ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Loss of knee extension following anterior cruciate ligament reconstruction with quadriceps tendon autograft

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UPMC LIFE CHANGING MEDICINE

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Disclosures

- I have no financial conflicts of interest to disclose

Background and Purpose

- Loss of knee extension (LOE) is a common complication following ACLR[1]
- Well described risk factors include female sex, concomitant meniscal repair, poor preoperative motion, and early surgery[1-3]
- QT autograft may increase the risk for postoperative LOE, possibly related to larger graft diameter[4]

Purpose:

Investigate the association between postoperative LOE following primary QT autograft ACLR and QT autograft diameter, notch volume, and other risk factors

Methods – Study Population

- Retrospective review: primary QT autograft ACLR
- Single healthcare institution (2014-2021)
- 7 orthopaedic surgeons fellowship trained in sports medicine

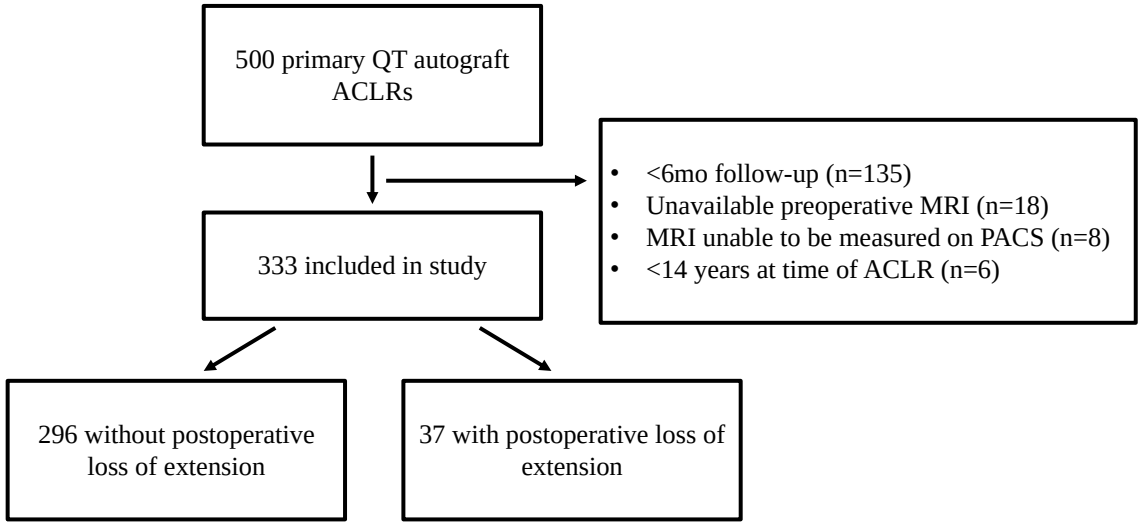
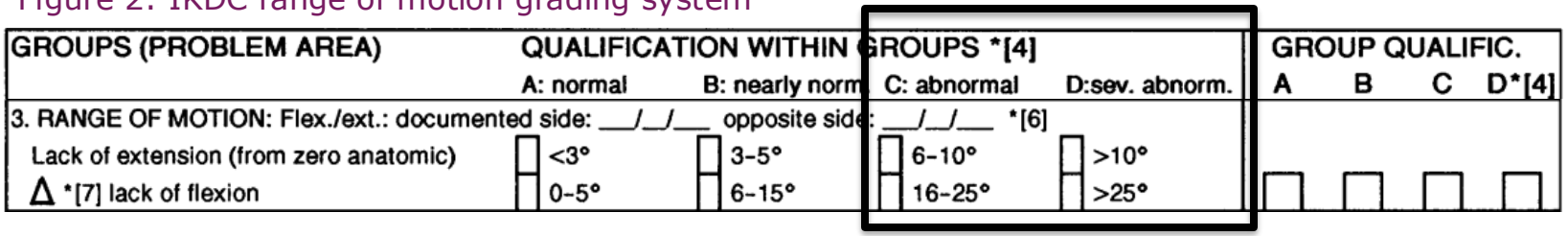


Figure 1: Study flow chart

Methods – Outcomes

- Primary outcome: postoperative LOE (IKDC criteria)[5]
  - **>5°** LOE compared to contralateral knee (IKDC C or D)
    - Extension deficits observed between **3-12mo** postoperatively
  - Undergoing subsequent surgery for LOE (cyclops debridement/scar tissue debridement/manipulation under anesthesia)

Figure 2: IKDC range of motion grading system



GROUPS (PROBLEM AREA)	QUALIFICATION WITHIN GROUPS *[4]				GROUP QUALIFIC.			
	A: normal	B: nearly norm	C: abnormal	D:sev. abnorm.	A	B	C	D*[4]
3. RANGE OF MOTION: Flex./ext.: documented side: ___/__/___ opposite side: ___/__/___ *[6]								
Lack of extension (from zero anatomic)	<3°	3-5°	6-10°	>10°				
Δ *[7] lack of flexion	0-5°	6-15°	16-25°	>25°				

