

Functional outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Autograft and Endo button with Supervised Physical therapy Rehabilitation.

Javed Iqbal¹, Zainab Aqeel Khan², Faizan Hassan³, Behram Sidhwa⁴, Zeeshan Khan⁵, Umer Butt⁶

¹Consultant Orthopaedic surgeon, Sports Medicine / Arthroscopy Super-specialty Fellow at AO Hospital Karachi

²Doctor of Physical Therapist and Clinical Research Lead, AO Hospital, Karachi, Pakistan

³Doctor of physical therapist, Physiotherapist, Dr. Ziauddin Hospital, Karachi, Pakistan

⁴Medical officer, Civil hospital, Karachi

⁵Consultant Orthopaedic Surgeon, Hayatabad Medical Complex, Peshawar and AO Hospital, Karachi, Pakistan

⁶Consultant Orthopaedic and Sports Injury Surgeon, AO Hospital, Karachi, Pakistan and Circle Bath Hospital, UK

Authorship and contribution

Declaration: Each author of this article fulfilled ALL 4 Criteria of Authorship:

1. Conception and design or acquisition of data, or analysis & interpretation of data. 2) Drafting the manuscript or revising it critically for important intellectual content. 3) Final approval of the version for publication. 4) All authors agree to be responsible for all aspects of their research work

Corresponding author:

Javed Iqbal
E-mail: drorthopda@gmail.com

ABSTRACT

Objective: To determine the functional outcome of arthroscopic anterior cruciate ligament reconstruction (ACLR) using hamstring tendon as autograft and endobutton followed by supervised physiotherapy.

Methods: This descriptive study was conducted in AO hospital Karachi from 2nd April 2017 to 2nd December 2020. All patients with Anterior Cruciate Ligament (ACL) tear meeting the inclusion criteria were operated arthroscopically for anterior cruciate ligament reconstruction (ACLR) using hamstring tendon as autograft and endobutton followed by 6 weeks supervised physiotherapy. The functional outcome was assessed with knee range of motion, Tegner-Lysholm score and International Knee Documentation Committee (IKDC) at 3rd, 6th and 12th months follow up and compared with pre-operative values. *P* value was calculated with Chi-square test for statistical significance. *P* value < 0.05 was considered significant.

Results: The total number of patients in our study were 79. The mean age was 25±3 years (range 18 to 40 years). Full range of knee motion (118±6°) was achieved in 75(95%) patients. The mean pre-operative IKDC score of 38.95±5 improved to 67.92±2 at 6th months and to 90.73±7 at 12th months follow up. The mean pre-operative Tegner-Lysholm score of 51 (poor) improved to 87 (good) at 6th months and 97 (excellent) at 12th months. The Lachman's test and pivot shift test was negative in all patients postoperatively and 56(70.8%) patients could performed single legged hopping test without any difficulty at 6th months post operatively.

Conclusion: Anterior Cruciate Ligament Reconstruction (ACLR) using hamstring tendon autograft with endobutton fixation and supervised rehabilitation yielded excellent functional outcomes in majority of our patients. We therefore recommend this protocol as treatment of choice for all patients with ACL tear.

Keywords: Anterior cruciate ligament, Arthroscopy, Endobutton, Hamstring tendon, Ligament injury, Rehabilitation

This article may be cited as:

Iqbal J, Khan ZA, Hassan F, Sidhwa B, Khan Z, Butt U. Functional outcome of Arthroscopic Anterior Cruciate Ligament Reconstruction Using Hamstring Autograft and Endo button with Supervised Physical therapy Rehabilitation J Pak Orthop Assoc. 2021;33(1):

INTRODUCTION

The Anterior Cruciate Ligament (ACL) injury change the kinematic gait and shifts the ambulatory forces to the articular cartilage thus increasing the wear and tear that leads to early degenerative changes.¹⁻³ It has been reported in the literature that 60% of patients who undergo anterior cruciate ligament

reconstruction (ACLR) are recreational sportsmen or athletes.¹ ACLR is considered as the gold standard specially for athletes with unstable knee.⁴ Although bone-patellar tendon-bone (BPTB) reconstruction is the most popular and commonly used technique for ACLR⁴ annoying patellofemoral problems and anterior knee pain is the cause of unsatisfactory outcome in

many patients.⁵ There has been increasing use of hamstring tendon graft for primary ACLR^{4,5} and comparable results to patellar tendon autograft for ACLR have been achieved with minimum harvest-site symptoms and early degenerative changes.⁶ However, post operative physiotherapy is of paramount importance for achieving excellent functional outcome. Literature supports the role of supervised physical therapy in improving clinical outcomes and early return to sporting activities after ACLR surgeries.⁷⁻¹⁰ Negligence in post-operative supervised rehabilitation can lead to poor functional outcomes especially in athletics who wish early return to their sporting activities.^{7,9} Carelessness towards post operative physical therapy is due to lack of awareness specially in developing countries.¹⁰

