Return to Play at Preinjury Level After Anterior Cruciate Ligament Reconstruction in Divisions II and III National Collegiate Athletic Association Student-Athletes

Olivia J. Bono,*†# MD, Albert Mousad,‡# BS, Michael Parman,§ MD, Eric Manz,‖ ATC, Jason Byrne,¶ ATC, Katharine Ives,§ BS, Matthew Salzler,‡ MD, and Sarav S. Shah,§ MD

Investigation performed at New England Baptist Hospital, Boston, MA, USA

Background: The rates of return to play (RTP) after anterior cruciate ligament (ACL) reconstruction among professional and National Collegiate Athletic Association (NCAA) Division I athletes are well described in the orthopaedic literature. Less is known about these rates and risk factors for failure to RTP in Division II and III collegiate athletes.

Purpose: To determine the RTP rate after ACL reconstruction among Division II and III collegiate athletes and to explore the factors associated with RTP.

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

Methods: Demographic and RTP data were retrospectively reviewed for collegiate athletes who underwent ACL reconstructions across high-risk sports over 6 years (2015/16 to 2021/22 seasons) at 5 northeastern NCAA Division II and III institutions. Clinical data collected included Patient Acceptable Symptom State (PASS) on the Knee injury and Osteoarthritis Outcome Score (KOOS) Sport and Recreation questionnaire, graft type, concomitant reparative surgery, reinjury, need for reoperation, and time to RTP and return to preinjury level. Participants completed the survey using a secure web-based questionnaire sent via email or over the telephone at a minimum 6-month follow-up. Descriptive frequencies were calculated for all documented variables, with chi-square and analysis of variance statistics used to assess for associations and significant differences between variables.

Results: A total of 61 eligible student-athletes with primary ACL reconstructions were identified in this study period, and 40 knees were enrolled for analysis with a mean time from surgery to survey completion of 45.0 months. The overall RTP rate was 77.5% (31/40) at a mean of 10.1 months. However, only 50.0% (20/40) returned to their preinjury level of competitive play. There was a graft failure rate of 20% (8/40). Of the 32 athletes who did not reinjure their ACL, 81.25% (26/32) demonstrated a PASS on KOOS Sports and Recreation. Graft rerupture ($P < .001$) and reoperation ($P = .007$) had significant effects on rates of RTP. Concomitant procedures ($P = .010$) influenced return to preinjury level of sports. Injury during the active season versus the off-season significantly influenced KOOS PASS status ($P = .038$).

Conclusion: This study demonstrated that the rate of RTP after ACL reconstruction in this patient population of Division II and III collegiate athletes was 77.5%, with only 50% returning to their preinjury level of competitive play. The graft failure rate in this population was 20%. Surgical factors, such as concomitant surgeries and reinjury of ACL graft, as well as athlete-specific data, such as injury in the off-season, were statistically significant negative influences on patient outcomes. Further research is needed to evaluate other potential factors that may play a role in RTP after ACL reconstruction.

Keywords: ACL; athletic training; collegiate athletes; knee; ligaments; preinjury level; reinjury; return to play

Rupture of the anterior cruciate ligament (ACL) is a frequent injury in young athletes, especially in contact and

The Orthopaedic Journal of Sports Medicine, 12(9), 23259671241260402
DOI: 10.1177/23259671241260402

pivoting sports. It is estimated that >200,000 ACL injuries occur each year in the United States,[20] with approximately 400,000 ACL reconstructions performed yearly because of these injuries.[8,11,13] As many as 18% of patients aged 20 years or younger returning to high-risk contact sports will experience a second ACL injury after a primary ACL reconstruction. Thus, complete healing and return of function should be carefully assessed before physician authorization to return to sports.[5,7]

The rates of return to play (RTP) have been widely studied in National Collegiate Athletic Association (NCAA) Division I athletes, including 92% reported across sports in a single Division I institution,[28] 85% reported in Division I female soccer athletes,[12] and 82% reported among Division I football athletes.[8] ACL retear rates have also been reported in this Division I athlete population in a range of 2% to 11%.[15,28] There are a variety of factors that may play a role specifically in the collegiate ranks for RTP and return to preinjury level of performance. For example, scholarship status has been demonstrated to have a positive effect on RTP at the Division I level.[8,12,28] Many studies have also shown the positive impact that a multifactorial approach with functional and psychological testing has on RTP and associated patient-reported outcome measures.[3,18,25]

Despite the development of prevention programs and growing research, there remains an increasing rate of ACL injuries in many NCAA collegiate sports across all divisions.[1] Return to sports after ACL reconstruction remains a key goal. "Critical criteria" identified to be part of the postoperative return to sports include time since surgery of 8 months, use of >2 functional tests, psychological readiness testing, and quadriceps/hamstring strength testing in addition to the modifying patient factors of age and female sex.[26] These and other factors affecting RTP after ACL reconstruction have been extensively studied in professional and Division I level collegiate athletes.[8,12,15,18,21,24,28] There is a paucity of literature exploring factors related to RTP in Division II and III collegiate athletics. The goals of this study were to determine the rates of RTP after ACL reconstruction surgery among athletes participating in Division II and III collegiate athletics and to explore potential associated factors for RTP in this population. We hypothesized that the RTP rate after ACL reconstruction in Division II and III athletes would be lower than previously reported for collegiate athletes, and factors such as need for concomitant reparative procedures and reinjury would negatively influence RTP.

