ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Hamstring Autografts May Lead To Better Dynamic Postural Stability Than Tibialis Anterior Allografts Following Anterior Cruciate Ligament Reconstruction With Remnant Preservation: A Prospective Comparative Study With 1-Year Follow-Up

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Introduction

➢ Autograft

- **Bone-patellar tendon-bone tendon (BPTB)**
  - ease of harvesting and opportunity for bone-to-bone healing
  - anterior knee pain and donor-site morbidity

Delay et al. Am J Knee Surg 2001

- **Hamstring tendon (HS)**
  - satisfactory clinical outcomes
  - reduced anterior knee pain and kneeling discomfort, and less donor-site morbidity

He et al. Injury 2020

➢ Allograft

- **Tibialis anterior (TA) and achilles tendon**
  - shorter surgical time, improved cosmesis, and diverse graft options and sizes

Sherman & Banffy. Arthroscopy 2004
Cole et al. Arthroscopy 2005

Introduction

➢ Autograft *vs.* Allograft

- Some systematic reviews showed similar functional and patient-reported outcomes between autografts and nonirradiated allografts

Mariscalco et al. Am J Sports Med 2014
Zeng et al. Arthroscopy 2016

- Despite these findings, some of the less explored yet important clinical considerations for graft selection are knee muscle strength and neuromuscular control

- However,
- little is known regarding any difference in the muscle strength and recovery of neuromuscular control between HS tendon autografts and TA allografts

Purpose & Hypothesize

- This study aimed to compare knee muscle strength, neuromuscular control, and patient-reported outcomes between HS tendon autografts and TA allografts in patients undergoing ACLR with remnant preservation for >1 year

- We hypothesized that there would be differences in functional and patient-reported outcomes between HS tendon autografts and TA allografts

Methods: prospective comparative study

Inclusion criteria

- A total of 321 patients who underwent primary ACLR with remnant preservation using HS tendon autografts or irradiated TA allografts (2018-2021)

Exclusion criteria

- concomitant ligament rupture
- revision ACLR
- knee osteoarthritis (Kellgren-Lawrence grade >1)
- inability to undergo isokinetic and postural stability tests owing to pain or restricted motion of the knee joint
- vestibular and visual impairment or neurological dysfunction
- lack of functional and patient-reported outcome data
- pain, dysfunction, or history of previous surgery in the nonoperated knee
- loss to follow-up

35 HS tendon autografts

VS.

35 TA allografts

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. PLoS One 2015
Lee et al. Medicine 2019

- **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)

Lee et al. PLoS One 2015
Lee et al. Medicine 2019

- **Lysholm**
- **IKDC**
- Lower scores indicated more severe symptoms and poorer functioning level

Collins et al. Arthritis Care Res 2011

Results: demographic

Demographic Data[a]

	HS Tendon Autograft Group (n = 35)	TA Allograft Group (n = 35)	*P*
Sex, male/female, n	21/14	19/16	.63
Age, y, mean ± SD (range)	32.5 ± 11.5 (20-60)	37.1 ± 11.1 (23-58)	.10
Height, cm	171.6 ± 7.5	171.8 ± 9.1	.90
Weight, kg	72.9 ± 12.6	77.1 ± 13.4	.20
Body mass index, kg/m^2	24.7 ± 3.4	26.0 ± 3.8	.11
Injured side, right/left, n	25/10	22/13	.45
Dominant knee, right/left, n	31/4	29/6	.31
Concomitant meniscal injury, n			.80
MM repair	13	12	
LM repair	7	3	
MM + LM repair	1	2	
Medial meniscectomy	0	1	
Lateral meniscectomy	1	3	
Medial + lateral meniscectomy	0	2	
Sports and activity, low:high, n	8:27	10:25	.58

[a]Data are presented as mean ± SD unless otherwise indicated. HS, hamstring; LM, lateral meniscus; MM, medial meniscus; TA, tibialis anterior.

No significant differences

Results: comparative LSI outcomes

Variable	Time	Autograft Mean ± SD	Allograft Mean ± SD	Source	*F*	*P*
Quadriceps LSI, %	Pre	61.4 ± 10.1	55.6 ± 15.5	Group	0.023	.88
	Post, 6 mo	64.4 ± 23.5	70.9 ± 20.9	Time	29.603	.001
	Post, 12 mo	80.3 ± 20.0	81.5 ± 25.6	Group × time	2.211	.12
HS LSI, %	Pre	66.5 ± 34.7	64.2 ± 21.1	Group	0.882	.35
	Post, 6 mo	77.6 ± 16.7	85.3 ± 16.7	Time	33.815	.001
	Post, 12 mo	89.4 ± 17.0	94.8 ± 17.9	Group × time	1.257	.28
HS LSI in deep knee flexion, %	Pre	66.2 ± 11.3	63.8 ± 20.0	Group	0.068	.57
	Post, 6 mo	78.3 ± 18.6	81.3 ± 21.1	Time	25.113	.001
	Post, 12 mo	90.7 ± 17.6	93.5 ± 20.1	Group × time	3.832	.08

[a]HS, hamstring; LSI, limb symmetry index; Post, postoperative; Pre, preoperative.

