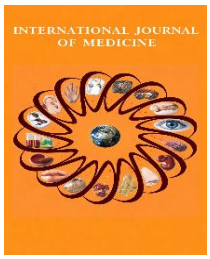

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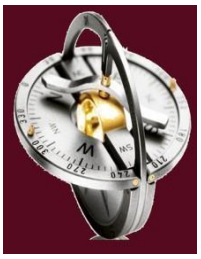

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Original Research

Evaluation of functional outcome of arthroscopic isolated anterior cruciate ligament reconstruction with quadriceps tendon

Clark, Sean C
MS; From the Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN.

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Abstract

Introduction The knee is a synovial hinge joint with an extensive network of ligaments and muscles. It is the largest and most complex joint with several internal structures. The anterior cruciate ligament (ACL) is one of the most important intra-articular ligaments in the knee joint. It is regarded as the main barrier preventing the tibia from anteriorly translating onto the femur. Additionally, it gives the knee joint rotational stability while walking normally and performing regular tasks.1 Classically, ACL injuries affect people during their prime working hours. The greatest incidence occurs in 15 to 25-year-old participants of work and pivoting sports. Work-related injuries and accidents are also common. Consequences of ACL injuries include lost time from work and a lower quality of life. Materials And Methods The study was conducted in the Department of Orthopaedics, after approval from the Institutional Ethics Review Board (IERB). The study included patients of either gender with ACL tears undergoing ACL reconstruction. This research was a descriptive study conducted over 18 months. A total sample size of 40 patients was determined using the formula for proportions. Results In this study, a total of 40 patients underwent arthroscopic isolated ACL reconstruction using a peroneus longus tendon autograft. The mean graft diameter was 8.25 ± 0.414 mm (range: 7.50 -9.00 mm). Pre-operatively, 70% of patients had Grade 3+ Lachman's test, while at the final follow-up after 9 months, 95% of patients were negative for Lachman's test ($p < 0.001$), indicating significant improvement in knee stability. The Tegner activity level score improved from a pre-operative mean of 2.95 ± 0.94 to 6.90 ± 1.21 post-operatively ($p < 0.001$), reflecting enhanced functional activity. Conclusion Functional outcome of patient undergoing arthroscopic-assisted ACL reconstruction is better in BQT group compared to SBHT group, both in subjective and objective parameters given. There is a difference of functional outcome between BQT autograft and SBHT autograft in arthroscopic-assisted ACL reconstruction for isolated ACL injury patients.[18]

Keywords: *ACL, Peroneus Longus Tendon, Knee Arthroscopy*

Introduction

The knee is a synovial hinge joint with an extensive network of ligaments and muscles. It is the largest and most complex joint with several internal structures.[1] The anterior cruciate ligament (ACL) is one of the most important intra-articular ligaments in the knee joint. It is regarded as the main barrier preventing the tibia from anteriorly translating onto the femur. Additionally, it gives the knee joint rotational stability while walking normally and performing regular tasks.1 Classically, ACL injuries affect people during their prime working hours. The greatest incidence occurs in 15 to 25-year-old participants of work and pivoting sports. Work-related injuries and accidents are also common. Consequences of ACL injuries include lost time from work and a lower quality of life.[2]

The treatment options for ACL deficient knee include nonoperative and operative management. Operative management includes re pair of the anterior cruciate ligament either isolated or with augmentation and reconstruction with either autograft allograft or synthetic graft.1 Current research supports the concept that under observance of several key factors, arthroscopic ACL reconstruction done with a biologic autograft significantly improves the stability and function of the knee in most ACL-deficient patients. The most common graft choices are the bone-patellar tendon-bone (BPTB) and the semitendinosus/gracilis (hamstring) tendon.[3]