The objective of our study was to determine the functional outcome of arthroscopic anterior cruciate ligament reconstruction (ACLR) using hamstring tendon as autograft and endobutton followed by

supervised physiotherapy. The results of our study will highlight not only the usefulness of our surgical technique but stressed upon the importance of physical therapy.

METHODS

We conducted this descriptive study in the AO hospital Karachi from 2nd April 2017 to 2nd December 2020. Patients of all age with symptomatic isolated ACL tear were included in our study. Patients with cartilage damage, meniscal tear, multi-ligament injuries and prior knee surgery on the injured or contralateral knee were excluded from the study. The study protocol was approved by the Ethical Committee of our hospital. Informed written consent for surgery and publication was taken from all the study participants. In the included subjects complete history, physical examination and relevant investigations (Radiographs, MRI) were ordered.

Table I: Hospital designed rehabilitation program after ACLR according to the recovery phase.

Phases	Weeks	Exercises	Criteria to start a new phase
Phase I	Week 1	<ul style="list-style-type: none"> Ice pack for pain and swelling Obtain range of motion 0 to 90 degrees and full extension at knee joint Regain muscle control; static quads, functional SLR and hamstring setting exercises Gait training with or without crutches 	<ul style="list-style-type: none"> No pain Mild swelling Independent walk Full extension and up to 90 degrees flexion at knee joint
Phase II	Week 2 to 8	<ul style="list-style-type: none"> Reach to full-extension, 120° flexion at 6 weeks Normalize gait pattern with walking exercises (jogging on treadmill from week 8). Isometric and isotonic strength training for hamstring, gastrocnemius, and soleus without weight Gentle open chain quadriceps exercise from week 2 but no resistance. 	<ul style="list-style-type: none"> Mild pain and swelling Full extension and at least 130° flexion possible Normal gait pattern Exercises from the previous week are performed correctly.
Phase III	Week 9 to week 14	<ul style="list-style-type: none"> Obtain and maintain full ROM Open chain and closed chain exercises for hams, quads and calf muscles with weight Two-legged jumping must be initiated and then one-legged jumping. From week 12 can swim using breaststroke From week 13 running and jogging can be allowed 	<ul style="list-style-type: none"> Complete range of motion and no pain Quadriceps and hamstring strength >75% compared to the contralateral side Exercises from the previous week are performed correctly.
Phase IV	Week 15 to 6 months	<ul style="list-style-type: none"> Muscle endurance and strength training Enhance neuromuscular control by adding jumping, agility training, and sport-specific tasks in rehabilitation program. 	<p>Criteria for returning to sports</p> <ul style="list-style-type: none"> No pain or swelling Full flexion and extension of the knee is possible (ROM-goniometer) Quadriceps and hamstring strength >85% compared to the contralateral side

All patients were examined clinically for knee instability. The Lachman's test, pivot shift, and anterior drawer tests were done pre-operatively to confirm the diagnosis. The pre operative range of motion was measured with goniometer while the functional outcomes were assessed with Lysholm Tegner knee score¹¹ and the International Knee Documentation Committee (IKDC).¹² Arthroscopic reconstruction was performed under spinal anesthesia in all patients. The same group of surgical team performed single bundle ACLR with hamstring auto graft in all cases. The hamstring tendon was harvested from the medial proximal tibia through a small incision. The endobutton was used on the femoral side for graft fixation and a bioabsorbable screw was used on the tibial side.

