



Poor Functional Outcome in Patients with Voluntary Knee Instability after Anterior Cruciate Ligament Reconstruction

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Background: Anterior cruciate ligament reconstruction (ACLR) remains the gold standard treatment for anterior cruciate ligament (ACL) injury. However, a good functional outcome even after a successful surgery depends on multiple factors. It has been observed that certain patients with a chronic ACL injury demonstrate knee instability voluntarily. The authors observed that these patients might not perform well even after a successful surgery. This study aims to assess the outcome after ACL and other ligament reconstruction in patients with voluntary knee instability.

Methods: From a total of 824 patients who underwent ACLR, 13 patients with a history of voluntary knee instability were selected, and data of these patients (demographic and clinical profile) were obtained. Outcomes of surgery in this group of patients were evaluated by using Lysholm score and Tegner activity level.

Results: All patients were young men with a chronic ACL injury and manifested instability. Associated injuries were lateral meniscus tear in 3 patients, medial meniscus tear in 2, and posterolateral corner (PLC) injury in 3. ACLR was done using the semitendinosus-gracilis graft in all patients. Further, anterolateral ligament reconstruction was done in 2 patients and PLC reconstruction, in 3 patients. The mean Lysholm score was 54.76 (range, 48–62) preoperatively and 60.92 (range, 54–78) at a mean follow-up of 14.3 months (range, 11–26 months). The median Tegner activity level was 6 (range, 5–7) before injury and 4 (range, 3–5) at the final follow-up. Twelve of the 13 patients were able to demonstrate instability voluntarily at the time of the final follow-up.

Conclusions: In patients with ACL and other ligament injuries who demonstrated voluntary knee instability, the functional outcome even after successful ligament reconstruction was poor.

Keywords: Knee joint, Anterior cruciate ligament, Voluntary knee instability

Anterior cruciate ligament (ACL) tears are commonly seen injuries in sports traumatology.¹⁾ Arthroscopic ACL reconstruction (ACLR) is considered the standard of care for patients with ACL tears with instability.²⁻⁴⁾ The aim of

ACLR is to restore the preinjury level of function, which is a challenging task.^{5,6)} The good functional outcome after ACLR depends upon multiple factors, which can be divided into extrinsic and intrinsic factors.⁷⁾ The extrinsic factors include the type of graft used, surgical technique, and preoperative and postoperative rehabilitation. The intrinsic factors are various, including the genetic and biological factors, type of tear, associated injuries, motivation, and psychological attitude.⁷⁻¹⁰⁾

Pain and swelling of the knee joint are the initial symptoms of an acute ACL injury, whereas instability of

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the knee joint is a symptom of chronic ACL tears.¹¹⁾ It has been observed that very rarely patients with a chronic ACL tear can voluntarily demonstrate instability. This instability is seen in either the anteroposterior or anterolateral to posteromedial direction with the knee joint in 90° flexion or in extension. Further, this instability is described as a part of the symptoms. We have given it the term *voluntary knee instability*. Although not mentioned in the literature, we have been observing this phenomenon in a few patients. The primary objective of this study was to define voluntary knee instability and prospectively evaluate the functional outcome of ACLR in these patients with or without additional ligament reconstruction. The functional outcome after ACLR was evaluated by using the Lysholm knee score and Tegner activity scale.^{12,13)}

METHODS

This study is a retrospective and prospective combined case series of 13 patients who were identified as having voluntary knee instability and managed at a military orthopedic center from January 2011 to December 2018. This study was approved by the Institutional Review Board of Command Hospital Western Command (IRB No. 04/09/May/CHWC), and informed consent was obtained.

