RESEARCH PAPER

Post-Operative Knee Stability Following Arthroscopic Anterior Cruciate Ligament Reconstruction: A Prospective Longitudinal Study

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ABSTRACT

Background

Anterior cruciate ligament injury is one of the commonest ligamentous injuries of the knee and is an important cause of anterior knee instability. Arthroscopic anterior cruciate ligament reconstruction is performed to restore knee stability, improve range of motion, regain muscle strength, and improve functional outcome.

Objective

To determine post-operative knee stability following arthroscopic anterior cruciate ligament reconstruction.

Materials and Methods

This institution-based prospective longitudinal study was conducted in the Department of Orthopaedics, KPC Medical College and Hospital, Kolkata, from 2022 to 2025. A total of 50 patients with anterior cruciate ligament tear who underwent arthroscopic anterior cruciate ligament reconstruction were included. Patients aged 18–45 years with ACL tear who were willing to participate and provide informed consent were included. Patients with ACL avulsion fracture, infected knee joint, previous surgery on the ipsilateral limb, meniscal tears, or multiligamentous injuries were excluded. Post-operative knee stability was assessed at 3 months and 6 months using Lachman test, knee range of motion, quadriceps power, Lysholm knee score, and International Knee Documentation Committee score. Data were analyzed using JAMOVI version 2.3.28. A p-value of less than 0.05 was considered statistically significant.

Results

Lachman test was negative in 47 patients (94.0%) at 3 months and 49 patients (98.0%) at 6 months. Knee range of motion improved from a mean of 123 degrees at 3 months to 133 degrees at 6 months, which was statistically significant ($t = -18.87$, $df = 49$, $p < 0.001$). Quadriceps power improved significantly, with all patients achieving grade 5 power at 6 months ($t = -7.00$, $df = 49$, $p < 0.001$). The mean Lysholm score improved from 76.5 at 3 months to 93.4 at 6 months ($t = -24.11$, $df = 49$, $p < 0.001$). The mean IKDC score improved from 68.5 at 3 months to 89.5 at 6 months ($t = -30.01$, $df = 49$, $p < 0.001$). Post-operatively, 80.0% of patients had no pain and 20.0% had mild pain.

Conclusion

Arthroscopic anterior cruciate ligament reconstruction resulted in good post-operative knee stability. The increase in negative Lachman test results from 94.0% at 3 months to 98.0% at 6 months indicates restoration of anterior knee stability. Significant improvement in knee range of motion, quadriceps power, Lysholm score, and IKDC score further supports functional recovery and improved dynamic knee stability following surgery.

Keywords: anterior cruciate ligament, arthroscopic ACL reconstruction, knee stability, Lachman test, Lysholm score, IKDC score, quadriceps power, range of motion.

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1. Introduction

The anterior cruciate ligament is one of the most important stabilizing ligaments of the knee joint. It prevents anterior translation of the tibia over the femur and contributes to rotational stability during daily and sports-related activities. Injury to the anterior cruciate ligament commonly results in pain, swelling, instability, giving-way episodes, reduced confidence, and limitation of functional activities. Anterior cruciate ligament injuries are frequently seen in young and physically active individuals, particularly those involved in sports, military training, manual work, and activities requiring pivoting, jumping, sudden deceleration, and directional change (Grindem et al., 2016). When ACL deficiency produces symptomatic instability, surgical reconstruction is commonly performed to restore stability and improve knee function. Arthroscopic ACL reconstruction has become the preferred surgical technique because it allows accurate intra-articular assessment, anatomical graft placement, reduced soft tissue trauma, early mobilization, and structured rehabilitation (Grevnerts, Terwee, and Kvist, 2015). The success of reconstruction is commonly assessed by clinical stability tests such as Lachman test and Anterior Drawer test, along with functional parameters such as range of motion, quadriceps power, Lysholm score, and IKDC score.

The present paper is based on the first objective: **to determine the post-operative knee stability** following arthroscopic anterior cruciate ligament reconstruction.

