Functional Outcome of Anterior Cruciate Ligament Reconstruction by Hamstring Tendon Autograft using Femoral Endobutton and Tibial Post Fixation

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ABSTRACT

Background: ACL rupture is a common disabling injury in young, active people, leading to knee instability, delayed return to sport or work, and potential early osteoarthritis. Arthroscopic ACL reconstruction with hamstring autograft is widely used, and femoral EndoButton fixation is reliable, but optimal tibial fixation remains debated, particularly for maintaining early stability during rehabilitation. This study aimed to assess functional outcomes and early complications after hamstring autograft ACL reconstruction using femoral EndoButton and tibial post fixation. **Methods & Materials:** This prospective observational study was conducted at NITOR, Dhaka (2024–2025), enrolling consecutive skeletally mature patients with clinically unstable, MRI-confirmed ACL rupture undergoing arthroscopic hamstring autograft reconstruction with femoral EndoButton and tibial post fixation. Functional outcomes (IKDC, Lysholm) and activity level (Tegner) were recorded preoperatively and at 6 weeks, 3 months, and 6 months; stability, range of motion, and complications were documented, with late adverse events noted up to 12 months when available. Data were analyzed in SPSS v26 using descriptive statistics and paired or repeated-measures comparisons of score changes over time. **Results:** Among 40 patients (mean age 28.6 ± 6.9 years, 85% male), non-contact sports pivoting injury was the commonest mechanism (62.5%), and MRI showed complete ACL tear in 90% with frequent concomitant meniscal injury (57.5%) and chondral lesions (22.5%). Most reconstructions used a 4-strand semitendinosus ± gracilis graft (95%) with a mean diameter of 8.1 ± 0.6 mm, predominantly via transportal femoral tunneling (87.5%). Functional outcomes improved steadily, with IKDC increasing from 44.9 ± 11.7 preoperatively to 75.6 ± 9.1 at 6 months, and Lysholm from 52.6 ± 13.9 to 88.3 ± 8.6; Tegner rose from a median of 3 to 5. Postoperative course was uncomplicated in 72.5%, with minor numbness/dysesthesia (12.5%), superficial infection (5.0%), arthrofibrosis (5.0%), and suspected graft failure (2.5%), and no deep infections. **Conclusion:** Arthroscopic ACL reconstruction using a hamstring autograft with femoral EndoButton and tibial post fixation produced significant early improvements in IKDC, Lysholm, and Tegner scores, with low complication rates. These findings support the technique as a safe and effective option for restoring function in symptomatic ACL-deficient knees.

Keywords: *Anterior cruciate ligament reconstruction, Hamstring tendon autograft, EndoButton femoral fixation, and Tibial post fixation*

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INTRODUCTION

Anterior cruciate ligament (ACL) rupture is a significant injury among young, active individuals, as it compromises knee stability, delays return to sport or work, and may accelerate post-traumatic osteoarthritis even after surgical intervention [1,2]. Population-level data from the United States indicate a substantial increase in ACL reconstruction utilization over time, reflecting both improved injury recognition and expanded surgical access across age and sex groups [1]. Comparable registry-based evidence from Europe confirms that ACL reconstruction remains prevalent at the national level, with distinct epidemiologic patterns by age and sex that inform service planning and outcome benchmarking [2]. Mechanistically, most ACL ruptures occur during non-contact pivoting, cutting, and landing activities in multidirectional sports, while a considerable proportion also results from high-energy trauma. This injury profile is particularly relevant in South Asian contexts, where football, cricket, and road-traffic incidents frequently contribute to knee trauma presentations [3].

The primary objectives of ACL reconstruction are to restore functional stability, reduce symptomatic instability, and facilitate a safe return to pre-injury activity levels. Hamstring tendon autograft is commonly utilized due to its favorable donor-site characteristics and adaptability in graft sizing and configuration. Recent comparative studies demonstrate that both hamstring and bone-patellar tendon-bone autografts yield favorable mid- to long-term outcomes, with specific trade-offs in anterior knee pain, kneeling discomfort, and rotational stability depending on surgical technique, fixation method, and rehabilitation protocol [4,5]. Clinical outcomes are frequently assessed using validated patient-reported measures such as the IKDC and Lysholm scores, which have shown significant postoperative improvement in prospective cohorts employing hamstring grafts with cortical suspensory femoral fixation in regional settings [4]. However, functional outcomes are influenced by multiple factors beyond graft selection, including fixation strategy, tunnel positioning, and perioperative

management, all of which are critical for graft incorporation and early mechanical stability.

