The Addition of Hip Arthroscopy to Periacetabular Osteotomy Does Not Increase Complication Rates

A Prospective Case Series

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Background: Previous studies on periacetabular osteotomy (PAO) reported complication and reoperation rates of 5.9% and 10%, respectively. Hip arthroscopy is increasingly utilized as an adjunct procedure to PAO to precisely treat associated intra-articular pathology. The addition of this procedure has the potential of further increasing complication rates.

Purpose: To determine the rates of complication and reoperation of combined hip arthroscopy and PAO for the treatment of acetabular deformities and associated intra-articular lesions.

Study Design: Case series; Level of evidence, 4.

Methods: Using a prospective database, the authors retrospectively reviewed 248 hips (240 patients) that underwent combined hip arthroscopy and PAO between 2007 and 2016. Data were collected at scheduled follow-up visits at approximately 1 month, 3 to 4 months, and 1 and 2 years after surgery. Mean follow-up from surgery was 3 years (range, 1-8 years). A total of 220 PAOs were done for symptomatic acetabular dysplasia, 18 for symptomatic acetabular retroversion, and 10 for combined acetabular dysplasia and acetabular retroversion. Central compartment arthroscopy was performed for treatment of intra-articular chondrolabral pathology in all cases. Select cases underwent femoral head-neck junction osteochondroplasty either arthroscopically before the PAO or through an open approach after it. Complications were graded according to the modified Dindo-Clavien complication scheme, which was validated for hip preservation procedures. Reoperations (excluding hardware removal) were recorded.

Results: Grade III complications occurred among 7 patients (3%) while there were no grade IV complications. Grade III complications included deep infection (n = 3), wound dehiscence (n = 1), hematoma requiring exploration (n = 1), symptomatic heterotopic ossification requiring excision (n = 1), and deep venous thrombosis (n = 1). There were 13 reoperations (5%), and 3 were repeat hip arthroscopy. Univariate Cox hazard models were used to estimate the relative risk factors for complication and reoperation. Increased age (per decade) showed over twice the increased likelihood for complications (hazard ratio, 2.5; 95% CI, 1.67-3.74). Also, preoperative diagnosis of acetabular retroversion, not acetabular dysplasia, showed >3 times the increased risk of reoperation (hazard ratio, 3.05; 95% CI, 1.41-6.61).

Conclusion: The rate of complications reported is comparable (3%) with previously published complication rates of PAO without hip arthroscopy. In this cohort, increasing age and diagnosis of acetabular retroversion were associated with higher complication and reoperation rates.

Keywords: periacetabular osteotomy; hip arthroscopy; Dindo-Clavien; complications; reoperations

Acetabular dysplasia, which results from developmental dysplasia of the hip, is a common condition associated with pain and functional limitations.[11,18] Structural instability of the hip joint places increased stress on soft tissue structures, including cartilage, labrum, and ligamentum teres, resulting in intra-articular pathologic changes.[27] In 1988, Ganz and colleagues[12] introduced the Bernese periacetabular osteotomy (PAO) for acetabular reorientation. However, intra-articular structures are not able to be treated with PAO alone and require either open arthrotomy or hip arthroscopy for treatment. Treatment of intra-articular pathology, however, remains controversial, as some authors believe that redirecting the acetabulum alone may lead to improvement in pain and clinical outcome.[12,15,24]

Although hip arthroscopy alone in the presence of dysplasia is commonly contraindicated,[10,22,26] hip arthroscopy has been increasingly utilized over the past few years as an adjunct to PAO procedures for patients with suspected intra-articular disease. Arthroscopy can provide suitable

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visualization and access to address labral, chondral, and ligamentum teres injuries, with a less invasive approach than open arthrotomy. Therefore, arthroscopy enables precise treatment of central or peripheral compartment disease, while PAO provides deformity correction and an improved mechanical environment of the hip.[5,10,21,22,26] Many studies showed that revision surgery after PAO is caused by central compartment issues that could have been addressed with combined hip arthroscopy.[10,14,25]

Major complication rates of PAO alone were reported to be from 5% to 7%.[4,34] The addition of hip arthroscopy to PAO increases surgical time and fluid extravasation into the soft tissues and theoretically could increase complication rates associated with PAO. There is little information about the additional benefits or risks of performing hip arthroscopy concomitantly with PAO for the treatment of acetabular dysplasia. In assessing the clinical benefit of this combined procedure, it is imperative to first demonstrate its safety. Specifically, does the addition of concurrent hip arthroscopy increase the complication profile associated with PAO?

