Check for updates

ORIGINAL ARTICLE

Arthroscopy
The Journal of Arthroscopic and Related Surgery
AANA ADVANCING THE SCOPE™
Practice-Changing Innovation

High Rate of Return to Sport in Competitive Athletes Undergoing Periacetabular Osteotomy With Concomitant Hip Arthroscopy

Alfred Mansour, M.D.,[1*] Nicole Lemaster, A.T.C., Ph.D.,[2] Jacob Jelmini, A.T.C., Ph.D.,[2] Philip Sheedy, P.T., D.P.T.,[2] Anota Adekunle, M.G.A.,[1] and Alexis Aboulafia, B.S.[1]

Purpose: To report the return-to-sport rate of competitive athletes with hip dysplasia, in relation to their preoperative level of competition, who underwent hip arthroscopy with concomitant periacetabular osteotomy (HA + PAO).

Methods: Patients participating in competitive sports who underwent HA + PAO for the correction of hip dysplasia between January 2016 and December 2023 by a single orthopaedic surgeon were retrospectively reviewed. Patients who underwent periacetabular osteotomy-alone or were classified as participating in recreational sports were excluded. Patients without documentation of attempted RTS or interest in RTS were also excluded. Pre- and postoperative level and type of sport were assessed. Sport level was categorized as high school, competitive club (regional, national, or international competition), college, and/or professional level. The level of RTS was classified as lower, same, or higher than preoperative status. A minimum 2-year follow-up was attempted for all patients.

Results: Forty-eight patients (56 hips) were identified. Four patients were lost to follow-up. Forty-four patients (37 women, 7 men) and 52 hips were included in the analysis. Eight patients underwent bilateral HA + PAO. Athletes from high school (n = 16), high school and competitive club (n = 6), competitive club (n = 12), college (n = 9), and professional (n = 1) levels were included. Of the 44, 41 returned (93.18%) to sport and 3 did not (6.82%). Of the 41 athletes who returned to sport, 33 (80.49%) returned to their preoperative level, 5 (12.19%) returned to a higher level of competition, and 3 (7.32%) returned to a lower level of competition. Data on subsequent surgeries after HA + PAO were available for 88.63% (39/44) of patients, with a minimum 2-year follow-up and a mean follow-up duration of 47.78 months (range = 24-120 months). Three patients sustained complications that required a return to the operating room.

Conclusions: This study reported an overall RTS rate of 93.1% in competitive athletes who underwent an HA + PAO, with an 86.36% (38/44) rate of return to the same or higher level of competition.

Level of Evidence: Level IV, retrospective case series.

Arthroscopy. 2026;00:1-11

Developmental dysplasia of the hip is defined as inadequate femoral head coverage of the acetabulum. Untreated hip dysplasia can lead to progressive, severe osteoarthritis that can only be mitigated with a total hip arthroplasty.[1,2] The Bernese periacetabular osteotomy (PAO) is an established surgical procedure to correct hip dysplasia and can delay total hip arthroplasty for 10 to 30 years.[3-8]

The PAO for the correction of hip dysplasia has been shown to improve pain, hip function, and overall quality of life.[9,10] Although the PAO can improve quality of life,[11] many patients with hip dysplasia have concomitant

From the [1]Department of Orthopaedic Surgery, The University of Texas Health Center at Houston, Houston, Texas, U.S.A.; [2]Memorial Hermann Rockets Sports Medicine Institute, Houston, Texas, U.S.A.

*Address correspondence to Alfred Mansour, M.D., Department of Orthopaedic Surgery, The University of Texas Health Center at Houston, 6400 Fannin, Suite 1700, Houston, TX 77030, U.S.A. E-mail: alfred.a.mansour@uth.tmc.edu

Received June 13, 2025; Accepted March 31, 2026.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

View this article online at wileyonlinelibrary.com. DOI: 10.1002/arj.70523

© 2026 The Author(s). *Arthroscopy* published by Wiley Periodicals LLC on behalf of the Arthroscopy Association of North America.

intra-articular abnormalities, such as chondrolabral pathology and femoral head deformity, which cannot be addressed with an isolated PAO.[12-17] Hip arthroscopy with concomitant periacetabular osteotomy (HA + PAO) allows surgeons to simultaneously correct the dysplastic pelvic structure and intra-articular pathologies. Outcomes of this combined procedure were first reported by Kim et al. in 2011.[18] In the last decade, data has shown that the HA + PAO yields promising results on quality of life and daily activities.[19-21]

Because of the invasive nature of the procedure, there is a lack of consensus as to whether athletes who undergo an isolated PAO (PAO-alone) or HA + PAO can successfully return to the same level of sport.[22-31] Those who argue against the use of PAO in athletes cite the wide range of reported return-to-sport (RTS) rates after PAO-alone (67%-92%),[22-26] in addition to some studies finding that athletes return to lower impact sports and activities.[24,25,27,28] Furthermore, the wide range of RTS rates after PAO-alone differs from RTS rates after isolated hip arthroscopy for femoroacetabular impingement (~93%).[32] Although a different cohort, this level of return is a common benchmark for returning to sport after athletic hip surgery. Moreover, there is limited evidence to support or refute whether athletes can undergo RTS after HA + PAO. Several studies have shown significant improvements in sports-related patient-reported outcomes (PROs), such as the UCLA Activity Scale and Hip Outcome Score-Sports Subscale after HA + PAO;[20,29] however, only 2 known studies have assessed RTS rates after HA + PAO. These studies reported RTS rates of 81.8% and 85.7%; however, in both instances, recreational athletes were included, in addition to competitive athletes.[30,31] The lack of consensus and limited evidence regarding athletes returning to sport after undergoing HA + PAO shows a critical need for continued investigation in determining the RTS rate among competitive athletic populations after HA + PAO. Therefore, the purpose of this study was to report the RTS rate of competitive athletes with hip dysplasia, in relation to their preoperative level of competition, who underwent HA + PAO. We hypothesized that there will be a high RTS rate (>80%) for competitive athletes who underwent HA + PAO, comparable to the RTS for patients who underwent isolated hip arthroscopy.

