RESEARCH PAPER

A Prospective Study On The Functional Outcomes Of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autograft

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Abstract

The research studied the first stage of functional recovery which occurred after patients underwent arthroscopic anterior cruciate ligament (ACL) surgery with hamstring tendon autograft. The study included 57 patients who mostly belonged to middle-aged demographic group and experienced their injuries through non-sports activities. The research showed that 43.2 years was the average age of participants who sustained their injuries through road traffic accidents and unintentional falls which accounted for 49.12 percent and 38.60 percent of injuries respectively. We achieved high operational performance because we managed to complete 70.18 percent of the operations within 1.5 hours and 92.98 percent of patients experienced only mild to moderate pain after surgery. The standardized assessment scales showed average functional performance scores of 72.58 for IKDC and 83.37 for Lysholm and 5.35 for Tegner when patients were evaluated at their 6th week assessment. The statistical tests showed a strong positive relationship between IKDC and Lysholm scores which reached a correlation coefficient of 0.904 and between IKDC scores and Tegner activity levels which reached a correlation coefficient of 0.892. The research demonstrates that the surgical approach delivers effective results for both initial functional development and pain relief which benefits a unique patient group that has both advanced age and trauma-related medical condition because it supports the need for customized recovery programs and public health strategies to prevent injuries in comparable environments.

KEYWORDS: Anterior Cruciate Ligament, Hamstring Tendon Autograft, Arthroscopic Surgery, Trauma, International Knee Documentation Committee (IKDC), Lysholm Score.

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Introduction

Reconstruction of the anterior cruciate ligament (ACL) is one of the most popular orthopaedic procedures ever out globally. The people most impacted are those who play organised sports.(1) One of the most frequent injuries to the knee is an anterior cruciate ligament (ACL) damage. The best graft source is still up for debate, despite the fact that a variety of graft types have been employed for ACL repair to restore knee stability. Anterior cruciate ligament injuries constitute a major proportion of knee ligament pathologies encountered in orthopaedic practice. The increasing number of people who participate in sports and the rise in road traffic accidents have led to more frequent ACL injuries. The ACL serves as the main knee stabilizer which prevents the tibia from moving forward while it controls both rotational and valgus stress forces. ACL injury results in clinical symptoms of knee pain and instability together with reduced knee movement ability. Non-operative management can work for certain patients but young active individuals with functional instability require surgical reconstruction. Patients who do not receive proper treatment for ACL injuries will develop secondary meniscal injuries together with early joint degeneration.(2) The incidence of articular cartilage damage in ACL-deficient knees reaches 16 to 46 percent among patients who experience acute knee ruptures. The risk of cartilage degeneration increases with chronic instability which emphasizes the need for urgent surgical procedures that will restore joint stability.(3) Both one-incision endoscopic and two-incision arthroscopically assisted procedures are now used for ACL restoration due to advancements in arthroscopic techniques. Improved cosmesis, less interference with the quadriceps action, better early recovery, and preservation of articular cartilage hydration are all benefits of arthroscopic procedures.(4) Despite these benefits, new prospective research has not demonstrated appreciably better functional results when compared to the open mini-arthrotomy procedure. The most effective treatment for ACL injuries is arthroscopic ACL reconstruction surgery. However, significant clinical symptoms such as local discomfort, edema, and decreased knee range of motion are typically present during the post-operative phase, delaying the functional recovery period. An accessible, affordable, and well-liked treatment for acute musculoskeletal injuries is the use of ice, also known as cryotherapy. Cold aids in the healing of injured tissues by lowering cellular metabolism, nerve conduction, edema formation, and pain. This prospective study was conducted to evaluate the early functional outcomes of arthroscopic anterior cruciate ligament (ACL) reconstruction using a hamstring tendon autograft in a distinctive patient population where trauma, rather than sports, is the predominant etiology. While ACL reconstruction is a well-established procedure, most existing research focuses on younger, athletic cohorts. There is a comparative lack of focused data on functional recovery in older, non-athlete patients, particularly in settings where road traffic accidents and accidental falls are the leading causes of injury. This study therefore aims to assess the surgical efficiency, postoperative pain, and early functional recovery at six weeks in such a cohort, utilizing validated outcome measures including the IKDC, Lysholm, and Tegner scales, and to analyse the correlations between these metrics to better inform clinical practice and rehabilitation protocols for this specific demographic.

