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Arthroscopic reconstruction of anterior cruciate ligament injury with and without anterolateral ligament reconstruction in patients with sports injury

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ABSTRACT

The current study aimed to evaluate postoperative knee stability in cases with high grade pivot shift test treated with ACL reconstruction with ALL reconstruction versus cases treated with ACL reconstruction only. This prospective comparative randomized study involved 40 patients with unilateral single ligamentous ACL injuries exhibiting advanced pivot shift test results. Patients were classified equally into two cohorts: Group I received solo ACL repair (ACLR), whereas Group II got ACL reconstruction with ALL reconstruction (ALLR). The postoperative scores from the International Knee Documentation Committee, Cincinnati, Lysholm, and Tegner were considerably elevated in the ACLR + ALLR group compared to the ACLR group ($p<0.05$), with notable improvements seen in both groups ($p<0.05$). The negative post-operative Lachman and Pivot shift tests were substantially greater in the ACLR + ALLR group than the ACLR group ($p<0.05$), and there was a high improvement pre- and post-operatively in the ACLR + ALLR group ($p<0.05$). The anterior drawer test demonstrated a substantial enhancement in both groups ($P<0.05$). Post-operative effusion exhibited a wide variation between groups ($p<0.05$), and there was a notable improvement in both groups ($p<0.05$). Post-operative pain was considerably reduced in the ACLR + ALLR group compared to the ACLR group ($p<0.05$), with notable improvement seen in both groups ($p<0.05$). The single leg hop test showed considerable improvement in both groups ($p<0.05$). Postoperative patient satisfaction exhibited a statistical variation between groups ($p<0.05$). Additional rotational stability is achieved through ACL + ALLR reconstruction, which enhances the likelihood of professional athletes returning to sports activities.

KEYWORDS

Arthroscopic Reconstruction; Anterior Cruciate Ligament Injury; Anterolateral Ligament Reconstruction; Patients; Sports Injury

1. INTRODUCTION

Anterior cruciate ligament (ACL) injuries are common among athletes and cause instability in the knee's ability to rotate laterally and anteriorly. Annually, over 400,000 ACL repair surgeries are conducted, representing fifty percent of all knee injuries (Abid et al., 2019).

The anterolateral ligament (ALL) attaches to the proximal tibia at Gerdy's tubercle and originates next to the lateral epicondyle of the distal femur. The ALL acts as ligamentous tissue, causing stress during internal rotation at 30 degrees. In the majority of specimens, the ACL is visible as a distinct ligament; but, in rare circumstances, it may only emerge as bundles of tight capsular tissue while applying internal rotation (Ariel et al., 2019).

Biomechanical research has shown that ALL serves as an auxiliary stabilizer to the ACL in reducing internal tibial rotation and anterior tibial translation. Biomechanical research demonstrates that simultaneous reconstruction of the ALL and ACL markedly decreases axial plane tibial translation and internal rotation relative to isolated ACL surgery in cases of ALL insufficiency (Arthur et al., 2020). A range of methodologies exists for ACL repair. The graft choices offered are the gracilis tendon allograft or autograft, iliotibial band, and semitendinosus tendon autograft or allograft. The fixation angles are varied between investigations, spanning from complete knee extension to flexion at 60° to 90° (Arthur et al., 2020).

An ACL injury patient's unique treatment plan takes into account their age, degree of exercise, and other personal circumstances. Both young athletes and active adults over the age of 40 are advised to have ACL repair. Restoring the ROM is essential prior to the treatment to prevent postoperative arthrofibrosis, unless a meniscal injury is causing a mechanical blockage of the knee. Considerable functional, psychological, and demographic factors impact surgery success and time to playback (Carter et al., 2020).

Despite breakthroughs in ACL repair surgical procedures, some people continue to have postoperative rotational instability. Recent biomechanical studies demonstrate that ALL functions as a vital stabilizer against anterolateral tibial rotation, and its restoration has shown exceptional first therapeutic results. Diverse methods have been developed to physically address this element during ACL reconstruction (Charalambous, 2023).

This work aims to evaluate postoperative knee stability in cases with high grade pivot shift test treated with ACL reconstruction with ALL reconstruction versus cases treated with ACL reconstruction only.

