

Research Article

Arthroscopic and Open Anterior Cruciate Ligament Reconstruction with Patellar Bone-Tendon-Bone Graft in Young Adult Knee

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Abstract

Objective: To compare the outcome of arthroscopic assisted Anterior Cruciate Ligament (ACL) reconstruction of knee with limited open anterior cruciate ligament reconstruction in young patient with complete anterior cruciate ligament rupture.

Methods: This randomized controlled trial single blinded study using probability simple rando sampling was conducted from October 2014 to October 2016. Total 30 patients fulfilling the inclusion and exclusion criteria were divided into two groups on the basis of availability of expertise of arthroscopy surgeon. Patients in group A was managed with arthroscopic ACL reconstruction while patient in group B were managed with limited open reconstruction. Each group consisted of 15 patients. The bone-tendon-bone was utilized as the graft material to reconstruct the ACL in both the groups. Rehabilitation protocol was same for both the groups. Duration of surgery, loss of range of motion (ROM) and Tegner Lysholm Knee score were compared in patients of both groups after 6 months of surgery.

Result: Mean age of the patient in group A was 24.33 ± 3.73 years (range 18-32 year) while that in group B was 24.89 ± 5.37 years (range 18-34 years). The duration of surgery was statically significantly high in arthroscopic ACL reconstruction than that in open ACL reconstruction (92.00 ± 2.64 vs 68.07 ± 3.63 minutes in group A and B respectively) with p-value less than 0.0001. Loss of ROM at the end of 6th month was comparable (6.000 ± 1.19 versus 5.730 ± 1.33 in group A and B respectively) between the two groups with p-value of 0.526 at 95% confidence interval. We had 86.67% (13) patient in group A and 80% (12) in group B with good- excellent result according to Tegner Lysholm knee score. There was no statistically significant difference in Tegner Lysholm test between two groups with p-value of 0.497. Two patients in group A and 3 in group B had superficial wound infection. Two patients in group B had failure of graft following RTA. All the patients from both group had lost sensation on the anterior aspect of knee in both groups.

Conclusion: The result did not substantiate superiority of either technique in terms of functional outcome. However, arthroscopic ACL reconstruction required more surgical time than the limited open technique.

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Introduction

The most frequent ligament injury of the knee is the rupture of ACL and is usually a result of participation in sports and other recreational activities.¹ Here, 50–80 % of ACL injuries befall in non-contact situations.²

It has been found that the patients who undergo ACL reconstruction has fewer subsequent meniscal injuries, less need for further surgery, and significantly greater improvement in activity level as measured with the Tegner score.³

In the preceding few decades, operative techniques for reconstruction of the ruptured ACL have seen vast advancements, from open and mini-open techniques with 1 or 2 incisions to arthroscopic techniques, various graft varieties, multiple bundle techniques, and change of graft placement.⁴ When endoscopic techniques are compared with open approaches, numerous advantages have been described: smaller incisions;⁵ avoiding lateral femoral incision, giving easier rehabilitation and improved quadriceps function;⁶ more precise visualization and exact location of the tunnels for improved biomechanics, enhanced stability and less osteoarthritis and more rapid rehabilitation.⁷ But there are studies which have shown no added benefits of arthroscopic assisted ACL over open ACL in aspects of rehabilitation,⁸ duration of hospital stay, quantity of pain killers given, or range of motion (ROM).⁹

Although arthroscopic techniques are most common today, huge patient cohorts were treated earlier with open surgery. In addition, the open and/or 2-incision techniques are still favored by many surgeons.⁴ No recent publications are available that compares the result of arthroscopic reconstruction to limited open ACL reconstruction.

The objective of this study was to decide the merits of either technique over one another, and to quantitate any significant disadvantage of open technique compared to arthroscopic technique.

