



## A STUDY OF FUNCTIONAL OUTCOME OF ACL RECONSTRUCTION WITH ANATOMICAL HAMSTRING TENDON AUTOGRAFT

### Orthopaedics

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### ABSTRACT

**Background:** The Anterior Cruciate ligament (ACL) is the primary stabilizer of the knee and prevents the knee against anterior translation. It is also important in counteracting rotational and valgus stress. Anterior Cruciate Ligament (ACL) reconstruction is an established and widely practiced surgical procedure with proven efficacy and a low morbidity profile. The arthroscopically aided approach has the advantages of smaller skin and capsular incisions, improved viewing of the intercondylar notch for placement of the tunnel and attachment sites, less postoperative pain, fewer adhesions, earlier motion, and easier rehabilitation. The advantages with anatomical hamstring grafts are availability of a greater sectional area and unaffected integrity of the extensor mechanism. Moreover tensile strength of quadrupled anatomical hamstring is found to be even better than a normal ACL. The rate of complications like extension loss, anterior knee pain and surgical site infections was also lower than other procedures. 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. The aperture fixation methods like the interference screws allows for early firm fixation and heal with tight bone-tendon interface. **Objectives:** To evaluate functional outcome of arthroscopy assisted ACL reconstruction with anatomical hamstring tendon graft using Endobutton and Bioabsorbable interference screw and tibial disc. **Methodology:** The study results included 30 patients admitted with clinical and radiological deficiency of ACL during October 2021 to December 2022, in Department of Orthopaedics, SMIMER Hospital, Surat. Study aims to assess the functional outcome of arthroscopy assisted anterior cruciate ligament reconstruction with anatomical hamstring tendon graft using Endobutton and Bioabsorbable interference screw and tibial disc in terms of range of motion, postoperative knee stability, graft site morbidity, subjective knee functions and prospective assessment of functional outcome using Tegner Lysholm knee scoring system. **Results:** All the patients included in the study were 23 male and 2 female patient. The analysis of the studied cases revealed that the most common affected age group was between 18 to 24 years. Majority of patients were operated more than 6 months after injury. Sports/BPET (Battle Physical Efficiency Test) injuries was the most common mode of injury. The mean size of graft used was  $8.2 \pm 0.39$ . Post-operatively at 3, 6, 12 month follow up, 1 case (4%) had a positive Pivot shift test with a "Glide" (Grade-I), whereas remaining 24 cases (96%) had a negative Pivot shift test. None of the patients had grade III laxity. The mean postoperative Lysholm score improved from pre-operative score of  $66 \pm 5.2$  to  $88.70 \pm 5.54$ . The overall satisfactory result (excellent + good) at follow up was 95%. All the patients had returned to preinjury level of activity. **Conclusion:** ACL injuries are common in younger age group individuals. Sports related injury and RTA are the most common modes of injury. Arthroscopy assisted ACL reconstruction using Anatomical hamstring tendon autograft provides a stable knee, reduces postoperative morbidity and enables early rehabilitation. Graft fixation using endobutton and Bioabsorbable interference screw will help the graft to facilitate graft tunnel healing and also maintain its strength until there is a good graft to bone healing occurs. It allows the patients to return to preinjury level of activity, allows the patient to squat, sit crossed leg and climb stairs without difficulty. Degeneration of the articular surfaces rarely occurs and the re-operation rates are minimal.

### KEYWORDS

ACL, anatomical hamstring tendon graft, Endobutton, Bioabsorbable interference screw

### INTRODUCTION

The Anterior Cruciate ligament (ACL) is the primary stabilizer of the knee and prevents the knee against anterior translation. It is also important in counteracting rotational and valgus stress<sup>[1]</sup>. The anterior cruciate ligament (ACL) is one of the most frequently injured ligaments in the human body. Estimated incidences of 0.24 to 0.34 ACL injuries per 1000 population per year have been reported. The anterior cruciate ligament (ACL) rupture is the most common serious injury of the knee<sup>[2]</sup>.

Because of its high prevalence of injury, the ACL continues to be intensively studied, and outcomes of ACL surgery receive considerable attention. Anterior Cruciate Ligament (ACL) reconstruction is an established and widely practiced surgical procedure with proven efficacy and a low morbidity profile<sup>[3]</sup>. Anterior cruciate ligament (ACL) function is closely associated with optimal activation of the muscles surrounding the knee joint. Rupture of the ACL leads to alterations in muscle recruitment patterns. It has been demonstrated that reconstruction of the ACL re-establishes muscle activation levels<sup>[4]</sup>. This has included research on technical factors such as tunnel position, graft choices, and fixation methods, as well as postoperative rehabilitation protocols. As a result, ACL reconstruction techniques have improved significantly over the last several decades<sup>[5]</sup>. Arthroscopic techniques have been advanced and refined to assist in the reconstruction of the anterior and posterior cruciate ligaments. The arthroscopically aided approach has the advantages of smaller skin and capsular incisions, improved viewing of the intercondylar notch for

placement of the tunnel and attachment sites, less postoperative pain, fewer adhesions, earlier motion, and easier rehabilitation<sup>[6]</sup>. Arthroscopically assisted ACL reconstruction using an anatomical hamstring or patella-bone- tendon-bone auto-graft is the standard surgical treatment particularly for those who are unable to perform jumping and cutting manoeuvres in sports because of resulting knee instability<sup>[7]</sup>.