The purpose of this study was to determine the rates of complication and reoperation of combined hip arthroscopy and PAO for the treatment of acetabular deformities and associated intra-articular lesions. We utilized the modified Dindo-Clavien classification system to compare with previously reported complications rates of PAO alone.[7,34] This complication grading scheme was validated for hip preservation procedures.[7,34]

Our hypothesis was that the addition of hip arthroscopy to PAO would not cause an increase in significant complications and would thus allow the sports surgeon to become an integrative part in the surgical treatment of an athletic population that may benefit from the combined approach.

METHODS

Patients

Patients with acetabular dysplasia or acetabular retroversion who underwent combined hip arthroscopy and PAO for acetabular dysplasia or retroversion between 2007 and 2016 were identified through a multicenter database that has prospectively followed all cases of PAO performed at these institutions since 2007. Patients were routinely evaluated at scheduled follow-up visits at approximately 1 month, 3 to 4 months, 1 year, and 2 years postoperatively. Institutional review board approval was obtained before initiation of the study.

Among 242 patients, 250 hips were treated with combined hip arthroscopy and PAO between 2007 and 2016. Patients were excluded if they did not have concomitant hip arthroscopy at the time of PAO, had <1 year of clinical follow-up, or had prior open surgical intervention on the affected hip. Two patients (1%) did not meet the minimum required 1 year of follow-up, leaving a total of 248 hips among 240 patients. No patients died during the study period. Mean follow-up was 3 years (range, 1-8 years). Demographic variables are listed in Table 1.

A total of 220 PAOs were done for acetabular dysplasia, 17 for diagnosis of acetabular retroversion, and 11 for patients whose hips had features of acetabular dysplasia and retroversion, such as a patient with acetabular dysplasia and an aspheric femoral head (Table 2).

Preoperative Radiographic Characteristics

All patients had preoperative radiographs, including 2 views of the pelvis (anterior-posterior and cross-table lateral), false profile, and frog leg lateral. The Tönnis[31] classification system was used to grade level of osteoarthritis. All patients had Tönnis grade 0 to 2: 150, grade 0 (63%); 87, grade 1 (36%); 2, grade 2 (1%). The mean joint space width was 4.2 mm (range, 0.5-19.9 mm). Joint congruity was excellent in 36 hips (15.2%), good in 176 hips (74%), and acetabular retroversion in 28 hips (11%). Lateral center-edge angle[2] was measured on anterior-posterior pelvis, and the mean was 18° (range, –5.7°-38°). The anterior center-edge angle or angle of Lequesne[13] was measured on the false-profile views, and the mean was 21° (range, –17° to 55°). The femoral head-neck junction was measured on cross-table lateral radiograph and classified per the appearance of the radius of curvature as symmetric (normal, 45%), increased head-neck offset (mild deformity, 34%), or convexity (deformity, 21%).[23] A posterior wall sign was present among 50% of patients, a crossover sign among 40%, and a prominent ischial spine sign among 25% (Table 4).[6,16]

Surgical Procedures

All patients in the study underwent PAO and hip arthroscopy by 1 of 3 fellowship-trained hip preservation surgeons (R.J.S., J.C.C.). Of these patients, 10 hips had diagnostic hip arthroscopy before PAO without additional procedures (no intra-articular treatment indicated); the remainder had at least 1 additional intra-articular procedure,

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TABLE 1
Demographic Variables[a]

