Return to Dance and Predictors of Outcome After Hip Arthroscopy for Femoroacetabular Impingement Syndrome

Gift C. Ukwuani, M.D., Brian R. Waterman, M.D., Benedict U. Nwachukwu, M.D., M.B.A., Edward C. Beck, M.P.H., Kyule N. Kunze, B.S., Joshua D. Harris, M.D., and Shane J. Nho, M.D., M.S.

Purpose: To investigate the rate of return to dance and factors influencing this primary outcome after hip arthroscopy for the treatment of femoroacetabular impingement syndrome. **Methods:** A consecutive series of self-identified dancers with femoroacetabular impingement syndrome was included. To assess for the impact of hypermobility on outcomes, patients were classified as having either generalized joint laxity (GJL) or no GJL based on the Beighton-Horan Joint Mobility Index. A return-to-dance survey, the modified Harris Hip Score, and the Hip Outcome Score (HOS)—Activities of Daily Living and HOS—Sports-Specific subscales were collected preoperatively and postoperatively at 6, 12, 24, and 36 months. The preoperative-to-postoperative outcome score change was compared using the minimal clinically important difference and patient acceptable symptomatic state. Return to dance was evaluated regarding (1) return to any dance activity, (2) return to prior level of dance, and (3) number of hours of dance participation after surgery. Clinical and demographic predictors and return to dance were analyzed using univariate or bivariate analysis where appropriate. **Results:** The study included 64 consecutive dancers (62 female and 2 male patients) (mean age, 22.3 ± 9.4 years; body mass index, 22.8 ± 4.1) with a mean follow-up period of 23.0 months. Postoperatively, 62 patients (97%) returned to dance at an average of 6.9 ± 2.9 months; 40 patients (62.5%) reported that they returned to a better level of participation, whereas 20 dancers (31%) returned to the same level of participation. Statistically significant increases were observed for the HOS—Activities of Daily Living subscale (60.5 ± 19.5 vs 92.4 ± 11.8, $P < .001$), HOS—Sports-Specific subscale (40.3 ± 20.3 vs 83.5 ± 19.4, $P < .001$), and modified Harris Hip Score (57.0 ± 13.6 vs 86.6 ± 13.9, $P < .001$). There was, however, a significant decrease in the number of hours of dance postoperatively: 11.5 ± 8.2 h/wk preoperatively versus 9.0 ± 7.3 h/wk postoperatively ($P = .041$). All postoperative hip outcome measures showed statistically significant ($P < .001$) and clinically relevant improvements. Patient-reported outcomes and return time showed no significant differences between the patient groups with GJL and without GJL ($P = .1$ and $P = .489$, respectively). For competitive dancers, a correlation was shown with a shorter time to return to dance ($r^2 = 0.45$, $P = .001$), but there were no significant differences by skill level in

From the Section of Young Adult Hip Surgery, Division of Sports Medicine, Department of Orthopedic Surgery, Rush University Medical Center (G.C.U., E.C.B., K.N.K., S.J.N.), Chicago, Illinois; Department of Orthopaedic Surgery, Wake Forest Baptist Medical Center (B.R.W.), Salem, North Carolina; Department of Orthopaedic Surgery, Hospital for Special Surgery (B.U.N.), New York, New York; and Department of Orthopaedic Surgery, Houston Methodist Hospital (J.D.H.), Houston, Texas, U.S.A.

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Address correspondence to Shane J. Nho, M.D., M.S., Department of Orthopaedics, Rush University Medical Center, 1611 W Harrison St, Ste 300, Chicago, IL 60612, U.S.A. E-mail: nho.research@rushortho.com

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patient-reported outcomes or dance hours. **Conclusions:** After hip arthroscopy, 97% of dancers returned to dance at an average of 6.9 months, with most dancers dancing at a level higher than their preoperative status. Dance experience level was the only significant factor influencing return-to-dance outcomes, with competitive dancers showing a faster return to dancing.conclusion **Level of Evidence:** Level IV, therapeutic case series.

