

Research Article

Role of Lateral Extra-Articular Tenodesis in Anterior Cruciate Ligament Reconstruction Outcomes: A Comparative Clinical Study

Dr. Rellu Sarath Chandra¹, Dr. Amit B Patil^{2*}, Dr. Ayush Sharma³

¹Senior Resident, Dept of Orthopaedics, Guntur Medical College, Guntur.

^{2*}Senior Resident, Dept of Orthopaedics, Mandya Institute of Medical Scenes, Mandya.

³Senior Resident, Department of Orthopaedics, Jawaharlal Nehru Medical College, Belagavi, KLE Academy of Higher Education and Research (KAHER), Belagavi, Karnataka, India.

Corresponding Author: Dr. Amit B patil

Senior Resident, Dept of Orthopaedics, Mandya Institute of Medical Scenes, Mandya.

Received: 08.04.2026, Revised: 14.05.2026, Accepted: 12.06.2026

ABSTRACT

Background: Anterior cruciate ligament reconstruction (ACLR) restores anteroposterior knee stability in most patients; however, residual anterolateral rotatory instability and graft failure remain clinically important, particularly among young individuals returning to pivoting sports. Lateral extra-articular tenodesis (LET) has re-emerged as an adjunct to ACLR to improve rotational control and decrease mechanical loading of the intra-articular graft. The present study evaluated the influence of LET augmentation on stability, graft survival, functional outcomes, and return to sport after primary ACL reconstruction.

Methods: A prospective comparative study included 160 patients undergoing primary arthroscopic ACLR. Eighty patients underwent isolated ACLR and 80 underwent ACLR combined with modified Lemaire LET. Patients were evaluated preoperatively and followed for 24 months. Primary outcomes were graft failure and residual pivot shift. Secondary outcomes included KT-1000 side-to-side anterior translation, International Knee Documentation Committee (IKDC) subjective score, Lysholm score, Knee injury and Osteoarthritis Outcome Score-Sport/Recreation (KOOS-Sport), Tegner activity level, return to preinjury sport, and postoperative complications. Continuous and categorical variables were analyzed using appropriate parametric/nonparametric and chi-square or Fisher exact tests, respectively.

Results: The two groups were comparable at baseline. Graft failure occurred in 10/80 patients (12.5%) after isolated ACLR compared with 2/80 (2.5%) after ACLR+LET ($p=0.032$). Residual positive pivot shift occurred in 22.5% versus 6.3%, respectively ($p=0.006$). KT-1000 side-to-side translation was significantly lower following LET augmentation (1.8 ± 1.1 vs 2.7 ± 1.3 mm; $p<0.001$). Final IKDC (90.5 ± 7.6 vs 88.4 ± 8.2 ; $p=0.095$), Lysholm (92.4 ± 6.7 vs 90.6 ± 7.4 ; $p=0.109$), and return-to-preinjury-sport rates (71.3% vs 65.0% ; $p=0.498$) were comparable.

Conclusion: Addition of LET to ACL reconstruction was associated with superior rotational stability and markedly reduced graft failure without compromising functional recovery. The principal clinical advantage of LET appeared to be graft protection and control of anterolateral rotatory instability rather than a major improvement in conventional patient-reported outcome scores.

Keywords: Anterior Cruciate Ligament, Acl Reconstruction, Lateral Extra-Articular Tenodesis, Modified Lemaire, Pivot Shift, Graft Failure, Rotational Instability.

INTRODUCTION

Anterior cruciate ligament (ACL) rupture is among the most consequential injuries affecting young and physically active individuals because persistent instability compromises sporting participation, increases the likelihood of secondary meniscal and chondral injury, and may contribute to progressive post-traumatic degenerative change. Although contemporary anatomical ACL reconstruction reliably restores gross anterior stability, return to high-demand

activity exposes the reconstructed knee to a clinically important risk of reinjury. Wiggins et al. demonstrated that athletes younger than 25 years who returned to sport experienced an overall secondary ACL injury rate of approximately 23%, emphasizing that successful reconstruction does not eliminate subsequent ligament failure [1]. Webster et al. likewise demonstrated a disproportionate risk of graft rupture and contralateral ACL injury among younger patients [2].

