ORIGINAL RESEARCH

Comparison of Functional Outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction between Adjustable Closed Loop and Endobutton for Femoral Fixation of Quadrupled Hamstring Autograft

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ABSTRACT

Background: Cortical suspension devices have been widely used in anterior cruciate ligament reconstruction (ACLR) for femoral side graft fixation. Fixed-length and adjustable-length loop devices are two common suspensory loop devices that are used in ACLR. They both have their own biomechanical pros and cons. The purpose of this study is to determine the difference in functional outcome of anatomical single-bundle ACLR using fixed-length versus adjustable-length loop in femoral fixation of quadrupled hamstring graft.

Materials and Methods: It is a longitudinal prospective study conducted in various military hospitals of Indian army. There were 60 patients enrolled in the study. The first 30 patients were treated with arthroscopic ACLR with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bioabsorbable interference tibial screw; similarly, in subsequent 30 patients, ACLR with quadrupled hamstring graft from ipsilateral limb fixed with closed adjustable loop on femoral side and bioabsorbable interference tibial screw. Their clinical and functional status were assessed preoperatively on the day before surgery and the last follow-up at one following the surgery with Tegner Lysholm score and 2000 International Knee Documentation Committee (IKDC) scores.

Results: The average pre-operative Tegner Lysholm score before surgery in Endobutton group was 56.63 ± 6.7 and post-operative score at last follow-up was 93.97 ± 4.1, and for closed adjustable loop group, it was 56.5 ± 7.1 and 94.7 ± 3.7, respectively. The average 2000 IKDC score before surgery in Endobutton group was 46.16 ± 6.1 and post-operative score at the last follow-up was 82.52 ± 4.2, and for closed adjustable loop group, it was 46.57 ± 6.5 and 83.98 ± 4.1, respectively. Two sample Student's *t*-test was conducted to compare the mean of post-operative Tegner Lysholm score and 2000 IKDC for each group it showed *P* value for Tegner Lysholm score to be 0.75 and that for 2000 IKDC score to be 0.7, which not statistically significant to reject the null hypothesis.

Conclusion: Cortical suspension devices for femoral tunnel graft fixation are very efficient devices whether fixed length or adjustable length. Fixed-length and adjustable-loop cortical suspension devices are equally effective in femoral fixation of graft in ACLR.

Keywords: Adjustable-length loop device, Anterior cruciate ligament, Cortical suspension device, Fixed-length loop device.

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INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most common injuries of knee among the high-level athletes which account for nearly about 50% of total knee injury. It is also common in young and active non-sports people. Its prevalence is estimated to be 1 in 3000 in the United States (>120,000 cases annually).[1] Anatomical ACL reconstruction (ACLR) has become the gold standard for the treatment of ACL tear to return patients to pre-injury status and to prevent instability and long-term osteoarthritis knee.[2] The use of the semitendinosus and gracilis (STG) tendons is becoming the choice method in ACLR. This graft, with four strands of STG tightened identically, presents the advantage of having a mechanical resistance theoretically superior to the mechanical resistance of a tendon from the patellar ligament with a minimum width of 10 mm, having a minimum of iatrogenic complications, preserving the extensor apparatus and thus reducing anterior knee pain. A wide variety of fixation solutions to attach the hamstring tendons have been proposed. Most commonly used devices for femoral fixation are interference

screws, transfix screws, and cortical suspension devices. Devices for tibial fixation can be divided according to the location of fixation: Intratunnel fixation and extratunnel fixation. Intratunnel fixation methods primarily rely on the metallic or bioresorbable interference screw, a relatively novel approach called Intrafix or a cross pin system.[3] Cortical suspension devices have been widely used in ACLR for femoral side graft fixation. Various studies have shown that cortical suspension devices have the necessary biomechanical properties with regard to ultimate failure strength, displacement, and stiffness for initial fixation of soft tissue in the femoral tunnel for ACLR.[4-6] Cortical suspension devices are available in two varieties: (1) Fixed-loop length device, for example, Endobutton and (2) Adjustable-loop length device, for example, Tightrope. Endobutton is the first-generation suspensory fixation with fixed-length loop. The length of the loop is fixed, but it is stiffer and slippage free which seems to have created a more favorable biomechanical environment. Closed adjustable loop is the second-generation suspensory fixation device with the adjustable-length loop which is reduced after flipping by tightening the rope. It allows full-length filling of graft part of the femoral tunnel and some degree of final tightening to tension the graft even after placement of the graft. This seems to be the theoretical advantage of tightrope over Endobutton which removes final slack off the knee after the placement of the graft and prevent long-term laxity of the reconstructed knee. However, experimental studies have shown that allow full-length filling of graft part of the femoral tunnel and some degree of final tightening to tension the graft even after placement of the graft.[7] The purpose of this study is to determine the difference in functional outcome following anatomical single-bundle ACLR using these techniques.

Hypothesis

There no difference in clinical outcome following ACLR between fixed-length loop and adjustable-length cortical suspension devices used for femoral side fixation.

MATERIALS AND METHODS

It is a longitudinal prospective study conducted in various military hospitals of the Indian army from January 2017 to February 2018. The sample was collected from January 2018 to February 2018. There were 60 patients enrolled in the study. The first 30 patients were treated with arthroscopic ACLR in the first 30 patients were done with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bioabsorbable interference tibial screw, similarly in subsequent 30 patients ACLR were done with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bio-absorbable interference tibial screw. Post-operative rehabilitation protocols were same for both the group. Their clinical and functional status was assessed preoperatively on the day before surgery with Tegner Lysholm score and 2000 International Knee Documentation Committee (IKDC) scores and at the last follow-up at least 1 year following the surgery. The last follow-up date was July 31, 2018. Data entry was done in Microsoft Excel 2010. Mean and standard deviation were calculated for all categorical data. Two sample Student's *t*-test was used to compare the mean of two groups.