METHODS

Approval from the institutional review board (IRB) of all participating institutions was obtained before study initiation (IRB No. 2019-30). The athletic medical records from a cohort of 4 northeastern regional NCAA institutions (1 Division II, 3 Division III) and a single National Association of Intercollegiate Athletics (NAIA) institution were retrospectively reviewed. Competition in the NAIA is comparable to Divisions II and III in the NCAA.[24,27] NAIA Division II and III and NCAA student-athletes across all sports of both sexes over 6 academic years (2015/16 to 2021/22 seasons) who underwent ACL reconstruction were identified. Screened medical records were then reviewed in depth for details of ACL reconstruction. Records were excluded if other knee pathology was identified without mention of ACL surgery. Final confirmation of ACL reconstruction details was completed with athletic training staff, attending surgeon, or surgeon's staff before participant recruitment.

Criteria for RTP

The criteria for RTP[23] were as follows:

1. Clearance from physician and all milestone criteria below have been met.
2. Completion of jog/run program without pain and swelling.
3. Functional assessment
   a. Quadriceps/hamstring/gluteus index ≥90%; handheld dynamometer mean preferred (isokinetic testing if available).
   b. Hamstring/quadriceps ratio ≥70%; handheld dynamometer mean preferred (isokinetic testing if available).
   c. ≥85% limb symmetry index on hop and strength test.
4. Knee injury and Osteoarthritis Outcome Score (KOOS)–Sport and Recreation questionnaire score >90%.
5. International Knee Documentation Committee (IKDC) Subjective Knee Form (IKDC 2000) score ≥85%.
6. Anterior Cruciate Ligament–Return to Sport After Injury score >47.

*Address correspondence to Olivia J. Bono, MD, Harvard Combined Orthopaedic Residency Program, 55 Fruit Street, Boston, MA 02114, USA (email: oliviabono@gmail.com).
†Harvard Combined Orthopaedic Residency Program, Boston, Massachusetts, USA.
‡Tufts University School of Medicine, Boston, Massachusetts, USA.
§New England Baptist Hospital, Boston, Massachusetts, USA.
‖Merrimack College Department of Athletics, North Andover, Massachusetts, USA.
¶Brandeis University Department of Athletics, Waltham, Massachusetts, USA.
#O.J.B. and A.M. contributed equally to this work.
Final revision submitted October 5, 2023; accepted February 2, 2024.
One or more of the authors has declared the following potential conflict of interest or source of funding: M.P. has received a grant from Arthrex; education payments from Arthrex, Smith + Nephew, and Legacy Ortho LLC; and hospitality payments from Stryker. M.S. has received education payments from Arthrex. S.S.S. has received education payments from Arthrex, Kairos Surgical, and Smith + Nephew; consulting fees from DePuy Synthes, Exactech, Medical Device Business Services, and Kairos Surgical; and hospitality payments from Kairos Surgical, Arthrex, Encore Medical, Exactech, and Stryker. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval for this study was obtained from New England Baptist Hospital (ref No. 2019-30).

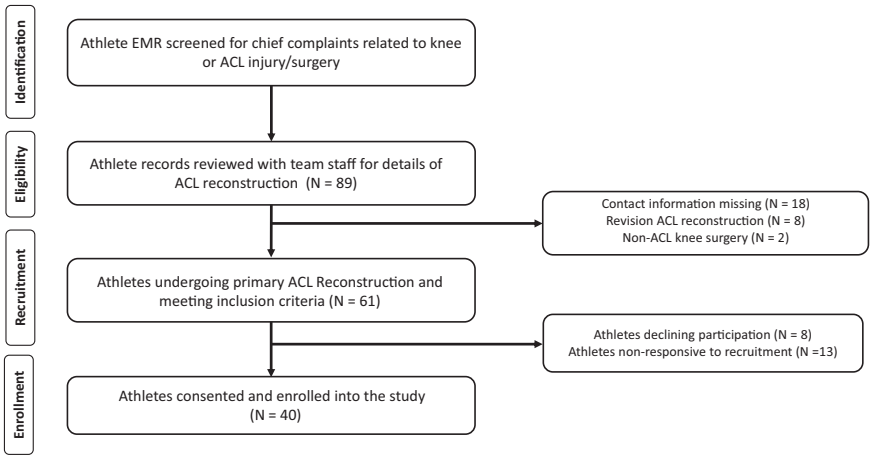

Figure 1. Flowchart of student-athlete inclusion eligibility and recruitment into study participation. ACL, anterior cruciate ligament; EMR, electronic medical record.

Data Collection

The inclusion criterion was any athlete at the 5 institutions being investigated over 6 years who underwent primary ACL reconstruction with minimum 6 month follow-up. The exclusion criteria included athletes with insufficient medical record and/or contact information. Athletes who graduated during the recovery period or who transferred schools were also excluded from this study. Demographic data and contact information were then collected from the appropriately included patient records. Once identified, student-athletes were contacted a minimum of 5 times by telephone before they were no longer considered potential participants of the study. Voicemails were left when the telephone call was not answered. After a participant's consent was obtained over the telephone, the study survey was completed using a secure web-based questionnaire sent via email or completed over the telephone, dependent on patient availability. A flow diagram detailing the inclusion and exclusion criteria for student-athlete participation is displayed in Figure 1. Collected data included athlete-specific factors related to injury and RTP. The various factors assessed were scholarship status, starter status, graft type, concomitant procedure(s), time to RTP from surgery, and years of sport participation after RTP. RTP was defined as clearance for full participation from the treating surgeon and training staff (complete practice or gameplay without restrictions) to return to competitive sport after ACL reconstruction. Return to preinjury level was defined as athletes' appraisal of their ability to physically perform at the same level of competitive play as before the injury.