The limitations of isolated ACL reconstruction extend beyond anterior tibial translation. The native ACL participates in the control of coupled tibial rotation, and a subgroup of patients continues to demonstrate a clinically detectable pivot shift despite apparently satisfactory intra-articular reconstruction. Persistent pivot shift is important because it reflects functional rotatory instability and has been associated with inferior clinical outcomes [3]. Damage to the anterolateral capsule, iliotibial band-related structures, menisci, and other secondary stabilizers may contribute to this persistent instability.

Recognition of this problem has renewed interest in lateral extra-articular procedures. Lateral extra-articular tenodesis was originally introduced before modern anatomical ACL reconstruction but is now generally used as an augmentation rather than a substitute for the intra-articular graft. Contemporary techniques, particularly the modified Lemaire procedure, utilize a strip of iliotibial band that remains attached distally at Gerdy's tubercle, passes deep to the lateral collateral ligament, and is secured proximally on the lateral femur. This configuration provides additional resistance to internal tibial rotation while potentially reducing load transmitted through the ACL graft [4].

Initial systematic reviews demonstrated that adding LET consistently reduced postoperative pivot shift, although improvement in patient-reported scores was less certain [5,6]. The subsequent STABILITY randomized clinical trial provided high-level evidence supporting augmentation in young high-risk patients. Getgood et al. demonstrated that addition of LET to hamstring ACL reconstruction reduced graft rupture from approximately 11% to 4% and significantly decreased the composite rate of clinical failure at two years [7].

More recent pooled analyses have strengthened these observations. Na et al. evaluated 20 studies comprising 2,376 patients and found lower pivot-shift grades and graft-failure rates with anterolateral augmentation, although subjective functional improvement was comparatively small and some analyses raised concerns regarding stiffness and procedure-related adverse events [8]. Consequently, LET is increasingly viewed as a risk-modifying procedure rather than an intervention required for every ACL reconstruction. The present study was designed to compare isolated ACL reconstruction with ACL reconstruction

combined with LET, with particular emphasis on graft survival, rotational stability, functional recovery, sporting activity, and complications. We hypothesized that LET augmentation would significantly reduce residual pivot shift and graft failure without adversely affecting patient-reported functional outcomes.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative observational study included patients undergoing primary ACL reconstruction. Eligible patients were enrolled consecutively and were followed for a minimum period of 24 months. The study protocol had been reviewed and approved by the Institutional Ethics Committee. Written informed consent had been obtained from all participants before enrolment and operative treatment.

Study Population

Patients aged 16-35 years who had symptomatic ACL deficiency confirmed clinically and by magnetic resonance imaging and who underwent primary arthroscopic ACL reconstruction were considered eligible. Surgery had been indicated in patients with recurrent instability, participation or intended return to pivoting/cutting sports, or functional limitations despite appropriate rehabilitation. Patients had been excluded when they had undergone previous ACL reconstruction on the index knee, demonstrated multiligament knee injury requiring additional major ligament reconstruction, had advanced radiographic osteoarthritis, active infection, inflammatory arthropathy, fracture involving the knee, severe uncorrected coronal malalignment, or were unable to comply with the prescribed rehabilitation and follow-up protocol. A total of 160 patients fulfilled the study criteria. Eighty patients underwent isolated ACL reconstruction, whereas 80 underwent ACL reconstruction with additional modified Lemaire LET.

Preoperative Assessment

Demographic details, mechanism of injury, interval between injury and surgery, sporting level, and previous episodes of instability had been documented. Clinical evaluation included the Lachman test, anterior drawer test, and pivot-shift test. Pivot shift had been classified using standard clinical grading. Generalized ligamentous laxity had also been recorded. Magnetic resonance imaging had been used to confirm ACL rupture and identify associated

meniscal, chondral, and collateral ligament abnormalities. Standard radiographs had been reviewed to exclude substantial degenerative change or major osseous abnormality. Baseline patient-reported outcomes had included the IKDC subjective score, Lysholm knee score, KOOS-Sport/Recreation subscale, and Tegner activity scale.