Physical exercises under the supervision of a qualified physiotherapist was commenced on the first post-operative day (table I). Full weight bearing was allowed with crutches on the first post-operative day. All the patients attended at least 16 physiotherapy sessions with twice a week schedule under the supervision of an experienced physiotherapists in the hospital. All the patients were reviewed at 3rd, 6th and 12th months postoperatively in OPD by a senior consultant who was not part of study team. In each visit Tegner- Lysholm score was calculated and graded as Poor(score<60),Fair(65 to 83 score),Good(84 to 90 score) and Excellent(>90 score).The IKDC score was calculated from 0 to 100 with 0 indicated lowest functional status/ higher symptoms and 100 indicates highest functional status and no symptoms. We also measured the thigh circumference of the operated thigh and compare it with non operated thigh to evaluate the donor site morbidity at 12th months post-operatively. The single legged hopping test was done in each visit.

We analyzed our data with SPSS version 21.0 (IBM SPSS Inc., NY USA).Quantitative variables were represented as frequency and percentages while qualitative variables as mean±SD. The preoperative assessment of functional outcome in terms of knee range of motion, Tegner-Lysholm score and International Knee Documentation Committee(IKDC) were compared with post operative values at 3rd, 6th and 12th months follow and *P* value was calculated with Chi-square test for statistical significance. *P* value < 0.05 was considered significant. Data was presented in table where necessary.

RESULTS

In this study 79 patients were included. Male patients were 65(82.2%) and female 14(17.7%). The mean

age was 25±3 years (range 18 to 40 years).The aetiology of ACL tear was road traffic accidents in 42(53.1%) patients followed by fall in 37(46.8%) patients. Majority(65.8%,n=52) of our patients had right ACL tear while 27(34.1%) had left ACL tear. The mean ACL injury time to surgery was 5±4(range 3 to 7 months).The mean follow up period was 18 months(range 12 to 20 months). As per clinical examination at 3 months following ACLR, all patients had negative Lachman's, pivot shift and anterior drawer test. Knee full range of motion(118±6°) was achieved in 75(95%) patients at 3rd month. No statistically significant difference was found between the operated and non operated thigh/knee circumference(*P* value 0.32).The mean pre-operative IKDC score of 38.95±5 improved to 67.92±2 at 6th months and to 90.73±7 at 12th months follow up. The mean pre operative Tegner-Lysholm score of 51(poor) improved to 87(good) at 6th months and 97(excellent) at 12th months. Majority(70.8%,n=56) patients could performed single legged hopping test without any difficulty at 6th months post operatively.The difference in the functional outcome of early ACLR versus delayed ACLR was not statistically significant(*P* value> 0.05).

We divided all patients into three groups based on their activity level. Patients who were professional sportsmen and involved in vigorous sports like rowing, racquetball, soccer and hockey were added to group A (vigorous activity group), whereas patients who were not professional sportsmen but involved in moderate physical activities like aerobic exercises, walking, running and jogging for at least 5 times a week were included in group B (moderate activity group). Patients who only performed their daily chores like shopping, walking around the office, sitting at computer, eating, preparing food, and washing dishes were included in group C (light activity group).A comparison of thigh circumferences and flexion-extension at 12 weeks for each activity group is shown in table II. There was a significant improvement in the mean scores of IKDC and Tegner- Lysholm at every follow up in all three groups (*P* <0.05). All of them resume their activities without any support after 3 months of ACLR.

We had documented 3(3.7%) complications in our series but none of the complications affected the functional outcome.The endobutton was displaced in one patient. The case was revised with removal of the endobutton and fixation of the femoral side with bio screw. Our second complication was superficial wound infection at the graft site but was resolved with oral antibiotics at 2 weeks. Our third

complication was saphenous nerve entrapment and loss of sensation in the operated leg with partial recovery at 8th month. No osteoarthritis was noted in

our series. No patient was lost to follow up.

Table II. Knee flexion-extension and thigh circumference and at 12th week postoperatively for each activity group and comparison with non operated knee/thigh.

TEST	Non operated knee	Operated Knee			P value
		Group A (n=29)	Group B (n=31)	Group C (n=19)	
Knee flexion (degrees)	120±5	118±6	116±4	112±5	0.32
Knee extension (degrees)	0.2±2.2	0.3±1.8	0.2±2	0.3±1	0.24
Thigh circumference(at knee level in cm)	38±2	38±3	36±2	33±4	0.32
Thigh circumference (10cm above knee)	50±3	48±4	46±2	45±4	0.91