2. METHODS

2.1. Design and Participants

This prospective randomized controlled study involved 40 patients, aged over 18 years, of both sexes, classified as ASA I or II, with a BMI ranging from 18 to 30, and diagnosed with a unilateral single ligamentous ACL damage exhibiting an advanced pivot shift test.

The research was conducted with authorization from the Ethical Committee of Beni-Suef University Hospitals, Beni-Suef, Egypt. Patients were asked to give their informed consent.

The exclusion criteria included collateral ligament (LCL) instabilities greater than grade I (2-5 mm), posterior instabilities, prior knee surgeries, meniscal sutures at the time of surgery (due to a specific rehabilitation protocol), cartilage damage rated above grade 2 by the International Cartilage Repair Society, axis deviation (varus or valgus) exceeding 5 degrees, and knee osteoarthritis classified as grade 2 or higher according to the Kellgren and Lawrence classification.

2.2. Procedures and Instruments

Patients were categorized into two equal cohorts: Group I had solitary ACL repair, whereas Group II got ACL surgery with ALL reconstruction.

Prior to surgery, all patients had comprehensive history taking, physical examinations, extensive laboratory testing, and radiographic assessments, which included recent plain X-rays and MRI of the knee.

Following the patient's transfer to the operating room, spinal anesthesia was decided upon for the procedure. The patient was in a supine posture, with the knee arranged to permit flexion beyond 120 degrees and to apply a valgus load for a comprehensive arthroscopic evaluation. An above-knee tourniquet was used to manage hemorrhage during graft harvesting and to improve visualization during the arthroscopic procedure.

The whole leg was sterilized and enclosed in a specialized knee arthroscopy kit to regulate the surplus saline flow throughout the operation. The anterolateral and anteromedial approaches to the knee were performed, and the arthroscope was inserted into the knee to start the arthroscopic surgery. The arthroscope was used to evaluate the knee structures, confirm the diagnosis, and address other knee issues related to the ACL rupture, such meniscal tears or articular cartilage lesions. A hamstring graft was acquired and analyzed in this investigation. In unilateral ACL surgery, the femoral tunnel was established at the most isometric location underneath the intercondylar ridge and immediately posterior to the resident ridge.

The space between the intercondylar eminences formed the tibial tunnel. To ensure stability in the tibial and femoral tunnels, either a tensioned rope or a screw fixation was utilized. In cases of concurrent ACL and ALL repair, an additional extra-articular reconstruction of the ALL was performed using a pedicle strip of fascia lata, while maintaining the tibial insertion at Gerdy’s tubercle. The graft was subsequently prepared and positioned deep to the LCL, then anchored to the femur immediately posterior to the lateral epicondyle using an interference screw. Measures were taken to avert Damage to the ACL's femoral tunnel. The skin was sutured, and a vacuum drain was inserted into the knee to evacuate excess blood and fluid.

Four weeks after surgery, the patient was evaluated using the modified Cincinnati rating system and the Tegner Lysholm knee scoring scale (LKSS) to assess the effectiveness of the ACL restoration treatments (Charalambous, 2023). The metrics used in this technique include pain severity, edema, instability, overall activity level, ambulation, stair navigation, running, and leaping or twisting exercises. Each parameter was populated according to the clinical assessment or the patient's reported satisfaction level. The scores of each parameter were aggregated, and the overall result assessed the efficacy of the ACL restoration operation. The patient was instructed to return to the clinic for dressing changes on the wound and to get guidance on the subsequent steps in their healing process to achieve optimal results.

Prioritize early full passive extension, especially in patients with MCL injury or patellar dislocation and enable quick weight bearing (shown to decrease patellofemoral pain) in the early postoperative period. Use intense cryotherapy immediately. Exercises that are easy on the graft should be the focus of therapy. A three-week program of eccentric strengthening has been shown to increase quadriceps volume and strength. Other exercises include isometric hamstring contractions at any angle, isometric quadriceps contractions, or simultaneous contractions of both muscles. During the program, patients will actively bend their knees from 35° to 90°, and they will also strengthen their gluteal and core muscles while performing closed-chain movements like squats and leg presses. Avoid isokinetic quadriceps strengthening at (15-30°) in the early rehabilitation, as well as open chain quadriceps strengthening exercises like leg extensions, which replicate the anterior drawer and Lachman procedures.