Performance arts often require complex joint movements that command a delicate mix of skill, strength, and balance. Specifically, the extreme motions involved with dance place the hip joint at risk of intra- and extra-articular impingement, often with compensatory osseous and muscular pathology.[1,2] The 5 positions in classical ballet require marked external rotation at the hip and knee with external tibial torsion.[2-4] Compared with nondancers, increased hip external rotation and abduction with limited passive adduction and internal rotation are observed in dancers.[5] Furthermore, hypermobility is often observed in dancers and may be innate or acquired as a result of long-term training.[4,5] The prevalence of hyperlaxity among dancers has been reported to be as high as 20% to 66% and is thought to confer the ability to achieve professional status.[6,7]

Hip pathologies account for up to 40% of injuries sustained by dancers, with hip impingement and iliotibial band tightness making up most of these injuries.[4,8] Femoroacetabular impingement syndrome (FAIS) is a condition in which anatomic abnormalities of the femoral head or the acetabulum result in abnormal contact during hip motion. The abnormal contact is more pronounced in positions of hip flexion and rotation and may lead to chondrolabral damage with resultant pain.[9] As with other athletes, dancers with FAIS often present with pain in the anterior thigh and groin areas during provocative activity.

The ability to return to play is an important measure of outcome for athletes and performers.[10] Several published case series have shown good return-to-sport rates for athletes after hip arthroscopy.[11-16] Dance performance places unique and specific challenges on the hip joint and is a common reason for symptomatic FAIS. Despite the importance of dance activity for FAIS, limited literature is available regarding the rate of return to dance activity and clinical outcomes after arthroscopic treatment of FAIS. The purpose of this study was to investigate the rate of return to dance and factors influencing this primary outcome after hip arthroscopy for the treatment of FAIS. We hypothesized that there would be a high rate of return to dance, with no differences based on age, laxity, or dance level.

Methods

Study Design

Institutional review board approval was obtained (12022108-IRB01, hip injury and arthritis repository) to allow for prospective collection of patients undergoing hip arthroscopy for FAIS by a single fellowship-trained hip surgeon (S.J.N.). Consent was obtained from all study participants, including consent for minors when appropriate. A query of the surgical repository was performed to isolate all patients who preoperatively identified themselves as dancers and had FAIS between January 1, 2012, and December 31, 2015. The inclusion criteria required clinical indications and radiographic diagnoses consistent with symptomatic FAIS, failure of nonsurgical management (including physical therapy, activity modification, and when necessary, intra-articular corticosteroid injections), and primary dance participation prior to surgery. Exclusion criteria were applied to the following: retired dancers, symptomatic contralateral hip requiring surgery, history of trauma or rheumatologic disease, history of pediatric deformities (developmental dysplasia of the hip, slipped capital femoral epiphysis, and Perthes disease), osteoarthritis or any joint space narrowing (Tönnis grade > 1), history of bilateral hip surgery, ipsilateral knee and ankle injuries or surgery within the postoperative period, and follow-up length of less than 12 months.

Patient Demographic Characteristics and Clinical Outcomes

Included patients completed a preoperative questionnaire consisting of information on demographic characteristics (sex, age, operative extremity, body mass index [BMI], sports participation, acute vs insidious onset, presence of limp, symptom duration, and comorbidities). All included patients underwent assessment for hypermobility, and patients were classified as having either generalized joint laxity (GJL) or no generalized joint laxity (NGJL) based on the Beighton-Horan Joint Mobility Index.[17] A Beighton score of 0 to 3 was considered normal, whereas a score between 4 and 9 was considered GJL disorder.

External and internal rotation range of motion was measured using a goniometer in 90° of hip flexion in the supine position. All patients were assessed for hypermobility and had range of motion evaluated either by the senior author (S.J.N.) or his physician assistants or by a sports medicine fellow (B.R.W.).

Patients completed preoperative and postoperative (minimum of 24 months) hip-specific functional outcome measures (modified Harris Hip Score [mHHS], Hip Outcome Score—Sports-Specific [HOS-SS] and Hip Outcome Score—Activities of Daily Living [HOS-ADL] subscales, VAS for satisfaction, and VAS for pain). A

nonvalidated postoperative return-to-dance survey was sent to all study participants (Appendix Table 1). Study participants provided information on type of dance (ballet, tap, Jazzercise [Jazzercise, Carlsbad, CA], hip hop, salsa, Zumba [Zumba Fitness, Hallandale Beach, FL], cheerleading, and pom dance), dance level (beginner, intermediate, competitive, or recreational), and dance affiliation (dance school, dance company, or dance group). To explain the rationale for decreased postoperative dance performance and/or hours, patients were asked to rate, on a 10-point scale, fear of reinjury, prolonged postoperative pain, and loss of interest as factors influencing return to dance participation.

