

Evaluation of the Results of Arthroscopic Anterior Cruciate Ligament Reconstruction by Tripled Semitendinosus Tendon Autograft Fixed by Bio Screws

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Abstract

Background: Reducing activity levels and becoming an economic burden, anterior cruciate ligament (ACL) injuries are most common in young adults as a result of sports injuries and post-traumatic knee conditions. It often leads to instability of the knee, especially during sports, exercise, or heavy work, and compels them to modify their jobs. The study's goal was to look at how well tripled semitendinosus tendon autograft reconstruction of the anterior cruciate ligament with bioscrews worked.

Methods: This quasi-experimental study was carried out in the Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh from July 2016 to April 2018. A total of 30 male patients who presented with unilateral knee complaints and were clinically diagnosed with ACL injuries attended the OPD of NITOR, Dhaka. Statistical Packages for Social Sciences (SPSS-24) and window-based Microsoft Excel were both used to analyze the results statistically.

Results: In this study, the highest number of patients was 18 (60%) observed in the 3rd decade. The lowest, 1 (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. And all of the patients were male (100%). Here are the causes of injury: sports activity 25 (83.33%), RTA 4 (13.33%), and others 1 (3.33%). And the mean diameter of the tripled ST autograft was 7.23 mm with SD (± 0.558), and the mean length was 23.57 cm with SD (± 0.615).

Conclusion: This study, which was designed to evaluate arthroscopic ACL reconstruction with a triple semitendinosus autograft and fixation of the graft by bioscrews, is justified and time-worthy.

Keywords: Bio screws; Tripled semitendinosus tendon autograft; Instability; Post-traumatic; Anterior cruciate ligament (acl)

Introduction

The knee joint is inherently unstable and depends primarily on soft tissue for stability. The knee's ability to function as a mechanism of support, balance, and thrust is attributed to its strong capsule, intra- and extraarticular ligaments, and controlling muscles [1]. The ACL, an intracapsular extrasynovial structure with a synovial envelope, is the main stabilizer of the knee for pivotal activities [2]. It plays a central role in anterior-posterior as well as rotational knee stability, where motion of the knee joint occurs in multiple planes. The anterior cruciate ligament is the most commonly injured ligament

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in the knee due to its anatomical configuration, exposure to external stresses, and functional demands [3]. It is commonly injured in athletic activities, especially contact sports and motor vehicle accidents [4].

ACL tear often results in joint effusion, affects knee stability, resulting in episodes of giving way, reduced functional performance, and may lead to the loss of an entire season or more of sports participation among young athletes [5]. As a result of the instability of the knee, there is also a decreased ability to perform strenuous activities in daily life and sports activities in young age groups, an increased risk of meniscal injuries, and early degeneration of the injured knee [6].

Chronic ACL rupture may be isolated or combined (anterolateral or anteromedial instability). Because the initial trauma or a subsequent episode of giving way frequently result in associated meniscal and collateral ligament injuries, a true isolated injury is uncommon [7]. Although some patients function well with an isolated ACL-deficient knee, most patients experience pain and recurrent episodes of instability from combined injuries. So, ACL injuries have long-lasting effects on the body, such as meniscal tears, chondral lesions, and a higher chance of developing early-onset osteoarthritis (OA) [5]. ACL tear with anterolateral or anteromedial instability, you may have problems with instability and early degenerative changes in the knee joint. Some people can compensate for the injured ligament with conservative treatment, but associated injuries to the knee contribute to the disappointing result of conservative treatment [6].

Arthroscopic reconstruction of the anterior cruciate ligament (ACL) is one of the surgeries performed most often in orthopedics. For this reason, graft type and fixation methods are studied intensively. The ideal ACL replacement graft should have structural and mechanical qualities like the native ligament, safe fixation, fast biological assimilation, and low donor site morbidity. The surgeon's experience, graft availability, patient activity, comorbidities, past procedures, and choice will impact this [8].

Another important issue is graft fixation. Today, we have basically three types of material available for use in the fixation of the graft. The fixation principle says there are three ways to hold the bone in place: the compression mechanism (interference screw) presses the graft against the bone tunnel wall; the expansion mechanism uses the initial press-fit mechanism of the graft in the bone tunnel along with transfixing pins; and the suspension mechanism (endobutton, etc.) [8].

Emond et al. [9] reported that the clinical outcome results associated with biodegradable screws and metallic screws are statistically almost similar [9]. There are no significant differences in the outcomes associated with biodegradable

screws as compared with metal screws for ACL reconstruction. Bioscrews avoid complications associated with metal screws & decrease the possibility of graft damage caused by metallic screws. Metal screws have magnetic properties, so further MRI cannot be done.

