-up, 9.9% of the hips underwent conversion to arthroplasty while 3.8% had revision arthroscopies for a cumulative survivorship of 86.3% at 2 years. Those patients having failed labral reconstruction tended to have lower mHHS scores, lower Lower Extremity Function Scores, and higher Visual Analog Pain Scores at rest and with activity. Furthermore, those who previously underwent an open surgery were at higher risk for labral reconstruction failure.**
 23. Chandrasekaran S, Darwish N, Close MR, Lodhia P, Suarez-Ahedo C, Domb BG. Arthroscopic reconstruction of segmental defects of the hip labrum: results in 22 patients with mean 2-year follow-up. *Arthrosc J Arthrosc Relat Surg.* 2017;33(9):1685–93 **The authors report on a small series of 22 patients that underwent labral reconstruction with gracilis autograft or semitendinosus allograft with a 2-year mean follow-up. The mean age was 32.2 years. One hundred percent of the cohort was available for follow-up after 2 years. One patient converted to THA while 2 out of 22 had undergone revision arthroscopy. The study also reports on significant improvements in patient reported outcomes and function.**
 24. Domb BG, El Bitar YF, Stake CE, Trenga AP, Jackson TJ, Lindner D. Arthroscopic labral reconstruction is superior to segmental resection for irreparable labral tears in the hip: a matched-pair controlled study with minimum 2-year follow-up. *Am J Sports Med.* 2014;42(1):122–30.
 25. Domb BG, Battaglia MR, Perets I, et al. Minimum 5-year outcomes of arthroscopic hip labral reconstruction with nested matched-pair benchmarking against a labral repair control group. *Am J Sports Med.* 2019;47(9):2045–55 **This article compares arthroscopic labral reconstruction with a labral control group at a minimum of 5 year outcomes. Data was collected from February 2008 to April 2013. Twenty-eight patients were eligible for the study but only 23 had a minimum 5-year follow-up. These 23 patients had a mean age of 35.2 years and a mean follow-up of 67.2 months. Four patients underwent revision arthroscopy and 3 underwent conversion to hip arthroplasty.**
 26. Ricciardi BF, Fields K, Kelly BT, Ranawat AS, Coleman SH, Sink EL. Causes and risk factors for revision hip preservation surgery. *Am J Sports Med.* 2014;42(11):2627–33 **The authors report on a cross-sectional study identifying the risk factors and causes for failure in both arthroscopic hip preservation surgery and open procedures. A single-center registry on hip preservation was reviewed and identified 147 patients (152 procedures) who underwent previous hip surgeries. The authors identified that the most common reason for revision surgery was residual impingement intra-articular pathology (FAI) (74.8%) and next followed by extra-articular impingement (9.5%). It was also**
 - seen that patients that underwent revision surgery tended to be female, younger in age, and had worse preoperative hip functional outcome scores than those in the primary cohort.
 27. Aprato A, Jayasekera N, Villar RN. Revision hip arthroscopic surgery: outcome at three years. *Knee Surg Sport Traumatol Arthrosc.* 2014;22(4):932–7.
 28. Larson CM, Giveans MR, Samuelson KM, Stone RM, Bedi A. Arthroscopic hip revision surgery for residual femoroacetabular impingement (FAI): surgical outcomes compared with a matched cohort after primary arthroscopic fai correction. *Am J Sports Med.* 2014;42(8):1785–90.