RESULTS

There were 60 patients included in study 30 in the Endobutton group and 30 in adjustable loop group. Age of the patients in Endobutton group ranged from 19 years to 53 years with mean age of 33.3 ± 18.2 years and in closed adjustable loop group, it ranges from 19 years to 51 years with mean age of 31 ± 20. The range of follow-up duration for Endobutton group was 6 to 12 months with mean follow-up duration of 21.3 ± 8.6, similarly that of closed adjustable loop group was 6 to 12 months with mean follow-up duration of 14.16 ± 5.5 months. The average Tegner Lysholm score before surgery in Endobutton group was 56.63 ± 6.7 and post-operative score at the last follow-up was 93.97 ± 4.1, and for tightrope group, it was 56.5 ± 7.1 and 94.7 ± 3.7, respectively. The average 2000 IKDC score before surgery in Endobutton group was 46.16 ± 6.1 and post-operative score at the last follow-up was 82.52 ± 4.2 and for closed adjustable loop group, it was 46.57 ± 6.5 and 83.98 ± 4.1, respectively. Two sample Student's *t*-test was conducted to compare the mean of post-operative Tegner Lysholm score and 2000 IKDC for each group it showed *P* value for Tegner Lysholm score to be 0.75 and that for 2000 IKDC score to be 0.7 which not statistically significant to reject the null hypothesis.

DISCUSSION

Cortical suspension device has been one of the most widely used for femoral fixation of quadrupled hamstring graft in ACLR. These devices have ultimate failure strength greater than that necessary for early ACL rehabilitation for clinical use in ACL femoral fixation. It consists of a button that rests on the femoral cortex and a loop that holds the folded graft in position until healing occurs. Controversy still exists whether fixed-length loop is better than adjustable-length loop for femoral fixation if cortical suspension device is

used. Fixed-length devices have high failure strength, but tunnel has to be over drilled to flip the button on the femoral cortex create a potential space between the graft and the bone. This potential space can cause "Bungee effect" eventually leading to tunnel widening and graft failure. Adjustable-length loop devices were designed to overcome this disadvantage of fixed-length loop devices. Biomechanical studies have shown that adjustable-length ACL graft cortical suspension devices lengthen under cyclic loads because free suture ends are pulled into the adjustable loop.[8,9] Watson conducted a review of four articles in 2014. All those studies provided the mechanical testing of the adjustable-length versus fixed-length loop devices using cyclic loading within the range considered normal for normal ACL undergoing basic activities of daily living. He found significantly less displacement for fixed-length loop than for adjustable-length design and had a higher tensile strength. He concluded from his study that adjustable-length loop could slip and elongate under load after they had been adjusted to their minimum length which might lead to delayed graft healing and joint instability.[10] Pasquali *et al*. conducted a comparative study on three adjustable cortical suspension devices for the femoral fixation of graft to see the displacement on cyclic loading and failure strength. Their study showed both TR and RLA showed clinically acceptable amounts of cyclic displacement and maximum strength.[11] In our study, we compared the patients based outcome measure using Endobutton as fixed-length loop femoral fixation device and adjustable-length loop device. We found that there was significant improvement in the clinical and functional status in both the groups after operation. However, there were no clinically significant changes in outcome between the groups. Both the implant showed similar outcome whatever be their experimental advantages and disadvantages. Boyle *et al*. conducted a retrospective study of 188 patients who underwent primary ACLR using hamstrings autograft. They performed ACLR with adjustable loop (TR [Arthrex Inc., Naples, FL]) in 73 patients and with fixed-loop (RetroButton [Arthrex Inc., Naples, FL]) femoral cortical suspension in 115 patients. They followed up their patients for 2 years and they found no difference in clinical outcome between the two devices.[12] Choi *et al*. conducted a retrospective study to compare clinical outcomes and tunnel widening after hamstring ACLR with fixed- and adjustable-loop cortical suspension device. They took a total of 117 consecutive patients who underwent hamstring ACLR at a single institution. The fixed-loop cortical suspension device was used in 67 patients, and the adjustable-loop cortical suspension device was used in 50 patients. All patients were observed for a minimum of 2 years. They found that femoral fixation by the use of the fixed-loop device or femoral fixation by the use of the adjustable-loop device showed similar clinical outcomes but did not reduce tunnel widening after hamstring ACLR.[13] Author found additional advantages of adjustable length device that final tightening of the graft could be done after tibial fixation of the graft which reassured the adequate tensioning of graft. Similar observation has been mentioned in the article, "Biomechanical evaluation of an adjustable loop suspensory ACLR fixation device: The value of retensioning and knot tying." by Noonan *et al*. They found increase cyclic elongation in adjustable length loop device more than fixed-length loop, but it was easily eliminated by retensioning and knot tying. Hence, they believed that retensioning and knot tying after initial reduction of graft with adjustable loop ACL fixation device might help to further reduce concerns of loop slippage and displacement with cyclic loading during post-operative rehabilitation.[13]

CONCLUSION

Cortical suspension devices for femoral tunnel graft fixation are very efficient devices whether fixed length or adjustable length. Fixed-length and adjustable-loop cortical suspension devices are equally effective in femoral fixation of graft in ACLR.

Limitation of the Study

The minimum follow-up period for Tightrope group is only 1 year.

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