Femoral cortical suspension devices, such as EndoButton-based fixation, are widely adopted due to their technical reproducibility and robust femoral-side fixation. In contrast, tibial fixation is frequently regarded as the "weak link," given the diversity of available devices and ongoing debate regarding the optimal construct, particularly when early rehabilitation necessitates secure initial fixation [6]. Biomechanical studies continue to investigate alternative tibial fixation methods, including post-based and hybrid techniques, to enhance resistance to cyclic loading and minimize slippage in clinical practice [7]. In Bangladesh, there is a notable lack of high-quality prospective outcome data on ACL reconstruction using hamstring autograft with femoral EndoButton and tibial post fixation, especially from high-volume public institutions. Therefore, the present study aims to evaluate functional outcomes and early complications following arthroscopic ACL reconstruction using hamstring tendon autograft with femoral EndoButton and tibial post fixation at NITOR, Dhaka, Bangladesh.

METHODS & MATERIALS

This prospective observational study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, over a 1-year period (2024–2025). Consecutive patients with symptomatic anterior cruciate ligament rupture who underwent arthroscopic ACL reconstruction using a hamstring tendon autograft, femoral EndoButton fixation, and tibial post fixation were enrolled. Inclusion criteria comprised skeletally mature patients with clinical instability and MRI-confirmed ACL tear who consented to follow-up; patients with prior ipsilateral knee surgery, multiligament injuries requiring reconstruction, periarticular fractures, active infection, or advanced degenerative changes were excluded.

Semitendinosus with or without gracilis was harvested and prepared as a multi-strand graft; standard arthroscopic tunnel preparation was performed, femoral fixation was achieved with an EndoButton, and tibial fixation was secured using post fixation, screw with washer or equivalent system, with meniscal and chondral procedures performed when indicated. Functional outcomes were assessed preoperatively and at 6 weeks, 3 months, and 6 months postoperatively using the IKDC subjective score and Lysholm score, with activity level recorded by the Tegner scale; clinical stability testing, range of motion, and complications were documented at each visit, with late adverse events captured up to 12 months when available. Data were analyzed using descriptive statistics (SPSS, v. 26.0); change in functional scores over time was tested using paired or repeated-measures methods as appropriate.

RESULTS

Table I summarizes baseline characteristics of the 40 patients, showing a predominantly young cohort, 87.5% were aged 18–35 years, with a mean age of 28.6 ± 6.9 years, and most were male, 34 (85.0%). Mean BMI was 24.3 ± 2.8 kg/m², manual workers and students formed the largest occupational groups, 13 (32.5%) and 12 (30.0%), and the right knee was more commonly operated, 22 (55.0%). Dominant-leg involvement was noted in 24 (60.0%), the median injury-to-surgery interval was 32 weeks (IQR 20–52), and recurrent instability was frequent, with 28 (70.0%) reporting at least 3 giving-way episodes.

Table I
Baseline demographic and clinical characteristics of patients undergoing ACL reconstruction (*n* = 40).

Variable	Category	n (%)
Age (years)	18-35	35 (87.5)
	36-50	5 (12.5)
	>50	0 (0.0)
	Mean ± SD	28.6 ± 6.9
Sex	Male	34 (85.0)
	Female	6 (15.0)
BMI (kg/m²)	Mean ± SD	24.3 ± 2.8
Occupation	Student	12 (30.0)
	Manual worker	13 (32.5)
	Service/office	10 (25.0)
	Athlete	5 (12.5)
Operated side	Right	22 (55.0)
	Left	18 (45.0)
Dominant leg involved		24 (60.0)
Time from injury to surgery (weeks)	Median (IQR)	32 (20–52)
Giving-way episodes	None	3 (7.5)
	1–2	9 (22.5)
	3–5	14 (35.0)
	>5	14 (35.0)

Table II presents injury mechanism and MRI findings, where non-contact pivoting sports injuries were the leading cause, 25 (62.5%), followed by road traffic accidents, 8 (20.0%). MRI confirmed complete ACL tears in 36 (90.0%) cases, and concomitant meniscal pathology was common, present in 23 (57.5%), most often medial meniscal injury, 14 (35.0%). Chondral lesions were identified in 9 (22.5%), and associated low-grade MCL sprain was noted in 6 (15.0%).

Table II
Injury mechanism and preoperative MRI findings among study participants (*n* = 40).

