

Functional Outcomes of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autograft in a Predominantly Chronic Anterior Cruciate Ligament Injury Cohort: A Prospective Study

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Learning Point of the Article:

Arthroscopic ACL reconstruction with hamstring autograft yields good stability and function even in chronic, delayed-presenting ACL injuries.

Abstract

Introduction: Anterior cruciate ligament (ACL) rupture is a common cause of knee instability. While arthroscopic ACL reconstruction is well established, most studies focus on acute or sports-related injuries. Data on functional outcomes following reconstruction in chronic ACL tears, particularly those due to road traffic accidents, are limited.

Objective: The objective of this study was to evaluate functional outcomes and knee stability following arthroscopic ACL reconstruction using an autologous hamstring tendon graft in patients with chronic ACL injuries.

Materials and Methods: This prospective study included 25 patients with clinically and radiologically confirmed ACL tears who underwent arthroscopic ACL reconstruction using a semitendinosus–gracilis tendon autograft. A standardized rehabilitation protocol was followed. Functional outcomes were assessed at 6 months using the International Knee Documentation Committee (IKDC) score, and knee stability was evaluated using the Lachman test.

Results: The mean age was 26.88 years with male predominance (24:1). Road traffic accidents were the most common mechanism of injury (60%). The mean duration from injury to surgery was 9.31 months. At final follow-up, 84% of patients had normal or nearly normal IKDC grades, with a mean IKDC score of 85.38. The Lachman test was negative in 84% of patients. All grafts were intact, and no graft failures occurred.

Conclusion: Arthroscopic ACL reconstruction using autologous hamstring tendon autografts provides good functional outcomes and knee stability in chronic ACL injuries at short-term follow-up.

Keywords: Anterior cruciate ligament, arthroscopy, hamstring autograft, chronic anterior cruciate ligament injury, International Knee Documentation Committee score.

Introduction

The anterior cruciate ligament (ACL) plays a pivotal role in maintaining knee stability, and its rupture is associated with functional impairment and long-term morbidity if left untreated. ACL injuries are increasingly common because of high-energy

trauma and sports activities [1]. Arthroscopic ACL reconstruction is the standard of care to restore knee stability and function [2].

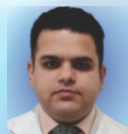
Hamstring tendon autografts are widely used because of reduced donor-site morbidity and reliable functional outcomes [3,4,5].

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Author's Photo Gallery



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Recent prospective studies have demonstrated excellent short-term knee function and stability with quadrupled hamstring autografts [6]. Systematic reviews have also shown significant improvements in the International Knee Documentation Committee (IKDC) and the Lysholm scores following hamstring tendon ACL reconstruction [7].

Most studies, however, focus on acute sports-related ACL injuries. In developing countries, chronic ACL tears with delayed presentation are common, particularly following road traffic accidents. Limited data are available on functional outcomes in such patients [7].

This study evaluates functional outcomes and knee stability following arthroscopic ACL reconstruction using hamstring tendon autografts in a predominantly chronic ACL injury cohort.

Materials and Methods

Study design and setting

A prospective study was conducted at a tertiary care orthopedic center over a period of 18 months.

Patient selection

Inclusion criteria

The following inclusion criteria were used to select participants for the study.

- Complete ACL rupture (acute or chronic)
- Symptomatic knee instability
- Age 17–50 years
- Magnetic resonance imaging (MRI)-confirmed ACL tear.

Exclusion criteria

The following exclusion criteria were used to exclude participants from the study.

- Tibial spine avulsion
- Multiligament injuries
- Neuromuscular disorders
- Knee osteoarthritis
- Active infection
- Fixed knee stiffness.

