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Assessment of outcome of arthroscopic reconstruction of anterior cruciate ligament using quadriceps tendon graft in Kashmiri population

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Abstract
Introduction: Arthroscopic reconstruction of the injured anterior cruciate ligament (ACL) has become the gold standard. Open reconstruction of ACL which was done earlier is not practiced nowadays due to the complications associated such as increased post-operative pain, stiffness, and a lengthy rehabilitation phase. The "ideal graft" for ACL reconstruction is still a topic of debate. The most used grafts are bone patellar tendon bone graft, hamstring graft & quadriceps tendon graft. Many studies have demonstrated comparable functional outcomes for different grafts. The purpose of the study was to assess the outcome of arthroscopic reconstruction of anterior cruciate ligament using quadriceps tendon graft in Kashmiri population with complete ACL rupture injuries.
Materials and Methods: This observational study was carried on 30 patients with correlative findings of ACL injury on clinical examination and MRI analysis. All patients were managed with arthroscopic reconstruction using quadriceps tendon graft. Postoperative evaluation was done on the basis of stability tests, knee scoring (Tegner activity level, IKDC subjective score and Lysholm scoring), subjective assessment of symptoms.
Results: In this study 26 (87%) patients achieved full ROM at the end of final follow-up while 4 (13%) patients had some motion deficit. 15 (50%) patients had excellent functional outcome while 10 (33%) had good outcome. The mean IKDC (International Knee Documentation Committee) subjective score improved from 49.86 (pre-operative) to 89.48 (postoperative).
Conclusion: Arthroscopic ACL reconstruction using quadriceps tendon provides a stable knee with minimal complications. Quadriceps tendon graft does not affect the patellar tendon and thus reduce the risk of intra-patellar scarring.

Keywords: Anterior cruciate ligament (ACL), arthroscopic reconstruction, quadriceps tendon graft, outcome

Introduction

The knee joint is one of the body's most complicated joint. Knee joint has proximal femur bone, distally tibia and fibula bone with ligaments and capsules, meniscus, and bursa. Important ligaments are Anterior cruciate ligament (ACL), Posterior cruciate Ligament (PCL), Medial collateral Ligament (MCL), Lateral collateral Ligament (LCL). The ACL together with other ligaments, is the primary knee stabilizer and prevents anterior translation, and limits valgus and rotational stress to some extent.

Ligament injuries of knee are common in the general population. There is an increase in the occurrence of knee ligament injuries due to the ever- increasing road traffic accidents and increased involvement in sports activities [1-5]. Anterior Cruciate Ligament (ACL) is the most frequent completely disrupted ligament of the knee.

Patients with less expected knee score can be treated with conservative treatment with intensive physiotherapy, bracing and lifestyle modification and in symptomatic young active individuals, ACL reconstruction is necessary. Without treatment, a complete ACL injury can result in progressively increasing symptomatic knee instability, which inflicts recurrent intra-articular damage and eventually early osteoarthritis [6-11]. The fundamental rationale for surgical reconstruction of the completely disrupted ACL is to stabilize the knee and prevent future meniscal tears and associated joint damage [12].

Graft choices for ACL reconstruction include autografts, allografts and synthetic grafts. Currently, commonly used autografts include bone-patellar tendon-bone (BPTB), quadrupled hamstring tendons and quadriceps tendon with or without bone. For many years BPTB autograft has been advocated as the gold standard but the issues relating to donor site have led to the increased use of hamstring tendon grafts [13]. The disadvantages of hamstring graft may include a longer healing time and graft integration time within the bone tunnel because of the absence of bone plugs at the ends of the graft. Moreover, the lack of both hamstrings eliminates the protective and stabilizing action that these muscles exert on the knee during specific movements; this lands the knee into quadriceps dominant & valgus position which may predispose to re-rupture of the ACL graft: the hamstrings and ACL together create a reflex-arc that contributes to proprioceptive control [14]. Allografts include BPTB, hamstring tendons, Achilles tendon, and tibialis anterior or posterior tendons. Allografts result in lower level of stability and higher failure rates than their autograft counterparts, besides risk of infection transmission [12]. Synthetic grafts are not in vogue due to their high rate of rupture and recurrent sterile knee effusions. Synthetic grafts include Goretex Ligament, Stryker Dacron Ligament and Kennedy Ligament Augmentation Device.

