International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2021; 7(1): 746-750
© 2021 IJOS
www.orthopaper.com
Received: 18-10-2020
Accepted: 08-12-2020

Mohammad Mahfuzur Rahman
Consultant, Department of
Orthopaedic Surgery,
Bangabandhu Sheikh Mujib
Medical University (BSMMU),
Shahbag, Dhaka 1000,
Bangladesh

Monaim Hossen
Professor, Department of
Orthopaedic Surgery, National
Institute of Traumatology and
Orthopaedic Rehabilitation
(NITOR), Dhaka, Bangladesh

Chowdhury Iqbal Mahmud
Associate Professor, Department
of Orthopaedic Surgery,
Bangabandhu Sheikh Mujib
Medical University (BSMMU),
Shahbag, Dhaka 1000,
Bangladesh

ATM Zulfikur Rahman
Assistant Professor, Department
of Orthopaedic Surgery,
Bangladesh Medical College,
Dhanmondi, Dhaka, Bangladesh

AM Farid Uddin Ahmed
Professor, Department of
Orthopaedic Surgery, National
Institute of Traumatology and
Orthopaedic Rehabilitation
(NITOR), Dhaka, Bangladesh

Tanvir Rahman
Registrar, Department of
Orthopaedic Surgery,
Evacare Hospital, Dhaka,
Bangladesh

Corresponding Author:
Mohammad Mahfuzur Rahman
Consultant, Department of
Orthopaedic Surgery,
Bangabandhu Sheikh Mujib
Medical University (BSMMU),
Shahbag, Dhaka 1000,
Bangladesh

Evaluation of the results of arthroscopic anterior cruciate ligament reconstruction with quadruple strand hamstring autograft fixed by biodegradable screws

Mohammad Mahfuzur Rahman, Monaim Hossen, Chowdhury Iqbal Mahmud, ATM Zulfikur Rahman, AM Farid Uddin Ahmed and Tanvir Rahman

DOI: <https://doi.org/10.22271/ortho.2021.v7.i11.2565>

Abstract

Introduction: Worldwide arthroscopic surgeons commonly used hamstring tendons as the favorable graft and biodegradable screws for fixation of the graft for Anterior Cruciate Ligament reconstruction (ACLR). The present research was undertaken to evaluate the results of arthroscopic ACL reconstruction with quadruple strand Semitendinosus and Gracilis (STG) autograft and fixed by biodegradable interference screws in both tibia and femur.

Materials and Methods: This quasi-experimental research was included thirty (30) patients with ACL injuries and were treated in the form of arthroscopic reconstruction of ACL by quadruple strand hamstring autograft fixed by biodegradable screws in both tibia and femur. Preoperative and postoperative evaluations were performed according to the Lysholm Knee Scoring Scale and rehabilitation protocol was followed accordingly. Final outcome was evaluated at 24 weeks post-operatively.

Results: In pre-operative evaluation, Lysholm Knee Score was poor in 93% cases and fair in 7% cases. Post operatively significant improvement was found. According to postoperative Lysholm knee score, an excellent result was obtained in 73% cases, good in 20% cases and fair in 7% cases which showed significant improvement.

Conclusion: For arthroscopic ACL reconstruction, quadrupled hamstring autograft fixed with biodegradable screws in both tibia and femur brings an excellent and acceptable result.

Keywords: Arthroscope, anterior cruciate ligament (ACL), hamstring, autograft

Introduction

Anterior Cruciate Ligament (ACL) is an intra-articular, extrasynovial structure present in the central complex of the knee joint and it act as a primary restraint to anterior translation functions. In concert with all other intra and extra-articular structures ACL control and limit the motion of the knee and maintain both static and dynamic equilibrium^[1]. ACL tear is one of the most common sports injuries resulting from a twisting injury to the knee which can occur with a sudden change of direction, a direct blow e.g., a tackle, landing awkwardly etc. Injuries vary in severity from a simple sprain to complete rupture^[2]. Swelling usually occurs within hours and complete tear leads to instability of the knee especially during exercise or heavy work, and in such cases usually requires surgical treatment^[3]. The exact incidence of ACL injuries remains unknown, annually Anterior cruciate ligament rupture has been estimated to occur in 200,000 persons in the U.S resulting in 100,000 anterior cruciate ligament reconstruction (ACLR) each year. The controversy for managing ACL injuries now centers more on the choice of graft selection for reconstruction instead of whether surgery is necessary or not^[4]. The fundamental rationale for ACL reconstruction indicates the natural history of untreated complete injury of the ligament has been suggested to progress to symptomatic instability leading to recurrent injury, damage to the menisci and articular cartilage and develop osteoarthritis^[5].

