

**Study of Arthroscopic Reconstruction of Anterior Cruciate Ligament Injury****Prasad Aparajit\***, M. R. Koichade and Nimesh Jain*Department of Orthopaedics, Indira Gandhi Government Medical College and Hospital, Nagpur, Maharashtra, India-440001***\*Correspondence Info:**

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E-mail: [aparajitprasad@yahoo.com](mailto:aparajitprasad@yahoo.com)**Abstract****Aims and Objective:** The present study was conducted to observe and evaluate the outcome results of arthroscopic ACL reconstruction by hamstring grafts using Endobutton- CL technique for femoral fixation and Bioabsorbable Intrafix Screw technique for tibial fixation in ACL injury.**Methods:** We prospectively studied 30 patients of both sex aged between 18-35 years posted for arthroscopic ACL reconstruction. All patients had hamstring grafts (7 mm) and EndoButton femoral fixation and tibial fixation with a Bioabsorbable Intrafix Screw. Patients were evaluated for pain, functioning and stability of knee using validated knee scoring systems which included VAS scales, tegner activity scale, IKDC score and knee society score at regular follow up with average follow up being 15 months.**Results:** All patients had a stable knee and an excellent functional outcome. The four strand graft and the method of graft fixation used in present research provided stable ACL reconstruct and improved knee stability which helped to achieve a normal knee function. Postoperatively, we observe significant improvement in the VAS, IKDC, knee society score and tegner activity scoring systems.**Conclusion:** The technique of arthroscopic ACL reconstruction offers an excellent knee function, knee stability and restoration of preoperative functional status with minimal complications.**Keywords:** Arthroscopic, Anterior Cruciate Ligament (ACL), Reconstruction, Semitendinosus - Gracilis Graft, Endobutton-CL, Bioabsorbable Intrafix Screw, Visual analogue scales (VAS), International knee documentation score (IKDC).**1. Introduction**

Anterior cruciate ligament (ACL) rupture is one of the major knee injuries throughout the world. The incidence of ACL tears has increased in the general population with the rise of participation in sports. The annual incidence of the ACL injury ranges between 100,000–200,000 in USA [1,2]. Due to the unsatisfactory outcomes of conservative treatment for ACL injuries, reconstruction surgery remains the treatment of choice in most young patients who want to maintain an active lifestyle. The goals of ACL reconstruction are to provide a functionally stable knee, relief from symptoms and return patients to their pre-injury activity level. It has been assumed that the success rate of ACL reconstructive surgery would be improved by a surgical technique that more closely reproduced the configuration and function of the native ACL [3]. However traditionally, ACL reconstruction has focused on non-anatomical single bundle reconstruction using a transtibial technique, which provides only anterior stability in knee flexion. Owing to the better understanding of anatomy, improvement in surgical

techniques, and advances in fixation devices, the single bundle ACL reconstruction has provided good clinical outcomes<sup>4</sup>.

Although the selection of a graft and the method of graft fixation are critical in anterior cruciate ligament (ACL) reconstruction surgery [5,6]. Bone-patellar tendon-bone and hamstring tendon autografts are the most commonly used grafts in ACL reconstruction<sup>7</sup>. The hamstring grafts were first introduced as a choice for ACL reconstruction three decades ago[8]. It is made with the semitendinosus tendon either alone, or accompanied by the gracilis tendon for a stronger graft. However it can avoid harvest site morbidity due this reason it increase in the popularity of hamstring tendons as autografts for ACL reconstructions [9]. Problem with the use of Semitendinosus and Gracilis (STG) technique are increased knee laxity, the development of flexion deficit and an increase risk of tunnel widening [10-13].

In present study we assume that the use of single bundle four strands semitendinosus - gracilis grafts for ACL

reconstruction using Endobutton- CL technique for femoral fixation and Bio-Intrafix Screw technique for tibial fixation in patients with ACL deficient knee would render good functional outcome. The purpose of this study was to evaluate functional outcome results of arthroscopic ACL reconstruction in patients of ACL injury.

