Original Article

Failure to Return to Preinjury Activity Level after Hamstring Anterior Cruciate Ligament Reconstruction: Factors Involved and Considerations in Goal Setting

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Abstract

Background: Recent interest in the return to sports, following anterior cruciate ligament reconstruction, has focused on the influence of psychological factors. However, many factors contribute to this endpoint. This study aimed to investigate the ability of nonprofessional athletes to return alongside the reasons for failure. **Materials and Methods:** We retrospectively studied 101 postreconstruction patients with followup in excess of 12 months. All patients underwent hamstring autograft anterior cruciate reconstruction. The Cincinnati Sports Activity Scale was used to define activity level preinjury, postinjury, and postreconstruction. Structured questionnaires were used to identify factors in those who did not return to the same level. **Results:** Seventy percent of patients returned to their preinjury activity score. Of the 30% of patients who failed, age, reconstruction type, and associated pathology were unrelated. However, reconstruction within 6 months of injury resulted in increased return to preinjury score ($P < 0.05$). Failure was associated with continued knee symptoms (57%), lifestyle changes (27%), anxiety (27%), fear (23%), and other musculoskeletal problems (10%). Considerable interplay was found between these factors. Failure to return was associated with increased further surgery, but this was successful in only one-third of patients. **Conclusion:** Psychological factors are important (and may require targeted input), but return-to-sport is multifactorial. Ongoing symptoms may prompt further surgery, but this is frequently unsuccessful in achieving return. Patient-specific goals should be sought and revisited throughout the rehabilitation program. Acknowledging psychological barriers, in those aiming to return to the same level, may help achieve this goal. In other patients, success may be return to a desired lower level. Understanding the patient's expectations is important in goal setting.

Keywords: *Anterior cruciate ligament reconstruction, psychological factors, return to play, social factors*

Introduction

Anterior cruciate ligament reconstruction (ACLR) is a successful procedure indicated in cases of persistent knee instability,[1] to enable return to normal activities of daily living,[2] as well as protection from meniscal and chondral injury.[3]

Anterior cruciate ligament (ACL) injuries frequently occur during sporting activity.[3] Return to preinjury levels of sport or activity is, therefore, often seen as an indicator for successful surgery. While over 85% of patients, after ACLR, return to normal or near-normal knee function, a meta-analysis has shown that only 63% of patients return to preinjury levels of activity, and only 56% of patients return to competitive sport.[1]

Many factors have been implicated determining return to activity after ACLR. These include psychological problems, changes in lifestyle or priorities, other health problems, and continued knee problems.[4-6] The kinds of psychological factors that have been described are anxiety, fear of further injury (kinesiophobia), and personality traits.[6,7] Recent studies have highlighted the importance of these psychological factors identifying at-risk individuals and suggesting targeted support for these patients.[8] It has been postulated that providing psychological support, for these individuals, may help them to return more sucessfully.[9,10] During postoperative rehabilitation, the physical therapist plays a vital role in guiding the patient's expectations and goals. An understanding of the factors involved in this process is,

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therefore, vital to engender realistic targets and improve the patient's satisfaction with the process.

We aimed to first evaluate the rate of returning to preinjury levels of activity after hamstring ACLR in a nonprofessional population (without graft failure) and then secondarily to evaluate the reasons for failure to return. Alongside other commonly identified reasons for failure of return to preinjury levels, we set out to quantify the prevalence and interplay of psychological factors in our patient group. Our hypothesis was that other factors would be found with interplay between individual factors.

Materials and Methods

Design

Patients were identified from a prospectively collected ACLR database. Data were collected including demographics, additional pathology (meniscal or chondral injuries), as well as details of the surgical procedure. Retrospective analysis was performed of this prospectively collected data. Followup data were collected at routine appointments or via telephone consultations. All patients provided their informed consent to have their data used in this work.