Method

This randomized controlled trial single blinded study using probability simple random sampling technique was conducted in the Department of Orthopaedic

Surgery and Traumatology of Mayo Hospital Lahore, unit-I from October 2014 to October 2016. Total of 30 young patients (18-45 years) with history of knee instability for more than 03 months following road traffic injury or twisting during recreational activity were evaluated clinically by anterior drawer test and Lachman test. Those with clinical diagnosis of anterior cruciate ligament (ACL) injury were subjected to Magnetic resonance imaging (MRI) were included in the study. Those patients with previous procedure on knee, multiple ligament injury on MRI and required no extra-articular reconstructions were not included in this study.

Approval from institutional review board was obtained. Following evidence of ACL injury on MRI these patients were divided into two groups by lottery method. Informed consent was obtained. All patients in group-A that were managed with arthroscopic assisted ACL reconstruction. In group-B all patients were managed with limited open ACL reconstruction due to unavailability of expertise for arthroscopic ACL reconstruction. Bone- tendon- bone graft was used in all patients.

Follow-up was conducted at 2nd, 6th, 12th and 24th weeks by the surgeon and his colleague. All patients took part in identical postoperative rehabilitation protocols. Immediate weight bearing was tolerated with crutches. The knee was immobilized in full extension. Physical therapy began on the 1st postoperative day. In first 6 weeks, ROM exercises and slight strengthening were the main aim of physical therapy. At 6th weeks, increased strengthening exercises along with different closed-chain exercises were performed. Progression of physiotherapy was increased to allow sports and other vigorous activities around 24 weeks.

Variables studied were time since injury, operative time and loss of range of motion (ROM) following surgery. The functional outcome was monitored by calculating Tegner Lysholm knee score¹⁰ at 24th week. This score has eight items. It has 25 points for pain, 25 points for instability, 15 points for locking, 10 points for swelling, 5 points for limp, 10 points for climbing stairs, 5 points for squatting and 5 points for need of support. The total score sum may range from 0-100. It has been graded as excellent (>90), good (84-90), fair (65-83) and poor (<65) score from eight items⁽¹¹⁾. Complications like superficial wound infection, septic arthritis, graft failure, posterior cruciate

ligament injury were also inquired about.

Data was analyzed using SPSS 20.0. The quantitative variables like age, duration since injury, duration of surgery and loss of ROM is presented as mean and standard deviation. The qualitative variable like sex and Tegner Lysholm knee score is presented as frequency and percentage. "independent sample t test" has been applied to compare the Tegner Lysholm knee with categorical variable i.e gender between the two groups taking $p\text{-value} \leq 0.05$ as significant for functional outcome.

Longitudinal incision was used to harvest graft from central one third of the patellar tendon for the patients being managed by arthroscopic assisted bone-patellar tendon–bone (PTB) reconstruction of ACL. It had 25-mm of trapezoidal bone from patella and a 25-mm of rectangular bone from tibial tuberosity. A 9-mm diameter gauge was used to size the bone block. A lateral portal was used for intra-articular procedure via an arthroscope and a medial portal was used for instrumentation. At 450 to the tibial tubercle, a guide wire was advanced to the preserved foot print of ACL from the medial side of the tibia. A 9mm cannulated was used to drill over this guide wire. A guide wire was advanced in the femur through this tibial tunnel and was drilled to the depth of 25 mm using 9mm cannulated drill over this guide wire. The graft was delivered into the knee via the tibial and femoral tunnel and was secured using a titanium interference screw of 7 X 25-mm. The knee was cycled under graft tensioning for the stress relaxation of the graft.

The graft was obtained by the same technique used in arthroscopy. The limited open ACL reconstruction uses the arthrotomy in the patellar tendon defect for the surgical procedure of harvesting, drilling, and fixation. All the instruments that are used for arthroscopic reconstruction were used. Self-retaining retractor with a light source was used for proper visualization. Fat pat were removed in all the cases managed by this modality of treatment procedure.