## 2. Material and Method

The design was a prospective type of study comprising 30 patients with ACL ligament injury in the age group of 18-35 years of arthroscopically assisted anterior cruciate ligament reconstruction. Patients with isolated anterior cruciate ligament tears with or without associated

ligament and meniscal injuries, also the patients undergoing primary ACL reconstruction using Semitendinosus and Gracilis graft were included in the study. Exclusion criteria included previously operated cases for ACL injury, patients with severe arthritis and cases in which different modality of fixation other than Endobutton and Bioabsorbable Screws were used. A written informed consent was obtained from all the patients after explaining the procedure. A detailed history and a thorough general and physical examination (By Lachman Test, Anterior Drawer Test and Pivot Shift Test) were done followed by radiographic investigation for all the patients.

**Figure 1: Physical examination**



**Figure 2: Preoperative Radiographic Investigation**



In acute cases of ACL injury patients were initially treated with anti-inflammatory drugs and physiotherapy to strengthen the quadriceps and vastus medialis obliquus muscles. After the gap of 4 to 6 weeks patients were subjected to surgery.

Preoperatively all patients were screened with X rays of the knee-standing AP view, lateral view and MRI and were evaluated using validated knee scoring systems and routine laboratory investigations. All patients medicated with intravenous antibiotics, cefuroxime 1.5 gm. Induction was done using general or combined spinal epidural anesthesia. Under anaesthesia injured knee was examined for

anteroposterior and mediolateral stability and compared with uninjured knee of the patient.

The procedure was done with patient in supine position with operative leg hanging down from the edge of the table with side thigh support. Pneumatic tourniquet was applied over upper thigh with tourniquet pressure maintained at 150 mm Hg above patients systolic blood pressure and maintained throughout the procedure after all preparation and esmarch bandage was applied to exsanguinate the limb. Entire limb was prepared after scrubbing with beta scrub. Draping was done as for standard arthroscopic procedure. A standard anterolateral and anteromedial portals for arthroscopy were established.

**Figure 3**



The arthroscope sheath with blunt trochar was introduced through anterolateral portal. The diagnostic arthroscopy was done to confirm diagnosis of ACL injury as well as to find if there are any associated injuries. After introducing arthroscope anterior cruciate ligament could be assessed by arthroscopic anterior drawer sign, empty lateral wall sign and probing. The stump of ACL was then shaved off and femoral and tibial attachments are prepared. However ACL tibial footprint was preserved.

In preparation of hamstring graft skin incision was made over the pes anserine. The surgeon should plan to

harvest graft and drill the tibial tunnel through this incision. Identify proximal thin cord like gracilis and distal flatter broad semitendinosus. Tendons are separated from superficial fat and fascia. Then free the distal end of the tendon to get the full length distally. Identify accessory bands running from semitendinosus including major band to medial gastrocnemius and this should be released. The tendon stripper is pushed up along the tendon to remove it from its muscular attachment. The tendon must be cut free from the bands that attach to gastrocnemius.

**Figure 4**



After that whip sutures were placed in each end of the gracilis and semitendinosus with no. 2 Ethibond. Both the grafts were than double to make a four strand graft. Then graft was sized for diameter and length. The tibial tunnel was drilled in a standard fashion at the site of ACL footprint, creating a tunnel that matched the diameter of the graft. A transtibial femoral tunnel was prepared using the arthrex guide enabling correct positioning of the prepared graft. The length of the femoral tunnel was measured. The size of the endobutton-CL to be used was calculated depending on the length of the femoral tunnel, length of the intraarticular graft. Then entire tunnel was drilled with 4.5 mm drill bit and calculated length of the tunnel with drill bit of size of graft.

The prepared semitendinosus and gracilis graft was passed through the loop of endobutton. Graft along with endobutton was pulled along tibial tunnel and joint through femoral tunnel. As the graft was passed through femoral tunnel and endobutton was passed past the tunnel FLIPPING was done. Once endobutton was flipped the graft was pulled back to confirm for the proper flip. This was followed by cyclic loading of the graft for approx. 30 times. Then at tibial end two loops of equal length were prepared with the Ethibond used for whip sutures. These two loops were connected to the Tie tensioner and tibial end of the graft and then subjected to about 15-20 N tension with the tensioner.