2. Review of Literature

2.1 Anatomy and Biomechanics of the Anterior Cruciate Ligament

The anterior cruciate ligament (ACL) is one of the principal stabilizing structures of the knee joint and functions primarily as a restraint against anterior tibial translation and rotational instability. It is composed mainly of type I collagen and is functionally divided into anteromedial and posterolateral bundles. The anteromedial bundle becomes relatively tight in knee flexion, whereas the posterolateral bundle contributes more significantly to stability in extension, allowing the ACL to maintain stability throughout the range of knee motion. Girgis, Marshall, and Monajem (1975) described the anatomical and functional importance of the cruciate ligaments in maintaining knee stability. Amis and Dawkins (1991) further emphasized the functional anatomy of ACL fibre bundles and their relevance in ligament reconstruction. Zantop et al. (2006) highlighted the importance of ACL anatomy and function in anatomical reconstruction, while Dargel et al. (2007) discussed the biomechanical role of the ACL and its implications for surgical reconstruction. Hassebrock et al. (2020) also described the relationship between knee ligament anatomy, biomechanics, and clinical stability.

2.2 Arthroscopic ACL Reconstruction and Graft Selection

The management of ACL injury has evolved from extra-articular procedures to intra-articular and arthroscopic anatomical reconstruction. Earlier extra-articular procedures attempted to control pivot shift and anterior tibial subluxation, but residual instability and later degenerative changes led to the development of more anatomical reconstruction techniques. Arthroscopic ACL reconstruction is now widely accepted because it allows better visualization, anatomical graft placement, reduced morbidity, and improved functional recovery. Karlsson et al. (2011) described the clinical application of anatomical single- and double-bundle ACL reconstruction, while Raines, Naclerio, and Sherman (2017) reviewed current concepts in ACL injury management. Graft selection remains an important factor in surgical outcome. Common autografts include hamstring tendon, bone-patellar tendon-bone graft, quadriceps tendon, and peroneus longus tendon. Hamstring grafts are commonly used due to easier harvest and lower donor-site morbidity, although harvest-related muscle weakness has been reported (Tashiro et al., 2003; Burks et al., 2005). Peroneus longus tendon has also been described as a useful alternative graft option in selected cases, with satisfactory functional outcomes (Joshi et al., 2021; Agarwal et al., 2023).

2.3 Assessment of Post-Operative Knee Stability and Functional Recovery

Post-operative knee stability depends not only on anatomical graft placement and fixation but also on graft healing, ligamentization, rehabilitation, muscle strength recovery, and neuromuscular control. Amiel, Kleiner, and Akeson (1986) and Amiel et al. (1986) described the biological process of graft ligamentization after ACL reconstruction. Ekdahl et al. (2008), Chen (2009), and Scheffler, Unterhauser, and Weiler (2008) further discussed graft healing, remodeling, and maturation after reconstruction. Tendon-to-bone healing is also essential for stable graft incorporation, as emphasized by Atesok et al. (2014). Clinically, the Lachman test is widely used to assess anterior knee stability after ACL reconstruction. Functional outcome measures such as the Lysholm knee score and IKDC score are also important because they assess symptoms, instability, pain, swelling, activity level, and patient-perceived function. Lysholm and Gillquist (1982) developed the Lysholm knee scoring system, while Irrgang et al. (2001) developed and validated the IKDC subjective knee form. Grevnerts, Terwee, and Kvist (2015) further described the measurement properties of the IKDC score. Quadriceps strength is another key determinant of dynamic knee stability, and persistent weakness may impair function and increase the risk of reinjury (Palmieri-Smith et al., 2008; Lepley et al., 2015). Rehabilitation protocols focusing on range of motion, quadriceps activation,

strengthening, proprioception, and functional progression are therefore essential for restoring post-operative stability and function (Shelbourne & Nitz, 1990; Adams et al., 2012; Grindem et al., 2016). Thus, available literature supports that assessment of post-operative knee stability after ACL reconstruction should include clinical stability testing, range of motion, quadriceps strength, and validated functional outcome scores.

3. Materials and Methods

Study Design

This was an institution-based prospective longitudinal study conducted to assess post-operative knee stability following arthroscopic anterior cruciate ligament reconstruction.