DISCUSSION

The results of our study showed excellent functional and clinical outcomes using hamstring tendon with supervised rehabilitation. The mean follow up was 18 months in our series. In literature studies of similar technique^{13,14} with post operative follow up of 5 to 15 years revealed excellent to good functional results without any evidence of knee osteoarthritis. In our study ACLR graft fixation was achieved by using endo button at femoral fixation and bio-absorbable screw at tibial fixation. Post-operatively, all of the patients achieved good stability and no graft laxity. The bio-absorbable screw and endo button is the technique of choice favored by many arthroscopic surgeons as it provides good functional outcome and fixation as compare to metal screws.¹⁵

Although it is difficult to prefer the hamstring graft over any other grafts used for ACLR in terms of stability^{16,17} anterior knee pain and extensor deficits had been found more with Bone-Patellar Tendon-Bone (BPTP) graft than with hamstring.¹⁸ Similarly in our study none of our patients had anterior knee pain and had good stability without any extension deficits.

Soon and Neo¹⁹ performed ACLR in 76 patients using hamstring tendon autograft and concluded that all patients had good quadriceps and hamstring strength, almost equal to preoperative status and most patients were satisfied with results according to IKDC ratings. Eriksson K et al²⁰ conducted a randomized control trial on 159 patients of ACLR and compared the functional outcomes of quadruple hamstring and patellar tendon grafts. They concluded that patellar tendon and quadruple hamstring tendon autograft had similar VAS, IKDC and Tegner-Lysholm functional scores but some loss to extension and anterior knee pain were reported in patellar group(P< 0.05).Contrary to our findings this study

reported better IKDC score in patients with ACLR repair in less than five months old than in chronic cases(P< 0.05).

After ACLR return to sports is the most important concern of an athlete and a successful outcome measure for the surgeon. In a meta analysis and systematic review Arden and Webster²¹ noted that 82% patients returned to some sports,63% to pre injury sports and 48% to competitive sports.These authors were of the opinion that despite 90% excellent functional status following ACLR the relatively low percentage of patients returning to sports had some psychological factors like fear of re injury.In our study 29(36.7%) patients were professional athletes and all of them return to their respective sports after 12 months of ACLR.

The rehabilitation protocols after ACLR has a great positive impact on early return to sports. Athletes who followed supervised physical therapy program predicts better functional outcomes and early return to sporting activities compared to those who did not follow physical therapy program post-operatively.²² In our study all patients followed a complete rehabilitation program under the supervision of an experienced physiotherapists and all of them return to their respective professions and sports. Our study although a descriptive one, is supported by Rahim et al²³ who documented better functional score and muscle strength in supervised physiotherapy group of ACLR patients than home based physical therapy group up to one year post ACLR.

There were certain limitations of our study. The design of our study was descriptive. We had a small sample size with short follow up period. We recommend further large scale clinical trials to verify our results.

CONCLUSION

Anterior Cruciate Ligament Reconstruction(ACLR) using hamstring tendon autograft with endobutton fixation and supervised rehabilitation yielded excellent functional outcomes in majority of our patients. We therefore recommend this protocol as treatment of choice for all patients with ACL tear.

