Research article

# FUNCTIONAL OUTCOME OF ARTHROSCOPIC RECONSTRUCTION OF ANTERIOR CRUCIATE LIGAMENT USING SEMITENDINOSUS TENDON AUTOGRAFT

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**ABSTRACT**

**BACK GROUND:** The development of new surgical techniques and recent advances in instrumentation in ACL reconstruction has enabled surgeons to achieve better results. However, varying opinion exist among experts with regard to the ideal technique and graft type to be used. Arthroscopic ACL reconstruction using quadrupled semitendinosus tendon autograft with fixation in the femoral tunnel using endobutton and in the tibial tunnel with hybrid fixation using suture disc and anchored with a cancellous screw and washer is a relatively new technique. We have undertaken this study to analyse the postoperative outcome in our experience with this procedure. **METHODS:** This was a prospective study of patients with ACL injury who underwent Arthroscopic ACL reconstruction using quadrupled semitendinosus tendon autograft. Postoperatively, all patients were initiated on the same rehabilitation protocol. All patients were followed up for four to six months period at regular intervals using IKDC, LGS scoring systems and a subjective questionnaire (SQ). Functional assessment with hop test was done. **RESULTS:** 90% of the patients had a favourable outcome as per three scoring systems. All three Scoring systems had a very high correlation as evidenced by the Kendal-tau values ranging from 0.464 to 0.923. Statistically, this was found to be highly significant (p value- 0.000– 0.001). There was good correlation between IKDC and the functional outcome –Pearson's correlation co- efficient of - 0.192 with IKDC and was statistically significant; p: 0.001 with IKDC. The mean limb symmetry index of hop tests were 83.503 +/- 3.65 [range: 66.36 to 93.33].

**CONCLUSION:** We conclude that the functional outcome of arthroscopic ACL reconstruction using quadrupled semitendinosus tendon autograft is excellent to good (90%). With proper patient selection and physiotherapy regimen, full occupational and recreational activities can be expected for most of the patients within six months of the procedure.

**Key words:** ACL (Anterior Cruciate ligament), PCL (Posterior Cruciate Ligament), Hamstring graft, Arthroscopy.

**INTRODUCTION:** Anterior Cruciate Ligament (ACL) injury has been studied extensively in the literature. The ACL is the weaker of the two Cruciate ligaments and therefore may be torn easily than Posterior Cruciate Ligament (PCL).[1] The ACL has a poor capacity for intrinsic repair. Thus ACL reconstruction is gold standard in stabilizing the tibio-femoral joint and restoring the function of the knee joint. Graft choices include both autografts (patellar tendon, hamstring tendon or quadriceps tendon), allografts (Achilles, patellar tendon, hamstring tendon or tibialis anterior) tendons.[2-4] The bone- patellar tendon- bone (B-PT-B) graft is the most commonly used graft in ACL reconstruction.[5] However, concerns regarding problems with the extensor mechanism of the knee, extensor lag, patella infra, patellar fracture and the development of chronic anterior knee pain have promoted surgeons to seek other graft materials for use in ACL reconstruction.[6,7] Arthroscopic ACL reconstruction with Hamstring tendon became popular in patients with symptomatic instability and in appropriately selected patients can yield successful and satisfactory result.[8] There are a wide variety of fixation devices for the quadrupled hamstring tendon graft; however only a few provide better strength and stiffness than interference screw fixation of a bone-patellar tendon- bone graft at implantation.[9-11] Aggressive rehabilitation is safe with both types as long as strong, stiff fixation methods are used.

Biau, et al, in 2007, performed a meta analysis to provide qualitative data to ascertain whether B-PT-B graft or hamstring graft provided superior knee function as

determined by overall IKDC evaluation and return to pre injury level of activity.[12] They found no difference in the final number of patients restoring to full activity after hamstring tendon graft and bone-patellar tendon- bone graft reconstruction.[9] There is fair evidence that patients reconstructed with hamstring graft report less morbidity than those reconstructed with BPTB graft.[13,14] The improvement of stability with bone-patellar tendon- bone graft compared with 4 strand hamstring graft remains of questionable importance in most patients. However, functional results between the two types of reconstruction remain unclear. The present study is designed to analyse the postoperative outcome of arthroscopic ACL reconstruction with quadrupled semitendinosus tendon autograft fixed in femoral tunnel using endobutton and in the tibia tunnel using interference screws and anchored with a cancellous screw.