The two most commonly used grafts are the central one-third of the patellar ligament (bone-patellar tendon-bone, BPTB) and the hamstring tendon (HT) and less commonly, quadriceps tendon and other graft are used [6]. The choice of graft for ACL reconstruction is a matter of debate, with patellar and hamstring tendons being the two most popular autograft options. Clinical and radiographic outcomes of ACL reconstruction with these grafts fixed with modern devices with proper rehabilitation techniques showed equivalent functional outcome [7]. During the last decade, hamstring tendon graft in the form of triple or quadruple ST or double STG tendons has become increasingly used for ACL reconstruction [8].

Graft fixation is another important issue in ACL reconstruction. The clinical results associated with biodegradable and metallic screws are statistically almost similar. There are no significant differences in the outcomes associated with biodegradable screws as compared with metal screw for ACL reconstruction [9]. But after use of metallic screws which have magnetic properties, further MRI cannot be done. Considering these facts, current research was designed to evaluate functional outcomes of arthroscopic ACL reconstruction with quadruple strand Hamstring autograft (Semitendinosus and Gracilis) fixed by two biodegradable screws in femur and tibia.

Materials and Methods: This quasi-experimental research

was conducted at National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka from January 2016 to December 2017. Thirty (30) patients, between 16-40 years with unilateral ACL injury after failed conservative treatment of adequate duration (4-6 weeks), with or without associated meniscus injury were purposively included after getting approval from the Institutional Review Board (IRB) of NITOR, Dhaka. However, 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 stiffness and osteoarthritis were excluded. Preoperative and postoperative evaluations were performed according to the Lysholm Knee Scoring Scale. Rehabilitation protocol was followed accordingly. Final outcome was evaluated at 24 weeks post-operatively.

To assess the patients pre-operatively, a complete history was taken, a thorough clinical & local examinations was carried out and associated injuries were noted. Preoperative radiograph and MRI (Figure-1) of the affected knee was done to assess the injury. It was ensured that patient had as near to full pain free movement as possible, the acute inflammatory phase of the injury was subsided and full range of motion and good quadriceps strength had been regained with no extensor lag (usually after 4-6 weeks of injury). Pre-operative scoring was done for comparing with postoperative outcome.

Fig 1: MRI shows torn ACL (Sagittal and coronal section)

The cases were treated in the form of arthroscopic reconstruction of ACL by quadruple strand Hamstring autograft fixed by biodegradable screws in both tibia and femur. After spinal anesthesia, Hamstring graft was harvested through an oblique incision on the antero-medial part of upper tibia mead to tibial tuberosity. Both Semitendinosus and Gracilis tendons were folded in double and were placed together to make it quadruple strand. The arthroscope was introduced and the knee was examined systematically to assess the pathology. A torn ACL was usually visualized as failing to extend to its normal femoral attachment (empty lateral wall sign). The remaining ACL tissue was removed using the basket forceps and shaver. Then femoral tunnel was

made first through accessory medial portal then tibial tunnel was made. Graft was passed through the tunnels and fixed with biodegradable interference screws in both femoral and tibial sides (Figure-2).

Patient was encouraged to lie supine with foot end elevated for 24 hours, as spinal anesthesia given during procedure. Wound inspection done on 3rd postoperative day. Only if the wound was healthy and patient's compliance for physiotherapy was assured, the patient discharged on oral antibiotics. Sutures were removed on 14th postoperative day. After reconstruction of the ACL accelerated rehabilitation protocol was followed, follow-up was recorded on two weeks, 4 weeks, 5 to 12 weeks and after 6 months.

Fig 2: a) Arthroscopic view of Torn ACL b) After ACL reconstruction

The data were tabulated, quantitative parameters of patient summarized in terms of mean with standard deviation and percentage expression for positivity of scoring were estimated along with 95% confidence interval. The significance of the results as determined in 95.0% confidence interval and a value of $p < 0.05$ considered to be statistically significant.