- **Did not show any significant interactions** between time and graft in terms of quadriceps strength and LSI

Results: comparative neuromuscular control

Variable	Time	HS Tendon Autograft Mean ± SD	TA Allograft Mean ± SD	Source	*F*	*P*
RPP, deg	Pre	–2.4 ± 9.9	–1.9 ± 9.1	Group	0.71	.40
	Post, 6 mo	–0.8 ± 5.0	–4.7 ± 9.3	Time	2.60	.08
	Post, 12 mo	–0.6 ± 4.3	0.1 ± 2.4	Group × time	2.50	.09
OSI, deg	Pre	2.9 ± 1.2	2.7 ± 1.1	Group	0.31	.58
	Post, 6 mo	2.5 ± 0.8	2.4 ± 0.9	Time	5.81	.004
	Post, 12 mo	2.1 ± 0.8	2.7 ± 1.0	Group × time	5.08	.007

[a]ACLR, anterior cruciate ligament reconstruction; HS, hamstring; OSI, overall stability index; Post, postoperative; Pre, preoperative; RPP, reproduction of passive positioning; TA, tibialis anterior.

- OSI was significantly greater in the allograft group than that of the autograft group **at 12 months**, indicating **better dynamic postural stability in the autograft group**

Results: comparative PRO

Variable	Time	HS Tendon Autograft Mean ± SD	TA Allograft Mean ± SD	Source	*F*	*P*
Lysholm, %	Pre	54.4 ± 19.7	56.6 ± 19.9	Group	0.72	.40
	Post, 6 mo	73.2 ± 18.4	74.2 ± 11.8	Time	66.02	<.001
	Post, 12 mo	75.9 ± 14.8	80.5 ± 12.1	Group × time	0.41	.63
IKDC, %	Pre	51.5 ± 15.4	51.4 ± 17.3	Group	0.67	.42
	Post, 6 mo	66.9 ± 14.8	70.0 ± 13.6	Time	68.66	<.001
	Post, 12 mo	72.8 ± 17.4	77.2 ± 16.1	Group × time	0.62	.49

[a]ACLR, anterior cruciate ligament reconstruction; HS, hamstring; IKDC International Knee Documentation Committee; Post, postoperative; Pre, preoperative; PRO, patient-reported outcome; TA, tibialis anterior.

- **No significant interaction** was observed between time and graft in Lysholm and IKDC

Conclusion

- Our study demonstrated no significant differences in knee muscle strength or patient-reported outcomes between HS tendon autografts and TA allografts after ACLR with remnant preservation for up to 1 year except for dynamic postural stability favoring HS tendon autografts

- However, whether this difference in dynamic postural stability translates into other clinical outcomes, such as return to sports, reinjury rate, or knee function, in the long term should be further investigated

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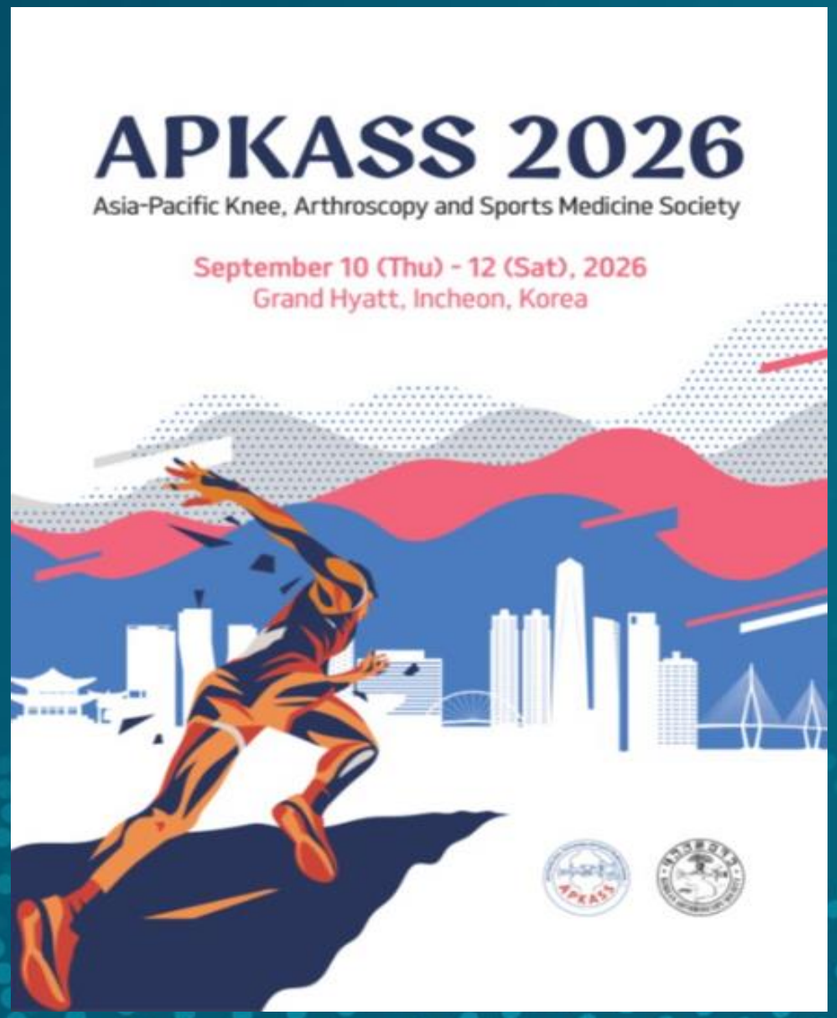
Thank you for your attention



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