

# Return to Play After Patellar Tendon Autograft for Primary Anterior Cruciate Ligament Reconstruction in Rugby Players

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*Investigation performed at the Sports Surgery Clinic, Dublin, Ireland*

**Background:** There is scant literature on outcomes after anterior cruciate ligament (ACL) reconstruction in rugby players, and no prior study has evaluated the outcomes of bone–patellar tendon–bone (BTB) autograft ACL reconstruction.

**Purpose:** To assess the rate of return to play, the timing of that return, and the subsequent graft reinjury rate among rugby players after ACL reconstruction with BTB autograft.

**Methods:** The ACL registry at a single hospital was screened for professional and amateur rugby players who had undergone a primary ACL reconstruction with BTB autograft. Professional rugby players were those playing for one of the professional provincial teams in Ireland. Outcomes were analyzed for the rate and timing of return to play, functional outcomes, and subsequent graft ruptures. Additionally, outcomes were compared between professional and amateur athletes.

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

**Results:** A total of 126 patients with 24 months of follow-up were enrolled. The overall rate of return to play was 84.9%, with 75.4% returning to the same level of play; 8.7% of patients did not return to play secondary to non–knee-related issues. The mean time to return was  $10.9 \pm 4.9$  months. Among professional rugby players, 93.3% were able to return at a mean time of  $9.7 \pm 4.4$  months; 80% returned to the same level. The mean Anterior Cruciate Ligament–Return to Sport after Injury score was  $78.4 \pm 20.2$ , the Cincinnati knee score was  $92.5 \pm 8.0$ , the International Knee Documentation Committee score was  $88.2 \pm 8.1$ , and the Marx score was  $9.7 \pm 5.3$ . Two patients sustained a subsequent rerupture of the reconstructed ACL, and 4 players sustained a contralateral ACL injury within the follow-up interval of 2 years.

**Conclusion:** Rugby players receiving BTB ACL reconstruction demonstrated good clinical outcomes with a high rate of return to sport, with the majority returning before 12 months. The rate of a subsequent ACL injury was low among the authors' cohort at short-term follow-up.

**Keywords:** anterior cruciate ligament; bone–patellar tendon–bone autograft; rugby; return to sport

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Rugby is a field-based collision sport with a high rate of traumatic injury.<sup>4,20</sup> Dallalana et al<sup>4</sup> found that in professional rugby, on average, at any single point in time, 1 player per team was missing time because of a knee injury. Among knee injuries in rugby players, anterior cruciate ligament (ACL) ruptures have a high incidence and occur at a rate of 0.4 to 1.2 per 1000 playing hours, resulting in the greatest proportion of missed time among rugby players.<sup>4,17,18</sup> Over half (57%) of ACL ruptures in rugby players are as a result of direct or indirect contact and occur at a higher rate in competition than in training.<sup>12</sup> This appears to be in contrast to other collision sports, with a recent study finding that 73% of ACL injuries in professional American football players occurred via a noncontact mechanism.<sup>7</sup>

For athletes who are looking to return to a high-demand, pivoting and landing sport, ACL reconstruction is generally considered the standard of care to restore stability of the knee, attempting to prevent further intra-articular damage and enable sports-specific function.<sup>11</sup> For most individuals, return to play (RTP) is one of the primary goals of surgical intervention, and of late, there has been specific attention on the evaluation of return-to-sports rates. However, the rate of RTP remains an underreported area after ACL reconstruction in rugby players.<sup>6,17,18</sup> This is of importance to clinicians in accurately guiding and counseling athletes on their expected outcomes.

Previous literature on RTP after ACL reconstruction in rugby players has focused on hamstring tendon (HT) autografts.<sup>6,17,18</sup> Despite being widely studied, the graft utilized for ACL reconstruction remains an area of much controversy.<sup>2,9</sup> Graft selection is multifactorial and largely dependent on individual surgeon preference and their training, patient activity level, clinician- and patient-perceived functional outcomes, and the potential for donor-site morbidity. Despite the recent popularity with HT grafts, the bone-patellar tendon-bone (BTB) autograft is considered by many surgeons to be the gold standard graft choice for ACL reconstruction, with large registry studies demonstrating a reduced rate of revision for graft rupture compared with HT.<sup>3,8,14,15</sup> However, no study to date has evaluated the specific outcomes of rugby players treated with a BTB autograft.