Results

Mean age of the patient in group A was 24.33 ± 3.73 years (range 18-32 year) while that in group B was 24.89 ± 5.37 years (range 18-34 years). The sex distribution and average duration since injury in group A was 6.53 ± 1.25 months (range 4 to 8 months) while that in group was 6.67 ± 1.18 months (range 5 to 9 months) are shown in table 01.

The duration of surgery was statically significantly high in arthroscopic ACL reconstruction than that in open ACL reconstruction (92.00 ± 2.64 vs 68.07 ± 3.63 minutes in group A and B respectively) with p-value less than 0.0001. Loss of ROM at the end of 6th

month was comparable (6.000 ± 1.19 versus 5.730 ± 1.33 in group A and B respectively) between the two groups with p-value > 0.05 at 95% confidence interval. We had 86.67% (13) patient in group A and 80% (12) in group B with good- excellent result according to Tegner Lysholm knee score. Using independent sample T-test, there was no statistically significant difference found in Tegner Lysholm knee score for functional outcomes with gender of the patients between group A and B with p-value of 0.422 (Table 02).

Two patients in group A and 3 in group B had superficial wound infection that was managed with dressing and intravenous antibiotics. Two patients in group B had failure of graft following RTA which was managed by interval reconstruction using semi-tendinous graft. All the patient had loss or disturbed sensation on the anterior aspect of knee. No case of osteoarthritis was seen in any case of this study.

Discussion

Advantages of arthroscopic reconstruction of ACL over the open reconstruction has been widely advocated. No studies on outcome following limited open arthrotomy reconstruction of ACL has been conducted in last few years. This may be due to preference of surgeons for arthroscopic over open reconstruction of ACL in chronic laxity of the knee. However, abandoning open reconstruction of ACL in absence of arthroscope in center, lack of instrumentation and expertise may deprive the patient of necessary care and these patients may end up with meniscal injury, early development of osteoarthritis

Table 1: Demographic Data of Gender, Age and Duration of Injury

Variables	Group A (n=15) (%)	Group B (n=15) (%)	Total (N=30) (%)
Gender of the Patient			
• Male	12 (80%)	10 (66.7%)	22 (73.4%)
• Females	03 (20%)	05 (33.3%)	08 (26.6%)
Age Mean (Years) Mean±S.D	24.33± 3.73	24.89± 5.37	
Duration of Injury (Months) Mean±S.D	6.53± 1.25	6.67± 1.18	

Table 2: Independent Sample T Test of Comparison of Tegner Lysholm Knee Score between the Two Study Groups

Variables	n	Mean	Standard Deviation	Standard error of Mean	p-value
Tegner Lysholm knee score					
• Group A	15	86.56	8.303	1.731	=0.422
• Group B	15	89.28	3.039	1.148	

(OA) and modification of activities due to inability to return of activity to preinjury level.¹²

In a study conducted by Levy et al, in his metanalysis compared outcome of arthroscopically ACL reconstruction to open reconstruction through limited open in terms of duration of surgery, duration of hospital stays, and quantity of pain medicine required. They also obtained Lysholm scores at 16th and 24th week follow-ups. Besides more operative time for arthroscopic group, there was no significant difference with p-value less than 0.02. They had 84% and 91% good-excellent results in open and arthroscopic group respectively.¹³ Their results were similar to our study where we also had statically significant less operative time for limited open arthrotomy group (68.07±3.63 minutes) compared to arthroscopic group (92.00±2.64 minutes) with p-value less than 0.0001. We had 86.67%¹³ group A patient and 80%¹² group B patient who had good- excellent result according to Tegner Lysholm knee score.

In a meta-analysis conducted by Freedman et. al., the mean Lysholm knee score in ACL reconstruction using arthroscopy was in the range of 85-96 which was comparable to our study.¹⁴ It has been postulated that arthroscopic reconstruction allows for more accurate visualization and precise placement of the tunnels for better biomechanics; better stability and less osteoarthritis.⁷

Evaluation of accuracy of graft placement was not studied in either technique of this study. The patients will be followed up for 2 years. We currently have no reason to suspect change in the outcome over the follow-up period. However, development of secondary changes in the joint requires long-term follow-up.

