*Original Article*

# Evaluation of Long-term Outcome of Arthroscopic Reconstruction of Anterior Cruciate Ligament Injury by Hamstring quadrupled Auto graft fixed by Bio Screws in a tertiary level hospital

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ABSTRACT

**Background:** Hamstring tendon auto grafts in the form of quadrupled semitendinosus and gracilis (STG) has become an increasingly used alternative for anterior cruciate ligament (ACL) reconstruction. Bio screw avoids complications by decreasing possibility of graft damage. Current study was designed to evaluate arthroscopic ACL reconstruction with quadrupled semitendinosus auto graft and fixation of the graft by two biodegradable screws in both femur and tibia.

**Objectives:** This study was conducted to evaluate the outcome of arthroscopic ACL reconstruction by semitendinosus tendon autograft using biodegradable screws for both tibia and femur.
Methods: 300 patients with ACL injury admitted from January 2010 to December 2015 in the then Apollo Hospitals Dhaka (Evercare Hospital Dhaka now) were enrolled. All patients underwent ACL reconstruction surgery by quadrupled semitendinosus or gracilis auto graft fixed by Bio Screws. After discharge, these patients were followed up for 3 weeks, 3 months and final outcome was recorded after 6 years.

**Results:** 270 patients (90%) had an uneventful post-operative period. 200 patients (66.67%) complained of postoperative pain after 3 weeks, 10 patients (3.33%) complained of knee swelling, 10 (3.33%) patients had infections & 20 patients (6.65%) had knee stiffness after 6 months. Postoperatively, Lachman test improved significantly, grade 0 in 93.33% cases (280 patients) and grade I was in 6.67% cases (20 patients). Anterior drawer test was also markedly improved. Grade 0 was in 93.33% cases (280 patients) and grade I was in 6.67% cases (20 patients). According to the Lysholm Knee Scoring, the final long-term outcome was excellent in 76.67% cases (230 patients), good in 20% cases (60 patients) and fair in 3.33% cases (10 patients).

**Conclusion:** Arthroscopic reconstruction of ACL by quadrupled hamstring autograft fixed by biodegradable screws for both tibia and femur, leads good to excellent results in the majority of the cases.

**Key words:** *Arthroscopic, reconstruction, auto graft, Bio Screw*

## INTRODUCTION

Anterior cruciate ligament (ACL) is the most frequently injured ligament of the knee because of its anatomic structure, exposure to external forces and functional demand place on it[1]. It is commonly injured in athletic activities, specially contact sports and motor vehicle accidents[2]. Rupture of the ACL results from twisting injury during sports or RTA which occurs due to sudden change of direction of movement. Injuries vary in severity from a simple sprain to complete rupture[3].

Although some patients function well with an isolated ACL-deficient knee, most patients experience pain and recurrent episodes of instability in combined injuries. Thus, ACL injuries are associated with long term clinical sequelae that include meniscal tears, chondral lesions and an increased risk of early onset post-traumatic osteoarthritis (OA) [4].

The purpose of ACL reconstruction is to restore normal stability of the knee joint and to protect the knee from further injury[5]. The ideal ACL replacement graft should have structural and mechanical properties similar to the native ligament; allow safe fixation and fast biological incorporation, besides limited morbidity of the donor site. This will depend on the surgeon's experience and preference, graft availability, the patient's level of activity and comorbidities, other surgeries and the patient's preference[6]. The choice of graft for ACL reconstruction is a matter of debate, with patellar and hamstring tendons being the two most popular autologous graft options. Clinical and radiographic outcomes of ACL reconstruction with these grafts, fixed with modern devices and with use of accurate and proven surgical techniques and rehabilitation protocol, semitendinosus and gracilis grafts are equivalent option for ACL reconstruction[7].

During the last decade, hamstring tendon auto grafts in the form of tripled semitendinosus (ST) or quadrupled semitendinosus and gracilis (STG) has become an increasingly used alternative for ACL reconstruction[8].The advantages of hamstring grafts are: 1) high load to failure and stiffness; 2) a greater cross-sectional area of tendon; 3) easier passage of the graft; 4) a small incision; 5) low postoperative morbidity; and 6) less donor site morbidity[9]. Gobbi.et al. in a comparative study concluded that the use of both semitendinosus and gracillis for ACL reconstruction offers satisfactory clinical results and they did not find important differences with the final outcome[10].

