

Comparison of Hamstring Tendon versus Patellar Tendon Graft Use in Arthroscopic ACL Reconstruction in Sports Persons

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Abstract

Background: The incidence of Anterior Cruciate Ligament (ACL) ruptures is relatively common in athletes and often causes knee functional instability that has negative effects on sports performance. Arthroscopic ACL reconstruction has become a well-established treatment, and Hamstring Tendon (HT) graft and Bone–patellar Tendon–bone (BPTB) graft are the most frequently used autografts. However, the best choice of grafts in this sense in regard to functional results, knee stability, donor site morbidity and return to sports is still a matter of controversy.

Materials and Methods: The present prospective comparative study was carried out in the Department of Orthopaedics, Nalanda Medical College and Hospital (NMCH) Patna, from December 2024 to December 2025. One hundred and twenty athletes with a clinical and MRI-documented diagnosis of ACL rupture were included. Patients were categorized into two groups: Group A (n = 60) underwent ACL reconstruction with HT graft, and Group B (n = 60) underwent reconstruction with the BPTB graft. Functional outcomes were measured with International Knee Documentation Committee (IKDC) and Lysholm scores, and knee stability was evaluated on the Lachman and pivot shift tests. Follow-up of patients occurred at 6 weeks, 3 months, 6 months and 12 months.

Results: On final follow up, the average IKDC score was 88.4 ± 6.1 in Group A and 89.6 ± 5.8 in Group B ($p > 0.05$). The average Lysholm score was 91.2 ± 5.4 for the hamstring group and 92.8 ± 4.9 for the BPTB group. Eighty percent of the patients of group A and 86.7% of the patients of group B had negative Lachman test while there was significantly more anterior knee pain in BPTB group (30%) as compared to hamstring group (10%). The average time of return to sports was 7.4 ± 1.2 months in Group A and 8.6 ± 1.5 months in Group B.

Conclusion: HT grafts and BPTB grafts offer excellent functional and stability outcomes after arthroscopic ACL reconstruction in athletes. Hamstring grafting is characterised by less donor site morbidity and earlier return to sports. BPTB grafts provide marginally better knee stability. The selection of the graft should be individualized for patients and by sport.

Keywords: Patellar tendon graft, ACL reconstruction, Sports injury, Hamstring graft.

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Introduction

The Anterior Cruciate Ligament (ACL) is one of the main stabilizing structures in the knee joint responsible for anteroposterior stability and rotational control as a dynamic movement. Anatomically, the ACL arises from the posteromedial aspect of the lateral femoral condyle and inserts within the anterior intercondylar area of the tibia [1]. The patella functions to resist anterior translation of the tibia on the femur, and plays an important role in proprioception and neuromuscular

control of the knee. The injury forces the knee to instability, repeated giving-way incidences and makes it prone for meniscal tear and early osteoarthritis in active individuals [2]. ACL injuries are the most frequent ligamentous knee injury among those engaged in the activities such as pivoting, and sudden deceleration, jumping and changes of direction [3]. Other sports like football, basketball, cricket, kabaddi and athletics also demonstrate a high rate of ACL tear. Reports

indicate that young, active people comprise the largest portion of ACL ruptures with an increasing incidence likely related to an increase in competitive and recreational sports [4]. No follow-up or problematic treatment of ACL injury in athletes leads to decreased performance, long-term absence from sport and ultimately joint degeneration, so its timely repair is necessary. Arthroscopic reconstruction of the ACL has become accepted as the gold standard for restoration of knee stability and the operative management to facilitate return to sports activities [5]. The choice of graft may be the most important factor in determining a successful surgical result. The ideal graft needs to be sufficiently strong, biologically incorporated, restore normal knee kinematics and cause minimal donor site morbidity [6]. Numerous autografts and allografts have been reported in the literature over the years, although hamstrings and BPTB are still likely to be most frequently used as an autograft in clinical practice [7].

The HT graft, which is commonly harvested from the semitendinosus and gracilis tendons, has increased in popularity because its use reduces the rate of donor site morbidity, anterior knee pain, and provides better cosmetic satisfaction [8]. It is characterized by a lower incidence of extensor mechanism rupture, and it is used more in patients with the need for kneeling activities [9]. Conversely, the BPTB graft has been regarded as the gold standard for its high initial fixation strength and consistent bone-to-bone healing. But it is commonly presented with anterior knee pain, kneeling difficulty, patellar fracture and extensor mechanism problems [10].

After numerous studies both favouring and refuting the use of each graft, the question on the superiority of one graft to another is based on functional results, knee stability, donor site morbidity and return to sports time [11,12].

Some reports show the advantages of BPTB grafts in terms of stability and time to return to high-demand sports, even as others have found similar results when comparing the hamstring graft with fewer complications. The absence of agreement draws attention to the necessity of additional comparative studies.

Further, there is a scarcity of prospective, regional data from India on assessing outcomes pertaining to graft choice in sports persons. Discrepancies in lifestyle, compliance with rehabilitation, nutritional status and possibilities for performing structured physiotherapy could impact results of surgery.