Many different autograft options exist. Bone-patellar tendon-bone (BPTB) autografts are the standard autograft of choice in the United States.4 Few studies have found patellar fracture, patellofemoral pain, increased donor-site morbidity, arthrofibrosis, and quadriceps weakness after surgery.[4] BPTB autograft also predisposes patients to a greater risk of knee osteoarthritis than other autograft types. Several studies reported that quadrupledhamstrings (QHS) autografts have been used as an alternative to BPTB autografts.6-10 However, QHS autografts have shown higher rates of failure than BPTB autografts and undersized grafts can be problematic in small-statured patients.[5]

Address for Correspondence Clark, Sean C, MS; From the Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN.
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The diameter of the graft is one of the most important considerations during ACL reconstruction surgery of the knee. The effect of the autograft diameter on the re-rupture and revision rate of the reconstructed ACL of the knee has been studied intensively and harvesting of small diameter graft can lead to a higher failure rate.[5] Grafts larger than 8 mm were found to reduce the failure rate and provide a protective effect. However, in our country as well as in Asian countries, it is very difficult to get quadruple strands of hamstring graft with a diameter of 8 mm. In addition, it is also very hard to predict the diameter of the hamstring (HT) graft due to its inherent variability of size, length, and diameter. Nowadays the use of quadriceps tendon (QT) autograft has been steadily increasing for ACL reconstruction. This was due to significant surgical advances and reliable harvesting techniques for the all- soft tissue QT autograft. Additionally, the QT provides favorable anatomy with low donor-site morbidity and a decrease in anterior knee pain and numbness.[6] Cavaignac et al demonstrated benefits of QT for ACLR include stronger, stiffer tissue and preservation of kneeflexor strength which may allow for more aggressive postoperative rehabilitation.[7] Jennifer et al reported that the use of a QT graft in ACL reconstruction leads to equal or better function al outcomes than the use of an HT graft.14 However, less published data are available in our country. Therefore, the present study has been designed to assess the functional outcome of arthroscopic isolated ACL reconstruction with quadriceps tendon.[8].

Materials and Methods

The study was conducted in the Department of Orthopaedics, after approval from the Institutional Ethics Review Board (IERB). The study included patients of either gender with ACL tears undergoing ACL reconstruction. This research was a descriptive study conducted over 18 months. A total sample size of 32 patients was determined using the formula for proportions.

Inclusion criteria

Patients with primary ACL injury, ACL injury with or without meniscal injury, and no previous knee surgeries were included.

Exclusion criteria

Patients with systemic infection or sepsis, additional ligamentous laxity in the affected knee, active articular infection or inflammatory joint disease, multiple ligament injuries, partial- or full-thickness cartilage defects, and femoral condyle fixation with an interference screw were excluded.

The study involved 32 patients with complete ACL tears who underwent arthroscopic ACL reconstruction using central quadriceps tendon grafts. Comprehensive case histories, including sociodemographic data and other medical conditions, were recorded. Preoperative preparation included X-ray and MRI imaging. Preoperative strength and range of movement of the knee joint were measured and documented. Static and dynamic quadriceps exercises were taught to patients while awaiting surgery. All patients were enlightened on the standard postoperative rehabilitation. Patients then underwent surgery according to the described methodology, and postoperat ive evaluations were conducted using X-rays and the Tegner Lysholm knee score to assess functional outcomes. Data were entered into a Microsoft Excel data sheet (Microsoft Corporation, United States) and analysed using IBM SPSS Statistics for Windows, Version 22.0 (released 2013, IBM Corp., Armonk, NY). A p-value of <0.05 was considered statistically significant after assuming all the rules of statistical tests.

Results

In this study, a total of 40 patients underwent arthroscopic isolated ACL reconstruction using a peroneus longus tendon autog raft. The mean graft diameter was 8.25 ± 0.414 mm (range: 7.50-9.00 mm). Pre-operatively, 70% of patients had Grade 3+ Lachman's test, while at the final follow-up after 9 months, 95% of patients were negative for Lachman's test ($p < 0.001$), indicating significant improvement in knee stability. The Tegner activity level score improved from a pre-operative mean of 2.95 ± 0.94 to 6.90 ± 1.21 post-operatively ($p < 0.001$), reflecting enhanced functional activity. The AOFAS score decreased slightly from 100 ± 0.00 to 96.75 ± 5.71 ($p = 0.020$), yet the majority (80%) of patients still achieved an excellent post-operative score. Regarding eversion power, 85% of patients retained Grade 5 strength, while 15% showed Grade 4 strength post-operatively ($p = 0.250$). These findings suggest that ACL reconstruction with a peroneus longus tendon autograft is an effective procedure with minimal donor site morbidity and significant functional improvement.