Another important issue is graft fixation. Emond, et al. reported that the clinical outcome results associated with biodegradable screws and metallic screws are statistically almost similar[11]. Bio screw avoids complications associated with metal one & decreases possibility of graft damage caused by metallic screws. Metallic screws (stainless screws or stainless steel with titanium coated) have magnetic properties so, further MRI cannot be done.

Considering these facts, current study was designed to evaluate long term outcome of arthroscopic ACL reconstruction with quadrupled semitendinosus autograft and fixation of the graft by two biodegradable screws in both femur and tibia. The objectives of the study were to assess clinical improvement & functional outcome and to observe the postoperative complications.

## METHODS

This was a prospective observational study, carried out in the then Apollo Hospitals Dhaka (Evercare Hospital Dhaka now), a tertiary Hospital in Dhaka, Bangladesh. A total of 300 cases were selected for the study. Inclusion criteria of study population were unilateral ACL injury confirmed by MRI, attending Orthopaedics OPD between 16 to 45 years of age. Purposive sampling was done. Exclusion criteria were bilateral ACL injury, multiple ligamentous injuries of the knee, presence of fractures around the knee, previously operated for knee injuries, osteoarthritis of knee joint. The variables were : pain, associated injury, duration from injury to operation, hospital stay, postoperative complications, functional score and result (According to Lysholm knee score scale).

Prior approval of protocol was taken by the Institutional Review Board (IRB) of the Hospital to conduct this study. The aims and objective of the study along with its procedure, alternative diagnostic methods, risks and benefits explained to the patients in easily understandable local language and then informed consent was taken from each patient before being included in the study. Trust and good faith were established with the patient, and it was assured that all records will be kept confidential, and the procedure will be helpful for both the physician and patient in making rational approach regarding the reconstruction of ACL. The cost of biodegradable screws and other logistics required for operation and hospital cost was paid by the patient without any conflict of interest. No financial support was taken from any organization or from patients and no financial benefit was given to patients for study purposes. Guidelines of research in accordance with the ethical standard responsible committee or with the Helsinki Declaration of 1977 as revised in 1983 was followed in terms of autonomy, beneficence, non-maleficence, and justice.

The data were collected in a structured data collection form with a pre-tested structured questionnaire containing all the variables of interest. Data was collected by interview, observation, clinical examinations and radiological and imaging findings. All the patients were thoroughly evaluated both clinically and radiologically and the Lysholm Score was calculated before. The patients were then admitted after counseling for surgery and pre-operative data were collected. Then the patients were investigated for anesthetic

check-ups and prepared for the operation. An informed written consent was taken for operation and anesthesia after proper pre-operative check-up. After discussing the technique with the surgical team, operation was performed methodically, per-operative and post-operative data recorded. Follow up given after 3 weeks, 3 months , 6 months and final outcome was recorded after 6 years. All the data were edited for calculation and assessment. The data were tabulated, and quantitative parameters of patient were summarized in terms of mean with standard deviation, to understand the variations present in the data. Percentage expression for positivity of scoring estimated along with 95% confidence interval. The significance of the results as determined by 95.0% confidence interval and a value of $p < 0.05$ considered to be statistically significant. For calculations, Microsoft SPSS and Microsoft Excel software were used.