Only patients who underwent primary ACLR, with followup longer than 12 months, were included in the study. Exclusion criteria were multiligament injuries, revision surgery, and followup <12 months. In addition, patients with graft rerupture before full return (two patients within the study period) were excluded to allow focus on the other factors involved. Those patients who had completed rehabilitation and suffered rerupture after successful return to a desired level (four patients) were included as this was thought to be a success of initial treatment (in line with the hypothesis).

All incidences of further surgery were investigated including the indications and procedure performed.

Patients

Prior to commencement, this work was approved by the Institutional Review Board as an audit project (Ref: 14-3177).

All patients underwent ACLR performed by the two senior authors (VM and PS). Patients underwent general anesthesia with a femoral nerve block. Examination under anesthesia and systematic arthroscopy was performed. Meniscal tears were repaired when possible; if irreparable, the meniscal tear was debrided to a stable rim. Chondral abnormalities were recorded. Ipsilateral hamstring autograft was used in all cases. An anatomical technique was used with the femoral and tibial tunnels centered within the remnant footprints under direct visualization.[11-13] Suspensory fixation was utilized on the femoral side, and the tibial fixation was performed using an interference screw and supplementary staple (if required).

All patients were enrolled in a standardized rehabilitation program. Each patient was seen individually, before being put in an ACL-dedicated physical therapy class. Initial rehabilitation focused on swelling control, restoring range of motion, muscle recruitment, and proprioception. The formal ACL group sessions, with patients at all stages of rehabilitation, were attended with strict individual programs/progression followed. Patients followed closed-chain exercises for first 12 weeks postoperatively. Progression of exercises continued as per individual progression and control of proprioception strength, with gradual introduction of change of direction and sport-specific activities. No contact sports were permitted until 9 months postoperative. Patients were discharged from physiotherapy once they had good muscle control, proprioception, control of tasks, when formal testing (including hop tests) had been passed, or when the patient decided to cease attendance.

Two outcome measures were used: activity level and reason for failure to return to the same level (where appropriate). The level of activity was measured using the Cincinnati Sports Activity Scale (CSAS).[14] This scale has been used by previous studies assessing return to sports after ACLR scoring level of activity according to the levels of intensity and frequency.[15-17] The maximum score of 100 demonstrates participation in sports that require jumping, hard pivoting, and cutting between 4 and 7 days per week [Table 1].

Return to preinjury level of activity was defined as having returned to the same CSAS score, or higher, as preinjury. A reduction in the score indicated participation at a decreased intensity, frequency, or both.

Table 1: Cincinnati Sports Activity Scale

Level and participation	Score
Level 1 (participates 4-7 days/week)	
Jumping, hard pivoting, and cutting (basketball, volleyball, football, gymnastics, and soccer)	100
Running, twisting, and turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, and wrestling)	95
No running, twisting, and jumping (cycling and swimming)	90
Level 2 (participates 1-3 days/week)	
Jumping, hard pivoting, and cutting (basketball, volleyball, football, gymnastics, and soccer)	85
Running, twisting, and turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, and wrestling)	80
No running, twisting, and jumping (cycling and swimming)	75
Level 3 (participates 1-3 times/month)	
Jumping, hard pivoting, and cutting (basketball, volleyball, football, gymnastics, and soccer)	65
Running, twisting, and turning (tennis, racquetball, handball, ice hockey, field hockey, skiing, and wrestling)	60
No running, twisting, and jumping (cycling and swimming)	55
Level 4 (no sports)	
Perform activities of daily living without problems	40
Moderate problems with activities of daily living	20
Severe problems with activities of daily living	0

Preinjury, preoperative (postinjury but pre-ACLR), and postoperative (at final followup) scores were collected.

Structured questions were asked to those who had been unable to return to their preinjury level of activity. The following options were given, and patients were allowed to choose more than one of these:

1. Fear of further injury
2. Anxiety about returning to preinjury levels of activity
3. Change in lifestyle
4. Other health problems preventing returning to preinjury levels of activity
5. Further knee problems; it was then clarified whether they experienced symptoms of instability.