Neither the criteria for clearance nor the time for return to sport are widely acknowledged. No later than nine months after surgery, as has been previously agreed upon. The functional evaluations that patients must complete mimic the demands of competitive athletics. Various hops and leaps with one or both legs. Excessive risk of contralateral and ipsilateral rupture is associated with dynamic valgus. An increased risk of re-rupture occurs when athletes return to their previous levels of activity before receiving medical clearance. Patients and surgeons must reach a mutual agreement about the patient's eligibility for a return to play. Psychological variables considerably influence the time of return and must not be disregarded. Injury prevention strategies include neuromuscular training and plyometrics, optimizing landing mechanics to reduce valgus stress and enhance knee flexion, and augmenting hamstring strength to mitigate quadriceps dominance.

2.3. Sample Size Calculation

The G*Power (3.1.9.4) program was employed to determine the sample size through a priori analysis. For the t-test, an effect size of 0.5 was used to compare two independent means. With a 10% attrition rate during follow-up and an α-error probability of 0.05, a sample size of 40 participants was decided to achieve 95% power.

2.4. Statistical Analysis

SPSS 26 (IBM Inc., Chicago, IL, USA) was employed to conduct statistical analysis. To compare the two groups' quantitative data, an unpaired Student's t-test was employed. Mean and standard deviation were used to display the data. When applicable, we used Chi-square or Fisher's exact tests to examine the proportion and frequency of the qualitative variables. The two-tailed P value was considered statistically significant when it was less than 0.05.

3. RESULTS

Demographic data was comparable between both groups. Operation and rehabilitation time were notably decreased in ACLR group than in ACLR + ALLR group (Table 1).

Postoperative IKDC subjective, Cincinnati, LKSS, Tegner scores were significantly higher in ACLR + ALLR group than in ACLR group ($P<0.05$), and they were significantly improved in both groups ($p<0.05$) (Table 2).

Table 1. Demographic data, operative and rehabilitation time among the studied groups

		ACLR group (n=20)	ACLR + ALLR (n=20)	p
Demographic data				
Age (years)		29±8.56	31.1±8.61	0.46
Sex	**Male**	15(75.0%)	16(80.0%)	0.71
	Female	5(25.0%)	4(20.0%)	
BMI (kg/m^2)		26.4±2.21	26.3±2.2	0.89
Affected side	**Right**	11(55.0%)	8(40.0%)	0.34
	Left	9(45.0%)	12(60.0%)	
Operative and rehabilitation time				
Time from injury to surgery (months)		5.85±2.04	5.13±2.16	0.28
Operation duration (minutes)		128±30.8	176±20.1	**<0.001***
Rehabilitation duration (months)		7.45±0.95	9.45±1.56	**<0.001***
Return to sport (months)		8.05±0.99	10.38±1.46	**<0.001***
Full recovery time (months)		9.65±1.86	10.88±1.51	**0.03***

*Note. Data is presented as mean ± SD or frequency (%). * Significant P value < 0.05. BMI: body mass index.*

Table 2. Knee function, modified Cincinnati rating, Lysholm, Tegner scores among the studied groups

	ACLR group (n=20)	ACLR + ALLR (n=20)	p
Knee function score			
Preoperative IKDC subjective score	51.3±12.9	55.1±10.8	0.31
Postoperative IKDC subjective score	80.2±4.58	84.5±6.6	**0.02***
P1 < 0.001*, P2 <0.001*			
Modified Cincinnati rating score			
Preoperative Cincinnati score	60.8±3.08	62.1±3.06	0.16
Postoperative Cincinnati score	82.7±2.47	87.1±2.66	**<0.001***
P1 < 0.001*, P2 <0.001*			
Lysholm score			
Preoperative Lysholm score	41.4±16.54	48.55±14.49	0.15
Postoperative Lysholm score	57.9±20.4	70.2±14.8	**0.04***
P1<0.001*, P2<0.001*			
Tegner score			
Preoperative Tegner score	3.35±2.01	3.05±0.76	0.42
Postoperative Tegner score	6.55±1.82	7.65±1.27	**0.03***
P1<0.001*, P2<0.001*			

*Note. Data is presented as mean ± SD. * Significant P value < 0.05. P1: Comparison within group I, P2: comparison within group II, IKDC: International knee documentation committee.*

Negative post-operative Lachman and Pivot shift tests were higher significantly in ACLR + ALLR than ACLR group ($p<0.05$) and they were improved significantly pre and post operatively in ACLR + ALLR group ($p<0.05$). The anterior drawer test was improved notably in both groups ($p<0.05$) (Table 3).