Case Definition & Enrollment

Patients with voluntary knee instability were defined as patients with chronic ACL-deficient knees or with any associated ligament injury who can voluntarily demonstrate knee instability by being able to move the tibia in an anteroposterior or anterolateral to posteromedial direction. With this definition, we enrolled 13 out of 824 patients who underwent arthroscopic ACLR with or without additional procedure at a military hospital in the past 8 years. The majority of these patients (786 of 824) were operated using the semitendinosus-gracilis (STG) graft, while the bone-patellar tendon-bone (BPTB) graft was used in the rest (38 of 824). The ethical clearance of the institutional committee was obtained to conduct this observational study. The first author observed 3 cases of voluntary instability and followed their outcomes. After observing a few failures in these cases, it was decided to carry out this retrospective and prospective case series. In 10 of the 13 cases, the data collection was prospective after case identification. Patients identified as having voluntary knee instability were enrolled in the study after counseling regarding the need for follow-up.

Preoperative Evaluation

The patients were evaluated preoperatively clinically and radiologically (using magnetic resonance imaging). A standard protocol was used to assess these patients, which included medical history taking regarding the mode, type, and duration of injury. The time between injury and first evaluation at our center was noted. The patients were examined clinically for pain, swelling, and instability, and special tests such as Lachman test, Pivot shift test, and valgus-varus stress test were performed. Any comorbidities or generalized ligament laxity (GLL) were also noted.

Operative Procedure

All patients were taken up for surgery, depending on the type of ligament involved. In a patient with an isolated ACL injury (grade 1 or 2 positive Pivot shift test), ACLR was performed by using the STG graft, and fixation was done with EndoButton on the femoral side and a biointerference screw on the tibial side. In the patients with grade 3 positive Pivot shift test, ACLR was augmented with anterolateral ligament (ALL) reconstruction using the ipsilateral gracilis tendon. The ALL reconstruction was fixed by using biointerference screws on both sides. Further, in a patient who had a positive valgus stress test or a posterolateral corner (PLC) injury (more than grade 2), ACLR was augmented with the Larson procedure using a STG graft of the opposite side.¹⁴⁾ All the patients were assessed in terms of tunnel position postoperatively by X-rays of the knee joint in standing position.

Postoperative Protocol

As per the standard institutional protocol, patients with ACLR or ACLR with ALL reconstruction underwent a uniform rehabilitation and exercise program. During the initial 6 weeks, patients were asked to do static quadriceps, straight leg raising, and range of motion exercises in full weight-bearing. At 6 weeks, patients were advised to perform closed chain exercises, cycling, and aquatic exercises. At 5 months, light jogging was allowed. At 6 months, they were allowed to undergo agility and sport-specific training. Return to sports was allowed after 9–10 months. In patients with ACL and posterior lateral corner reconstruction, during 0–8 weeks, static quadriceps and range of motion exercises from 0° to 60° were started along with touch down weight-bearing with crutches. A knee brace locked in extension was worn at all times. At 8 weeks, patients were advised to perform straight leg raising and range of motion exercises and discontinue the use of crutches. At 16 weeks, full weight-bearing and the full range of motion exercises were recommended along with 1–2 miles of

walk. At 6 months, they were allowed to undergo agility and sport-specific training. Return to sports was allowed after 10–12 months.

Follow-up & Data Collection

At follow-up, all these patients were evaluated with a physical examination using Lachmann and Pivot shift test and the functional outcome was evaluated by using Lysholm knee score and Tegner activity level, which were compared with the preoperative knee scores. The data of these patients with voluntary knee instability were analyzed to obtain the demographic profile, comorbidities, type of graft, clinical presentation, and the treatment given. At the final follow-up, all these patients were evaluated with a physical examination using Lachmann and Pivot shift test and functional outcome, using Lysholm and Tegner activity level, which were compared with the preoperative knee scores.

Statistical Analysis

The categorical variables were reported as numbers and percentages while the continuous data were given as mean \pm standard deviation (SD) and range or median and interquartile range as appropriate. Preoperative to final follow-up comparison was done by Wilcoxon signed-rank test.

