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ACL reconstruction preserving the ACL remnant achieves good clinical outcomes: A case control study

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Abstract

Introduction: Orthopaedic surgeons have been trying hard to optimize the technique of ACL reconstruction to have better functional outcome. In addition to stability a high quality of proprioception is also required. The presence of remnant containing mechanoreceptors and free neural endings, can help reinnervate the ACL autograft.

Aims & Objectives: To compare clinical outcomes in patients undergoing ACL reconstruction with or without remnant preservation.

Materials & Methods: 86 patients who underwent ACL reconstruction between September 2016 and March 2018. These patients were divided into 2 groups : those in whom the remnant was preserved (group 1 = 22) and those in whom the remnant was not preserved (group 2= 64). Patients were followed up for atleast 18 months.

Results: The Tegner Lysholm score was higher in group 1 than group 2 ($p < 0.05$). Anterior stability of the knee as measured by Lachman test and Pivot shift test was significantly better in group 1. Post surgery rehabilitation and return to sports was faster in group 1 when compared to group 2. Graft rupture rates were also significantly lower in group 1.

Conclusion: Remnant preserving ACL reconstruction has higher potential for early healing, superior functional recovery, earlier return to sports and lower incidence of reinjury.

Keywords: ACL, remnant, lachmans test, anterior drawers test, tegner lysholm test

Introduction

Anterior cruciate ligament (ACL) injury is one of the most common knee injuries. An injured ACL cannot heal naturally and will lead to an increased risk of meniscal injury and osteoarthritis. Thus, ACL reconstruction is a conventional surgical technique to restore function to the knee with a ruptured ACL, and excellent clinical outcomes have been reported. Residual ACL remnants are commonly observed during arthroscopic examination. To identify the ACL attachment, the ACL remnant is debrided clearly during ACL reconstruction using standard techniques. In recent years, the importance of the ACL remnant has been recognized in terms of biomechanical, vascular, and proprioceptive function. Some studies reported that mechanoreceptors that control knee proprioception are located in the inner membrane of the synovium near the tibial attachment of the ACL. In addition, the ACL remnant tissue has good subsynovial and intrafascicular vascularity. This may accelerate cell repopulation and revascularization in the graft.

Materials & Methods

86 patients who underwent ACL Reconstruction surgery were included in the study. The period of study was from September 2016 to March 2018. The patients were divided in two groups. Group 1 (n=22) and Group 2 (n = 64). Mean age of them was 29 years (13 – 58). Group 1 were patients who had undergone ACL reconstruction without the remnant preservation technique. Group 2 comprised of patients where the ACL remnant from both the femoral and tibial side was preserved [Fig 1].

All patients were operated by a single surgeon (first author). ACL reconstruction was done using quadrupled hamstring tendon autograft using the transportal technique.

The remnants were classified as per the description of Craig et al [Fig 2]. The femoral side was fixed using a fixed loop endobutton and the tibial side with interference screw. Accessory anteromedial portal was used to achieve an anatomical femoral tunnel. To establish the femoral bone tunnel we carefully resect the necessary femoral fibres of the torn parts of the AC to visualize the femoral insertion site of the AM or PL. Then we create an adequate low anteromedial portal to establish the femoral bone tunnel. After using the 4.5 mm Endobutton drill the final diameter of the femoral bone tunnel is usually established by dilatation for not to damage the intact ACL remnants by the head of a drill. Usually the length of the femoral bone tunnel is between 32-40 mm. Consequently we choose a 15mm or 20 mm long Endobutton for femoral fixation. On the tibial side the ACL stump is usually intact. Fixation on the tibial side is performed with a resorbable screw and by fixing the distal fibre-wire sutures over a tibial bone bridge. This is needed because the 3-4 fold graft is too short for screw fixation alone. The result is a double fixation on the tibia.

Postoperatively all patients were put on a long knee brace. Static quadriceps and ankle pump was started on day 0. Patient was allowed to walk with full weight bearing using crutches from day 1 post operation. Sports like running and jogging was started at 2 months.