Variable	Category	n (%)
Mechanism of injury	Non-contact pivoting sports (football, cricket, etc.)	25 (62.5)
	Road traffic accident	8 (20.0)
	Fall or twisting during daily activity	7 (17.5)

MRI: ACL tear type	Complete tear	36 (90.0)
	Partial tear with clinical instability	4 (10.0)
MRI: Meniscus injury	None	17 (42.5)
	Medial only	14 (35.0)
	Lateral only	6 (15.0)
	Both medial and lateral	3 (7.5)
	MRI: Chondral lesion present	9 (22.5)
	Associated MCL sprain (Grade I–II)	6 (15.0)

Table III outlines operative and graft characteristics, with spinal anesthesia used in 29 (72.5%) cases, mean tourniquet time 61.5 ± 12.4 minutes, and mean operative time 88.2 ± 18.7 minutes. Most reconstructions used semitendinosus plus gracilis grafts, 37 (92.5%), predominantly configured as 4-strand grafts, 38 (95.0%), with a mean graft diameter of 8.1 ± 0.6 mm. Transportal femoral tunneling was most common, 35 (87.5%), fixed-loop EndoButtons were used in 28 (70.0%), tibial post fixation was performed in all cases, and more than half required no concomitant procedure, 21 (52.5%), while partial meniscectomy and meniscal repair were performed in 10 (25.0%) and 9 (22.5%), respectively.

Table III
Intraoperative details, graft characteristics, fixation methods, and concomitant procedures (*n* = 40).

Variable	Category	n (%)
Anesthesia	Spinal	29 (72.5)
	General	11 (27.5)
Tourniquet time (min), mean ± SD		61.5 ± 12.4
Operative time (min), mean ± SD		88.2 ± 18.7
Tendons harvested	ST+G	37 (92.5)
	ST only	3 (7.5)
Graft configuration	4-strand	38 (95.0)
	5-strand	2 (5.0)
Graft diameter (mm), mean ± SD		8.1 ± 0.6
Femoral tunnel technique	Transportal	35 (87.5)
	Outside-in	5 (12.5)
EndoButton type	Fixed loop	28 (70.0)
	Adjustable loop	12 (30.0)
Tibial fixation (Post fixation used)		40 (100)
Tibial post type	Screw + washer	34 (85.0)
	Post system	6 (15.0)
Concomitant procedures	None	21 (52.5)
	Partial meniscectomy	10 (25.0)
	Meniscal repair	9 (22.5)
Chondroplasty performed		6 (15.0)

Table IV shows consistent improvement in functional outcomes over follow-up, with IKDC rising from 44.9 ± 11.7 preoperatively to 75.6 ± 9.1 at 6 months, and Lysholm improving from 52.6 ± 13.9 to 88.3 ± 8.6 over the same period. Activity level also improved, with Tegner increasing from a median of 3 (IQR 2–4) preoperatively to 5 (IQR 4–6) by 6 months.

Table IV
Functional outcome scores over follow-up after ACL reconstruction (*n* = 40).

Outcome	Pre-op	6 weeks	3 months	6 months
IKDC (0–100), mean ± SD	44.9 ± 11.7	56.3 ± 10.8	67.8 ± 9.9	75.6 ± 9.1
Lysholm (0–100), mean ± SD	52.6 ± 13.9	69.1 ± 11.6	80.2 ± 10.1	88.3 ± 8.6
Tegner (0–10), median (IQR)	3 (2–4)	3 (2–4)	4 (3–5)	5 (4–6)

Table V summarizes postoperative complications, indicating that most patients had an uncomplicated course, 29 (72.5%) reported no complication. The most frequent minor issue was harvesting site numbness or dysesthesia, 5 (12.5%), while superficial infection occurred in 2 (5.0%), arthrofibrosis` requiring intensified physiotherapy occurred in 2 (5.0%), and suspected graft failure was uncommon, 1 (2.5%), with no deep infections recorded.

Table V
Postoperative complications and adverse events following ACL reconstruction (*n* = 40).

Complication	Frequency (n)	Percentage (%)
Superficial infection (managed with antibiotics, dressings)	2	5.00
Deep infection	0	0.00
Hemarthrosis requiring aspiration	1	2.50
Persistent effusion beyond 6 weeks	2	5.00
Harvest site numbness or dysesthesia	5	12.50
Arthrofibrosis requiring intensive physiotherapy	2	5.00
Tibial post region irritation, symptomatic	2	5.00
Suspected graft failure by 12 months	1	2.50
No complication	29	72.50

DISCUSSION

In this prospective cohort, arthroscopic anterior cruciate ligament (ACL) reconstruction using a hamstring autograft with femoral EndoButton and tibial post fixation resulted in early functional recovery. The International Knee Documentation Committee (IKDC) score improved from 44.9 to 75.6, and the Lysholm score increased from 52.6 to 88.3 by six months, with a median Tegner activity level rising from 3 to 5. These outcomes align with current evidence indicating that hamstring-based ACL reconstruction provides significant short-term patient-reported improvements and facilitates a gradual return to recreational activity, particularly when fixation is stable and rehabilitation protocols are structured. Long-term studies further demonstrate that hamstring autograft ACL reconstruction can maintain satisfactory outcomes beyond the early postoperative period, although degenerative changes and secondary injuries increasingly influence later results [8].

