

Research Article

Evaluation of Surgical Outcome of Treatment of Anterior Cruciate Ligament Reconstruction by Hamstring Graft

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Abstract

Anterior Cruciate Ligament (ACL) reconstruction by surgery is an important issue for knee stability. The purpose of this study was to evaluate the surgical outcomes after ACL reconstruction using four-strand hamstrings graft. This experimental study was conducted in the department of orthopedics at Bangabandhu Sheikh Mujib Medical University, Dhaka from January 2012 to December 2014 for a period of two years. Patients presented with a symptomatic unilateral ACL rupture who were underwent ACL reconstruction by using Hamstrings graft were selected as study population. All surgery was performed by the same surgeon and the procedure was arthroscopically assisted. Operation was performed at least three weeks after initial trauma. All patients were assessed by independent examiner before surgery, and after operation at 6 months, 12 months and then annually by clinically. A total number of 35 patients were treated with hamstrings tendon as a graft. The mean age (\pm SD) was 26.97 ± 10.10 years with majority of younger (15-30 years). Maximum (71.4%) patients were male and more than one-third (37.1%) were student followed by 25.7% service holders. Monthly family income of the patients was USD 594.5 (\pm 258.1). Tegner score to assess the knee activity increased significantly from 2.1 (\pm 1.0) in preoperative to 5.8 (\pm 1.5) in post-operative. Regarding outcome of the operation, more than half (51%) found excellent and 46% cases had a good result. Surgical outcome after ACL reconstructions by hamstrings graft is outstanding. Extensive training on this procedure might accelerate the performance of orthopedic surgeons.

Keywords: Anterior cruciate ligament; Reconstruction; Hamstrings graft; BSMMU

Introduction

Anterior Cruciate Ligament (ACL) rupture is most frequent injuries of the knee joint [1]. Therefore, ACL reconstruction techniques are very crucial and have undergone an evolution over few decades both in terms of graft choice and in surgical techniques [2]. Advances in the treatment of ACL injuries include extensive investigations of injury, technical improvements providing more anatomical reconstructions with considerations of the relative success rate of the variety of graft options and effects of different rehabilitation [3].

The choice of a graft in ACL reconstruction is an important issue [4]. The four-strand band hamstrings tendon auto-graft is the most popular used grafts for ACL reconstruction [5]. There are a large number of intrinsic and extrinsic patient variables confounding the results of outcome studies for ACL reconstructions [6]. However, controversy continues over the choice of graft tissue to which graft is superior to others. Therefore, the purpose of the study was to evaluate the surgical outcomes after ACL reconstruction using four-strand hamstrings graft in Bangladesh.

Materials and Methods

An experimental study was conducted in the department of orthopedics at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from January 2012 to December 2013 for a period

of two years. Inclusion criteria were: symptomatic unilateral ACL rupture and ACL injury associated with meniscus and chondral lesion (1&2) patients willing to undergo ACL reconstruction by using hamstrings graft, were selected as study population. Exclusion criteria were: ACL rupture associated with posterior cruciate ligament injury, and lateral collateral ligament injury, previous ligament reconstruction, stage 3 & 4 chondral lesion and advanced osteoarthritis of knee were excluded from this study. All patients were diagnosed clinically, Magnetic Resonance Imaging (MRI) and arthroscopically during surgery. All surgery was performed by the same surgeon. The surgical procedure was arthroscopically assisted. Operation was performed at least three weeks after initial trauma.

Hamstring tendon graft procedure

For the patients undergoing reconstruction with the hamstring tendon graft, the graft was harvested through a longitudinal incision at the site of the pes anserinus insertion [5]. The Sartorius fascia was split, and the gracilis and semitendinosus tendons were harvested with a tendon stripper. The tendons were cleaned of adherent muscle fibers. A graft preparation device was used to tension the tendons, and the free ends of both tendons were sutured together with No. 2 polyester suture in a running baseball-style whipstitch. The tendons were looped over to create a quadruple graft, and the graft was sized between 7 and 8 mm. A titanium button (EndoButton, Smith and Nephew) was placed into the holder on the Graft Master and