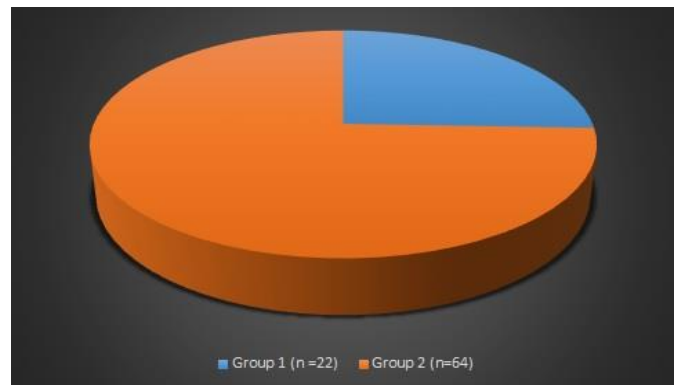


Fig 1: Comparison between the 2 groups

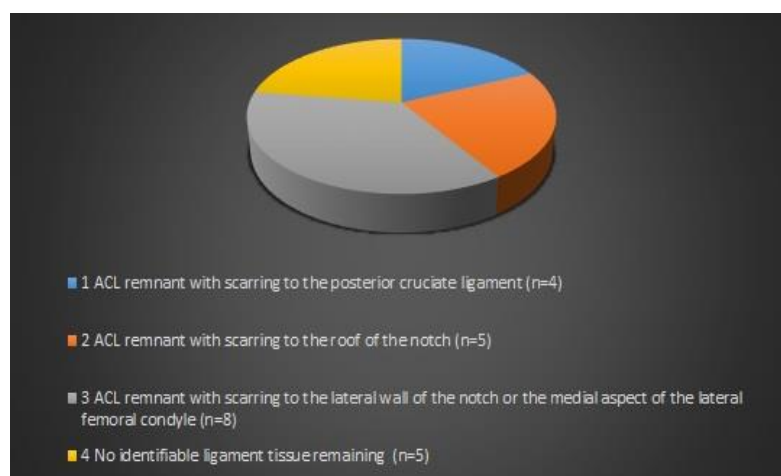


Fig 2: Showing the distribution of the different types of remnants

Results

Patients were followed up for a period of two years. Preoperative and postoperative assessment was done using the Lachman's test, Anterior Drawer test and Pivot shift test [Fig 3 and Fig 4]. The Lysholm Tegner Knee Score was used to assess the postoperative outcome between the two groups [Fig 5]. Groups were compared using the Mann - Whitney U Test. There was a statistically significant (p value < 0.05) in the Lysholm Tegner knee score of the patients belonging to group

1 postoperatively. The patients belonging to group 1 also showed early return to sports and other activities when compared to group 2. There was also reduced graft rupture rates in patients belonging to group 1.

No Cyclops lesion was noted in any of the cases. Non anatomical femoral tunnels were seen in 3 cases where the accessory anteromedial portal was not used. One superficial infection at the graft site was managed conservatively using local antibiotics.

