

Predictors and Outcomes of Stiffness Following Anterior Cruciate Ligament Reconstruction with Quadriceps Autograft in Children and Adolescents

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INTRODUCTION: Quadriceps tendon (QT) autograft has become increasingly popular for anterior cruciate ligament reconstruction (ACLR). Post-operative stiffness can impact outcomes and require reoperation. Data on stiffness after QT ACLR in children and adolescents are limited. This study aims to (1) identify risk factors for flexion and extension deficits following pediatric QT ACLR and (2) compare operative and non-operative treatment of stiffness.

METHODS: This retrospective cohort study included patients undergoing primary soft tissue QT ACLR at a tertiary children's hospital. Stiffness was defined as lacking >10 degrees of extension or >20 degrees of flexion compared to the contralateral knee at 3 months post-operatively. Extension and flexion stiffness were analyzed as distinct outcome variables. We then compared operative vs. non-operative for patients who were stiff at 3 months after ACLR. Multivariable regression was performed to control for confounders (reported as odds ratios, OR, and 95% confidence intervals, CI).

RESULTS: In total, 411 patients were included (mean age 15.4 +/- 1.9 years; 53.3% female). Eighty patients (19.5%) had flexion stiffness at 3 months postoperatively, of which 36 underwent reoperation (8.8%). Female sex (OR 3.1; 95% CI 1.7-5.7; $p<0.001$) and inability to achieve 90 degrees of flexion at 6 weeks (OR 8.3; 95% CI 4.2-16.3; $p<0.001$) were associated with higher odds of stiffness at 3 months. Fifty-two patients (12.7%) developed extension stiffness, of which 29 underwent reoperation (7.1%). Female sex (OR 3.5; 95% CI 1.6-7.9; $p=0.003$) and extension deficit >10 degrees at 6 weeks post-operatively (OR 10.6; 95% CI 4.1-27.5; $p<0.001$) conferred higher odds of stiffness at 3 months. Continuous passive motion machines lowered the odds of extension stiffness 3.1 times (95% CI 1.1-9.0; $p=0.03$). We then compared surgical vs. non-surgical treatment of stiffness. For patients with flexion or extension stiffness at 3 months, there was no difference in initial motion between treatment groups at 6 and 12 weeks after ACLR. Those with flexion stiffness treated non-operatively had greater flexion 6, 9, and 12 months after ACLR than those treated operatively. There was no difference between treatment groups at these timepoints for patients with extension deficits. For both flexion and extension stiffness, the frequency of persistent deficits at final follow-up was not different between treatment groups.

DISCUSSION AND CONCLUSION: Risk factors for flexion and extension stiffness after pediatric QT ACLR include female sex and deficits at 6 weeks postoperatively. Stiffness after ACLR may be treated successfully without reoperation, but further research is needed to better understand when non-operative treatment is appropriate.