ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Addition of anterolateral ligament reconstruction to primary anterior cruciate ligament reconstruction could benefit recovery of functional outcomes

Jin Hyuck Lee PT,.PhD, Gyu Bin Lee, WooYong Chung, Seung-Beom Han MD,. PhD & Ki-Mo Jang M.D,.PhD

Department of Sports Medical Center, Anam Hospital, Korea University College of Medicine, Seoul 02841, Republic of Korea

Department of Orthopedic Surgery, Anam Hospital, Korea University College of Medicine,Seoul 02841, Republic of Korea

KU MEDICINE

Introduction

➢ ACL reconstruction (ACLR)

- Current standard surgical treatment to regain knee joint stability and improve knee function
- However, still have difficulty returning to pre-injury sports participation levels after isolated ACLR
- Therefore, the addition of anterolateral ligament reconstruction (ALLR) to ACLR recently emerged as a potential solution

Introduction

➢ Combined ACLR and ALLR

- Studies have reported good clinical outcomes, including the pivot-shift test, graft failure rate, and patient-reported outcomes

Na et al. Orthop. J. Sports Med 2021
Mogos et al. Phys. Sportsmed 2023

- Improve anteroposterior and anterolateral rotational stability of the knee joint and reduce the risk of failure

Lai et al. Orthop. J. Sports Med 2023

- However, there is still controversy regarding functional outcomes, such as knee muscle strength, between combined ACLR and ALLR and isolated ACLR Therefore, to our knowledge, few studies have compared the functional outcomes of combined ACLR and ALLR versus isolated ACLR over time

Introduction

Purpose

- To compare the functional outcomes of combined ACLR and ALLR with those of isolated ACLR at four different time points (preoperatively and 3, 6, and 12 months postoperatively) up to 1 year following surgery

Hypothesis

- The functional outcomes would be superior with combined ACLR and ALLR versus isolated ACLR

Methods: prospective comparative study

Inclusion criteria

- A total of 250 patients who underwent primary ACLR using hamstring tendon autografts (2018-2021)

Exclusion criteria

- Bilateral ACL injury
- Revision
- ACLR using allograft
- Concomitant injury (meniscus, another ligmament)
- Kellgren–Lawrence grade > 1
- Incomplete medical data or loss to follow-up

24 combined ACLR and ALLR

VS.

26 isolated ACLR

- Muscle performance, proprioception, functional performance, and patient-reported outcomes (PROs)
- Preoperative and 3, 6, and 12 months postoperative

Methods: outcome measures

- **The strength of isokinetic knee extension/flexion**
  - Each test consisted of 15 repetitions of extension/flexion (ROM, 90° to 0°) for each leg at 180°/s
  - Resting time of 30 s between the tests
  - Flexor and extensor strengths were regarded as hamstring and quadriceps muscles strength, respectively

Lee et al. Sports Health 2021

- **Acceleration time(AT, msec)**
  - Time for attaing a pre-set angular velocity (180°/s for knee joint in our study) during maximal muscle contraction
  - Indicating the acceleration ability of the muscle
  - ✓ A fast AT was indicated greater muscle activation ability

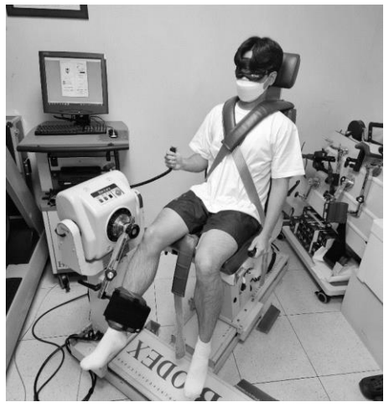
Lee et al. Sports Health 2021

Methods: outcome measures

- **Joint position sense**
  - The reproduction of passive positioning (RPP) to assess joint position sense
  - Target angle: 45° of knee
- ✓ Positive values indicate that the angle instructed by the patient exceeded the target angle

- **Dynamic postural stability**
  - Gradual progression platform
  - Level 12 (stable) ~ 1 (unstable)
  - Overall stability index (OSI)
- ✓ A lower stability index indicates good postural stability

Lee et al. PLoS One 2015



- **Limb Symmetry Index (LSI)**
  - Involved limb/uninvolved limb × 100%
  - Quad-LSI, Hams-LSI, and SLHD-LSI
- **Single-leg hop distance (SLHD)**
  - The average distances between the two trials were used

Ohji. J Exp Orthop 2021

- **Lysholm**
- **Tegner**
  - In particular, a patient with a Tegner Activity Scale score ≥ 6 is presumed to participate in strenuous knee sports