The values for variables of functional outcomes were compared with the values of other studies by the method of one-sample *t*-test. A *p*-value < 0.05 was considered statistically significant. The analysis was conducted by using IBM SPSS ver. 22.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The demographic profile of the 13 patients is presented in Table 1. All were nonobese young men. Barring 1 patient who got injured in a road traffic accident, most of the injuries were sustained in sports and military training activities. Three patients were not able to specify the mode of injury, but they presumed that they might have got injured in military training activities. Two patients had features of GLL based upon Beighton score. The delay in presentation was 11.5 months (range, 6–24 months; SD, 4.82) from the date of onset of symptoms. Three patients had an associated lateral meniscus tear, 2 had a medial meniscus tear, and 3 had a PLC injury. ACLR was done in all patients who underwent surgery using the STG graft. Also, in 2 patients with grade 3 Pivot shift, anterior lateral ligament reconstruction was done at the time of index surgery, and in 3 patients, PLC reconstruction was done using the opposite side STG graft.

Table 1. Demographic and Injury Profile

Patient no.	Age (yr)	Mode of injury	Type of injury	Comorbidity	Duration of injury (mo)	Side	Injury	Procedure performed	Resurgery	Reinjury after surgery
1	21	Road side accident	C	-	6	Right	ACL + MM	ACLR	ACL ALL	-
2	27	Training	NC	GLL	13	Left	ACL	ACLR	-	-
3	24	Sports	NC	-	7	Left	ACL + LM	ACLR	Rev ACLR	-
4	26	Training	NC	ADS	8	Left	ACL + PLC	ACLR + PLCR	-	-
5	31	No specific injury	None	-	13	Right	ACL	ACLR	-	-
6	26	Sports	C	-	9	Right	ACL + MM	ACLR	-	-
7	21	No specific injury	None	-	7	Left	ACL + PLC	ACLR + PLCR	-	-
8	22	Training	NC	GLL	11	Right	ACL	ACLR	-	Yes
9	28	No specific injury	None	AD	14	Right	ACL	ACLR	-	-
10	24	Sports	NC	-	24	Left	ACL + LM	ACLR + ALL	-	-
11	32	Sports	NC	-	16	Right	ACL + LM	ACLR + ALL	-	-
12	21	Sports	NC	-	12	Left	ACL + PLC	ACLR + PLCR	-	-
13	23	Sports	NC	-	10	Left	ACL	ACLR	-	Yes

C: contact, ACL: anterior cruciate ligament, MM: medial meniscus, ACLR: anterior cruciate ligament reconstruction, ALL: anterior lateral ligament, NC: non-contact, GLL: generalized ligament laxity, LM: lateral meniscus, Rev ACLR: revision ACLR, ADS: alcohol dependence syndrome, PLC: posterior lateral corner, PLCR: posterolateral corner reconstruction, AD: adjustment disorder.

At a mean follow-up of 14.3 months (range, 11–26 months), there was no significant improvement in Lachman test and Pivot shift test as compared to preoperative measurements (Table 2). Even the Lysholm knee score improved by just 6 points. The median Tegner activity scale was 6 (range, 5–7) before the injury and 4 (range, 3–5) at the final follow-up. Twelve of the 13 patients were able to demonstrate instability voluntarily at the time of the final follow-up. In 2 patients, resurgery was performed. Of these 2 patients, ALL reconstruction was done in one while in the other patient, revision ACLR was done using the BPTB graft.

DISCUSSION

The present study aimed to assess the functional outcome of ACLR and other associated ligament reconstructions in patients with voluntary knee instability. The patient was considered to have voluntary knee instability if he/she demonstrated instability as a part of symptomatology. As the study was conducted at a military hospital, all the patients were young men with a chronic ACL injury sustained mostly in sports or military training activities. Of the 13 patients, 2 had GLL, which is considered as one of the factors associated with poor outcome after ACLR. Thus, we cannot attribute this voluntary knee instability to ligament laxity as only 15% (2 of 13) of the patients had features of GLL. Further, 15% (2 of 13) had some psychiatric issues.