Conflict of Interest: None

Grants/Funding: None

REFERENCES

1. Lee DY, Karim SA, Chang HC. Return to sports after anterior cruciate ligament reconstruction-a review of patients with minimum 5-year follow-up. *Ann Acad Med Singap* 2008;37(4):273-78.
2. Chaudhari AM, Briant PL, Bevill SL, Koo S, Andriacchi TP. Knee kinematics, cartilage morphology, and osteoarthritis after ACL injury. *Med Sci Sports Exerc* 2008;40(2):215-22.
3. Van Eck CF, Fu FH. Anatomic anterior cruciate ligament reconstruction using an individualized approach. *Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology*.2014;1(1):19-25.
4. Kapoor B, Clement DJ, Kirkley A, Maffulli N. Current practice in the management of anterior cruciate ligament injuries in the United Kingdom. *Br J Sport Med* 2004;38(5):542-4.
5. Freedman KB, D'Amato MJ, Nedeff DD, Kaz A, Bach BR. Arthroscopic anterior cruciate ligament reconstruction: a metaanalysis comparing patellar tendon and hamstring tendon autografts.*Am J Sports Med* 2003;31(1):2-11.
6. Pinczewski LA, Lyman J, Salmon LJ, Russell VJ, Roe J, Linklater J. A 10-year comparison of anterior cruciate ligament reconstructions with hamstring tendon and patellar tendon autograft: a controlled, prospective trial. *Am J Sports Med* 2007;35(4):564-74.
7. Przybylak K, Sibinski M, Domzalski M, Kwapisz A, Momaya AM, Zielinska M. Supervised physiotherapy leads to a better return to physical activity after anterior cruciate ligament reconstruction. *J Sports Med Phys Fitness* 2019 Sep;59(9):1551-1557.
8. Krolkowska A, Sikorski L, Czamara A, Reichert P. Effects of postoperative physiotherapy supervision duration on clinical outcome, speed, and agility in males 8 months after anterior cruciate ligament reconstruction. *Med Sci Monit* 2018;24:6823-6831.
9. Han F, Banerjee A, Shen L, Krishna L. Increased compliance with supervised rehabilitation improves functional outcome and return to sport after anterior cruciate ligament reconstruction in recreational athletes. *Orthop J Sports Med* 2015;3(12):515-520.
10. Tay KS, Tan AH. Clinical outcomes, return to sports, and patient satisfaction after anterior cruciate ligament reconstruction in young and middle-aged patients in an asian population—a 2-year follow-up study. *Arthroscopy* 2018 ;34(4):1054-9.
11. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res.* 1985 Sep;(198):43-9.
12. Irrgang JJ, Anderson AF, Boland AL, Harner CD, Kurosaka M, Neyret P, *et al.* Development and validation of the international knee documentation committee subjective knee form. *Am J Sports Med.* 2001;29(5):600-13
13. Bourke HE, Gordon DJ, Salmon LJ, Waller A, Linklater J, Pinczewski LA. The outcome at 15 years of endoscopic anterior cruciate ligament reconstruction using hamstring tendon autograft for 'isolated' anterior cruciate ligament rupture. *J Bone Joint Surg Br* 2012 ;94(5):630-7.
14. Ponzo A, Monaco E, Basigliani L, Iorio R, Caperna L, Drogo P, *et al.* Long-Term Results of Anterior Cruciate Ligament Reconstruction Using Hamstring Grafts and the Outside-In Technique: A Comparison Between 5-and 15-Year Follow-up. *Orthop J Sports Med.* 2018;6(8):23-29.
15. Plaweski S, Rossi J, Merloz P. Anterior cruciate ligament reconstruction: Assessment of the hamstring autograft femoral fixation using the EndoButton CL. *Orthop Traumatol Surg Res* 2009 ;95(8):606-13.
16. Harilainen A, Linko E, Sandelin J. Randomized prospective study of ACL reconstruction with interference screw fixation in patellar tendon autografts versus femoral metal plate suspension and tibial post fixation in hamstring tendon autografts: 5-year clinical and radiological follow-up results. *Knee Surg Sports Traumatol Arthrosc* 2006 ;14(6):517-28.
17. 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. *Am J Sports Med* 2001;29(6):722-8.
18. Calvisi V, Lupporelli S, Padua R. Patellar tendon autograft versus hamstring tendon autograft in arthroscopic anterior cruciate ligament reconstruction: appraisal of the evidence. *J Orthop Traumatol.* 2006 ;7(2):103-107.
 19. Soon M, Chang P, Neo CP, Mitra AK, Tay BK. Morbidity following anterior cruciate ligament reconstruction using hamstring autograft. *Ann Acad Med Singap* ;33(2):214-9.
 20. Eriksson K, Anderberg P, Hamberg P, Löfgren AC, Bredenberg M, Westman I, *et al.* comparison of quadruple semitendinosus and patellar tendon grafts in reconstruction of the anterior cruciate ligament. *J Bone Joint Surg Br* 2001;83(3):348-54.
 21. Ardern CL, Webster KE, Taylor NF, Feller JA. Return to sport following anterior cruciate ligament reconstruction surgery: A systematic review and meta-analysis of the state of play. *Br J Sports Med.* 2011 1;45(7):596-606.
 22. Han F, Banerjee A, Shen L, Krishna L. Increased compliance with supervised rehabilitation improves functional outcome and return to sport after anterior cruciate ligament reconstruction in recreational athletes. *Orthop J Sports Med* 2015;3(12):232-338.
 23. Rhim HC, Lee JH, Lee SJ, Jeon JS, Kim G, Lee KY, *et al.* Supervised Rehabilitation May Lead to Better Outcome than Home-Based Rehabilitation Up to 1 Year after Anterior Cruciate Ligament Reconstruction. *Medicina (Kaunas)* 2020;57(1): 19-28.