Radiographic Measurements

Preoperative and postoperative radiographs including anteroposterior pelvis, false-profile, and Dunn lateral views were obtained. The Tönnis grade and lateral center-edge angle (LCEA) were measured on the anteroposterior pelvis radiographs, and the alpha angle (AA) was measured on Dunn lateral radiographs.[18]

Surgical Technique and Intraoperative Assessment

All arthroscopic procedures were performed with the patient under general anesthesia in the supine position on a standard traction table.[14,19,20] Anterolateral and midanterior portals provided visualization of the central and peripheral compartments. Hip traction was taken down after work in the central compartment was complete. Procedures performed may have included the following, depending on osseous pathomorphology and soft-tissue injury: labral refixation or partial debridement, acetabular rim trimming, femoral osteochondroplasty, limited synovectomy, subspine decompression, and/or microfracture.

Intraoperative findings were documented in terms of the presence of labral injury, tear size and location, and cartilage injury. Chondral status was assessed using the Outerbridge classification (grade 0-4).[21] A T-capsulotomy was placed at the midpoint of the anterior femoral neck through the distal anterolateral accessory portal to assist with arthroscopic visualization in the peripheral compartment. A thorough femoral osteochondroplasty was performed in the peripheral compartment where cam pathology was observed. A dynamic examination was used to confirm no further evidence of impingement. The capsule was closed by plication at the end of each procedure using high-tensile nonabsorbable sutures passed through the vertical and interportal aspects of the T-capsulotomy, with 2 or 3 sutures in each limb.

Postoperative Rehabilitation Protocol

After surgery, patients went through the same 4-phase rehabilitation protocol lasting 24 to 32 weeks (Appendix Table 2). Patients ambulated with the aid of bilateral crutches for a minimum of 3 weeks with a 20-lb, foot-flat weight-bearing restriction. Hip orthosis was used to prevent active abduction, hip flexion beyond 90°, extension beyond neutral, and external rotation. Daily passive motion and soft-tissue mobilization with supervised physical therapy started on postoperative day 1. At 3 weeks, closed-chain exercises were initiated, and patients progressed to weight bearing as tolerated without crutches or a brace. At 12 weeks, patients progressed to straight-line rotational control, agility, and plyometric exercises.

Therapy specific to a return-to-dance protocol included certain precautions for the first 6 weeks, including avoidance of the extremes of range of motion in all planes to protect the capsular closure or plication and repaired labrum, as well as to prevent secondary injury to tight or weak muscular tissue structures. Patients were subsequently introduced to cycling exercises and progressed using an upright stationary elliptical machine. Patients progressed to single—leg stance balance activities, eccentric and concentric core and lower-extremity strength training, advanced core activation and proximal control, and femoroacetabular and acetabulofemoral rotational control and strength. On the basis of the clinician's assessment and the ability to progress with minimal pain, good proximal control with exercises and functional activities, and the absence of a compensatory gait pattern, patients were cleared to return to dance at 24 weeks.

Statistical Analysis

Return to dance was evaluated regarding (1) return to any dance activity, (2) return to prior level of dance, and (3) number of hours of dance participation after surgery. Patients were stratified according to participation level: competitive (including professional dancers), intermediate (including high school—level dancers), and recreational (including Zumba, Jazzercise, and low-level dancers). As part of the return-to-dance questionnaire, patients were asked to self-describe whether they had returned to the same level or a higher level of function based on these 3 tiers. In addition, return to prior function was assessed based on the number of hours of dance participation.

Clinical data were analyzed using SPSS statistical software (IBM SPSS Statistics for Windows, version 22.0; IBM, Armonk, NY). Descriptive statistics summarizing patient demographic characteristics were presented as means and standard deviations or percentages where appropriate. Return-to-dance survey responses were averaged to provide continuous data for hours spent on dance per week, time during which dancing was discontinued preoperatively, and time to return to dance after surgery. Parametric and nonparametric tests were used to compare continuous and categorical data, respectively. The Tukey-Kramer

Table 1. Patient Demographic Characteristics, Dance Affiliations, Levels of Participation, and Dance Types

	Data
Demographic characteristic	
Female sex	62 (97%)
Age, yr	22.3 ± 9.4
BMI	22.8 ± 4.1
Left laterality	28 (43%)
Dance affiliation*	
Dance school	40 (63%)
Dance company	36 (56%)
Dance group	38 (59%)
Participation level	
Competitive	33 (51%)
Intermediate	21 (33%)
Recreational	10 (6%)
Dance type*	
Ballet	42 (66%)
Cheerleading	13 (20%)
Pom dance	12 (18%)
Hip-hop	18 (28%)
Tap	18 (28%)
Zumba	11 (17%)
Salsa	7 (11%)
Jazzercise	14 (22%)

NOTE. Data are presented as frequency or mean ± standard deviation.