Methods and Materials

This quasi-experimental study was carried out in the Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh during July 2016 to April 2018. About 30 male patients who were presented with unilateral knee complaints and clinically diagnosed as having an ACL injury attended the OPD of NITOR, Dhaka. Inclusion criteria were unilateral ACL injury, symptomatic patient after conservative treatment of adequate duration (4-6 weeks), all sexes and between 16 and 45 years of age. Bilateral ACL injury, Multiple ligament injuries of the knee, Presence of fractures around the knee (tibial plateau, patella, femoral condyles, etc.), Patient previously operated for knee injuries, Loss of knee motion due to acute injury or stiffness, and Osteoarthritis of knee joint were excluded. Prior approval of protocol was given by Institutional Review Board (IRB) of National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Sher-E-Bangla Nagar, Dhaka, to conduct this study. The aims and objectives of the study, along with its procedure, alternative diagnostic methods, risks and benefits, were explained to the patients in easily understandable local language and then informed consent was obtained from each patient before they were included in the study. Trust and good faith were established with patient and it was assured that all records will be kept confidential and that the procedure will be helpful for both the physician and patient in making rational approach regarding the reconstruction of ACL. After taking consent and matching eligibility criteria, data were collected from patients on variables of interest using the predesigned structured questionnaire by interview and observation. 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 is determined by 95.0% confidence interval, with a value of $p < 0.05$ considered to be statistically significant. Statistical analyses of the results were obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).

Results

Distribution of patients by age. The highest number of patients was 18 (60%) observed in the 3rd decade. The lowest, 1 (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 (Figure1).

The bar diagram shows the causes of injury: sports activity (football, cricket, badminton, high jump, etc.): 83.33% (25 patients), RTA: 13.33% (4 patients), and others: 3.33% (1 patient) (Figure 2).

The pie chart shows that 43.33% (13 patients) had an isolated ACL injury, 20% (6 patients) had an ACL with a lateral meniscus injury, 26.67% (8 patients) had an ACL with a medial meniscus injury, and 10% (3 patients) had an ACL with both menisci injuries (Figure 3).

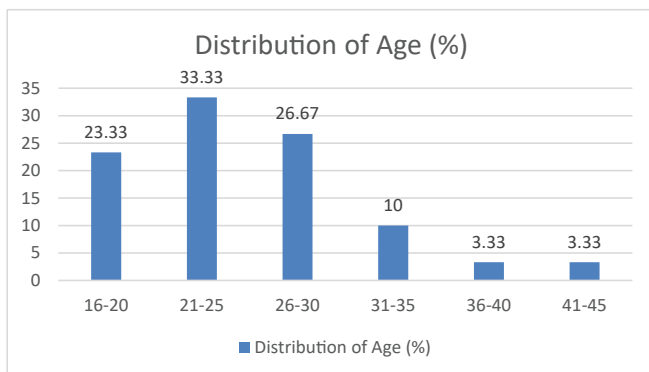


Figure 1: Percentage distribution of the study population by age (n=30).

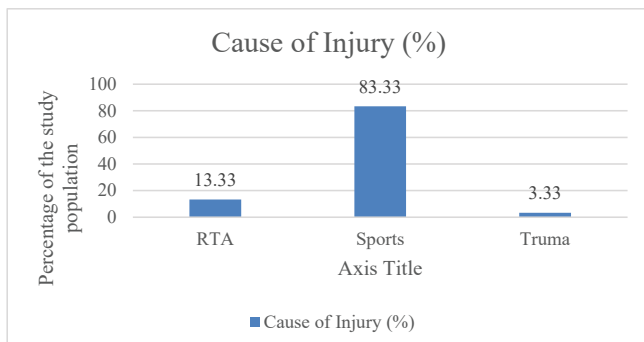


Figure 2: Bar-Diagram Showing Percentage Distribution of Patients According to Causes of Injury (n=30).

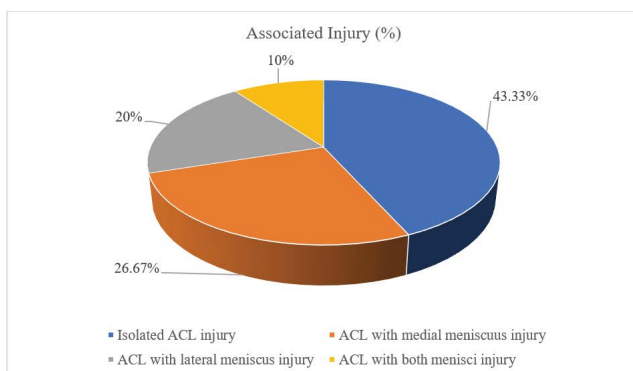


Figure 3: Pie-Chart showing percentage distribution of Patients According to associated injury (n=30).