The first use of the quadriceps tendon (QT) graft dates back to 1979 [15]. Historical studies suggested that QT autograft had inferior biomechanics and was associated with rotator knee laxity and quadriceps weakness. The substitution graft consisted of the quadriceps tendon-prepatellar retinaculum-patellar tendon construct.

Renewed interest in the quadriceps tendon autograft for ACL reconstruction began in the late 1990s when Stäubli [16] published his series using the central-third quadriceps tendon with a patellar bone block. In 2003 Theut *et al.* [17] described harvesting the tendon without a bone block (central quadriceps free tendon), thus eliminating the risk of patellar fracture during harvest and hoping to reduce the morbidity of graft harvest. They also cited a reduced operative time, easier postoperative rehabilitation, and less risk of anterior knee pain using a free quadriceps graft technique.

The aim of present study was to assess the outcome of arthroscopic anterior cruciate ligament (ACL) reconstruction using quadriceps tendon graft in Kashmiri population.

Materials and Methods

The present study was conducted in the Postgraduate Department of Orthopaedics, SKIMS Medical College, Bemina, Srinagar from March 2018 to June 2019. This observational study was carried on 30 patients with correlative findings of complete ACL injury on clinical examination and MRI analysis.

Inclusion criteria

- Age 18 to 50 years.
- Both males and females.
- Chronic ACL tears with functional instability.
- ACL rupture associated with meniscal tears and/or grade 1 collateral ligament tears.

Exclusion criteria

- Conditions in which knee arthroscopy is impossible or risky; included partial or complete ankylosis around the joint, knee deformities and unfavourable local skin condition.
- Ligament injury to the contralateral knee.
- Patients with previous ACL surgery.
- ACL rupture associated with fractures around the ipsilateral knee.
- ACL injury associated with PCL rupture
- Osteoarthritis of the involved knee
- ACL injury associated with MCL, LCL, and posteromedial or posterolateral capsule tears alone or in combination.
- Mentally subnormal persons.

Table 1: Demography of patients

Characters of patients		Patients	Percentage
Gender	Male	26	87
	Female	4	13
Age group	18 - 26	11	37
	27 - 34	10	33
	35 - 42	8	27
	43 - 50	1	3
Side	Right	17	57
	Left	13	43
Mechanism of injury	Sports Injury	12	40
	Road accidents	12	40
	Fall	6	20
Injury to surgery duration	UPTO 3 months	10	33
	4 - 6 months	12	40
	7 - 9 months	2	7
	10- 12 months	5	17
	>12 months	1	3
Type of tear	Partial (medium grade)	1	3
	Partial (high grade)	5	17
	Complete	24	80
Location of tear	Femoral	3	10
	Middle one-third	27	90
	Tibial	0	0
Symptoms of presentation	Knee pain	15	50
	Instability	9	30
	Locking	3	10
	Knee pain & Instability	3	10

Operative technique

Patient Positioning: The patient receives an adductor canal block. The patient is positioned supine with the surgical limb secured in an arthroscopic leg holder and the contralateral leg in a foam well-leg holder. After the induction of general anesthesia or spinal anaesthesia, an examination with the patient under anesthesia is performed to assess knee stability and range of motion. A non-sterile tourniquet is placed high on the leg and is set to 250 mm Hg.