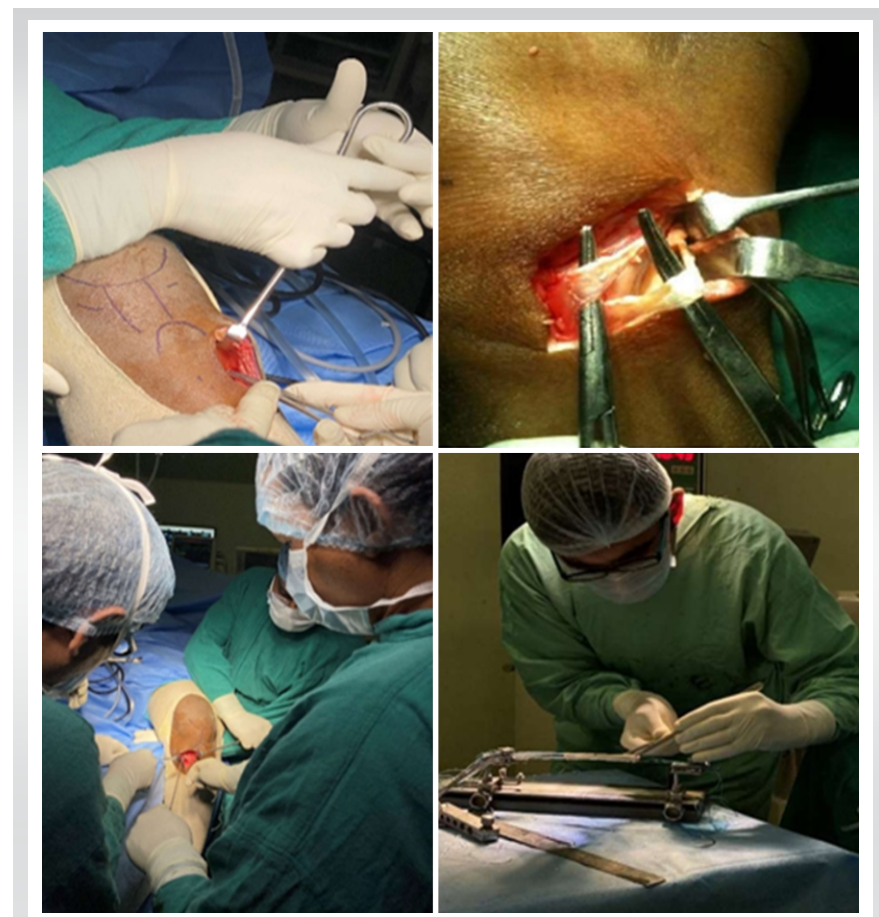


Figure 1: Graft harvesting and preparation. (a) Incision for graft harvest, (b) identification of semitendinosus and gracilis tendons, (c) tendon harvest using, and (d) graft preparation and tensioning.

Pre-operative evaluation

Clinical assessment included Lachman, anterior drawer, and pivot shift tests. Associated injuries were excluded using clinical examination and MRI [8].

Surgical technique

Under spinal anesthesia, the semitendinosus and gracilis tendons were harvested through a 3-cm incision over the pes anserinus. The tendons were whip-stitched and folded to form a five-strand graft (Figs. 1a, 1b, 1c, 1d). Femoral and tibial tunnels were drilled anatomically, and graft fixation was performed using an adjustable-loop endobutton on the femoral side and an interference screw on the tibial side (Fig. 2). Post-operative radiographs confirmed tunnel position and hardware placement (Fig. 3) [9].

Post-operative rehabilitation and follow-up

Early mobilization with continuous passive motion was initiated on the 1st post-operative day. A knee brace was used for 4 weeks. Progressive range-of-motion and strengthening exercises were introduced, and return to sports was permitted after 6 months. Follow-up