Patient-Reported Outcome Measures

In addition, a patient-reported outcome measure was included in the questionnaire to assess the patient's current symptoms and functional status. The KOOS-Sport and Recreation is a reliable and validated self-administered questionnaire to assess a patient's symptom state in sport and recreational function after undergoing ACL reconstruction.[22] The threshold for a Patient Acceptable Symptom State (PASS) after ACL reconstruction for the KOOS-Sport and Recreation subscale has been previously determined to be 75.0 (sensitivity, 0.87; specificity, 0.88).[19] A "PASS" indication was assigned to those with transformed KOOS-Sport and Recreation scores $\geq$75.0. A "NON-PASS" indication was assigned to those with transformed KOOS-Sport and Recreation scores <75.0. The scores of those athletes who reinjured their ACLs after reconstruction were not collected or included in our analysis.

Statistical Analysis

Descriptive frequencies were calculated for all documented variables. Chi-square tests for independence (a priori α level set as $P \leq .05$) were conducted to assess the association of investigated risk factors on patient-reported outcomes and RTP status using SPSS Version 28.0.1.1 software (IBM Corp). Analysis of variance statistics were also calculated to assess for potential significant differences in mean time (in months) to RTP, transformed KOOS score, and years of participation after RTP between stratifications of collegiate class, KOOS follow-up period, and graft tissue. For any significant analysis of variance test results, post hoc Tukey tests were calculated to identify the specific statistically significant difference in means between groups.

RESULTS

Recruitment

A total of 89 student-athletes across the 5 institutions were identified as potentially undergoing ACL reconstruction surgery in the 6-year study period. Upon complete medical record review and confirmation with medical staff, 18 student-athletes were excluded due to insufficient contact information, 8 were excluded due to confirmed revision ACL reconstructions, and 2 were excluded due to non-ACL knee surgeries. In total, 61 were identified as eligible

TABLE 1
Characteristics of Study Participants (n = 40)[a]

Demographics	Value
Sex	
Male	22 (55.0)
Female	18 (45.0)
Age, y	23.2 ± 2.78 (19-29)
Age at time of injury, y	19.5 ± 1.69 (17-23)
Time from surgery to completion of survey, mo	45.0 ± 21.7 (7-91)
Collegiate class	
Freshman	15 (37.5)
Sophomore	13 (32.5)
Junior	10 (25.0)
Senior	2 (5.0)
Sport	
Baseball	3 (7.5)
Basketball	5 (12.5)
Football	7 (17.5)
Hockey	1 (2.5)
Lacrosse	8 (20.0)
Rugby	1 (2.5)
Soccer	13 (32.5)
Track and field	2 (5.0)
Starter	29 (72.5)
Scholarship	20 (50.0)
Injured during season	23 (57.5)
Graft type	
Patellar	23 (57.5)
Hamstring	7 (17.5)
Quadriceps	5 (12.5)
Mixed hamstring tendon autograft/allograft	3 (7.5)
Unknown	2 (5.0)
Concomitant surgeries	
Meniscus repair	13 (32.5)
Partial meniscectomy	5 (12.5)
MCL repair	1 (2.5)
Meniscus + MCL repair	3 (7.5)
Meniscus + LCL repair	2 (5.0)
None	16 (40.0)
Reinjury of ACL graft	8 (20.0)
Reoperation	9 (22.5)
Mean time to return to play, mo (n = 29)	10.1 (7-19)
Mean participation after RTP, y (n = 31)	1.8 (1-3)
RTP	31 (77.5)
Nonreinjured (n = 32)	31 (96.9)
Reinjured (n = 8)	0 (0.0)
Return to preinjury level	20 (50.0)
Nonreinjured (n = 32)	20 (62.5)
Reinjured (n = 8)	0 (0.0)
KOOS-Sport and Recreation (n = 32)[b]	
PASS	26 (81.25)
Non-PASS	6 (18.75)

[a]Data are reported as n (%) or mean ± SD (range). KOOS, Knee injury and Osteoarthritis Outcome Score; LCL, lateral collateral ligament; MCL, medial collateral ligament; PASS, Patient Acceptable Symptom State; RTP, return to play.
[b]KOOS only reported for nonreinjured athletes.

study participants who underwent primary ACL reconstruction. Of these 61 identified athletes, 8 declined to participate (declination rate of 13.1%) and 13 were unresponsive despite being contacted at least 5 times. This left 40 athletes (40 knees) to be enrolled in our study for analysis (enrollment rate of 65.6%).

Characteristics of Participants and Return to Sports

Overview characteristics of the study participants are summarized in Table 1. From this cohort, the overall RTP rate was 77.5% (31/40) (86.4% for men, 66.7% for women), with a mean of 10.1 months after surgery for RTP. However, only 50.0% (20/40) returned to their preinjury level of competitive play. There were 8 athletes who reinjured their ACL graft. Of the 32 who did not experience reinjury, 96.9% (31/32) returned to play and 81.25% (26/32) demonstrated a PASS on the KOOS-Sport and Recreation questionnaire, but only 62.5% (20/32) returned to their prior level of play. Interestingly, there was no correlation found between athletes' assessment of return to prior level of play and KOOS PASS status (Cramer V = 0.124, $P = .483$).