	Institution 1 (n = 206)	Institution 2 (n = 42)	Total (N = 248)
Age at time of surgery, y			
Mean ± SD	26.9 ± 9.5	25.1 ± 7.6	26.6 ± 9.2
Median	25.0	22.0	24.5
Quartile 1, quartile 3	19.0, 34.0	18.0, 32.0	19.0, 33.5
Range	12.0-53.0	15.0-41.0	12.0-53.0
Sex			
Female	177 (86.9)	30 (76.2)	207 (85.1)
Male	25 (13.1)	8 (23.8)	33 (14.9)
Side			
Left	92 (44.7)	21 (50.0)	113 (45.6)
Right	114 (55.3)	21 (50.0)	135 (54.4)
Race			
African American	3 (1.5)	0 (0.0)	3 (1.2)
Asian	1 (0.5)	0 (0.0)	1 (0.4)
White	195 (96.6)	39 (97.6)	234 (96.7)
Hispanic	1 (0.5)	1 (2.4)	2 (0.8)
Other	0 (0.0)	0 (0.0)	0 (0.0)

[a]Values are presented as n (%) unless noted otherwise.

including labral repair (n = 150, 61%), femoral head/neck osteochondroplasty (n = 175, 71%), and acetabular chondroplasty (n = 95, 38%) (Table 3). Additional procedures were performed on a case-by-case basis depending on the integrity of the labrum, articular cartilage, and ligamentum teres. For 175 hips (71%), osteochondroplasty was performed at the index operation for femoral head and neck abnormalities, such as insufficient head-neck offset. The total duration of combined surgery was a mean 210 minutes (range, 68-360 minutes). The mean estimated blood loss was 431 mL (range, 75-1501 mL).

Complication Grading System

We utilized the modified Dindo-Clavien classification scheme as proposed in the general surgery literature and recognized across surgical specialties as a standardized and validated method to classify complication based on grade of severity.[3,9] In the modified Dindo-Clavien system, grade I complications are those that require no treatment or deviation from the normal postoperative course; grade II complications require deviation with pharmacological or additional outpatient follow-up; grade III complications necessitate surgical intervention and may include unplanned hospitalization; finally, grade IV complications are untreatable and cause permanent disability or death.[9] This system was validated in the orthopaedic literature and in the same study cohort as a method to categorize complications based on various orthopaedic interventions, including PAO surgical hip dislocation and hip arthroscopy.[19,28,29,34]

Statistical Methods

Data are presented as mean values with ranges. Analysis was completed with the paired Student *t* test.[30] Univariate Cox proportional hazards models were utilized to assess risk for complication and reoperation.[8] The results were considered significant at a $P < .05$ error probability.[8,30] The survival estimates and cumulative survival were determined with Kaplan-Meier survivorship[17] analysis based on 3 endpoints: survivorship free from serious complication (grade III or IV), survivorship free from any complication (grades I-IV), and survivorship free from any reoperation.

RESULTS

The patient demographic, preoperative, surgical, and radiographic variables are shown in Tables 1 to 4.

Complications

The Dindo-Clavien graded complications are listed in Table 5.

Overall, there were 7 (3%) major complications (grade III or IV) and 17 minor (grade I or II). Seventeen grade I and II complications occurred among 17 patients (7%). Grade III complications were present among 7 patients (3%), and there were no grade IV complications. Grade III complications included deep infection (n = 3), wound dehiscence (n = 1), hematoma requiring exploration (n = 1), symptomatic heterotopic ossification requiring excision (n = 1), and deep venous thrombosis (n = 1). There were 13 reoperations (5%), and 3 were repeat hip arthroscopy. Univariate Cox hazard models were used to estimate the relative risk factors for complication (Table 6).

Increase age (per decade) at the time of surgery showed over twice the increased likelihood for complications (hazard ratio, 2.5; 95% CI, 1.67-3.74; $P < .001$) (Table 6). All other variables that were evaluated showed no significant effect on the outcomes of complication or reoperation (Table 6).

TABLE 2
Preoperative Indications[a]

	Institution 1 (n = 206)	Institution 2 (n = 42)	Total (N = 248)
Acetabular dysplasia	188 (91.3)	32 (76.2)	220 (88.7)
Acetabular retroversion	8 (3.9)	9 (21.4)	17 (6.9)
Combined acetabular dysplasia and retroversion	10 (4.9)	1 (2.4)	11 (4.4)

[a]Values are presented as n (%).