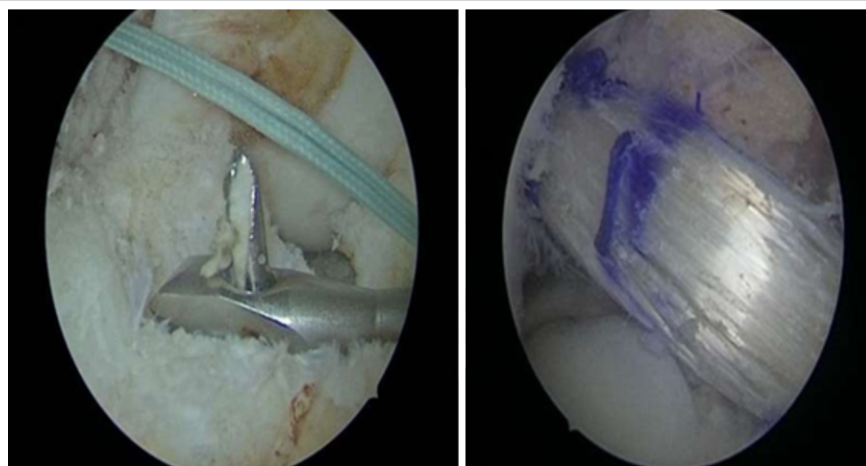


Figure 2: Intraoperative arthroscopic images.

evaluations were performed at 1, 2, 3, and 6 months.

Results

Demographics and injury pattern

A total of 25 patients were included in the study. The mean age was 26.88 years (range, 17–38 years), with a male-to-female ratio of 24:1. Road traffic accidents accounted for 15 patients (60%), sports injuries for 9 patients (36%), and other trauma for 1 patient (4%). The mean duration from injury to surgery was 9.31 months. The right knee was involved in 16 patients (64%) and the left knee in 9 patients (36%).

Intraoperative findings

Six patients (24%) had associated meniscal tears, of which five were lateral and one was medial; all were treated with partial meniscectomy. No significant cartilage lesions requiring additional procedures were noted.

Graft characteristics

The mean graft length was 88.6 mm (range 82–95 mm). The mean graft diameter was 8.12 mm on the femoral side and 8.8 mm on the tibial side (Table 1, 2, 3). All grafts were positioned anatomically and confirmed radiographically (Fig. 3).

Functional outcomes

- The Lachman test was negative in 21 patients (84%), whereas 4 patients (16%) demonstrated grade 1+ laxity (Table 4).
- IKDC grading showed normal results in 13 patients (52%), nearly normal in 8 patients (32%), and abnormal in 4 patients (16%), with a mean IKDC score of 85.38 (Table 5) (Fig. 4).
- Twenty-two patients (88%) returned to their pre-injury

activity level, whereas three patients (12%) were limited to recreational activities due to mild stiffness or apprehension.

Complications

One patient (4%) developed post-operative knee stiffness and was managed with manipulation under anesthesia. Two patients (8%) had mild effusion, which resolved with aspiration and physiotherapy. One patient (4%) developed hemarthrosis requiring arthroscopic lavage. No graft failures or infections were observed.

Overall, most patients (84%) achieved normal or nearly normal IKDC grades, and satisfactory knee stability was restored in the majority of cases.

Discussion

The present study evaluated functional outcomes following arthroscopic ACL reconstruction using hamstring tendon autografts in a predominantly chronic ACL injury cohort. The principal finding was that the majority of patients achieved satisfactory functional recovery and restoration of knee stability at short-term follow-up despite delayed surgical intervention. At 6 months, 84% of patients demonstrated normal or nearly normal IKDC grades, with a mean IKDC score of 85.38. In addition, the Lachman test was negative in 84% of patients, indicating successful restoration of anterior knee stability following reconstruction.

The functional outcomes observed in this study are comparable with those reported in previously published literature



Figure 3: Post-operative anteroposterior radiograph showing proper tunnel placement and fixation device on the lateral femoral condyle following arthroscopic anterior cruciate ligament reconstruction.

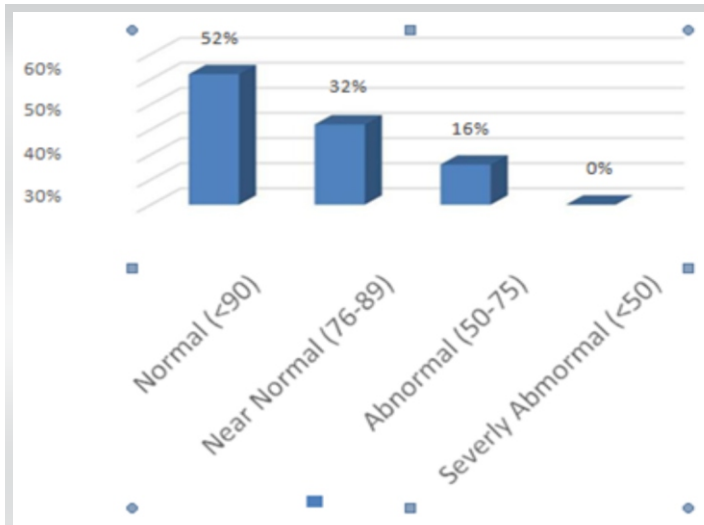


Figure 4: International Knee Documentation Committees score.

