OKLAHOMA STATE UNIVERSITY/ATHLETIC TRAINING

Does the Quadriceps Tendon Graft for ACL Repair Produce Similar Quadriceps Strength Measures Compared to Hamstring Tendon Graft? A Critically Appraised Topic

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INTRODUCTION

Anterior cruciate ligament (ACL) ruptures are one of the most common and one of the most challenging injuries to manage in competitive sports. It is estimated that 100,000 to 250,000 ACL injuries occur per year.[3] Return of quadriceps strength is highly correlated with returning to pre-injury competitive levels of athletic performance and may decrease the likelihood of subsequent knee ligament injury[4,5,9,10,11]. The hamstring tendon (HT) graft is often cited as a favorable choice for ACL repair because it spares the knee extensor mechanism. Conversely, one of the concerns surrounding the quadriceps tendon (QT) graft, a graft choice which has recently become more popular, is the recovery of the knee extensor mechanism and subsequent quadriceps strength.

OBJECTIVES

The purpose of this critically appraised topic is to determine if the QT graft is an effective choice for ACL repair compared to HT graft with regards to recovery of quadriceps strength in patients undergoing primary ACL reconstruction.

METHODS

Search Strategy
- Quadriceps tendon
- Hamstring Tendon
- Graft
- Anterior Cruciate Ligament
- Reconstruction
- Quadriceps Strength

Databases searched
- *EBSCO*
- *PubMed*
- *GoogleScholar*
- *SPORTDiscus*
- *TripResearch*
- *PEDro*

Inclusion Criteria
- Compare QT graft to HT graft
- Utilize a measure of quadriceps strength
- Patients sustained only a primary, unilateral ACL injury (concomitant injury of meniscus acceptable)
- Must have been completed in the last 10 years (2009-2019)
- Must be in the English language

Exclusion Criteria
- There was no HT graft comparison
- There was no measure of quadriceps strength
- Included patients had multi-ligament injuries or other knee pathology
- Patients underwent ACL revision surgery
- Grafts were allografts instead of autografts
- Studies were conducted before 2009
- Studies were not written in the English language