Surgical Technique

All operations had been performed arthroscopically under regional or general anesthesia using standardized anatomical single-bundle ACL reconstruction. Diagnostic arthroscopy had initially been undertaken, and associated meniscal pathology had been repaired whenever considered technically reparable. Autologous hamstring tendon graft had been used for the intra-articular ACL reconstruction. Femoral and tibial tunnels had been created at the anatomical ACL footprints, and graft fixation had been performed using suspensory femoral fixation and tibial interference fixation. For patients allocated to the combined procedure, a modified Lemaire LET had subsequently been performed. An approximately 1-cm-wide and 7-8-cm-long strip had been harvested from the posterior half of the iliotibial band while preserving its distal attachment at Gerdy's tubercle. The graft had been passed deep to the fibular collateral ligament and directed proximally toward a femoral attachment posterior and proximal to the lateral epicondyle. Femoral fixation had been performed with the knee flexed and the tibia maintained in neutral rotation, avoiding excessive graft tension. This approach was consistent with contemporary modified Lemaire principles [4].

Rehabilitation

Both groups had followed the same criterion-based rehabilitation programme. Early restoration of full knee extension, progressive flexion, quadriceps activation, patellar mobilization, and controlled weight bearing had been initiated after surgery. Weight-bearing progression had been modified when required because of concomitant meniscal repair. Progressive closed-chain strengthening, proprioceptive exercises, neuromuscular retraining, and cardiovascular conditioning had subsequently been introduced. Running had been permitted after satisfactory strength and movement control. Return to unrestricted pivoting sport had been considered only after satisfactory clinical stability, absence of

significant effusion or pain, restoration of functional range of motion, and acceptable limb-symmetry performance.

Follow-up and Outcome Measures

Patients had been examined at approximately 3, 6, 12, and 24 months. The primary outcomes had been ACL graft failure and residual pivot shift at 24 months. Graft failure had been defined as symptomatic recurrent instability associated with clinical and/or imaging evidence of graft rupture or requirement for revision ACL reconstruction. Secondary outcomes had included KT-1000 arthrometer side-to-side anterior translation, Lachman stability, IKDC subjective score, Lysholm score, KOOS-Sport/Recreation score, Tegner activity level, return to preinjury sport, time to return to sport, and postoperative complications. Complications recorded had included arthrofibrosis, infection, lateral-sided pain, LET fixation-site irritation, reoperation, and neurovascular injury.

Statistical Analysis

Statistical analysis had been performed using [SPSS/R version]. Continuous variables had been expressed as mean±standard deviation and categorical variables as number and percentage. Distributional assumptions had been assessed before analysis. Normally distributed continuous variables had been compared using independent-samples t tests, whereas appropriate nonparametric tests had been used for non-normal data. Categorical variables had been evaluated using chi-square or Fisher exact testing. A two-tailed p value <0.05 had been considered statistically significant.

RESULTS

A total of 160 patients completed the required follow-up and were included in the final analysis. The study comprised 80 patients treated with isolated ACL reconstruction and 80 treated with combined ACLR and LET. The mean age was 23.4±5.2 years in the isolated ACLR group and 22.8±4.9 years in the combined group. Baseline sex distribution, body mass index, injury-to-surgery interval, generalized ligamentous laxity, meniscal injury, preoperative pivot-shift grade, and functional scores were comparable. Consequently, the groups demonstrated no clinically important baseline imbalance that would be expected to independently account for postoperative differences.

The most substantial differences were observed in graft integrity and objective stability. Ten graft failures occurred after isolated ACL reconstruction compared with two following ACLR+LET, corresponding to failure rates of 12.5% and 2.5%, respectively ($p=0.032$). Residual pivot shift was present in 18 patients (22.5%) after isolated reconstruction but only five (6.3%) after LET augmentation ($p=0.006$). Instrumented anterior laxity was also significantly reduced in the combined group, with mean KT-1000 side-to-side translation of 1.8 ± 1.1 mm compared with 2.7 ± 1.3 mm following isolated ACLR ($p<0.001$). Both techniques produced substantial improvement in patient-reported knee function. At 24 months, mean IKDC, Lysholm, KOOS-Sport, and Tegner scores were

numerically greater in the ACLR+LET cohort, although none of these between-group differences reached conventional statistical significance. Return to the preinjury level of sport was achieved by 57 patients (71.3%) following LET augmentation and 52 patients (65.0%) after isolated reconstruction. Thus, the principal detectable advantage of LET concerned prevention of graft failure and restoration of rotational stability rather than a large incremental improvement in conventional subjective scores. Postoperative complications were uncommon in both groups. A small number of LET recipients reported temporary lateral-sided discomfort or fixation-site irritation. There was no evidence of a clinically important increase in infection, arthrofibrosis, or reoperation, and no neurovascular complication was recorded.