Analysis for Association of Investigated Factors With RTP Status and KOOS-Sport and Recreation PASS Status

As demonstrated in Table 2, chi-square tests for association demonstrated a significant effect of the injury occurring during the season versus the off-season on the KOOS PASS status ($P = .038$). Notably, 7 of the 8 athletes who reinjured their ACLs experienced their initial injury in the off-season. Athletes originally injured in the off-season only achieved a PASS on KOOS 60% (6/10) of the time, whereas those injured during the active season had an acceptable patient outcome at a rate of 90.9% (20/22). Reinjury and reoperation influenced rate of RTP ($P < .001$ and .007, respectively); 0.0% (0/8) of the athletes experiencing reinjury returned to sports versus 96.8% (31/32) of those without a reinjury. Two different factors, reinjury of the graft ($P = .002$) and the presence of concomitant procedures ($P = .010$), had an impact on the rate of athletes' return to preinjury level. Both the absence of reinjury (62.5%, 20/32 vs 0%, 0/8) and the absence of concomitant surgeries (75%, 12/16 vs 33.3%, 8/24) significantly improved the likelihood that student-athletes returned to sport at their preinjury level of play.

Concomitant Procedures

A summary of outcomes stratified by the various concomitant surgeries is displayed in Table 3. Notably, concomitant reparative procedures, which exclude meniscectomies, did statistically decrease the rates of return to prior level of play (26.3%, 5/19 vs 71.4%, 15/21; $P = .004$).

Collegiate Class

Athletes in their junior year of eligibility demonstrated the fastest RTP (mean, 8.3 months; range, 6-10 months) and highest mean transformed KOOS score (mean, 89.4; range,

TABLE 2
Association of Investigated Factors With RTP Status and KOOS-Sport and Recreation PASS Status[a]

	KOOS-Sport and Recreation PASS (n = 32)		RTP (n = 40)		Return to Preinjury Level (n = 40)	
	Chi-Square Statistic	*P*	Chi-Square Statistic	*P*	Chi-Square Statistic	*P*
Sport	9.398	.225	4.216	.755	10.778	.149
Starter status	1.726	.189	1.672	.196	0.125	.723
Collegiate class	6.317	.097	2.136	.545	2.544	.467
Scholarship status	0.544	.461	0.143	.705	3.600	.058
During or off-season	4.311[b]	.038[b]	5.914[b]	.015[b]	0.921	.337
Type of graft tissue	4.707	.319	2.563	.633	3.363	.499
Presence of concomitant surgeries	2.201	.138	1.529	.216	6.667[b]	.010[b]
Reinjury of ACL graft	NA	NA	34.444[b]	<.001[b]	10.000[b]	.002[b]
Reoperation on ACL graft	1.055	.304	7.277[b]	.007[b]	3.584	.058
Contralateral ACL injury	0.238	.625	0.913	.339	0.000	>.99

[a]ACL, anterior cruciate ligament; KOOS, Knee injury and Osteoarthritis Outcome Score (only reported for nonreinjured athletes); NA, not applicable; PASS, Patient Acceptable Symptom State; RTP, return to play.
[b]Summary of chi-square analysis. Statistically significant finding at a priori α level of $P \leq .05$.

TABLE 3
Summary of Outcomes Stratified by Concomitant Procedures[a]

	All Concomitant Procedures (n = 24)	Concomitant Reparative Procedures (n = 19)	Partial Meniscectomy (n = 5)	Meniscus Repair (n = 12)	Meniscus + MCL Repair (n = 4)	Meniscus + LCL Repair (n = 2)	MCL Repair (n = 1)
Rate of RTP	70.8% (17/24)	68.4% (13/19)	80.0% (4/5)	50.0% (6/12)	100.0% (4/4)	100.0% (2/2)	100.0% (1/1)
Mean time to RTP, mo	10.1	10.0	10.8	10.7	10.0	12.0	9.0
Rate of return to preinjury level	33.3% (8/24)	26.3% (5/19)	60.0% (3/5)	25.0% (3/12)	50.0% (2/4)	0.0% (0/2)	0.0% (0/1)
Mean KOOS (transformed)[b]	85.3 (n = 18)	84.3 (n = 14)	71.0 (n = 4)	86.4 (n = 7)	71.25 (n = 4)	95 (n = 2)	100 (n = 1)
Rate of reinjury to ACL graft	25.0% (6/24)	26.3% (5/19)	20.0% (1/5)	41.7% (5/12)	0.0% (0/4)	0.0% (0/2)	0.0% (0/1)
Rate of ACL reoperation	29.2% (7/24)	31.6% (6/19)	20.0% (1/5)	33.3% (4/12)	25.0% (1/4)	0.0% (0/2)	100.0% (1/1)
Mean years of participation after RTP	1.8	1.8	1.8	1.7	1.8	1.0	2.0

[a]ACL, anterior cruciate ligament; KOOS, Knee injury and Osteoarthritis Outcome Score; LCL, lateral collateral ligament; MCL, medial collateral ligament; RTP, return to play.
[b]KOOS only reported for nonreinjured athletes.