Hence, a comparison study in NMCH Patna will help us to know how graft responds at pathological level in our local population and accordingly take

some objective evidence-based approach for reconstruction of ACL among sports persons.

Objectives

1. To evaluate knee stability following ACL reconstruction using both grafts.
2. To compare post-operative functional outcomes using standardized scoring systems.
3. To assess donor site morbidity in both graft types.
4. To compare time taken for return to sports activity.
5. To document post-operative complications in both groups.

Materials and Methods

Study Design: The present study was therefore set up in the form of a prospective comparative study and undertaken to assess and compare clinical and functional outcome of reconstruction of ACL arthroscopically using HT graft vs BPTB graft in sports persons.

Study Setting: The study was carried out in the Department of Orthopaedics, NMCH, Patna, which is a tertiary care teaching hospital receiving a large number of cases presenting with sports-related musculoskeletal injury.

Study Duration: The total study period was 1 year December 2024 to December 2025 recruitment of patients, operation performance and follow-up.

Study Population: The Sports persons diagnosed cases of ACL tear attending orthopaedics OPD/emergency services (NMCH Patna) constituted the study population. Both clinical examination and Magnetic Resonance Imaging (MRI) were used for diagnosis.

Sample Size: In all, 120 patients meeting the inclusion criteria were included in our study. The patients were assigned to 2 groups randomly. Group A (n=60) comprised the patients who underwent arthroscopic ACL reconstruction using HT graft. Patients in Group B (n=60) underwent arthroscopic ACL reconstruction with BPTB graft. Group assignment was by surgeon preference dictated by patient willingness to participate.

Inclusion Criteria

- Age between 18 and 40 years
- History of sports ACL injury
- Clinically suspected ACL tear
- MRI-confirmed ACL tear
- Willingness to undergo arthroscopic ACL reconstruction
- Ability to adhere to the recommended postoperative rehabilitation programme.
- Willingness and capacity to return for regular follow-up visits

Exclusion Criteria

- Presence of multiligament knee injuries
- History of surgery to the knee in question
- Fractures associated with the knee joint
- Significant osteoarthritis of the knee
- Non-sports persons
- Patients refusing to give informed consent
- Patients who were not able or willing to attend the follow-up period

Surgical Technique: All the patients experienced arthroscopic ACL reconstruction under spinal or general anesthesia performed by expert orthopaedists. The semitendinosus and gracilis tendons were harvested from the HT in Group A through a small anteromedial incision. The central one-third of the patellar tendon was harvested with bony blocks on each side from the patella and tibial tuberosity for preparing the BPTB graft in Group B. Femoral and tibial tunnels were formed via an arthroscopic technique, and appropriate fixation was made with exceptive fixation materials such as interference screws according to the routine surgical procedure.

Post-operative Rehabilitation Protocol: Both groups underwent a uniform post-operative rehabilitation programme. The early mobilization of the knee was promoted with progressive range-of-motion exercises. Partial weight-bearing commenced independently, followed by full weight-bearing. Structured physiotherapy in the form of quadriceps strengthening, hamstring conditioning, proprioceptive training and functional training was maintained up to return to play.

Outcome Measures: Functional and clinical results were evaluated based on various standard scores such as IKDC score and/or Lysholm knee scoring system. Knee stability was assessed using the Lachman test and pivot shift test. Flexion, the anterior knee pain and return to sports were also recorded.

Follow-up Schedule: Six weeks, three months, six months, and twelve months after surgery, patients were checked up again. Functional evaluations and clinical examinations were documented at each visit.

Statistical Analysis: Collected data was entered into analyzed on SPSS. Continuous variables were described as mean and standard deviation, and the categorical variables were described by frequencies and percentages. Comparison between two groups was done with the help of Student t-test for continuous variables and Chi-square test for categorical variables. A value of $p < 0.05$ was considered to be significant.

Ethical Considerations: The study was carried out after receiving permission from the Institutional Ethics Committee of NMCH, Patna. All of them were provided with the details of the study, surgery performed initially, risks and benefits of sinus surgery and written and signed informed consent was also acquired before recruitment.

Patient anonymity was maintained at all times during the study, and data were only used for research purposes with ethical committee approval.

Results

The subjects included 120 athletes following arthroscopic ACL reconstruction. Patients were grouped according to using Group A (HT graft, $n = 60$) and Group B (BPTB graft, $n = 60$). All of the patients had been viewed for at least 12 months.

Demographic Distribution: The demographics of the patients in both groups were the same. Most of the cases were men, and most of them were between the ages of 21 and 30. In terms of age, sex, and side distribution, there were no big changes between the two groups.

Table 1: Demographic Distribution of Patients

Parameter	Group A (Hamstring)	Group B (BPTB)
Mean age (years)	26.8 \pm 5.2	27.1 \pm 4.9
Male: Female	52: 8	50: 10
Right knee	34 (56.7%)	36 (60%)
Left knee	26 (43.3%)	24 (40%)

Comparison of Functional Scores: At the last follow-up, the IKDC and Lysholm knee scoring methods were used to look at functional outcomes. When comparing scores before and after surgery, both groups had statistically better results. But there wasn't a big difference between the two groups in their end-of-functional scores.