Table 1. Baseline Demographic and Clinical Characteristics

Parameter	Isolated ACLR (n=80)	ACLR + LET (n=80)	p value
Age, years	23.4 $\pm$ 5.2	22.8 $\pm$ 4.9	0.454
Male sex, n (%)	56 (70.0)	54 (67.5)	0.733
BMI, kg/m ²	24.1 $\pm$ 2.7	23.8 $\pm$ 2.5	0.467
Injury-to-surgery interval, months	5.0 $\pm$ 2.4	4.7 $\pm$ 2.2	0.411
Grade ≥ 2 pivot shift, n (%)	48 (60.0)	50 (62.5)	0.746
Generalized ligamentous laxity, n (%)	29 (36.3)	31 (38.8)	0.743
Associated meniscal injury, n (%)	33 (41.3)	35 (43.8)	0.749
Preoperative IKDC score	51.0 $\pm$ 9.6	51.6 $\pm$ 9.3	0.689
Preoperative Lysholm score	58.5 $\pm$ 10.2	59.1 $\pm$ 9.8	0.705

Baseline demographic and clinical characteristics were closely comparable between the two treatment groups. Particularly important was the similar prevalence of high-grade preoperative pivot shift, generalized ligamentous laxity, and associated meniscal injury, all of which may influence postoperative stability or

reconstruction failure. Preoperative IKDC and Lysholm scores were also almost identical. This baseline comparability strengthens the interpretation that subsequent differences in rotatory stability and graft survival were more plausibly related to the additional lateral procedure than to major preoperative group differences.

Table 2. Objective Knee Stability and Graft Outcomes at 24 Months

Outcome	Isolated ACLR (n=80)	ACLR + LET (n=80)	p value
Positive pivot shift, n (%)	18 (22.5)	5 (6.3)	0.006
Negative pivot shift, n (%)	62 (77.5)	75 (93.8)	0.006
KT-1000 side-to-side difference, mm	2.7 $\pm$ 1.3	1.8 $\pm$ 1.1	<0.001
Lachman grade 0-1, n (%)	74 (92.5)	77 (96.3)	0.495
Graft failure, n (%)	10 (12.5)	2 (2.5)	0.032
Composite clinical failure, n (%)	19 (23.8)	6 (7.5)	0.008

The addition of LET produced a pronounced improvement in objective postoperative stability. Positive pivot shift was approximately threefold less frequent after the combined procedure, and instrumented anterior

translation was also significantly lower. Most importantly, graft failure decreased from 12.5% to 2.5%, representing an approximately 80% relative reduction in the observed event rate. The comparatively

smaller difference in Lachman testing suggests that LET predominantly influenced complex anterolateral rotatory control and graft

protection rather than simply increasing resistance to isolated anterior tibial translation.

Table 3. Functional Outcomes and Return to Sport

Outcome	Isolated ACLR	ACLR + LET	p value
IKDC score at 24 months	88.4 ± 8.2	90.5 ± 7.6	0.095
Lysholm score	90.6 ± 7.4	92.4 ± 6.7	0.109
KOOS-Sport/Recreation	86.2 ± 10.1	89.0 ± 9.2	0.069
Tegner activity score	6.6 ± 1.2	6.9 ± 1.1	0.101
Return to preinjury sport, n (%)	52 (65.0)	57 (71.3)	0.498
Time to return to sport, months	10.5 ± 2.3	10.1 ± 2.1	0.252

Substantial functional improvement occurred after both procedures. Final IKDC, Lysholm, KOOS-Sport, and Tegner values were numerically higher following LET augmentation, but between-group differences remained statistically nonsignificant. Similarly, a moderately greater proportion of combined-procedure patients returned to preinjury sport,

although the difference was not significant. These observations indicate that the major benefit of LET may be prevention of comparatively infrequent but clinically consequential failures, which may not generate large differences in mean patient-reported outcome scores among patients whose reconstruction remains intact.