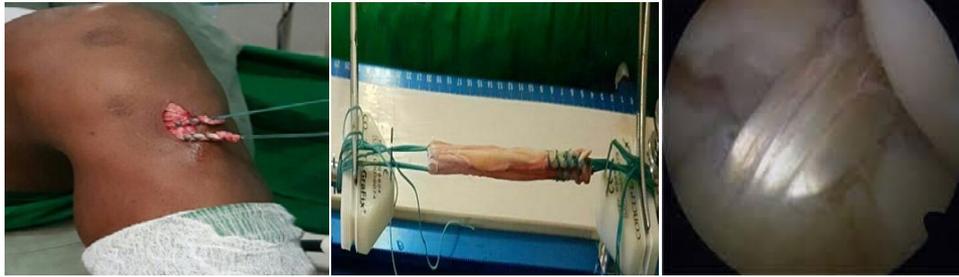


Figure 1: Hamstring graft procedure.

Table 1: Baseline information of the patients.

Variable	Frequency	Mean (±SD)
	n (%)	
Age (years)		26.97 (±10.10)
15-30 years	24 (68.6)	
31-40 years	6 (17.1)	
40 years	5 (14.3)	
Gender		
Male	25 (71.4)	
Female	10 (28.6)	
Marital Status		
Married	16 (45.7)	
Unmarried	19 (54.3)	
Occupation		
Student	13 (37.1)	
Service	9 (25.7)	
Business	4 (11.4)	
Housewife	3 (8.6)	
Sportsman	5 (14.3)	
Driver	1 (2.9)	
Monthly Family Income (USD)		594.5 (±258.1)
200-600	22 (62.9)	
601-1000	9 (25.7)	
>1000	4 (11.4)	
Type of injury		
Meniscal	6 (17.1)	
Chondral	4 (11.4)	
Both	4 (11.4)	
Other	21 (60.0)	
Meniscectomy		
Yes	7 (20.0)	
No	28 (80.0)	
Meniscus repair		
Yes	2 (5.8)	
No	33 (94.2)	

pretensioned to 20 pounds on the Graft Master while the remainder of the procedure was completed.

The tibial tunnel was prepared according to the method used for the patellar tendon grafts, but the size of the drill bit was selected according to the graft size. For the femoral tunnel preparation, a 5.5-mm offset femoral aimer was used. The guide-wire was passed through the accessory medial portal advanced completely through the femoral cortex and over drilled by a 4.5-mm drill bit. A depth gauge was used to measure the length of this tunnel. A closed-end femoral socket was drilled 25 mm into the femur with an additional 10 mm for the graft. The knee was cycled under graft tensioning to settle the EndoButton and to allow stress relaxation of the graft. The graft was tensioned and fixed with a biodegradable interference screw (RCI, Smith and Nephew) in the tibial tunnel with the knee extended (Figure 1).

Rehabilitation

Patients began immediate active quadriceps isometric and passive flexion exercises. Six weeks after surgery, full flexion was allowed, and patients were told to walk gradually without the brace. Full weight bearing was allowed after the fourth week as tolerated. Physical therapy started the day after surgery. Patients were allowed to running, riding a bicycle, swimming after 3 months of surgery, non-contact sports at six months and contact sports at 9 months.

Evaluation

All patients were assessed by an independent examiner before surgery and post operatively at 6 months, 12 months and then annually by clinically. Anterior Drawer Test (ADT), Lachman Test (LT), Pivot Shift Test (PST), Tegner Score (TS) were performed by the examiner. All patients were followed prospectively for a minimum of two years for assessment of knee stability, the ADT, LT, PST were performed. To analyze donor site morbidity including donor site pain, saphenous nerve injury, medial collateral ligament injury, premature graft amputation, and temporary hamstring weakness were assessed. For subjective satisfaction during the follow-up examination the patients were asked to evaluate their post-operative knee function and grade as excellent, good, fair or poor.

Results

A total number of 35 patients were recruited who were treated with hamstrings tendon as a graft. The mean age with SD was 26.97±10.10 years; of them more than two-thirds were younger (15-30 years). Maximum (71.4%) patients were male and more than one-third (37.1%) were student followed by 25.7% service holders. Monthly family income of the patients was USD 594.5 (±258.1). Meniscal and Chondral injury were found 6 (17%) and 4 (11.4%) cases, respectively (Table 1).

Table 2: Assessment of ligamentous stability tests of knee among the study population.

