Postoperative Tunnel Widening Following ACL Reconstruction: A Comparison of Bone-Patellar Tendon-Bone versus All-Soft Tissue Quadriceps Tendon Autograft

Cody Ashy[1], Henry Baird, Mary-Katherine Lynch, John W Xerogeanes, William Michael Pullen, Harris Slone[2]
[1]Orthopaedics, Medical University of South Carolina, [2]Med Univ of SC Teaching Hosps

INTRODUCTION:
Tunnel widening is a known complication following ACL reconstruction. The degree of tunnel widening for all-soft tissue quadriceps tendon (QT) autografts is not well described. Therefore, the purpose of this study is to quantify the tunnel widening associated with QT use after ACL reconstruction and compare it to bone-patellar tendon-bone (BTB) autografts.

METHODS:
A retrospective review of all ACL reconstructions performed at a single academic institution were reviewed. Subjects with repeat MRIs performed after ACL reconstruction were identified for tunnel measurement. Two reviewers independently measured the maximum diameter of the femoral and tibial tunnels 1 cm from the aperture. These measurements were then compared to the original tunnel diameters drilled at the time of surgery to calculate tunnel widening.

RESULTS:
Seventy-five patients (38 BTB and 37 QT autografts) were identified including 42 females and 33 males. With respect to graft type (QT vs. BTB), there was no statistically significant difference in median patient age ((19.0 (16.0-31.5) years vs. 20.0 (16.8-30.0) years, respectively; p=0.799)) or median time to MRI ((12.0 (9.0-19.5) months vs. 13.0 (7.0-43.25) months, respectively, p=0.762)). Mean tunnel diameter changes or widening was statistically significantly greater for QT autografts compared to BTB autografts at the tibial tunnel: (0.39 (±0.61) mm vs. -0.37 (±1.05, mm; p<0.001). Similarly, the mean tunnel diameter change was also significantly greater at the femoral tunnel for QT compared to BTB. (0.24 (±0.63) mm vs. -0.43 (±0.80) mm; p<0.001). However, no patients with QT grafts demonstrated tibial or femoral tunnel diameters >12 mm, and only one had net tunnel widening > 2 mm.

DISCUSSION AND CONCLUSION:
QT autografts widened more than BTB grafts. However, the degree of widening is likely clinically insignificant with mean tunnel widening less than 0.3mm, and no patients demonstrated tibial or femoral tunnel diameters >12 mm. This study supports the safety of QT use for ACLR given the amount of tunnel widening associated with these grafts.

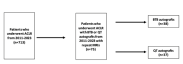

Figure 1: Patient selection flow diagram.

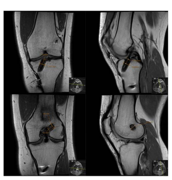
Figure 2: Demonstration of tibial coronal measurement (top left), Tibial sagittal measurement (top right), Femoral coronal measurement (bottom left), and Femoral sagittal measurement (bottom right).

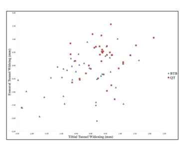
Figure 3. Scatterplot of Femoral and Tibial Tunnel Widening (mm) by Graft Type.

Table 1. Demographic data for patients undergoing ACLR with BTB and QT autografts. *

Demographic	Total	BTB Autograft	QT Autograft	P value
N	75	38	37	--
Age (y)	19.0 (16.0-30.0)	20.0 (16.8-30.0)	19.0 (16.0-31.5)	0.799
Sex (%)				
Male	44.0	39.5	48.6	0.424
Female	56.0	60.5	51.4	
Time to MRI (m)	12.0 (8.0-23.0)	13.0 (7.0-43.25)	12.0 (9.0-19.5)	0.762

*Data represented as means (±SD) and medians (IQR). ACLR, anterior cruciate ligament reconstruction; BTB, bone-patellar tendon-bone; m, months; MRI, magnetic resonance imaging; QT, quadriceps tendon; y, years.

Table 2. Tunnel measurements and widening data for patients undergoing ACLR with BTB and QT autografts.*

	Measurement (mm)	P value
Drilled Femoral Tunnel Diameter	9.45 (±0.50) R: (8.50-10.00)	**<0.001**
Drilled Tibial Tunnel Diameter	9.81 (±0.73) R: (8.50-11.00)	
Measured Femoral Tunnel Diameter**	9.35 (±0.75) R: (7.41-10.90)	**<0.001**
Measured Tibial Tunnel Diameter**	9.82 (±0.86) R: (7.65-12.34)	
Femoral Tunnel Widening***	-0.10 (±0.79) R: (-2.10-1.56)	0.439
Tibial Tunnel Widening***	0.01 (±0.94) R: (-2.46-2.14)	

*Data represented as means (±SD) and ranges (R);
**Represent the combined mean measurements of both reviewers;
***Represent the difference in combined mean measurements of both reviewers. ACLR, anterior cruciate ligament reconstruction; BTB, bone-patellar tendon-bone; mm, millimeters; QT, quadriceps tendon; R, range.

Table 3. Tunnel measurements and widening data for patients undergoing ACLR with BTB vs. QT autografts. *

Measurement (mm)	BTB Autograft	QT Autograft	P value
Drilled Femoral Tunnel Diameter	9.59 (±0.49) R: (9.00-10.00)	9.30 (±0.46) R: (8.50-10.00)	**0.009**
Measured Femoral Tunnel Diameter**	9.16 (±0.78) R: (7.41-10.90)	9.54 (±0.67) R: (8.25-10.71)	**0.027**
Femoral Tunnel Widening***	-0.43 (±0.80) R: (-2.10-1.01)	0.24 (±0.63) R: (-1.28-1.56)	**<0.001**
Drilled Tibial Tunnel Diameter	10.16 (±0.74) R: (9.00-11.00)	9.46 (±0.54) R: (8.50-10.50)	**<0.001**
Measured Tibial Tunnel Diameter**	9.79 (±0.94) R: (7.65-12.34)	9.85 (±0.77) R: (8.37-11.64)	0.741
Tibial Tunnel Widening***	-0.37 (±1.05) R: (-2.46-1.64)	0.39 (±0.61) R: (-0.69-2.14)	**<0.001**

*Data represented as means (±SD) and ranges (R);
**Represent the combined mean measurements of both reviewers;
***Represent the difference in combined mean measurements of both reviewers. ACLR, anterior cruciate ligament reconstruction; BTB, bone-patellar tendon-bone; mm, millimeters; QT, quadriceps tendon; R, range.