

Original Research Article

Functional assessment after anterior cruciate ligament reconstruction using quadrupled semitendinosus graft

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ABSTRACT

Background: Anterior cruciate ligament is the primary stabilizer of the knee and prevents translation and rotatory forces and it is one of the most prevalent ligament injuries in the knee. Arthroscopic ACL reconstruction is recommended for which different graft options can be Quadrupled Semitendinosus and Gracilis, doubled Peroneus, Quadriceps Tendon, and Bone patellar tendon-bone. As all grafts have their advantages and disadvantages in terms of donor site morbidity, fixation, and failure rate; the ideal ACL reconstruction graft remains a point of contention. So, we did a functional assessment after ACL reconstruction using Quadrupled Semitendinosus graft.

Methods: The prospective cohort study included 30 patients under the age of 55 years admitted with ACL deficiency from August 2019 to August 2020 in the orthopedic department of a Sapthagiri hospital, Bangalore who underwent arthroscopic ACL reconstruction. This study aims to evaluate the functional result of arthroscopic anterior cruciate ligament reconstruction with only quadrupled semitendinosus tendon graft using the Tegner, Lysholm, and IKDC knee grading systems.

Results: Patients were followed up for a minimum period of one year. On evaluation, the maximum Lysholm, IKDC score achieved was 97 and 79 respectively while the minimum score was 86 and 69 respectively. Comparisons of pre- and postoperative improvement scores were statistically significant.

Conclusions: Arthroscopic ACL reconstruction with quadrupled semitendinosus graft yields good functional results with minimal postoperative morbidity irrespective of graft diameter.

Keywords: Arthroscopic ACL reconstruction, Quadrupled semitendinosus tendon, Tegner, Lysholm, IKDC

INTRODUCTION

Injuries to the anterior cruciate ligament (ACL) are the most prevalent in the knee and are a common and significant occurrence in the active population. Management of ACL tear has progressed from nonoperative treatment to extracapsular augmentation and primary ligament repair to ACL reconstruction (ACLR).^{1,2} Acute anterior cruciate ligament injury can result in impaired knee function, limited activity, and low quality of life, and many individuals with a ruptured

anterior cruciate ligament develop osteoarthritis of the knee regardless of treatment.³⁻⁵ More than 200,000 ACL injuries occur each year, with 100,000 knees undergoing reconstruction. Non-contact mechanisms account for approximately 70% of ACL injuries, while direct contact account for the remaining 30%.^{6,7} As a result, reconstructive surgery is recommended using a semitendinosus and Gracilis or patella-bone-tendon-bone or quadriceps tendon autograft after a clinical diagnosis of ACL rupture to restore functional stability. The operation is needed to enhance knee function and reduce

the risk of post-traumatic osteoarthritis. Smaller skin and capsular incisions, better sight of the intercondylar notch for tunnel and attachment site placement, less postoperative pain, fewer adhesions, earlier motion, and easier rehabilitation are all advantages of the arthroscopically assisted method.⁸ To attain the best results, key technical aspects such as graft selection for ACL reconstruction need more research. The ideal graft for ACLR should mimic the natural ligament's properties, reduce donor site morbidity, and enable stable fixation and quick integration. Studies have shown that harvesting doubled Peroneus will affect foot and ankle function, i.e. decreasing eversion strength and plantar flexion. While using BPTB (Bone patellar tendon-bone) autograft advantage is that bone-to-bone healing is similar to fracture healing and is faster and stronger than soft tissue healing but there are complications associated with i.e., patellar fractures (0% to 2%), patellar tendon rupture (0.25%), patellar tendonitis and OA have been reported to be as high as 39% at 10 years after BPTB compared to 18% at 10 years after hamstring autograft.^{9,10} It also has been found that there is less residual anterior knee laxity and improved stability with the use of BPTB autograft versus hamstring autograft at longer-term follow-up.¹¹ The benefits of semitendinosus grafts include a larger cross-sectional area and the extensor mechanism's integrity remaining intact. Furthermore, quadrupled semitendinosus graft tensile strength is proven to be much superior to a normal ACL.¹² Length and diameter of graft are a concern in quadrupled semitendinosus graft. Numerous studies have revealed differences in the functional outcomes and long-term stability using different grafts during ACL reconstruction methods. The outcome measures specific to the knee are used as an evaluation. The present study aims to assess the outcome after anterior cruciate ligament reconstruction done using quadrupled semitendinosus graft. The outcomes were assessed using Lysholm, IKDC scoring, and Tegner activity level.