**METHODOLOGY:** We conducted a prospective study of 30 skeletally mature patients who underwent arthroscopic ACL reconstruction using quadrupled semitendinosus tendon autograft. After obtaining ethical clearance, all the patients were clinically evaluated for complete ACL tear with or without meniscal injury and confirmed by MRI. Rehabilitation protocol included unrestricted range of motion exercises and full weight bearing gait. Patients with concomitant PCL injury, associated bony injury around knee, previous ACL injury, bony avulsion of ACL, concomitant postero-lateral corner injury, collateral ligament injuries requiring surgery are excluded from the study.After confirming ACL tear with initial diagnostic arthroscopy, semitendinosus tendon is harvested and quadruple graft is prepared with proper tensioning. After preparing tibial & femoral tunnels in standard fashion, the pre tensioned graft with endobutton and its threads are passed through the beath pin tibial end loop and are pulled out of the femoral tunnel, so that the endobutton thread is out of the thigh. Under arthroscopic visualization in the joint, the threads of the endobutton are pulled using the principle of flipping the endobutton. The femoral fixation is confirmed by togging of the endobutton. When tension is placed on the grafts, the knee is taken through approximately 15 to 20 cycles of complete flexion and extension. This helps to align the grafts and also tests for impingement between the grafts and bony structures. The tibial side of the graft is fixed with a hybrid type of fixation. Suture disc is held over the tibial tunnel by passing the ethibond threads through the suture disc and tightening the knots around the disc. Further the fixation is strengthened by anchoring screw of 4.5 mm size with a washer and the ethibond threads are tied around the screw below the washer as shown in figure 1. The screw is then tightened and the excess thread is cut. Wound is closed in standard fashion after thorough lavage. Compression dressing and knee brace applied.

All patients were initiated on postoperative ACL Protocol [adapted from Wilk et al] on postoperative day 1. On the operative day, after patient recovers from anaesthesia, patient is taught to do foot and ankle pump movements. The next day patient was taught static quadriceps exercises. On the 2nd post operative day, active knee bending with gradual increase of 10-20 degrees of flexion/ day was started. On the 3rd post operative day, assisted SLRT, abduction and adduction exercises of thigh and hamstring strengthening exercises were started. By the end of 1st weak, patient will be able to walk full weight bearing with long knee brace. Patients were advised to wear long knee brace for 2 months to protect the knees from getting injured. Patients were followed up every month for the first 6 months and the progresses are assessed. Patients are subject to single hop test at 4th, 5th and 6th month of post operative period and at the end of 6th month, the patients are subjected to IKDC, Lysholm Scoring and the subjective questionnaire.

**SINGLE HOP TEST:** The subjects performed one practice trial for each limb, followed by measured and recorded trials. The subjects were instructed to begin with the normal limb. Subjects started each test with the lead toe behind a clearly marked starting line. No restrictions were placed on arm movement during testing, and no instructions were provided regarding where to look. Subjects were encouraged to wear the foot wear they would normally wear during their rehabilitation sessions. For the hop test to be deemed successful, the landing must have been maintained for 2 seconds. An unsuccessful hop was classified by any of the following: touching down of the contralateral lower extremity, touching down of either upper extremity, loss of balance, or an additional hop on landing. If the hop was unsuccessful, the subject was reminded of the requirement to maintain the landing, and the hop was repeated.[15-17]

