Section ?

Original Research Article

FUNCTIONAL OUTCOME OF ARTHROSCOPIC SINGLE-BUNDLE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING SEMITENDINOSUS QUADRUPLED GRAFT FIXED WITH ADJUSTABLE LOOP ON FEMUR AND SUTURE DISC ON TIBIA: A PROSPECTIVE CLINICAL STUDY

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Abstract

Background: The anterior cruciate ligament (ACL) is crucial for knee joint stability, and its rupture is common often resulting from sports or road traffic accidents. ACL reconstruction using hamstring autografts is commonly utilised, yielding positive clinical outcomes. A suspensory method is widely used, with an adjustable loop endobutton device providing various advantages over a fixed loop endobutton. This study aims to evaluate the functional outcomes of arthroscopic ACL reconstruction with a quadrupled semitendinosus autograft using an adjustable loop endobutton on the femur and a suture disc for the tibia. **Materials and Methods:** A prospective clinical study was conducted from August 2022 to January 2024 at Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka, India. The study included thirty-three patients with ACL tears operated with arthroscopic ACL reconstruction with quadrupled semitendinosus autograft using an adjustable loop endo-button on the femoral and a suture disc on the tibial side. Functional outcomes were assessed using the Lysholm and International Knee Documentation Committee (IKDC) scores preoperatively and at 6 and 12 months postoperatively with a significance of $p<0.05$. **Result:** Out of 33 patients, 30 (90.9%) were males and 3 (9.1%) were female. Significant improvements were observed in both Lysholm and IKDC scores at 6 and 12 months postoperatively ($p < 0.05$). The majority of patients (91%) returned to their pre-injury level of activity. The study observed minimal complications, with a low incidence of postoperative anterior joint laxity. **Conclusion:** The use of an adjustable loop endo-button and suture disc for ACL reconstruction with a semitendinosus quadrupled graft gives excellent to good functional outcomes with significant improvement in knee stability, and a good chance of return to pre-injury activity levels. We conclude that suspensory method on both sides gives predictable results on follow-up.

INTRODUCTION

The core complex of the knee joint accommodates the extra-synovial, intra-articular anterior cruciate ligament (ACL), playing a critical role in maintaining both static and dynamic stability of the joint. The general population is experiencing more ACL tears due to increased interest as well as engagement in sports. Following an ACL injury, the likelihood of experiencing symptomatic knee instability varies from 16% to nearly around 100%.[1]

ACL reconstruction is one of the most commonly and frequently performed arthroscopic procedure and Bone-patellar tendon-bone (BPTB) or hamstring

constructs are mostly used for the reconstruction of the ACL. Hamstring autografts give the advantages of fewer problems of anterior knee pain, quadriceps muscle deficits, donor site morbidity, fewer sensory deficits, and loss of extension than with BPTB autografts.[2-5]

Two popular techniques for fixing grafts are suspensory fixation (involves attachment of the graft to bone outside cortex)and aperture fixation (securing the graft to the bone through a tunnel by putting a screw).[6] Presently, there are two common types of cortical suspension devices: fixed loop (initial generation) and adjustable loop (2nd generation).[7,8]

The fixed-loop device (FLD), fills the tunnel with graft without the need for an additional implant by securing the graft to a continuous suture loop that is attached to a button that is flipped and locked at the distal femoral cortex. Following graft tensioning, a cavity is left above the graft as the femoral socket has a 6-8mm longer drilling than required, accommodating the button's flip movement. This may contribute to the "bungee cord effect" and the windshield wiper effect, increasing the likelihood of tunnel widening (TW).[7,9]

Conversely, in an adjustable-loop device (ALD), which features a button fixed to the graft, there is no longer a need for extra tunnel length to flip the button because this loop is tightened to pull the graft through to the top of the femoral aperture.[8,10]

ALD was designed to adapt seamlessly to varying tunnel lengths; it features a unidirectional locking mechanism4, with its length maintained by friction between the sutures. Utilizing an adjustable loop endo button facilitates better control and re-tensioning of the graft after passive knee cycling, ensuring no excess space within the tunnel.[11,12] Their widespread use is attributed to their simplicity, elimination of the need for additional incisions on the femoral side,[13] their potential to accelerate tendon-to-bone healing,[14,15] and also protect the graft from damage caused by the insertion of screws.[16,17]

Current biomechanical data suggest that adjustable loop devices are the strongest fixation devices at "time zero" in terms of load to mechanical failure.[8]

Increased stiffness of the construction is related to aperture fixation compared with the suspensory method,[18,19] and increased graft ruptures, whereas suspensory fixation showed increased overall arthrometric stability and decreased graft ruptures.[20]

Studies show that to facilitate graft tunnel healing and to maintain its strength, it is better to use an adjustable loop endo button for the femur and suture disc for the tibia.[21] Hence, to substantiate the existing literature, we plan to conduct this prospective clinical study to assess the functional outcome of using the same.