evaluating hamstring tendon autograft reconstruction. Hosseinzadeh et al. reported significant improvements in IKDC scores and knee stability following anatomic ACL

reconstruction using quadrupled hamstring autografts at short-term follow-up [8]. Similarly, systematic reviews evaluating ACL reconstruction outcomes have consistently demonstrated substantial improvement in functional scores such as IKDC and Lysholm scores following reconstruction with hamstring tendon grafts [9]. Long-term studies have also shown that hamstring autografts provide reliable functional outcomes with durable knee stability in active individuals [10]. The mean IKDC score observed in the present study is therefore consistent with previously reported functional outcomes after arthroscopic ACL reconstruction.

An important observation in the present study was the predominance of road traffic accidents as the mechanism of injury, accounting for 60% of cases. This pattern differs from many previously reported series in which sports injuries represent the most common cause of ACL rupture. Such differences reflect regional variations in injury epidemiology. In many developing countries, high-energy trauma related to road traffic accidents is a major cause of ligamentous knee injuries. Consequently, ACL tears may occur in individuals who are not necessarily competitive athletes but still require restoration of knee stability to return to normal occupational and daily activities.

Another distinctive feature of this study was the chronic nature of ACL injuries in the study population. The mean duration between injury and surgery was more than 9 months, indicating delayed presentation in most patients. Delayed surgical intervention is frequently encountered in clinical practice in developing healthcare systems due to factors such as delayed diagnosis, financial constraints, or limited access to specialized orthopedic care. Despite these delays, the majority of patients in the present study achieved good functional outcomes following reconstruction. This finding suggests that satisfactory knee stability and functional recovery can still be achieved even when reconstruction is performed several months after the initial injury.

The effectiveness of delayed ACL reconstruction observed in

Table 1: Length of hamstring graft, femoral thickness, and tibial thickness of graft		
Length of hamstring graft	Number of patients	Percentage
110 mm	1	4
105 mm	0	0
100 mm	1	4
95 mm	3	12
90 mm	8	32
85 mm	8	32
80 mm	4	16
Femoral thickness of graft	Number of patients	Percentage
7.0 mm	1	4
7.5 mm	7	28
8.0 mm	8	32
8.5 mm	4	16
9.0 mm	4	16
9.5 mm	1	4
Tibial thickness of graft	Number of patients	Percentage
7.5 mm	1	4
8.0 mm	3	12
8.5 mm	6	24
9.0 mm	10	40
9.5 mm	5	20

Table 2: Lachman test pre-operative versus post-operative		
Lachman grade	Pre-operative	Post-operative
Negative	0	21
1+	0	4
2+	9	0
3+	16	0



Table 3: Comparison of sex distribution

Sex	Maurilio Marcacci <i>et al.</i> [14]	Nikolaou <i>et al.</i> [15]	Sriharsha <i>et al.</i> [16]	Present study
Males	40	30	30	24
Females	10	16	0	1
Total	50	46	0	25