The purpose of this study was to assess the rate of RTP, the timing of return, patient-reported outcomes, and the reinjury rates among rugby players receiving a BTB autograft. Our hypothesis was that there would be a high rate of return to sport, with good clinical outcome scores and low reinjury rates among those treated with a BTB autograft.

## METHODS

### ACL Registry

An institutional review board-approved ACL registry was used for this study. All patients undergoing an ACL reconstruction at our institution gave consent before their surgery to be included in the institutional ACL registry database. Preoperative data relating to sport, injury mechanism, and patient characteristics were collected before surgery, along with the intraoperative details, including the evaluation and treatment of meniscal and chondral pathologies, recorded by the operating surgeons (M.J. and R.M.). Patients were subsequently followed up with via email by the ACL registry coordinator at 6, 9, 12, and 24 months postsurgery. They reported on whether they were able to RTP and at what level at each of the time points, with a specific date requested as to when they were able to return. Individuals were also asked to clarify, if applicable, their reasons for not returning to sport. There are 4 main parameters evaluated for clinical outcomes in the ACL registry: (1) Marx score for activity level, (2) International Knee Documentation Committee (IKDC) score as a knee-specific questionnaire, (3) Cincinnati knee score as an

ACL-specific questionnaire, and (4) Anterior Cruciate Ligament-Return to Sport after Injury (ACL-RSI) score as a psychological questionnaire after ACL reconstruction. All of these outcome measures were collected at baseline and each follow-up visit.

A retrospective review of prospectively collected data was carried out of all patients who underwent an ACL reconstruction between January 2014 and August 2016. The inclusion criteria were professional or amateur rugby players with primary ACL reconstruction and BTB autograft. No patient was excluded based on their meniscal or chondral injuries or their treatments, but they were excluded if they had a concomitant ligamentous injury. Professional rugby players were those playing for one of the professional provincial teams in Ireland.

### Surgical Technique

All surgery was performed by 1 of 2 dedicated knee surgeons (R.M., M.J.) using equivalent arthroscopic and surgical techniques. Although frequently also performing ACL surgery with soft tissue HT grafts, both surgeons prefer BTB as a graft choice in young athletic individuals desiring to return to demanding contact sports such as rugby. A standard ipsilateral graft harvest was performed utilizing the middle third of the patellar tendon with bone blocks, usually resulting in a typical graft size of 10 to 11 mm in male athletes and 9 to 10 mm in female athletes. Femoral tunnel drilling was performed through the anteromedial portal, and bone blocks were secured with metal interference screws (Softsilk; Smith & Nephew). The bone tunnel positions and BTB grafts were placed within the original ligament footprints, concentrating mainly on reproducing the anteromedial bundle fiber positions. Routine arthroscopy was performed to address coexisting intra-articular meniscal and chondral pathology and treated accordingly.

### Rehabilitation

All patients entered a standardized institutional ACL program after surgery, with rehabilitation carried out with their preferred physical therapist. Patients were immediately mobilized with weightbearing as tolerated postsurgery and then progressed with a standard restoration of motion, gait, and a simple closed-chain lower limb strengthening program. This was followed by more advanced power and plyometric development as strength and symptoms allowed, and progression then to running, change-of-direction drills, and return-to-sport rehabilitation according to the individual's progress. To guide their program, patients were physically assessed at the 3-, 6-, and 9-month stage within our unit using isokinetic and force plate strength and power tests as well as a 2- and 3-dimensional biomechanical analysis to assess their progress through the rehabilitation process. Patients were advised not to RTP before 6 months postsurgery and until clearance from the operating surgeon and the rehabilitation process was deemed complete. Knee stability, range of motion, proprioception, strength, and functional movement were all considered in clearing an athlete to RTP.

**TABLE 1**  
Patient Characteristics (N = 126)<sup>a</sup>

Variable	Value
Age, y, mean ± SD	22.3 ± 5.2
Sex, male/female, n	114/12
Dominant leg injured	73 (57.9)
Professional	15 (11.9)
Injury contact	
Direct	37 (29.4)
Indirect	38 (30.2)
None	51 (40.5)
Injury mechanism	
Tackling	9 (7.1)
Tackled	49 (38.9)
Pivot	56 (44.4)
Jump/landing	9 (7.1)
Other	4 (3.2)
Concomitant injuries	
Medial meniscal tear	29 (23.0)
Lateral meniscal tear	46 (36.5)
Chondral damage	35 (27.8)

<sup>a</sup>Data are reported as n (%) unless otherwise indicated.