**RESULTS:**

The mean age in our study was 29 years. The maximum number of patients were in the age group of 21-25yrs (36.67%) followed by the age group 26-30yrs (23.33%). Right knee was predominantly involved and most common mechanism being road traffic accidents (44%). Lachman test and Anterior drawer test was found to be 90% positive which was grade 3in 46.67% and grade 4 in 53.33%, and pivot shift test, 56.67% sensitive by clinical examination which was 100% and 96.67% respectively by evaluation under anaesthesia. Medial meniscal tear was the commonest associated injury (46.67%) detected by MRI followed by lateral meniscus (20%) and grade 1 medial collateral ligament injury (10%) not requiring surgery. There was no lateral collateral ligament and PCL injury. Diagnostic arthroscopy prior to ACL reconstruction confirmed the medial meniscal tear in 40% cases and 26.67% lateral meniscal tear. The rest of the cases (43.33%) were isolated ACL injuries. Four patients (13.33%) had pain at the graft site at the end of 6 months. Early superficial infection of the site was present in 2 cases (6.67%) which delayed wound healing. There was no deep infection. Majority of the patients (76.67%) were having grade I laxity at the end of 6 months but with hard end point. 1 patient (3.33%) had FFD due to noncompliant physiotherapy. 2 patients (6.67%) complaint of click but no instability. According to IKDC Scoring system (Table 1), 90% of the patients graded their post operative recovery as normal and 30% as near normal whereas 3 patients (10%) graded recovery as abnormal. The abnormal group included two patients with superficial infection and one with FFD. On LGS Scale (Table 2), around 93% of the patients reported outcome as excellent and good with scores above 95 and 84-94 respectively , 2patients (6.67%) scored >65 & <83 and were grouped as fair outcome. At the regular follow up and at the end of 6 months, 66.67% patients graded their recovery as very satisfied and the remaining 33.33% were satisfied with the outcome. Limb symmetry index (Table 3) was calculated by the percentage of affected limb over the normal limb. The preoperative index ranges from 22.72 to 57.14 with a mean of 44.355. Post operatively the index improved to a mean 0f 83.503 ranging from 66.36 to 93.33. All three Scoring systems had a very high correlation as evidenced by the Kendal-tau values ranging from 0.464 to 0.923 as shown in table 4. Statistically, this was found to be highly significant (p value- 0.000–0.001). Twenty six (86%) patients were able to return to their pre injury activity including farming and to competitive sports. Four patients (10.33%) were not satisfied with physiotherapy regimen and these patients were noncompliant to the protocol.

**Table 1: Post-operative IKDC Scoring**

| | Frequency | Percentage |
|---|---|---|
| Excellent | 17 | 56.67% |
| Good | 11 | 36.67% |
| Fair | 02 | 06.67% |
| Poor | 00 | 00.00% |
| Total | 30 | 100% |

**Table 2: Post operative LGS Scoring**

| | **Frequency** | **Percentage** |
|---|---|---|
| Excellent | 17 | 56.67% |
| Good | 11 | 36.67% |
| Fair | 02 | 06.67% |
| Poor | 00 | 00.00% |
| **Total** | **30** | **100%** |

**Table 3: Limb Symmetry Index**

| Limb Symmetry Index | Minimum | Maximum | Mean |
|---|---|---|---|
| Pre-operative | 22.72 | 57.14 | 44.355 |
| Post-operative | 66.36 | 93.33 | 83.503 |

**Table 4: Comparison between single leg hop test, IKDC, SQ & LGS**

| IKDC | Normal | Near normal | Abnormal | P value |
|---|---|---|---|---|
| Hop test | 85.7+/- 8.7 | 84.7+/- 20.23 | 77.1+/-3.3 | >0.05 |
| LGS | Excellent | Good | Fair | |
| Hop test | 86.3+/- 8.8 | 83.8+/- 18.6 | 77.1+/- 3.3 | >0.05 |
| SQ | VS | S | NS | |
| Hop test | 88.6+/- 19.8 | 76.9+/- 14.3 | 00 | =0.04 |

**Table 5: Comparison between our studies with literature**

| | Fareed et al (2003) | K Button & Others | Present study |
|---|---|---|---|
| No. Of patients | 25 | 48 | 30 |
| Average follow up | 25.4 weeks | 20 weeks | 24 weeks |
| IKDC Scores Normal | 12 (48%) | 26 (54%) | 18(60%) |
| Near normal | 12 (48%) | 18 (38%) | 09 (30%) |
| Abnormal | 01 (4%) | 04 (8%) | 03 (10%) |


**Fig.1: Tibial side of the graft is fixed with a hybrid type of fixation with suture disc and further stabilised by screw.**