BMI, body mass index.

*A number of subjects reported multiple dance affiliations and dance types.

honest significant difference (HSD) test was used to compare outcome differences between participation levels and generalized hyperlaxity. To compare patient-reported outcomes and return-to-dance time in ballet versus non-ballet dancers, *t* tests were used. Tests were considered significant at $P < .05$. A post hoc matched-pairs power analysis with an α value of .05 and β value of .8 confirmed that the study was adequately powered to detect differences between preoperative and postoperative outcome scores.

Results

Patient Demographic Characteristics

Our study included 69 patients who identified as dancers prior to surgery. We excluded 10 patients because of a history of bilateral hip surgery (n = 7), postoperative retirement that was not related to surgery (n = 2), and recent surgery on the contralateral extremity (n = 1), leaving 66 patients who met the study criteria. The retired patients reported advanced age (n = 1) and career change (n = 1) as reasons for retirement. A total of 64 patients completed the final follow-up at 23.0 ± 12.2 months (range, 12-60 months) and responded to return-to-dance surveys as well as patient-reported outcome scores. Two patients were lost to follow-up.

There were 62 female patients (97%) and 2 male patients (3%); the average age was 22.3 ± 9.4 years, and the average BMI was 22.8 ± 4.1 (Table 1). Competitive or professional dancers comprised 33 patients (51%), and the average preoperative session (hours per week) was 8.9 ± 11.6 h/wk (range, 1-30 h/wk). Of the patients, 52 (81%) had to discontinue or decrease their dance participation prior to surgery at an average of 9.1 ± 6.8 months because of pain (Table 2).

Radiographic Parameters

The average preoperative AA measured on Dunn lateral radiographs was 59.6° ± 9.2°, and the average LCEA was 31.7° ± 5.8°. Cam morphology (AA > 50°) was found in 63 patients (98%). Pincer morphology was evident in 6 patients (9%) and borderline dysplasia was evident in 7 patients (11%), whereas no cases of hip dysplasia were noted. All patients had a joint space greater than 2 mm and Tönnis grade 0.

Intraoperative Findings and Surgical Procedures

All patients had evidence of a labral tear intraoperatively; 62 patients underwent labral repair, whereas 2 underwent selective labral debridement. Cam, pincer, and cartilage delamination was seen in 59 cases (92%), 54 cases (84%), and 24 cases (38%), respectively.

Clinical and Patient-Reported Outcomes

Compared with preoperative values, significant improvement was seen in all mean patient-reported outcomes (HOS-ADL, HOS-SS, mHHS, and VAS for pain). Minimal clinically important difference and patient acceptable symptomatic state values were derived from previously published literature.[22,23] The minimal clinically important difference for the HOS-ADL, HOS-SS, and mHHS were met at 90% (n = 56), 88% (n = 55), and 97% (n = 60), respectively. The patient acceptable symptomatic state for the HOS-ADL, HOS-SS, and mHHS were met at 79% (n = 49), 74% (n = 46), and 85% (n = 53), respectively (Table 3).

Generalized Joint Laxity

Of the patients, 21 (33%) met the criteria for the diagnosis of GJL. Patients with GJL were found to be younger than those without joint laxity. No significant difference across groups was found in any of the postoperative patient-reported outcomes or return to dancing activity (Table 4).

Return to Dance

The beginner and intermediate levels comprised high school dancers, choreographers, and dancers with dance school and dance group affiliations. Competitive dancers were professional and amateur dancers

Table 2. Dance-Specific Metrics for Returning to Dance

	Data
Return to dance, n	62 (97%)
Preoperative dance years	11.4 ± 7.6
Preoperative hours per week	11.5 ± 8.2
Postoperative hours per week	9.0 ± 7.3*
Time dance was discontinued preoperatively, mo	8.5 ± 5.2
Time to return to dance, mo	6.9 ± 2.9
Dance years correlated with faster return	$r^2 = 0.45$, $P = .001$
Return-to-dance participation level, n	
Higher level	40 (62.5%)
Same level	20 (31%)
Lower level	2 (3%)
Unable to return	2 (3%)
Reason for inability to return to dance, n	
Grade 4 chondromalacia	1 (1.5%)
MVA	1 (1.5%)

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.
MVA, motor vehicle accident.
*Statistically significant ($P < .05$).

affiliated with dance companies. Dancers participated in more than 1 dance type. Recreational dancers consisted mostly of older subjects who participated in Zumba and Jazzercise.