80-100) (Figure 2). The rate of return to preinjury level was also highest in juniors (60.0%). Freshmen had the highest rate of RTP (86.7%) but a lower rate of return to preinjury level (46.7%). There was no statistically significant difference in mean KOOS score ($P = .954$) or mean years of participation after injury ($P = .118$) when comparing freshman, sophomore, and junior years ($n \geq 10$). There was a significant difference in mean time to RTP ($P = .036$) between the class years, due to the juniors returning to play a mean of >2 months sooner than freshmen and sophomores. The data from seniors could not be adequately compared to that of the other classes given the sample size of 2, including 1 reinjury. Of note, both seniors played lacrosse and were injured in the off-season (fall or winter).

Type of Graft Tissue

Patient outcomes stratified by graft type are summarized in Table 4. The most popular graft selection was bone-patellar tendon-bone autograft (23/40, 57.5%), followed by the hamstring tendon autograft (7/40, 17.5%). The chi-square statistics demonstrated no influence of graft tissue choice on the rates of RTP ($P = .111$) or ACL graft reinjury ($P = .791$). The most common reoperation across all graft types was arthroscopic surgical debridement indicated for symptomatic cyclops lesion (5/9, 55.6%). There was no statistically significant difference in mean KOOS score ($P = .357$), time to RTP ($P = .729$), and years of participation after injury ($P = .158$) among choices of graft tissue.

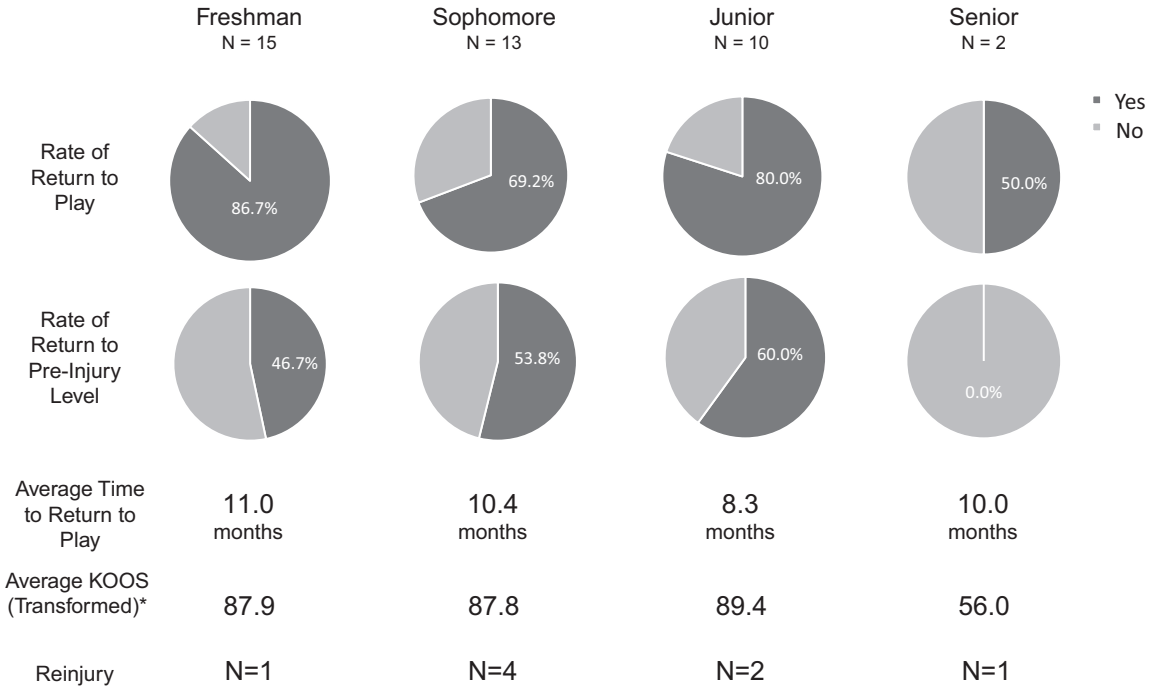

Figure 2. Comparison of rates of return to play and return to preinjury level as well as mean time to return to play and mean KOOS-Sport and Recreation score, stratified by collegiate class year. KOOS only reported for nonreinjured athletes. KOOS, Knee injury and Osteoarthritis Outcome Score.

KOOS Follow-up

Overall, there was a mean follow-up, ie, length of time from date of surgery to functional assessment evaluated by KOOS-Sport and Recreation, of 47.6 ± 21.5 months (n = 32; range, 12-91). The 2 patients with especially short follow-ups (<12 months) were both reinjured and expectedly had poorer outcomes (Figure 3). However, when excluding the <12-month follow-up group, stratification by follow-up period (12-24 months, 24-48 months, >48 months) found no significant associations between follow-up period and rates of RTP (P = .573) or return to preinjury level (P = .995) (Figure 3). Furthermore, there was no statistically significant difference in mean KOOS score (P = .764), time to RTP (P = .532), and years of participation after injury (P = .460) among the different follow-up periods beyond 12 months.