Results

This quasi-experimental research was carried out to evaluate the outcome of reconstruction of ACL by STG quadrupled autograft fixed by two biodegradable screws in both femur and tibia in a group of patients whose knees were otherwise normal. A total of 30 cases were selected for the research. Follow up given for 4 months to 6 months and final outcome was recorded after 6 months post-operatively.

Table-1 shows age distribution of patients and majority of the patients belongs to the age group of 21-25 years. This bar chart described the distribution of the subjects by occupation and half of the patients were students (Figure-3).

Table 1: Age distribution of patients (n=30)

Age group	Number of patients	Percentage (%)	Mean±SD
16-20	08	26.67	24.33±3.31
21-25	12	40.00	
36-30	05	16.67	
31-35	04	13.33	
36-40	01	3.33	
Total	30	100	

n: Total number of patients

Fig 3: Occupational Distribution of Patients (n=30)

In this study, more than half of the patient's right side involved and rest of the patients shows the involvement of left ACL. The bar diagram showed the causes of injury and about 80% were due to sporting activity (Football, cricket, badminton, high jump etc.) 80% (Figure-4).

Fig 4: Bar diagram showing distribution of patients according to causes of injury (n=30)

In our study, 16 patients (53%) had isolated ACL injury, 5 (17%) patients had ACL with lateral meniscus injury, 6 patients (20%) ACL with medial meniscus injury and 3 patients (10%) had ACL with both menisci injury. The ideal time for ACL reconstruction is at least after 6-8 weeks after subsidence of post traumatic inflammatory response. Too much delay does not bring good results. So, duration from injury to operation was studied. Here, mean duration was 12.83 months with SD (± 2.763). (Table-2).

Table 2: Duration from injury to operation-in months (n=30)

Duration of suffering (months)	Number of patients	Percentage (%)	Mean±SD
0-10	13	43.33	12.83±2.763
11-20	12	40	
21-30	05	16.67	
Total	30	100	

n: Total number of patients

Table-3 shows the mean diameter of quadrupled STG autograft was 7.23 mm with SD (± 0.568) and mean length was 23.57 cm with SD (± 0.626).

Table 3: Diameter and Length of Quadrupled STG autograft of individual patient (n=30)

Feature of autograft	Mean±SD
Diameter of STG autograft	7.23mm±0.568
Length of STG autograft	23.57cm±0.626

n: Total number of patients

More than half (63.33%) patients stay in hospital for less than 4 days post- operatively and rest (36.67%) patients stayed for 4 to 5 days. Pre-operative Lachman test was positive in all

patients. Among them, most of the patients was in Grade II than Grade III. All patients had anterior drawer test positive. Among them, Grade II was maximum in patients and Grade III was observed in fewer number. Pivot shift test was negative in all patients. Post operatively, Lachman test improved significantly, Grade 0 in 90% cases and Grade I was in 10% cases. Anterior drawer test was also markedly improved. Grade 0 in 96.67% cases (29 patients) and Grade I was in 3.33% cases (1 patient). Table-4 show the clinical outcome after 6 months.

Table 4: Objective clinical outcome evaluated at six months (n=30)

Clinical Outcome		No. of patient		Percentage	
		Preoperative	Postoperative	Preoperative	Postoperative
Lachman test	G - 0	0	27	0.00%	90.00%
	G - I	0	3	0.00%	10.00%
	G - II	23	0	76.67%	0.00%
	G - III	7	0	23.33%	0.00%
Anterior drawer test	G - 0	0	29	0.00%	96.67%
	G - I	0	1	0.00%	3.33%
	G - II	26	0	86.67%	0.00%
	G - III	4	0	13.33%	0.00%

n: Total number of patients

The study demonstrates that the preoperative evaluation and Lysholm Score was poor in more than 90% of patients and rest of the patients had fair score. This pie chart describes the distribution of post-operative final outcome. According to the Lysholm Knee Scoring, the final outcome was excellent in 73% cases (22 patients), good in 20% cases (6 patients) and fair in 7% cases (2 patients). (Figure-6)

Fig 6: Pie chart showing distribution of patients by final outcome (n=30)

Table-5 illustrates significant improvement between preoperative and postoperative Lysholm scores ($p < 0.0005$).

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

Comparison	No. of the patients	Mean±SD	P value
Preoperative	30	51.567±6.667	<0.0005*
Postoperative	30	92.967±5.477	

* Significant by paired sample 't' test.