TABLE 3
Surgical Variables[a]

	Institution 1 (n = 206)	Institution 2 (n = 42)	Total (N = 248)
No. of procedures performed at index operation			
2	10 (4.9)	2 (4.8)	12 (4.8)
3	31 (15.0)	22 (52.4)	53 (21.4)
4	53 (25.7)	10 (23.8)	63 (25.4)
5	70 (34.0)	8 (19.0)	78 (31.5)
6	42 (20.4)	0 (0.0)	42 (16.9)
Acetabular chondroplasty			
No	149 (72.3)	4 (9.5)	153 (61.7)
Yes	57 (27.7)	38 (90.5)	95 (38.3)
Femoral head/neck osteochondroplasty			
No	42 (20.4)	31 (73.8)	73 (29.4)
Yes	164 (79.6)	11 (26.2)	175 (70.6)
Open arthrotomy			
No	47 (22.8)	40 (95.2)	87 (35.1)
Yes	159 (77.2)	2 (4.8)	161 (64.9)
Labral repair			
No	71 (34.5)	27 (64.3)	98 (39.5)
Yes	135 (65.5)	15 (35.7)	150 (60.5)
Duration of surgery, min			
Mean ± SD	209.5 ± 38.3	211.2 ± 45.0	209.8 ± 39.5
Median	205.5	209.0	206.0
Quartile 1, quartile 3	192.0, 226.0	179.0, 237.0	188.0, 227.0
Range	98.0-360.0	111.0-330.0	68.0-360.0
Estimated blood loss, mL			
Mean ± SD	397.2 ± 246.0	595.8 ± 366.5	431.3 ± 279.8
Median	325.0	750.0	350.0
Quartile 1, quartile 3	250.0, 500.0	325.0, 751.0	250.0, 550.0
Range	100.0-1400.0	75.0-1501.0	75.0-1501.0

[a]Values are presented as n (%) unless noted otherwise.

Reoperations

Hardware removal was recorded in this cohort but was not considered a reoperation, as it is an expected subsequent procedure after PAO. Of note, 39 hardware removals were done within the study period. Excluding hardware removal, there were 13 reoperations (5%). The reoperations were for scar revision (n = 1), excision of heterotopic bone (n = 2), repeat hip arthroscopy (n = 3), irrigation and debridement (n = 4), and other (n = 3). For all 3 patients requiring repeat hip arthroscopy as a reoperation, all were performed for continued postoperative intra-articular hip pain. Univariate Cox hazard models were used to estimate the relative risk factors for reoperation (Table 7).

The preoperative diagnosis of acetabular retroversion, not acetabular dysplasia, showed >3 times the increased risk of reoperation (hazard ratio, 3.05; 95% CI, 1.41-6.61; $P < .005$). All other variables that were evaluated showed no significant effect on the outcomes of complication or reoperation (Table 7).

Survivorship

Of all the complications, 7 were major (grade III or IV). Thus, the overall survivorship free from major complication was 98% at 6 months (95% CI, 96%-100%), 97% at 1 year (95%-99%), 95% at 2 years (91%-99%), and 95% at 3 years (91%-99%) (Figure 1).

There were a total of 13 reoperations excluding hardware removal (n = 39). The overall survivorship free from reoperation was 98% at 6 months, 95% at 1 year, 90% at 2 years and 86% at 3 years (Figure 2). There were no

TABLE 4
Radiographic and MRI Variables[a]

