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The diameter of single bundle, hamstring autograft does not significantly influence revision rate or clinical outcomes after anterior cruciate ligament reconstruction☆,☆☆

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ABSTRACT

Background: Anterior cruciate ligament (ACL) graft failure is a complication of ACL reconstruction (ALCR). Smaller autograft diameter may be a contributing factor. Our aim was to determine if hamstring autograft diameter influences graft rupture and patient-reported outcome scores.
Methods: This study included 786 consecutive patients undergoing primary, single bundle, autograft hamstring ACLR. The primary outcome was revision ACLR surgery. Secondary outcomes were patient reported International Knee Documentation Committee (IKDC) score, Knee Injury & Osteoarthritis Outcome Score (KOOS) and Tegner Activity score. Multiple logistic regression and Fischer Exact tests were employed for statistical analysis.
Results: Increasing autograft diameter did not lead to a reduction in revision ACLR surgery (odds ratio [OR], 1.093; 95% confidence interval [CI], 0.612 to 1.954; $P = 0.76$). Revision ACLR positively correlated with male gender (OR, 3.971; 95% CI 1.109 to 14.214; $P = 0.03$) and negatively correlated with increasing age (OR, 0.919; 95% CI 0.882–0.958, $P < 0.0001$). There was no association between graft rupture rate and dichotomized graft size. At latest follow-up, there was no correlation between graft diameter and IKDC (Pearson's adjusted $R^2 = 0.058$; $P = 0.75$), Tegner Activity score (Pearson's adjusted $R^2 = 0.244$; $P = 0.53$), or any component of the KOOS (Pearson's adjusted R^2 range: 0.008 to 0.141; P-value range: 0.21 to 0.76).
Conclusion: Increased hamstring autograft diameter did not significantly reduce revision ACLR surgery or improve clinical outcomes. Other factors such as gender and age do influence the rate of revision ACL surgery.
Study design: Level IV, retrospective case series.

1. Introduction

Anterior cruciate ligament (ACL) rupture is a common knee injury with a reported annual incidence of one in 3500 individuals and even higher rates in professional sporting groups [1,2]. Rupture of the ACL is common in Australia with over 10,000 patients requiring an ACL reconstruction (ACLR) each year [3]. One complication of ACLR is graft failure. The literature reports graft failure

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occurring between 1.8% and 10.4% of cases [4,5]. One major surgical factor for graft re-rupture may be graft diameter. Biomechanical studies have shown that increased graft diameter is associated with increased joint stability, lower meniscal and articular cartilage stresses and higher tensile strength [6–9]. The Swedish National Anterior Cruciate Ligament Register shows there is a significant increase in re-rupture in the younger patient cohort and that younger patients have statistically smaller graft diameters than their older counterparts (age ≥ 40), although the relationship may not be causal [10]. Only three retrospective clinical studies have reported on a positive correlation between graft diameter and knee function [11–13]. Other studies, including the Swedish National Anterior Cruciate Ligament Register, have not been able to show a direct connection between graft diameter and graft failure [14–17]. Understanding whether graft diameter is an influential factor in graft failure is important as patient safety is at risk with artificial and/or allograft augments and the use of contralateral hamstring tendons in order to attain graft bulk.

The purpose of this study is to answer the following clinical questions: Does an increased hamstring autograft diameter reduce the rate of revision ACL reconstruction? Secondarily, does an increased hamstring autograft diameter improve patient reported outcome measures? Our hypothesis is that autograft diameter does not influence the rate of revision surgery.

2. Materials and methods

2.1. Study design and setting

This is a level IV, retrospective case series of 786 consecutive patients who were consented for primary ACLR at two urban centres by three fellowship trained knee surgeons between January 2007 and July 2015. Inclusion criteria were patients with Magnetic Resonance Imaging (MRI) confirmed primary ACL rupture. Exclusion criteria included associated fracture, multi-ligament injuries, and previous open surgery to the knee. Ethics committee approval was received.

2.2. Surgical technique

All procedures were carried out under general anaesthesia. A longitudinal incision was performed over the pes anserina bursa. The gracilis and semitendinosus tendons were retrieved using Lahey's forceps after an incision was made in the investing layer of the sartorial fascia. The tendons were left attached at their distal insertion and vinculae were identified and released. The individual tendons were harvested using a closed end tendon harvester (Linvatec, Largo, FL) and all muscle fibres were removed.

A single bundle construct was created and passed through a closed-hole sizing block. The sizing block measured 0.5 mm incremental diameters from three millimetres to 12 mm. The diameter of the graft was determined by the narrowest hole the tendon could fit through at its widest point, which was generally the portion wrapped over the suture. It is this portion of the tendon that will be passed into the femoral tunnel to create a tight fit. A four-strand construct was used in the majority of cases; if the construct was less than 5.5 mm in diameter then a five or six strand construct was created.

Femoral tunnels were created using a medial portal technique. The lateral wall was cleared of soft tissue and an awl was used to create a guide hole. Placement of this starting point in the sagittal plane was at the junction of the anterior two thirds and posterior one third of the wall at approximately the 10 o'clock position in a left knee. Grafts were fixed with an Endobutton (S&N, Andover MA). The tibial tunnel was created with a 55° tunnel guide aimed to exit in the centre of native footprint. Once passed, the graft was tensioned with the knee in 20° of flexion. Tibial fixation was achieved with either polyether ether ketone (PEEK) or metal RCI screws and a staple if there was sufficient graft (S&N, Andover MA). Local anaesthetic (0.2% ropivacaine) was injected to harvest site, along the length of hamstring harvest site, knee joint, and arthroscopic portholes. Most patients were discharged on the same day as their operation and completed an outpatient physiotherapy protocol. Patients were encouraged to immediately weight bear with crutches that were discarded once gait normalized. Braces were not used and immediate range-of-motion exercises were instituted. Generally, running commenced at three months, agility and pivoting activities at six months with return to full sport by nine to 12 months.

2.3. Outcomes

The primary outcome was revision ACLR surgery for graft failure. Secondary outcomes were the following orthopaedic scores: International Knee Documentation Committee (IKDC), Tegner Activity score and Knee Injury & Osteoarthritis Outcome Score (KOOS). The IKDC and KOOS were collected both pre-operatively and post-operatively while the Tegner Activity score was completed for the patients' pre-injury status and then post-operatively.

2.4. Post-operative follow-up

Each patient was followed up at two, six, 12, 24 and 52 weeks post-operatively. Patients beyond one year were mailed, emailed or telephoned for inquiry of revision ACL surgery and completion of outcome scores. There were two patients with missing data and one patient had a bone–tendon–bone (BTB) graft, which was excluded in the analysis. There were 435 patients who had a minimum of two years since surgery. Seventy-six of these patients could not be contacted for follow-up questionnaires. The mean follow-up time of the 359 patients that had a minimum of two year follow-up was 3.82 $\pm$ 1.42 years for graft rupture and Tegner Activity scores. Only 222 patients had IKDC scores (mean follow-up 3.39 $\pm$ 1.2 years) and 202 had completed KOOS (mean follow-up 3.29 $\pm$ 1.2 years). A study flow diagram can be seen in Figure 1.

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