Discussion

In present research, we evaluated the results of arthroscopic ACL reconstruction by quadruple strand Hamstring autograft in the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), from January 2016 to December 2017. Successful clinical outcomes following ACL reconstruction by hamstring graft have been reported by many authors [10]. 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 [11].

The demographic features of the present research showed that among 30 patients, all were male. age range was 16-40 years (mean±SD 24.33±3.31). Majority of the patients (40%) were from age 21 to 25 years. Eriksson, *et al.* (2001) had study over 164 patients, age ranges were between 15 and 45 years (mean±SD 25.7±6.9 years) which is comparable with present study. None of the patients were professional sportsman in this research. Right knee involvement was found in more cases (n=16) and left knee involvement (n=14). Sporting activity is the main cause of injury observed in this research.

Arangio, *et al.* (1998) reported that, ACL ruptures were often combined with meniscal tears and medial collateral ligament (MCL) ruptures. In this research, 20% patients had ACL with medial meniscus injury, 16.67% had ACL with lateral meniscus injury and 53.33% patients had isolated ACL injury and 10% had associated injury in both menisci [12]. The ideal time for ACL reconstruction is at least after 6-8 weeks after the subsidence of post traumatic inflammatory response. Although too much delay does not bring good results. So, duration from injury to operation was observed in this study and a mean duration was 12.83 months with SD±2.763. The mean diameter of quadrupled STG autograft is 7.23 mm with SD±0.568 and mean length is 23.57 cm with SD±0.626.

In this research, majority of patient stayed in hospital after operation less than 4 days with a mean±SD 4.833±0.679 days. Buss, *et al.* (1993) investigated 67 ACL reconstructions and found mean hospital stay was 5 days (range 3 to 8 days) [13].

Preoperative clinical evaluation showed that all patients had abnormal knee function, mild to moderate pain. Postoperatively, all patients regained normal knee function. Preoperatively, Lachman test was positive in all patients. Among them, grade II was 76.67% (23 patients) and grade III was 23.33% (7 patients). 100% patients had anterior drawer test positive. Pivot shift test was negative in all of the cases. Post operatively, during final follow-up, Lachman test improved significantly, grade-0 in 90% cases (27 patients) and grade I was in 10% cases (3 patients). In the study of Williams III, *et al.* (2004), postoperative Lachman test was negative in 89% patients after 28 months of reconstruction of

ACL by four stranded hamstring tendons. Anterior drawer was positive in 10% cases ^[13]. So, present research is closely comparable with that of the study of Williams. Preoperative versus post-operative Lysholm Knee Score in this series shows significant improvements ($p < 0.0005$). Preoperative and postoperative Lysholm score were 51.567 ± 6.667 and 92.967 ± 5.477 respectively. Wagner, *et al.* (2005) showed significant improvement of the Lysholm score in his study ($P < 0.05$) ^[14]. In the research of Williams III, *et al.* (2004), preoperative mean Lysholm score was 55 and postoperative 91 points at 2 years follow-up over 120 patients ^[15].

Gobbi (2005) reported in a comparative research where Lysholm score 95 in the ST group and 94 in the STG group and Subjective score: 89% in the ST group and 87% in the STG group ^[16]. Present research was closely comparable with this study. Regarding final outcome, out of 30 patients, 28 (93%) had satisfactory (excellent + good), 2 (7%) had unsatisfactory (fair) outcome. At 95% Confidence Interval (CI), confidence level is 84% - 102%.

In this study most of the patients showed satisfactory functional outcome in ACL reconstruction surgery with Hamstring autograft. However, our sample size was small with short postoperative follow-up period. In addition, neither second-look arthroscopy nor postoperative MRI evaluation was done to see the graft condition, even though almost all patients were asymptomatic and the knees were stable.

Conclusion

Arthroscopic reconstruction of ACL by quadruple Hamstring autograft and fixation of the graft using two biodegradable screws in both tibia and femur is an effective procedure with good functional outcome. The hamstring autograft has got adequate strength and provide excellent post-operative knee stability. In addition, very low incidence of graft donor site morbidity and almost no anterior knee pain.

Conflicts of interest

The authors declare that there is no conflict of interest.