## RESULTS

Among 300 patients, the highest number of patients was 180 (60%) and were observed in 3rd decade. The lowest, 10 (3.33%), was observed in the 5th decade. The mean age was 25.13±5.90 years with a range from 16 to 45 years. All study population were male. Right side involvement was 63.33% (190 patients) and left side involvement was 36.67% (110 patients). Causes of injury included sports activity (Football, cricket, badminton, high jump etc.) 83.33% (250 patients), RTA 13.33% (40 patients) and others 3.33% cases (10 patients). 43.33% (130 patients) had isolated ACL injury, 20% (60 patients) had ACL with lateral meniscus injury, 26.67% (80 patients) had ACL with medial meniscus injury and 10% (30 patients) had ACL with both menisci injury. The mean duration from injury to operation was 11.77 months with SD (± 6.72). The mean diameter of hamstring quadrupled auto graft was 8.23 mm with SD (±0.558) and mean length was 28.57 mm with SD (±0.615). 83.33% cases (250 patients) stayed in hospital for less than 4 days after operation and 16.67% cases (50 patients) stayed for 4 to 5 days. Mean duration of hospital stay was 2.80 days and SD ±0.791. 270 patients (90%) had uneventful post-operative period in this series with 200 patients (66.67%) complained post-operative pain after 3 weeks, 10 patients (3.33%) complained of knee swelling ,10 patients had infections 20 patients(6.65%) had knee stiffness after 6 months. Pre-operative Lachman test was positive in all patients. Among them, grade II was 83.33% (250 patients) and grade III was 16.67% (50 patients). All patients had anterior drawer test positive. Among them, grade II was 90% (270 patients) and grade III was 10% (30 patients). Post operatively, Lachman test improved significantly, grade 0 in 93.33% cases (280 patients) and grade I was in 6.67% cases (20 patients). Anterior drawer test was also markedly improved. Grade 0 in 93.33% cases (280 patients) and grade I was in 6.67% cases (20 patient). In preoperative evaluation,

Lysholm Score was poor in 270 patients (90%) and fair in 30 patients (10%). According to postoperative Lysholm Knee Scoring at 6 years, the final outcome was excellent in 76.67% cases (230 patients), good in 20% cases (60 patients) and fair in 3.33% cases (10 patients). Preoperative Lysholm Knee Score was 52.93±7.14 and post-operative score was 93.43±4.05. Preoperative versus postoperative Lysholm scores showed significant improvement ($p<0.0005$). Estimate of proportion of satisfactory Lysholm Knee Score among population at 95% CI was ≈90-103.Thus among the population we found 90% to 103% satisfactory result which was quite acceptable outcome in the long term.

**Table 1:** Percentage distribution of the study population by age(n=300)

| Age group | Number of patients | Percentage (%) |
|---|---|---|
| 16-20 | 70 | 23.33 |
| 21-25 | 100 | 33.33 |
| 26-30 | 00 | 26.67 |
| 31-35 | 30 | 10.00 |
| 36-40 | 10 | 3.33 |
| 41-45 | 10 | 3.33 |
| Mean± SD: 25.13±5.90 | Range (min-max): (16-45) | |