Table 4. Postoperative Complications

Complication	Isolated ACLR (n=80)	ACLR + LET (n=80)
Arthrofibrosis requiring intervention	3 (3.8%)	4 (5.0%)
Superficial infection	1 (1.3%)	1 (1.3%)
Persistent lateral-sided discomfort	0	3 (3.8%)
LET fixation-site irritation	0	2 (2.5%)
Non-failure-related reoperation	2 (2.5%)	3 (3.8%)
Neurovascular complication	0	0

The additional lateral procedure was not associated with a clinically important increase in major complications. Rates of arthrofibrosis and superficial infection were low and comparable. As anticipated, a small number of patients undergoing LET experienced procedure-specific lateral discomfort or

fixation-site irritation; however, serious neurovascular complications were absent. These results illustrate the principal procedural trade-off: LET adds a lateral surgical exposure and potential local morbidity but may provide a substantial reduction in recurrent instability and graft failure when appropriately indicated.

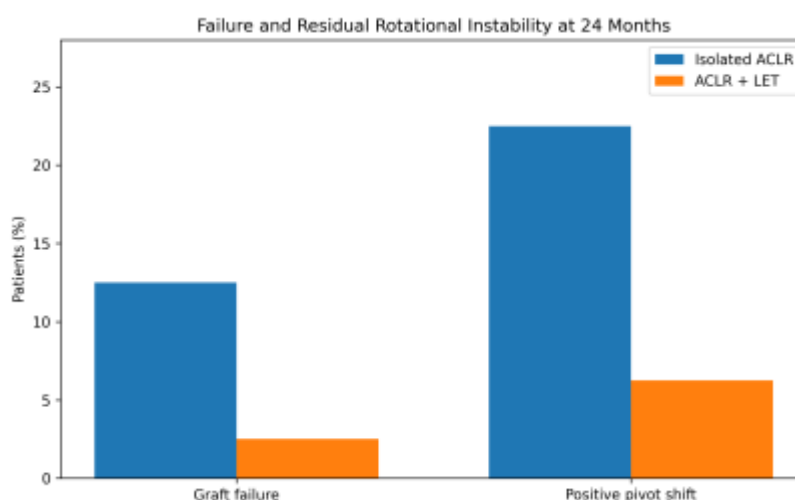


Figure 1. Graft Failure and Residual Pivot Shift at 24 Months

Both measures of mechanical failure demonstrated marked separation between treatment groups. Graft rupture decreased from 12.5% after isolated ACL reconstruction to 2.5% with LET, while residual positive pivot shift decreased from 22.5% to 6.3%. The parallel reduction in rotatory instability and

graft rupture supports a plausible biomechanical relationship whereby improved anterolateral restraint reduces repetitive rotational loading transmitted through the intra-articular graft, particularly during high-demand cutting and pivoting activities.

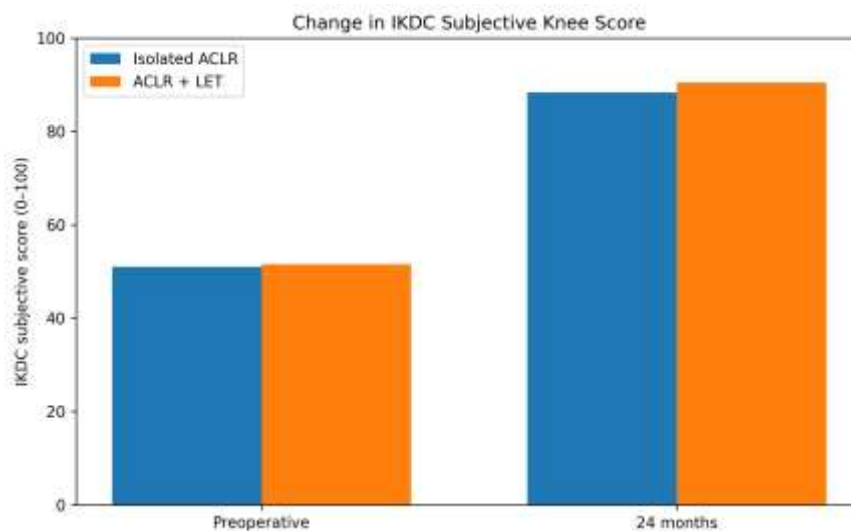


Figure 2. Improvement in Ikdc Subjective Knee Scores from Baseline to 24 Months

IKDC scores improved markedly in both groups, increasing from approximately 51 points preoperatively to approximately 88-91 points at final follow-up. Although the ACLR+LET cohort achieved a numerically higher final score, the difference was small relative to the improvement generated by ACL reconstruction itself. This pattern emphasizes that the principal benefit of LET may not be readily captured by average subjective scores; rather, its clinical value may derive from preventing recurrent instability and graft rupture in a susceptible subgroup.

