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## Comparative study on fixed versus adjustable-length loop device for femoral fixation of graft in anterior cruciate ligament reconstruction

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### Abstract

**Aims and Objectives:** Cortical suspension devices have been widely used in ACL reconstruction for femoral side graft fixation. Fixed-length and adjustable-length loop devices are two common suspensory loop devices that are used in ACL reconstruction. 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 ACL reconstruction using fixed length versus adjustable length loop in femoral fixation of quadrupled hamstring graft.

**Material and methods:** It is a longitudinal prospective study conducted in Bone and Joint Centre, Kokilaben Dhirubhai Ambani Hospital (KDAH), Mumbai from Jan 2014 to June 2016. There were 60 patients enrolled in the study. The first 30 patients were treated with Arthroscopic ACL reconstruction in the first 30 patients were done with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bio-absorbable intrafix tibial screw, similarly in subsequent 30 patients ACL reconstruction were done with quadrupled hamstring graft from ipsilateral limb fixed with Tightrope on femoral side and bio-absorbable intrafix tibial screw. Their clinical and functional status were assessed pre-operatively on the day prior to surgery and the last follow up at one following the surgery with Tegner-Lysholm Score and 2000 IKDC scores.

**Results:** The average Tegner- Lysolm score before surgery in Endobutton group was  $56.63 \pm 6.7$  and post op score at last follow up was  $93.97 \pm 4.1$  and for Tightrope group it was  $56.5 \pm 7.1$  and  $94.7 \pm 3.7$  respectively. The average 2000 IKDC score before surgery in Endobutton group was  $46.16 \pm 6.1$  and post-op score at last follow up was  $82.52 \pm 4.2$  and for Tightrope group it was  $46.57 \pm 6.5$  and  $83.98 \pm 4.1$  respectively.

Two sample student t-test was conducted to compare the mean of post-operative Tegner-Lysolm score and 2000 IKDC for each group it showed P value for Tegner-Lysolm 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 and 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 ACL reconstruction.

**Keywords:** Anterior cruciate ligament, cortical suspension device, Fixed-length loop device, Adjustable-length loop device

### Introduction

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 (greater than 120 000 cases annually) [1]. Anatomical ACL reconstruction 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 OA knee [2].

The use of the semitendinosus and gracilis (STG) tendons is becoming the choice method in anterior cruciate ligament (ACL) reconstruction. 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 10mm, having a minimum of iatrogenic complications, preserving the extensor apparatus and thus reducing anterior knee pain.

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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<sup>[3]</sup>.

Cortical suspension devices have been widely used in ACL reconstruction 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 ACL reconstruction<sup>[4, 5, 6]</sup>. Cortical suspension devices are available in two varieties 1. Fixed Loop-length device e. g. Endobutton and 2. Adjustable Loop-length device e. g. 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 favourable biomechanical environment.

Tightrope 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 remove final slack off the knee after the placement of the graft and prevent long term laxity of the reconstructed knee. But experimental studies has shown that 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<sup>[7]</sup>.

The purpose of this study is to determine the difference in functional outcome following anatomical single bundle ACL reconstruction using these techniques.

**Hypothesis**

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

**Material and Methods**

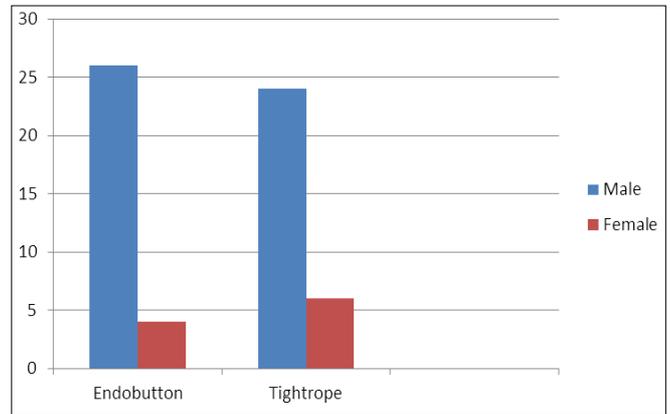
It is a longitudinal prospective study conducted in Bone and Joint Centre, KDAH, Mumbai from Jan 2014 to June 2016. Sample was collected from Jan 2014 to June 2015. There were 60 patients enrolled in the study. The first 30 patients were treated with Arthroscopic ACL reconstruction in the first 30 patients were done with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bio-absorbable intrafix tibial screw, similarly in subsequent 30 patients ACL reconstruction were done with quadrupled hamstring graft from ipsilateral limb fixed with Endobutton on femoral side and bio-absorbable intrafix tibial screw. Post-operative rehabilitation protocols were same for both the group.

Their clinical and functional status were assessed pre-operatively on the day prior to surgery with Tegner-Lysholm Score and 2000 IKDC scores and at the last follow up at least one year following the surgery. The last follow up date was 31<sup>st</sup> July 2016.