Graft Harvest and Preparation: With the leg flexed to 90^0, the proximal pole and the medial and lateral borders of the patella were marked. A 1.5- to 2-cm vertical mark was made extending proximal from the proximal pole of the patella, just lateral to the midpoint (Figure 1A). A longitudinal incision was made with a No. 15 blade, and the subcutaneous tissue was excised. After identifying the vastus medialis, a mark was placed on the anterior thigh at the point of maximum transillumination, marking the rectus tendon. The distance between the mark and the superior pole of the patella was measured to confirm the graft length of 8 cm. A No. 15-blade knife was used to connect the 2 vertical incisions just off the superior pole of the patella. Careful dissection first with the scalpel and then with Metzenbaum scissors was carried proximally, and the graft end was controlled with an Allis clamp. Once 2 to 3 cm of graft was elevated, a tagged Fiber Loop suture was used to whipstitch the tendon (4 throws), starting 2 cm proximal to the tendon end, and

exiting the central portion of the graft. With traction on the sutures, Metzenbaum scissors was used to dissect the graft proximally. With firm tension on the sutures, the Arthrex quadriceps tendon cutter was used to strip, and then cut the graft proximally once the desired graft length was achieved (Figure 1 A, B). This was measured with the Cutter handle.
A fiber loop was used to whipstitch the graft in the same manner as was done during graft harvest starting 2 cm away from the other end of the tendon, and the last stitch was locked as it exited the central portion of the tendon. The diameter of each graft end was then measured. The previously placed tagged Fiber Loop was passed through the loop of the Arthrex tight Rope and was whip stitched (Figure 1D). The length of the femoral adjustable loop button was marked to the length of the potential femoral tunnel + 5 mm.

Preparation of the intercondylar notch: On tibial footprint, the ACL stump was sufficiently removed to avoid development of a Cyclops lesion. Notchplasty was not required in any of the patients. The over the top position was clearly visualized and confirmed with an arthroscopic probe.

Tunnel Preparation
The ACL footprint was visualised on the medial surface of the lateral femoral condyle in 90 degrees of knee flexion and the entry point was marked. Then with the femoral offset aimer device inserted through the anteromedial portal, the entry point was drilled with a guide wire in 120 degrees of knee flexion. Back wall was preserved by selection of appropriate increment of aimer offset using Transportal Guide (TPG). The drilling was continued till the tip of the guidewire emerged on the lateral side of the distal thigh at the level of epicondyle of femur. Then using the 4.5 mm cannulated drill bit, the femoral tunnel was made by drilling both the near and far cortices. With the tunnel center chosen, the patients' knee was flexed to 90 degrees, and the tip of the tibial drill guide was adjusted to create the desired tunnel length. The guide wire was drilled into place and its tip visualized as it entered the joint. The tibial tunnel was drilled using a cannulated drill bit, with diameter corresponding to the diameter of graft.

Graft passage and fixation
A passing pin was advanced through both tunnels, and distal thigh with the knee flexed between 90 and 110 degrees. The pin contains an eyelet that was threaded with the leading and lagging threads attached to the two ends of the tightrope. The passing pin was extracted proximally, bringing the sutures out through the distal thigh. The leading strand was pulled to pull the graft construct proximally into the joint. The graft was viewed arthroscopically to ensure the graft marker line is even with the entrance of the femoral socket. The trailing thread was then pulled to flip the tightrope external to the femoral tunnel. The graft was pulled firmly distally, confirming that the tightrope had been flipped and secured on the anterolateral cortex of the distal femur which was confirmed with intraoperative flouroscopy. Knee was cycled five to ten times through a full range of motion with graft under tension. Tibial interference screw was placed with knee in full extension and graft under longitudinal traction to prevent proximal migration during screw advancement. Evaluation for notch impingement and tensioning was done.
Wound was closed in layers. Ports were closed. Sterile dressings were applied. Tourniquet was removed and distal circulation checked.