After arthroscopic management of FAIS, 62 patients (97%) returned to dance including 41 of 42 patients (98%) involved in ballet. The average number of years that subjects participated in dance prior to surgery was 11.4 ± 7.6 years (range, 1.5-37 years). The mean time to return to dance after surgery was 6.9 ± 2.9 months. Of the patients, 40 (62.5%) reported that they returned to a better level of participation, 20 (31%) returned to the same level of participation, and 2 (3%) returned to a lower level of activity than that prior to the onset of hip symptoms. Two patients were unable to return to dance. One patient had grade 4 chondromalacia observed intraoperatively with persistent pain and symptoms postoperatively, and the other patient was involved in an automobile accident affecting the ipsilateral knee in the postoperative period.

Patients danced an average of 11.5 ± 8.2 h/wk preoperatively and 9.0 ± 7.3 h/wk postoperatively ($P = .041$). On Pearson coefficient analysis, the number of years that patients had danced prior to surgery was moderately correlated with the time to return to dancing ($r^2 = 0.45$, $P = .001$). Age, BMI, and level of competition had no significant correlation with return time.

Ballet dancers had a significantly higher number of dance participation years than non-ballet dancers ($P = .024$). There was no difference in BMI, return-to-dance time, AA, LCEA, and preoperative and postoperative patient-reported outcomes across groups (Table 5). Dance type (ballet vs non-ballet dancers), age, BMI, and dance level (competitive, intermediate, or recreational) were built into the regression model to determine the influence on return-to-dance time (in months), and no single variable showed a significant influence on return time.

Discussion

In this study, we found a high rate of return to dance after arthroscopic treatment of FAIS in active dancers. After hip arthroscopy, 97% of dancers returned to dance at an average of 6.9 months, with most dancers dancing at a level higher than their preoperative status; however, there was also a decrease in the number of dance hours after surgery. Dance experience level was the only significant factor influencing return-to-dance outcomes, with more experienced dancers showing a faster return to dancing. As such, we accept our hypothesis that there would be a high rate of return to dance, but we reject the null hypothesis because we found that the level of dance competition was a significant predictor of return to dance. Of note, a moderate correlation was found between years spent dancing prior to surgery and return to dance after surgery. However, the correlation was not strong enough to conclude with certainty that years of dancing is a predictor of returning to dance.

The time to return to play was similar to a prior study by Nwachukwu et al.[16] that found that National Football League athletes undergoing arthroscopic treatment of FAIS returned to sport at a mean of 6.0 months after surgery. In addition, the authors found a 92.5% return-to-play rate—which is comparable to our study. Similarly, Menge et al.[24] found an 87% return-to-play rate in a series of National Football League athletes at another institution. Degen et al.[12] evaluated return to sport among competitive baseball players and found that the return rate was high (88%) with significant clinical outcome improvement. As such, our study builds on prior work looking at return to sport after hip arthroscopy by assessing outcomes in dance performers.

Table 3. Patient-Reported Outcome and Hip Passive Range-of-Motion Data

	Preoperative	Postoperative	*P* Value
Patient-reported outcome			
HOS-ADL	60.5 ± 19.5	92.4 ± 11.8	.001
HOS-SS	40.3 ± 20.3	83.5 ± 19.4	.001
mHHS	57.0 ± 13.6	86.6 ± 13.9	.001
VAS for pain	7.8 ± 6.41	0.9 ± 1.1	.001
VAS for satisfaction		90.3 ± 18.0	
Range of motion, °			
Flexion	115.9 ± 11.9	121.8 ± 8.4	.001
External rotation	44.5 ± 10.7	44.8 ± 12.1	.47
Internal rotation	19.9 ± 9.6	26.6 ± 4.8	.001

NOTE. Data are presented as mean ± standard deviation.
HOS-ADL, Hip Outcome Score—Activities of Daily Living subscale; HOS-SS, Hip Outcome Score—Sports-Specific subscale; mHHS, modified Hip Harris Score; VAS, visual analog scale.