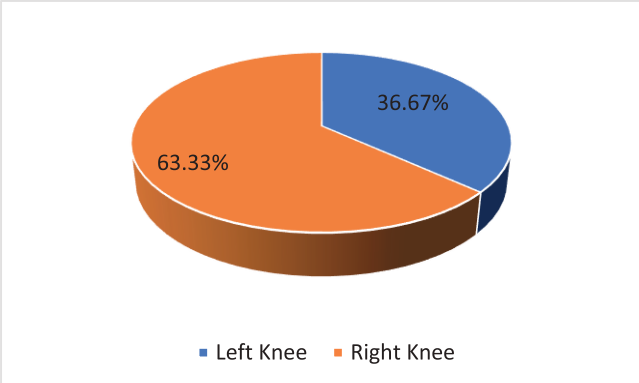


**Figure 1:** Pie-Chart Showing Side of Involvement of Patient (n=300)

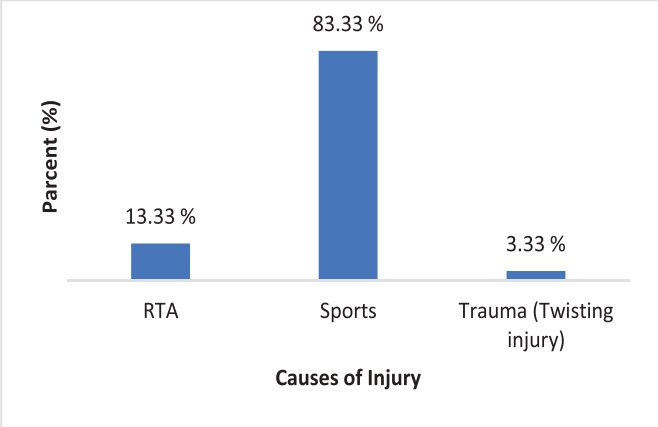


**Figure 2:** Bar-Diagram Showing Percentage Distribution of Patients According to Causes of Injury (n=300)

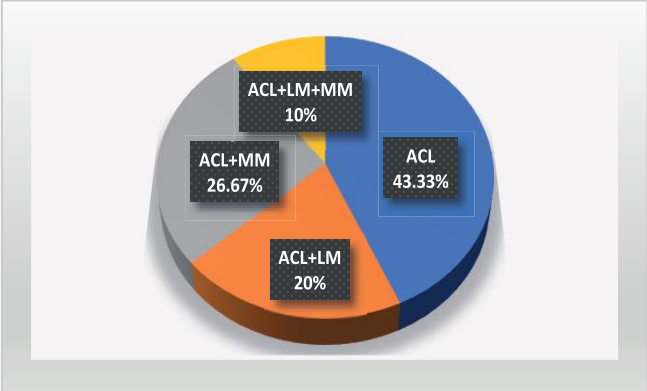


**Figure 3:** Pie-Chart showing percentage distribution of Patients According to associated injury (n=300)

**Table 2:** Duration from Injury to Operation- In Months (n=300)

| Duration of sufferings(months) | Number of patients | Percentage (%) |
|---|---|---|
| 0-10 | 140 | 46.67 |
| 11-20 | 120 | 40.00 |
| 21-30 | 40 | 13.33 |
| Total | 30 | 100 |

Mean ± SD: 11.77 ± 6.72 [Range (min -max): (3-30)]

**Table 3:** Percentage Distribution of Patients by Postoperative Hospital Stay (in days) (n=300)

| Hospital stay (days) | Number of patients | Percentage (%) | Mean ±SD |
|---|---|---|---|
| 2-3 | 250 | 83.33 | 2.80±0.791 |
| 4-5 | 50 | 16.67 | |
| **Total** | 300 | 100 | |

**Table 4:** Percentage of Postoperative Complications (n=300)

| Complications | Number of patients | Percentage (%) |
|---|---|---|
| Pain | 200 | 66.67 |
| Infection | 10 | 3.33% |
| Displacement or breakage of screw | 1 | .3% |
| Stiffness | 20 | 6.65% |
| Graft failure | 0 | 0 |
| Laxity/Instability | 0 | 0 |
| Swelling | 10 | 3.33% |

**Table 5:** Objective Clinical Outcome Evaluated at Six Years (n=300)

| Clinical Outcome | | No. of patients Pre-operative | No. of patients Post-operative | Percentage Pre-operative | Percentage Post-operative |
|---|---|---|---|---|---|
| Lachman test | G - 0 | 0 | 280 | 0.00% | 93.33% |
| | G - I | 0 | 20 | 0.00% | 6.67% |
| | G - II | 250 | 0 | 83.33% | 0.00% |
| | G - III | 50 | 0 | 16.67% | 0.00% |
| Anterior drawer test | G - 0 | 0 | 280 | 0.00% | 93.33% |
| | G - I | 0 | 20 | 0.00% | 6.67% |
| | G - II | 270 | 0 | 90.00% | 0.00% |
| | G - III | 30 | 0 | 10.00% | 0.00% |