References

1. Khera B. Arthroscopic Anterior Cruciate Ligament Reconstruction Using Bone-Patellar Tendon-Bone Autograft and Four Strand Hamstring Tendon Autograft: A Comparative Analysis. Ph.D. University of Seychelles. American Institute of Medicine 2010. Available at: www.mch-orth.com/.../dr. Vipal Khera.pdf [Assessed on 20th April 2017]
2. Nayagam S. Injuries of the Knee and Leg. In: Solomon, L., Warwick, D., Nayagam, S., editors, Apley's system of orthopaedics and fractures, 9th ed. London: Hodder Arnold, A Hachette UK Company 2010, 876.
3. Beynnon BD, Johnson RJ, Abate JA, Fleming BC, Nichols CE. Treatment of Anterior Cruciate Ligament Injuries, Part I. The American Journal of Sports Medicine 2005;33(10):1579-1602.
4. Miller III RH. Arthroscopy of Lower Extremity. Campbell's Operative Surgery, 8th ed., Copyright © by Mosby, an imprint of Elsevier Inc., St. Louis, USA 1992; 3:1787-88.
5. Frank CB, Jackson DW. The Science of Reconstruction of the Anterior Cruciate Ligament. The Journal of Bone and Joint Surgery American 1997;79-A(10):1556-76.
6. Herrington L, Wrapson C, Matthews M, Matthews H. Anterior Cruciate Ligament Reconstruction, Hamstring Versus Bone-Patella Tendon-Bone Grafts: A Systematic Literature Review of Outcome from Surgery. The Knee 2005;12(1):41-50.
7. Aglietti P, Giron F, Buzzi R, Biddau F, Sasso F. Anterior Cruciate Ligament Reconstruction: Bone-Patellar Tendon-Bone Compared with Double Semitendinosus and Gracilis Tendon Grafts: A Prospective, Randomized Clinical Trial. The Journal of Bone and Joint Surgery American 2004;86-A(10):2143-55.
8. Ejerhed L, Kartus J, Sernert N, Kohler K, Karlsson J. Patellar Tendon or Semitendinosus Tendon Autografts for Anterior Cruciate Ligament Reconstruction? A Prospective Randomized Study with A Two Year Follow Up. The American Journal of Sports Medicine 2003;31(1):19-25.
9. Emond CE, Woelber EB, Kurd BA, Ciccotti SK, Cohen MG, SB. A Comparison of the Results of Anterior Cruciate Ligament Reconstruction Using Bioabsorbable Versus Metal Interference Screws: A Meta-Analysis. The Journal of Bone and Joint Surgery American 2011;93-A(6):572-80.
10. Aglietti P, Buzzi R, Zaccherotti G, Biase PD. Patellar Tendon Versus Doubled Semitendinosus and Gracilis Tendons for Anterior Cruciate Ligament Reconstruction. The American Journal of Sports Medicine 1994;22(2):211-17.
11. Aune AK, Holm I, Risberg MA, Jensen HK, Steen H. Four-Strand Hamstring Tendon-Autograft Compared with Patellar Tendon-Bone Autograft for Anterior Cruciate Ligament Reconstruction: A Randomized Study with Two Year Follow-Up. The American Journal of Sports Medicine 2001;29(6):722-28.
12. Arangio GA, Cohen EW. Incidence of Associated Knee Lesions with Torn Anterior Cruciate Ligament: Retrospective Cohort Assessment. Journal of Sports Rehabilitation 1998;7(1):1-8.
13. Buss DD, Warren RF, Wickiewicz TL, Galinat BJ, Panariello R. Arthroscopically Assisted Reconstruction of the Anterior Cruciate Ligament with Use of Autogenous Patellar-Ligament Grafts: Results after Twenty-Four to Forty-Two Months. The Journal of Bone and Joint Surgery 1993;75-A(9):1346-55.
14. Wagner M, Käab MJ, Schallock J, Haas NP, Weiler A. Hamstring Tendon Versus Patellar Tendon Anterior Cruciate Ligament Reconstruction Using Biodegradable Interference Fit Fixation: A Prospective Matched-Group Analysis. The American Journal of Sports Medicine, 2005;33(9):1327-36.
15. Williams RJ, III, Hyman J, Petrigliano F, Rozental T, Wickiewicz TL. Anterior Cruciate Ligament Reconstruction with A Four-Strand Hamstring Tendon Autograft. The Journal of Bone and Joint Surgery American 2004;86(2):225-32.
16. Gobbi A, Francisco R. Quadruple Semitendinosus Tendon for Anterior Cruciate Ligament Reconstruction. Techniques in Orthopaedics 2005;20(3):203-6.