METHODS

Patient Selection

This study reflects a larger cohort that is based on preliminary results that were previously presented.[33] This retrospective cohort study was performed at the University of Texas Health Science Center Houston, Department of Orthopaedic Surgery (IRB approval HSC-MS-22-0471). Patients who underwent HA + PAO for the correction of hip dysplasia between January 2016 and December 2023 by a single orthopaedic surgeon (A.M.) were reviewed. Patients with a prior history of ipsilateral hip arthroscopy were included. Patients who reported participation in competitive sports were evaluated. Competitive athletes were defined as those whose sports participation was at the high school, competitive club, collegiate, and/or professional level. Of those patients, only those who had a desire to return to their sport postoperatively were included.[34] Exclusion criteria consisted of those who underwent PAO-alone or were classified as participating in recreational sports; patients under the age of 13 years old; patients with a Tönnis grade > 1; patients without documentation of attempted RTS; or revision PAO.

Clinical and Radiological Evaluation

Each patient's medical history was evaluated preoperatively by an orthopaedic surgeon (A.M.). A physical examination was performed by the physician as standard of care, which included a gait assessment, hip provocation testing, and hip range of motion to determine diagnosis.[35] Patients with hip dysplasia and intra-articular pathology (labral tears, cam morphology, subspinous impingement, etc.), who had continued pain despite attempted conservative management, were indicated for surgery. Patients underwent conservative management with 1 or all of the following for at least 6 weeks—physical therapy, activity modifications, and intra-articular injections—prior to being indicated for surgery. Preoperative radiographs, magnetic resonance imaging (MRI), and computed tomography (CT) scans were reviewed.[36,37] Tönnis grade, lateral center edge angle (LCEA), and acetabular inclination (AI) angle were obtained and recorded via 3 radiographic views: anteroposterior, 45° modified Dunn, and false profile.[38,39] For this study, hip dysplasia was radiographically defined as LCEA < 20° and/or AI > 10°.[14,21,39-44] Borderline hip dysplasia (BHD) was defined by a LCEA of 20°-24° and AI < 10°.[45] The presence of cam morphology was defined by an alpha angle of ≥50°, as measured on the 45° modified Dunn radiographic view and confirmed with 3-dimensional MRI or CT imaging.[39,46,47] Other intra-articular abnormalities, such as labral pathology and cartilage status, were assessed via MRI.[48] Patients with a Tönnis grade > 1 and/or significant chondral damage were not candidates for a PAO.[49] Additionally, all patients underwent a preoperative CT scan to assess

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Arthroscopy The Journal of Arthroscopic and Related Surgery AANA Advancing the Scope Practice-Changing Innovation

version and potential posterior-superior or anterior undercoverage that was not evident radiographically.[36]

Surgical Technique

Hip Arthroscopy

Patients had either an epidural or an erector spinae catheter placed by anesthesia prior to induction.[50] The feet were placed in padded boots, and the patient was secured on a hip distractor table. The senior author transitioned from post to postless traction during the study period. Foley was placed, and neuromonitoring leads were placed and used during the PAO portion in all cases.

Anterior peritrochanteric portal was created first, followed by a modified mid-anterior portal. The distal anterolateral accessory (DALA) portal was used for labral anchor placement or burr positioning for femoroplasty. Interportal capsulotomy was used for central compartment treatment including selective labral debridement, chondroplasty, microfracture, or labral repair. T-capsulotomy was performed as the surgeon's preferred technique to access the cam region in cases when femoroplasty was performed. In all cases, the capsule was completely closed at the end of the arthroscopic portion using nonabsorbable sutures.

PAO

Baseline neuromonitoring waveforms were obtained. Tranexamic acid was administered, and cell saver was used for this portion. An 11- to 15-cm oblique bikini line incision was made, and a rectus-sparing PAO was performed as previously published.[51] A supracetabular Schanz pin was placed, and the fragment was then repositioned to correct the acetabular coverage. Provisional fixation with 2.4-mm K-wires was obtained, and fluoroscopic imaging was scrutinized to guide repositioning of the fragment to obtain an LCEA of approximately 30° with good anterior and posterior coverage and no overcoverage or retroversion. Pins were then exchanged with either 3.5-mm or 4.5-mm screws for the final stabilization of the fragment. Typically, the most anterior portion of the osteotomized segment anterior spike was then resected and used as a wedge of bone tamped in the gap at the anterior portion of the iliac wing. Allograft putty admixed with an autograft was placed into the osteotomy gap. The ASIS wafer osteotomy was reattached with #2 nonabsorbable suture. The external oblique fascia was reapproximated to the crest with #1 absorbable suture, and the incisions were closed in a layered fashion.

Postoperative Rehabilitation

All patients were admitted postoperatively, and regional anesthesia was discontinued on the morning of postoperative day 2. Ketorolac or celecoxib was used as part of multimodal pain control while inpatient, but no NSAIDs or additional heterotopic ossification prophylaxis was prescribed on discharge. A continuous passive motion device was provided for 2 weeks postoperatively. Aspirin 81 mg was prescribed twice daily for 6 weeks as deep vein thrombosis prophylaxis. Touch-down weightbearing was maintained for the first 6 weeks, and then, progressive limp-free ambulation was initiated. An informal, patient-led aquatic rehabilitation program to be performed at home was offered at 3 weeks, and formal physical therapy was initiated at 4 to 6 weeks. A detailed criteria-based HA + PAO physical therapy protocol (Supporting Information) was prescribed and advanced according to postoperative objective metrics with the goal of return-to-run progression around 4.5 to 6 months and gradual RTS-specific training thereafter.

RTS Evaluation

Pre- and postoperative level and type of sport were extracted from electronic medical records or by contact with the patient via email or phone. Patients who did not RTS were asked if they did not return because of hip pain or issues or for non-hip-related reasons (i.e., lack of eligibility, school graduation, etc.). Sport level was categorized as high school, competitive club (regional, national, or international competition), college, and/or professional level. The level of RTS was classified as lower, same, or higher than preoperative status (e.g., high school athlete returned to high school athletics: same level of RTS). The RTS was defined as a patient's reported return to any competitive level of participation in his or her chosen sport at any time point after surgery for any length of time. RTS timelines began after the second surgery for patients who underwent bilateral HA + PAO that occurred within 1 year of each other. A minimum of 2-year follow-up was attempted for all patients to determine if the patient had undergone any subsequent surgical procedure on their involved hip at any time point after HA + PAO.