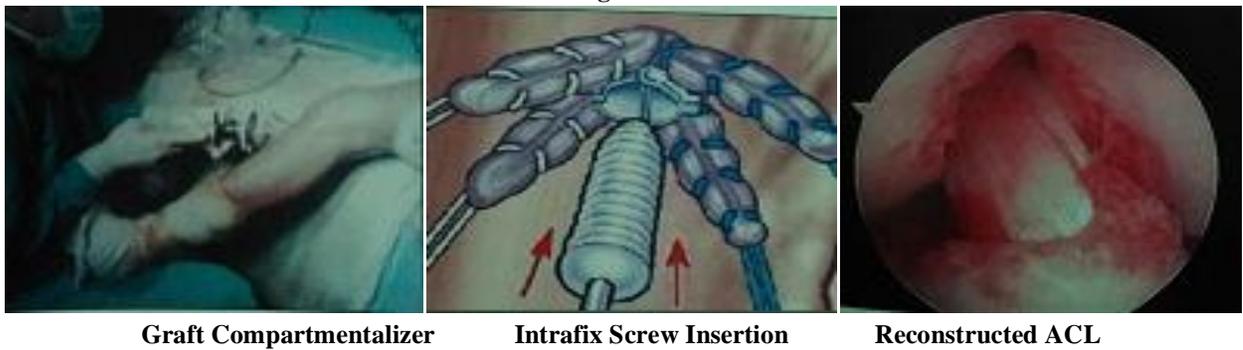
**Figure 5**



While the tension was being applied a graft compartmentalizer was used to separate four strands of graft in four different compartments. After that biodegradable tibial

sheath is inserted with the help of sheath inserter and then fixed with biodegradable intrafix tibial screw of appropriate selected size.

**Figure 6**



Postoperatively patients were given locking ROM knee brace for four weeks. Patients were followed at the end of one week for dressing, two weeks for suture removal; thereafter patients were followed up at 4 weeks, 8 weeks, 12 weeks, 6 months, 12 months and 15 months. All patients were

evaluated for pain, functioning and stability of knee using validated knee scoring system which includes VAS scales, tegner activity scale, IKDC score, knee society score and single legged Hop test.

**Figure 7: Post operative Radiograph**

### 2.1 Statistical analysis

Observations were subjected to statistical analysis. Data were reported as mean  $\pm$ SD. For categorical data, Fischer exact test was used. For continuously distributed variables, student's paired t test was used. Comparison was done between patients preoperatively and postoperatively. P-Value of 0.05 or less was considered to be statistically significant.

### 3. Observations and Result

Total 30 patients with ACL injuries were enrolled in the study; average age of the patients was 26 years with a range of 18–35 years. Of the patients, 26 were male and 4 were female, sex distribution showed male predominance in our study. Right limb was more commonly involved with road traffic injuries accounting for most of the cases followed by sports injuries as the next common cause. Medial meniscus was the most frequent finding and it was present in 9 patients with a chronic ACL deficiency whereas lateral meniscus was more commonly associated injury in acute ACL presentation. While in 14 patients there was no associated injury. Maximum patients in the study were operated within 3 months of injury while 7 patients were operated more than a

year after injury. Average duration between the injury and surgery was being 6.9 months.

The average graft size harvested with the gracilis and semitendinosus tendon was 7 mm. Most commonly endobutton of size 12 $\times$ 25 mm was used with an average total femoral tunnel length of 55 mm thereby indicating that we could achieve an excellent 30 mm intra femoral graft length in most cases. All patients achieved an average postoperative flexion and hyperextension in degree was 137.33 $\pm$ 3.40 and 8.89 $\pm$ 0.74 respectively in operated limb which was comparable to normal limb (139.17 $\pm$ 1.89 and 9.23 $\pm$ 0.82 respectively). All the operated knees were stable when tested clinically with lachman test, anterior drawer test and pivot shift test at every follow up. The single legged Hop test at 6 months was negative indicating dynamic and functional stability for all the patients post operatively.