this study is consistent with findings from previous investigations evaluating outcomes in chronic ACL deficiency. Chronic instability may predispose patients to recurrent giving-way episodes and secondary meniscal injuries; however, reconstruction remains capable of restoring the mechanical stability of the knee joint. Gifstad *et al.* demonstrated that patients undergoing ACL reconstruction using hamstring autografts maintained satisfactory functional outcomes even at long-term follow-up [10]. Similarly, other clinical studies have reported that delayed reconstruction can still provide meaningful improvement in knee stability and patient-reported functional outcomes [11]. The results of the present study support these findings and further reinforce the role of surgical reconstruction in patients presenting late with symptomatic instability. The graft characteristics observed in this study were also within the recommended range for successful reconstruction. Adequate graft diameter and proper tunnel placement are important determinants of graft stability and long-term success. Hamstring tendon grafts provide favorable biomechanical properties, including high tensile strength and the ability to create multistrand constructs that approximate the structural characteristics of the native ACL. These biomechanical advantages contribute to the reliable restoration of knee stability following reconstruction. Furthermore, the absence of graft failure in the present study indicates satisfactory graft incorporation during the early post-operative period. Another relevant consideration is the comparison of hamstring tendon autografts with other graft options used in ACL reconstruction. Several studies have evaluated the outcomes of alternative graft sources such as quadriceps tendon and peroneus longus tendon grafts. Comparative analyses have generally demonstrated similar functional outcomes and knee stability across these graft options [12,13]. Nevertheless, hamstring autografts remain widely used because of their technical familiarity, favorable biomechanical properties, and relatively low donor-site morbidity. The satisfactory outcomes observed in the present study further support the continued use of hamstring tendon autografts as a reliable option for primary ACL reconstruction. The novelty of the present study lies in its focus on outcomes following ACL reconstruction in a predominantly chronic injury cohort resulting largely from

road traffic accidents. Much of the existing literature originates from sports medicine centers where early surgical intervention following athletic injuries is common. In contrast, the present study reflects a real-world clinical scenario frequently encountered in many developing regions, where patients present with long-standing knee instability after trauma. Demonstrating favorable functional outcomes despite a mean injury-to-surgery interval of more than 9 months provides clinically relevant evidence supporting the effectiveness of arthroscopic ACL reconstruction in delayed presentations.

From a clinical standpoint, the findings of this study highlight that delayed presentation should not be considered a contraindication for ACL reconstruction. Many patients with chronic ACL injuries continue to experience instability that limits daily activities, occupational work, and recreational participation. The results of this study indicate that surgical reconstruction can still restore knee stability and functional capacity in such patients when appropriate surgical technique and structured rehabilitation are employed.

The present study has certain limitations. The sample size was relatively small, which may limit the generalizability of the findings. The duration of follow-up was limited to 6 months, and therefore, long-term functional outcomes and the development of degenerative changes could not be evaluated. In addition, objective instrumented laxity measurements were not performed, and knee stability assessment relied primarily on clinical examination. Future studies with larger patient cohorts, longer follow-up periods, and additional functional outcome measures would further strengthen the evidence regarding outcomes of ACL reconstruction in chronic injury populations.

In summary, the findings of this study demonstrate that arthroscopic ACL reconstruction using hamstring tendon autografts can achieve satisfactory functional outcomes and restoration of knee stability even in patients presenting with delayed or chronic ACL injuries. These results support the role of surgical reconstruction in managing chronic ACL instability and provide clinically relevant data for healthcare settings where delayed presentation after knee trauma is common.

Conclusion

Table 4: Comparison of laterality

Laterality	Maurilio Marcacci <i>et al.</i> [14]	Nikolaou <i>et al.</i> [15]	Sriharsha <i>et al.</i> [16]	Present study
Right	29	21	21	16
Left	21	25	9	9
Total	50	46	30	25

Table 5: Comparison of International Knee Documentation Committee score

IKDC Score	Fareed <i>et al.</i> [17]	Kyung-Wooknha <i>et al.</i> [18]	Sriharshaet <i>al.</i> [16]	Present study
Normal	12	42	17	13
Near normal	12	13	10	8
Abnormal	1	0	2	4
Severly abnormal	0	0	1	0
Total	25	55	30	25

Clinical Message

Arthroscopic ACL reconstruction with hamstring tendon autograft is an effective option for restoring knee stability and function in patients presenting late with chronic ACL injuries, particularly following road traffic accidents.

Arthroscopic ACL reconstruction using autologous hamstring tendon grafts provides good functional outcomes and satisfactory knee stability in patients with chronic ACL injuries. With appropriate surgical technique and a structured rehabilitation protocol, favorable short-term recovery can be achieved even in cases with delayed presentation.

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

Conflict of interest: Nil **Source of support:** None

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