Study Setting

The study was conducted in the Department of Orthopaedics, KPC Medical College and Hospital, Kolkata.

Study Duration

The study was conducted from 2022 to 2025, including patient selection, surgical treatment, follow-up, data collection, and analysis.

Study Population

Patients presenting with knee injuries and diagnosed with ACL tear who underwent arthroscopic ACL reconstruction at KPC Medical College and Hospital were included.

Sample Size

A total of 50 patients were included in the study.

Sampling Design

Random cases of ACL tear presenting to the outpatient department were included according to predefined inclusion and exclusion criteria.

Inclusion Criteria

Patients were included if they fulfilled the following criteria:

1. Age between 18 and 45 years.
2. Diagnosed case of ACL tear.
3. Underwent arthroscopic ACL reconstruction.
4. Willing to participate in the study.
5. Able to provide written informed consent.

Exclusion Criteria

Patients were excluded if they had any of the following:

1. ACL injury with avulsion fracture.
2. Infected knee joint.
3. History of previous surgery on the ipsilateral limb.
4. Associated meniscal tear.
5. Multiligamentous injury.

Pre-Operative Evaluation

All patients underwent detailed pre-operative evaluation. Patient history, demographic details, mode of injury, clinical findings, and imaging findings were recorded. Clinical examination included Lachman test and Anterior Drawer test to assess anterior knee laxity. MRI was used to confirm the diagnosis and to rule out associated injuries.

Operative Procedure

All patients underwent arthroscopic ACL reconstruction under spinal anaesthesia or general anaesthesia according to anaesthetic indication. The patient was placed supine on the operating table. A well-padded tourniquet was applied over the mid-thigh of the operative limb. The limb was prepared and draped under strict aseptic precautions, allowing free manipulation of the knee during surgery.

Standard arthroscopic landmarks were marked, including the patella, patellar tendon, joint lines, anterolateral portal, anteromedial portal, and accessory anteromedial portal. Diagnostic arthroscopy was performed through standard portals. The patellofemoral joint, medial compartment, lateral compartment, menisci, cartilage surfaces, and cruciate ligaments were examined.

After arthroscopic confirmation of ACL tear, reconstruction was performed. In complete ACL tears, complete reconstruction was done. In partial tears, remnant preservation was performed wherever possible. The semitendinosus tendon was harvested through an incision over the pes anserinus region. The graft was prepared and measured. If the semitendinosus graft was inadequate, the peroneus longus tendon was harvested.

ACL remnants at the tibial and femoral footprints were preserved where possible for anatomical identification. The femoral tunnel was drilled at the anatomical femoral footprint. The tibial tunnel was prepared using a tibial drill guide. The prepared graft was passed through the femoral and tibial tunnels. Femoral-side fixation was done using an Endobutton, and tibial-side fixation was done using an appropriate-sized interference screw. Graft tensioning and position were checked arthroscopically. The knee was moved through flexion and extension to confirm graft stability and absence of impingement. The wound was closed in layers and sterile dressing was applied.

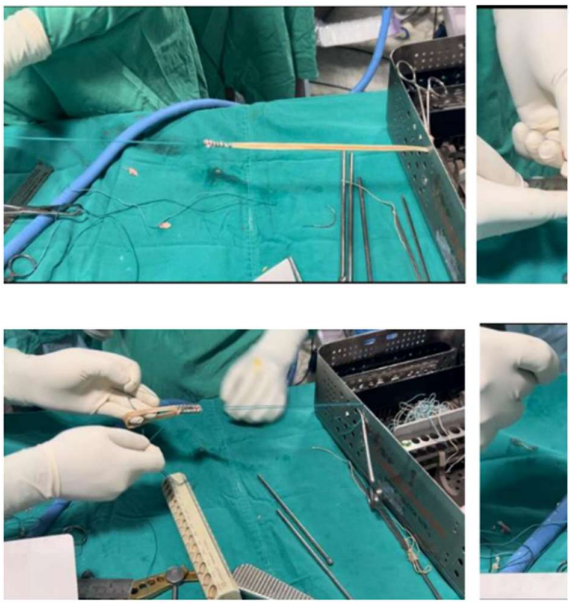

Figure 1: Graft harvesting and preparation for ACL reconstruction.