Statistical Analysis

Descriptive analysis was performed using a statistical software package (SPSS [version 28], SPSS, Chicago, IL) to calculate means and standard deviations of continuous variables. In our descriptive reporting, patients were

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

analyzed rather than individual joints in the dataset. We did not apply a statistical correction in the descriptive analyses because analyses were conducted at the patient level rather than treating each joint as an independent observation.

RESULTS

Demographics

Fifty-nine patients (67 hips) were identified. Eleven patients (13 hips) were excluded because of lack of desire/attempt to RTS or other non-hip-related orthopaedic issues. Four patients (4 hips) were lost to follow-up and excluded (Figure 1). Therefore, 44 patients (52 hips) were included in the final analysis, with 37 women (7 men) at an average age of 18.69 ± 5.33 years and a body mass index of 23.15 ± 3.50 at time of surgery. Race demographics of the final cohort consisted of 36 White, 2 Hispanic or Latino, 1 Black or African American, 1 Asian, and 4 N/A.

Surgical Descriptives

Concomitant arthroscopic procedures are listed in Table 1. Eight patients underwent bilateral HA + PAO, 7 of which were staged and within 1 year of each other. The final bilateral case underwent contralateral HA + PAO 14.5 months after the first. For the purposes of this study, this patient's RTS status was assessed after the second HA + PAO. Data on subsequent surgeries after HA + PAO were available for 88.63% (39/44) of patients,

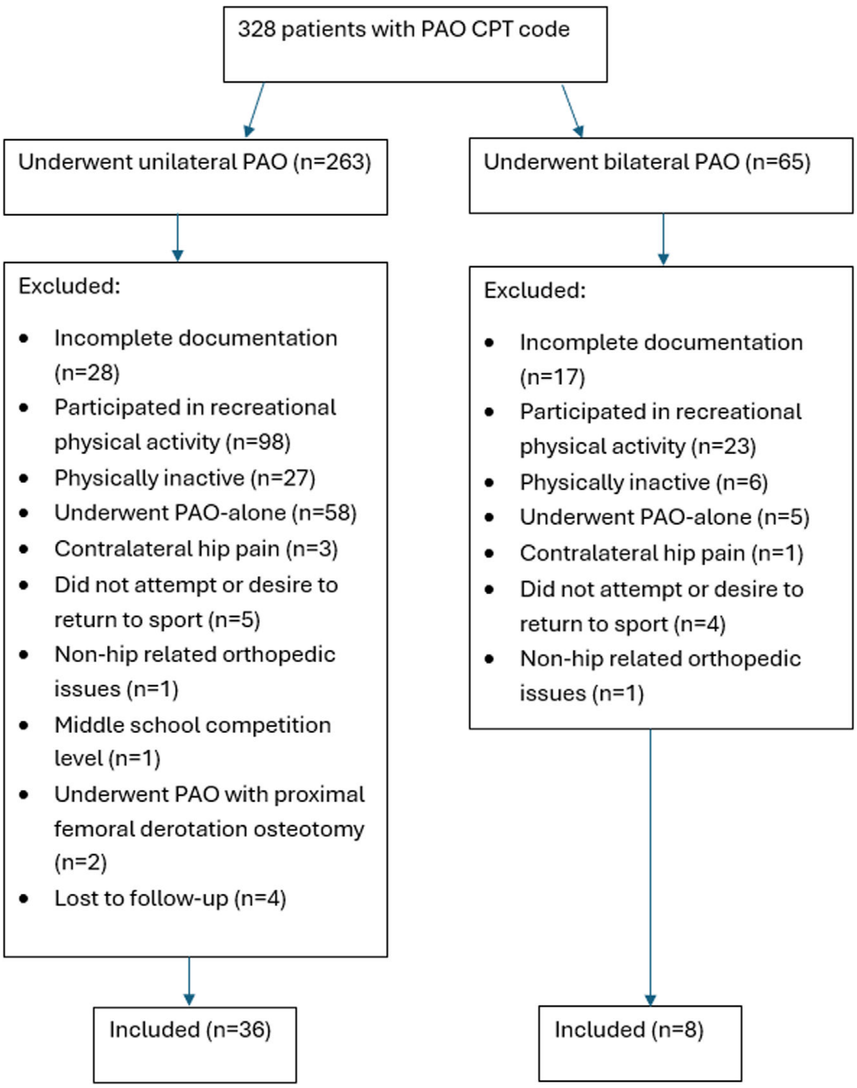

FIGURE 1 STROBE (strengthening the reporting of observational studies in epidemiology) diagram depicting patient selection criteria. (CPT, Current Procedural Terminology; PAO, periacetabular osteotomy.)

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Arthroscopy The Journal of Arthroscopic and Related Surgery AANA ADVANCING THE SCOPE Practice-Changing Innovation

TABLE 1 Concomitant Hip Arthroscopic Procedures

	Total Subjects (Total Hips)
Labral treatment	
Labral repair	28 (33)
Selective labral debridement	6 (6)
No labral treatment	11 (13)
Femoroplasty	38 (45)
Chondroplasty of acetabulum	11 (14)
Subspinous decompression	4 (5)

Note: Other concomitant procedures include acetabular microfracture (1), chondrolabral debridement (1), diagnostic arthroscopy (1), loose body removal (1), foreign body removal (1), paralabral cyst decompression (1), synovial debridement (1), open femoral osteochondroplasty (1), unstable chondral flap debridement (1), open capsular mobilization (1), and lysis of adhesions (2).

with a minimum 2-year follow-up and a mean follow-up duration of 47.78 months (range = 24-120 months).

Three patients had a history of prior hip arthroscopy, 2 of whom underwent bilateral HA + PAO. Three patients sustained complications that required a return to the operating room: 1 underwent open excision of heterotopic ossification 4 months after surgery; the second underwent revision hip arthroscopy 2 years postoperatively for lysis of adhesions, revision labral repair, and revision femoroplasty; and the third patient underwent irrigation and debridement for a superficial abscess of the proximal thigh 6 weeks postoperatively. For the 52 hips included in the analysis, LCEA angle increased from 17.44° ± 4.55° preoperatively to 33.59° ± 3.18° postoperatively. AI decreased from 13.5° ± 4.74° preoperatively to 0.15° ± 2.91° postoperatively. All patients had a Tönnis grade ≤ 1 pre- and postoperatively.