Table 3. Knee stability tests among the studied groups

		ACLR group (n=20)	ACLR + ALLR (n=20)	P
Preoperative Anterior drawer test	**Positive**	18(90.0%)	17(85.0%)	1.00
	Negative	2(10.0%)	3(15.0%)	
Postoperative Anterior drawer test	**Positive**	5(25.0%)	2(10.0%)	0.41
	Negative	15(75.0%)	18(90.0%)	
P1 < 0.001*, P2 <0.001*				
Preoperative Lachman test	**Positive**	15(75.0%)	10(50.0%)	0.113
	Negative	5(25.0%)	10(50.0%)	
Postoperative Lachman test	**Positive**	7(35.0%)	1(5.0%)	**0.04***
	Negative	13(65.0%)	19(95.0%)	
P1=0.06**, P=0.007***				
Preoperative Pivot shift test	**Positive**	12(60.0%)	8(40.0%)	0.213
	Negative	8(40.0%)	12(60.0%)	
Postoperative Pivot shift test	**Positive**	6(30.0%)	0(0.0%)	**0.02***
	Negative	14(70.0%)	20(100.0%)	
P1=0.16**, P2=0.002***				

*Note. Data is presented as frequency (%). * Significant P value < 0.05. P1: Comparison within group I, P2: comparison within group II.*

Preoperative and postoperative extension and flexion deficit were similar between both groups, while postoperative extension and flexion deficit were significantly improved among both groups (p<0.05). Post-operative effusion varied between groups (P<0.05), and it was significantly in both groups (p<0.05) (Table 4).

Table 4. Extension, flexion deficit and effusion among the studied groups

		ACLR group (n=20)	ACLR + ALLR (n=20)	p
Extension deficit				
Preoperative extension deficit	**Full extension**	2(10.0%)	0(0.0%)	0.63
	Minimal deficit	5(25.0%)	6(30.0%)	
	Moderate deficit	10(50.0%)	12(60.0%)	
	Severe deficit	3(15.0%)	2(10.0%)	
Postoperative extension deficit	**Full extension**	12(60.0%)	12(60.0%)	1.00
	Minimal deficit	5(25.0%)	6(30.0%)	
	Moderate deficit	3(15.0%)	2(10.0%)	
	Severe deficit	0(0.0%)	0(0.0%)	
P1=0.003*, P2<0.001*				
Flexion deficit				
Preoperative flexion deficit	**Full extension**	2(10.0%)	3(15.0%)	0.61
	Minimal deficit	8(40.0%)	7(35.0%)	
	Moderate deficit	8(40.0%)	9(45.0%)	
	Severe deficit	2(10.0%)	1(5.0%)	
Postoperative flexion deficit	**Full extension**	10(50.0%)	13(65.0%)	0.47
	Minimal deficit	9(45.0%)	5(25.0%)	
	Moderate deficit	1(5.0%)	2(10.0%)	
	Severe deficit	0(0.0%)	0(0.0%)	
P1=0.005*, P2=0.007				

Effusion				
Preoperative effusion	**None**	2 (10%)	3 (15%)	1.00
	Mild	7 (35%)	7 (35%)	
	Moderate	9 (45%)	9 (45%)	
	Severe	2 (10%)	1 (5%)	
Postoperative effusion	**None**	8 (40%)	16 (80%)	**0.02***
	Mild	9 (45%)	4 (20%)	
	Moderate	3 (15%)	0 (0%)	
	Severe	0 (0%)	0 (0%)	
P1=0.04*, P2<0.001*				

*Note. Data is presented as frequency (%). * Significant P value < 0.05. P1: Comparison within group I, P2: comparison within group II.*

Post-operative pain decreased significantly in ACLR + ALLR than ACLR group (p<0.05), it was improved significantly between groups (p<0.05). Preoperative and postoperative compartment findings were similar between both groups (Table 5).

