Revision Anterior Cruciate Ligament Reconstruction using Reharvested Ipsilateral Quadriceps Tendon Autograft

College of Human Medicine
MICHIGAN STATE UNIVERSITY

College of Osteopathic Medicine
MICHIGAN STATE UNIVERSITY

Joshua Prabhu[1], Charles Woodhams[1], Adam Haddad[1], Victoria Vespa[1], Ari Paa[1], Matthew Holen[2,3], DO, Dr. Micah Lissy[1,2,3], MD, MS PT, ATC, CSCS

Michigan State College of Human Medicine[1], Michigan State College of Osteopathic Medicine[2], Michigan State University Health Care Sports Medicine[3]

SPARTAN SPORTS MEDICINE SSMORG ORTHOPEDIC RESEARCH GROUP

Background

Context: Quadriceps tendon (QT) autograft utilization in primary ACL reconstruction (ACLR) is rising due to favorable biomechanical properties, predictable size, and low donor-site morbidity.

Problem: Revision ACLR is complex due to altered anatomy, compromised bone stock, and limited autograft availability.

Current Practice Gaps:

- Allografts in young, active patients carry up to a 2x higher risk of rerupture compared to autografts.
- Harvesting contralateral or alternative autografts (bone–patellar tendon–bone (BPTB)/hamstring) introduces donor-site morbidity to previously uninjured tissues.

Precedent & Concept:

- Reharvesting BPTB autografts has shown success when guided by preoperative MRI.
- QT donor sites undergo substantial remodeling and structural regeneration post-harvest, yet ipsilateral QT reharvest has not been previously reported.

Objective: Present the first clinical report of a successful revision ACLR utilizing an ipsilateral reharvested QT autograft guided by preoperative MRI donor-site evaluation.

Case Presentation

Patient Profile: 23-year-old female soccer player.

Surgical History: Left ACLR using ipsilateral QT autograft and medial meniscus repair (September 2023).

Injury Mechanism: Non-contact twisting injury and popping sensation during a 45° cutting maneuver while playing soccer (April 2025).

Presenting Symptoms: Persistent left knee pain, swelling, mechanical symptoms, and subjective instability during ambulation.

Physical Examination:

- **Gait & Alignment:** Nonantalgic gait; mild knee joint effusion.
- **Stability:** Positive Grade II B Lachman test; positive Grade II B Anterior Drawer test; positive McMurray test medially.
- **Preserved:** Varus, valgus, and posterior drawer stability intact.

Preoperative Imaging:

- **ACL Graft:** Insufficient, wavy contour, rotationally incompetent.
- **Donor Site:** Regenerated QT with preserved continuity and 9 mm residual thickness, signaling feasibility for repeat harvest.

Intervention

Table 1. Surgical Intervention Summary

Procedure Phase	Intraoperative Findings	Surgical Technique
Joint Inspection	Rotationally incompetent primary graft; displaced bucket-handle medial meniscus tear.	Meniscus repair (inside-out + all-inside); hardware removal; notchplasty.
QT Reharvest	Preserved tendon continuity, adequate bulk, no residual suture material.	Reharvested 7-cm QT autograft via prior incision; preserved joint capsule.
Reconstruction	Retrodrilled revision sockets: Femur (10.5×25 mm), Tibia (9.5×30 mm).	Bio-ACLR with internal brace (pretensioned to 20 N); ALLR with gracilis allograft.

Table 2. Postoperative Outcomes and Return to Sport Testing

Outcome Category	Metric / Variable	9-Month Follow-Up	12-Month Follow-Up	Clinical Interpretation
Quadriceps Strength	Peak Force (N)	311.4 (L) / 553.8 (R)	348.0 (L) / 612.0 (R)	Persistent quad strength deficit relative to uninjured limb; normalized torque/BW improved internally.
	Peak Torque (Nm)	121.4 (L) / 216.0 (R)	131.9 (L) / 231.9 (R)	
	Torque / Body Weight (Nm/kg)	1.79 (L) / 3.17 (R)	2.08 (L) / 3.65 (R)	
	Limb Symmetry Index (LSI)	56.2%	56.9%	
Hamstring Strength	Peak Force (N)	182.4 (L) / 184.6 (R)	132.0 (L) / 136.0 (R)	Symmetric hamstring strength restored.
	Limb Symmetry Index (LSI)	98.8%	97.1%	
Functional Hop Testing	Single-Leg Hop	—	1.22 m (L) / 1.41 m (R) (86.9% LSI)	Near-symmetric functional performance achieved.
	Triple Hop	—	3.49 m (L) / 3.85 m (R) (90.8% LSI)	
	Y-Balance Composite	—	58.0 (L) / 69.3 (R) (83.7% LSI)	
Patient-Reported Outcomes	LEFS (max 80)	—	74.0	High subjective function and psychological readiness.
	ACL-RSI (max 100)	—	85.4 (Confidence: 85.0, Risk: 92.5)	

Discussion

Proof of Concept: Demonstrates that the ipsilateral quadriceps tendon possesses sufficient regenerative capacity to serve as a high-quality autograft source in revision ACLR.

Value of Preoperative MRI:

- MRI accurately depicted donor-site structural continuity and tissue thickness (~9 mm), which correlated directly with intraoperative surgical suitability.
- Establishes a non-invasive protocol to screen donor-site viability before committing to reharvest.

Clinical Decision-Making:

- Avoids allograft usage in young, active patients, mitigating elevated revision and failure risks.
- Prevents donor-site morbidity on the uninjured contralateral limb or secondary extensor/flexor structures.

Strength vs. Function Dissociation:
Despite near-symmetric functional hop performance (LSI 87–91%) and high psychological readiness (ACL-RSI 85.4), **isokinetic quad strength remained markedly low (LSI ~57%)**.
Highlights that functional hop tests can mask true quadriceps deficits; strength recovery remains the primary rate-limiting factor for full return-to-sport clearance.

Conclusion

- Ipsilateral QT reharvest is a viable, high-quality autograft option for select revision ACLR cases.
- Preoperative MRI is an essential non-invasive tool to confirm donor-site tendon continuity and thickness prior to reharvest.
- Reharvesting preserves other primary autograft options and eliminates allograft-associated failure risks in active patients.
- Persistent quadriceps strength deficits require close postoperative monitoring; functional hop testing alone is insufficient to clear patients for unrestricted return to sport.

Future Directions: Larger, long-term cohort studies are needed to establish standardized selection criteria, donor-site thickness thresholds, and long-term functional recovery profiles.