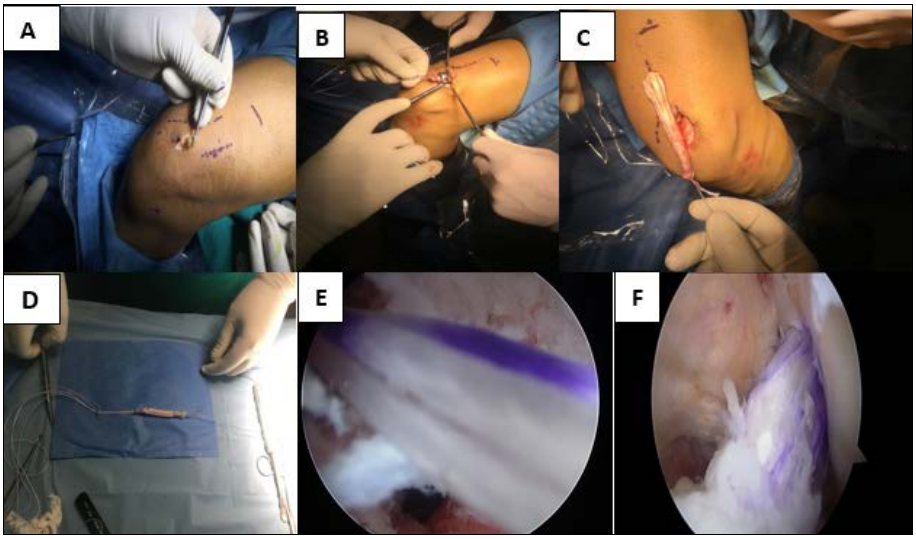

Fig 1: A (Quadriceps tendon exposed), B (Arthrex Quadriceps Tendon Cutter used to strip and cut the tendon), C (Graft retrieved), D (Prepared graft) E (Graft passage through the tunnel), F (Final picture of the graft).

Post-operative rehabilitation and follow-up
Patient received intravenous fluids besides intravenous antibiotics and analgesics. Operated limb was elevated on a pillow and hinged knee brace was worn with knee in 20 degrees of flexion. Post-op x-rays of the involved knee were assessed regarding tunnel position. AP and Lateral x-rays of knee were taken. SQE and ankle pumps were started. All patients were advised to follow-up regularly. Follow ups were done at 1 week, 2 weeks, 4 weeks, 8 weeks, 12 weeks, 4 months, 6 months and a final follow-up at 9 months post-surgery. Postoperative evaluation was done on the basis of stability tests, knee scoring (Tegner activity level, IKDC subjective score and Lysholm scoring), subjective assessment of symptoms.

Results
Thirty cases of arthroscopic ACL reconstruction were regularly followed up for an average period of 13.3 months. Of the 30 patients included in our study, 26 (87%) were Male patients and 4 (13%) were female. Most of the patients 11 (37%) were in the age group of 18 to 26 years. In this study, the right side was

more commonly injured in 17 (57%) than the left side 13 (43%). The most common mode of injury in our study was sports injury and Motor vehicle accidents 12 (40%) each. 12 (40%) patients presented 4 to 6months after injury. 24 (80%) of ACL injuries were complete tears. 27 (90%) patients had tear in the middle one-third portion of the ACL followed by femoral site tear in 10% of patients. The most common symptom at presentation was knee pain in 15 (50%) patients. The mean time taken for the surgery was 109 (range 90 - 130) minutes.

In this study median Lachman grading value decreased from 3 (range 1-3) to 0 (range 0-1), median anterior drawer value decreased from 3 (range 1- 3) to 0 (range 0 -1) and median pivot shift grading value decreased from 2 (range 1-3) to 0 (range 0-2) (Table 2).

Table 2: Results on the basis of stability tests

Stability Test	Grading	Pre-operative		Post-operative	
Lachman manual test	0	0	0	26	87
	1	2	7	4	13
	2	7	23	0	0
	3	21	70	0	0
Anterior drawer test	0	0	0	27	90
	1	3	10	3	10
	2	8	27	0	0
	3	19	63	0	0
Pivot shift test	0	0	0	27	90
	1	6	20	2	7
	2	20	67	1	3
	3	4	13	0	0

In this study 26 (87%) patients achieved full ROM at the end of final follow-up while 4 (13%) patients had some motion deficit. We encountered a few complications as deep layer and suprapatellar pouch disruption (intra-operative) in 2 (7%), Superficial infection at tibial screw site in 1 (3%), Flexion deficit of 15º in 1 (3%), Extension deficit of 5º in 2 (7%) and Flexion deficit of 10º, extension deficit of 5º in 1 (3%) patients (Table 3).