Trans-portal approach for femoral tunnel preparation and placement of graft is widely used by arthroscopic surgeon with certain advantage over trans-tibial approach. Adoption of this approach has been shown improve femoral tunnel placement in terms of visualization, long horizontal tunnel placement and fewer chances for posterior blow out. Last but not the least it has obviate the need for notch plasty which is a regular procedure in trans tibial approach<sup>[8]</sup>.

ACL reconstruction with soft parts (anatomical hamstring – gracilis muscles), a method more frequently used nowadays<sup>[9]</sup>. The anatomical hamstring tendon autograft is becoming the graft of choice in anterior cruciate ligament (ACL) reconstruction. The graft with four strands of STG tightened identically has a theoretical advantage over bone patellar tendon bone graft as its mechanical resistance is superior. There are no iatrogenic complications to extensor apparatus and no anterior knee pain. The advantages with anatomical hamstring grafts are availability of a greater sectional area and unaffected integrity of the extensor mechanism. Moreover tensile strength of quadrupled anatomical hamstring is found to be even better than a normal ACL<sup>[10]</sup>.

Many studies have found that the rate of return to pre-surgical levels of activity was more than 60% after this procedure and the rate of complications like extension loss, anterior knee pain and surgical site infections was also lower than other procedures like in BPTB grafts<sup>[11]</sup>.

Various fixation methods have been described for ACL reconstruction. They can be classified into aperture fixation and suspensory methods. The suspensory methods can be sub-classified into cortical, cancellous and cortico-cancellous suspension methods<sup>[12]</sup>. Most commonly used devices for femoral fixation are interference screws, transfix screws and cortical suspension devices. 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>[13, 14, 15]</sup>. Devices for tibial fixation can be divided according to the location of fixation: intratunnel fixation and extratunnel fixation. Intratunnel fixation methods primarily rely on interference screw (metallic or bioabsorbable) or a cross pin system<sup>[16]</sup>. The aperture fixation methods like the interference screws allows for early firm fixation and heal with tight bone-tendon interface<sup>[17, 18]</sup>.

The objective of this study was to evaluate functional outcome of arthroscopy assisted ACL reconstruction with quadrupled anatomical hamstring tendon graft using Endobutton and Bioabsorbable interference screw.

## MATERIALS AND METHODS

The prospective study consists of 25 patients who had undergone Arthroscopic ACL reconstruction using Anatomical hamstring autograft at the Department of Orthopedic Surgery, SMIMER Hospital, Surat. From October 2021 to December 2022.

### Inclusion Criteria

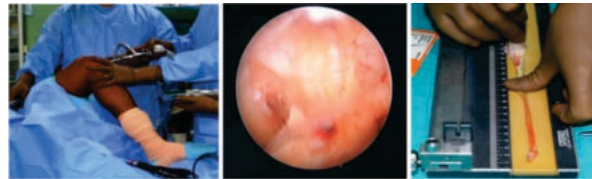
- No prior knee surgery
- Normal contralateral knee
- Clinical evaluation of instability by surgeon
- Chronic cases only

### Exclusion Criteria

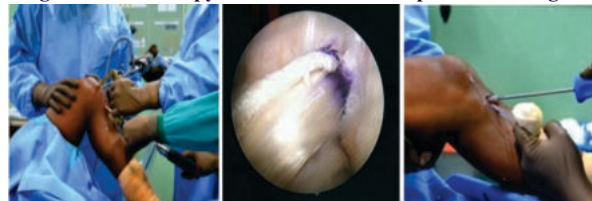
- ACL injuries with associated intra articular fractures
- Osteoarthritic changes in x ray
- Acute injury
- Associated with injuries to other structures like LCL, MCL, PCL, Chondral injuries
- Pediatric patients

### Operative Procedure

All patients were operated by single surgeon using Anteromedial portal technique. Arthroscopy assisted ACL reconstruction with single bundle quadrupled anatomical hamstring tendon autograft from ipsilateral limb using Endobutton, cortical suspensory fixation method for femoral side and Bioabsorbable interference screw, tibial fixation method for tibial side.