### Statistical Analysis

The outcome measures analyzed were RTP rate and time, patient-reported outcome measures, and subsequent knee injury, including ipsilateral and contralateral ruptures. Statistical analysis was performed using SPSS Statistics for Windows Version 22.0 (IBM). Continuous variables were reported as weighted mean and estimated standard deviation, whereas categorical variables were reported as frequencies with percentages.

## RESULTS

### Patient Characteristics

There were 1780 ACL reconstructions performed by the 2 surgeons during the study period. There were 150 patients identified who were playing rugby at the time of their injury; 10 were excluded as they had revision procedures, 2 more had multiligament knee injuries, and 12 additional patients did not complete the final follow-up at 2 years. Therefore, 126 patients with a follow-up of 2 years fit our inclusion criteria and formed the patient cohort to be assessed. The patient characteristics are reported in Table 1.

### Rate of RTP

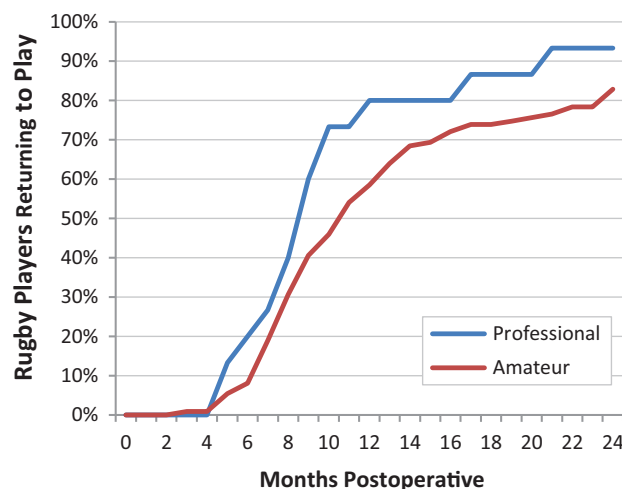
By the 24-month follow-up, 84.9% (107/126) of patients had returned to rugby at a mean time of 10.9 ± 4.9 months, with 75.4% (95/126) of players returning at the same or higher level. Of the professional rugby players, 93.3% (14/15) returned to play at a mean of 9.7 ± 4.4 months, and 80% (12/15) returned to the same level of play.

Overall, of those reporting that they had not returned to rugby, 6.3% (8/126) did not return for reasons relating to

**TABLE 2**  
RTP Data<sup>a</sup>

	Overall (N = 126)	Professional (n = 15)
RTP time, mo, mean ± SD	10.9 ± 4.9	9.7 ± 4.4
RTP rate	107 (84.9)	14 (93.3)
Return to same level	95 (75.4)	12 (80.0)
RTP rate, mo		
postoperative		
9	55 (43.7)	8 (53.3)
12	79 (62.7)	12 (80.0)
18	96 (76.2)	13 (86.7)
24	107 (84.9)	14 (93.3)

<sup>a</sup>Data are reported as n (%) unless otherwise indicated. RTP, return to play.



**Figure 1.** Timing of return to play.

their injury (1 because of recurrent knee pain, 5 because of fear of reinjury, and 2 because of lack of confidence in performance), and 8.7% (11/126) did not return because of non-knee-related issues. The reasons given included work commitments, age, other injuries, and personal choice.

The RTP data for the overall cohort and professional rugby players are reported in Table 2. The timing of return is illustrated in Figure 1.

### Functional Outcomes and Reinjuries

The mean ACL-RSI score was 78.4 ± 20.2, the mean Cincinnati score was 92.5 ± 8.0, the mean IKDC score was 88.2 ± 8.1, and the mean Marx score was 9.7 ± 5.3. Regarding reinjuries, 2 patients (1.6%) reported an ipsilateral ACL graft reinjury, and 4 patients (3.2%) reported a contralateral ACL rupture.

## DISCUSSION

The study results indicate that rugby players undergoing ACL reconstruction using an ipsilateral BTB autograft

have a high rate of return to sport and high rates of return at the same level. A previous study looking at rugby players concluded that HT autograft might not be an appropriate graft choice for young players because of the 23% failure rate in the <20-year age group, at a mean of 22.8 months to failure.<sup>17</sup> However, our study found that at the 24-month follow-up, there were few failures despite a third (42/126) of our cohort being <20 years of age, suggesting that the use of BTB autograft in young rugby players is an attractive and appropriate option.