	Institution 1 (n = 206)	Institution 2 (n = 42)	Total (N = 248)
Tönnis osteoarthritis (grades 0-4)			
Missing	8	1	9
0	126 (63.6)	24 (58.5)	150 (62.8)
1	70 (35.4)	17 (41.5)	87 (36.4)
2	2 (1.0)	0 (0.0)	2 (0.8)
Joint space width			
Missing	7	1	8
Mean ± SD	4.1 ± 1.3	4.8 ± 1.1	4.2 ± 1.3
Median	4.0	5.0	4.1
Quartile 1, quartile 3	3.6, 4.5	4.3, 5.3	3.6, 4.7
Range	2.4-19.9	0.5-7.0	0.5-19.9
Lateral center-edge angle			
Missing	7	1	8
Mean ± SD	17.7 ± 5.5	21.4 ± 8.5	18.3 ± 6.2
Median	17.6	20.0	18.0
Quartile 1, quartile 3	14.3, 20.4	18.0, 25.0	15.0, 21.1
Range	–5.7 to 36.5	–3.0 to 38.0	–5.7 to 38.0
Crossover sign			
Missing	7	1	8
No	124 (62.3)	20 (48.8)	144 (60.0)
Yes	75 (37.7)	21 (51.2)	96 (40.0)
Posterior wall sign			
Missing	9	1	10
No	105 (53.3)	14 (34.1)	119 (50.0)
Yes	92 (46.7)	27 (65.9)	119 (50.0)
Prom ischial spine			
Missing	65	1	66
No	116 (82.3)	21 (51.2)	137 (75.3)
Yes	25 (17.7)	20 (48.8)	45 (24.7)
Femoral head-neck junction offset			
Missing	10	1	11
Deformity (convexity)	46 (22)	3 (7.3)	49 (20.6)
Mild deformity	77 (62.8)	4 (9.8)	81 (34.2)
Normal	73 (37.2)	34 (82.9)	107 (45.1)
Joint congruity			
Missing	10	1	11
Excellent	20 (10.2)	16 (39.0)	36 (15.2)
Fair	22 (11.2)	3 (7.3)	25 (10.5)
Good	154 (78.6)	22 (53.7)	176 (74.3)
Anterior center-edge angle			
Missing	13	7	20
Mean ± SD	20.2 ± 8.4	28.0 ± 12.6	21.4 ± 9.5
Median	20.6	23.0	20.7
Quartile 1, quartile 3	14.9, 25.2	19.0, 37.0	15.9, 26.2
Range	–16.8 to 47.9	11.0 to 55.0	–16.8 to 55.0
MRI acetabular cyst			
Missing	6	8	14
No	9 (4.5)	33 (97.1)	42 (17.9)
Yes	191 (95.5)	1 (2.9)	192 (82.1)

[a]Values are presented as n (%) unless noted otherwise. MRI, magnetic resonance imaging.

patients in the study period who went on to repeat PAO or total hip arthroplasty.

DISCUSSION

The combination of hip arthroscopy with PAO at the same index procedure has been thought to increase the likelihood of success owing to improved visualization and correction of any intra-articular pathology at the time of acetabular reorientation surgery. However, it was suggested that combining PAO with hip arthroscopy may lead to increased complications secondary to an increase in operative time and fluid extravasation into the soft tissues.[5]

The study presented has limitations that should be acknowledged to appropriately interpret the results and apply them in the correct clinical scenarios. Primarily,

TABLE 5
Complications Graded According to the Dindo-Clavien Classification System (Grades I-IV)[a]

Dindo-Clavien: Complication	n (%)
Grade I	16 (6)
LFCN dysesthesia	13
HO	3
Grade II: sacroiliitis	1 (<1)
Grade III	7 (3)
Deep infection	3
Wound dehiscence	1
Hematoma	1
HO requiring excision	1
Deep venous thrombosis	1

[a]There were no grade IV complications. HO, heterotopic ossification; LFCN, lateral femoral cutaneous nerve.

the retrospective nature of the study and the selection bias inherent to the study population are known limitations. Given the interest in performing hip arthroscopy at the time of PAO, there has been some concern over the risks versus benefits of the added procedure. Our goal was to survey the current cohort of prospectively collected data to investigate the complications associated with combined hip arthroscopy and PAO versus PAO alone. For that reason, our 2-institution study has only historical comparisons, which is a known limitation. Prior series reported improved outcomes and evidence of chondrolabral pathology not detected on magnetic resonance imaging with the addition of hip arthroscopy before PAO.[10,25] For this reason, we focused only on complications rather than on comparing outcome measures. However, some may prefer a more comprehensive statistical analysis to include the outcomes, and this could also be considered a limitation.