Test	Pre-operative	After 6 months	After 12 months	After 24 months
Anterior Drawer Test				
Grade 0	0 (0.0)	27 (77)	27 (77)	28 (80)
Grade 1	1 (2.9)	8 (23)	8 (23)	7 (20)
Grade 2	4 (11.4)	0 (0.0)	0 (0.0)	0 (0.0)
Grade 3	30 (86)	0 (0.0)	0 (0.0)	0 (0.0)
Lachman Test				
Grade 0	0 (0.0)	30 (86)	32 (91)	32 (91)
Grade 1	0 (0.0)	5 (14.3)	3 (8.6)	3 (8.6)
Grade 2	6 (17)	0 (0.0)	0 (0.0)	0 (0.0)
Grade 3	29 (83)	0 (0.0)	0 (0.0)	0 (0.0)
Pivot Shift Test				
Grade 0	1 (2.9)	32 (91)	33 (94)	33 (94)
Grade 1	8 (23)	3 (8.6)	2 (5.8)	2 (5.8)
Grade 2	8 (23)	0 (0.0)	0 (0.0)	0 (0.0)
Grade 3	18 (51)	0 (0.0)	0 (0.0)	0 (0.0)

Table 3: Tegner score among study population.

Tegner score	Mean (\pm SD)	P value
Pre-operative	2.1 (\pm 1.0)	< 0.001
Post-operative	5.8 (\pm 1.5)	

Table 4: Outcome of hamstring graft (n=35).

Outcome	Frequency	Percentage
Excellent	18	51
Good	16	46
Fair	1	3
Poor	0	0

When assessment of ligamentous stability was performed (Table 2), anterior drawer test showed, grade 2 and 3 were not present after 6 months, 12 months and 24 months. In grade 1 preoperatively was found only 1 (2.9%) case and 8 (23%) cases were found after 6 and 12 months. In case of Lachman test, Grade 2 and 3 were not present after 6 months, 12 months and 24 months. In grade 1 no case was found preoperatively and 5 (14%) and 3 (9%) cases were found after 6 and 12 months. Grade 2 and 3 were not present after 6 months, 12 months and 24 months when pivot shift test was performed. In grade 1 preoperatively 8 (23%) cases were found, and 3 (9%) and 2 (5.8%) cases were found after 6 and 12 months, respectively.

Tegner scores were measured pre-operatively and post-operatively. The mean score were 2.1 ± 1.0 and 5.8 ± 1.5 in pre-operatively and post-operatively. Statistically significant difference was found pre and post-operatively (Table 3). Regarding outcome of the operation excellent were 18 (51%) cases. good were 16 (46%) cases (Table 4).

Discussion

ACL injury is most commonly a non-contact injury involving a sudden stop or twisting movement, it is also known to be about three times more common in women than men [7]. But in our study

ACL was more in males because of their more active lifestyle as well as higher participation in sports and works. It is most prevalent in patients 15-45 years of age [8], which is similar with the finding in our study.

The surgical outcomes of ACL reconstruction depends on surgeon experience, correct graft position, choice of graft fixation, and postoperative rehabilitation. There are several factors related to the patient like preoperative function, concurrent intra-articular injury and physiologic and pathologic joint laxity; all these affect in the long term [9]. In this study the related factors were mentioned which can involve the outcome of the ACL reconstructions result.

Rupture of the ACL affects knee stability. This gives the symptoms in daily and sports activities, as well as increased risk of meniscal injuries and early degeneration of the injured knee [10]. If surgery is indicated, the use of autologous tendon grafts for the replacement of the injured ligament is recommended. One of the controversial topics in ACL reconstruction is the choice of a graft and its fixation [11]. We used hamstring graft during the reconstructions of ACL repair.

The mid-third patellar tendon and multiple stranded hamstring tendons (semitendinosus and gracilis) are the most frequently used auto grafts [12]. During the past few years, hamstring tendon grafts have increased in popularity [13]. Advantages of the hamstring tendon are reduced donor site morbidity associated with fewer kneeling problems and muscular deficits and less anterior knee pain in the long-term follow-up [14-16] and this is in consisted with the present study result. However, numerous clinical outcome studies comparing hamstring tendon grafts in ACL reconstructions have been published. In a meta-analysis, it has been reported a significantly poorer static knee stability after hamstring tendon ACL reconstruction [17]. However, most of these investigations included different types of fixation for the hamstring tendon graft [18]. Mechanical and biological improvements in hamstring tendon graft fixation have been achieved, such as the use of anatomical joint line fixation [19-24].