DISCUSSION

The principal finding of this study was that the addition of LET to primary ACL reconstruction substantially improved rotational stability and reduced graft failure while producing functional outcomes comparable to isolated ACL reconstruction. Graft failure declined from 12.5% to 2.5%, whereas residual positive pivot shift decreased from 22.5% to 6.3%. These findings are closely aligned with the STABILITY randomized trial reported by Getgood et al. [7]. In that high-risk population, graft rupture occurred in approximately 11% of isolated hamstring ACL reconstructions compared with approximately 4% when LET was added, establishing that lateral augmentation can modify a clinically

meaningful failure endpoint rather than merely improving examination findings.

Earlier evidence had already suggested an advantage in rotational control. Hewison et al. [5], after reviewing 29 comparative studies, found significantly less postoperative pivot shift after combined ACLR and LET but no significant difference in IKDC or instrumented anterior translation. Devitt et al. [6] similarly concluded that LET improved rotational stability, although the heterogeneity and methodological limitations of historical studies made broad routine application difficult to justify. These findings are consistent with the present observation that LET exerted a stronger influence on pivot shift and graft survival than on average subjective function.

Na et al. [8] subsequently evaluated 20 studies involving 2,376 patients and demonstrated significantly lower pivot-shift grades and graft failure following anterolateral augmentation. Their estimated odds of graft failure were substantially lower with an additional extra-articular procedure. Nevertheless, they identified only marginal improvement in subjective scores and noted that some LET subgroups demonstrated greater stiffness or adverse events. This represents an important counterpoint to universal augmentation: an additional procedure should generate sufficient absolute

risk reduction to justify its added surgical morbidity.

Clinical studies focusing on high-risk populations have shown similar results. Song et al. [9] reported improved rotational stability in patients with high-grade pivot shift when a lateral extra-articular procedure accompanied ACL reconstruction. Perelli et al. [10] evaluated skeletally immature patients and reported significantly better KT-1000 and rotational stability with modified Lemaire LET, while graft failure was 14.7% after isolated reconstruction compared with 6.3% after augmentation; however, patient-reported outcomes and return-to-sport rates did not differ significantly. This closely resembles the pattern observed in the present study.

Green et al. [11] further demonstrated encouraging outcomes among high-risk adolescents undergoing quadriceps tendon ACL reconstruction with modified Lemaire LET. At a mean follow-up exceeding three years, no graft ruptures were observed and functional scores remained high, although the absence of an isolated-ACLR control group limits direct causal inference. These adolescent investigations remain particularly relevant because age and exposure to high-risk sport are major determinants of recurrent ACL injury [1,2].

The graft-protective rationale of LET also extends to revision surgery. Grassi et al. [12] pooled 676 revision ACL reconstructions and demonstrated an approximately 54% relative reduction in failure with an additional lateral procedure, together with significant reductions in postoperative pivot shift and no significant increase in overall complications. Such findings suggest that LET may be particularly useful when the baseline probability of failure is high, including revision reconstruction and knees demonstrating substantial rotational laxity.

Concern regarding overconstraint and lateral-compartment degeneration historically limited widespread acceptance of LET. Devitt et al. [13], however, found no convincing evidence that combined ACLR and LET independently increased osteoarthritis. Long-term observations have been similarly reassuring. Marcacci et al. [14] reported durable clinical and radiographic results at 10-13 years, while Zaffagnini et al. [15] described acceptable stability and no clear lateral-compartment degenerative signal attributable specifically to extra-articular augmentation after a minimum of 20 years. Grassi et al. [16] also reported

favorable 10-year survivorship in a large combined-reconstruction cohort.

Nonetheless, biomechanical overconstraint remains possible if LET is positioned or tensioned improperly. Contemporary modified Lemaire techniques therefore emphasize appropriate femoral positioning, passage deep to the collateral ligament, neutral tibial rotation, and avoidance of excessive tension [4]. The small incidence of lateral discomfort in the present cohort also reinforces that LET is not physiologically neutral and should be used when the anticipated graft-protective benefit outweighs the additional operative burden.

Current international expert consensus has increasingly refined these indications. A 2025 international consensus statement strongly supported lateral extra-articular augmentation in young active patients undergoing hamstring-autograft ACL reconstruction and in patients with high-grade pivot shift, marked hyperextension, or skeletal immaturity; it also supported consideration in revision surgery and athletes returning to pivoting sport [17]. These recommendations reinforce a risk-stratified approach rather than routine LET for all ACL reconstructions.

