



A Comparative Study of Clinical and Functional Outcomes of ACL reconstruction: Remnant Preserving Versus Remnant Sacrificing Techniques

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Abstract

Background: Keeping the remaining anterior cruciate ligament (ACL) tissue during reconstruction is thought to help graft healing by preserving blood supply and nerve endings that support proprioception. However, whether this practice improves clinical outcomes remains debated.

Methods and materials: We conducted a prospective cohort study of primary arthroscopic ACL reconstructions performed at a tertiary centre between June 2016 and December 2017. Patients with prior ipsilateral knee surgery, multi-ligament injuries, infection, or inability to complete follow-up were excluded. Hamstring autografts were used for all cases. The decision to preserve the remnant was made intra-operatively if the stump was viable and did not obstruct accurate tunnel placement. Outcomes recorded at 3, 6 and 12 months included IKDC and Lysholm scores, Lachman and anterior drawer grades, range of motion and KT-1000 arthrometry.

Result: Both remnant-preserving and remnant-sacrificing groups showed large functional improvements by one year. Remnant preservation was associated with better early arthrometric stability at 3 and 6 months; by 12 months outcomes were similar between groups. Complication rates were low and comparable.

Conclusion: Selective remnant preservation can offer transient early mechanical benefit without increasing complications when it does not compromise anatomic tunnel placement. Larger randomized, imaging-based studies with longer follow-up are required.

Keywords: ACL reconstruction; remnant preservation; hamstring autograft; KT-1000; IKDC.

Introduction

Tearing the anterior cruciate ligament (ACL) is one of the most common and life-changing knee injuries for active people. It causes instability, limits sports participation and can accelerate joint degeneration. Modern ACL reconstruction aims for anatomic restoration using autograft tissue and reliable fixation, but grafts require time to revascularize and remodel, and some patients experience lingering laxity or loss of joint sense (proprioception) that can impair full recovery [1–4].

A debated technique is to preserve whatever viable native ACL tissue remains at reconstruction. The remnant may carry blood vessels and nerve endings that speed graft revascularization and help maintain proprioception; it could also provide some mechanical restraint early after surgery [5–8]. On the other hand, leaving the remnant can make arthroscopic visualization and precise tunnel placement harder and, if neglected, might contribute to impingement or formation of a cyclops lesion that limits extension [9–11].



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Clinical studies offer mixed messages. Some series report earlier graft revascularization or modest early stability benefits with remnant preservation, while larger comparative studies and meta-analyses often find no durable functional advantage at medium-term follow-up [12–15]. Because of this, many surgeons take a selective approach: preserve the remnant when it looks suitable and will not interfere with anatomic reconstruction; otherwise debride it. This study compares short-term clinical and objective outcomes between remnant-preserving and remnant-sacrificing ACL reconstruction to see whether the theoretical benefits translate into meaningful patient improvement. [1–8]

Materials and Methods

We ran a prospective cohort at a tertiary orthopaedic centre including consecutive primary arthroscopic ACL reconstructions from June 2016 to December 2017. Exclusion criteria were revision ACL surgery, prior major ipsilateral knee operations, and multi-ligament injury necessitating altered protocols, active joint infection and inability to follow up. Preoperative evaluation included history, clinical exam, radiographs and MRI for tear characterization and remnant appearance.

Hamstring autograft (semitendinosus ± gracilis) were harvested and prepared as multi-strand constructs. The intra-operative decision to preserve the remnant followed defined criteria: the stump had to appear viable, be amenable to retraction or tensioning that would allow accurate tibial and femoral tunnel placement, and pose no clear impingement risk. When the remnant blocked anatomic tunnel positioning or risked impingement, partial or complete debridement was performed. Femoral tunnels were drilled via an anteromedial portal with cortical button fixation; tibial fixation used interference screw techniques. Final graft position and absence of impingement were confirmed arthroscopically.