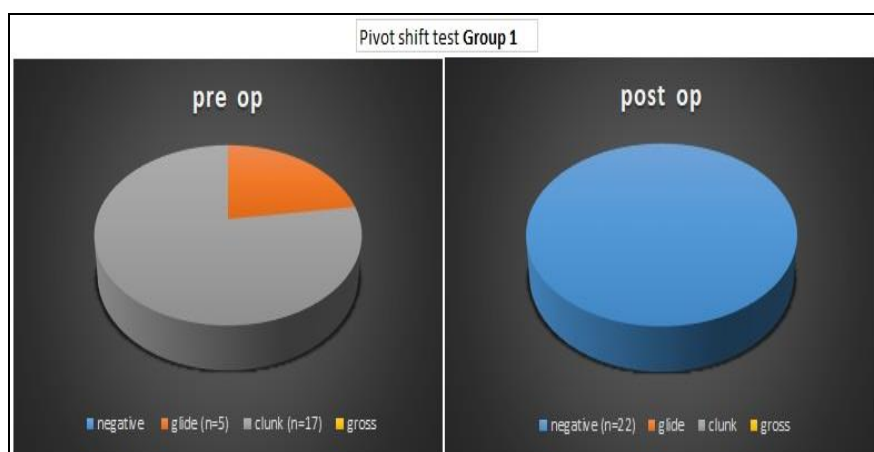


Fig 3: Showing Pivot Shift test of Group 1

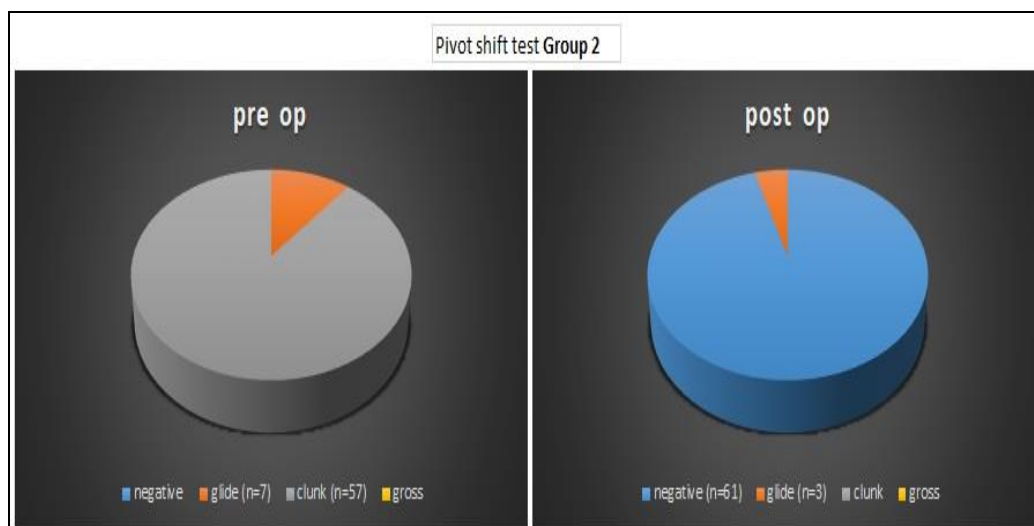


Fig 4: Pivot Shift test of Group 2

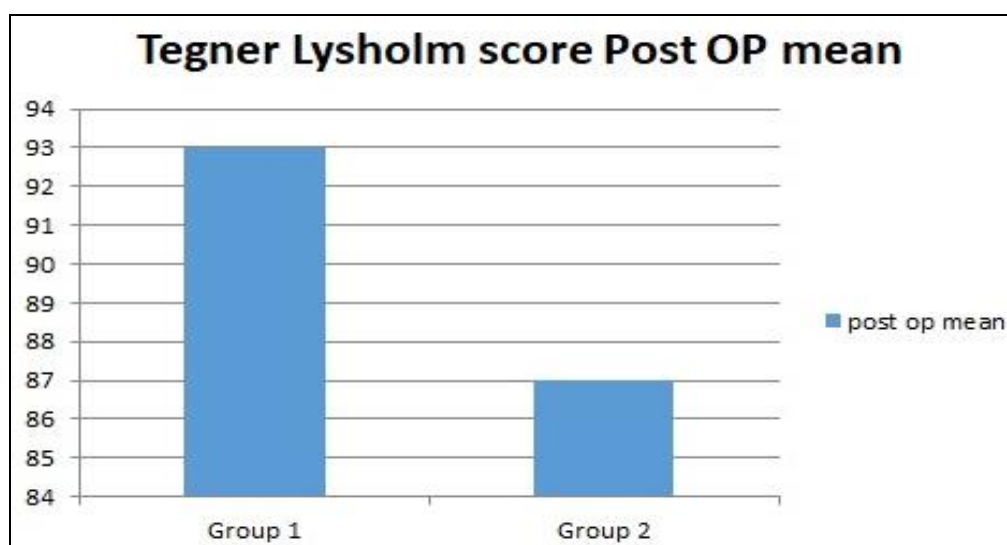


Fig 5: Graph showing the comparison of scores

Discussion

Remnant preservation has been recognized to have an important role in ACL reconstruction. For patients with ACL injury, the first concern is subjective patient evaluation and complications. The differences in subjective evaluation and complications between the use of the remnant preservation technique and the standard technique (without remnant preservation) play an important role in patient choice.