This prospective interventional study was carried out to assess the functional outcome of arthroscopic isolated ACL reconstruction by peroneus longus tendon autograft and assessment of donor site morbidity. A total of 40 cases were enrolled for the study.

Table 1 presents the age distribution of the patients. The mean age of all participants was 27.35±4.03 years (21-40 years), with the majority of patients (40%) belonging to the 20-25 years age group.

Table 1: Age Composition of Study Population (N=40)

Age Group (in years)	Frequency	Percentage (%)
20-25	16	40
26-30	14	35
31-35	8	20
36-40	2	5
Total	40	100
Mean± SD (Range)	27.35±4.03 years (21-40 years)	

Table 2: Cause of Injury Among Study Patients (N=40)

Cause of Injury	Frequency	Percentage (%)
Sports	24	60
Road Traffic Accidents	12	30
History of Fall	4	10
Total	40	100

In this study, most of the study patients had suffered from injury over right knee joint (60%).

Table 3: Intraoperative Graft Diameter (mm) of Study Patients (N=40)

Graft Diameter (mm)	Frequency	Percentage (%)
7.50	4	10
8.00	16	40
8.50	16	40
9.00	4	10
Mean ± SD (Range)	8.25 ± 0.414 (7.50-9.00)	

Table 4: Evaluation of Function by Lachman's Test (N=40)

Lachman's Test Grade	Pre-operative n (%)	Post-operative Final Follow-up (9 months) n (%)	P-value
Negative	0 (0%)	38 (95%)	<0.001
Grade 1+	0 (0%)	2 (5%)	
Grade 2+	12 (30%)	0 (0%)	
Grade 3+	28 (70%)	0 (0%)	

Table 5: Evaluation of Pre- and Post-operative Tegner Activity Level Score (N=40)

Tegner Activity Level Score	Pre-operative n (%)	Post-operative Final Follow-up (9 months) n (%)	P-value
Mean ± SD	2.95 ± 0.94	6.90 ± 1.21	3.4×10^{-14}†
Score			
2	16 (40%)	0 (0%)	4.7×10^{-5} Ψ
3	12 (30%)	0 (0%)	
4	10 (25%)	2 (5%)	
5	2 (5%)	2 (5%)	
6	0 (0%)	8 (20%)	
7	0 (0%)	18 (45%)	
8	0 (0%)	6 (15%)	

Table 6: Evaluation of Pre- and Post-operative AOFAS Score (N=40)

AOFAS Score	Pre-operative n (%)	Post-operative Final Follow-up (9 months) n (%)	P-value
Poor (0-50)	0 (0%)	0 (0%)	0.125 Ψ
Fair (51-74)	0 (0%)	2 (5%)	
Good (75-94)	0 (0%)	6 (15%)	
Excellent (95-100)	40 (100%)	32 (80%)	
Mean ± SD (Range)	100 ± 0.00	96.75 ± 5.711 (74-100)	0.020†

Table 7: Evaluation of the Power of Eversion by MRC Grading (N=40)

MRC Grade	Pre-operative n (%)	Post-operative Final Follow-up (9 months) n (%)	P-value
4	0 (0%)	6 (15%)	
5	40 (100%)	34 (85%)	0.250

Discussion

In patients with where ACL injury is ignored and not treated timely, knee disability is worrisome which in turn can bring upon joint, pernicious consequences if the injury persists. With the advancements in surgical methods and improved outcomes, the expectations of patients to return to their pre-injury levels has put up a lot of burden. In providing and fulfilling such expectations, graft choice also plays a major role, out of which, the use of hamstring grafts is gaining popularity especially the quadrupled hamstring graft. 4 string hamstring graft has been proven to have better graft strength and stiffness as compared to patellar tendon graft.[9]