DISCUSSION

The major findings of our study demonstrated that the overall RTP rate was 77.5% (86.4% men, 66.7% women) in this cohort of Division II and III athletes. In addition, 81.25% (26/32) of those without reinjury demonstrated a PASS on the KOOS-Sport and Recreation. However, only 50.0% (20/40) of the athletes in this study returned to their self-described preinjury level of play. The mean time to RTP for this cohort was 10.1 months, which is consistent with other data and studies. Clinical data provide evidence that a threshold for graft failure and, thus, likely graft maturation may occur at approximately 8 to 9 months after graft implantation.[26] In another study, young athletes who returned to sports before 9 months after ACL reconstruction were shown to have a 7 times higher reinjury rate versus those who delayed return.[7] Furthermore, the rate of graft rerupture of 20% (8/40) in this cohort is higher than reinjury rates (2%-11%) previously reported in other collegiate athletes.[15,28]

Over half of the student-athletes (60%, 24/40) in our study underwent concomitant procedures with their ACL reconstruction, including partial meniscectomy, meniscus repair, medial collateral ligament repair, meniscus repair with medial collateral ligament repair, and meniscus repair with lateral collateral ligament repair (Table 1). The absence of concomitant surgeries significantly improved the likelihood that student-athletes returned to sport at their preinjury level (75%, 12/16 vs 33.3%, 8/24; P = .010). Notably, concomitant reparative procedures, which exclude meniscectomies, did statistically decrease the rates of return to prior level of play (26.3%, 5/19 vs 71.4%, 15/21; P = .004). An explanation for this trend is likely 2-fold. Obviously, undergoing more surgical procedures warrants even more recovery. In addition, the fact that concomitant surgery was required implies there was a more extensive injury that naturally would pose a more challenging recovery. Given that concomitant reparative surgeries alone significantly worsened the rate of RTP, this would suggest an increased demand for healing of not only the ACL but also the additional repaired soft tissue, such as the meniscus.

The 50.0% return to preinjury level of play observed in this study is lower than the 81.4% observed at the Division

TABLE 4
Summary of Outcomes Stratified by Graft Tissue Utilized in ACL Reconstruction[a]

	Bone-Patella Tendon-Bone (n = 23)	Hamstring Tendon (n = 7)	Quadriceps Tendon (n = 5)	Mixed Hamstring Tendon Autograft/Allograft (n = 3)	Unknown (n = 2)
Rate of RTP	82.6% (19/23)	85.7% (6/7)	60.0% (3/5)	66.7% (2/3)	50.0% (1/2)
Mean time to RTP, mo	10.1	9.2	11.8	10.5	11.0
Rate of return to preinjury level	65.2% (15/23)	57.1% (4/7)	20.0% (1/5)	33.3% (1/3)	50.0% (1/2)
Mean KOOS (transformed)[b]	86.8 (n = 19)	95.0 (n = 6)	81.3 (n = 4)	90.0 (n = 2)	90.0 (n = 1)
Rate of reinjury to ACL graft	17.4% (4/23)	14.3% (1/7)	20.0% (1/5)	33.3% (1/3)	50.0% (1/2)
Rate of ACL reoperation	13.0% (3/23)	28.6% (2/7)	0.0% (0/5)	66.7% (2/3)	100.0% (2/2)
Mean years of participation after RTP	1.8	2.3	1.0	1.5	1.0

[a]ACL, anterior cruciate ligament; KOOS, Knee injury and Osteoarthritis Outcome Score; RTP, return to play.
[b]KOOS only reported for nonreinjured athletes.

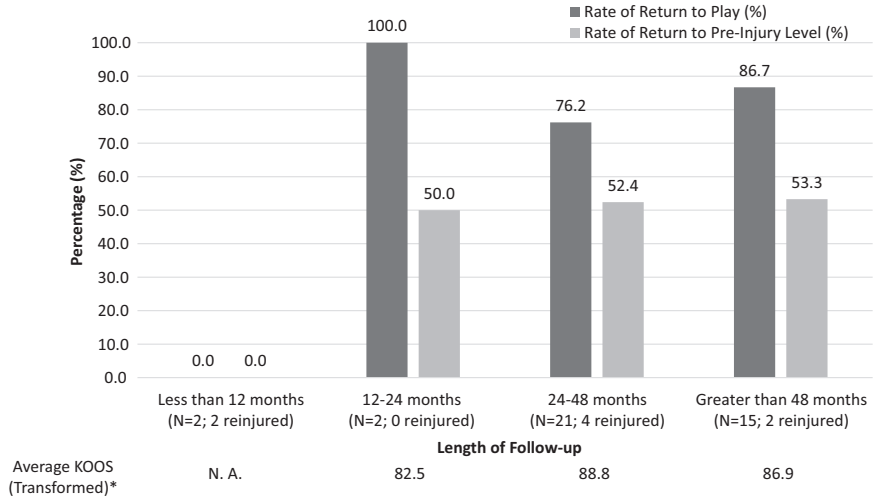

Figure 3. Comparison of rates of return to play and return to preinjury level, stratified by length of follow-up from date of surgery to functional assessment evaluated by KOOS-Sport and Recreation outcome measure. KOOS only reported for nonreinjured athletes. KOOS, Knee injury and Osteoarthritis Outcome Score; NA, not applicable.

I level[2] and is more consistent with data from the general population (irrespective of level of sports participation), which showed a 63% to 65% return to preinjury level.[2,4] Interestingly, the athletes' perception of return to prior level of play did not correlate with a PASS on the KOOS questionnaire. The data showed that, oftentimes, athletes who reached PASS status did not perceive that they had returned to their preinjury level of competition. In this cohort, athletes on scholarships trended toward a higher rate of return to preinjury level when compared to athletes not receiving a scholarship, although this did not reach statistical significance (P = .058). This is similar to the relationship between scholarship status and RTP already demonstrated at the Division I level.[8,12,28] Additional external pressure of being on a scholarship adds to the host of psychosocial factors that may contribute to an athlete's decision to RTP.[9] This may suggest a prioritization of financial incentives or academic priorities (Division III athletes) in RTP.