Some previous studies reported that there are mechanoreceptors located in the subsynovial layer near the tibial site of ACL fibers. Moreover, many authors showed that the regeneration of mechanoreceptors may be accelerated by revascularization of the graft and that the recovery of knee proprioceptive function could be promoted by the surviving mechanoreceptors of the ACL remnant and the regenerated mechanoreceptors. Therefore, some authors have preserved the ACL remnant during ACL reconstruction, assuming that remnant preservation can better restore proprioceptive and functional outcomes of the knee joint. Kondo *et al.* [9] reported that remnant preservation significantly improved postoperative knee stability and arthroscopic evaluation than using the remnant resecting technique during ACL reconstruction. Lee *et al.* [10] reported in a group of 16 patients that better proprioceptive and functional outcomes occurred in those with a preserved remnant greater than 20% of the length of the ACL than in those where the remnant was less than

20%. Yanagisawa *et al.* [7] reported that the remnant preservation technique reduces the amount of bone tunnel enlargement. Kitamura *et al.* demonstrated that the preservation of ACL remnant tissue in anatomic double-bundle ACL reconstruction appears to improve the control of pivot-shift laxity at a minimum of 12 months after surgery.

The remnant ACL tissue has good subsynovial and intrafascicular vascularity. Wu *et al.* reported in an experimental study that blood flow to the grafts was significantly higher in the remnant-preserved group than in the remnant-resected group. Therefore, many authors believed that as the remnant was preserved, a portion of blood vessels from the tibial attachment were also preserved, which may accelerate cell repopulation and revascularization in the graft, resulting in acceleration of graft remodeling and early restoration of the mechanical properties of the graft. Ahn *et al.* reported that magnetic resonance imaging showed significantly larger ACL grafts in the remnant bundle preservation group than in the standard procedure group, and these preserved remnant bundles showed progressive remodeling in the ACL graft. In addition, improved graft remodeling was confirmed by using arthroscopic second-look evaluation. Ahn *et al.* performed a second-look evaluation in 62% patients who underwent ACL reconstruction with remnant preservation and reported that 91% had fair synovialization of the ACL graft. Kondo *et al.* demonstrated

on second-look evaluation that the remnant-preserving procedure was significantly better than the remnant-resecting procedure with regard to postoperative laceration or tear of the grafts as well as synovial and fibrous tissue coverage of the grafts. Lu *et al.* [21] showed that the grafts in the remnant preservation group had a better quality in terms of synovium coverage, apparent tension, and thickness compared with the standard group.

Several studies confirmed that preservation of the remnant during ACL reconstruction can influence the stability of the knee joint, particularly the anterior-posterior stability. Adachi *et al.* [25] reported that KT-1000 results in remnant-preserved group were 0.7 ± 1.8 mm versus 1.8 ± 2.1 mm in the standard technique group ($P < 0.05$). Kim *et al.* reported that the postoperative mean side-to-side difference was 1.67 mm on KT-2000 in patients who underwent double-bundle ACL reconstruction with the remnant-preserved technique. There are likely several reasons why postoperative knee stability was significantly improved by sufficient preservation of the ACL remnant tissue. The biology of graft healing is a process of creeping substitution. The ACL remnant has good subsynovial and intrafascicular vascularity. Therefore, first, the preserved remnant may accelerate the revascularization and ligamentation of the grafts, as well as its incorporation and stability.

A potential complication of ACL reconstruction using remnant preservation is cyclops syndrome or a cyclops lesion [41-43]. The incidence of cyclops syndrome, which involves serious loss of knee extension caused by a hard nodule around the reconstructed ACL, has been reported to range from 2 to 11%. The incidence of a cyclops lesion, which is a soft synovial tissue mass without any clinical symptoms around the reconstructed ACL, has been reported to range from 2 to 47%. Only one patient required arthroscopic arthrolysis for cyclops syndrome. Some magnetic resonance imaging studies showed that there was no significant difference in the prevalence of cyclops lesion after single-bundle ACL reconstruction between the remnant-preserved and remnant-resected techniques (12.2% and 15.0%, respectively). Thus, preservation of ACL remnant tissue does not increase the incidence of cyclops lesions.

Our study had a few limitations as it was a small study group with a short follow up period. No tool like the KT 1000 was used to measure the anterior stability. No follow up MRI or Second - look diagnostic arthroscopy was done to assess graft healing.

Conclusion

Preserving the remnants helps in early healing of the graft, improves functional stability. It reduces the operative time and provides early return to activity.

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