The morbidity of the donor site is also less when compared to BPTB graft and additionally decreasing the risk of patellar fracture too. For a successful outcome using hamstring autograft, a good and stable initial fixation is needed which has been achieved with the usage of end buttons which has a good pull-out strength.[10]

In our study all the 15 patients underwent ACL reconstruction using hamstring autograft during the study period. The graft was fixed with end button on the femoral side while interference screw was used in the tibial tunnel for fixation with additional strengthening material if necessary such as suture discs for a better hold.[11]12 males and 3 females were part of the study with majority having injury to right knee. In a study by Brown et al., it was seen that in spite of the female sex being more prone for getting injured, due to limited exposure to ci rcumstances in context to the mode and cause of injury, the incidence is more in males. It was also deduced that the side of limb involved had no influence in functional outcome.[12]

In the knee scoring scale by Lysholm, 27% of the patients had excellent outcome, 53% good, 13% fair and 7% poor. In a similar study by Bourke et al. where 143 patients were included in the study, good or excellent Lysholm score at the end of one year follow -up was seen in 94% of participants in the study. In this study 67% of the study participants returned to pre-injury level while 33% did not return to pre-injury level.[13]

In a recent study, very good outcomes for ACL reconstruction were observed with the use of hamstring graft, given the surgery being timed well, an appropriate thickness of the graft used and an excellent protocol for post-op physiotherapy. A drastic increase in IDKC score was also seen. The timing of surgery and protocol for rehabilitation greatly influence the end results.[14]

Kautzner et al. compared the functional outcome of ACL reconstruction using hamstring graft versus patellar tendon graft and found significant betterment of the patient's functional status and knee stability after ACL reconstruction using either one of the grafts. In this study both the grafts had comparable results.[15]

A prospective randomized comparison between the use of BPTB graft and hamstring graft, it was seen that patient had very less discomfort in knee walking test when the latter was used and had an excellent functional outcome too. A study by Williams et al.[16] achieved a significant improvement in the mean scoring post operatively at the end of 2 years. The score improved from a preoperative value of 55 to 92 post-operatively which had a significant p value. Another retrospective study reported an excellent outcome of around 96% in patients who underwent arthroscopic reconstruction of ACL using 4-stranded hamstring graft. Gulick et al. did a study on 57 patients and achieved a good result; around 85% of the patients returned to a functional level comparable to as was before the injury[17]

Conclusion

Functional outcome of patient undergoing arthroscopic-assisted ACL reconstruction is better in BQT group compared to SBHT group, both in subjective and objective parameters given.

There is a difference of functional outcome between BQT autograft and SBHT autograft in arthroscopic-assisted ACL reconstruction for isolated ACL injury patients.[18]

In this study, BQT autograft had superior outcome in both subjective and objective measurements (biomechanic, biomaterial, and return to strenuous/sport activity) compared to SBHT autograft.[19]