Materials and Methods

Study Design and Setting

This was a prospective, observational study conducted over 18 months at the Department of Orthopaedics, Ananta Institute of Medical Sciences and Research Centre, Rajsamand, Rajasthan, India. The study protocol received approval from the Institutional Ethics Committee under Approval No. AIMS/IEC/2023/15 and all participants provided their written informed consent.

Study Population and Sample Size

The study recruited participants who required arthroscopic ACL reconstruction. The minimum sample size was calculated to be 52, assuming a 95% confidence level ($z=1.96$). The study determined that 57 patients would constitute the final sample size after adjusting for a 10% attrition rate.

Inclusion and Exclusion Criteria

Inclusion Criteria: (1) Age > 18 years; (2) Diagnosis of an ACL tear (Grade 3) with or without associated meniscal injury.

Exclusion Criteria: (1) ACL injuries with bony avulsions or associated intra-articular condylar fractures; (2) Multi-ligament knee injuries; (3) Meniscal injuries requiring surgical repair; (4) Congenital ligamentous laxity.

Surgical Technique

All patients underwent arthroscopic ACL reconstruction using a quadruple stranded hamstring

tendon (semitendinosus and gracilis) autograft under spinal or general anesthesia. The graft was harvested through a standard anteromedial incision. The surgical team debrided the torn ACL remnant before they drilled tibial and femoral tunnels with appropriate jigs. The graft was secured in the femoral tunnel with an Endo Button and in the tibial tunnel with a bio absorbable interference screw.

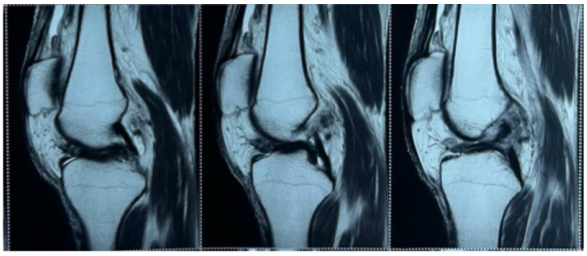

Fig.1: Pre-operative Imaging

Fig.2: Image showing intra operative procedure

Fig.3: Post-operative radiographs

Postoperative Rehabilitation

A standardized rehabilitation protocol was followed at an expedited pace. The knee was initially immobilised using a long leg brace to maintain joint stability. The patient started doing isometric quadriceps exercises together with ankle pump workouts from the first day after surgery. The patient developed active knee flexion which progressed from 45-90° to 120° between weeks 4 and 6. Patients required six weeks of using axillary crutches for mobility. The patient could resume normal activities after three months and was able to engage in full physical activity after one year.

Data Collection and Outcome Measures

Preoperative demographic and injury related data were recorded. Intraoperative data, including surgical duration and graft characteristics, were noted.

Functional outcomes were assessed at the 6-week follow-up using:

- International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form: To evaluate symptoms, function, and sports activity.
- Lysholm Knee Scoring Scale: To assess knee specific function (limp, support, locking, instability, pain, swelling, stair climbing, squatting).
- Tegner Activity Scale: To gauge the level of sports and work activity.
- Visual Analogue Scale (VAS): To quantify postoperative pain (0 = no pain, 10 = worst pain imaginable).

Statistical Analysis

The data were analysed through statistical software which included SPSS. Descriptive statistics were presented through means with standard deviation (SD) for continuous variable values and through categorical variable frequencies combined with percentages. The study used Pearson's correlation coefficient (r) to assess the relationship between IKDC, Lysholm, and Tegner scores. A p-value of < 0.05 was considered statistically significant.

Results

Patient Demographics and Baseline Characteristics

The study included 57 patients who underwent ACL reconstruction. The mean age was 43.2 ± 10.5 years, with the largest proportion of patients (35.09%, n=20) belonging to the 41-50 years' age group. There was a male predominance (63.16%, n=36). Most patients were from urban areas (54.39%, n=31) and had atleast a secondary education (89.47%). The most common socio-economic group among the population studied was upper middle class, which accounted for 28.07% of individuals (n=16) (Table 1).