Table 3: Complications encountered in study population

Complications	No. of patients	Percentage
Deep layer and suprapatellar pouch disruption (intraop)	2	7
Superficial infection at tibial screw site	1	3
Flexion deficit of 15º	1	3
Extension deficit of 5º	2	7
Flexion deficit of 10º, extension deficit of 5º	1	3

In this study 15 (50%) patients had excellent functional outcome while 10 (33%) had good outcome. The remaining 5 (17%) patients had a fair outcome according to Lysholm knee score (Table 4). In this study the mean IKDC (International Knee Documentation Committee) subjective score improved from 49.86 (pre-operative) to 89.48 (postoperative).

Table 4: Lysholm knee score

Parameters	No. of patients	Percentage
Excellent	15	50
Good	10	33
Fair	5	17
Poor	0	0

Discussion

Due to the increased occurrence of motor vehicle accidents and increased number of persons participating in sports activities, the number of ACL reconstructions being done has increased. Arthroscopic reconstruction of the injured ACL has become the gold standard and is one of the most common procedures done in orthopaedics and thus it has been extensively studied and outcomes of ACL reconstruction have gained considerable attention. The advantages of arthroscopic reconstruction of the anterior cruciate ligament are that there is minimum injury to the synovial membrane of the joint and yet it achieves the goals accomplished by open operative technique. The theoretical advantage of arthroscopic surgery includes less injury to patellofemoral mechanism and possibly less frequent symptoms and contractures of the patellofemoral joint post operatively. The proper site for location of bone tunnels can be better identified by an arthroscope. In addition, the correct relationship of the graft with respect to the lateral wall of the intercondylar notch can be established.

This study was conducted to assess the outcome of arthroscopic reconstruction of ACL using quadriceps tendon graft. This Technical Note is a detailed surgical technique of quadriceps tendon graft preparation and fixation using the Quad Link ACL FiberTag TightRope implant in a single bundle ACL reconstruction. Advantages of this technique include decreased donor site morbidity because of the small 4 to 5 cm incision used for graft harvest, reliable acquisition of a graft with appropriate length and cross-sectional area, and increased graft strength when compared to alternative graft types.

Historically, quadriceps tendon grafts were less commonly used because of concerns about donor site morbidity, with patella fractures occurring more frequently and failures of femoral fixation. Advances in surgical technique and graft harvest have allowed for a minimally invasive approach while using an all tissue graft rather than obtaining a bone block from the patella. Cadaveric studies have also allowed for improved anatomic characterization of the quadriceps tendon. These studies have demonstrated that the quadriceps tendons provide greatest length and depth lateral to the midline, allowing for consistent tendon acquisition [18].

The present method of harvesting tendon using a quad tendon graft harvester requires a 4 to 5 cm incision that extends proximally from the proximal pole of the patella. Additional exposure is provided by careful retractor placement. These modifications have allowed for improved tendon harvest with smaller incisions and lower donor site morbidity. The quadriceps tendon graft has also provided improvements in graft strength. Shani *et al*. [19] performed a biomechanical comparison of quadriceps tendon grafts versus patellar tendon grafts in ACL reconstructions and found significantly higher load to failure in quadriceps tendons. Their analysis also found that quadriceps tendons had significantly greater cross-sectional areas compared to patellar tendons. These findings demonstrate that quadricep tendon grafts are reliable options for ACL reconstruction (ACLR).

Final evaluation was done on the basis of functional scores (Lysholm score, Tegner activity level and IKDC subjective score), and stability tests (Lachman, Anterior drawer and Pivot shift tests).

The average Lysholm score at the end of the study done by Ashok Kumar *et al*. [20] 2016 was 90 and in our study average Lysholm score at last follow-up was 90.5 which was near about equivalent.

The Tegner activity level improved from a mean pre-operative value (post injury) of 3.4 (range 2 - 4) to 5.7 (range 4 - 8) comparable with the study done by Mirzatolooei 2012 [21], where he got post-operative Tegner activity level of 6.5.

The mean pre-operative IKDC score in this study was 49.86 whereas the post-operative score was 89.48. There was significant improvement in post-operative IKDC score when compared with preoperative score, which is equivalent to the the mean post-operative score 89.38 obtained in the study of Kumar *et al.* [20].