Table 4. Comparison of Outcomes Based on Joint Laxity

	GJL	NGJL	*P* Value
n	21 (33%)	43 (67%)	
Beighton score	5.5 ± 1.4	0.9 ± 0.6	<.001
Age, yr	19.9 ± 6.7	23.3 ± 10.4	<.001
BMI	21.9 ± 3.4	23.2 ± 4.6	.057
Time dance was discontinued preoperatively, mo	6.9 ± 4.2	8.9 ± 5.8	.185
Time to return to dance, mo	7.1 ± 2.9	6.6 ± 2.4	.489
Postoperative-reported outcome			
HOS-ADL	96.7 ± 3.1	94.4 ± 6.1	.110
HOS-SS	88.2 ± 10.7	82.5 ± 21.4	.295
mHHS	90.0 ± 7.4	88.9 ± 12.7	.741
VAS for satisfaction	93.5 ± 19.0	87.3 ± 19.5	.243

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

BMI, body mass index; GJL, generalized joint laxity; HOS-ADL, Hip Outcome Score—Activities of Daily Living subscale; HOS-SS, Hip Outcome Score—Sports-Specific subscale; mHHS, modified Hip Harris Score; NGJL, no generalized joint laxity; VAS, visual analog scale.

On the basis of the available data, dancers show the highest reported return-to-performance rate in the available literature.

Repetitive movements such as the ballet turnout, grand *plié*, and *developpé à la seconde* entail a combination of extreme hip flexion, abduction, and external rotation of up to 55° to 70° that may lead to developmental abnormalities, such as relative femoral retroversion, and earlier symptomatic onset of acetabular labral tears with pincer-type (or less commonly cam-type) FAIS, typically involving the more superior or posterolateral aspect of the hip.[25-27] Recurrent edge loading and abnormal contact stresses may also lead to disproportionately higher rates of chondral pathology among dancers and, potentially, early secondary osteoarthritis.[25,27] In addition, femoroacetabular impingement (FAI) and hip instability are not mutually exclusive. In this unique patient subset, impingement-related instability, with both anteroinferior and posteroinferior subluxation due to a dynamic bony conflict and acetabular retroversion with posterior deficiency, respectively, may also be recognized.[25]

Despite the prevalence of hip pathology among dance populations, clinical outcome studies documenting their functional results are surprisingly lacking, particularly investigations evaluating arthroscopic management of dance-related FAI. Given the predilection for patients with generalized or acquired hyperlaxity to pursue dancing involvement, numerous studies have likely encompassed dance athletes or performance artists within their broader series.[28,29] To our knowledge, only 1 known series has evaluated the return to dance activity after hip arthroscopy. Kocher et al.[26] reviewed a series of 30 patients with a mean age of 20.1 years who underwent arthroscopic debridement of symptomatic labral tears with a minimum 5-month follow-up (range, 5-51 months). They noted significant improvements in the Harris Hip Score from 52.7 preoperatively to 91.5 postoperatively, as well as decreases in the pain score from 7.5 to 2.5 after surgery. However, only 22 patients (73%) had returned to dance, with an average of 11.1 h/wk (preoperatively 17.1 h/wk), including 17 (57%) with a return to their preinjury level of activity. This study was limited,

Table 5. Grouping Based on Dance Level

	Competitive	Intermediate	Recreational	*P* Value
n	33	21	10	
Age, yr	20.8 ± 6.8	17.2 ± 3.1	30.9 ± 9.5	.001*
BMI	21.5 ± 3.2	23.4 ± 5.1	24.7 ± 3.2	.57
Dance years prior to surgery	14.1 ± 6.1	5.9 ± 2.9	4.8 ± 4.2	.001*
Time dance was discontinued preoperatively, mo	7.1 ± 5.1	9.4 ± 5.9	8.7 ± 4.2	.229
Time to return to dance, mo	7.6 ± 2.8	5.7 ± 1.7	7.3 ± 4.6	.098
Preoperative AA, °	58.4 ± 8.7	62.6 ± 9.9	56.7 ± 9.5	.174
Preoperative LCEA, °	30.3 ± 5.2	32.6 ± 6.5	34.4 ± 6.1	.111
Postoperative reported outcome				
Postoperative HOS-ADL	94.9 ± 7.4	90.5 ± 15.6	96.2 ± 5.2	.274
Postoperative HOS-SS	86.7 ± 14.4	82.3 ± 23.9	91.6 ± 16.2	.274
Postoperative mHHS	89.2 ± 9.2	88.7 ± 14.2	90.9 ± 10.1	.889

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

AA, alpha angle; HOS-ADL, Hip Outcome Score—Activities of Daily Living subscale; HOS-SS, Hip Outcome Score—Sports-Specific subscale; LCEA, lateral center-edge angle; mHHS, modified Hip Harris Score.