Injury Characteristics:

The left knee sustained injuries at a rate of 54.39% which resulted in 31 total cases while the right knee sustained injuries at a lower rate. The most frequent injury mechanism occurred through road traffic accidents which accounted for 49.12% of cases and 28 total cases while accidental falls followed with 38.60% of cases and 22 total cases. The study found that 30 participants sustained partial ACL tears which occurred more frequently than 27 participants who suffered complete ACL tears (Table 1).

Surgical and Immediate Postoperative Outcomes:

The majority of surgical procedures (70.18%, n=40) were completed within 1.5 hours. Postoperative pain

assessment using the VAS revealed that most patients experienced mild to moderate pain: 49.12% (n=28) had a VAS score of 0-4 (mild), and 43.86% (n=25) had a score of 5-7 (moderate). Only 7.02% (n=4) reported severe pain (VAS 8-10). (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Cohort (n=57)

Characteristic	Category	n	%
Age Group (years)	20-30	6	10.53
	31-40	16	28.07
	41-50	20	35.09
	51-60	13	22.81
	>60	2	3.51
Gender	Male	36	63.16
	Female	21	36.84
Residence	Urban	31	54.39
	Rural	26	45.61
Cause of Injury	Road Traffic Accident	28	49.12
	Accidental Fall	22	38.60
	Fall from Height	4	7.02
	Heavy Object Fall	3	5.26
ACL Tear Type	Partial	30	52.63
	Complete	27	47.37
Surgery Duration	<1.5 hours	40	70.18
	>1.5 hours	17	29.82
Post-op VAS Score	0-4 (Mild)	28	49.12
	5-7 (Moderate)	25	43.86
	8-10 (Severe)	4	7.02

Functional Outcomes at 6 Weeks:

IKDC Score: The mean IKDC score was 72.58 ± 14.16. Outcomes were classified as Good/Excellent in 50.88% of patients (Good: 42.11%, n=24; Excellent: 8.77%, n=5). Patients showed Fair and Poor outcomes in 24.56% of cases which included 14 patients (Table 2). The Lysholm score produced an average result of 83.37 with a standard deviation of 11.27. The study found Good and Excellent results for 56.14% of patients which included 21 patients showing Good results and 11 patients showing Excellent results. The study results showed Fair outcomes in 33.33% of patients which included 19 patients and showed Poor outcomes in 10.53% of patients which included 6 patients. (Table 2). The study results showed a mean Tegner score of 5.35 with a standard deviation of 2.76. The study results showed that 42.11% of patients (n=24) reached a moderate activity level (score 4-7) while 26.32% of patients (n=15) achieved high activity levels (score >8) (Table 2).

Table 2: Functional Outcome Scores at 6-Week Follow-up

Outcome Measure	Category	n	%	Mean ± SD
IKDC Score	Excellent	5	8.77	72.58 ± 14.16
	Good	24	42.11	
	Fair	14	24.56	
	Poor	14	24.56	
Lysholm Score	Excellent	11	19.30	83.37 ± 11.27
	Good	21	36.84	
	Fair	19	33.33	
	Poor	6	10.53	
Tegner Activity Level	<4 (Low)	18	31.58	5.35 ± 2.76
	4-7 (Moderate)	24	42.11	
	>8 (High)	15	26.32	

Correlation Between Outcome Measures:

We discovered a strong positive correlation between IKDC and Lysholm scores which produced a correlation coefficient of r 0.904 and a statistical significance level of 'p' less than 0.001. The study found a strong positive correlation between IKDC score and Tegner activity level which showed that participants who reported better knee function could resume more activities (Table 3).

Table 3: Correlation between Functional Outcome Measures

Correlation	Pearsons 'r'	p-value
IKDC Score vs. Lysholm Score	0.904	<0.001
IKDC Score vs. Tegner Activity Level	0.892	<0.001

Discussion

The results of this prospective study provide a detailed evaluation of functional outcomes following arthroscopic ACL reconstruction using hamstring

tendon autografts in a non-athlete, trauma dominated cohort. Our findings reveal distinct demographic, etiological, and recovery patterns that both align with and diverge from the established literature, offering valuable insights for clinical practice in similar settings.