RTS

Preoperative and postoperative levels of competition are found in Table 2. Preoperative sports are classified in Figure 2, and postoperative RTS status by sport is shown in Table 3. Of the 44 patients included in this study, 41 (93.18%) returned to sport after HA + PAO, and 3 did not return (6.82%). Those who did not return attributed this to issues related to the hip that underwent HA + PAO: 2 indicated persistent pain and 1 indicated painful hardware. Of the 41 athletes who returned to sport, 33 (80.49%) returned to their preoperative level, 5 (12.19%) returned to a higher level of competition, and 3 (7.32%) returned to a lower level of competition. Of the 8 patients who underwent bilateral HA + PAO, all went on to successfully return to the same level of competition.

Eight (9 hips) of the 44 patients (18.19%) had borderline hip dysplasia. Six (7 hips) of these 8 (75%) patients returned to sport, with all 6 of those returning to their preoperative level of competition (Table 4).

DISCUSSION

This study found that 93.18% of competitive athletes returned to sport after HA + PAO, and 86.36% (38/44) returned to sport at the same or higher level of competition, compared with their preoperative level. These promising results support the notion that competitive athletes can RTS after HA + PAO and should be used by surgeons when counseling competitive athletes with hip dysplasia who desire to RTS. These findings add to the limited body of evidence regarding whether patients who undergo PAO-alone or HA + PAO can return to their preoperative level of sport. Heyworth et al. reported an 80% RTS rate at

TABLE 2 Level of Competition Preoperatively and Postoperatively

	Preoperative Competition Level (n = 44)	Returned to Same Competition Level (n = 34)	Returned to Higher Competition Level (n = 5)	Returned to Lower Competition Level (n = 3)	Did not Return (n = 3)
High school	16 (1)	12 (1)	1	2	1
High school and competitive club	6	3	2	0	1
Competitive club	12 (2)	10 (2)	1	0	1
College	9 (3)	7 (2)	1 (1)	1	0
Professional	1 (1)	1 (1)	0	0	0

Note: The total number of subjects are listed with the subset of men listed in parenthesis.

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

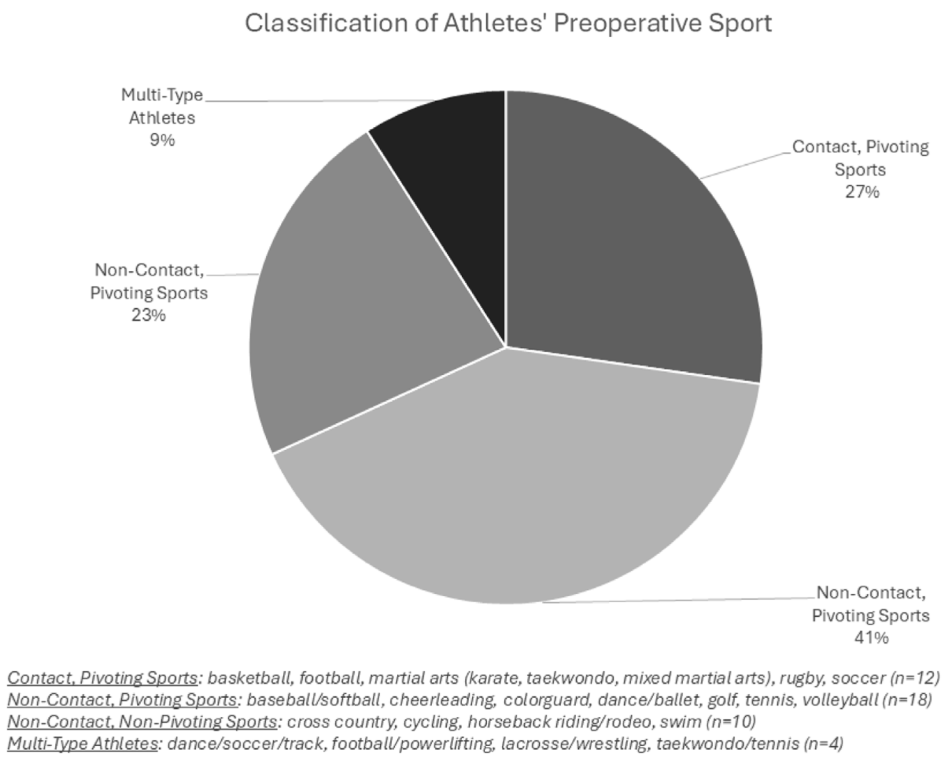

FIGURE 2 Preoperative classification of sports, based on categories by Ishøi et al.[52]

TABLE 3 Return to Sport by Individual Sport

	Returned to Same Competition Level	Returned to Higher Competition Level	Returned to Lower Competition Level	Did not Return
Contact, pivoting sports	14	0	1	1
Basketball	3[□]			
Football	2[‡]			
Martial arts	3			1[†]
Wrestling			1[•]	
Lacrosse			1[•]	
Rugby	1			
Soccer	6[□,◇]			
Noncontact, pivoting sports	13	4	2	1
Baseball	1			
Softball	1			
Cheerleading	2			
Color guard	1			
Dance/ballet	4[◇]	1	1	
Golf	2			
Tennis		2		1[†]
Volleyball	2	1	1	

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Arthroscopy The Journal of Arthroscopic and Related Surgery AANA ADVANCING THE SCOPE Practice-Changing Innovation

TABLE 3 (Continued)

	Returned to Same Competition Level	Returned to Higher Competition Level	Returned to Lower Competition Level	Did not Return
Noncontact, nonpivoting sports	11	1	0	1
Cross country running		1		1
Track	3◊			
Cycling	1			
Horseback riding/ rodeo	3			
Swimming	3			
Powerlifting	1‡			

Note: Total values are for the total of individual athletes in each category. A total of 5 athletes participated in multiple sports and are individually denoted by the unique symbols above (*, †, ‡, □, ◊).