**DISCUSSION:** Anterior Cruciate Ligament (ACL) tear, if left untreated lead to subsequent knee disability, which can be severe with potentially devastating long term complications.[18,19] With improving results and increasingly reliable outcomes, patient and physician expectations have evolved to include the goal of return to activities and sports at normal or near normal levels. Several studies have shown that multiple-strand hamstring tendon ACL reconstruction has higher strength, stiffness, and cross-sectional area compared with patellar tendon grafts.[20-23] Technical factors, specifically the absence of adequate fixation techniques, initially limited the use of hamstring grafts for ACL reconstruction. New techniques focus on optimizing graft strength and stiffness. Successful ACL reconstruction using hamstring autograft requires stable initial graft fixation and, ultimately, graft- to- bone healing. Hamstring reconstruction using femoral endobutton fixation has been shown to have excellent initial mechanical properties, including pullout strength.[24,25] Tibial hybrid fixation with suture disc and an anchoring screw with a washer provide excellent soft tissue to bone fixation. In 2003, Fareed H et al reported the results of a retrospective study on patients who underwent arthroscopic ACL reconstruction.[26] The purpose of their study was to evaluate their initial experience with this procedure. All patients underwent the same rehabilitative program. Patients were evaluated using the IKDC ligament evaluation system. The average follow up was 25.4 months. Similarly Button K and others, in 2005, evaluated the outcome of ACL reconstruction with semitendinosus tendon autograft with same rehabilitation protocol in 48 patients at 20 months.[27] The results of these studies were compared to our study and are tabulated as shown in table 5. In their study, a satisfactory outcome was seen in 96% & 92% respectively while it was 90% in our study. In the LGS system 56.67% [17 patients] had an excellent outcome while 36.67% [11patients] had a good and 06.67% [2 patients] had a fair outcome. Similarly, 66.67% [20 patients] were very satisfied as per the subjective questionnaire and 33.33% [10 patients] were satisfied. No patient was dissatisfied. This was probably due to the fact that most of the patients were keen on normal day to day activities than return to sports. All three scoring systems had a very high correlation as evidenced by the Kendaltau values ranging from 0.647 to 0.923. Statistically, this was found to be highly significant [p value 0.000-0.0001]. 87% of the patients were able to return to the pre-injury activity level. All patients performed the hop test in the postoperative four to six months period. The

mean limb symmetry index of the single hop test was 83.503. These values gradually reduced when the outcome became poorer on the three scoring systems. Statistically the hop test was more of a trend with regards to IKDC and LGS, whereas it was significant with SQ.

Andrea Reid et al, in March 2007, published their results of a series of hop tests on patients, 15 – 45 years of age who had undergone ACL reconstruction.[28]

The mean limb symmetry index in above study was calculated at the 22nd postoperative week against at 24th postoperative week in our study. The mean values of above study were all above 85%. In our study the mean value is around 83%. This could be due to some patients, especially the ones with a poorer outcome had much lower limb symmetry indices which was skewing the mean to the lower side. Moreover, many patients were quite apprehensive in performing the hop test, thereby increasing the disparity between the normal and the operated limb scores.

**CONCLUSION:** Evaluation with Lachman test under anaesthesia equates with arthroscopic evaluation (100%). Medial meniscus was the commonest associated injury (40%). All the 30 cases underwent arthroscopic ACL reconstruction with quadrupled semitendinosus tendon autograft and were given Wilk et al rehabilitation protocol for a period of 6 months from first postoperative day and the results were evaluated periodically at 16 wks, 20 wks and 24 wks. On evaluation of the patients during the follow up by IKDC, LGS, SQ & single hop test, 90% of the patients had excellent to good results with 87% of the patients were able to return to pre injury level of activity. Mild residual laxity was noted in the follow up period. Superficial infection (2 patients) was the complication encountered in our study. However, these had no contribution in the final outcome. The functional outcome of ACL reconstruction with quadrupled semitendinosus tendon autograft is excellent to good (90%) with mild laxity at the end of 6 months. With proper patient selection and physiotherapy regimen, full occupational and recreational activities can be expected for most of the patients within six months of the procedure.

**Conflicts of interests: Nil**

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