RESULTS

Study Authors	Fischer et. al.[2]	Cavaignac et. al. [1]	Lee et. al.[7]	Martin-Alguacil et. al.[8]	Iriuchishima et. al[6]
Participants	124 pts 61 QT - avg age 21.7 (14-56) - 34 male, 27 female - Time to test 1: avg 5.6 mo (3.5-8.3) - Time to test 2: avg 7.8 mo (5.9-12.7) 63 HT - avg age 21.5 (11-41) - 47 male, 17 female - Time to test 1: avg 5.4 mo (3-9.4) Time to test 2: avg 7.5 mo (4.8-15)	86pts 45 QT - avg age 32.1 - BMI 22.4 - 55 Male/ 45 female - Follow up 3.4 - Time between injury and surgery 10.2 HT 41 - Avg age 30.9 - BMI 24.3 - 58 Male/ 42 female - Follow up 3.8 - Time between injury and surgery 11.9	96pts 48 HT - Age 29.9 (17-58) - 44 Male 4 Female - 26 R 22 L - Height, cm 173.5 - Weight, kg 74.8 - BMI, kg/m^2 24.8 - Duration of follow up 24-61 (34.1) 48 QT - Age 31.1 (17-57) - 44 Male 4 Female - 29 R 29 L - Height, cm 174.4 - Weight, kg 76.6 - BMI, kg/m^2 25.1 - Duration of follow up 24-61 (35.6)	56 consecutive patients enrolled from Andulusian Matuality of soccer players (Spain) 26 QT (19 at 24 mo follow up) - Age 18.7 - 23 male 3 female - 12 right 14 left - BMI 23 - Time playing (yrs) 10.1 25 HT (17at 24 mo follow up) - 19.2 yo avg - 16 male 9 female - 13 right 12 female - BMI 23.5 - Time playing 10.2	20 subjects - 2 males 18 females - avg age 49yo
Interventions	Standardized rehab protocol Isokinetic testing w/ standardized protocol at 60dg/s Peak extensor torques recorded	Graft chosen depending on treating surgeon All pts underwent same rehab regiment via provided booklet Isokinetic testing w/ standardized protocol at 90dg/s Peak extensor torque recorded	Standardized rehab protocol Minimum of 2 yr follow up Isokinetic testing at 60dg/s and 180dg/s at 1 yr and 2 yr	Supervised rehab protocol, criteria based Isokinetic testing w/ standardized protocol at 60dg/s, 180 dg/s, and 300dg/s	Measurements taken pre-op, 3 mo, 6 mo, 9 mo, 12 mo Compared QT measurements to average HT metrics
Inclusion/Exclusion Criteria	All inclusion criteria met No exclusion criteria found in study	All inclusion criteria met No exclusion criteria found in study	All inclusion criteria met No exclusion criteria found in study	All inclusion criteria met No exclusion criteria found in study	All inclusion criteria met No exclusion criteria found in study
Outcome Measures	Peak extensor torque of QT significantly lower than HT at test 1 (P<0.01) (QT 123.9 +/- 40.2, HT 144.3 +/- 40.7) and at test 2 (P<0.05) (QT 150.2 +/- 43.2, HT 167.9 +/- 43.2) Knee Extension – main effect found for time (p<0.001) and graft (p=0.05)	Knee extension isokinetic strength at 90dg/s - Extension: QT 26.3 +/-11.3, HT 23.1+/-12.6 (P=0.61)	Knee ext isokinetic testing 60dg/s - 1yr HT 73.9 +/-26.0, QT 71.9 +/- 24.4, (P=.749) - 2yr HT 82.9 +/-25.0, QT 81.0 +/- 17.7, (P=.714) 180 dg/s - 1yr HT 78.5 +/-27.5, QT 73.5 +/- 25.1, (P=.462) - 2 yr HT 85.1 +/- 27.5, QT 83.8 +/- 17.8, (P=.809)	Knee ext isokinetic testing 60dg/s - Pre: Ext QT 110.4 +/-36.4, HT 104.3+/-40.1 - 3 mo: Ext QT 85.2+/-40.1, HT 118.4+/-45.3 - 6 mo: Ext QT 125.7+/-40.3, HT139.9+/-47.9 - 12 mo: Ext QT 139.5+/-47.3, HT 144.94+/-51.4 180dg/s - Pre: Ext QT 93.4+/-24.1, HT 88.5+/-27.5 - 3 mo: Ext QT 71.7+/-27.6, HT 98.6+/-32.5 - 6 mo: Ext QT 104.0+/-29.1, HT 113.6+/-32.3 - 12 mo: Ext QT 115.6+/-33.2, HT 114.7+/-32.9 300dg/s - Pre: Ext QT 69.0+/-15.6, HT 67.4+/-23.3 - 3 mo: Ext QT 58.7+/-19.3, HT 75.8+/-24.6 - 6 mo: Ext QT 81.5+/-19.7, HT 84.6+/-22.4 - 12 mo: Ext QT 87.0+/-21.3, HT 82.0+/-19.9	Knee ext isometric (90dg) testing - Pre: 90.5 +/-19, HT 99.5+/-13.7(P>0.05) - 3 mo: 67.8+/-21.4, HT 78.7+/-11.4 (P<0.05) - 6 mo: 84+/-17.5, HT 90.5+/-19 (P<0.05) - 9 mo: 87.5+/-15, HT 91+/-10.3 P(0.05) - 12 mo 85.1+/-12.6, HT 96.7+/-13.8 (P>0.05)
Results	QT graft extensor strength was significantly lower vs. HT graft	QT graft extensor strength was not significantly different from HT graft	QT graft extensor strength was not significantly different from HT graft	Significant differences noted at 3, and 6 mo between HT and QT No significant differences at 12 mo between groups	No significant difference observed beyond 6 mo post-op between HT and QT groups
Level of Evidence	3	3	3	1	3
Quality Score	16/27	17/27	17/27	21/27	9/27
Support for Answer	No	Yes	Yes	Yes	Yes

RESULTS

Four of five studies found similar outcomes of quadriceps strength after ACL repair when comparing QT to HT graft. All studies showed significant improvement from baseline strength measures as well. There was variability across all studies with regards to strength measurements, rehabilitation protocol, and research design. There was only one study that utilized randomization and no studies were blinded at any level. All studies included met the afore described inclusion and exclusion criteria. Studies were assessed by one author utilizing the Downs and Black Checklist for Measuring Quality.

CONCLUSION

The current evidence supports the utilization of the QT graft for primary ACL reconstruction with regards to recovery of quadriceps strength. There does not appear to be any long-term differences in strength outcomes when compared to HT grafts. Future studies should focus on high quality design, standardized strength testing protocols, standardized rehabilitation protocols, and larger patient populations.

RECOMMENDATION

There is level B evidence according to the GRADE Guidelines that the QT graft produces similar outcomes compared to HT grafts for primary ACL reconstruction with regards of quadriceps strength recovery.

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