

Factors Associated with Knee Extension Strength Symmetry Following Anterior Cruciate Ligament Reconstruction with Quadriceps Tendon Autograft

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Background

- Quadriceps weakness often occurs in the postoperative period after anterior cruciate ligament reconstruction (ACLR) with quadriceps tendon (QT) autograft^{1, 2}
- Factors that influence restoration of knee extensor strength following ACLR with other autografts have been described^{3,4}
- Given the increased utilization of QT ACLR, understanding the factors that influence restoration of extensor strength is warranted

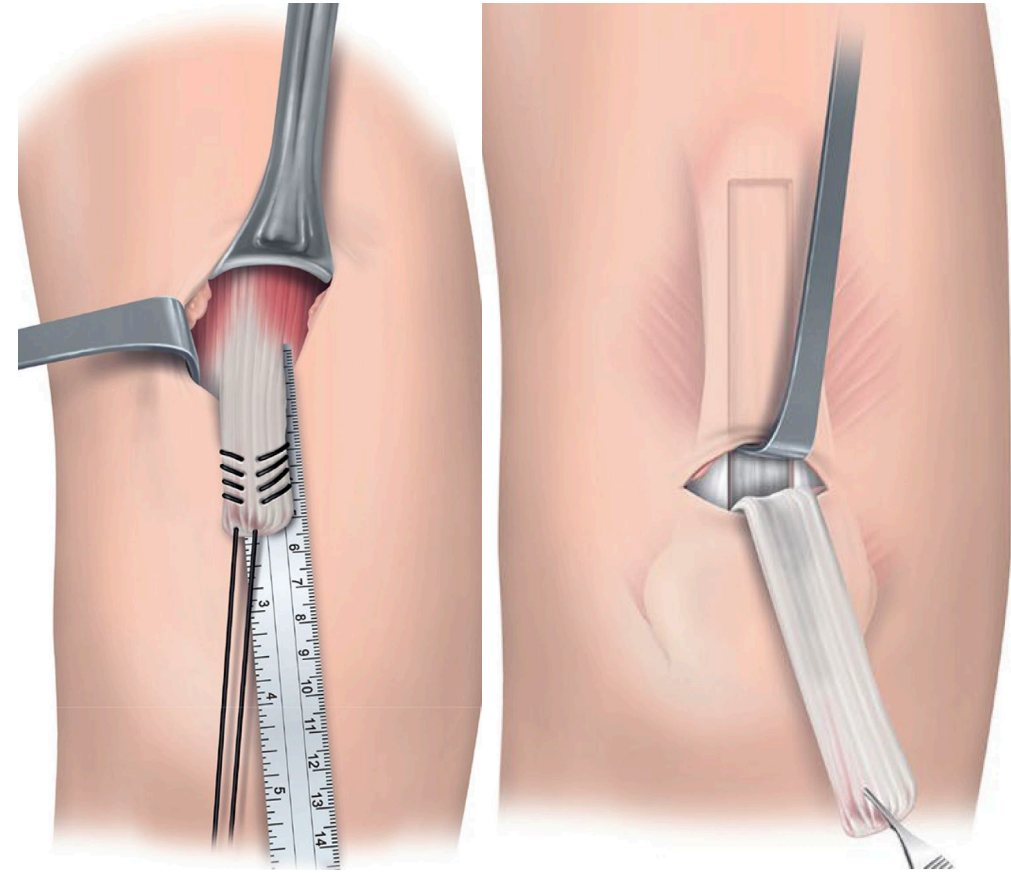


Figure 1. QT autograft harvest⁵. Advantages of QT autografts include low retear rate and favorable donor site morbidity profile⁶.

Study Aim

- Identify factors associated with return of knee extensor strength symmetry following ACL Reconstruction with QT autograft

Hypothesis

- Factors from patient, surgical, rehabilitation, and preoperative patient reported outcome measure (PRO) domains would be associated with postoperative knee extensor limb symmetry index (LSI)

Methods

Study Design

- Retrospective review of patients undergoing primary QT ACLR at a single institution between 2010-2021

Inclusion Criteria

- ≥ 1 dynamometer testing ≥ 6 months post-op

Exclusion Criteria

- Revision ACLR, < 6 months follow-up, concomitant procedures (e.g., osteotomy, cartilage restoration) or multi-ligamentous injury

Methods (continued)

Data Collection and Analysis

- Knee extensor LSI was calculated by comparing ratio of knee extension peak torque between operative and nonoperative extremities
- Univariable and multivariable analysis identified associations ($p < 0.15$) between domains and variables with LSI (entire cohort analysis and subset analysis with complete PROs performed)

| Patient Domain | Surgical Domain | Rehabilitation Domain | Preop PRO Domain [†] |
|--|--|---|---|
| <ul style="list-style-type: none">• Sex• Age at surgery• Time to surgery• BMI• Sport level• Laterality• Cartilage lesion | <ul style="list-style-type: none">• Graft width• Graft length• Graft thickness• Femoral tunnel diameter• Tibial tunnel diameter• Tourniquet time• Meniscus surgery• Regional anesthesia | <ul style="list-style-type: none">• Preop rehab• Postop blood flow restriction therapy | <ul style="list-style-type: none">• VAS• PROMIS Mental• PROMIS Physical• Marx• IKDC |

Figure 2. Factors Analyzed for Association with Knee Extensor LSI by Domain

[†]Evaluated for the subset of 60 patients with complete preop PRO data collection

Results

- 107 patients were included
 - 58 [54%] males, mean age: 22.8 ± 7.4 years
 - 81 [76%] partial thickness QT autografts, mean length: 74.4mm
- Mean knee extensor LSI was 0.82 ± 0.18 at mean 7.5 ± 2.0 months post-op
- 35 (33%) patients demonstrated $LSI \geq 0.90$
- No associations identified in rehabilitation domains
- Positive associations identified in patient and surgical domains

Results (continued)

- Female sex, older age, and increased QT graft width associated with lower extensor LSI in the entire cohort analysis (Table 1)

Table 1. Multivariable Analysis of Entire Cohort Factors Associated with Extensor LSI

| <u>Factor</u> | <u>Estimate (SE)</u> | <u>p-value</u> |
|----------------|----------------------|----------------|
| Female sex | -0.12 (0.032) | 0.0004 |
| Age at surgery | -0.01 (0.002) | 0.018 |
| Graft width | -0.049 (0.025) | 0.053 |

Statistical significance $p < 0.15$

Results (continued)

- Subset PRO univariable analysis identified association with IKDC
- Multivariable model identified female sex and older age as factors associated with decreased LSI

Table 2. Multivariable Analysis of Factors Associated with Extensor LSI in Cohort with PROs

| <u>Factor</u> | <u>Estimate (SE)</u> | <u>p-value</u> |
|------------------|----------------------|----------------|
| Female sex | -0.15 (0.040) | 0.001 |
| Age at surgery | -0.01 (0.003) | 0.011 |
| Graft width | -0.05 (0.032) | 0.168 |
| Preop IKDC score | 0.001 (0.001) | 0.515 |

Statistical significance $p < 0.15$

Conclusion

- Female sex, older age at surgery, and larger QT autograft harvest width were associated with decreased knee extensor LSI after QT ACLR
- No other factors from the patient and surgical domains were associated with extensor LSI and there were no associations seen in the PRO and rehab domains

Clinical Significance

The associations found in this study are important to consider in order to optimize clinical outcomes following QT ACLR and may be relevant to improving pre- and post-operative rehabilitation strategies.

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