MATERIALS AND METHODS

We have done a "Prospective Clinical Study" conducted on patients admitted in the Department of Orthopedics in B.L.D.E (DEEMED TO BE UNIVERSITY) Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura, with diagnosed Anterior cruciate ligament rupture from 5th August 2022- 31st January 2024.

Sample size calculation: In our study, 33 patients were involved, of whom 30 (91%) were male and 3 (9%) were female A minimum of 12 months and a maximum of 21 months of follow-up were achieved.

Inclusion Criteria

Study included patients aged between 18-45 years with clinically and MRI confirmed diagnosis of Anterior cruciate ligament ruptures. Associated meniscal injury who have undergone repair were also included.

Exclusion Criteria

Patients with Anterior cruciate ligament ruptures which needed meniscectomy, Multi Ligament knee injuries, associated neurovascular injury, Polytrauma, Patients medically unfit for surgery, Ligament reconstruction of the contralateral knee, Chondral lesion that modifies the postoperative rehabilitation protocol. (grade III and grade IV cartilaginous lesions).

Procedure: A total of 33 patients were included in our study, who were diagnosed with ACL tear both clinically and radiologically. All 33 patients underwent arthroscopic ACL reconstruction using an adjustable loop endobutton on the femoral side and a suture disc at the tibial side. Post-operative rehabilitation protocol was same for all the patients.

Patient's demographics, side of injury, functional outcomes (measured by Lysholm and IKDC scores),[22,23] return to preinjury level, and complications were assessed. Follow-up evaluations were conducted for a minimum of 6 months and a maximum of 12 months. The Lysholm and IKDC scores were calculated pre-operatively and post-operatively. The Lysholm scoring system evaluated patients' perceptions of their function and indications of instability, with scores ranging from excellent (91-100) to unsatisfactory (<65) [22]. The IKDC scoring system assessed subjective assessment, symptoms, range of motion, and ligament inspection, with scores ranging from 0 (lowest level of function or highest level of symptoms) to 100 (highest level of function and lowest level of symptoms.[23]

Surgical technique:

(a) Graft harvest: An oblique incision was made, one fingerbreadth medial to the tibial tuberosity. Fingertips were used to locate the superior boundary of pes anserinus, the sartorius fascia was incised, and the semitendinosus tendon was identified, hooked out, vincula and adhesions were removed, and graft was harvested using a tendon stripper. [Figure 1 A, B]

(b) ACL reconstruction: Anatomical ACL reconstruction of the quadruped semitendinosus autograft was performed, fixing an adjustable loop endobutton and the femoral and suture disc on the tibial side in all cases. [Figure 2 A, B]

The postoperative protocol and rehabilitation were similar for all the patients operated, including

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quadriceps strengthening, patellar mobilisation, ankle pumps, gradual range of movement (ROM) of 0-90 degrees, and partial weight bearing with crutches in the first two weeks. Increase in ROM up to 120 degrees by 6 weeks with full weight bearing. By 3 months, slow and controlled drills for lateral sports started, by 8 months, total return to sports was advised.

Figure 1: Semitendinosus autograft harvest incision(A) and tendon exposure (B)

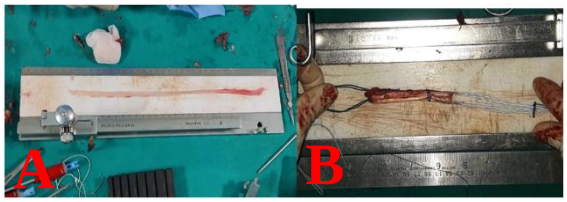

Figure 2: Harvested (A) and prepared (B) semitendinosus autograft

Statistical Analysis: Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) Version 20. Lysholm as well as IKDC scores, were assessed preoperatively and postoperatively at 6 and 12 months. A p-value <0.05 was considered statistically significant.