 29. Newman JT, Briggs KK, McNamara SC, Philippon MJ. Revision hip arthroscopy: a matched-cohort study comparing revision to primary arthroscopy patients. *Am J Sports Med.* 2016;44(10):2499–504 **These authors report a matched cohort analysis comparing revision with primary hip arthroscopy. In total, 246 patients undergoing revision hip arthroscopy were included. Ten percent of the primary cohort underwent future surgery versus 6% of the revision cohort. The rate of conversion to arthroplasty was different between the two cohorts: (2%) versus 10/246 (4%) in the primary cohort. Revision patients who had a previous labral tear that was not prepared and those who underwent capsular plication had the greatest improvements in PROMs.**
 30. Gupta A, Redmond JM, Stake CE, Dunne KF, Hammarstedt JE, Domb BG. Outcomes of revision hip arthroscopy: 2-year clinical follow-up. *Arthroscopy.* 2016;32(5):788–97 **The authors report that retrospective case series comparing clinical outcomes and pain and patient satisfaction after revision hip arthroscopy with a minimum 2-year follow-up. A total of 70/87 (80.5%) patients were included in the study. Mean age was 36.55 years and mean follow-up was 27.99 months. The authors note that 10 patients underwent conversion arthroplasty. The authors also report that all patients underwent revision hip arthroscopy and showed improved clinical outcomes for all in the categories of patient satisfaction, PROs, and high survivorship for short-term outcomes.**
 31. Perets I, Craig MJ, Mu BH, Maldonado DR, Litrenta JM, Domb BG. Midterm outcomes and return to sports among athletes undergoing hip arthroscopy. *Am J Sports Med.* 2018;46(7):1661–7 **This is a single center's series of 66 high school, collegiate, or professional athletes who underwent hip arthroscopy with a minimum of 5-year follow-up. Seventy-one percent of the athletes returned to at least their previous level of sport following the procedure. As for survivorship, 10/66 hips required a secondary hip arthroscopy (15.2%) and none underwent conversion to THA for a total survivorship of 84.8%.**
 32. Fukui K, Trindade CAC, Briggs KK, Philippon MJ. Arthroscopy of the hip for patients with mild to moderate developmental dysplasia of the hip and femoroacetabular impingement: outcomes following hip arthroscopy for treatment, of chondrolabral damage. *Bone Joint J.* 2015;97-B(10):1316–21.
 33. Hevesi M, Hartigan DE, Wu IT, Levy BA, Domb BG, Krych AJ. Are results of arthroscopic labral repair durable in dysplasia at mid-term follow-up? A 2-center matched cohort analysis. *Am J Sports Med.* 2018;46(7):1674–84 **These authors report 5.7 year average follow-up on a 2 center matched cohort of 48 patients undergoing hip arthroscopy with labral repair in the setting of dysplasia (LCEA < 25°). At this follow-up period, the overall survivorship was 83.3% (versus 78.1% in the control cohort). BMI < 30 was determined to be a risk factor for failure of the dysplasia group. When subgrouping severe dysplasia, defined as LCEA of < 20°, and comparing that with borderline dysplasia (LCEA 20–25°), the authors found no differences or risk factors between these two subgroups.**
 34. Domb BG, Chaharbakshi EO, Perets I, Yuen LC, Walsh JP, Ashberg L. Hip arthroscopic surgery with labral preservation and capsular plication in patients with borderline hip dysplasia:

- minimum 5-year patient-reported outcomes. *Am J Sports Med.* 2018;46(3):305–13.
35. Faucett SC, Nepple JJ, Andrade T, Aoki S, Bedi A, Bharam S, et al. Randomized controlled trial of hip arthroscopy surgery vs physical therapy: letter to the editor. *Am J Sports Med.* 2018;46(8):NP35–8.
 36. Griffin DR, Dickenson EJ, Wall PDH, Achana F, Donovan JL, Griffin J, et al. Hip arthroscopy versus best conservative care for the treatment of femoroacetabular impingement syndrome (UK FASHIoN): a multicentre randomised controlled trial. *Lancet.* 2018;391(10136):2225–35.
 37. Palmer AJR, Ayyar Gupta V, Fernquest S, Rombach I, Dutton SJ, Mansour R, et al. Arthroscopic hip surgery compared with physiotherapy and activity modification for the treatment of symptomatic femoroacetabular impingement: multicentre randomised controlled trial. *BMJ.* 2019;364.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.