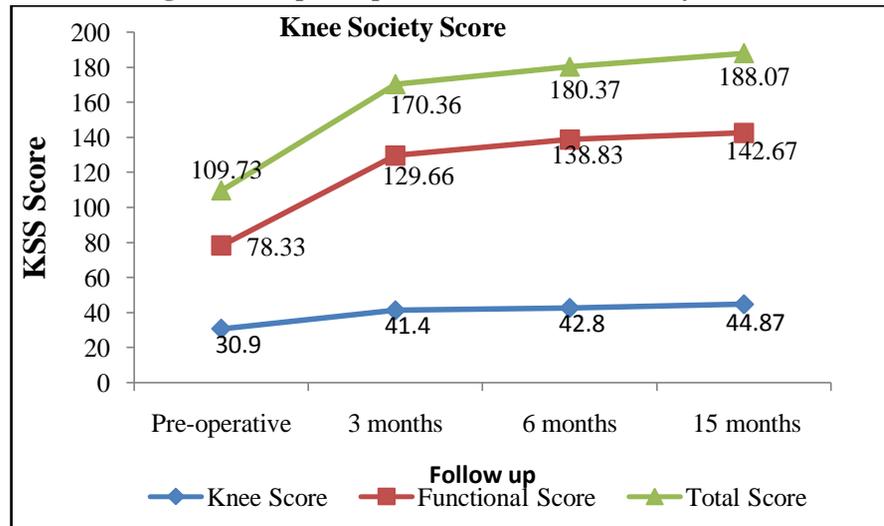
We observe significant improvement in the VAS, IKDC, knee society score and tegner activity scoring systems from preoperative to that of postoperative follow up. Significant improvement in visual analogue score indicating a pain free functional knee. However the improvement in tegner activity score shows preoperative functional status of the knee (Table 1).

**Table 1: Comparison of pre and postoperative result of validated knee scoring systems**

Validated Knee Scoring Systems	Preoperative (Mean $\pm$ SD)	Postoperative (Mean $\pm$ SD)		
		3 Months	6 Months	15 Months
VAS	5.53 $\pm$ 0.51	4.20 $\pm$ 0.61	3.03 $\pm$ 0.67	2.27 $\pm$ 0.58
Tegner activity scale	2.23 $\pm$ 0.43	3.53 $\pm$ 0.51	4.50 $\pm$ 0.57	5.60 $\pm$ 0.81
IKDC Score	50.50 $\pm$ 3.72	76.60 $\pm$ 2.85	86.03 $\pm$ 2.72	94.33 $\pm$ 1.89

Knee society score preoperative functional score and total score was improved at final follow up which show

subjective as well as objective functional improvement in the knee (Figure 8).

**Figure 8: Graphical presentation of Knee Society Score**

Post operatively all patients had a stable knee and an excellent functional outcome as shown by the various validated knee scoring systems used in the study. None of the patients developed arthrofibrosis or stiffness following the surgery. Also there were no major complications in the study and even the incidence of graft site morbidity was negligible.

#### 4. Discussion

ACL reconstruction surgery has progressed considerably in the last decade with many recent advances and new developments. A lot of studies explored many factors involved in the different technical aspects of ACL fixation. Anterior cruciate ligament tear usually leads to torsional instability of the knee joint, which can cause secondary progressive degenerative meniscal and chondral lesions [14-15]. The advantages of arthroscopically assisted anterior cruciate ligament reconstruction include elimination of capsular incisions, avoidance of desiccation of the articular cartilage, better visualization of the femoral attachment, and a lower incidence of post-operative patella-femoral pain than with open reconstruction. However importance of surgical reconstruction in the long term is to prevent onset of arthritis and associated meniscal injuries which occur in an ACL deficient knee. The primary disadvantage of arthroscopically assisted technique is that the technique has a long learning curve and is a technically demanding procedure. The results of ACL reconstruction depend on various factors like preoperative activity level of the patient, muscle strength, associated injuries and postoperative rehabilitation. Variations in operative techniques may also affect the outcome, like use of different graft, single or double bundle reconstruction and graft size and also on type of fixation methods.

In modern surgery various grafts and fixation methods are being utilized. Although various studies showed similar results with both patellar tendon and hamstrings graft types with comparable results and no significant differences providing similar objective, subjective and functional

outcomes[16-19]. Hamstrings tendons for ACL reconstruction was found to be superior in some studies and its use associated with less morbidity [12,13,20-23]. In present research we used four strands semitendinosus gracilis graft for ACL reconstruction. There has been increased use of hamstring grafts with multiple strands 80. Noyes *et al*[24] and Woo *et al*[25] have tested and compared the biomechanics of the native ACL, BPTB and hamstrings.