Statistical analysis

Analysis was performed using GraphPad Prism version 6.00 for Windows (GraphPad Software, La Jolla, California, USA). Continuous parametric data were analyzed using paired or unpaired *t*-tests. Categorical data were analyzed using Chi-square test. Contingency data were analyzed using Fisher's exact test. Statistical significance for each test was set at $P < 0.05$.

Results

Demographics and surgical technique

Data were collected for 101 patients who had undergone ACLR. The median age of patients was 30 years (range 12–54), median time from injury 11 months (range 1–240), and median followup 31 months (range 14–52). 58% of patients were right knees. Seventy nine (78%) patients underwent single-bundle ACLR, 14 (14%) patients underwent double-bundle ACLR, and 8 (8%) underwent bundle augmentation (three anteromedial and five posterolateral).

44% (n = 44) of patients had meniscal pathology and 28% (n = 28) had chondral pathology present at time of ACLR (17% (n = 17) had both meniscal and chondral pathology present). A breakdown of the type of pathology is demonstrated in Table 2.

Return to preinjury level of activity

Figure 1 illustrates the change in activity after injury and ACLR. The mean preinjury CSAS of the study population was 87.5 (range 55–100). Following ACL rupture, the mean CSAS was reduced to 55.6 (range 20–90). Postreconstruction, the mean CSAS of the group increased again to a mean of 84.2 (range 40–100).

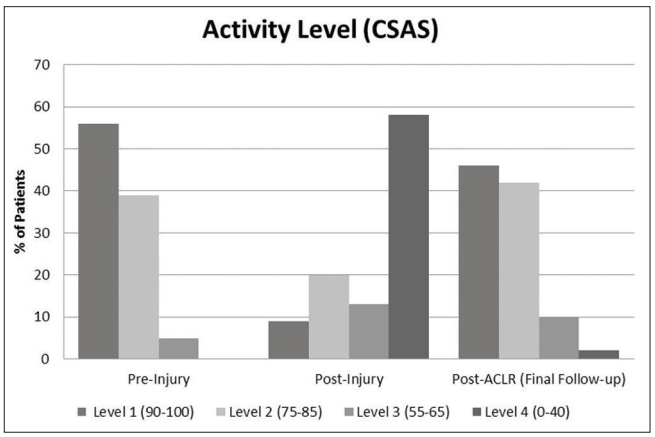

Figure 1: Bar chart showing distribution of the Cincinnati Sports Activity Scale scores preinjury, postinjury, and following reconstruction (original)

Table 2: Summary of patient demographics, reconstruction technique, and associated pathology

	Total number	Number able to return to preinjury CSAS (%)	Number unable to return to preinjury CSAS (%)
Patients	101	71 (70)	30 (30)
Median age (range), years	30 (12-54)	29 (12-54)	30 (14-47)
Median time since injury (range), months	11 (1-240)	10 (1-180)	13 (5-240)
Type of reconstruction			
Single bundle	79	57 (72)	22 (28)
Double bundle	14	8 (57)	6 (43)
Bundle augmentation	8	6 (75)	2 (25)
Chondral pathology present	28	19 (68)	9 (32)
Grade 2	15	11 (73)	4 (27)
Grade 3	6	3 (50)	3 (50)
Grade 4	7	5 (71)	2 (29)
Meniscal pathology treatment	44	32 (73)	12 (27)
Lateral meniscal repair	6	5 (83)	1 (27)
Medial meniscus repair	15	9 (60)	6 (40)
Lateral and medial meniscus repair	2	1 (50)	1 (50)
Lateral meniscus debridement	6	4 (67)	2 (33)
Medial meniscus debridement	15	13 (87)	2 (13)
Chondral and meniscal pathology	17	13 (76)	4 (24)
Chondral or meniscal pathology	60	43 (72)	17 (28)

CSAS=Cincinnati Sports Activity Scale

Overall, 70% of patients returned to their preinjury level. Of this group, 90% of patients were still performing at the same level at final followup (median 31 months). Therefore, 30% of patients were unable to return to the same preinjury level of activity. Table 2 demonstrates that the demographics of the two groups were similar including the rates of chondral or meniscal pathology.