TABLE 4 Level of Competition Preoperatively and Postoperatively for Athletes With Borderline Hip Dysplasia

	Preoperative Competition Level (n = 8)	Returned to Same Competition Level (n = 6)	Returned to Higher Competition Level (n = 0)	Returned to Lower Competition Level (n = 0)	Did not Return (n = 2)
High school	4	3	0	0	1
High school and competitive club	1	0	0	0	1
Competitive club	2	2	0	0	0
College	1	1	0	0	0

an average of 9 months postoperatively in adolescents and young adults after PAO-alone, with 73% of those patients returning to their same or higher level of sport.[22] Another study assessing RTS in dancers after PAO-alone reported a lower RTS rate of 63%, with an average RTS time of 8.8 months postoperatively,[23] which is in contrast with our present findings showing 6 dancers with successful RTS (100%), with only 1 returning at a lower level of competition. It is likely that athletes participating in sports that require extreme ranges of motion (i.e., dancing and cheerleading) may benefit from the adaptive increase in ROM associated with dysplasia.[53] However, more recent evidence indicates that athletes undergoing HA + PAO show greater than an 80% RTS rate.[30,31] Our results report an overall RTS rate of 93.18%, with 86.36% of all athletes returning to the same or higher level of sport after undergoing HA + PAO, which is in agreement with Jimenez et al. and Quesada-Jimenez et al.'s findings.[30,31] The contrasting RTS rates between PAO-alone and HA + PAO outcomes (approximately 20%-30% difference) highlight a noteworthy disparity between each procedure and, therefore, warrants continued investigation.

In addition to the wide range of reported RTS rates, there is also concern as to whether athletes can return to the same preoperative level of activity. Our results showed that 86.36% of competitive athletes returned to sport at the same or higher level of competition. This contrasts with the findings from Petrie et al., which reported a significant decrease in high-impact activities postoperatively among patients who participated in high-impact activities preoperatively.[10] However, they also determined that patients who participated in low-impact activities preoperatively and underwent PAO-alone or HA + PAO shifted to medium-impact activities postoperatively.[10] Similarly, in 2022, Wirries et al. reported a shift from low-impact to moderate- and high-impact sports after PAO-alone, indicating the success of the procedure.[28] Conversely, Leopold et al. reported the opposite in

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

PAO-alone, as more patients shifted to low-impact activities postoperatively, while length of exercise and weekly sports frequency increased.[26] Although these studies give valuable insight into a patient's ability to return-to-impact activities postoperatively, they do not focus on high-level competitive athletes. As such, our study aimed to narrow the cohorts used in these previous studies by focusing solely on athletes of high school competition level or higher to better evaluate their ability to return to the same competitive level of sport.

There is even greater skepticism with regard to whether athletes with BHD can RTS after PAO, as there have been promising results for RTS after isolated hip arthroscopy in these patients.[54-57] RTS rates after hip arthroscopy in patients with BHD are 80%-90% when evaluating athletes of high school competition level and above.[54-57] However, evaluation of whether athletes with BHD can RTS after PAO-alone is scarce, with only 1 known study reporting RTS rates for this population. This study by Leopold et al. defined BHD as those with a LCEA of 18° to 25°.[27] Although their study of 55 patients and 52 hips reported a 92.5% RTS rate after PAO-alone in patients with BHD, it did not separate recreational from competitive athletes, therefore making it not comparable to the studies assessing RTS after hip arthroscopy in those with BHD.[27] Our study includes 8 patients (9 hips) with BHD, 6 (7 hips) of whom returned to sport. Although these results appear to support the notion that athletes with BHD who undergo HA + PAO can RTS, further investigation with a larger sample size is necessary. Although many studies focus on BHD alone, we chose to include this population, as they showed clinical and advanced imaging findings associated with hip instability and dysplasia that led to the decision for HA + PAO instead of isolated hip arthroscopy.

Additionally, several prior studies that focused on RTS after PAO-alone or HA + PAO included athletes of all levels, with subanalyses of competitive athletes.[25,30,31] Hara et al. reported a 55% RTS rate based on a single question of "yes/no" in all patients undergoing PAO-alone at an average of 8 years after surgery. However, they reported an average age of 42 years old at time of surgery, and stratified by low-, intermediate-, and high-impact sports, but did not stratify by level of competition.[25] Similarly, Jimenez et al. and Quesada-Jimenez et al. found rates of 81.8% and 87.5%, respectively, of those attempting to RTS after HA + PAO were able to do so successfully; however, both cohorts consisted of both recreational and competitive athletes.[30,31] Our study is uniquely focused on athletes of high school competition level or higher. This selection criteria may explain why the reported RTS rate from this study is higher than previous studies assessing RTS after PAO-alone or HA + PAO, as there are inherent differences between athletes seeking to return to recreational versus competitive level sports. The differences in RTS based on population have been shown after anterior cruciate ligament reconstruction, where competitive athletes have greater RTS rates than noncompetitive athletes.[58-61] In the authors' clinical experience, those returning to competitive sports tend to have access to more resources through schools, clubs, or professional organizations to better support their recovery. Additionally, there is an increased desire to RTS in these individuals related to the dedication, current or future financial gain, and community support systems.

Because of the lack of consensus and the wide variety of reporting methods for RTS,[62] our study defined RTS based on postoperative competition level compared with preoperative competition level. Prior studies have frequently used PROs to evaluate RTS in those who undergo PAO-alone or HA + PAO. The UCLA Activity Scale, Hip Outcomes Score-Sports Subscale, and Hip Disability and Osteoarthritis Outcome Score-Sport and Recreational Activity questionnaires are commonly used to evaluate RTS after PAO-alone or HA + PAO[22,29,31,63-65] and also to compare outcomes after PAO-alone and HA + PAO.[41,44,65,66] Although these PROs are useful in determining a patient's perspective about their level of function, they lack the objectivity required to report RTS. As such, our assessment of whether an athlete returned to their preoperative level of activity was defined solely by the level of competition and did not incorporate PROs.[25,30,31]