Zsidai et al, Br. J. Sports Med 2023

- **IKDC**
- **TSK-11 (kinesiophobia)-** fear of movement

ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Results: demographic

Table 1. Participants' demographic data by study group

	Combined ACLR and ALLR (n = 24)	Isolated ACLR (n = 26)	P value
Sex (male/female)	13/11	16/10	0.565
Age, years	29.4±16.2	31.5±13.5	0.095
Height, cm	174.2±8.1	177.0±7.5	0.898
Weight, kg	69.4±10.6	71.1±11.4	0.175
Body mass index, kg/m^2	25.8±4.3	27.1±2.8	0.112
Injured side, right/left	19/5	20/6	1.0
Dominant knee, right/left	21/3	24/2	0.661
Time from injury to surgery, days	40.7±31.2	29.7±9.8	0.094
Sports and activity, n, low/high	7/17	9/17	0.767
Preoperative pivot shift grade (0/1/2/3), n	0/0/8/16	0/1/10/15	0.185
Postoperative 1-year pivot shift grade (0/1/2/3), n	18/6/0/0	13/10/3/0	0.026

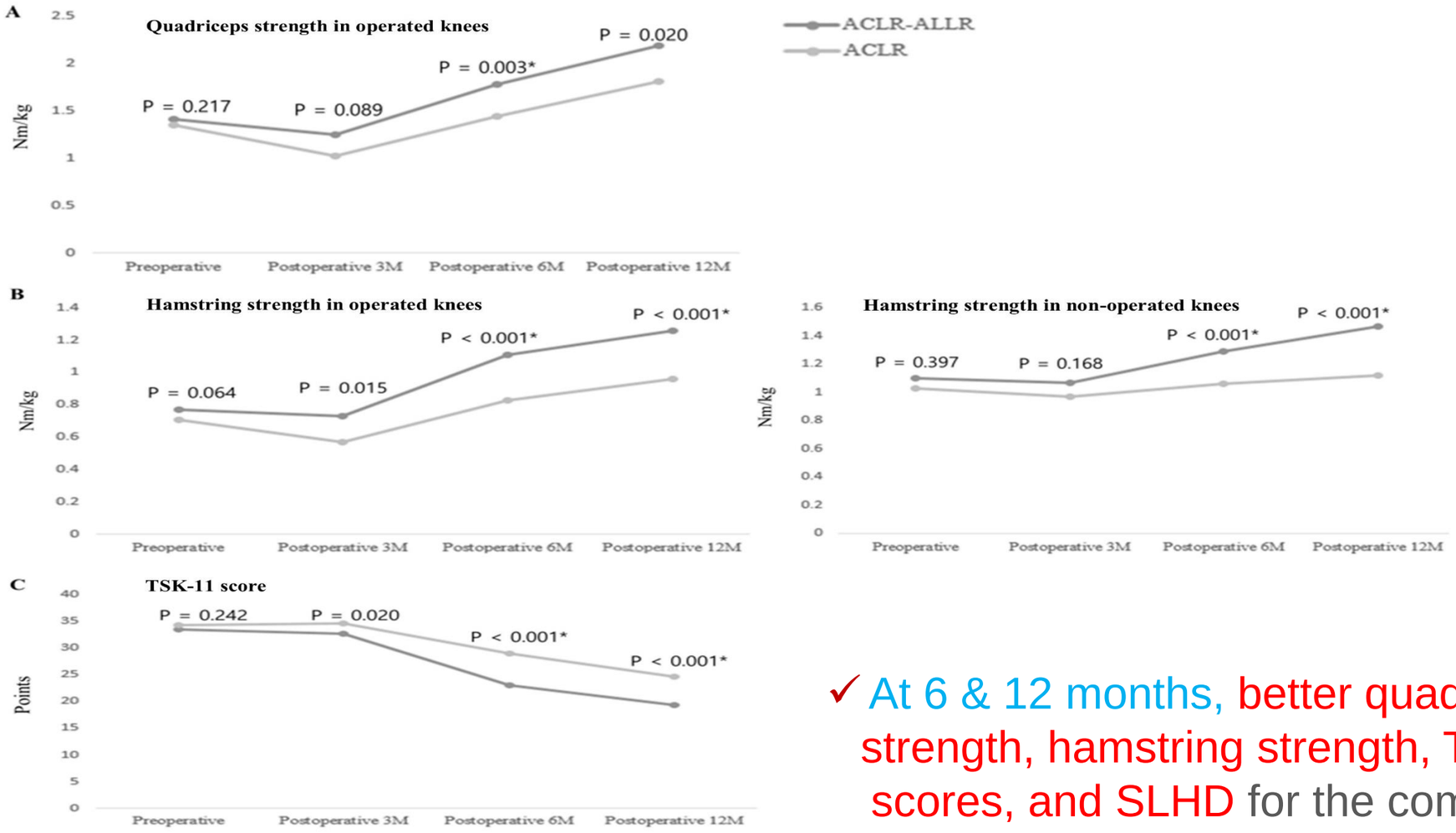
ACLR anterior cruciate ligament reconstruction; ALLR antero-lateral ligament reconstruction
Values are expressed as mean ± standard deviation or n as appropriate.