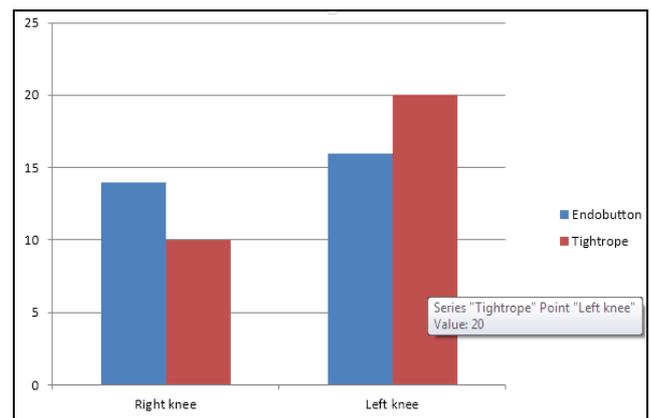
Data entry was done in Microsoft excel 2010. Mean and standard deviation were calculated for all categorical data. Two sample-t test was used to compare the mean of two group.

**Results**

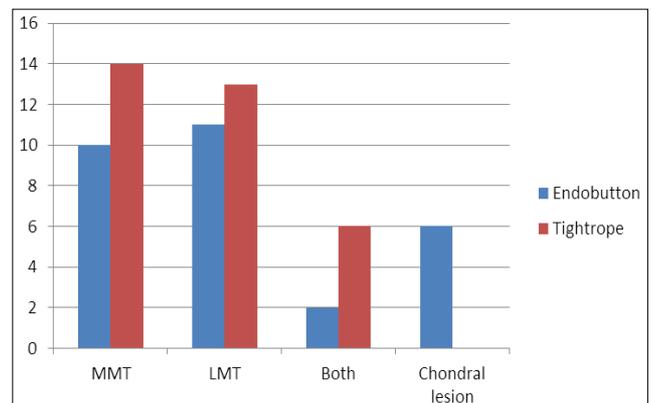
There were 60 patients included in the study 30 in Endobutton group and Tightrope group. Age of the patients in Endobutton group ranged from 19 years to 53 years with mean age of 33.3±18.2years and in Tightrope group it ranges from 19 years to 51 years with mean age of 31±20.



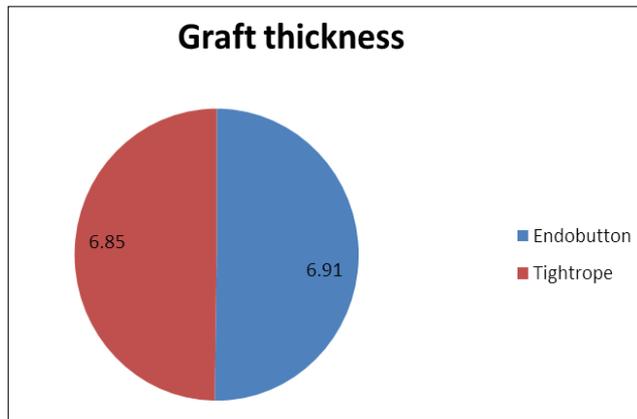
**Fig 1: Gender distribution**



**Fig 2: Side distribution**



**Fig 3: Associated Lesions**



**Fig 4:** Graft Size (Average)

The range of follow up duration for Endobutton group were 18 months to 30 months with mean follow up duration of  $21.3 \pm 8.6$ . Similarly, that of Tightrope group was 12 months to 18 months with mean follow up duration of  $14.16 \pm 5.5$  months.

The average Tegner-Lysolm score before surgery in Endobutton group was  $56.63 \pm 6.7$  and post op score at last follow up was  $93.97 \pm 4.1$  and for Tightrope group it was  $56.5 \pm 7.1$  and  $94.7 \pm 3.7$  respectively. The average 2000 IKDC score before surgery in Endobutton group was  $46.16 \pm 6.1$  and post-op score at last follow up was  $82.52 \pm 4.2$  and for Tightrope group it was  $46.57 \pm 6.5$  and  $83.98 \pm 4.1$  respectively. Two sample student t-test was conducted to compare the mean of post-operative Tegner-Lysolm score and 2000 IKDC for each group it showed P value for Tegner-Lysolm 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 ACL reconstruction. 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 hold the folded graft in position until healing occur. 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 has shown that Adjustable-length ACL graft cortical suspension devices lengthen under cyclic loads because free suture ends are pulled into the adjustable loop<sup>[8,9]</sup>. Watson J conducted a review of 4 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 fro 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<sup>[10]</sup>.

Pasquali M *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 Arthrex's TightRope RT (TR), and DePuy Mitek's RIGIDLOOP Adjustable (RLA) showed clinically acceptable amounts of cyclic displacement and maximum strength<sup>[11]</sup>.