In this study the manual Lachman grading improved from a median preoperative value of 3 (range 1 - 3) to final median level of 0 (range 0 - 3). No patient had Lachman grading beyond 1.

Conclusion

Arthroscopic ACL reconstruction using Quadriceps provides a stable knee with minimal complications. Quadriceps tendon graft does not affect the patellar tendon and thus reduce the risk of intra-patellar scarring. There is no risk of injury to the infra-patellar branch of the saphenous nerve, which is a common complication during patellar tendon graft harvesting. Arthroscopic ACL reconstruction using Quadriceps results in a much lower incidence of anterior knee pain.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Arbes S, *et al*. The functional outcome of total tears of the ACL in the skeletally immature patient. Int. Orthop SICOT. 2007;31:471-475.
2. Howell SM. The loss of motion due to graft Impingement. Oper Tech Sports Med. 2006;14:27-35.
3. Jackson DW, *et al*. Arthroscopic Treatment of ACL injuries. Operative Arthroscopy 3rd edition-2003. Lippincot Williams and Wilkins.
4. Matthews LS. Orthopaedics. Essentials of diagnosis and treatment. JBJS Am. 1995;77:157-158.
5. Solman CG, *et al*. Hamstring tendon harvesting. The orthopaedic clinics of North America. ACL reconstruction Part 2nd. Vol 34-2003.
6. Bach BR, *et al*. The pivot shift phenomenon. Am J Sports Med; c1988, 16(6).
7. Byakika TK. ACL injuries and outcome of Arthroscopic ACL reconstruction using Quadrupled hamstrings. EAOJ; c2007 Mar, 1.
8. Getelman MH, *et al*. Revision ACL surgery. JAAOS; c 1999 May-Jun, 7(3).
9. Lyman S, *et al*. Epidemiology of ACL reconstruction. Trends, Readmissions, and subsequent knee surgery. JBJS Am. 2009;91:2321-2328.
10. O Neill. Arthroscopically assisted reconstruction of the ACL. A Prospective Randomized Analysis of Three Techniques. JBJS Am. 1996;78-A:803-13.
11. Prodomos CC, *et al*. ACL reconstruction and Basic Science. Sanders Elsevier; c2008.
12. Prodomos CC, *et al*. A meta-analysis of stability of autografts compared to allografts after anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc. 2007;15:851-856.
13. Jones KG. Reconstruction of the anterior cruciate ligament using the central one-third of the patellar ligament. J Bone Joint Surg Am. 1970;52(4):838-839.
14. Marcacci M, *et al*. Anatomic double-bundle anterior cruciate ligament reconstruction with hamstrings, Arthroscopy. 2003;19(5):540-546.
15. Marshall JL, *et al*. The anterior cruciate ligament: a technique of repair and reconstruction. Clin Orthop. 1979;143:97-106.
16. Stäubli HU. The quadriceps tendon-patellar bone construct for ACL reconstruction. Sports Med Arthrosc Rev. 1997;5:59-67.
17. Theut PC, *et al*. Anterior cruciate ligament reconstruction utilizing central quadriceps free tendon. Orthop Clin North Am. 2003;34:31-39.
18. Lippe J, Armstrong A, Fulkerson JP. Anatomic guidelines for harvesting a quadriceps free tendon autograft for anterior cruciate ligament reconstruction. Arthroscopy. 2012;28:980-984.
19. Shani RH, Umpierez E, Nasert M, Hiza EA, Xerogeanes J. Biomechanical comparison of quadriceps and patellar tendon grafts in anterior cruciate ligament reconstruction. Arthroscopy. 2016;32:71-75.
20. Kumar PK, *et al*. Functional outcome of arthroscopic reconstruction of anterior cruciate ligament tears. J Evolution Med Dent Sci. 2016;5(10):427-432. DOI: 10.14260/jemds/2016/98.
21. Mulcahey MK, *et al*. Transtibial Versus Anteromedial Portal Anterior Cruciate Ligament Reconstruction Using Soft-Tissue Graft and Expandable Fixation. Arthroscopy: The Journal of Arthroscopic and Related Surgery; c2014. p. 1-7.

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