Methods – Variables

- Demographics
- Preoperative extension
- Graft diameter
    - Average of tibial and femoral tunnel diameter (op report)
- Notch volume (MRI)[6]
    - 2 observers
    - ICC 0.93-0.98

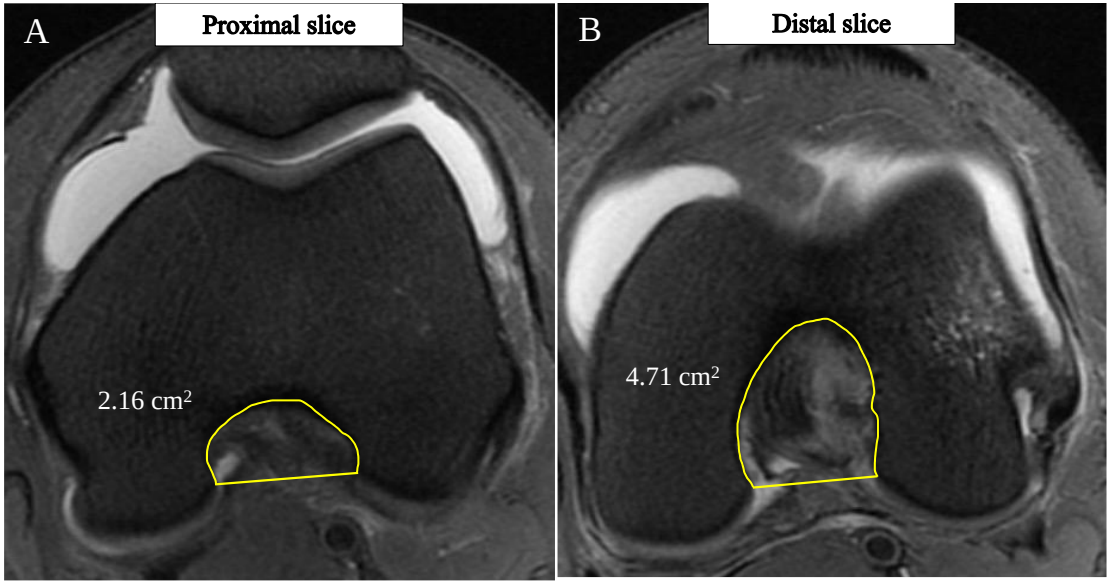


Figure 3: Notch volume measurement in subsequent axial cuts on MRI

Results

- 333 patients included
  - Mean age 22.8 ± 7.7yrs
  - 45% female
  - Mean 1.6yrs follow-up
- 11% (n=37) postoperative LOE
  - 70% of which underwent surgery (n=26/37)

Table 1: Baseline characteristics

	No postoperative loss of extension (n=296)	Postoperative loss of extension (n=37)	P value
Demographics			
Age at time of ACLR (years)	23.0 ± 7.9	21.4 ± 6.0	0.43
Female sex, n (%)	130 (44)	21 (57)	0.14
BMI (kg/m^2) (n=330)	25 ± 5	26 ± 4	0.60
Mean follow-up in years	1.5 ± 1.3	2.0 ± 1.6	0.04*
Surgical timing			
Time from injury to ACLR in years, median (IQR) (n=324)	0.1 (0.1 – 0.2)	0.1 (0.1 – 0.3)	0.59
ACLR within 0.1 years (6 weeks) after injury, n (%) (n=324)	145 (51)	21 (57)	0.48
Concomitant meniscus procedures			
Concomitant meniscus pathology present, n (%)			
Any meniscus surgery	185 (63)	24 (65)	0.78
Any meniscus repair	149 (50)	20 (54)	0.67
Lateral meniscus repair	77 (26)	12 (32)	0.41
Medial meniscus repair	102 (35)	12 (32)	0.81
Any meniscectomy	36 (12)	4 (11)	1.00
Lateral meniscectomy	37 (13)	5 (14)	1.00
Medial meniscectomy	14 (5)	1 (3)	0.71