METHODS

The prospective cohort study was conducted on 30 patients under the age of 55 years admitted with an ACL tear from August 2019 to August 2020 in Saphthagiri hospital, Bangalore. Patients with ages between 19 to 48 years of either sex having clinically and Radiologically ACL deficient knees examined by a single surgeon were included. Patients who were lost in the follow-up, not willing to involve in the study, with associated PCL tears, Meniscal injuries, tibial plateau fractures, infected knee joints, and bilateral knee injuries were excluded from the study. Patients who met the inclusion and exclusion criteria were chosen for the study. When the patient was admitted, after taking informed consent, a thorough history was taken to determine the mechanism of injury and the degree of the trauma. Lachman and Anterior drawer tests were used to measure the patients' clinical laxity while scoring was done using Lysholm and IKDC knee scoring system. Anteroposterior and lateral

radiographs of the affected knee were taken. A preoperative MRI of the affected knee was also done to assess patients. Alignment of the Lower extremity was assessed by sonogram.

Operative technique

All of the patients were administered spinal anesthesia for the examination. Diagnostic arthroscopy was performed with help of an anterolateral portal. ACL tears were identified, and Meniscal injuries and cartilage lesions were assessed if they are present. The Semitendinosus tendon is harvested and prepared into a quadrupled graft through a separate anteromedial incision over the proximal tibia. Graft diameter was measured and noted. The femoral tunnel was made with 1-2mm of the posterior wall and 3mm of the inferior wall and the diameter corresponding to the femoral end of the graft. The tibial tunnel was prepared at the center of the tibial stump of the ACL and its diameter corresponds to the tibial end of the graft. The graft was passed in tunnels and cycling was done. Fixation of the graft was done on the femoral side with an endobutton (suspensory fixation) and with an interference screw on the tibial side (aperture fixation). Supplemental suspensory fixation was done for short grafts on the tibial side.

Post operative period

Immediate post-operative problems, such as post-operative swelling, compartment syndrome, and neurological and vascular injury, were assessed. Patients were admitted to the hospital for two days after surgery and then discharged. Rehabilitation was started from post-op day 1.

Follow up

At 2 weeks, 6 weeks, 10 weeks, 6 months, 9 months, and 1 year after surgery, the patients were followed up at regular intervals. An aggressive rehabilitation program was followed for all the patients. The IKDC and Lysholm scoring system was used to assess the patients.

Statistical analysis

Statistical Analysis was performed using SPSS 21.0 Version and student t-test and chi-square test were used to assess significant association and statistical significance was considered when $p < 0.05$.

RESULTS

In this study 30 cases (12 females & 18 males) underwent ACL reconstruction with an autologous quadrupled semitendinosus tendon graft, with a mean age of 29.47 years (range, 19-48 yrs) (Figure 1). The right knee was more commonly involved being 53.34%. The mean thickness of the graft was found to be 7.25mm (range, 6.5-8 mm). The pre-op evaluation was done using the

Lysholm score, & IKDC scores & mean scores were found to be 61.7, and 34.67 respectively. Patients were assessed functionally at an interval of 2 weeks, 6 weeks, 10 weeks, 6 months, 9 months & 1-year post-op. At 1 year of follow-up, the mean Lysholm score & IKDC score were found to be 92.07 (range, 86-97) and 73.87 (range, 69-79) respectively (Figure 2-3). Patients returned to the same Tegner activity level as that before the injury (Figure 4).