Limitations

There are several limitations to our study that must be acknowledged, the first of which is the retrospective nature of the current study, which could lead to potential selection bias. Furthermore, PRO measures were not available because of the retrospective chart review design. Second, many patients were asked about their RTS status months to years after they did or did not RTS, therefore introducing potential patient recall bias. Additionally, the lack of RTS dates has prohibited us from providing exact timelines for when athletes were able to RTS. Additionally, this study only included patients who desired to return to competitive sports, therefore potentially making these results nongeneralizable to recreational-level athletes attempting to RTS after HA + PAO. We believe that including only the competitive athletes reflects a more applicable cohort to the orthopaedic sports surgeon. Another limitation of this study is that we did not perform a detailed subgroup analysis of concomitant procedures or sport-specific categories and their potential influence on RTS outcomes. Our primary objective was to evaluate RTS after PAO as the main procedure, with concomitant interventions reported

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Arthroscopy The Journal of Arthroscopic and Related Surgery AANA Practice-Changing Innovation

descriptively, given that PAO represents the dominant surgical intervention because of recovery timelines. Although sport type and additional procedures may meaningfully influence RTS outcomes, future predictive analyses specifically designed to examine these variables would further clarify their independent contributions to postoperative sport participation. Furthermore, the distribution of the cohort was imbalanced, with 84.1% women and 15.9% men. This substantial disparity limited our ability to perform a statistically meaningful comparison of RTS rates between sexes. The small number of male participants reduces statistical power, increases the risk of type II error, and may result in estimates that can be misleading or not generalizable. As such, we were unable to draw valid conclusions regarding sex-based differences in RTS in the present study.

CONCLUSIONS

This study reported an overall RTS rate of 93.18% of competitive athletes who underwent a PAO with concomitant hip arthroscopy, with an 86.36% (38/44) rate of return to the same or higher level of competition.

DISCLOSURES

The author (A.M.) declares the following financial interests/personal relationships which may be considered as potential competing interests: A.M. reports a relationship with Newclip Technics, Stryker, and Medical Device Business Services that includes consulting or advisory. The other authors (N.L., J.J., P.S., A.A., A.A.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

ACKNOWLEDGMENTS

The authors would like to acknowledge Nicole Lemaster, Abbey Phelps, Angela Yu, Jessica Dziuba Waters, Emily Gardner, and Brian Duncan for their contributions to this paper.

ORCID

Alfred Mansour https://orcid.org/0000-0001-5073-246X
Nicole Lemaster https://orcid.org/0000-0003-4600-6849
Jacob Jelmini https://orcid.org/0000-0001-9785-9679
Philip Sheedy https://orcid.org/0000-0002-2368-560X
Alexis Aboulafia https://orcid.org/0009-0002-4428-487X

REFERENCES

1. Ganz R, Leunig M, Leunig-Ganz K, Harris WH. The etiology of osteoarthritis of the hip: An integrated mechanical concept. *Clin Orthop Relat Res.* 2008;466:264-272.
2. Leunig M, Siebenrock KA, Ganz R. Rationale of periacetabular osteotomy and background work. *Instr Course Lect.* 2001;50:229-238.
3. Kralj M, Mavcic B, Antolic V, Iglic A, Kralj-Iglic V. The Bernese periacetabular osteotomy: Clinical, radiographic and mechanical 7-15-year follow-up of 26 hips. *Acta Orthop.* 2005;76:833-840.
4. Larsen JB, Mechlenburg I, Jakobsen SS, Thilleman TM, Søballe K. 14-year hip survivorship after periacetabular osteotomy: A follow-up study on 1385 hips. *Acta Orthop.* 2020;91:299-305.
5. Matheney T, Kim YJ, Zurakowski D, Matero C, Millis M. Intermediate to long-term results following the Bernese periacetabular osteotomy and predictors of clinical outcome. *J Bone Joint Surg Am.* 2009;91:2113-2123.
6. Sohatee MA, Ali M, Khanduja V, Malviya A. Does hip preservation surgery prevent arthroplasty? Quantifying the rate of conversion to arthroplasty following hip preservation surgery. *J Hip Preserv Surg.* 2020;7:168-182.
7. Wells J, Millis M, Kim YJ, Bulat E, Miller P, Matheney T. Survivorship of the bernese periacetabular osteotomy: What factors are associated with long-term failure? *Clin Orthop Relat Res.* 2017;475:396-405.
8. Ziran N, Varcadipane J, Kadri O, et al. Ten- and 20-year survivorship of the hip after periacetabular osteotomy for acetabular dysplasia. *J Am Acad Orthop Surg.* 2019;27:247-255.
9. Clohisy JC, Ackerman J, Baca G, et al. Patient-reported outcomes of periacetabular osteotomy from the prospective ANCHOR cohort study. *J Bone Joint Surg Am.* 2017;99:33-41.
10. Petrie JR, Novais EN, An TW, ANCHOR Study Group, Clohisy J. What is the impact of periacetabular osteotomy surgery on patient function and activity levels? *J Arthroplasty.* 2020;35:S113-S118.
11. O'Brien MJ, Semciw AI, Mechlenburg I, Tønning LC, Stewart CJ, Kemp JL. Pain, function and quality of life are impaired in adults undergoing periacetabular osteotomy (PAO) for hip dysplasia: A systematic review and meta-analysis. *Hip Int.* 2024;34:96-114.
12. Fujii M, Nakashima Y, Jingushi S, et al. Intraarticular findings in symptomatic developmental dysplasia of the hip. *J Pediatr Orthop.* 2009;29:9-13.
13. Savoye-Laurens T, Verdier N, Wettstein M, Baulot E, Gédouin JE, Martz P. Labral tears in hip dysplasia and femoroacetabular impingement: A systematic review. *Orthop Traumatol Surg Res.* 2023;109:103539.
14. Sankar WN, Duncan ST, Baca GR, et al. Descriptive epidemiology of acetabular dysplasia: The academic network of conservational hip outcomes research (ANCHOR) periacetabular osteotomy. *J Am Acad Orthop Surg.* 2017;25:150-159.
15. Robertson DD, Essinger JR, Imura S, et al. Femoral deformity in adults with developmental hip dysplasia. *Clin Orthop Relat Res.* 1996;327:196-206.
16. Mahieu P, Hananouchi T, Watanabe N, Claes P, Li H, Audenaert E. Morphological abnormalities of the femur in the dysplastic hip. Relation between femur en acetabulum. *Acta Orthop Belg.* 2018;84:307-315.