In our study we compared the patients based outcome measure using Endobutton as fixed-length loop femoral fixation device and tightrope as adjustable-length loop device. We found there was significant improvement in the clinical and functional status in both the group after operation. But 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 MJ *et al.* conducted a retrospective study of 188 patients who underwent primary ACL reconstruction using hamstrings autograft. They performed ACLR with adjustable-loop (Tightrope RT (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<sup>[12]</sup>.

Choi *et al.* conducted retrospective study to compare clinical outcomes and tunnel widening after hamstring ACL reconstructions with fixed-and adjustable-loop cortical suspension device. They took total of 117 consecutive patients who underwent hamstring ACL reconstruction 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 use of the fixed-loop device or femoral fixation by use of the adjustable-loop device showed similar clinical outcomes but did not reduce tunnel widening after hamstring ACL reconstructions<sup>[13]</sup>.

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 anterior cruciate ligament reconstruction fixation device: the value of retensioning and knot tying." by Noonan BC *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. So 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<sup>[14]</sup>.

## 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 ACL reconstruction.

## Limitation of the Study

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

## References

1. Kiapour AM, Murray MM. Basic sciences of anterior cruciate ligament injury and repair. *Bone Joint Res*, 2014; 3:20-31. DOI: 10.1302/2046-3758.32.2000241
2. Sethilkumar K, Rajmohan GA. Clinical outcome of Arthroscopic anatomical anterior cruciate ligament reconstruction using single bundle hamstring tendon. *IOSR-JDMS*, 2017; 16(9):1-4. DOI: 10.9790/0853-1609020104. Available at: [www.iosrjournals.org](http://www.iosrjournals.org)
3. Zeng C, Lei G, Gao S, Luo W. Methods and devices for graft fixation in anterior cruciate ligament reconstruction. *Cochrane database of systematic reviews*, Issue 9. Art No. CDO10730, 2013. DOI: 10.1002/14651858.CD010730
4. Petre BM, Smith SD, Jansson KS, de Meijer PP, Hackett TR, LaPrade RF *et al.* Femoral cortical suspension devices for soft tissue anterior cruciate ligament reconstruction: a comparative biomedical study. *Am J Sports Med*. 2013; 41(1):416-22. (ISSN: 1552-3365)
5. Johnson JS, Smith SD, LaPadre CM, Turnbull TL, LaPadre RF, Wijdicks CA. A biomechanical comparison of femoral cortical suspension devices for soft tissue anterior cruciate ligament reconstruction under high loads. *Am J Sports Med*. 2015; 43(1):154-60. (ISSN: 1552-3365)
6. Moré ADO, Pizzolatti ALA, Fancello EA, Roesler. Biomechanical performances of Bio Cross Pin and Endobutton for ACL reconstruction at femoral side: a porcine model. *Res. Biomed. Eng*, 2016; 32(1):28-34. DOI: <http://dx.doi.org/10.1590/2446-4740.0720>
7. Barrow AE, Pilia M, Guda T, Kadrmas WR, Burns TC. Femoral suspension devices for anterior cruciate ligament reconstruction. Do adjustable loop lengthen? *Am J Sports Med*. 2014; 42(2):343-49. (ISSN: 1552-3365)
8. Eguchi A, Ochi M, Adachi N, Deie M, Nakamae A, Usman MA. Mechanical properties of suspensory fixation devices for anterior cruciate ligament reconstruction: Comparison of the fixed-length loop device versus the adjustable-length loop device. *Knee*, 2014; 21(3):743-8. doi: 10.1016/j.knee.2014.02.009.
9. Watson J. Endobutton CL ULTRA fixed-length cortical suspension devices versus adjustable-loop fixation designs: Review of mechanical data, 2014; 4(4):1-9
10. Pasquali M, Plante MJ, Monchik KO, Spenciner DB. A comparison of three adjustable cortical button ACL fixation devices. *Knee Surg Sports Traumatol Arthrosc*, 2017; 25:1613. <https://doi.org/10.1007/s00167-015-3711-8>
11. Boyle MJ, Vovos TJ, Walker CG, Stabile KJ, Roth JM, Garrett WE Jr. Does adjustable-loop femoral cortical suspension loosen after anterior cruciate ligament reconstruction? A retrospective comparative study. *Knee*, 2015; 22(4):308-8. DOI:10.1016/j.knee.2015.04.016
12. Choi NH, Yang BS, Victoroff BN. Clinical and Radiological Outcomes after Hamstring Anterior Cruciate Ligament Reconstructions: Comparison between Fixed-Loop and Adjustable-Loop Cortical Suspension Devices. *Am J Sports Med*. 2016; 45(4):826-31. <https://doi.org/10.1177/0363546516674183>
13. Noonan BC, Dines JS, Allen AA, Altchek DW, Bedi A. Biomechanical evaluation of an adjustable loop suspensory anterior cruciate ligament reconstruction fixation device: the value of retensioning and knot tying. *Arthroscopy*, 2016; 32(10):2050-2059. doi: 10.1016/j.arthro.2016.02.010. PMID: 27157659