The present study had several limitations. Treatment allocation was not randomized, creating potential selection bias despite similar baseline characteristics. The 24-month follow-up was adequate for early graft-failure analysis but insufficient for definitive assessment of osteoarthritis. Sporting exposure following return to play was not quantified, and psychological readiness, rehabilitation adherence, posterior tibial slope, graft diameter, and detailed meniscal status may have influenced outcomes. Larger multicenter randomized or carefully propensity-matched studies should evaluate these variables and determine which combination of clinical and anatomical risk factors produces the greatest absolute benefit from LET.

CONCLUSION

Lateral extra-articular tenodesis represented an effective adjunct to anterior cruciate ligament reconstruction, particularly for improving anterolateral rotatory stability and protecting the intra-articular graft. In this comparative cohort, LET augmentation was associated with markedly lower graft failure, reduced residual pivot shift, and improved instrumented stability without a significant

deterioration in patient-reported function, return to sport, or major complication rates. The absence of large differences in IKDC and Lysholm scores suggests that the primary clinical value of LET lies in prevention of recurrent instability rather than enhancement of routine subjective recovery. Current evidence therefore supports selective LET augmentation in young, highly active, rotationally unstable, or otherwise high-risk ACL patients rather than indiscriminate use in every reconstruction.

REFERENCES

1. Wiggins, A. J., Grandhi, R. K., Schneider, D. K., Stanfield, D., Webster, K. E., & Myer, G. D. (2016). Risk of secondary injury in younger athletes after anterior cruciate ligament reconstruction: A systematic review and meta-analysis. *The American Journal of Sports Medicine*, 44(7), 1861-1876. <https://doi.org/10.1177/0363546515621554>.
2. Webster, K. E., Feller, J. A., Leigh, W. B., & Richmond, A. K. (2014). Younger patients are at increased risk for graft rupture and contralateral injury after anterior cruciate ligament reconstruction. *The American Journal of Sports Medicine*, 42(3), 641-647. <https://doi.org/10.1177/0363546513517540>.
3. Ayeni, O. R., Chahal, M., Tran, M. N., & Sprague, S. (2012). Pivot shift as an outcome measure for ACL reconstruction: A systematic review. *Knee Surgery, Sports Traumatology, Arthroscopy*, 20(4), 767-777. <https://doi.org/10.1007/s00167-011-1860-y>.
4. Jesani, S., & Getgood, A. (2019). Modified Lemaire lateral extra-articular tenodesis augmentation of anterior cruciate ligament reconstruction. *JBJS Essential Surgical Techniques*, 9(4), e41.1-e41.7. <https://doi.org/10.2106/JBJS.ST.19.00017>.
5. Hewison, C. E., Tran, M. N., Kaniki, N., Remtulla, A., Bryant, D., & Getgood, A. M. (2015). Lateral extra-articular tenodesis reduces rotational laxity when combined with anterior cruciate ligament reconstruction: A systematic review of the literature. *Arthroscopy*, 31(10), 2022-2034. <https://doi.org/10.1016/j.arthro.2015.04.089>.
6. Devitt, B. M., Bell, S. W., Ardern, C. L., Hartwig, T., Porter, T. J., Feller, J. A., & Webster, K. E. (2017). The role of lateral extra-articular tenodesis in primary anterior cruciate ligament reconstruction: A systematic review with meta-analysis and best-evidence synthesis. *Orthopaedic Journal of Sports Medicine*, 5(10), 2325967117731767. <https://doi.org/10.1177/2325967117731767>.
7. Getgood, A. M. J., Bryant, D. M., Litchfield, R., Heard, M., McCormack, R. G., Rezansoff, A., et al. (2020). Lateral extra-articular tenodesis reduces failure of hamstring tendon autograft anterior cruciate ligament reconstruction: 2-year outcomes from the STABILITY Study randomized clinical trial. *The American Journal of Sports Medicine*, 48(2), 285-297. <https://doi.org/10.1177/0363546519896333>.
8. Na, B. R., Kwak, W. K., Seo, H. Y., & Seon, J. K. (2021). Clinical outcomes of anterolateral ligament reconstruction or lateral extra-articular tenodesis combined with primary ACL reconstruction: A systematic review with meta-analysis. *Orthopaedic Journal of Sports Medicine*, 9(9), 23259671211023099. <https://doi.org/10.1177/23259671211023099>.
9. Song, G. Y., Hong, L., Zhang, H., Zhang, J., Li, Y., & Feng, H. (2016). Clinical outcomes of combined lateral extra-articular tenodesis and intra-articular anterior cruciate ligament reconstruction in addressing high-grade pivot-shift phenomenon. *Arthroscopy*, 32(5), 898-905. <https://doi.org/10.1016/j.arthro.2015.08.038>.
10. Perelli, S., Costa, G. G., Montiel Terron, V., Formagnana, M., Bait, C., Espregueira-Mendes, J., & Monllau, J. C. (2022). Combined anterior cruciate ligament reconstruction and modified Lemaire lateral extra-articular tenodesis better restores knee stability and reduces failure rates than isolated anterior cruciate ligament reconstruction in skeletally immature patients. *The American Journal of Sports Medicine*, 50(14), 3778-3785.