Regarding fixation, the use of suspensory femoral fixation in this cohort is consistent with large comparative analyses that report similar clinical outcomes across various femoral fixation methods, despite minor differences in laxity measurements. Network meta-analyses indicate that interference screw constructs may offer slight advantages in certain stability parameters, but cortical buttons and cross-pin systems generally yield comparable patient-reported outcomes, supporting the clinical acceptability of EndoButton-based constructs in standard practice [9-11]. Comparative studies have found no significant functional disadvantage for EndoButton compared to cross-pin fixation, reinforcing that suspensory femoral fixation can achieve reliable clinical results when tunnel placement, graft preparation, and tensioning are optimized [12]. Evidence from randomized and pooled studies suggests that both fixed-loop and adjustable-loop devices provide similar functional outcomes, which is pertinent since most cases in this cohort utilized fixed-loop EndoButtons [13,14]. In resource-limited settings, these findings imply that consistent surgical technique and standardized rehabilitation protocols may be more critical than minor differences between commonly used button designs.

The high prevalence of concomitant meniscal injury (57.5%) and chondral lesions (22.5%) observed in this cohort is likely related to delayed reconstruction, as indicated by a median injury-to-surgery interval of 32 weeks. Data from both regional and high-income settings demonstrate that longer intervals between injury and ACL reconstruction are associated with increased meniscal and cartilage pathology, as well as reduced opportunities for meniscal preservation [15,16]. This case mix may have contributed to lower six-month IKDC scores compared to cohorts undergoing earlier intervention. These findings underscore a key clinical implication for Bangladesh: enhancing referral pathways and minimizing surgical delays may decrease secondary intra-articular damage, preserve meniscal tissue, and potentially improve long-term knee health.

The observed early suspected graft failure rate of 2.5% should be interpreted with caution due to the limited duration of primary follow-up; however, this rate is consistent with expected early outcomes. Meta-analyses indicate that hamstring autografts are associated with slightly higher failure rates compared to bone-patellar tendon-bone grafts, though the absolute differences are minimal and patient-reported functional outcomes are often comparable. This evidence supports the continued use of hamstring autografts in cases where donor-site morbidity, kneeling requirements, and patient preference are significant considerations [17,18]. As many participants were manual workers or students, it is essential to base return-to-sport or return-to-demanding-work decisions on objective criteria, since delayed return and achievement of adequate strength symmetry significantly reduce the risk of reinjury [19].

The observed complication patterns were within acceptable limits, with no deep infections and predominantly minor morbidity. Current literature indicates that anterior cruciate ligament reconstruction (ACLR) infections are infrequent and highlights the significance of preventive measures, such as meticulous graft handling and, in some protocols, topical antibiotic graft presoaking, which has been linked to a reduced risk of infection in hamstring grafts [20,21]. The 5% incidence of arthrofibrosis, managed through intensified physiotherapy, aligns with reported ranges. Recent analyses emphasize the necessity of early restoration of motion, strict adherence to rehabilitation protocols, and vigilant monitoring of patients predisposed to stiffness [22]. Harvest-site numbness or dysesthesia (12.5%) remains a recognized morbidity associated with hamstring harvest. Published data confirm that saphenous nerve sensory disturbance is not uncommon, generally improves over time, and is pertinent for patient counselling and refinement of incision and harvest techniques [23].

LIMITATIONS

This was a single-center observational study with a small sample and no comparison group, so causal inferences and generalizability are limited. Functional outcomes were mainly short-term (6 months) with incomplete longer follow-up, and unmeasured rehabilitation adherence or activity exposure may have influenced results.

CONCLUSION

Arthroscopic anterior cruciate ligament (ACL) reconstruction utilizing a hamstring tendon autograft with femoral EndoButton and tibial post fixation at NITOR demonstrated significant improvements in IKDC, Lysholm, and Tegner scores at six months, with predominantly minor complications. These results indicate that this fixation construct is an effective and safe approach for early functional recovery in patients with symptomatic ACL-deficient knees. The findings also highlight the necessity of structured rehabilitation and extended follow-up to validate long-term durability and return-to-activity outcomes.

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CONFLICT OF INTEREST.

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