**Diagnostic arthroscopy      ACL tear      Preparation of ST graft**



**Preparation of tunnel      Passage of graft      Bioscrew fixation**

### Follow Up

The Patients were followed up at regular intervals at 0 to 2 weeks, 2 to 5 weeks, 5 to 12 weeks, 3 to 6 months post operatively. At these intervals the results were evaluated as per LYSHOLM KNEE SCORE.

## RESULTS

### Age Distribution

**Table 1**

| Age in years | Number | Percentage |
|--------------|--------|------------|
| 18-24 yrs    | 9      | 36%        |
| 25-31 yrs    | 5      | 20%        |
| 32-38 yrs    | 8      | 32%        |
| 39-45 yrs    | 3      | 12%        |
| Total        | 25     | 100%       |

The analysis of the age groups of the studied cases revealed that the most common affected age group was between 18 to 24 years(36%) followed by 32-38 years (32) and 25-31 years (20%).

### Side of injury

**Table 2**

| Side of injury | Frequency | Percentage |
|----------------|-----------|------------|
| Right          | 11        | 44%        |
| Left           | 14        | 56%        |
| Total          | 25        | 100%       |

### Duration from injury to surgery

**Table 3**

| Duration             | Number | Percentage |
|----------------------|--------|------------|
| Upto 3 weeks         | 0      | 0%         |
| 3 weeks – 3 months   | 4      | 16%        |
| 3 months to 6 months | 5      | 20%        |
| More than 6 months   | 16     | 64%        |
| Total                | 25     | 100%       |

In this series no patients were operated within 3 weeks after injury, 16% patients were operated within 3weeks-12 weeks (3 months) after injury, 20% patients were operated within 3 months-6months after injury and 64% patients were operated more than 6 months after injury.

### Mode of injury

**Table 4**

| Mode of injury     | Number | Percentage |
|--------------------|--------|------------|
| Sports/BPET        | 16     | 64%        |
| RTA                | 4      | 16%        |
| Fall from height   | 3      | 12%        |
| Household injuries | 2      | 8%         |
| Total              | 25     | 100%       |

In this series we had 64% patients due to sports/BPET (Battle Physical Efficiency Test) injuries as the most common mode of injury, 16% patients due to RTA, 12% patients due to fall from height and in 8% patients mode of injury was household injuries.

### Graft Size

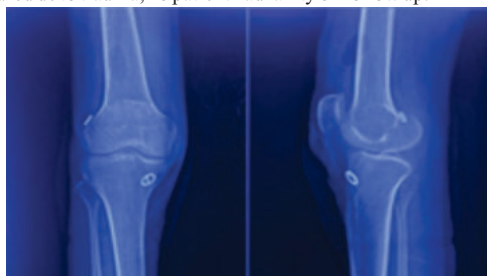
**Table 5**

|       | Number | Percentage |
|-------|--------|------------|
| 7     | 4      | 16%        |
| 8     | 13     | 52%        |
| 9     | 8      | 32%        |
| Total | 25     | 100%       |

The Graft size used consisted of graft of 7mm, 8mm and 9mm. 8mm graft was used in majority (52%) of the patients followed by 9 mm (32%) and 7 mm (16%) grafts.

### Complications

No patient had major post operative complication except one, who had reinjured de to trauma, no patient had laxity on follow up.



**Post-Operative X-Ray:**

## DISCUSSION

The advantages of arthroscopically assisted reconstruction of the anterior cruciate ligament are;

- Minimum injury to the synovial membrane of the joint.
- It achieves the goals accomplished by open operative technique.
- Less injury to patellofemoral mechanism; less frequent symptoms and minimal contractures of the patellofemoral joint post-operatively.
- The proper site for location of bone tunnels can be better identified by an arthroscopy.
- The correct relationship of the graft with respect to the lateral wall of the intercondylar notch can be established.

In this study, postoperative knee stability and functions were evaluated after anatomical ACL reconstruction, using a low accessory anteromedial portal.

The obliquity and anatomical placement of the femoral tunnel has been a major point of interest in recent research on ACL reconstruction. More vertical tunnel orientation has been correlated with rotatory instability, non-anatomical tunnel placement has been associated with pain and instability; both of which could eventually result in poor outcome and graft rupture<sup>58, 59</sup>. Kaseta et al<sup>59</sup> emphasized the importance of portal position and reconstruction surgical technique; which determines the femoral tunnel position, which ultimately affects the outcomes of ACL reconstruction.

The conventional transtibial technique, where the tibial tunnel is created first, does not allow for anatomical femoral tunnel placement. The relatively high position of the femoral tunnel requires close to perpendicular placement of a graft, which is not conducive to restoration of rotatory stability.