The ideal time for ACL reconstruction is at least 6-8 weeks after the subsidence of the post-traumatic inflammatory response. Too much delay does not bring good results. So, the duration from injury to operation was studied (Table 1).

The mean diameter of the tripled ST autograft was 7.23 mm with SD (± 0.558), and the mean length was 23.57 cm with SD (± 0.615) (Table 2).

Table 1: Duration from Injury to Operation- In Months (n=30).

| Duration of sufferings(months) | n=30 | % |
|---------------------------------|-------------------------|-------|
| 0-10 | 14 | 46.67 |
| 11-20 | 12 | 40 |
| 21-30 | 4 | 13.33 |
| Total | 30 | 100 |
| Mean \pm SD: 11.77 \pm 6.72 | Range (min-max): (3-30) | |

Table 2: Diameter and Length of Tripled ST Autograft of Individual Patient (n=30).

| | Mean | SD |
|--------------------------|---------|-------------|
| Diameter of ST autograft | 7.23mm | ± 0.558 |
| Length of ST autograft | 23.57cm | ± 0.615 |

83.33% of cases (25 patients) stayed in the hospital for less than 4 days after the operation, and 16.67% of cases (5 patients) stayed for 4 to 5 days. The mean duration of the hospital stay was 2.80 days and SD ± 0.791 (Table 3).

The pre-operative Lachman test was positive in all patients. Among them, grade II was 83.33%, and grade III was 16.67%. All patients had an anterior drawer test positive. Among them, grade II was 90% and grade III was 10%. Postoperatively, the Lachman test improved significantly, with a grade 0 in 93.33% cases and a grade I in 6.67% cases. The anterior drawer test was also markedly improved. Grade 0 was in 93.33% of cases, and Grade I was in 6.67% of cases (Table 4).

The Postoperative Complications (n=30). Here, 27 patients (90%) had uneventful post-operative period in this series with 2 patients (6.67%) complained post-operative pain, 1 patient (3.33%) complained of knee swelling (Table 5).

Table 3: Percentage Distribution of Patients by Postoperative Hospital Stay (in days) (n=30).

| Hospital stays (days) | n=30 | % | Mean \pm SD |
|-----------------------|------|-------|------------------|
| 1-2 | 25 | 83.33 | 2.80 \pm 0.791 |
| 3-5 | 5 | 16.67 | |
| Total | 30 | 100 | |

Table 4: Percentage Distribution of Patients by Postoperative Hospital Stay (in days) (n=30).

| Clinical Outcome | | n=30 | | % | |
|----------------------|---------|--------------|---------------|--------------|---------------|
| | | Preoperative | Postoperative | Preoperative | Postoperative |
| Lachman test | G - 0 | 0 | 28 | 0 | 0.9333 |
| | G - I | 0 | 2 | 0 | 0.0667 |
| | G - II | 25 | 0 | 0.8333 | 0 |
| | G - III | 5 | 0 | 0.1667 | 0 |
| Anterior drawer test | G - 0 | 0 | 28 | 0 | 0.9333 |
| | G - I | 0 | 2 | 0 | 0.0667 |
| | G - II | 27 | 0 | 0.9 | 0 |
| | G - III | 3 | 0 | 0.1 | 0 |

Table 5: Postoperative Complications (n=30).

| Complications | n=30 | % |
|-----------------------------------|------|------|
| Pain | 2 | 6.67 |
| Infection | 0 | 0 |
| Displacement or breakage of screw | 0 | 0 |
| Stiffness | 0 | 0 |
| Graft failure | 0 | 0 |
| Laxity/Instability | 0 | 0 |
| Swelling | 1 | 3.33 |
| Total | 3 | 10 |

The preoperative Lysholm knee score was 52.93 ± 7.14 and the postoperative score was 93.43 ± 4.05 . Preoperative versus postoperative Lysholm scores showed significant improvement ($p < 0.0005$) (Table 6).