Of those who were unable to return to their preinjury levels of activity, 80% (24/30) of these cases showed improvement compared to their preoperative levels of activity. Therefore, only six patients (out of the original cohort of 101) failed to improve their CSAS after ACLR.

Subgroup analysis

Thirty seven patients scored maximum possible CSAS score pre-ACL injury. 65% (n = 24) of these were able to return to the same maximum possible CSAS score following reconstruction. No significant difference was found when comparing the ability to return of this group compared to the remaining patients (P = 0.39).

Patients aged under 26 years had higher rates of returning to preinjury levels of activity than those aged 26 years or over, although this did not reach statistical significance (28/34 [82%] vs. 43/67 [64%]; P = 0.06).

ACLR within 6 months of ACL injury led to a higher rate of returning to preinjury level of activity (84%; 26/31) compared with those who waited longer than 3 years after ACL injury (58%; 11/19, $P < 0.05$). The rates of meniscal pathology at the time of ACLR were higher in the cohort who waited >3 years before ACLR (12/19; 63%), compared to those reconstructed within 6 months of injury (11/31; 35%; P = 0.08).

The presence of meniscal or chondral pathology at the time of ACLR was not associated with return to preinjury activity (P = 0.83). Of the 44 patients with meniscal pathology, 73% returned to the same level of activity, and of the 28 patients with chondral pathology, 68% returned to the same level of activity. Table 2 shows further information on the meniscal or chondral pathology present at the time of ACLR.

72% of single-bundle ACLRs, 57% of double-bundle ACLRs, and 75% of bundle augments returned to the same level of activity. However, the rate of return to preinjury activity comparing types of reconstruction did not reach statistical significance (P = 0.50).

Reasons for failure of return to preinjury levels

Table 3 details the reasons given by those patients who were unable to return to their preinjury level. Patients were able to give more than one reason, which is why the percentages combine to more than 100%.

Overall, 30% of patients did not return to preinjury levels of activity. Of these patients, 57% gave continued knee symptoms, 27% lifestyle issues, 27% anxiety, 23% fear, and 10% other musculoskeletal problems as a reason for failing to return to the same level. This is shown in Table 2. Some patients gave a combination of reasons, with 4 (13%) patients having knee problems as well as fear of further injury or lifestyle changes. Two (6%) patients suffering both fear of further injury and having made lifestyle changes.

Table 3: Summary of reasons given for not returning to preinjury level

Reason	Number stating this reason (%)
Knee problems	17 (57)
Subjective instability	3 (10)
Other symptoms	14 (47)
Anxiety	8 (27)
Change in lifestyle	8 (27)
Fear	7 (23)
Other musculoskeletal problems	3 (10)

Of those with continued knee symptoms (n = 17), three complained of continued subjective instability. However, none of the patients (with subjective instability) had objective features on examination or magnetic resonance imaging (MRI) and all were found to have had incomplete physiotherapy rehabilitation (appointments missed or patient terminated early). Defined diagnoses for continued knee pain were three patients with arthritis (Grade 4 changes on further arthroscopy), three patients with chondromalacia patellae, and three patients with meniscal problems requiring further arthroscopy (one repair and two debridements). Eight patients had no further source for the pain identified (with normal repeat MRI studies).

Further surgery and complications

Ten (33%) patients who failed to return to preinjury levels of activity underwent further surgery. One patient suffered an infection that required arthroscopic washout (with graft retention), six underwent debridement of meniscal tears, and three had chondroplasty performed.