Table 5. VAS score and compartment findings among the studied groups

		ACLR group (n=20)	ACLR + ALLR (n=20)	P
VAS				
Preoperative VAS score		5.95±1.15	5.9±1.12	0.89
Postoperative VAS score		3.45±1.57	2.25±1.02	**0.007***
P1<0.001*, P2<0.001*				
Compartment findings				
Preoperative Compartment findings	**None**	19(95.0%)	19(95.0%)	1.00
	Mild	1(5.0%)	1(5.0%)	
	Moderate	0(0.0%)	0(0.0%)	
	Severe	0(0.0%)	0(0.0%)	
Postoperative Compartment findings	**None**	19(95.0%)	19(95.0%)	1.00
	Mild	1(5.0%)	1(5.0%)	
	Moderate	0(0.0%)	0(0.0%)	
	Severe	0(0.0%)	0(0.0%)	
P1=1.00, P2=1.00				

*Note. Data is presented as frequency (%). * Significant P value < 0.05. P1: Comparison within group I, P2: comparison within group II, VAS: Visual analogue scale.*

Pre- and post-operative harvest site pathology, single leg hop (SLH) test, return to sport and complications were similar between both groups. SLH test was improved significantly between groups (p<0.05). Postoperative patient satisfaction was considerably varied between groups (p<0.05) (Table 6).

Table 6. Harvest site pathology, single leg hop test, return to sport, complications and postoperative patient satisfaction among the studied groups

		ACLR group (n=20)	ACLR + ALLR (n=20)	p
Harvest site pathology				
Preoperative Harvest site pathology	**Normal**	20(100.0%)	20(100.0%)	1.00
	Mild	0(0.0%)	0(0.0%)	
	Moderate	0(0.0%)	0(0.0%)	
Postoperative Harvest site pathology	**Normal**	18(90.0%)	17(85.0%)	1.00
	Mild	2(10.0%)	3(15.0%)	
	Moderate	0(0.0%)	0(0.0%)	
P1=0.49, P2=0.23				
Single leg hop (SLH) test				
Preoperative SLH test	**Poor**	17(85.0%)	16(80.0%)	1.00
	Fair	3(15.0%)	4(20.0%)	
	Good	0(0.0%)	0(0.0%)	
	Excellent	0(0.0%)	0(0.0%)	
Postoperative SLH test	**Poor**	0(0.0%)	0(0.0%)	1.00
	Fair	5(25.0%)	3(15.0%)	
	Good	6(30.0%)	5(25.0%)	
	Excellent	9(45.0%)	12(60.0%)	
P1<0.001*, P2<0.001*				
Return to sport				
Return to sport	**No**	8(40.0%)	4(20.0%)	0.17
	Yes	12(60.0%)	16(80.0%)	
Complications				
Graft failure		2(10.0%)	1(5.0%)	1.00
Infection		1(5.0%)	1(5.0%)	1.00
Postoperative patient satisfaction				
Very dissatisfied		1(5.0%)	0(0.0%)	**0.02***
Dissatisfied		3(15.0%)	0(0.0%)	
Satisfied		9(45.0%)	5(25.0%)	
Very satisfied		7(35.0%)	15(75.0%)	

*Note. Data is presented as frequency (%). * Significant P value < 0.05. P1: Comparison within group I, P2: comparison within group II.*

4. DISCUSSION

ACL injuries often occur in the athletic population, resulting in anterior and lateral rotational instability of the knee (Abid et al., 2019).

Our research demonstrated a considerable disparity between the examined groups for post-operative IKDC scores, with the ACLR + ALLR group exhibiting a superior IKDC score. Moreover, a substantial increase in IKDC scores was seen in both groups. In the current research group undergoing simultaneous ACL repair and lateral extra-articular tenodesis, we noticed significant enhancement in the postoperative LKSS score. This study also demonstrates an enhanced LKSS score, as shown in the research conducted by Ferreti et al. (2006) (96.2) and Vadala et al. (2013) (95.8). The mean LKSS of 94.9 indicates a favorable functional result. The research indicated a substantial enhancement in the mean subjective IKDC post-surgery, increasing from 51.52 to 94.43.

In our investigation, the Tegner activity score exhibited an increasing tendency post-surgery. The eleven-month average follow-up showed improvement, but it was still short of the levels seen before the injury. Therefore, a longer follow-up period is needed to identify any additional improvement. There was a strong correlation between pre-injury and post-operative Tegner scores during the last follow-up, according to previous research (Marcacci et al., 2009; Zaffagnini et al., 2006). However, post-surgery, there was a significant enhancement in the Tegner score, almost returning to its pre-injury status (Ferretti et al., 2016).