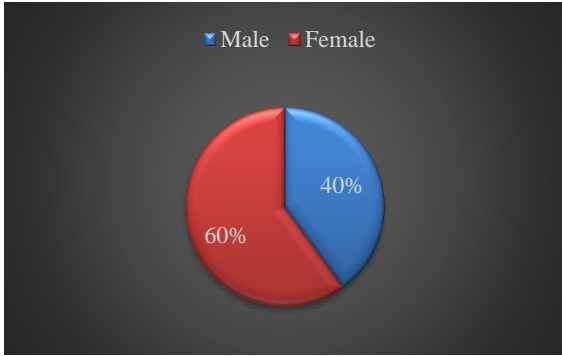


Figure 1: Demographic data.

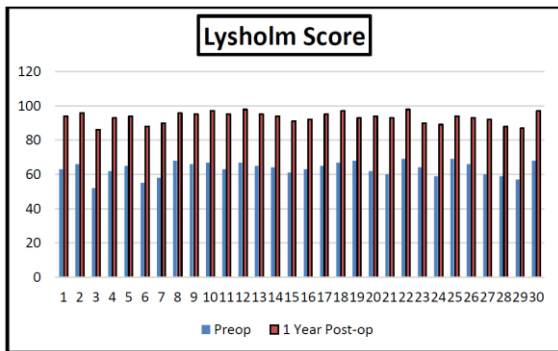


Figure 2: Comparison of pre & post-op Lysholm.

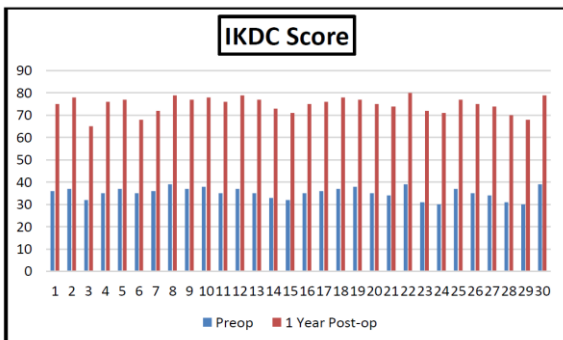


Figure 3: Comparison of pre & post-op IKDC score.

DISCUSSION

The ACL contributes to the overall stability of the knee by preventing anterior tibial translation and tibial rotation. ACL is one of the commonest ligaments to be injured in knee injuries, and a large number of ACL

reconstructions are being done. ACL reconstruction surgery is recommended for patients with an ACL injury as conservative treatment of ACL injury has been associated with poor functional outcomes.

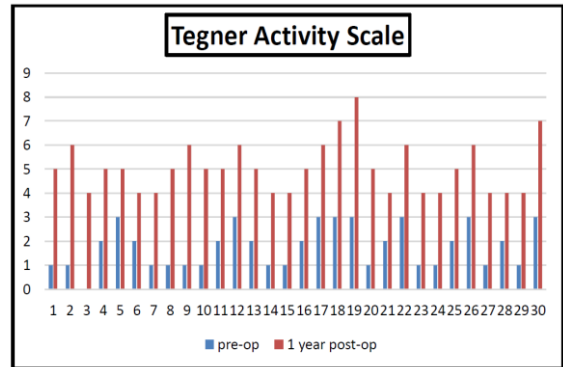


Figure 4: Comparison of pre & post-op Tegner activity scale.



Figure 5: Pre op knee flexion.

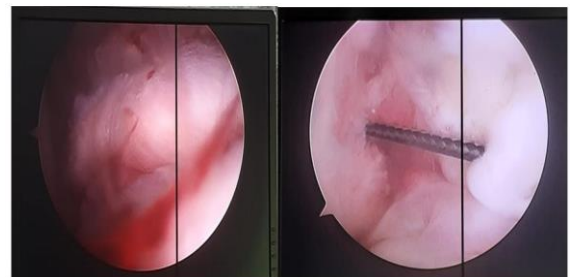


Figure 6: Intra-operative pictures.



Figure 7: Post-operative pictures.