The pivot shift was graded as grade 0 (absent), grade 1 (glide), grade 2 (clunk), and grade 3 (gross).

ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

No significant differences

Results: post-hoc analysis (p <0.013)



✓ At 6 & 12 months, better quadriceps strength, hamstring strength, TSK-11 scores, and SLHD for the combined ACLR and ALLR group

ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Results: functional performance

Table S4. Comparative LSI and SLHD by study group using repeated-measures analysis of variance

Variable (operated side)	Time	Combined ACLR and ALLR Mean±SD	Isolated ACLR Mean±SD	Source	F	P[1] (η^2)	P[2] (post-hoc analysis)
LSI-quadriceps (%)	Pre	61.3±17.9	61.7±21.2	Group	3.541	0.066 (0.07)	
	Post 3M	53.7±20.4	51.4±18.8	Time	10.361	0.002 (0.18)	a
	Post 6M	78.1±14.8	73.2±20.5	Group × Time	1.393	0.244 (0.03)	
	Post 1Y	89.6±18.1	78.5±16.2				
LSI-hamstring (%)	Pre	70.1±16.2	69.3±14.8	Group	1.136	0.292 (0.02)	
	Post 3M	68.5±16.7	59.2±13.4	Time	3.681	0.061 (0.07)	a
	Post 6M	87.1±12.8	79.6±15.7	Group × Time	3.446	0.070 (0.07)	
	Post 1Y	88.2±12.8	87.2±15.0				
Single-leg hop distance (cm)	Pre	-	-	Group	5.583	0.022 (0.10)	a
	Post 3M	-	-	Time	19.117	<0.001 (0.29)	
	Post 6M	101.6±30.7	83.0±28.4	Group × Time	0.014	0.905 (0.01)	**0.022**[+]
	Post 1Y	115.5±29.6	96.2±32.6				**0.024**[+]

1Y, 1 year; 3M, 3 months; 6M, 6 months; ACLR, anterior cruciate ligament reconstruction; ALLR, anterolateral ligament reconstruction; LSI, Limb Symmetry Index; SD, standard deviation; SLHD, single-leg hop distance
P[1]: p-value of RM-ANOVA, $p < 0.05$
P[2]: p-value of post-hoc analysis. [+]p <0.025

ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

➢**RM-ANOVA**

- Significant group-by-time interactions were identified for LSI-Quad and LSI-SLHD

Results: multiple linear regressional

Table 9. Multiple linear regression analysis of predictors of the single leg hop distance of the operated knees

Dependent variable	Group	Independent variables	Unstandardized coefficients		Standardized coefficients	
			B	SE (B)	β	p-value
SLHD at POD 6M	Combined ACL with ALL reconstruction group	Hamstring strength	0.402	0.230	0.262	0.096
		LSI-quad	1.311	0.311	0.633	<0.001
	Isolated ACL reconstruction group	Hamstring strength	0.628	0.159	0.538	**0.001**
		LSI-quad	0.705	0.188	0.511	**0.001**
SLHD at POD 1Y	Combined ACL with ALL reconstruction group	Quadriceps strength	0.221	0.096	0.470	0.32
		Hamstring strength	0.055	0.284	0.041	0.849
		LSI-quad	0.694	0.276	0.425	**0.021**
	Isolated ACL reconstruction group	Quadriceps strength	0.139	0.125	0.211	0.280
		Hamstring strength	0.372	0.279	0.246	0.196
		LSI-quad	1.032	0.299	0.513	**0.002**

LSI, Limb-symmetry index, SLHD, single leg hop distance, ALL, antero-lateral ligament, ACLR anterior cruciate ligament reconstruction, POD, postoperative day.

- ✓ At 6 months, LSI-quad was independent predictor for SLHD in the combined ACLR and ALLR group, whereas hamstring strength and LSI-quad were independent predictor for SLHD in the isolated ACLR group
- ✓ At 12 months, only LSI-quad was independent predictor for SLHD in the combined ACLR and ALLR group and isolated ACLR group