The majority of patients in this research exhibited pivot shift negative. Furthermore, Zaffagnini et al. (2006) reported that 94.3% of patients exhibited no gross pivot shift and Trichine et al. (2014) found that 93.2% of patients showed the same result.

Our research demonstrated a considerable disparity between the examined groups concerning the post-operative modified Cincinnati rating score, with the ACLR + ALLR group exhibiting a superior postoperative Cincinnati score. Moreover, there was a notable improvement in the Cincinnati score across both groups.

Our research demonstrated a significant variation between the examined groups for post-operative Lachman and Pivot shift tests, with 95% of patients in the ACLR + ALLR group exhibiting a negative Lachman test, compared to 65% in the ACLR group. Furthermore, the ACLR + ALLR group exhibited a negative Pivot shift test, while 70% of patients in the ACLR cohort did so.

Moreover, a notable improvement was seen in the Lachman and Pivot shift tests within the ACLR + ALLR sample; preoperatively, 50% of patients had a positive Lachman test, but postoperatively, this percentage decreased to 5%. Moreover, 95% of the patients had a positive Pivot shift test preoperatively; however, postoperatively, none of the patients showed a positive Pivot shift test. Moreover, a statistically significant enhancement in the anterior drawer test was seen in both cohorts; preoperatively, 90% of patients in the ACLR group exhibited a positive anterior drawer test, but postoperatively, only 25% did. In the ACLR + ALLR sample, 85% of patients exhibited a positive anterior drawer test preoperatively, but only 10% had a positive test postoperatively.

Our study indicated no substantial difference between the evaluated groups for pre-operative and post-operative extension deficits. Moreover, there was a notable enhancement in the extension deficit in both cohorts, including the ACLR cohort. In the ACLR + ALLR group, 60% of patients had a little extension deficit preoperatively, while postoperatively, 60% achieved full extension without deficit.

Our research indicated no substantial difference between the evaluated groups for pre-operative and post-operative flexion deficit (P>0.05). Furthermore, a notable enhancement in flexion deficit was seen in both cohorts; specifically, in the ACLR group, the majority of patients had a 40% moderate flexion deficit preoperatively, while postoperatively, 50% of patients achieved complete flexion. In the ACLR + ALLR sample, 45% of patients had modest preoperative flexion limitations, while 65% achieved complete flexion without deficits postoperatively.

Our research demonstrated a notable disparity between the examined groups for post-operative effusion; 45% of the ACLR group exhibited moderate effusion, while 80% in the ACLR + ALLR group presented no effusion. A statistically significant increase in effusion was seen in both groups; specifically, in the ACLR group, 45% of patients exhibited moderate effusion preoperatively, while postoperatively, 45% had mild effusion. In the ACLR + ALLR sample, 45% of patients had substantial effusion preoperatively, while 80% demonstrated an absence of effusion postoperatively.

Our research demonstrated a notable disparity between the examined groups for post-operative pain, with the ACLR + ALLR group exhibiting a reduced VAS score. Moreover, both groups exhibited a significant increase in pain levels.

Our study indicated no substantial difference between the evaluated groups for pre-operative and post-operative compartment results. Our research indicated comparable pre-operative and post-operative harvest site pathology. Our research indicated comparable pre-operative and post-operative SLH test (P>0.05).

Moreover, a significant improvement in SLH evaluations was seen in both groups. In the ACLR group, 85% of patients exhibited poor SLH test results preoperatively; however, postoperatively, 45% achieved good scores (P<0.001). In the ACLR + ALLR sample, 85% of patients had subpar performance on the SLH test preoperatively, while 60% demonstrated good performance postoperatively. Our results indicated no substantial difference between the examined groups for patient resumption of athletic activities. No notable disparity is seen between the examined groups concerning complications.

Our research revealed a notable disparity in patient satisfaction across the examined groups, with 75% of the ACLR + ALLR group expressing high satisfaction, compared to 35% in the ACLR group.

The study's limitations included a significantly constrained sample size, being conducted at a single institution, and monitoring patients for only very short durations.

5. CONCLUSIONS

In patients with high-grade pivot-shift positive and overall hyperlaxity, especially among high-demand athletes, ACLR combined with anterolateral extra-articular tenodesis of the knee joint using the modified Lemaire approach achieves excellent to good functional results. This approach increases the chances of resuming sports activities as professional athletes by providing better rotational stability.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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