Finally, while multiple possible explanations exist for the lower RTP rates, including patient goals for return, academic constraints, and financial constraints, it is noteworthy that reinjury may occur secondary to strenuous exercise on the ACL in a premature stage of healing, when the ACL graft is most susceptible. An assessment of factors that may influence the ACL graft healing time course, such as appropriate introduction of physical therapy and sufficient athletic training support resources, is critical to understanding the road to recovery and burden of reinjury in competitive athletes. Interestingly, athletes

originally injured in the off-season comprised 7 of the 8 graft failures in our study, and they also had a significantly lower rate of KOOS PASS status compared with athletes injured during the season. This discrepancy may reflect the importance of athletic training resources in rehabilitation of these injuries, which in Division III institutions is available predominantly during the in-season as opposed to year-round. Implementation of certified athletic trainer support at particular points in the recovery timeline, even as early as 6 to 8 weeks postoperatively, can help return full range of motion and build strength during the late recovery period.[14] Often, NCAA Division I institutions have greater staffing resources, in terms of both full-time and part-time athletic trainers, compared to all other competition levels.[6,10] Furthermore, team athletic trainers and physical therapists, in addition to providing rehabilitation services, are also burdened with varied responsibilities, including coverage for games and administrative personnel management.[29] This close oversight, outside of the physician office visits, further minimizes the risk of reinjury. As a result, patient expectations need to be altered commensurate to the available resources. An additional factor to consider contributing to higher rates of RTP in Division I athletes is the difference in ability and likelihood of athletes at the Division I versus Division II and III levels to preserve years of eligibility through a medical redshirt year. Medical redshirt years are notoriously harder to obtain and less common for a Division II/III athlete, which may contribute to the lower rates of RTP in these athletes.

Limitations

As with any study, this study has several limitations. The sample size (N = 40) was smaller compared to that in previous research conducted among Division I institutions.[8,12,15,28] An overall response rate of 78.7% is respectable given the current era of spam advertisement reducing the likelihood of individuals to answer telephone calls without recognizable caller identification. Even with voicemails left, some contacts had voicemail boxes that were not set up or full, reducing the likelihood of callbacks. This limited sample size could have also contributed to type 1 statistical error to identify relationships in patient outcomes when stratifying by collegiate class, type of graft tissue, and KOOS follow-up. Additional studies of this underinvestigated patient population of Division II and III student-athletes, with larger sample sizes, remain necessary to draw assertive conclusions on the potential impact of inferior resources on post-ACL reconstruction outcomes in the collegiate athlete. Although no significant conclusions should be reached concerning the effect on outcomes of athlete demographics, graft type, and concomitant surgeries, these data are important to evaluate to continue to enhance decisions around treatment. Another limitation of this study is the lack of investigation into the psychological factors in readiness to return to sports.[16,17,25] The fear of reinjury, while not independently investigated, was referenced in self-initiated conversation by several participants for whom the study survey was conducted via telephone call. Early positive psychological responses have been demonstrated to influence an athlete's ability to return to preinjury level of sport.[3] It may be that athletes in higher levels of collegiate sports have greater access to resources to address these factors than student-athletes participating in lower divisions. Lastly, the COVID-19 pandemic, having begun within the study period, may have further complicated accurate assessment of RTP due to cancelled or delayed seasons.

CONCLUSION

Our study demonstrated that the rate of RTP after ACL reconstruction in this patient population of Division II and III collegiate athletes was 77.5%, with only 50% returning to their preinjury level of competitive play. The graft failure rate in this population was 20%. Surgical factors, such as concomitant surgeries and reinjury of ACL graft, as well as athlete-specific data, such as injury in the off-season, were statistically significant negative influences on patient outcomes. Further research is needed to evaluate other potential factors that may play a role in RTP after ACL reconstruction.

ORCID iD

Sarav S. Shah https://orcid.org/0000-0002-7656-8482

REFERENCES

1. Agel J, Rockwood T, Klossner D. Collegiate ACL injury rates across 15 sports: National Collegiate Athletic Association Injury Surveillance System Data Update (2004-2005 through 2012-2013). *Clin J Sport Med*. 2016;26(6):518-523.
2. Ardern CL, Taylor NF, Feller JA, Webster KE. Fifty-five percent 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(21):1543-1552.
3. 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(7):1549-1558.
4. 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(7):596-606.
5. Barber-Westin S, Noyes FR. One in 5 athletes sustain reinjury upon return to high-risk sports after ACL reconstruction: a systematic review in 1239 athletes younger than 20 years. *Sports Health*. 2020;12(6):587-597.
6. Baugh CM, Kroshus E, Lanser BL, Lindley TR, Meehan WP. Sports medicine staffing across National Collegiate Athletic Association Division I, II, and III Schools: evidence for the medical model. *J Athl Train*. 2020;55(6):573-579.
7. Beischer S, Gustavsson L, Senorski EH, et al. Young athletes who return to sport before 9 months after anterior cruciate ligament