Arthroscopy procedure not only can confirm ACL injury but also is helpful in visualization of intra-articular structures. For reconstruction graft options can be either autograft or allograft. Autograft options for reconstruction of ACL can be Patellar Tendon graft, semitendinosus, and Gracilis autograft. Semitendinosus post-surgical outcomes were found to be similar to patellar tendon graft but patellar tendon graft is associated with donor site morbidity like anterior knee pain and kneeling pain.¹³⁻¹⁵ Although allograft has minimal donor site morbidity, a quicker surgical time, and a lower incidence of graft length and diameter concerns; Graft failure, infection, and tear rate are significantly higher than the autograft, as per study.¹⁶⁻¹⁸ As per our study, the incidence was found to be higher in males i.e., 60% in agreement with a study conducted by Brown et al.¹⁹ Multiple studies have stated that Functional outcome depends upon multiple factors i.e., pre-operative planning, patient selection, radiological evaluation, graft type/size, the timing of surgery, operative technique, lateral extra-articular Tenodesis, and post-operative rehabilitation. One of the challenges in ACL reconstruction using semitendinosus autograft will be to harvest an adequate diameter. There have been previous studies reporting the evaluation of the semitendinosus graft size effect with the functional outcome of ACL reconstruction.²⁰ A study by Figueroa et al reported that hamstring graft diameter is associated with surgery failure, but still graft diameter recommendation is not proven.²¹ A study conducted by Boniello et al showed that there is a statistically significant difference between graft diameter and tensile strength i.e., as graft diameter increased tensile strength also increased.²² As per Kumar et al graft thickness is the most important factor determining functional outcomes and it has a direct relation with patient's anthropometry.²² Mariscalco et al in the study concluded that a smaller hamstring autograft is a predictor of poorer 2-year KOOS functional scores.²³ Another study by Fahal et al determined 8mm to be the cut-off value for the higher incidence of ACL revision chances.²⁴ Still, there is no consensus regarding appropriate graft thickness and its relation to functional outcome post ACL reconstruction. Many studies like Rokas et al have opined contrary to the above i.e., graft diameter has no relation with recurrent instability and post-op laxity.²⁵ Bedi et al stated that it is the native ACL footprint restoration that plays a pivotal role in the better functional outcome, not the graft diameter.²⁶ In this study, we evaluated 30 ACL reconstructions using quadrupled semitendinosus graft & concluded that post-op outcome is independent of the ACL graft thickness. As we achieved excellent scores on functional evaluation of patients with graft size less than 8 mm and were comparable as well. There are several limitations of the current study. First, selection bias may have affected our study results because we included only patients who underwent MRIs. Also, the sample size is insufficient to conclude. Secondly, the mean 1-year follow-up might not be long enough to identify the regeneration of the graft after harvesting on MRI.

CONCLUSION

Arthroscopic ACL reconstruction with quadrupled semitendinosus graft produces consistent, excellent functional results with minimal morbidity, allowing patients to return to their old jobs. It is the preferred treatment for ACL-deficient knees.