There was a marginal improvement of 5.7 in the mean Lysholm score at the final follow-up from the preoperative values. This finding is in contrast to that of various other recent studies, which show an average improvement of 25–30 points in Lysholm score after ACLR.^{3,15,16} Fur-

Table 2. Objective and Patient-Reported Functional Outcome Preoperative and Final Follow-up

Variable	Preoperative	Final follow-up
Objective, mean (range)		
Lachman	2.61 (1–3)	2.15 (1–3)
Pivot shift	2.23 (1–3)	1.61 (0–2)
Valgus stress test	2 (1–3)	1.5 (1–3)
Patient-reported outcome		
Lysholm, mean (range)	54.76 (48–62)	60.92 (54–78)
Tegner activity scale, median (range)	6 (5–7)*	4 (3–5)

*Preinjury level.

Table 3. Functional Outcome Comparison with Various Studies

Variable	This study		Gupta et al. ³⁾		Sud et al. ¹⁶⁾		Suomalainen et al. ¹⁷⁾		Toanen et al. ¹⁸⁾		Lee et al. ⁶⁾	
	Preop	Final follow-up	Preop	Final follow-up	Preop	Final follow-up	Preop	Final follow-up	Preop	Final follow-up	Preop	Final follow-up
Lysholm score	54.76 ± 3.98 (48–62)	60.46 ± 6.61 (54–72)	-	89.79 ± 10.52	55.19 (38–66)	82.65 (69–100)	64 ± 18	87 ± 17	55.7 ± 12.4	93.2 ± 9	-	85.2 ± 11.3
Comparison with the present study	-	-	-	< 0.001**	0.710	< 0.001**	0.078	< 0.001**	0.797	< 0.001**	-	< 0.001**

Values are presented as mean ± standard deviation (range).
 Preop: preoperative.
 **Statistically significant.

ther, this difference in scores between other studies and the present study were statistically significant (Table 3).^{3,6,16-}

¹⁸⁾ Also, based on the Tegner activity scale, the majority of patients were not able to return to the preinjury level. Only 1 of 13 patients (7.7%) were able to return to the preinjury level. These findings are also in contrast to those of other studies, which showed as many as 35%–60% of patients were able to return to the preinjury level.^{19,20)} The marginal improvement in Lachman test and Pivot shift test was not found to be significant. Although manual examination to check the stability of the joint cannot be considered as foolproof, it has a definite role as an examination performed by a single person.^{21,22)} Furthermore, 12 of the 13 patients (92.3%) were able to demonstrate instability at the final follow-up. In 2 patients, we had to revise the surgery as the symptoms did not improve with primary surgery and the patients were still symptomatic with instability. In 1 case, we augmented the surgery with ALL reconstruction, while in the other case, we did revision ACLR with the BPTB graft, as the ACL was found to be torn entirely intraoperatively without significant injury.

The exact cause of voluntary knee instability is not known. However, it seems something similar to the voluntary shoulder dislocation.²³⁾ One of the possible causes of persistent instability postoperatively could be that the patient's tendency to demonstrate knee joint instability,

which persisted even after surgery, might have led to the failure of the graft. Furthermore, some studies have documented abnormal mechanical load and microtrauma as a cause of ACL failure.^{24,25)} The patients demonstrating voluntary knee instability may also be causing microtrauma and abnormal load to the newly reconstructed ACL, leading to failure of the graft. However, this phenomenon requires to be studied extensively. One of the limitations of the study is the short follow-up. Also, being a case series, we did not plan a comparative control cohort, and we did not use any arthrometric-testing tool such as the KT 1000 arthrometer to check instability before and after the surgery.

To conclude, voluntary knee instability is a rare entity. The functional outcome in patients with symptoms of voluntary knee instability is poor. This case series is the first to describe this phenomenon of voluntary knee instability and helps generate a hypothesis that these patients may have poor surgical outcomes, which needs to be studied by using a better study design.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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