*Statistically significant.

however, by the use of labral debridement, which is no longer preferred, as well as lack of discussion of capsular management strategies. The current data set provides a detailed study of surgical technique and shows a significantly higher return-to-dance rate than that previously reported by Kocher et al.

The decrease in time spent dancing after hip arthroscopy is similar to what was observed in other studies looking at return to dance and other types of physical activity.[26,30,31] However, as with the other studies that analyzed the amount of time being active preoperatively and postoperatively, the difference was small and most patients returned to sport after hip arthroscopy. It is possible that the decrease in average time spent dancing is because of a loss of interest or because of kinesiophobia, as seen in athletes recovering from anterior cruciate ligament reconstruction.[32]

The impact of generalized joint hypermobility on surgical outcomes of FAI treatment remains an area of debate, and its role in the dance athletes undergoing arthroscopy is not well understood. Previous authors have expressed concerns about the dangers of increased mobility with pincer decompression and secondary microinstability or macroinstability, even with judicious capsular management. Conversely, overzealous capsular plication may adversely constrain necessary hip motion, particularly external motion required for the lower-extremity turnout.[4] Naal et al.[11] initially suggested that hypermobile female patients with pincer-type FAI have less predictable clinical outcomes after open surgical management. In their follow-up study of 232 consecutive patients undergoing open, mini-open, and arthroscopic management of FAI, they showed no correlation between Beighton scores and subjective failure or postoperative patient-reported outcome measures, including the Oxford Hip Score, University of California at Los Angeles Activity Scale, and EuroQol-5 Dimension Index or VAS.[33] Conversely, patients with subsequent conversion to hip arthroplasty had significantly lower mean Beighton scores than patients without objective failure. Pontiff et al.[34] evaluated the role of hyperlaxity in 166 female patients undergoing hip arthroscopy for FAI, including 35 patients with and 131 patients without GJL based on a Beighton score of 4 or greater. At 6 months postoperatively, no significant differences were found in mean postoperative scores or changes in outcome scores for the HOS-ADL, International Hip Outcome Tool (iHOT-33), or Short Form 12-item Health Survey (SF-12) among patients with or without hyperlaxity. With a third of individuals identified with a Beighton score of 4 or greater, our investigation also showed no significant differences in postoperative patient-reported outcome measures or return to dance activity among patients with or without hyperlaxity. Further investigations are warranted to delineate whether athletes, specifically those involved in dance or the performing arts, necessitate differing arthroscopic management in the presence of symptomatic FAI.

Limitations

A number of limitations to this study must be acknowledged. Given the nature of the retrospective return-to-dance questionnaire including self-reported dance level and hours of training, our study may be subject to recall bias. In addition, this study performed comparisons across different dance types, which may limit single-sport generalizability and not encompass all styles of dance with other types of intensity or biomechanical requirements. However, we defined competitive dancers as those with professional or semiprofessional affiliations, and as such, this lends fidelity to our findings on the impact of competition level and skill. In addition, given the individual-surgeon series, our data set may be subject to selection bias, with titration of capsular plication based on preoperative evaluations or level, type of dance involvement, and surgeon preference. Furthermore, joint laxity, BMI, age, and other sport activity were not controlled for in this study, which could have confounded the clinical outcomes (pain and satisfaction). Finally, the survey used to identify dance type and level of dance has not been validated.

Conclusions

After hip arthroscopy, 97% of dancers returned to dance at an average of 6.9 months, with most dancers dancing at a level higher than their preoperative status. Dance experience level was the only significant factor influencing return-to-dance outcomes, with competitive dancers showing a faster return to dancing.