Figure 2A: Femoral-side graft fixation using Endobutton.

Figure 2B: Tibial-side graft fixation using interference screw.

Figure 3: Arthroscopic view after graft passage and fixation.

Figure 4: Final wound closure after arthroscopic ACL reconstruction.

Follow-Up

Patients were evaluated at 3 months and 6 months after surgery. At each follow-up visit, post-operative knee stability and functional recovery were assessed.

Outcome Measures Related to Objective 1

The following parameters were used to determine post-operative knee stability:

1. Lachman test.
2. Knee range of motion.
3. Quadriceps power.
4. Lysholm knee score.
5. IKDC score.
6. Post-operative pain.

Data Collection

Data were collected using structured clinical assessment records and standard functional scoring tools. Knee range of motion was measured clinically. Quadriceps power was assessed using muscle power grading. Knee laxity was assessed using the Lachman test. Functional outcome was assessed using Lysholm knee score and IKDC score.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using JAMOVI version 2.3.28. Frequencies and percentages were used for categorical variables. Mean values were used for continuous outcome variables. Paired sample t-test was used to compare outcomes between 3 months and 6 months. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Institutional Ethics Committee approval was obtained prior to initiation of the study. Written informed consent was obtained from all participants. Patient confidentiality and anonymity were maintained throughout the study.

4. Results

Only data directly related to post-operative knee stability were included in this paper.

Lachman Test

The Lachman test was used as the main clinical test for assessing post-operative anterior knee stability.

Table 1: Distribution of Lachman test results at 3 months and 6 months

Lachman Test Result	Frequency at 3 Months	Percentage at 3 Months	Frequency at 6 Months	Percentage at 6 Months
Negative	47	94.0%	49	98.0%
Positive	3	6.0%	1	2.0%
Total	**50**	**100.0 %**	**50**	**100.0 %**

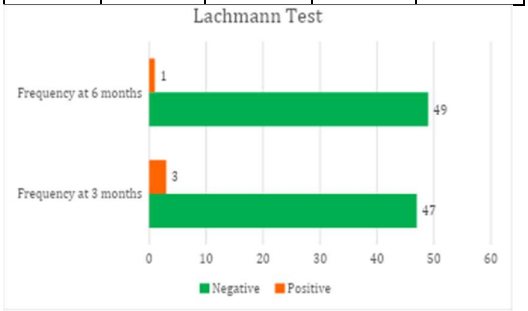

Figure 5: Distribution of Lachman test results at 3 months and 6 months.

At 3 months post-operatively, 47 patients (94.0%) had a negative Lachman test, while 3 patients (6.0%) had a positive Lachman test. At 6 months, 49 patients (98.0%) had a negative Lachman test and only 1 patient (2.0%) had a positive Lachman test. This finding indicates progressive improvement in anterior knee stability following arthroscopic ACL reconstruction.

Knee Range of Motion

Knee range of motion was assessed as a supportive functional parameter of post-operative knee stability.

Table 2: Distribution of knee range of motion at 3 months and 6 months

Knee Range of Motion	Frequency at 3 Months	Frequency at 6 Months
5–120 degrees	2	1
0–120 degrees	17	0
0–125 degrees	29	0
0–130 degrees	2	15
0–135 degrees	0	34
Total	**50**	**50**

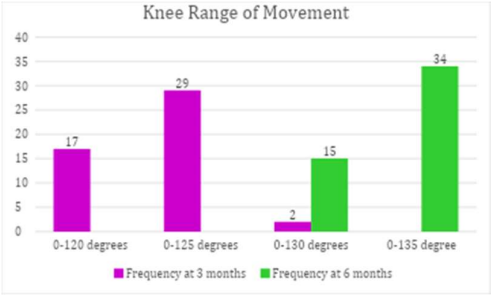

Figure 6: Distribution of knee range of motion at 3 months and 6 months.

At 3 months, most patients had knee range of motion of 0–125 degrees. At 6 months, most patients achieved 0–135 degrees. The mean knee ROM improved from 123 degrees at 3 months to 133 degrees at 6 months.