All patients followed a standardized postoperative rehabilitation program. Outcomes measured at 3, 6 and 12 months included IKDC and Lysholm scores, Lachman and anterior drawer testing, KT-1000 arthrometry and range of motion. Data were recorded prospectively on standardized forms and analyzed to compare the two groups. [7, 8]

Literature Review

The ACL contains distinct fiber bundles with differing tension patterns, receives vascular contribution mainly from the middle geniculate artery, and includes neural elements that contribute to proprioception. Histologic studies sometimes show persistent mechanoreceptors and vascular channels in ruptured stumps months after injury, lending biological plausibility to remnant preservation [5, 7, and 13]. Animal and in-vitro work emphasizes that tendon-to-bone healing depends on vascular ingrowth and formation of a fibrocartilaginous interface—processes that could theoretically be aided by

preserving viable native tissue [3, 4].

Clinically, several preservation techniques have been described: traction sutures on the stump, careful posterior tibial drilling, partial debridement when needed, and meticulous notch work to prevent impingement [11–14]. Smaller series and second-look arthroscopy/MRI studies sometimes show earlier graft revascularization and less tibial tunnel widening when remnants are conserved, but larger clinical comparisons and meta-analyses generally report that early imaging or arthrometric advantages do not consistently translate into better patient-reported function or durable stability [12–15]. Concerns about cyclops lesions and loss of extension exist, but larger comparative series do not uniformly show higher complication rates when preservation is performed judiciously [16–18].

Overall, the literature supports a selective preservation strategy guided by remnant quality, timing from injury and intra-operative feasibility rather than universal conservation for all ACL tears. [9–15]

Results

During the study period, 508 patients met inclusion criteria and underwent primary arthroscopic ACL reconstruction. Fifty-two procedures (10.2%) involved intentional remnant preservation and 456 (89.8%) underwent standard remnant debridement. Patients chosen for preservation were typically younger and had a shorter time from injury to surgery. Both groups showed large improvements in patient-reported scores by one year; mean Lysholm and IKDC scores rose substantially and were similar between groups at 12 months. Range of motion recovered well in most patients. KT-1000 arthrometry showed better anterior translation values for the preservation group at three and six months, but differences were no longer significant at twelve months. Overall complication incidence was low (under 5%) and included stiffness and wound problems; two patients required intervention for deep infection. There was no significant difference in complication frequency between groups. In short, remnant preservation produced a transient early stability benefit, but one-year functional outcomes were comparable across cohorts.

Discussion

This series indicates that selective remnant preservation can provide a modest early mechanical advantage, which shows on arthrometric testing during the first months after surgery. That finding fits the biologic idea that preserved tissue may offer immediate restraint and possibly speed revascularization in the early remodeling window. The disappearance of this advantage by one year suggests that long-term graft function is mainly governed by correct anatomic reconstruction, graft selection and rehabilitation rather than remnant status alone.

Selection bias is an important caveat: surgeons favored

preservation in younger patients and when surgery occurred earlier, so the observed early benefits may partly reflect patient selection. Concerns that preservation increases cyclops lesions or arthrofibrosis were not realized in this cohort when surgeons preserved stumps carefully and prioritized anatomic tunnel placement—if the remnant threatened correct positioning, partial or full debridement was preferred. Thus, remnant preservation is a reasonable option when it can be performed without compromising tunnel accuracy; it should not override the technical imperatives of anatomic reconstruction.

Limitations include nonrandomized allocation with possible selection bias, lack of routine MRI or second-look arthroscopy to quantify graft ligamentization and neural recovery, and a one-year follow-up that does not address long-term graft survival or osteoarthritis risk. Randomized trials with imaging biomarkers and formal proprioception testing would more definitively determine whether remnant preservation confers durable biological or functional benefits. [16–20]

Conclusion

In this prospective cohort, selectively preserving the ACL remnant during reconstruction produced a modest early improvement in objective anterior stability but did not deliver superior patient-reported outcomes or objective measures at one year. Complication rates were low and comparable when preservation was undertaken carefully without compromising anatomic tunnel placement. Therefore, remnant preservation is appropriate when it does not hinder accurate reconstruction, but inability to preserve the stump does not preclude excellent outcomes with standard anatomic techniques and structured rehabilitation. Larger randomized and imaging-driven studies with longer follow-up are needed to determine whether remnant preservation has durable benefits for graft biology, proprioception and long-term joint health.

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