We thus suggest long term follow-up to suggest limited open ACL reconstruction in centre with no arthroscope and to expect the same functional outcome.

Conclusion

The result did not substantiate superiority of either technique in terms of functional outcome. However, arthroscopic ACL reconstruction required more surgical time than the limited open technique.

References

- Lai CCH, Feller JA, Webster KE. Fifteen-Year Audit of Anterior Cruciate Ligament Reconstructions in the Australian Football League From 1999 to 2013: Return to Play and Subsequent ACL Injury. *Am J Sports Med* 2018;46(14): 3353-60.
- Saw R, Finch CF, Samra D, Baquie P, Cardoso T, Hope D et al. Injuries in Australian Rules Football: An Overview of Injury Rates, Patterns, and Mechanisms Across All Levels of Play. *Sports Health*. 2018; 10(3):208-16.
- Chalmers PN, Mall NA, Moric M, Sherman SL, Paletta GP, Cole BJ, et al. Does ACL Reconstruction Alter Natural History? *J Bone Joint Surg Am*. 2014;96(4):292-300.
- Paschos NK. Anterior cruciate ligament reconstruction and knee osteoarthritis. *World J Orthop*. 2017; 8(3):212-7.
- Malahias MA, Chytas D, Nakamura K, Raoulis V, Yokota M, Nikolaou VS. A Narrative Review of Four Different New Techniques in Primary Anterior Cruciate Ligament Repair: "Back to the Future" or Another Trend?. *Sports Med Open*. 2018;4(1):1-7.
- Paschos NK, Howell SM. Anterior cruciate ligament reconstruction: principles of treatment. *EFORT Open Rev*. 2016;1(11):398-408.
- Mahapatra P, Horriat S, Anand BS. Anterior cruciate ligament repair - past present and future. *J Exp Orthop*. 2018;5(1):1-10.
- Yanasse RH, Lima AA, Antoniassi RS, Ezzedin DA, Laraya MH, Mizobuchi RR. Transtibial technique versus two incisions in anterior cruciate ligament reconstruction: tunnel positioning, isometricity and functional evaluation. *Rev Bras Ortop*. 2016; 51(3): 274-81.
- McDonall J, de Steiger R, Reynolds J, Redley B. Patient participation in postoperative care activities in patients undergoing total knee replacement surgery: Multimedia Intervention for Managing patient Experience (MIME). Study protocol for a cluster randomised crossover trial. *BMC Musculoskeletal Disord* 2016;17(3):1-10.
- Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res*. 1985;Sep;(198):43-9.
- Desai VS, Anderson GR, Wu IT, Levy, BA, Dahm, et al. Anterior Cruciate Ligament Reconstruction With Hamstring Autograft: A Matched Cohort Comparison of the All-Inside and Complete Tibial Tunnel Techniques. *Orthop J Sports Med*. 2019;7(1):1-7.
- Shahpari O, FallahKezabi M, Kalati HH, Bagheri F, Ebrahimzadeh MH. Clinical Outcome of Anatomical Transportal Arthroscopic Anterior Cruciate Ligament Reconstruction with Hamstring Tendon Autograft. *Arch Bone Jt Surg*. 2018;6(2):130-9.
- Levy DM, Erickson BJ, Bach BR. Open versus arthroscopic anterior cruciate ligament reconstruction: a systematic review of randomized controlled trials. *Current Orthopaedic Practice* 2017; 28 (5): 449-52.
- Samuelsen BT, Webster KE, Johnson NR, Hewett TE, Krych AJ. Hamstring Autograft versus Patellar Tendon Autograft for ACL Reconstruction: Is There a Difference in Graft Failure Rate? A Meta-analysis of 47,613 Patients. *Clin Orthop Relat Res*. 2017; 475(10): 2459-68.