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

17. Clohisy JC, Nunley RM, Carlisle JC, Schoenecker PL. Incidence and characteristics of femoral deformities in the dysplastic hip. *Clin Orthop Relat Res.* 2009;467:128-134.
18. Kim KI, Cho YJ, Ramteke AA, Yoo MC. Peri-acetabular rotational osteotomy with concomitant hip arthroscopy for treatment of hip dysplasia. *J Bone Joint Surg Br.* 2011;93:732-737.
19. Domb BG, LaReau JM, Hammarstedt JE, Gupta A, Stake CE, Redmond JM. Concomitant hip arthroscopy and periacetabular osteotomy. *Arthroscopy.* 2015;31:2199-2206.
20. Maldonado DR, LaReau JM, Perets I, et al. Outcomes of hip arthroscopy with concomitant periacetabular osteotomy, minimum 5-year follow-up. *Arthroscopy.* 2019;35:826-834.
21. Ruzbarsky JJ, Comfort SM, Rutledge JC, et al. Improved functional outcomes of combined hip arthroscopy and periacetabular osteotomy at minimum 2-year follow-up. *Arthroscopy.* 2024;40:352-358.
22. Heyworth BE, Novais EN, Murray K, et al. Return to play after periacetabular osteotomy for treatment of acetabular dysplasia in adolescent and young adult athletes. *Am J Sports Med.* 2016;44:1573-1581.
23. Novais EN, Thanacharoenpanich S, Seker A, et al. Do young female dancers improve symptoms and return to dancing after periacetabular osteotomy for the treatment of symptomatic hip dysplasia? *J Hip Preserv Surg.* 2018;5:150-156.
24. Takahashi Y, Takahira N, Uchiyama K, et al. Sports activity participation after curved periacetabular osteotomy for acetabular dysplasia. *BMC Musculoskelet Disord.* 2020;21:637.
25. Hara D, Hamai S, Fukushi JI, et al. Does participation in sports affect osteoarthritic progression after periacetabular osteotomy? *Am J Sports Med.* 2017;45:2468-2475.
26. Leopold VJ, Szarek A, Hipfl C, et al. Changes in sports activity after periacetabular osteotomy: A qualitative and quantitative analysis. *Am J Sports Med.* 2023;51:481-486.
27. Leopold VJ, Szarek A, Hipfl C, Bärtl S, Perka C, Hardt S. Outcomes and return-to-sports rates in patients with borderline hip dysplasia after periacetabular osteotomy: A case series with 5-year follow-up. *Am J Sports Med.* 2024;52:383-389.
28. Wirries N, Posselt C, Ettinger M, et al. Sports activity after pelvic osteotomy for treatment of developmental dysplasia of the hip: A comparative study between the triple pelvic and periacetabular osteotomy techniques. *Orthopadie (Heidelb).* 2022;51:775-780.
29. Edelstein AI, Nepple JJ, Abu-Amer W, Pascual-Garrido C, Goss CW, Clohisy JC. What mid-term patient-reported outcome measure scores, reoperations, and complications are associated with concurrent hip arthroscopy and periacetabular osteotomy to treat dysplasia with associated intraarticular abnormalities? *Clin Orthop Relat Res.* 2021;479:1068-1077.
30. Quesada-Jimenez R, Strok MJ, Schab AR, Becker N, Kahana-Rojkind AH, Domb BG. Return to sport and outcomes after periacetabular osteotomy with concomitant hip arthroscopy in athletes: Minimum 5-year follow-up. *Am J Sports Med.* 2026;54:63-71.
31. Jimenez AE, Lee MS, Owens JS, Maldonado DR, LaReau JM, Domb BG. Athletes undergoing concomitant hip arthroscopy and periacetabular osteotomy demonstrate greater than 80% return-to-sport rate at 2-year minimum follow-up. *Arthroscopy.* 2022;38:2649-2658.
32. Memon M, Kay J, Hache P, et al. Athletes experience a high rate of return to sport following hip arthroscopy. *Knee Surg Sports Traumatol Arthrosc.* 2019;27:3066-3104.
33. Mansour A, Dziuba J, Lemaster N, et al. FP2.2 high level of return to sport after periacetabular osteotomy with concomitant hip arthroscopy in high school to professional level athletes. *J Hip Preserv Surg.* 2025;12(suppl 1):i3-i4.
34. Owens JS, Lee MS, Jimenez AE, Maldonado DR, Lall AC, Domb BG. Elite female athletes demonstrate a comparable improvement in midterm patient-reported outcome scores and rate of return to sport compared with elite male athletes after hip arthroscopic surgery: A sex-based comparison in professional and collegiate athletes. *Am J Sports Med.* 2022;50:3600-3609.
35. Harris JD, Lewis BD, Park KJ. Hip dysplasia. *Clin Sports Med.* 2021;40:271-288.
36. Nepple JJ, Wells J, Ross JR, Bedi A, Schoenecker PL, Clohisy JC. Three patterns of acetabular deficiency are common in young adult patients with acetabular dysplasia. *Clin Orthop Relat Res.* 2017;475:1037-1044.
37. Beltran LS, Rosenberg ZS, Mayo JD, et al. Imaging evaluation of developmental hip dysplasia in the young adult. *AJR Am J Roentgenol.* 2013;200:1077-1088.
38. Clohisy JC, Carlisle JC, Beaulé PE, et al. A systematic approach to the plain radiographic evaluation of the young adult hip. *J Bone Joint Surg Am.* 2008;90(suppl 4):47-66.
39. Welton KL, Kraeutler MJ, Garabekyan T, Mei-Dan O. Radiographic parameters of adult hip dysplasia. *Orthop J Sports Med.* 2023;11:23259671231152868.
40. Orner CA, Haws BE, Reuter J, Kenney R, Cook PC, Giordano BD. Patient-reported outcomes are similar in the first 2 years after staged versus combined hip arthroscopy and periacetabular osteotomy for hip dysplasia. *Arthroscopy.* 2023;39:1857-1865.
41. Thanacharoenpanich S, Boyle MJ, Murphy RF, et al. Periacetabular osteotomy for developmental hip dysplasia with labral tears: Is arthrotomy or arthroscopy required? *J Hip Preserv Surg.* 2018;5:23-33.
42. Maldonado DR, Chen SL, Walker-Santiago R, et al. An intact ligamentum teres predicts a superior prognosis in patients with borderline dysplasia: A matched-pair controlled study with minimum 5-year outcomes after hip arthroscopic surgery. *Am J Sports Med.* 2020;48:673-681.
43. Sabbag CM, Nepple JJ, Pascual-Garrido C, Lalchandani GR, Clohisy JC, Sierra RJ. The addition of hip arthroscopy to periacetabular osteotomy does not increase complication rates: A prospective case series. *Am J Sports Med.* 2019;47:543-551.
44. Ricciardi BF, Mayer SW, Fields KG, Wentzel C, Kelly BT, Sink EL. Patient characteristics and early functional outcomes of combined arthroscopic labral refixation and periacetabular osteotomy for symptomatic acetabular dysplasia. *Am J Sports Med.* 2016;44:2518-2525.
45. Kraeutler MJ, Garabekyan T, Pascual-Garrido C, Mei-Dan O. Hip instability: A review of hip dysplasia and other contributing factors. *Muscles Ligaments Tendons J.* 2016;6:343-353.
46. Smith KM, Gerrie BJ, McCulloch PC, Lintner DM, Harris JD. Comparison of MRI, CT, Dunn 45° and Dunn 90° alpha angle measurements in femoroacetabular impingement. *Hip Int.* 2018;28:450-455.
47. Nötzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. *J Bone Joint Surg Br.* 2002;84:556-560.