Table 3: Paired sample t-test comparing knee ROM at 3 months and 6 months

Variable Compared	t-statistic	df	p-value
Knee ROM at 3 months vs 6 months	-18.87	49	<0.001

The improvement in knee range of motion was statistically significant.

Quadriceps Power

Quadriceps power was assessed because it contributes to dynamic knee stability after ACL reconstruction.

Table 4: Distribution of quadriceps power at 3 months and 6 months

Quadriceps Power	Frequency at 3 Months	Percentage at 3 Months	Frequency at 6 Months	Percentage at 6 Months
Grade 4	25	50.0%	0	0.0%
Grade 5	25	50.0%	50	100.0 %
Total	**50**	**100.0 %**	**50**	**100.0 %**

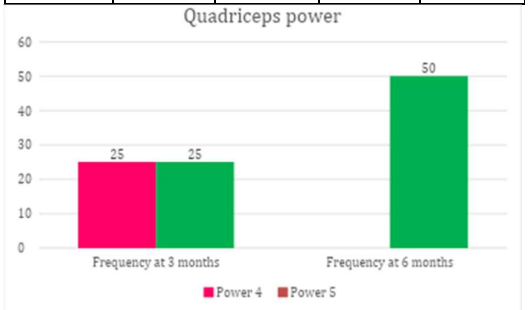

Figure 7: Distribution of quadriceps power at 3 months and 6 months.

At 3 months, 25 patients (50.0%) had grade 4 quadriceps power and 25 patients (50.0%) had grade 5 quadriceps power. At 6 months, all patients achieved grade 5 quadriceps power.

Table 5: Paired sample t-test comparing quadriceps power at 3 months and 6 months

Variable Compared	t-statistic	df	p-value
Quadriceps power at 3 months vs 6 months	-7.00	49	<0.001

The improvement in quadriceps power was statistically significant.

Lysholm Knee Score

Lysholm knee score was used to assess functional outcome related to pain, instability, swelling, limp, stair climbing, squatting, and functional knee stability.

Table 6: Distribution of Lysholm score at 3 months and 6 months

Lysholm Score at 3 Months	Frequency	Lysholm Score at 6 Months	Frequency
70–75	23	90–95	38
76–80	15	>95	12
81–85	12	—	—
Total	**50**	**Total**	**50**

The mean Lysholm score improved from 76.5 at 3 months to 93.4 at 6 months.

Table 7: Paired sample t-test comparing Lysholm score at 3 months and 6 months

Variable Compared	t-statistic	df	p-value
Lysholm score at 3 months vs 6 months	-24.11	49	<0.001

The improvement in Lysholm score was statistically significant, indicating better functional knee stability and recovery.

IKDC Score

IKDC score was used to assess patient-reported knee symptoms and function after ACL reconstruction.

Table 8: Distribution of IKDC score at 3 months and 6 months

IKDC Score at 3 Months	Frequency	IKDC Score at 6 Months	Frequency
60–65	18	85–90	30
66–70	14	91–95	20
71–75	10	—	—
76–80	8	—	—
Total	**50**	**Total**	**50**

The mean IKDC score improved from 68.5 at 3 months to 89.5 at 6 months.

Table 9: Paired sample t-test comparing IKDC score at 3 months and 6 months

Variable Compared	t-statistic	df	p-value
IKDC score at 3 months vs 6 months	-30.01	49	<0.001

The improvement in IKDC score was statistically significant, suggesting improved subjective knee function and stability.

Post-Operative Pain

Post-operative pain was assessed as a supportive recovery parameter.

Table 10: Distribution of post-operative pain

Post-Operative Pain	Frequency	Percentage
None	40	80.0%
Mild	10	20.0%
Moderate	0	0.0%
Severe	0	0.0%
Total	**50**	**100.0%**

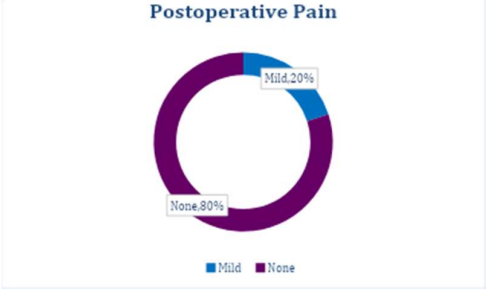

Figure 8: Distribution of post-operative pain.