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

| Comparison | n=30 | % | P value |
|---------------|------|------------------|--------------|
| Preoperative | 30 | 52.93 ± 7.14 | $< 0.0005^*$ |
| Postoperative | 30 | 93.43 ± 4.05 | |

Discussion

Arthroscopic reconstruction of the anterior cruciate ligament (ACL) is one of the surgeries performed most often in orthopedics. For this reason, graft type and fixation methods are studied intensively. An ideal ACL replacement graft should include structural and mechanical characteristics that closely resemble those of the original ligament. It should also enable secure fixation and rapid biological integration while minimizing any negative effects on the donor site. The choice of surgical approach will vary based on the surgeon's expertise and desire, the availability of grafts, the patient's level of physical activity and any other existing medical conditions, previous surgeries, and the patient's personal preference [8]. Much debate continues in the current literature concerning the ideal method for ACL reconstruction. There

are suggestions for both patellar and hamstring tendon grafts; some suggest that the patellar tendon provides better stability, and others point to a lower incidence of anterior knee pain with the hamstring tendon graft [10]. Many authors have reported positive clinical outcomes following hamstring graft ACL reconstruction [11].

In this study, the age range was 16-41 years. The mean age of our study was 25.13 years, with a SD of 5.90. The majority of the patients (60%) were within the age range of 21 to 30 years. Eriksson et al. (2001) studied over 164 patients; their age ranges were between 15 and 45 years (mean 25.7 ± 6.9 years), which is comparable to the present study. It is observed that the active age group was mostly affected, probably due to twisting injuries to the knee joint when taking part in sports and also due to RTA being exposed to an environment filled with traffic and motor vehicles. In this series, 26.67% of patients had ACL with medial meniscus injury, 20% had ACL with lateral meniscus injury, 43.33% had isolated ACL injuries, and 10% had associated injuries in both menisci. Arangio et al. reported that ACL ruptures were often combined with meniscal tears and medial collateral ligament (MCL) ruptures [7].

The ideal time for ACL reconstruction is at least 6-8 weeks after the subsidence of the post-traumatic inflammatory response. Reconstruction should be performed at least 3 weeks after injury to avoid arthrofibrosis [12]. Again, too much delay does not bring good results. So, the duration from injury to operation was studied. The mean duration of delay from injury to operation of our study was 11.77 months, with a SD of 6.72. Barbara et al. reported in their study that the average length of harvested semitendinosus tendon was about 23 cm. when the tendon is folded into triple strands, this produces an overall graft length of about 7 cm [13]. Thus, an intra-articular length of 3 cm, spares 2-cm lengths for insertion into the bone tunnels (femoral & tibial). This length is sufficient for secure graft fixation. In this study, the mean diameter of tripled ST autograft is 7.23 mm with $SD \pm 0.558$ and mean length is 23.57 cm with $SD \pm 0.615$.

In this study, 83.33% of patients stayed in hospital for less than 4 days after operation. mean duration of hospital stay was 2.8 days and $SD \pm 0.791$ days. Buss et al. [14] investigated 67 ACL reconstructions and found mean hospital stay was 5 days (range 3 to 8 days) [14]. 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, 2 patient (6.67%) complained pain which subsided on NSAIDs and early rehabilitation. Among them, 1 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, and giving way. Postoperatively, all patients showed improvement in outcome. Preoperatively, Lachman test was positive in all patients. Among them, grade II was 83.3 % (25 patients) and grade III was 16.67% (5 patients). 100% patients had anterior drawer test positive; among them, grade II was 90% (27 patients), and grade III was 10% (3 patients). Post-operatively, during final follow-up, Lachman test improved significantly, with a grade of 0 in 93.3% cases (28 patients) and a grade I in 6.67% cases (2 patients). Postoperatively, during final follow-up, the anterior drawer test improved significantly, with a grade of 0 in 93.3% cases (28 patients) and a grade I in 6.67% cases (2 patients).

In the study of Barber, preoperative mean Lysholm score was 46 and postoperative 90 at 28 months followup over 21 patients of reconstruction of ACL using tripled semitendinosus tendon, with excellent to good results in 82% cases [13]. Wagner et al. [15] showed significant improvement of the Lysholm score in his study ($P < 0.05$). Gobbi et al. [16] recommended using the semitendinosus tendon alone, which yields similar results to ACL reconstruction with the semitendinosus and gracilis tendons. They observed Lysholm score 95 in the ST group and 94 in the STG group, and a subjective score 89% in the ST group and 87% in the STG group. Present study was closely comparable with this study. Waly, after his study, found that arthroscopic ACL reconstruction using triple Semitendinosus tendon graft showed 92% outcome and recommended its use [4]. Moreover, gracilis can be reserved for future use in revision ACL reconstruction and in other reconstructive surgery. So, only Semitendinosus tendon should be used whenever possible.

Conclusion

Arthroscopic reconstruction of the ACL by a tripled ST autograft fixed by biodegradable screws for both the tibia and femur leads to excellent results in the majority of cases and is an effective procedure for the treatment of ACL injury patients. It has adequate strength and stability, less donor site morbidity, and almost no anterior knee pain.

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