

Favorable Outcomes following Anterior Cruciate Ligament Reconstruction with Quadriceps Tendon in Adolescent Athletes at Mean Follow Up of 4 Years

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INTRODUCTION: Despite increasing use of quadriceps tendon (QT) autograft in primary anterior cruciate ligament reconstruction (ACL-R), limited data exists regarding the outcomes of QT ACL-R in high-risk populations, such as high-performing adolescent athletes. The purpose of this study was to report on outcomes following QT ACL-R in adolescent athletes, including rates of revision ACL-R and subsequent ipsilateral knee surgery, patient-reported outcomes (PROs), and return to sport (RTS). The secondary purpose of this study was to identify patient-related and surgeon-related factors that may influence failure rates following QT ACL-R.

METHODS: All patients age 14-17 years old who underwent primary anatomic, transphyseal, single-bundle ACL-R with QT autograft between 2010 and 2021 with minimum two-year follow up were included for analysis. Demographic data including patient age, sex, sport type and level of participation, and preoperative International Knee Documentation Committee (IKDC) and Marx activity scores were collected retrospectively. All patients included for analysis were prospectively contacted for completion of a questionnaire assessing postoperative PROs and RTS information (including time from surgery to RTS, level of sports participation, and reason for lack of successful RTS). Rates of future ipsilateral knee surgeries, (revision ACL-R, meniscus procedures, stiffness (defined as undergoing lysis of adhesions or manipulation under anesthesia), cyclops lesions, and hardware removal) and future contralateral ACL-R were assessed. Patient demographic and surgical characteristics were compared between groups who underwent revision ACL-R and those who did not undergo revision ACL-R.

RESULTS:

A total of 89 patients (mean age: 16.2 ± 1.1 years, 64% female) were included for analysis at mean follow up of 4.0 years, of which 76 (85%) patients participated in a pivoting sport at time of injury and 78 (88%) patients participated in organized (versus recreational) sports. Concomitant meniscus procedures were performed in 45 (52%) patients, and 6 (7%) patients underwent QT ACL-R with lateral extra-articular tenodesis (LET). The overall revision ACL-R rate was 10% (n=9), and contralateral ACL tears occurred in 12 (14%) patients. Additional ipsilateral knee reoperations occurred in 20 (22%) patients (Table 1), with the most common reason being postoperative loss of range of motion for lysis of adhesions or cyclops lesions (n=8, 9%). Subsequent meniscus tears occurred in 6 patients (87% success rate), whereas 2 patients sustained new ipsilateral meniscus injury. Postoperative IKDC scores were significantly higher than preoperative scores (88.5 vs. 37.5; $p < 0.001$), whereas Marx activity scores decreased postoperatively (14.3 vs. 12.2; $p = 0.011$). Among the 50 (56%) patients who completed the postoperative questionnaire, 40 (80%) patients successfully returned to sport at a mean time of 9.7 ± 6.9 months, of which 34 (85%) patients returned to the same or higher level of sport. The most common reasons for failure to RTS included lack of time (n=7, 70%) and fearing re-injury or lacking confidence in the operative knee (n=5, 50%). No statistically significant differences were observed between patients who underwent revision ACL-R and those who did not. Among the 6 patients who underwent QT ACL-R with LET, no patients underwent revision ACL-R.

DISCUSSION AND CONCLUSION: The most important finding of the present study was the favorable outcomes following QT ACL-R in adolescent athletes. Namely, at minimum two-year follow up, adolescent athletes experienced low ipsilateral graft failure rates, high rates of RTS, and significantly improved postoperative IKDC scores. Altogether, the findings of this study suggest that the QT is a viable graft choice for primary ACL-R in adolescent athletes who wish to return to a high level of sports activity.

Table 1. Descriptive Characteristics of Complications and Subsequent Knee Surgeries

Variable:	Total Cohort (n = 89)
Lachman at Final Follow-Up*	
Grade 1A, n (%)	83 (93.3)
Grade 2A, n (%)	6 (6.7)
Ipsilateral Revision ACL-R, n (%)	9 (10.1)
Other Ipsilateral Knee Surgeries	
Stiffness, n (%)	2 (2.2)
Cyclops Lesion, n (%)	6 (6.7)
Medial Meniscus, n (%)	4 (4.5)
Lateral Meniscus, n (%)	4 (4.5)
Wound Dehiscence, n (%)	1 (1.1)
Hardware Removal, n (%)	3 (3.4)
Contralateral ACL-R, n (%)	12 (13.5)
ACL-R = anterior cruciate ligament reconstruction *For patients who sustained ipsilateral failure and subsequent revision ACL-R, Lachman grade at final follow-up prior to ACL-R failure was used.	