Most patients had no post-operative pain. Forty patients (80.0%) reported no pain and 10 patients (20.0%) reported mild pain. No patient reported moderate or severe pain.

5. Discussion

The present study assessed post-operative knee stability following arthroscopic anterior cruciate ligament reconstruction. Objective 1 was evaluated primarily by the Lachman test, supported by knee range of motion, quadriceps power, Lysholm score, IKDC score, and post-operative pain assessment. These parameters together provide a comprehensive assessment of both mechanical and functional knee stability after ACL reconstruction.

The Lachman test results demonstrated progressive improvement in anterior knee stability. At 3 months, 47 patients (94.0%) had a negative Lachman test, which increased to 49 patients (98.0%) at 6 months. Only one patient (2.0%) had persistent Lachman positivity at 6 months. This finding indicates that arthroscopic ACL reconstruction was effective in restoring anterior knee stability in the majority of patients. The ACL is the primary restraint against anterior tibial translation, and restoration of this function is the principal goal of reconstruction (Girgis et al., 1975; Amis & Dawkins, 1991; Dargel et al., 2007). Anatomical reconstruction aims to reproduce the native ACL footprint and restore normal knee biomechanics, thereby improving clinical stability (Zantop et al., 2006; Karlsson et al., 2011; Hassebrock et al., 2020). The improvement in Lachman test findings in the present study is also supported by the biological process of graft healing and ligamentization. After ACL reconstruction, the graft undergoes necrosis, revascularization, cellular proliferation, remodeling, and gradual maturation, which contribute to progressive improvement in graft function and knee stability over time (Amiel et al., 1986; Ekdahl et al., 2008; Chen, 2009; Scheffler

et al., 2008). Tendon-to-bone healing is also essential for graft incorporation within the tunnels and for achieving stable fixation (Atesok et al., 2014). Therefore, the increase in negative Lachman test results from 3 months to 6 months may reflect progressive graft incorporation, improved neuromuscular control, and continued rehabilitation.

Knee range of motion improved significantly between 3 months and 6 months. At 3 months, most patients had knee ROM of 0–125 degrees, whereas at 6 months most patients achieved 0–135 degrees. The mean ROM improved from 123 degrees at 3 months to 133 degrees at 6 months, and this improvement was statistically significant ($t = -18.87$, $df = 49$, $p < 0.001$). Restoration of knee range of motion is an important component of post-operative recovery because stiffness, extension loss, and restricted flexion may impair gait, stair climbing, squatting, and functional activity. Early mobilization and criterion-based rehabilitation have been shown to improve knee mobility and functional recovery after ACL reconstruction (Shelbourne & Nitz, 1990; Adams et al., 2012; Grindem et al., 2016). In the present study, improvement in ROM supported better functional knee stability and reflected satisfactory rehabilitation progression.

Quadriceps power also improved significantly between 3 months and 6 months. At 3 months, 25 patients (50.0%) had grade 4 quadriceps power and 25 patients (50.0%) had grade 5 quadriceps power. By 6 months, all patients achieved grade 5 quadriceps power. This improvement was statistically significant ($t = -7.00$, $df = 49$, $p < 0.001$). Quadriceps strength is essential for dynamic knee stability, controlled knee movement, gait normalization, and return to functional activities. Persistent quadriceps weakness after ACL reconstruction may negatively affect knee function and may increase the risk of reinjury (Palmieri-Smith et al., 2008; Lepley et al., 2015). The complete recovery of quadriceps power by 6 months in the present study suggests that structured rehabilitation was effective in restoring muscle strength and supporting dynamic stability.