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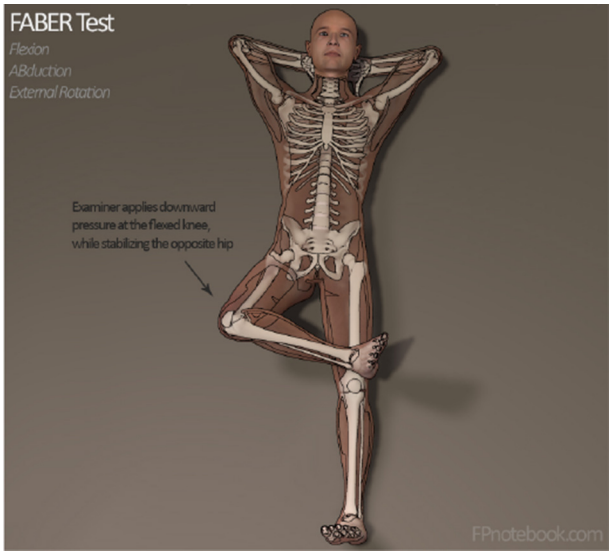
Appendix

Appendix Table 1. Return-to-Dance Survey

Question Prompts	Answer Prompts
1. How long have you been dancing prior to surgery (years)? Please, check all types of dance you did prior to surgery.	Ballet Zumba Choreography Break-dancing/hip-hop Cheerleading Salsa Jazzercise Pom dance Marching band Tap dance Other: __
2. On average, how many hours per week did you dance prior to surgery? What level would you consider yourself (beginner, intermediate, advanced, recreational, etc)? Please check all dance affiliations that apply.	Dance school Dance company Group dancing (band, church, recreational, Zumba, dance class) Other: __
3. In the immediate period prior to surgery, were you able to dance at your usual pace? Mark only one.	Yes, there was no change in my ability to dance No, I decreased my pace/hours No, I completely stopped dancing Other: __
4. For how long prior to surgery (in months) did you decrease/ discontinue dancing?	Number of months: ___
5. If you could not dance at your usual pace, why? Mark only one.	Pain Lack of interest Availability Other: __
6. How long (in months) did it take before you could dance with minimal pain after surgery?	Number of months: ___
7. On average, how many hours per week do you dance now (since surgery)?	Number of hours: ___
8. If you have either not returned to dance or have decreased the hours since after surgery, please rank the following from 1 (not at all a factor) to 10 (extremely important factor) as to why you changed your dancing habits. Mark only one per row.	Pain or discomfort: 1-10 Loss of interest: 1-10 Availability of resources: 1-10 Fear of reinjury: 1-10
9. What ability level have you returned to currently? Mark only one.	Same level (prior to hip pain) Better level Lower level
10. Currently, can you do this position with minimal pain? Mark only one.	Yes No Other: __



(continued)

Appendix Table 1. Continued

Question Prompts	Answer Prompts
11. Currently, can you do this position with minimal pain? Mark only one. 	Yes No Other: __
12. Please check all you could do before symptoms/surgery. Check all that apply.	*Développé arabesque* *Rond de jambe en l'air* Pirouette Fan kick Side leg lifts and adductor lift Pique turn Battement *La chatte* *Plié* Other: __
13. Please check all you can do currently. Check all that apply.	*Développé arabesque* *Rond de jambe en l'air* Pirouette Fan kick Side leg lifts and adductor lift Pique turn Battement *La chatte* *Plié* Other: __
14. On a scale of 1-10, rate your satisfaction with your surgery. Mark only one.	1 (not satisfied at all) 2 3 4 5 6 7 8 9 10 (highly satisfied)

Appendix Table 2. Rehabilitation Regimen for Returning to Activity or Dance After Hip Arthroscopy

Phase	Goal	Restrictions	Techniques
1	Protect joint	20-lb, foot-flat weight bearing at 3 wk Limit flexion, abduction, and extension at 3 wk No active sitting > 30 minutes at 3 wk	Soft-tissue mobilization Isometrics
2	Noncompensatory gait progression and active ROM	Work to avoid compensatory or gait	Joint mobilization Gait training Core strengthening and/or lumbar stabilization Scar mobilization Lumbar stabilization Elliptical at week 6
3	Return to preinjury function	Avoid agility drills until week 10 Avoid hip rotational activities until week 10	Single-leg squat Soft-tissue and joint mobilization Core strengthening Joint mobilization Gait training
4	Return to dance	Muscle strength and full ROM goals at week 12	Soft-tissue and joint mobilization Slow progression to return to presurgery level

ROM, range of motion.