Clinical results for stability in the hamstring tendon groups were often reported in these series. Beard et al [23] showed no significant differences concerning Lysholm scores using a fixation technique with titanium interference screws for both grafts in a 1-year follow-up study of 45 patients. Aglietti et al [24] found no significant difference in the Tegner scores and significantly better ability in knee walking in the hamstring tendon group two years after surgery using titanium interference screws for both grafts. Petre et al [20] demonstrated no differences concerning stability, range of motion, and general symptoms 1 and 2 years after surgery, however, they found less thigh atrophy in the hamstring tendon group after 1 year. This difference disappeared 2 years after surgery, however, hamstring tendon patients showed significantly better ability in knee walking after 2 years.

Aune et al. [25] found superior results for single-leg hop and isokinetic knee extension tests in the hamstring tendon group at 6 and 12 months. With hamstring grafts patients suffer less quadriceps muscle wasting and able to return to sporting activity early. The chances of suffering anterior knee pain and pain on kneeling were fewer with hamstring tendon grafts [26]. Shaerf et al. [27] in fact, hamstring grafts is a good all-round graft choice with fewer donor site complications and good results.

Conclusion

The ACL reconstructions by hamstrings grafts cases have a good surgical outcome. The surgical outcomes are significantly improved after ACL reconstructions by hamstrings graft. Therefore, to accelerate the performance of orthopedic surgeons extensive training on this procedure is highly recommended in Bangladesh.

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Conflict of Interest

The authors declare there is no conflict of interest.