Conclusion

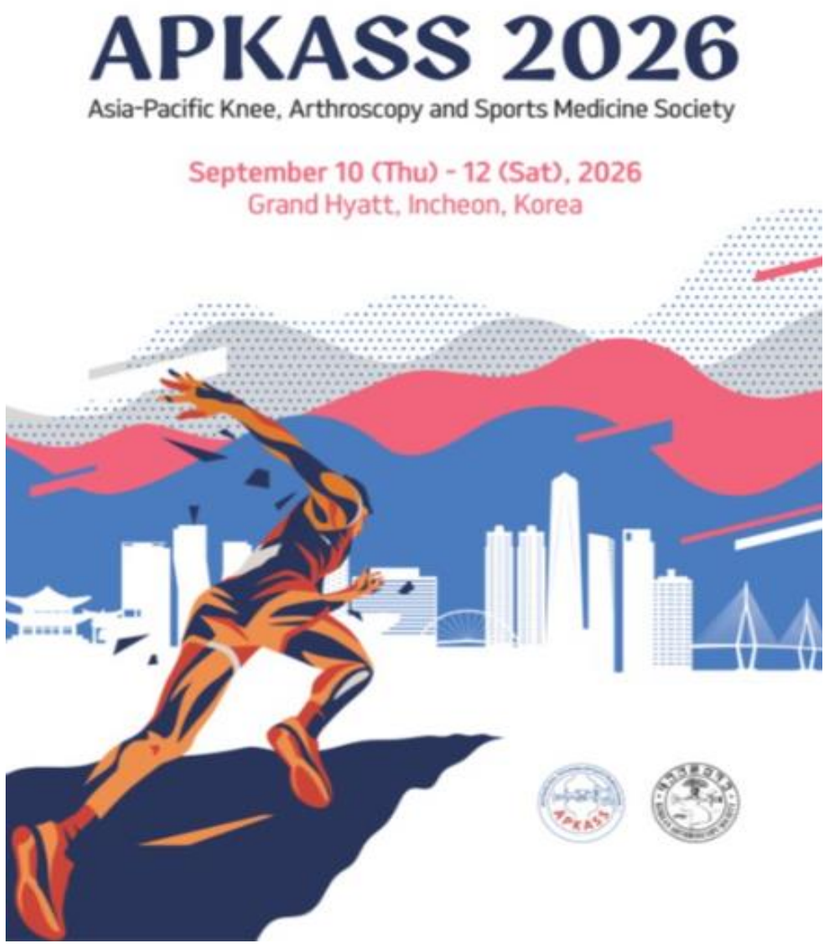
- The addition of ALLR to primary ACLR resulted in **better muscle performance, fear of movement, and functional performance** than isolated ACLR up to 1 year postoperative

- These results suggest that **additional ALLR** should be considered to improve knee function, stability, and fear of movement in **athletes or occupations requiring more dynamic knee stability**

References

1. Na, B. R., Kwak, W. K., Seo, H. Y. & Seon, J. K. Clinical outcomes of anterolateral ligament reconstruction or lateral extraarticular tenodesis combined with primary ACL reconstruction: A systematic review with meta-analysis. Orthop. J. Sports Med. 9, 23259671211023100. https:// doi. org/ 10. 1177/ 23259 67121 10230 99 (2021)
2. Mogos, Ș, Antonescu, D., Stoica, I. C. & D'Ambrosi, R. Superior rotational stability and lower re-ruptures rate after combined anterolateral and anterior cruciate ligament reconstruction compared to isolated anterior cruciate ligament reconstruction: A 2-year prospective randomized clinical trial. Phys. Sportsmed. 51, 371–378. https:// doi. org/ 10. 1080/ 00913 847. 2022. 21129 14 (2023)
3. Lai, S., Zhang, Z., Li, J. & Fu, W. L. Comparison of anterior cruciate ligament reconstruction with versus without anterolateral augmentation: A systematic review and meta-analysis of randomized controlled trials. Orthop. J. Sports Med. 11, 23259671221149404. https:// doi. org/ 10. 1177/ 23259 67122 11494 03 (2023)
4. Ohji, S. et al. Single-leg hop distance normalized to body height is associated with the return to sports after anterior cruciate ligament reconstruction. J. Exp. Orthop. 8, 26. https:// doi. org/ 10. 1186/ s40634- 021- 00344-z (2021)
5. Lee, D. H., Lee, J. H., Ahn, S. E. & Park, M. J. Effect of time after anterior cruciate ligament tears on proprioception and postural stability. PLoS One 10, e0139038. https:// doi. org/ 10. 1371/ journ al. pone. 01390 38 (2015)
6. Lee, J. H., Jang, K. M., Kim, E., Rhim, H. C. & Kim, H. D. Effects of static and dynamic stretching with strengthening exercises in patients with patellofemoral pain who have inflexible hamstrings: A randomized controlled trial. Sports Health 13, 49–56. https:// doi. org/ 10. 1177/ 19417 38120 932911 (2021)
7. Zsidai, B. et al. Generalised joint hypermobility leads to increased odds of sustaining a second ACL injury within 12 months of return to sport after ACL reconstruction. Br. J. Sports Med. 57, 972–978. https:// doi. org/ 10. 1136/ bjspo rts- 2022- 106183 (2023).

Thank you for your attention



ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11