

Fresh-Frozen Non-Irradiated Allograft versus Autograft ACL Reconstructions in Sport-Related Injuries Result in Similar Performance Outcomes in Patients 25 years of Age and Younger

Alexandra Diane Moutafis, John E Zvijac, David Vasserman, Brogan Ness, Matthias Schurhoff, Luis A Vargas, Gautam P Yagnik, Keith S Hechtman, John William Uribe

INTRODUCTION: Anterior cruciate ligament (ACL) tears are common sport injuries. A recent systematic review reported an average return-to-sport timeline of 6 to 12 months. Autografts are frequently advocated for young, active patients, yet current literature lacks consistent recommendations for graft type. The purpose of this study was to determine the impact of graft type on patient-reported outcomes (PROs) and performance levels in sport-related ACL tears. We hypothesized that fresh-frozen non-irradiated allografts result in similar PROs and high-performance levels when compared to autografts in patients 25 years of age and younger.

METHODS:

The retrospective study included patients 25 years and under who underwent primary ACL reconstruction for sport-related injuries. A standardized technique with transtibial ACL tunnel placement (10mm diameter graft females, 11mm males) was used. Revisions and multiligament injuries were excluded. Intraoperative data included graft type (allograft, autograft) and source (patella bone-tendon-bone, anterior tibialis, hamstring, quadriceps tendon). Performance outcomes were defined as activity levels according to the International Knee Documentation Committee (IKDC) (strenuous, moderate, light, or unable to perform). PROs included [the Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS JR), and the PROMIS Global Mental Health (GMH)/Global Physical Health (GPH). The primary endpoint was the change in PROs stratified by graft type. The secondary endpoints included a correlation between patient symptoms (pain, swelling, instability) and level of activity. Paired t-tests and the Wilcoxon signed-rank test (RStudio) were used to determine the change in PROs (significance $p < 0.05$). Fischer's Exact test and the Pearson's chi-squared test determined the difference in activity levels. Monte Carlo simulation and the Bonferroni correct adjusted for false positives.

RESULTS: From 2020-2024, 1437 ACL injuries were enrolled in our institutional registry. Of those, 1118 (77.8%) were sport related and 621 (55.5%) occurred in patients 25 years and younger. There were 420 males and 201 females with a mean age of 19 ± 3.1 years and mean BMI of 25.3 ± 6.6 kg/m². Patient factors (age, gender, BMI, last follow-up) were statistically similar between graft types ($p > 0.05$). Sport involvement included 175 soccer (28.2%), 132 basketball (21.3%), 121 football (19.5%), and 193 in other sports (31.0%). ACL grafts included 302 allografts (69.2% patella bone-tendon-bone, 29.8% anterior tibialis, 0.7% quadriceps tendon, 0.3% hamstring tendon) and 319 autografts (78.4% patella bone-tendon-bone, 17.9% quadriceps tendon, 3.7% hamstring tendon). All PROs significantly improved from baseline to a mean last follow-up of 14.3 ± 11.6 months: IKDC (51.8-80.6, $p < 0.001$), KOOS Jr (52.1-77.8, $p < 0.001$), GMH (57.3-58.0, $p = 0.023$), GPH (51.5-56.3, $p < 0.001$). There were no significant differences in IKDC ($p = 0.075$), GMH ($p = 0.1619$), and GPH ($p = 0.6982$) at baseline and last follow-up between allograft versus autografts. Activity increased from 18.8% moderate to very strenuous levels preoperatively to 82.3% at last follow-up with 91% performing strenuous and very strenuous activities on a regular basis without pain or swelling and 97% without instability. At last follow-up there were no significant differences between graft types ($p = 0.99$).

DISCUSSION AND CONCLUSION: Fresh-frozen non-irradiated allograft and autograft ACL reconstruction, with appropriate anatomic graft sizing, demonstrated similar PRO improvements. High activity levels were obtained in a young, active patient population at the literature-based return-to-sport timeline. These findings support the use of allografts as a reliable selection for patients 25 years of age and younger with sport-related ACL injuries.