References

- Brand J, Weiler A, Caborn DN, Brown CH Jr, Johnson DL. Graft fixation in cruciate ligament reconstruction. *American J Sports Med.* 2000; 28: 761-774.
- Bartlett R, Clatworthy M, Nguyen T. Graft selection in reconstruction of the anterior cruciate ligament. *J Bone Joint Surg Br.* 2001; 83: 625- 634.
- Campbell J. Treatment trends with ACL, PCL, MCL and cartilage problems. ACL Study Group Meeting. Sardinia, Italy. 2004.
- Adam F, Pape D, Kohn D, Seil R. Length of the patellar tendon after anterior cruciate ligament reconstruction with patellar tendon auto-graft: a prospective clinical study using Roentgen stereometric analysis. *Arthroscopy.* 2002; 18: 859-864.
- 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. *American J Sports Med.* 2001; 29: 722-728.
- Wipfler B, Donner S, Zechmann CM, Springer J, Siebold R, Paessler HH. Anterior cruciate ligament reconstruction using patellar tendon versus hamstring tendon: a prospective comparative study with 9-year follow-up. *Arthroscopy: J Arthroscopic Related Surg.* 2011; 27: 653-665.
- Prodromos CC, Han Y, Rogowski J, Joyce B, Shi K. "A meta-analysis of the incidence of anterior cruciate ligament tears as a function of gender, sport, and a knee injury-reduction regimen". *Arthroscopy.* 2007; 23: 1320-1325.
- Griffin LY. Noncontact Anterior Cruciate Ligament Injuries: Risk Factors and Prevention Strategies. *J American Acad Orthopaedic Surg.* 2000; 8: 141-150.
- Magnussen RA, Lawrence JT, West RL, Toth AP, Taylor DC, Garrett WE. Graft size and patient age are predictors of early revision after anterior cruciate ligament reconstruction with hamstring autograft. *Arthroscopy: J Arthroscopic Related Surg.* 2012; 28: 526-531.
- Hussein M, van Eck CF, Cretnik A, Dinevski D, Fu FH. Prospective randomized clinical evaluation of conventional single-bundle, anatomic single-bundle, and anatomic double-bundle anterior cruciate ligament reconstruction 281 cases with 3-to 5-year follow-up. *American J Sports Med.* 2012; 40: 512-520.
- Dejour D, Vanconcelos W, Bonin N, Saggin PR. Comparative study between mono-bundle bone-patellar tendon-bone, double-bundle hamstring and mono-bundle bone-patellar tendon-bone combined with a modified Lemaire extra-articular procedure in anterior cruciate ligament reconstruction. *Inter Orthopaedics.* 2013; 37: 193-199.
- Sajovic M, Strahovnik A, Demovsek MZ, Skaza K. Quality of life and clinical outcome comparison of semitendinosus and gracilis tendon versus patellar tendon auto grafts for anterior cruciate ligament reconstruction an 11-year follow-up of a randomized controlled trial. *American J Sports Med.* 2011; 39: 2161-2169.
- Mohtadi NG, Chan DS, Dainty KN, Whelan DB. Patellar tendon versus hamstring tendon autograft for anterior cruciate ligament rupture in adults. *The Cochrane Library.* 2011.
- Araki D, Kuroda R, Kubo S, Fujita N, Tei K, Nishimoto K, et al. A prospective randomized study of anatomical single-bundle versus double-bundle anterior cruciate ligament reconstruction: quantitative evaluation using an electromagnetic measurement system. *Inter Orthopaedics.* 2011; 35: 439-446.
- Tsai AG, Wijdicks CA, Walsh MP, LaPrade RF. Comparative Kinematic Evaluation of All-Inside Single-Bundle and Double-Bundle Anterior Cruciate Ligament Reconstruction A Biomechanical Study. *American J Sports Med.* 2010; 38: 263-272.
- Hussein M, van Eck CF, Cretnik A, Dinevski D, Fu FH. Individualized Anterior Cruciate Ligament Surgery A Prospective Study Comparing Anatomic Single- and Double-Bundle Reconstruction. *American J Sports Med.* 2012; 40: 1781-1788.
- Frobell RB, Roos EM, Roos HP, Ranstam J, Lohmander LS. A randomized trial of treatment for acute anterior cruciate ligament tears. *New Eng J Med.* 2010; 363: 331-342.
- Guo L, Yang L, Duan XJ, He R, Chen GX, Wang FY, et al. Anterior cruciate ligament reconstruction with bone-patellar tendon-bone graft: comparison of autograft, fresh-frozen allograft, and γ -irradiated allograft. *Arthroscopy: J Arthroscopic Related Surg.* 2012; 28: 211-217.
- Park SJ, Jung YB, Jung HJ, Jung HJ, Shin HK, Kim E, et al. Outcome of arthroscopic single-bundle versus double-bundle reconstruction of the anterior cruciate ligament: a preliminary 2-year prospective study. *Arthroscopy: J Arthroscopic Related Surg.* 2010; 26: 630-636.
- Petre BM, Smith SD, Jansson KS, de Meijer PP, Hackett TR, LaPrade RF, et al. Femoral Cortical Suspension Devices for Soft Tissue Anterior Cruciate Ligament Reconstruction A Comparative Biomechanical Study. *American J Sports Med.* 2013; 41: 416-422.
- Spindler KP, Kuhn JE, Freedman KB, Matthews CE, Dittus RS, Harrell FE. Anterior cruciate ligament reconstruction autograft choice: bone-tendon-bone versus hamstring does it really matter? A systematic review. *American J Sports Med.* 2004; 32: 1986-1995.
- Muneta T, Koga H, Mochizuki T, Ju YJ, Hara K, Nimura A, et al. A prospective randomized study of 4-strand semitendinosus tendon anterior cruciate ligament reconstruction comparing single-bundle and double-bundle techniques. *Arthroscopy: J Arthroscopic Related Surg.* 2007; 23: 618-628.
- Beynon BD, Johnson RJ, Abate JA, Fleming BC, Nichols CE. Treatment of anterior cruciate ligament injuries, part I. *American J Sports Med.* 2005; 33: 1579-1602.

25. 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. *J Bone Joint Surg Am.* 2004; 86: 2143-2155.
26. Aune AK, Holm I, Risberg MA, et al. Four-strand hamstring tendon autograft compared with patellar tendon-bone autograft for anterior cruciate ligament reconstruction: a randomized study with two-year follow-up. *Am J Sports Med.* 2001; 29: 722-728.
27. Reed MR. Anterior Cruciate Ligament Reconstruction with Patellar or Hamstring Tendon Grafts: A Review of the Evidence. *West London Medical Journal.* 2009; 1: 1-6.
28. Shaerf DA, Pastides PS, Sarraf KM, Willis-Owen CA. Anterior cruciate ligament reconstruction best practice: a review of graft choice. *World J Orthop.* 2014; 5: 23-29.