Our patient population showed a unique demographic pattern. The 41-50 year age group included 35.09 percent of our patient sample who developed ACL injuries, which shows a different pattern from Western research that finds this injury peak develops in active athletes between 20 and 30 years of age.(5) The population shows an increasing age trend, which Trojani et al. (2009) showed through their research that found rising ACL injury rates among middle-aged people because this group needed more time to recover from surgery and developed higher rates of sports activities.(6) The study found 63.16 percent of participants to be male, which matches worldwide patterns, while the female percentage of 36.84 percent exceeds sports research studies from previous research (7) because it shows different physical activity patterns and healthcare availability between regions.

Our study shows differing results regarding the causes of ACL injuries. Road traffic accidents (RTAs) were the leading cause (49.12%), followed by accidental falls (38.60%), with sports injuries being conspicuously absent from the primary mechanism. This pattern differs from developed nations which show that sports activities lead to most ACL. The established pattern demonstrates how developing regions experience trauma patterns that develop through established medical practices. The study demonstrates that proper road safety regulations should function as the main ACL injury prevention method which protects similar population groups. Rehabilitation protocols need to address the higher probability of patients needing treatment for multiple injuries according to Christensen et al. (2013) who studied sports injuries.(8)

The surgical efficiency achieved a result where 70.18 percent of operations finished their work within 1.5 hours which met established performance standards.(9) The study discovered an interesting finding because partial tears occurred at 52.63 percent while complete tears happened at 47.37 percent which conflicts with earlier research that found complete tears to be more common.(10) The data indicates that both regional medical practices and different ways of sustaining injuries have an impact on the situation. The research shows that native proprioception protection through selective bundle reconstruction techniques will benefit most patients who need this treatment.(11) The hospital successfully managed patient pain after their surgery when 92.98 percent of patients experienced only mild to moderate pain according to the VAS. The study found that only 7.02 percent of participants experienced severe pain which resulted from the application of multimodal analgesic protocols together with regional anesthesia methods that were used during the study.(12)

The functional outcomes at the early (6-week) follow up, assessed using the IKDC and Lysholm scales, showed that 50.88% and 56.14% of patients achieved Good/Excellent results, respectively. The assessment results show lower success rates than 65 to 70 percent excellent or good outcomes found in previous studies which assessed patients after they had their treatment completed.(5) The period after surgery shows its peak functional improvement between 6 and 9 months.(8) The strong positive correlation between the IKDC and Lysholm scores indicates our outcome measurement shows reliable and consistent results which our early assessment has established as a foundation for assessment. The mean Lysholm score of 83.37 ± 11.27 shows positive results because it meets international standards, which demonstrate that our surgical and early rehabilitation methods succeed. The mean IKDC score of 72.58 ± 14.16 which is lower than some reports(5) shows that patients remain in the initial steps of their recovery process. The Tegner scale assessment showed that 68.43% of patients had achieved moderate or high activity level restoration. The strong correlation between IKDC scores and Tegner activity levels ($r = 0.892$, $p < 0.001$) demonstrates that patients use their knee function assessment to predict when they will resume their activities.(13) The mean Tegner score of 5.35 shows that most patients had not yet returned to pre-injury activity levels which matches the anticipated recovery schedule.(8)

Our findings on socio-demographic factors, such as the majority of patients having secondary or higher education, align with studies suggesting health literacy influences the decision to pursue surgical management.(14) The under-representation of elderly patients (>60 years) in our cohort, despite evidence supporting successful ACLR in active older adults [64], may indicate a tendency towards conservative management in this age group in our setting, a potential area for practice review.

Conclusion

The cohort study shows that road traffic accidents result in ACL injuries which doctors successfully treat through hamstring autograft arthroscopic

reconstruction because it produces good early functional results and keeps patients free from pain. The public health prevention strategies and rehabilitation protocols require specific development because middle aged patient demographic growth and unique injury patterns create distinct needs. The IKDC and Lysholm and Tegner outcome measures show a strong relationship that demonstrates their effectiveness in measuring patient progress. The initial findings show potential but require long term assessment to validate the results. This study adds to existing research which demonstrates that ACL reconstruction success applies to active older adults who suffer from various injury types not just young athlete population.

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