Eight (11%) patients who returned to preinjury level of activity underwent further surgery. Three patients had arthroscopy performed for meniscal or chondral problems, one had hematoma washout (at 2 weeks post-ACLR), and four revision ACLRs were performed (traumatic graft ruptures after returning back to preinjury level of activity).

Following this further surgery, only 6 (33%) of the 18 patients were then able to return to their preinjury level of activity.

Discussion

The most important findings of this study were that 70% of nonprofessional athletes were able to return to their preoperative activity level following ACLR. Multiple

factors influenced failure to do so in the remaining 30%. Continued knee symptoms and psychological issues were common, but there was considerable interplay between the factors measured. Therefore, our hypothesis was accepted. Further surgery occurred more frequently, when the patient did not return to their preinjury level, but resulted in only a 33% chance of achieving this goal (even when pathology was identified).

Our findings must be considered alongside previous studies in this area. The 70% of our patients, able to return to preinjury levels of activity, compares favorably with the 63% found in meta-analysis results.[1] In addition, the majority of our patients who achieved this goal (90%) maintained this level at followup averaging almost 3 years postsurgery. However, in this study, we chose to concentrate on the 30% of our patients who failed to achieve this goal. What were the factors that contributed to this outcome and was this outcome always appropriate?

In a study comparing nonoperative therapy with ACLR, Grindem *et al*. found no difference in return to sports 1-year postinjury (rates of 68% from 138 patients).[18] However, in our surgical cohort, despite a median 11 months between injury and surgery, we found that the functional level remained impaired ($P < 0.01$). The mean postinjury CSAS score was 44 points lower than the preinjury CSAS score (the equivalent of taking part in sports once per month compared to 4–7 times per week). Therefore, we feel that adequate time was allowed to see improvement, were it to occur. It is, however, an interesting finding that the timing of reconstruction did have an effect. In our study, reconstruction within 6 months of injury resulted in more patients returning to their pre-injury level (compared to those reconstructed after this time point).

Potential reasons for failure to return, post-ACLR, included surgical, physical, psychological, and social factors.[10] Each of these categories was considered in turn.

Surgical factors include reconstruction technique and the treatment of associated pathology. In our study, both factors had no effect on return to preinjury activity level. The treatment of chondral or meniscal pathology was unrelated to return although the presence of such pathology, when found while investigating continued knee symptoms, seemed to result in further surgery. The relevance of surgical factors was, therefore, not significant. It should be noted that other studies have seemingly contradictory findings to our study. In a study of 272 ACL reconstructions (from the Swedish National Knee Ligament Register), Hamrin Senorski *et al*. found the absence of both meniscal injury and chondral injury to be associated with an increased odds ratio of return to sport at 1 year.[19] However, the level of return (in comparison to preinjury) in their study was not considered. Further, the relative merits of meniscal treatment (resection or repair) were not evaluated by our study. These areas require further investigation with the second variable needing the longevity to be evaluated alongside return as a single endpoint.

Physical factors, identified in a systematic review by Czuppon *et al*., included higher preinjury activity score and resulted in increased return to play levels.[10] However, again, in our study, no difference was found between those with a maximum CSAS preinjury score compared to the rest of the group. Equally, our subgroup analysis, looking at age as a factor, showed no difference in return rates. A comparison of strength (particular quadriceps and hamstring) may be useful, but was not performed in our study due to the lack of preinjury data.

Psychological factors, identified by the same systematic review, included lower kinesiophobia and higher preoperative self-motivation and self-efficacy.[10] Other groups have identified self-confidence, optimism, and self-motivation as key factors,[20] with strategies such as self-talk and goal-setting shown to be key to optimizing this.[8,20] Our study supports the finding that many patients cite psychological reasons as a reason for failure to return to preinjury levels of activity. Combining fear of re-injury and anxiety, 50% of our patients referred to psychological issues as a key factor. This is similar to previous studies reporting the rates of between 45% and 52%.[5,6,21,22]

The final suggested domain is social factors. In a study of 31 patients, Tjong *et al*. found that only 36% returned to the same level with many choosing not to.[7] This conscious decision, incorporated in the 27% of our cohort who stated lifestyle changes as a key factor, may make return to preinjury levels and inappropriate measure for these patients. Furthermore, the interplay (found in our study) of fear and anxiety, with these social factors, further increases the number of patients this is relevant to.