reconstruction have a rate of new injury 7 times that of those who delay return. *J Orthop Sports Phys Ther*. 2020;50(2):83-90.
8. Daruwalla JH, Greis PE, Hancock R, Xerogeanes JW. Rates and determinants of return to play after anterior cruciate ligament reconstruction in NCAA Division 1 college football athletes: a study of the ACC, SEC, and PAC-12 Conferences. *Orthop J Sports Med*. 2014;2(8):2325967114543901.
9. Dunn WR, Spindler KP. Predictors of activity level 2 years after anterior cruciate ligament reconstruction (ACLR): a Multicenter Orthopaedic Outcomes Network (MOON) ACLR cohort study. *Am J Sports Med*. 2010;38(10):2040-2050.
10. Gallucci AR, Petersen JC. The size and scope of collegiate athletic training facilities and staffing. *J Athl Train*. 2017;52(8):785-794.
11. Gornitzky AL, Lott A, Yellin JL, Fabricant PD, Lawrence JT, Ganley TJ. Sport-specific yearly risk and incidence of anterior cruciate ligament tears in high school athletes: a systematic review and meta-analysis. *Am J Sports Med*. 2016;44(10):2716-2723.
12. Howard JS, Lembach ML, Metzler AV, Johnson DL. Rates and determinants of return to play after anterior cruciate ligament reconstruction in National Collegiate Athletic Association Division I soccer athletes: a study of the Southeastern Conference. *Am J Sports Med*. 2016;44(2):433-439.
13. Junkin DM, Johnson DJ, Fu FH, et al. Knee ligament injuries. In: Kibler W.B., ed. *Orthopaedic Knowledge Update: Sports Medicine 4*. American Academy of Orthopaedic Surgeons, 2009:135-153.
14. Kakavas G, Malliaropoulos N, Bikos G, et al. Periodization in anterior cruciate ligament rehabilitation: a novel framework. *Med Princ Pract*. 2021;30(2):101-108.
15. Kamath GV, Murphy T, Creighton RA, Viradia N, Taft TN, Spang JT. Anterior cruciate ligament injury, return to play, and reinjury in the elite collegiate athlete: analysis of an NCAA Division I cohort. *Am J Sports Med*. 2014;42(7):1638-1643.
16. Kuenze CM, Farner N, Lewis J, Lisee CM, Schorfhaar A, Erickson K. Adolescent patient, parent, and clinician perceptions of rehabilitation after anterior cruciate ligament reconstruction: a qualitative study. *J Athl Train*. 2022;57(9-10):929-936.
17. Kvist J, Ek A, Sporrstedt K, Good L. Fear of re-injury: a hindrance for returning to sports after anterior cruciate ligament reconstruction. *Knee Surg Sports Traumatol Arthrosc*. 2005;13(5):393-397.
18. Lai CCH, Ardern CL, Feller JA, Webster KE. Eighty-three percent of elite athletes return to preinjury sport after anterior cruciate ligament reconstruction: a systematic review with meta-analysis of return to sport rates, graft rupture rates and performance outcomes. *Br J Sports Med*. 2018;52(2):128-138.
19. Muller B, Yabroudi MA, Lynch A, et al. Defining thresholds for the patient acceptable symptom state for the IKDC Subjective Knee Form and KOOS for patients who underwent ACL reconstruction. *Am J Sports Med*. 2016;44(11):2820-2826.
20. Musahl V, Karlsson J. Anterior cruciate ligament tear. *N Engl J Med*. 2019;380(24):2341-2348.
21. Paterno MV, Schmitt LC, Thomas S, Duke N, Russo R, Quatman-Yates CC. Patient and parent perceptions of rehabilitation factors that influence outcomes after anterior cruciate ligament reconstruction and clearance to return to sport in adolescents and young adults. *J Orthop Sports Phys Ther*. 2019;49(8):576-583.
22. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther*. 1998;28(2):88-96.
23. Shah S. Rehabilitation protocol for ACL reconstruction. New England Shoulder and Elbow Center. Accessed February 26, 2023. https://newenglandshoulderandelbow.com/for-patients
24. The difference between NCAA & NAIA? Birmingham United Soccer Association. April 23, 2020. Accessed February 26, 2023. https://www.birminghamunited.com/the-difference/
25. Tripp DA, Stanish W, Ebel-Lam A, Brewer BW, Birchard J. Fear of reinjury, negative affect, and catastrophizing predicting return to sport in recreational athletes with anterior cruciate ligament injuries at 1 year postsurgery. *Rehabil Psychol*. 2007;52:74-81.
26. Turk R, Shah S, Chilton M, et al. Return to sport after anterior cruciate ligament reconstruction requires evaluation of $>$2 functional tests, psychological readiness, quadriceps/hamstring strength, and time after surgery of 8 months. *Arthroscopy*. 2023;39(3):790-801.e6.
27. What are the differences between NAIA vs. NCAA? NCSA College Recruiting. February 3, 2023. Accessed February 26, 2023. https://www.ncsasports.org/recruiting/how-to-get-recruited/college-divisions/naia-vs-ncaa
28. Zampogna B, Vasta S, Torre G, et al. Return to sport after anterior cruciate ligament reconstruction in a cohort of Division I NCAA athletes from a single institution. *Orthop J Sports Med*. 2021;9(2):2325967120982281.
29. Zarro M, Silverson O, Soenksen W, et al. Roles and responsibilities of the physical therapist in collegiate athletics: results of a national survey. *Int J Sports Phys Ther*. 2022;17(6):1128-1135.