The results of this multi-institution study evaluating the combined procedure of hip arthroscopy and PAO showed a 3% rate of significant complications (Dindo-Clavien grade III or IV) in this cohort. This is lower than the reported complication rates in other studies of PAO alone from a similar multicenter prospective database, estimated as 5% to 7%.[4,34] Interestingly, there was a statistically significant increase in risk for grade III or IV complications related to age at index procedure, with a 2.5-times higher risk of significant complication per decade of advanced age at the time of surgery. The surgical duration was evaluated via univariate analysis but did not effect the risk for overall complication in this cohort. Interestingly, a recent prospective study of overall survivorship free from total hip arthroplasty after PAO also cited increased age at surgery as a risk factor for failure.[32]

A previous publication from a similar multicenter prospective cohort was published on complications after PAO alone.[34] This study also utilized a Dindo-Clavien classification system for complications. In the study of PAO alone, there was a 5.9% rate of major complications (Dindo-Clavien grade III or IV) and 11% rate of minor complications (I or II). In comparison, our results—based on the same classification system and the methods for prospective collection of data—show similar complication rates, with a slightly lower rate of major complications (3% vs 5.9%) and minor complications (6% vs 11%). We believe that the increase in minor complications (mainly lateral femoral cutaneous nerve neurapraxias) could be related to better data collection and reporting in this newer cohort or a higher incidence based

TABLE 6
Univariate Cox Model of Effect of Variables on Risk for Grade III-IV Complications[a]

		95% CL		
Risk Factor	HR	Lower	Upper	*P* Value
Age, per decade	2.50	1.67	3.74	<.001[b]
Sex				
Male	0.48	0.02	10.34	.64
Female	1.0			
Race				
Nonwhite	1.56	0.07	33.57	.78
White	1.0			
Diagnosis group				
Acetabular dysplasia	1.0			
Acetabular retroversion	2.69	0.34	21.6	.35
Combined acetabular dysplasia and retroversion	3.46	0.39	30.5	.26
Surgery group				
Arthrotomy	0.52	0.10	2.76	.45
Labral repair (and no arthrotomy)	0.26	0.01	7.69	.44
Neither arthrotomy or labral repair	1.0			
Surgical duration, per 10 min	1.04	0.93	1.16	.51
Estimated blood loss, per 100 mL	1.01	0.84	1.22	.88

[a]CL, confidence limit; HR, hazard ratio.
[b]$P < .05$.

TABLE 7
Univariate Cox Model of Effect of Variables on Reoperation (Excluding Hardware Removal)[a]

Risk Factor	HR	95% CL		P Value
		Lower	Upper	
Age, per decade	0.84	0.62	1.13	.25
Sex				
Male	0.78	0.28	2.16	.63
Female	1.0			
Race				
Nonwhite	0.84	0.18	3.83	.82
White	1.0			
Diagnosis group				
DDH	1.0			
FAI/other	3.05	1.41	6.61	.005[b]
DDH + FAI	1.94	0.81	4.64	.14
Surgery group				
Arthrotomy	0.45	0.21	0.98	.044
Labral repair (and no arthrotomy)	0.72	0.28	1.88	.50
Neither arthrotomy or labral repair	1.0			
Surgical duration, per 10 min	0.995	0.94	1.06	.87
Estimated blood loss, per 100 mL	1.03	0.93	1.14	.59

[a]CL, confidence limit; DDH, developmental dysplasia of the hip; FAI, femoroacetabular impingement; HR, hazard ratio.
[b]$P < .05$.