Functional outcome scores showed significant improvement. The mean Lysholm score improved from 76.5 at 3 months to 93.4 at 6 months, with a statistically significant difference ($t = -24.11$, $df = 49$, $p < 0.001$). The Lysholm knee score assesses limp, support, locking, instability, pain, swelling, stair climbing, and squatting, making it a useful measure of functional recovery after ligament surgery (Lysholm & Gillquist, 1982). The improvement in Lysholm score in the present study indicates reduction in symptoms and improvement in functional knee stability. Similarly, the mean IKDC score improved from 68.5 at 3 months to 89.5 at 6 months, with a statistically significant difference ($t = -30.01$, $df = 49$, $p < 0.001$). The IKDC score is a validated patient-reported outcome measure used to assess symptoms, function, and sports-related activities in patients with knee ligament injuries (Irrgang et al., 2001; Grevnerts et al., 2015). The improvement in IKDC score suggests better subjective knee function, improved confidence, reduced symptoms, and improved activity-related performance following ACL reconstruction.

The improvement in both Lysholm and IKDC scores is consistent with the purpose of arthroscopic ACL reconstruction, which is to restore stability and improve functional outcome. Arthroscopic reconstruction allows better visualization of intra-articular structures, anatomical tunnel placement, and reduced surgical morbidity, which may contribute to improved recovery (Fu et al., 1999; Karlsson et al., 2011; Raines et al., 2017). Studies on graft choice and reconstruction techniques have also shown that appropriate graft selection and secure fixation contribute to improved stability and function after ACL reconstruction (Burks et al., 2005; Joshi et al., 2021; Agarwal et al., 2023).

Post-operative pain was minimal in the present study. Forty patients (80.0%) reported no pain, while 10 patients (20.0%) reported mild pain. No patient reported moderate or severe pain. Reduced pain after arthroscopic ACL reconstruction may be related to the minimally invasive nature of the procedure, appropriate surgical technique, and effective post-operative rehabilitation. Lower pain levels may also help patients participate better in physiotherapy, thereby improving range of motion, muscle strength, and functional outcome. Pain control is important because persistent pain can delay rehabilitation and impair recovery after ACL reconstruction (Friel & Chu, 2013; Adams et al., 2012). Overall, the present findings demonstrate that arthroscopic ACL reconstruction restored post-operative knee stability in most patients by 6 months. The increase in negative Lachman test results from 94.0% at 3 months to 98.0% at 6 months indicates improvement in anterior knee stability. Significant improvement in knee range of motion, quadriceps power, Lysholm score, and IKDC score further supports both mechanical and functional recovery. These findings are in accordance with existing literature emphasizing anatomical reconstruction, biological graft healing, quadriceps strengthening, and structured rehabilitation as key factors in achieving successful ACL reconstruction outcomes (Amiel et al., 1986; Ekdahl et al., 2008; Palmieri-Smith et al., 2008; Adams et al., 2012; Grindem et al., 2016). Thus, based on the clinical and functional parameters assessed in this study, arthroscopic ACL reconstruction was effective in improving post-operative knee stability and functional recovery.

6. **Conclusion**

The present study concludes that arthroscopic anterior cruciate ligament reconstruction is effective in restoring post-operative knee stability and

improving functional recovery in patients with ACL tear. Knee stability, assessed mainly by the Lachman test, showed progressive improvement from 3 months to 6 months. At 3 months, 94.0% of patients had a negative Lachman test, which increased to 98.0% at 6 months, indicating successful restoration of anterior knee stability in the majority of patients. Functional parameters also showed significant improvement during follow-up. Knee range of motion improved from a mean of 123 degrees at 3 months to 133 degrees at 6 months, suggesting better joint mobility and recovery. Quadriceps power improved significantly, with all patients achieving grade 5 power by 6 months, indicating restoration of dynamic knee stability. Patient-reported functional outcomes also improved, as shown by the rise in mean Lysholm score from 76.5 to 93.4 and mean IKDC score from 68.5 to 89.5 between 3 and 6 months. Post-operative pain was minimal, with 80.0% of patients reporting no pain and 20.0% reporting only mild pain. No patient had moderate or severe pain. These findings suggest satisfactory surgical outcome, effective rehabilitation, and good functional recovery. Thus, arthroscopic ACL reconstruction provides reliable post-operative knee stability, improves range of motion, restores quadriceps strength, reduces symptoms, and enhances functional knee outcome by 6 months after surgery.

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