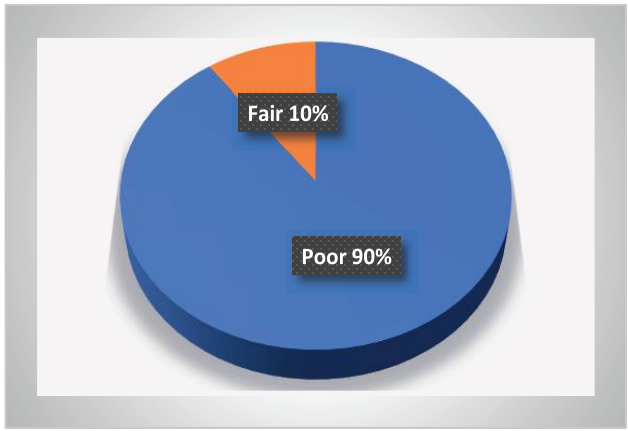


**Figure 4:** Pie- chart showing Percentage distribution of the study population by pre-operative Objective Functional Outcome evaluation according to Lysholm Knee Score (n=300)

**Table 6:** Comparison of pre-operative and postoperative Lysholm Knee Score

| Comparison | No. of the patients | Mean ± SD | P value |
|---|---|---|---|
| Preoperative | 300 | 52.93±7.14 | <0.0005* |
| Postoperative | 300 | 93.43±4.05 | |

*Significant paird sample't' test

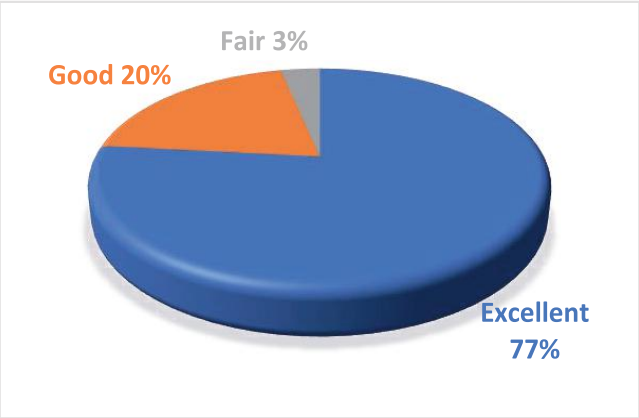


**Figure 5:** Pie- chart showing Percentage distribution of the study population by post-operative final Functional Outcome at 6years according to Lysholm Knee Score (n=300)

## DISCUSSION

Arthroscopic reconstruction of the anterior cruciate ligament (ACL) is one of the surgeries performed most often in orthopedics. Much debate continues in the current literature concerning the ideal method for ACL reconstruction. Strong suggestion for both patellar and hamstring tendon grafts, some suggest that the patellar tendon provides better stability, and others point to lower incidence of anterior knee pain with the hamstring tendon graft[12].

Clinical and radiographic outcomes of ACL reconstruction with these grafts fixed with modern devices and with use of accurate and proven surgical techniques and rehabilitation protocol, both grafts are equivalent option for ACL reconstruction[7]. But possible complication of using both the semitendinosus and gracilis (STG) tendon graft is that of hamstring strength deficit in deep flexion and internal rotation, so it is better to use only ST tendon in order to reduce donor morbidity[10]. So in this study, we evaluated the results of arthroscopic ACL reconstruction by quadrupled autograft of hamstring (gracilis or semi tendinosus) tendon, fixed with bioscrews.

We had 300 patients, mostly were male. This may be due to the fact that most of ACL injuries result from sports thus males are more prone to these kinds of injuries in our country. Age range was 16-45 years. Mean age of our study was 25.13 years with SD±5.90. Majority of the patients (60%) were within age range of 21 to 30 years. Eriksson, et al. (2001) had study over 164 patients, age ranges were between 16 and 45 years (Mean 25.7±6.9 years) which is comparable with present study[13].

It was observed that active age group was mostly affected, probably due to twisting injury of knee joint when taking part in sports and also due to RTA being exposed to the environment filled with traffic and motor vehicles. In this study, the cause of injury was recreational sports activity in 83.33% (25 patients), RTA in 13.33% (4 patients) and twisting injury due to accidental fall in 3.33% (1 patient) cases.

In this series, 26.67% patients had ACL with medial meniscus injury, 20% had ACL with lateral meniscus injury and 43.33% patients had isolated ACL injury and 10% had associated injury in both menisci. Arangio, et al. reported that ACL ruptures were often combined with meniscal tears and medial collateral ligament (MCL) ruptures[14].