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

48. Mak MS, Teh J. Magnetic resonance imaging of the hip: Anatomy and pathology. *Pol J Radiol.* 2020;85:e489-e508.
49. Murphy S, Deshmukh R. Periacetabular osteotomy: Preoperative radiographic predictors of outcome. *Clin Orthop Relat Res.* 2002;405:168-174.
50. Fiedler AK, Siahaan JJ, Aboulafia AH, Ham AA, Mansour AA. Periacetabular osteotomy multimodal pain control using erector spinae plane versus epidural catheter: A retrospective cohort analysis. *Anesthesiology.* 2025;142:907-915.
51. Novais EN, Kim YJ, Carry PM, Millis MB. The Bernese periacetabular osteotomy: Is transection of the rectus femoris tendon essential? *Clin Orthop Relat Res.* 2014;472:3142-3149.
52. Ishøi L, Thorborg K, Kraemer O, Hölmich P. The association between specific sports activities and sport performance following hip arthroscopy for femoroacetabular impingement syndrome: A secondary analysis of a cross-sectional cohort study including 184 athletes. *J Hip Preserv Surg.* 2019;6:124-133.
53. Stocks OG, Han S, Song B, et al. Poster 208: Predicting patient-specific hip motion during functional activities after periacetabular osteotomy. *Orthop J Sports Med.* 2024;12(suppl 2): 2325967124S00177.
54. Alter TD, Knapik DM, Chapman RS, et al. Return to sport in athletes with borderline hip dysplasia after hip arthroscopy for femoroacetabular impingement syndrome. *Am J Sports Med.* 2022;50:30-39.
55. Owens JS, Jimenez AE, Lee MS, Monahan PF, Maldonado DR, Domb BG. High-level athletes with borderline hip dysplasia achieve favorable outcomes and return to sport rates following primary hip arthroscopy: Minimum 5-year outcomes comparison to a propensity-matched control group. *Arthroscopy.* 2023;39:271-282.
56. Jimenez AE, Monahan PF, Miecznikowski KB, et al. Achieving successful outcomes in high-level athletes with borderline hip dysplasia undergoing hip arthroscopy with capsular plication and labral preservation: A propensity-matched controlled study. *Am J Sports Med.* 2021;49:2447-2456.
57. Saito M, Yamamoto T, Kamono E, et al. EP1.57 Rate of return to sports by athletes following primary hip arthroscopy to treat borderline developmental dysplasia of the hip: A systematic review and meta-analysis. *J Hip Preserv Surg.* 2025;12(suppl 1):i52-i53.
58. Ardern CL, Taylor NF, Feller JA, Webster KE. Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: An updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. *Br J Sports Med.* 2014;48:1543-1552.
59. Ardern CL, Taylor NF, Feller JA, Whitehead TS, Webster KE. Psychological responses matter in returning to preinjury level of sport after anterior cruciate ligament reconstruction surgery. *Am J Sports Med.* 2013;41:1549-1558.
60. Ardern CL, Webster KE, Taylor NF, Feller JA. Return to sport following anterior cruciate ligament reconstruction surgery: A systematic review and meta-analysis of the state of play. *Br J Sports Med.* 2011;45:596-606.
61. Ardern CL. Anterior cruciate ligament reconstruction—Not exactly a one-way ticket back to the preinjury level: A review of contextual factors affecting return to sport after surgery. *Sports Health.* 2015;7:224-230.
62. Doege J, Ayres JM, Mackay MJ, et al. Defining return to sport: A systematic review. *Orthop J Sports Med.* 2021;9: 23259671211009589.
63. Bogunovic L, Hunt D, Prather H, Schoenecker PL, Clohisy JC. Activity tolerance after periacetabular osteotomy. *Am J Sports Med.* 2014;42:1791-1795.
64. Swarup I, Zaltz I, Robustelli S, Sink E. Outcomes of periacetabular osteotomy for borderline hip dysplasia in adolescent patients. *J Hip Preserv Surg.* 2020;7:249-255.
65. Nepple JJ, Parilla FW, Pashos GE, Clohisy JC. Outcomes of periacetabular osteotomy for borderline acetabular dysplasia. *J Bone Joint Surg Am.* 2023;105:137-144.
66. Panos JA, Gutierrez CN, Wyles CC, et al. Addressing intraarticular pathology at the time of anteverting periacetabular osteotomy for acetabular retroversion is associated with better short-term patient-reported outcomes. *J Hip Preserv Surg.* 2021;8: 90-104.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section.

15263231, 0, Downloaded from https://arthroscopyjournals.onlinelibrary.wiley.com/doi/10.1002/arj.70523, Wiley Online Library on [09/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License