There are numerous ways to fix the graft into the bone tunnels. The endobutton CL fixation system was developed by Smith & Nephew to assist surgeons performing bone-tendon-bone (BTB) ACL reconstructions. This technique delivers strong fixation without the drawbacks of interference fixation such as screw divergence, posterior blow-out, laceration of the graft, the need for long grafts, and screw breakage. In addition, this technique makes it easier for surgeons to apply powerful fixation for interference fixation of the tibial bone block, namely between cortical bone on the tibia and the tibial bone block. In our study we used Endobutton –CL for femoral fixation of the graft. Endobutton –CL combines the Endobutton with a continuous loop of polyester tape resulting in one of the strongest fixation device available for soft tissue reconstruction [26].

Bioabsorbable interference screw [27] offers a number of advantages over metallic implants. Major advantage is revision ligament reconstruction surgery. Retained metal screws may be problematic at the time of revision. However, bioabsorbable screws degrade and are replaced with bone, allowing revision to be performed similar to a primary procedure. An additional advantage is the decreased likelihood of graft laceration, which has been reported with metal interference screws. The major disadvantage is screw failure; failure usually occurs during screw insertion and is related to several factors including drive shape, drive diameter, drive length, and core diameter. Tibial fixation of soft-tissue anterior cruciate ligament grafts remains challenging [28]. We used bioabsorbable intrafix

sheath-screw technique for tibial fixation of the graft. In our study average diameter of graft was 7 mm. Similarly study conducted by Laoruengthana *et al*[29] and Aglietti *et al*[16] showed averages 6 fold diameters was 9.54 and 4 fold diameter was 8 mm respectively. We used single bundle technique for ACL reconstruction that was consistent with several studies [30,31]. Also we used Mitek Tie tensioner for tensioning of the graft during fixation of the graft on tibial side of the construct. The Mitek Tie tensioner is used to equally tension each limb of the tendon graft separately to approximately 40 lb.

All patients in our series underwent accelerated protocols of knee rehabilitation with early knee movement. Literature also states that after reconstruction of the ACL accelerated<sup>32</sup> knee rehabilitation protocols are now common and not associated with an increase in complications or morbidity [33]. Our study reported that one patient had anterior knee pain and one patient had donor site pain initially in early follow up however donor site pain relieved completely at final follow up at around 15 months. Similar results of postoperative complications were shown by Kartus *et al*[34]. There is no loss of hamstring strength in our series which corresponds to study conducted by Lipscomb AB [35].

Evaluation of knee stability postoperatively showed that none of the patient had instability. Also there was no postoperative dynamic instability of operated knee as tested by a single legged hop test which was negative postoperatively in all patients at 6 months. A similar result of knee stability was found by Wang *et al*[36]. Increased stability is associated with improved ROM and decreased pain. Average postoperative ROM was to  $137 \pm 3.76$  degree in the study compared to that of normal limb to be 139.7 degree. Similar study conducted by Chen CH *et al*[37]. Preoperative VAS score was  $5.40 \pm 0.51$  which improved to a statistically significant score of  $2.25 \pm 0.63$  postoperatively. Currently activity scale and functional score reporting by the patient is an important criterion for assessment of these subjects. For assessment of score we used Tegner activity scale, IKDC score and Knee society score. All score showed significant postoperative improvement. This result correlates with different studies [36,38,39].

## 5. Conclusion

- Arthroscopic ACL reconstruction using four strands semitendinosus - gracilis graft by Endobutton- CL and Bio-Intrafix technique for fixation was an excellent modality of treatment in patients with complete ACL tears.
- It provided excellent outcomes in terms of knee stability, range of motion and functional improvement of the operated knee. The graft fixation with endobutton CL and bioabsorbable intrafix on the tibial side provided a very strong fixation thereby allowing for an accelerated rehabilitation protocol achieving early mobilization,

excellent range of motion while maintaining the knee stability.

- Thus the technique of arthroscopic ACL reconstruction using the four strand graft with the endobutton CL and bioabsorbable intrafix screw offers an excellent knee function, knee stability and restoration of preoperative functional status with minimal complications.

## Acknowledgement

We sincerely thank the department of orthopaedics, surgery, other staff of operation theatre and administration of Indira Gandhi Government Medical College and Hospital, Nagpur, Maharashtra, for permission to study and providing facility to carry out the work.

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