RESULTS

Of 33 patients, 30 (90.9%) were males and 3 (9.1%) were females. 21 (63.6%) patients sustained right-sided and 12 (36.4%) patients sustained left-sided injury. 7 (21.2%) patients also suffered from medial meniscus, 3 (9.1%) from a lateral meniscus injury, and 23 (69.7%) patients did not have any meniscal injury. The mean value of Lysholm knee score was 45.91 preoperatively, which improved to 96 at six months postoperatively and up to 97.67 at 12 months postoperatively. The IKDC score also showed improvements with a mean value of 45.5 preoperatively to 90.03 at six months postoperatively and 94.4 at 12 months. [Table 1 and 2]

In our study, according to the IKDC scale, 96.7% of patients had a normal postoperative recovery, and 3.3% had an abnormal recovery. according to Lysholm knee score, 90.9% of patients showed excellent results, 6% of patients with good and 3% of patients got fair results. [Figure 3]

Figure 3: (A)Preop T2 weighted MRI showing increased signal intensity at femoral attachment site and disruption in ACL continuity; (B) Postoperative X-ray showing Adjustable loop endobutton at femoral side and suture disc on the tibial side; (C) Clinical pictures at 1 year follow-up showing complete range of movement

Table 1: Preoperative and Postoperative Lysholm score comparison.

Lysholm score	Mean	Std. Deviation	Minimum	Maximum	Friedman Test	P-value
LYSHOLM PREOP (%)	45.91	5.779	38	54	61.270	0.001
LYSHOLM POSTOP 6 MON (%)	96.00	3.518	86	100		
LYSHOLM POSTOP 12 MON (%)	97.67	3.159	86	100		

Table 2: Preoperative and postoperative IKDC score comparison

IKDC	Mean	Std. deviation	Minimum	Maximum	Friedman Test	P-value
IKDC PREOP (%)	45.5485	6.97182	37.90	60.90	61.800	0.001
IKDC POSTOP 6 MON (%)	90.0394	6.06027	77.20	96.60		
IKDC POSTOP 12 MON (%)	94.4091	3.66976	80.00	96.60		

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Complications: Four patients showed poor compliance with post-operative rehabilitation but showed complete improvement with passive and aggressive physiotherapy. Two patients who had preoperative restriction of flexion by 20 degrees had restricted terminal flexion by 10 degrees at 6 months follow-up. Two patients reported numbness over the anteromedial aspect of the proximal leg. Three patients complained of graft site pain at subsequent follow-ups. One patient developed a hypertrophic scar over the graft harvest site and complained of an unsatisfactory cosmetic appearance. None of the patients experienced implant or fixation failure at the end of one year. No patient reported any instability postoperatively, none of the cases had any superficial or deep infection.

DISCUSSION

A prospective study was conducted where thirty-three patients with confirmed ACL tears underwent arthroscopic ACL reconstruction with quadrupled semitendinosus autograft and were prospectively followed up for a minimum of 12 months. months. A similar prospective study by Chidanand KJC et al.[24] In 2015 was followed up for two years. Another study was done by Vinod Jagtap et al.[21] in 2017, where patients were followed up for up to 2 years.

Suspensory fixation offers superior arthrometric stability with fewer graft ruptures. With an adjustable loop endo button, we can put the desired 1.5-2 cm graft inside the femoral tunnel, which is difficult with fixed loop devices. Aperture fixation may compromise graft integrity, cause soft tissue graft slippage, damage, and compromised primary graft stability, possibly leading to early failure especially on the tibial side.[25,26]

Adjustable loop Endo button does not directly fix into the graft and has the potential to stretch during cyclic loading, which can lead to increased anterior joint laxity.[7,19] This can be overcome with graft tension readjustment and intraoperative tightening to remove excess laxity,[27] improve graft placement, and maximise the bone-graft interface. Wolfgang Nebelung et al,[28] concluded that hamstring tendon autograft, when fixed with an endo button, can lead to bone tunnel enlargement and osteolytic reaction. In our study, no tunnel widening was noted.

The titanium suture disc has MRI compatibility, and also performing revision surgery becomes easier when compared with metal screws

In our study, according to the IKDC scale, 96.7% of patients had a normal postoperative recovery, and 3.3% had an abnormal recovery. according to Lysholm knee score, 90.9% of patients showed excellent results, 6% of patients with good and 3% of patients got fair results. These findings can be compared with the study done by Chidanand et al., where 93.3% of patients showed normal postoperative recovery, 6.6% of patients were abnormal and related to knee stiffness in IKDC scores and 93.3% of patients according to Lysholm knee scores showed excellent to good results and 6.7% with fair result. In another study done by Vinod Jagtap et al. where 90% of patients had a normal postoperative recovery, and 10% of patients had an abnormal recovery, according to IKDC scores, 90% of patients showed excellent to good scores, and 10% showed fair results.

Hence, the findings of our study were similar to those of other studies, which concluded with excellent clinical and functional outcomes.

Limitations: A smaller sample size, short follow-up duration, and reliance on subjective scores were the limitations of our study.

CONCLUSION

We conclude ACL reconstruction using suspensory fixation on both femoral and tibial ends gives excellent to good functional outcomes at the end of 1 year follow-up. This method may enable graft tunnel healing while maintaining its strength until good graft-to-bone healing occurs completely.

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