Table 2: Comparison of Functional Outcome Scores

Score	Group A	Group B	P value
IKDC score	88.4 \pm 6.1	89.6 \pm 5.8	>0.05
Lysholm score	91.2 \pm 5.4	92.8 \pm 4.9	>0.05

Knee Stability Outcomes: On clinical examination by Lachman and pivot shift tests, the stability of the knee was acceptable in both groups. There was a trend toward more patients in the BPTB group having Grade 0 Lachman's findings, which did not reach statistical significance.

Table 3: Knee Stability Assessment

Test Outcome	Group A	Group B
Negative Lachman test	48 (80%)	52 (86.7%)
Negative Pivot shift test	50 (83.3%)	54 (90%)

Donor Site Morbidity: Comparative donor site morbidity between both groups varied. Anterior knee pain and inability to kneel were more common in the BPTB group, but mild hamstring weakness developed in a few patients among those who had undergone the hamstrings graft procedure.

Table 4: Donor Site Morbidity

Morbidity	Group A	Group B
Anterior knee pain	6 (10%)	18 (30%)
Kneeling discomfort	4 (6.7%)	20 (33.3%)
Hamstring weakness	8 (13.3%)	2 (3.3%)

Return to Sports: Return to Sports was significantly earlier in the hamstring graft group than that of BPTB. More patients in Group A also returned to the pre-injury level of sport return at 6–9 months.

Table 5: Return to Sports Activity

Parameter	Group A	Group B
Mean time to return (months)	7.4 ± 1.2	8.6 ± 1.5
Return to pre-injury level	46 (76.7%)	42 (70%)

Complications: There were a few post-operative complications in either group. Incisional infection and knee stiffness were uncommon and treated nonoperatively. There were no failed grafts during the follow-up.

Table 6: Post-operative Complications

Complication	Group A	Group B
Superficial infection	2 (3.3%)	3 (5%)
Knee stiffness	3 (5%)	4 (6.7%)
Graft failure	0	0

Discussion

A prospective, comparative research study was done to observe the way an arthroscopic ACL repair with an HT graft worked compared to a BPTB graft in a group of athletes. Functional and clinical profiles of both the grafts were acceptable at 12 months follow-up. Functional scores, namely the IKDC and Lysholm scores, significantly improved after surgery in both groups with no statistically significant difference between them. Knee stability as evaluated by the Lachman test and pivot shift test were effectively recovered in most patients in both groups. Nevertheless, we found evidence of differences in the set of donor sites' morbidity and time to return to sports with graft-specific strengths and weaknesses.

Comparison with Previous Studies: The results from our investigation are similar to those of numerous national and international studies that have demonstrated similar functional outcomes in hamstring versus BPTB grafts.

International studies of study 1,2 have shown equivalent knee stability and patient-reported outcome between the two grafts.

Indian studies by study 3 also similarly observed no difference in functional scores between the 2 grafts. Nevertheless, a greater amount of anterior knee pain in the BPTB group as seen in the current study is consistent with supporting the concern over donor-site morbidity from patellar tendon harvesting.

Table 7: Comparison of the Present Study with Previous Studies

Study	Sample Size	Key Findings
Present Study (NMCH Patna)	120	Comparable functional outcomes in both grafts; hamstring graft showed less anterior knee pain and earlier return to sports, while BPTB graft showed better knee stability.
Study 1 [13]	1348	BPTB graft provided better stability but had higher donor site morbidity compared to hamstring graft.
Study 2 [14]	330	No significant difference in long-term functional outcomes; hamstring graft had fewer donor site complications.
Study 3 [15]	100	Similar functional results; anterior knee pain more common with BPTB graft; hamstring graft favored for patient comfort.

Conclusion

This prospective study compared the results of arthroscopic ACL restoration in athletes utilising hamstring and BPTB grafts. Clinical data showed improved stability and function in both knees after one year of follow-up. There was no significant difference in IKDC and Lysholm scores between the two groups, indicating that knee function is equally efficiently restored by both grafts. There were disparities in donor site morbidity and sports return. The HT graft resulted in reduced anterior knee pain, less kneeling discomfort, and faster return to sports. The BPTB graft demonstrated significant knee stability due to tendon bone-to-bone healing, but had higher donor site morbidity.

HT grafts may be chosen for early rehabilitation and kneeling exercises, but reliability for high-demanding athletes prioritising stability is maintained by the BPTB graft. We recommend doing long-term, multicentric trials to examine graft survival, re-injury rates, and long-term functional outcomes.

Limitations of the Study

These studies have some limitations. The research was only done in one referral center, so the results might not be applicable to other groups. Additionally, the follow-up period in our study was only 1 year, which may not have been enough to show all secondary events like graft failure, osteoarthritis of the ankle or late complications. Moreover, despite the sample size being enough for comparison, coverage of a greater number may lead to more statistical power. Further multicenter-based investigations with longer follow-up are needed to overcome these limitations.

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