Continued knee symptoms remain the most frequent factor we identified in those patients who were unable to achieve preinjury levels. This has been shown by other researchers with similar published rates.[6,23] In addition, in our study, a three-fold increase in the occurrence of further surgery was found in those who did not return to preinjury levels. Although some patients had a presumed cause of these symptoms, further surgery did not seem to be effective with only one-third benefiting from this. Therefore, it is possible that the higher rates of surgery reflect the surgeon's and physical therapist's continued efforts to enable the patient to return to their preinjury activity level. However, given our findings, it could be argued that rationalizing continued symptoms, managing these nonsurgically, and addressing concomitant psychological factors may be at least as useful as offering these patients further surgery.

The strength of our study lies in the detailed data collection at the time of hamstring ACL reconstruction, especially the degree of chondral or meniscal pathology present at the time of reconstruction. We were able to accurately

compare these data and confidently show no association between the rates of chondral or meniscal pathology and return to activity. There are, however, weaknesses in this study including the retrospective analysis of data and the small numbers in various subgroups. The inclusion of only one graft type (autologous hamstring) can be seen as a strength, by removing another potential confounder, but does potentially limit the generalizability of our data to other reconstruction techniques. In addition, there are some limitations in the use of the CSAS as an outcome. We chose to use a return to the preinjury score as a discreet outcome whereas near return to this level was not seen as equivalent. However, a minimal clinically important difference has not been established for this scale and some of the failures may have been as significant to the patients. Finally, we chose to include all types of reconstruction (single bundle, double bundle, and bundle augmentation) within our analysis. It can be argued that reconstruction type may affect outcome (including rerupture rate) and therefore may confound our study of return-to-activity. Although our data do not support this finding, with no statistically significant difference between reconstruction groups, it should be considered as our study was not specifically powered for this variable.

Questions still exist about whether success of an ACLR should be measured by return to preinjury level of sports or function and whether failure to do so represents a need for further surgery. Although this is still a commonly stated goal of professional athletes and keen sportspeople, athletes nearing the end of their natural career and recreational amateurs may view their ACL injury as a reason to retire from their sport at their preinjury level. Postsurgical rehabilitation is lengthy and requires both commitment and motivation to achieve maximal results. Meanwhile, other life events (social factors) such as work and family may take precedence and thus goals may change throughout this period. Individuals may be simply satisfied with a knee that they can trust and that feels stable. It is clear that the psychological impact of the injury is significant and the goals may change during the lengthy rehabilitation process. The relationship between the physical therapist and the patient is key to managing goals and expectations. Establishing rapport and individualized goals is vital to ensuring patient buy-in and more likely satisfaction following the process. It is important for the treating team to manage expectations (including the likelihood of continued low-level symptoms) and identify personality traits and psychological factors.

For those patients where return to preinjury level remains a primary goal, providing targeted support and using strategies such as goal setting and self-talk may be of use to ensure optimism and motivation. For other patients, failure to return to the same level of sports does not necessarily mean that the ACLR surgery has not been a success. Goals may change during the lengthy rehabilitation process and should be regularly revisited. Awareness of the factors that may limit successful return and acceptance of patient-specific goals is likely to lead to a more accurate measure of success after ACLR. In some patients, return to a desired level of activity may be a better outcome measure than the one used in this study.

Conclusion

This study adds to the increasing literature surrounding return to play following anterior cruciate ligament reconstruction. Achieving this goal is reliant on a number of inter-related factors. However, for some patients, a return to the same level may not be the most appropriate goal. These findings should be considered in goal-setting

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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