Modified transtibial techniques were designed to overcome the shortcomings of the traditional transtibial technique by allowing changes in the tibial tunnel position and the insertion site of a reamer<sup>60</sup> for less oblique femoral tunnel placement. However, the techniques have inherent problems: the tunnel orientation is still more oblique than that in other surgical techniques, the acceptable margin of error is narrow and the tibial tunnel to be located through the medial collateral ligament and the medial condyle or at an excessively posterior site. In a cadaveric study by Sim et al<sup>61</sup>, a modified transtibial technique was less effective than the anteromedial portal technique or outside-in technique in restoring anterior translation at 0° flexion of the knee.

The conventional anteromedial portal allows for less oblique femoral tunnel orientation compared to the transtibial technique. However, the field of view is limited by the sole availability of the anterolateral portal for arthroscopic visualization, extensive cortical bone destruction is unavoidable; in addition the femoral tunnel is relatively short compared to that in modified transtibial techniques due to the insufficient working space and angle<sup>62</sup>. Further, intraoperative visualization requires an additional procedure of removing tunneling instrument and transferring the arthroscope, which increases the risk of enlarging the tunnel diameter and changing the tunnel obliquity.

The accessory anteromedial portal technique can be an alternative to the above mentioned techniques that offers the following advantages<sup>63</sup>:

1. Femoral tunneling can be performed without interference with visualization by the lateral femoral condyle by using the anteromedial portal as a viewing portal. Tunnel position can be identified intraoperatively without removal of drilling instrument.
2. The femoral tunnel can be created close to the lateral wall of the notch by adjusting the obliquity compared to the anteromedial technique, which allows more flexibility with tunnel obliquity and length; according to bone quality, graft type, and graft fixation method.
3. Notchplasty for working space and visualization can be avoided.

As per Lysholm Knee Scoring we compared our results to the results of Lysholm and Gillquist published in 1997<sup>43</sup>. They had studied 60 cases totally and had excellent and good results in 88%; 8 % had fair results and 4% had poor outcome. As per Lysholm knee score, we also had 60% excellent results & 40 % good results.

Fox et al<sup>64</sup> published that Lysholm and Gillquist knee scoring scale was used in 12 studies and the mean score was 91 (range: 85 - 96). Ibrahim et al<sup>65</sup> study had a mean Lysholm and Gillquist score of 91.6 in the reconstructions using bone-patellar tendon-bone graft. The mean lysholm knee score of our study was 92.88.

In our study none of the patient has positive Lachman sign or Pivot shift Test in the follow up period.

None of the patient had complication in form of infection, either superficial or deep.

Almost full Range of motion has been achieved in most of the patient in the 6 months time interval.

Several factors have been identified as significantly influencing the biomechanical characteristics and the functional outcome of an ACL reconstructed knee joint. These factors are:

- (1) Individual choice of autologous graft material using either patellar tendon-bone grafts or quadrupled anatomical hamstring tendon grafts
- (2) Anatomical bone tunnel placement within the footprints of the native ACL
- (3) Adequate substitute tension after cyclic graft preconditioning
- (4) Graft fixation close to the joint line using biodegradable graft fixation materials that provide an initial fixation strength exceeding those loads commonly expected during rehabilitation.<sup>67</sup>

The long term benefits of Arthroscopic anterior cruciate ligament reconstruction are not yet determined however short term results are encouraging. There is a clear need for prospective long term (5 to 10 years) follow up studies with focus on objective measures of stability, functional outcome and onset of degenerative arthritis to scientifically investigate continued results of anatomical anterior cruciate ligament reconstruction with a focus on risk factors associated with poor outcomes.

## CONCLUSION

From the above series following conclusions are made:

- ACL injuries are common in young individual between 18.24 years of age (36%).
- Left side is more commonly affected (56%).
- Most common mechanism of injury is valgus external rotation (48%) followed by valgus internal rotation (28%) and anterior-posterior displacement. (24%).
- Medial meniscus more commonly (48%) involved than lateral meniscus (32%).
- Sports is most common cause of ACL tear (64%), followed by RTA (16%) and fall down from height (12%).
- In this series excellent results are obtained in 60% of cases where as good results are obtained in 40% of the cases, as per Lysholm knee score.
- Arthroscopic anterior cruciate ligament reconstruction reduces postoperative morbidity and enables early rehabilitation.
- Anatomical ACL reconstruction provides excellent stability especially rotational stability which was not possible in non-anatomical ACL reconstruction.

So from this series, it can be concluded that Anatomical ACL reconstruction using Anatomical hamstring Graft Technique has yielded excellent to good results in almost all patients with minimal complication and provides stable knee.

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