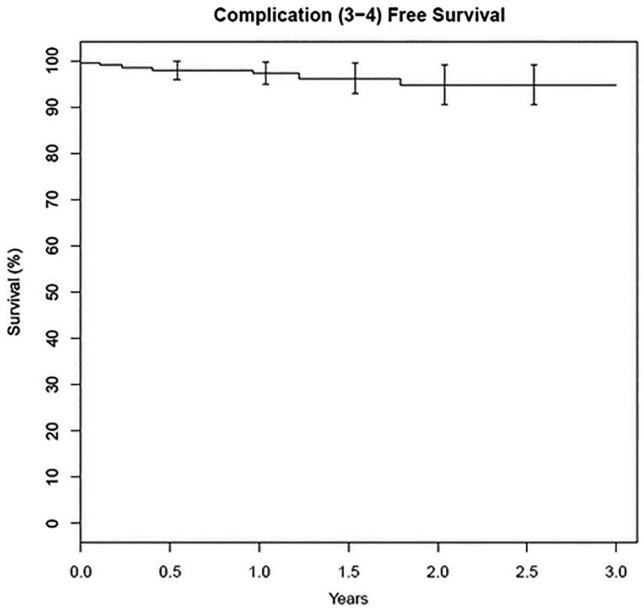

Figure 1. Kaplan-Meier survivorship curve for survival free from significant complication (Dindo-Clavien grade III or IV). Error bars indicate 95% CI.

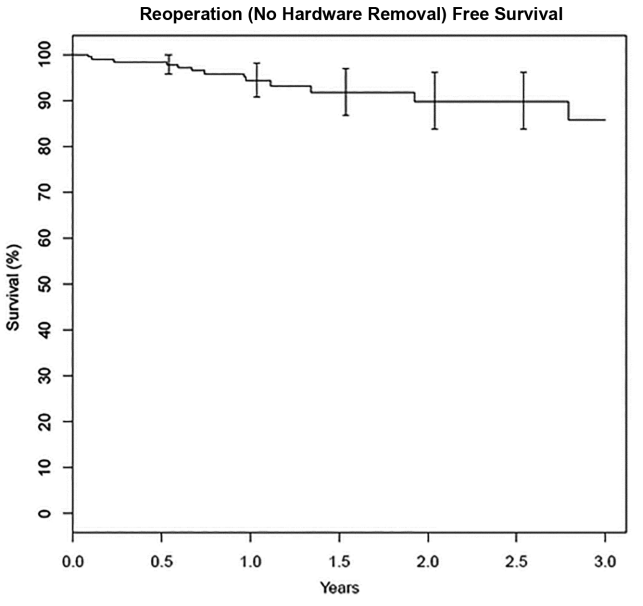

Figure 2. Kaplan-Meier survivorship curve for survival free from reoperation, excluding hardware removal. Error bars indicate 95% CI.

on the combined procedure. This number is below what was reported prospectively for hip arthroscopy alone (18%).[19]

The survivorship free from reoperation for any reason at 3 years was 86%. These reoperations were not associated with failure of PAO in this group, which is similar to the comparative literature (94% at 5 years).[1] The results also showed a 3-times increased risk to require reoperation among patients with the diagnosis of acetabular retroversion as compared with those with a preoperative indication of acetabular dysplasia. As discussed previously, it has been speculated that hip arthroscopy may be of benefit to patients with known labral pathology who undergo PAO to address the intra-articular pathology. Magnetic resonance imaging studies showed that patients with

acetabular retroversion have a shorter superior labral length and less capsular thickening than do patients with acetabular dysplasia.[20] Perhaps anatomic differences like these play a role in the subsequent need for reoperation among these patients. Most studies evaluate survivorship after PAO with the endpoint of total hip arthroplasty in mind. An article evaluating the intermediate-term survivorship after PAO, with survivorship defined as being free from conversion to total hip arthroplasty, was recently reported to be 92% at 15 years,[32,33] deeming PAO a durable and successful procedure in preventing progression to severe hip arthritis requiring total hip arthroplasty. None of the patients in our cohort progressed to total hip arthroplasty; however, the significance of that information is limited owing to the relatively short follow-up period.

Thus, these prospective data provide us with reassurance that the combination of hip arthroscopy and PAO does not have an increased rate of significant complications or reoperations when compared with PAO alone. In addition, patients undergoing combined hip arthroscopy and PAO had >2 times the increase in risk for significant complication per advanced decade of life and a 3-times greater likelihood for reoperation if they had a primary diagnosis of acetabular retroversion as opposed to acetabular dysplasia. Thus, we have demonstrated the safety of the combined arthroscopy-PAO procedure. Future studies will focus on investigating the potential clinical benefit of the combined procedure and its effect on patient-reported outcomes and mid- to long-term hip survivorship.

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