The ideal time for ACL reconstruction is at least 6-8 weeks after subsidence of post-traumatic inflammatory response. Any attempt before 3 weeks of injury has a high chance of arthrofibrosis[15]. Again, too much delay does not bring good results. So, duration from injury to operation was studied. The mean duration of delay from injury to operation of our study was 51.14 weeks or 11.77 months with SD±6.72. The unusual delay is due to lack of proper equipped tertiary level hospitals with and skilled surgeon as well as patient awareness.

In another study it is observed that the use of one of hamstring tendon alone is adequate in almost all cases and the rate of insufficiency for even quadrupled reconstruction was only one in 300 cases and was almost the result of improper graft harvest[16].

In this study, 83.33% of patients stayed in hospital for less than 4 days after operation. The mean duration of hospital stay was 2.8 days and SD±0.791 days. Buss, et al. investigated 67 ACL reconstructions and found mean hospital stay was 5 days (range 3 to 8 days) [17]. This success of fast-track surgery goes to Arthroscopy. It has reduced pain, rate of infection ,patient load and upgraded service delivery.

In early postoperative period, 200 patient (66.67%) complained pain which subsided on NSAIDs and early rehabilitation .Among them 10 patient (3.33%) developed knee swelling which continued for about 6 weeks and subsided following quadriceps, hamstring and ROM exercises.

In this study, preoperative clinical evaluation showed that, all patients had abnormal knee function, mild to moderate pain, swelling, giving way. Postoperatively, all patients showed improvement in outcome. Preoperatively, Lachman test was positive in all patients. Among them, grade II was 83.3% (250 patients) and grade III was 16.67% (50 patients). 100% patients had anterior drawer test positive among them grade II was 90% (270 patients), grade III was 10% (30 patients) Post operatively, during final follow-up, Lachman test improved significantly, grade-0 in 93.3% cases (280 patients) and grade I was in 6.67% cases (20 patients). Postoperatively during final follow up anterior drawer test improved significantly, grade-0 in 93.3% cases (280 patients) and grade I was in 6.67% cases (20 patients). In another study, postoperative Lachman test was negative in 89% patients after 72 months of reconstruction of ACL by hamstring tendon[18]. Anterior drawer was positive in 10% cases. So, the present study is closely comparable with that study.

Preoperative versus postoperative Lysholm Knee Score in this series shows significant improvements ($p<0.0005$). The preoperative and postoperative Lysholm score were 52.93±7.14 and 93.43±4.05 respectively. In the study of Barber, preoperative mean Lysholm score was 46 and postoperative 90 at 28 months follow-up over 21 patients of reconstruction of ACL using semitendinosus tendon with an excellent to good results in 82% cases[15]. Wagner, et al. showed significant improvement of the Lysholm score in his study ($P<0.05$)[19]. In our study it was a long-term evaluation after 6 years(72months) and results are still satisfactory.

Gobbi. et al. recommended using the semitendinosus tendon alone yields similar results to ACL reconstruction with the semitendinosus and gracilis tendons. They observed Lysholm score 95 in the semi T group and 94 in the ST and G group, Subjective score 89% in the ST group and 87% in the ST with G group[10]. The present study was closely comparable with this study. Another study showed arthroscopic ACL reconstruction using Semitendinosus tendon graft showed 92% outcome and recommend its use[20]. Regarding the final outcome evaluated after 6 years, out of 300 patients, 290 (96.67%) had satisfactory (excellent + good), 10 (3.33%) had unsatisfactory (fair) outcome. At 95% Confidence Interval (CI), confidence level was 90% - 103%. So, among the population we found more than 90% satisfactory result in the long run by this procedure. It was quite an acceptable outcome.

## CONCLUSION

It is concluded that Arthroscopic reconstruction of ACL by quadrupled hamstring autograft fixed by biodegradable screws for both tibia and femur, leads good to excellent results in majority of the cases in the long term. It has got adequate strength, stability, less donor site morbidity and almost no anterior knee pain and is an effective procedure for treatment of ACL injury patient.

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