The overall rate of RTP and return at the same level was high in our study with BTB autograft, and the majority of professional rugby players were able to return to the same level. These results are similar compared with other studies evaluating RTP among athletes.<sup>1,5,9,13,16</sup> Ardern et al<sup>1</sup> found that in a cohort of 314 athletes, 93% were able to return at some point to athletic participation, although less than half returned at their previous level. Although some studies have found lower rates of return in professional athletes playing collision sports such as American football, a recent systematic review by Lai et al<sup>9</sup> found that 83% of elite athletes returned to sport after ACL reconstruction. The majority of athletes returned at between 7 and 13 months, similar to the findings by Lai et al in elite athletes. Takazawa et al<sup>17</sup> previously found that more than 90% of players treated with HT autograft were able to return to rugby, but no previous study has reported BTB autograft return in rugby players. Return to sports is one of the most important considerations in deciding to undergo ACL reconstruction in competitive athletes, and our study showed that BTB autografts result in high rates of return.

ACL graft rerupture remains a dreaded outcome with significant sequelae and is a key determinant in choosing an appropriate graft. This is often one of the patient's primary concerns, alongside one's ability to RTP. Encouragingly, only 2 patients included in our study cohort sustained a rerupture before the 2-year follow-up, and the majority of the total cohort were back playing for at least 1 full year after their ACL reconstruction. However, there were 4 patients who sustained a contralateral ACL rupture. While these short-term outcomes are encouraging, there is still debate over the optimal graft choice for the lowest rerupture rate. BTB autograft is often considered the gold standard, with multiple meta-analyses showing a lower rerupture rate than HT autograft.<sup>2,9</sup> However, HT autograft has become a popular graft choice and is more commonly utilized by many surgeons, with the Scandinavian registries showing that 63% to 95% of all ACL reconstructions are performed using a HT autograft.<sup>3</sup> Graft failure can be reduced by surgeon experience with their graft of choice, and surgeon preference remains a key determinant in graft choice, with training during fellowship playing a likely role in graft preference.

The patient-reported outcomes were excellent. Multiple high-quality studies have found that there is no significant difference in functional outcome measures between BTB autograft and HT autograft in ACL reconstruction at either the short- or long-term follow-up.<sup>2,8,9,14,15</sup> The ACL-RSI questionnaire is a useful tool in deciding when an athlete is able to RTP after ACL reconstruction, as it evaluates the

athlete's psychological perception of one's ability to return, and we found a high mean ACL-RSI, indicating confidence in the operated limb. Tjong et al<sup>19</sup> found that fear, lifestyle changes, and the athlete's innate personality were the 3 most important barriers in psychological RTP. Additionally, of those unable to RTP in our study, approximately half chose not to return for other lifestyle reasons.

Rugby is a highly physical collision sport, which is popular in Western Europe and the southern hemisphere, but there remains a paucity of data on the outcome of ACL reconstruction in this sport.<sup>6,17,18</sup> While the findings in this study show a high rate of return in the short term, further long-term follow-up is needed. Additionally, this is the first study to examine the exclusive results of BTB autograft in ACL reconstruction in rugby players, and thus, this requires further study.

### Limitations

There are several limitations and bias inherent in this study. While all of these data were prospectively gathered, they were retrospectively analyzed.<sup>10</sup> Additionally, the follow-up time was 24 months, which, as a result of being approximately 15 months after the mean time to RTP, may be insufficient to study subsequent graft rupture rates. This study was also limited by the lack of a control group. Moreover, there was also a lack of comparison with preoperative functional outcomes. The data reflect the authors' practice and may not reflect all mixes of athlete and functional levels. Additionally, the rigor of the postoperative rehabilitation and supervision by use of a biomechanical lab may have had an effect on RTP and failure/reinjury rates and may not be reflected in broader practice. Finally, the number of professional athletes was small, and it was not possible to perform comparative analyses with amateurs.

### CONCLUSION

Our cohort of rugby players receiving a BTB ACL reconstruction demonstrated a high rate of return to sport, with the majority returning before 12 months. Additionally, the rate of a subsequent ACL injury was very low among our cohort at short-term follow-up.

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