Results

- No statistically significant differences in graft diameter or notch volume

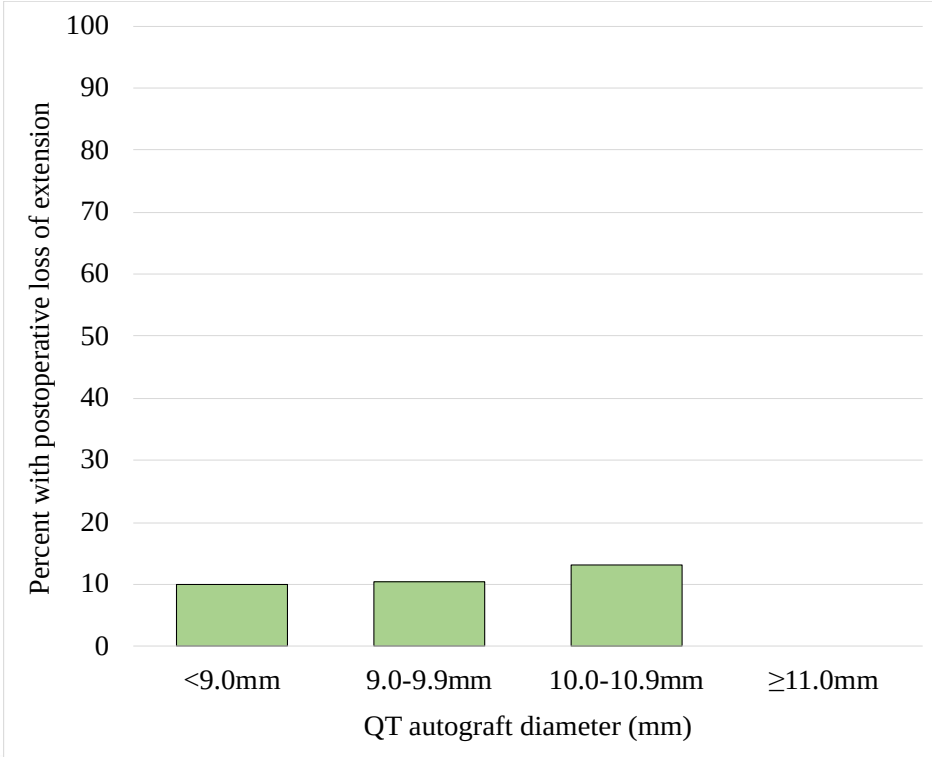
Table 2: QT autograft diameter, notch volume

	No postoperative loss of extension (n=296)	Postoperative loss of extension (n=37)	P value
Tunnel diameters (mm)			
Femoral tunnel (n=320)	9.5 ± 0.8	9.5 ± 0.6	0.99
Tibial tunnel (n=308)	9.7 ± 0.7	9.6 ± 0.6	0.40
Quadriceps tendon ACL graft			
QT autograft diameter (mm) (n=330)	9.6 ± 0.7	9.5 ± 0.6	0.81
QT autograft diameter ≥10mm, n (%) (n=330)	147 (50)	20 (54)	0.66
Harvest with patellar bone block, n (%)	23 (8)	5 (14)	0.34
Notch measurements			
Notch volume (cm^3)	6.5 ± 1.8	6.3 ± 1.5	0.70
Ratio of QT autograft diameter : notch volume (mm/mm^3) (n=326)	1.6 ± 0.5	1.6 ± 0.4	0.75

Results

- No statistically significant differences in LOE between QT diameter groups (P=0.51)

Figure 4: Loss of extension grouped by QT autograft diameter



Results

- No statistically significant differences in extension between QT autograft <10mm vs ≥10mm
- Preoperative lack of terminal extension (0°) only factor associated with postoperative LOE
    - OR 2.23, P=0.03
    - (95% CI 1.10-4.50)

Table 3: Preoperative and postoperative extension

	QT autograft diameter <10mm (n=163)	QT autograft diameter ≥10mm (n=167)	P value
Preoperative			
Initial presentation			
ROM (n=317)			
Extension (degrees)	3 ± 6	2 ± 5	0.62
Lack of terminal extension (>0°) (n=317)	70 (45)	68 (42)	0.64
Postoperative			
2-4 months			
ROM (n=274)			
Extension (degrees)	1 ± 3	1 ± 3	0.99
Lack of terminal extension (>0°) (n=274)	29 (21)	30 (22)	0.88
5-8 months			
ROM (n=264)			
Extension (degrees)	0 ± 2	0 ± 3	0.71
Lack of terminal extension (>0°) (n=264)	24 (19)	23 (17)	0.78
≥9 months			
ROM (n=219)			
Extension (degrees)	0 ± 3	-1 ± 3	0.95
Lack of terminal extension (>0°) (n=219)	11 (10)	12 (11)	0.81

Discussion and Limitations

- No association between QT autograft diameter, notch volume, and LOE following primary QT autograft ACLR
- 11% overall rate of LOE, 70% of which underwent surgery
- Preoperative lack of terminal extension only factor associated with postoperative LOE
- Other reasons for LOE following QT autograft ACLR should be explored
- LOE should be closely and carefully monitored in the early postoperative phase
- Patient education, pre-and perioperatively important
- Limitations
    - Retrospective design
    - Limited standardization of surgical technique/rehabilitation protocols

Conclusion

- 11% of patients undergoing primary QT autograft ACLR experienced >5° LOE postoperatively
- QT autograft diameter and notch volume were not associated with LOE
- Surgeons may consider the preoperative lack of terminal extension as a risk factor for postoperative LOE (OR 2.23)

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