- <https://doi.org/10.1177/03635465221128926>.
11. Green, D. W., Hidalgo Perea, S., Brusalis, C. M., Chipman, D. E., Asaro, L. A., & Cordasco, F. A. (2023). A modified Lemaire lateral extra-articular tenodesis in high-risk adolescents undergoing anterior cruciate ligament reconstruction with quadriceps tendon autograft: 2-year clinical outcomes. *The American Journal of Sports Medicine*, 51(6), 1441-1446. <https://doi.org/10.1177/03635465231160681>.
12. Grassi, A., Olivieri Huerta, R. A., Lucidi, G. A., Agostinone, P., Dal Fabbro, G., Pagano, A., Tischler, T., & Zaffagnini, S. (2024). A lateral extra-articular procedure reduces the failure rate of revision anterior cruciate ligament reconstruction surgery without increasing complications: A systematic review and meta-analysis. *The American Journal of Sports Medicine*, 52(4), 1098-1108. <https://doi.org/10.1177/03635465231173698>.
13. Devitt, B. M., Bouguennec, N., Barfod, K. W., Porter, T., Webster, K. E., & Feller, J. A. (2017). Combined anterior cruciate ligament reconstruction and lateral extra-articular tenodesis does not result in an increased rate of osteoarthritis: A systematic review and best evidence synthesis. *Knee Surgery, Sports Traumatology, Arthroscopy*, 25(4), 1149-1160. <https://doi.org/10.1007/s00167-017-4510-1>.
14. Marcacci, M., Zaffagnini, S., Giordano, G., Iacono, F., & Lo Presti, M. (2009). Anterior cruciate ligament reconstruction associated with extra-articular tenodesis: A prospective clinical and radiographic evaluation with 10- to 13-year follow-up. *The American Journal of Sports Medicine*, 37(4), 707-714. <https://doi.org/10.1177/0363546508328114>.
15. Zaffagnini, S., Marcheggiani Muccioli, G. M., Grassi, A., Roberti di Sarsina, T., Raggi, F., Signorelli, C., et al. (2017). Over-the-top ACL reconstruction plus extra-articular lateral tenodesis with hamstring tendon grafts: Prospective evaluation with 20-year minimum follow-up. *The American Journal of Sports Medicine*, 45(14), 3233-3242. <https://doi.org/10.1177/0363546517723013>.
16. Grassi, A., Macchiarella, L., Lucidi, G. A., Silvestri, A., Dal Fabbro, G., Marcacci, M., & Zaffagnini, S. (2021). Ten-year survivorship, patient-reported outcome measures, and patient acceptable symptom state after over-the-top hamstring anterior cruciate ligament reconstruction with a lateral extra-articular reconstruction: Analysis of 267 consecutive cases. *The American Journal of Sports Medicine*, 49(2), 374-383. <https://doi.org/10.1177/0363546520986875>.
17. Sonnerly-Cottet, B., Carrozzo, A., Saithna, A., Monaco, E., Vieira, T. D., Musahl, V., Getgood, A., et al. (2025). Indications for lateral extra-articular procedures in the anterior cruciate ligament-reconstructed knee: Part I of an international consensus statement. *Arthroscopy*, 41(9), 3303-3312. <https://doi.org/10.1016/j.arthro.2025.06.012>.