References

1. Gans I, Retzky JS, Jones LC, Tanaka MJ. Epidemiology of recurrent anterior cruciate ligament injuries in national collegiate athletic association sports: the injury surveillance program, 2004-2014. Orthop. J. Sports Med. 2018 Jun 9;6(6), 2325967118777823. https://doi.org/10.1177/2325967118777823.
2. Longo UG, Nagai K, Salvatore G, et al. Epidemiology of anterior cruciate ligament reconstruction surgery in Italy: a 15-year nationwide registry study. J Clin Med. 2021 Jan 10;10(2):223. https://doi.org/10.3390/jcm10020223.
3. Sanders TL, MaraditKremers H, Bryan AJ, et al. Incidence of anterior cruciate ligament tears and reconstruction: a 21-year population-based study. Am J Sports Med. 2016 Jun;44(6):1502-1507. https://doi.org/10.1177/0363546516629.
4. John R, Dhillon MS, Syam K, Prabhakar S, Behera P, Singh H. Epidemiological profile of sports-related knee injuries in northern India: an observational study at a tertiary care centre. J. Clin. Orthop. Trauma. 2016 Jul 1;7(3):207-211. https://doi.org/10.1016/j.jcot.2016.02.003.
5. Adams D, Logerstedt D, Hunter-Giordano A, Axe MJ, Snyder-Mackler L. Current concepts for anterior cruciate ligament reconstruction: a criterion-based rehabilitation progression. J Orthop Sports Phys Ther. 2012 Jul;42(7):601-614. https://www.jospt.org/doi/10.2519/jospt.2012.3871.
6. Ellison TM, Flagstaff I, Johnson AE. Sexual dimorphisms in anterior cruciate ligament injury: a current concepts review. Orthop. J. Sports Med. 2021 Dec 17;9 (12), 23259671211025304. https://doi.org/10.1177/23259671211025304.
7. Zbrojkiewicz D, Vertullo C, Grayson JE. Increasing rates of anterior cruciate ligament reconstruction in young Australians, 2000-2015. Med J Aust. 2018 May; 208(8):354-358. https://doi.org/10.5694/mja17.00974.
8. Mlv SK, Mahmood A, Vatsya P, Garika SS, Mittal R, Nagar M. Demographic characteristics of patients who underwent anterior cruciate ligament reconstruction at a tertiary care hospital in India. World J Clin Cases. 2023 May 5;11(15):3464. https://doi.org/10.12998/wjcc.v11.i15.3464.
9. Buerba RA, Boden SA, Lesniak B. Graft selection in contemporary anterior cruciate ligament reconstruction. JAAOS Glob Res Rev. 2021 Oct 1;5(10), e21. https://doi. org/10.5435/JAAOSGlobal-D-21-00230.
10. Runer A, Keeling L, Wagala N, et al. Current trends in graft choice for anterior cruciate ligament reconstruction -part I: anatomy, biomechanics, graft incorporation and fixation. J. Exp. Orthop. 2023 Apr 1;10(1):37. https://doi.org/10.1186/s40634- 023-00600-4.
11. Sousa PL, Krych AJ, Cates RA, Levy BA, Stuart MJ, Dahm DL. Return to sport: does excellent 6-month strength and function following ACL reconstruction predict midterm outcomes. Knee. Surg. Sports. Traumatol. 2017 May;25:1356-1363. https://doi.org/10.1007/s00167-015-3697-2.
12. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj. 2021 Mar 29;372. https://doi.org/ 10.1136/bmj.n71.
13. Li Z. Efficacy of repair for ACL injury: a meta-analysis of randomized controlled trials. Int J Sports Med. 2022 Dec;43(13):1071 -1083. 10.1055/a-1755-4925.
14. VenkateshMulimani DS, Mariswamy G. A clinical study to determine the early functional outcome of ACL injuries managed by arthroscopic reconstruction using four strand hamstring graft with interferrence screw. Int. J. Orthop. 2023;9(1): 400-406. https://doi.org/10.22271/ortho.2023.v9.i1f.3323.
15. Nama KG. Functional outcome of arthroscopic ACL reconstruction with tripled hamstring tendon autograft. Int J Life Sci Biotechnol Pharma Res. Sept 2023:2977, 0122.
16. Joshi S. To compare the functional outcome of arthroscopic reconstruction of anterior cruciate ligament using patellar tendon bone grafts v/s hamstrings graft: a multicentric study. Int J Life Sci Biotechnol Pharma Res. June 2023:2250-3137.
17. Shekhar H, Srivastava A, Rajnish RK, Bhatt S, Jain AK, Haq RU. Clinical outcome and computer tomography -based tunnel placement evaluation following arthroscopic anteromedial portal anterior cruciate ligament reconstruction in nonathletic population. Int J Burn Trauma. 2022;12(6):232. https://doi.org /ISSN:2160- 2026/IJBT0146016.