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Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Fu FH, Bennett CH, Lattermann C, Ma CB. Current trends in anterior cruciate ligament reconstruction, part 1: biology and biomechanics of reconstruction. *Am J Sports Med.* 1999;27(6):821-30.
2. Fu FH, Bennett CH, Ma CB, Menetrey J, Lattermann C. Current trends in anterior cruciate ligament reconstruction, part II: operative procedures and clinical correlations. *Am J Sports Med.* 2000;28(1): 124-30.
3. Spindler KP, Warren TA, Callison JC Jr, Secic M, Fleisch SB, Wright RW. Clinical outcome at a minimum of five years after reconstruction of the anterior cruciate ligament. *J Bone Joint Surg Am.* 2005;87:1673-9.
4. Lohmander LS, Englund PM, Dahl LD, Roos EM. The long-term consequence of ACL and meniscus injuries: osteoarthritis. *Am J Sports Med.* 2007;35: 1756-69.
5. Oiestad BE, Engebretsen L, Storheim K, Risberg MA. Knee osteoarthritis after anterior cruciate ligament injury: a systematic review. *Am J Sports Med.* 2009; 37:1434-43
6. Anterior cruciate ligament injury: surgical considerations. Available at: <https://www.msn.com/en-in/health/condition/anterior-cruciate-ligament-injury?> Accessed on 20 November 2021.
7. Griffin LY, Agel J, Albohm MJ, Arendt EA, Dick RW, Garrett WE, et al. Noncontact Anterior cruciate ligament injuries: risk factors and prevention strategies. *J Am Acad Orthop Surg.* 2000;8:141-50.
8. Ryan L, Steve T, Leica CS. A review of systematic reviews on anterior cruciate ligament reconstruction rehabilitation. *Phys Ther Sport.* 2012;5:1-9
9. West RV, Harner CD: Graft selection in anterior cruciate ligament reconstruction. *J Am Acad Orthop Surg.* 2005;13:197-207.
10. 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;31:2-11.
11. Cerulli G, Placella G, Sebastiani E, Tei MM, Speziali A, Manfreda F. ACL reconstruction: Choosing the graft. *Joints.* 2013;1:18-24.

12. Friedman MJ. Arthroscopic semitendinosus (gracilis) reconstruction for anterior cruciate ligament deficiency. *Tech Orthop.* 1988;2:74-80.
13. Feller JA, Webster KE. A randomized comparison of patellar tendon and hamstring tendon anterior cruciate ligament reconstruction. *Am J Sports Med.* 2003;31: 564-73.
14. Freedman KB, D'Amato MJ, Nedeff DD, Kaz A, Bach BR Jr. Arthroscopic anterior cruciate ligament reconstruction: a metaanalysis comparing patellar tendon and hamstring tendon autografts. *Am J Sports Med.* 2003;31:2-11.
15. Laxdal G, Kartus J, Hansson L, Heidvall M, Ejerhed L, Karlsson J. A prospective randomized comparison of bone-patellar tendon-bone and hamstring grafts for anterior cruciate ligament reconstruction. *Arthroscopy.* 2005;21:34-42.
16. Kaeding CC, Aros B, Pedroza A, Pifel E, Amendola A, Andrich TJ, et al. Allograft versus autograft anterior cruciate ligament reconstruction. *sports health: a multidisciplinary approach. Arthroscopy.* 2011;3:73-81.
17. Oro FB, Sikka SR, Wolters B, Graver R, Boyd LJ, Nelson B, et al. Autograft versus allograft: an economic cost comparison of anterior cruciate ligament reconstruction. *Arthroscopy J Arthroscop Related Surg.* 2011;27(9):1219-25.
18. Cooper MT, Kaeding C. Comparison of the hospital cost of autograft versus allograft soft-tissue anterior cruciate ligament reconstructions. *Arthroscopy J Arthroscop Related Surg.* 2010;26(11):1478-82.
19. Brown CH, Sklar JH. Endoscopic anterior cruciate ligament reconstruction using doubled gracilis and semitendinosus tendons and endobutton femoral fixation. *Oper Tech Sports Med.* 1999;7(4):201-13.
20. Iriuchishima T, Shirakura K, Yorifuji H, Aizawa S, Fu FH. Size comparison of ACL footprint and reconstructed auto graft. *Knee Surg Sports Traumatol Arthros.* 2013;21(4):797-803.
21. Figueroa F, Figueroa D, Espregueira-Mendes J. Hamstring autograft size importance in anterior cruciate ligament repair surgery. *EFORT Rev.* 2018;3(3):93-7.
22. Boniello MR, Schwingler PM, Bonner JM, Robinson SP, Cotter A, Bonner KF. Impact of hamstring graft diameter on tendon strength: a biomechanical study. *Arthroscopy: J Arthroscop Related Surg.* 2015;31(6): 1084-90.
23. Mariscalco MW, Flanigan DC, Mitchell J, Pedroza AD, Jones MH, Andrich JT, et al. The influence of hamstring autograft size on patient-reported outcomes and risk of revision after anterior cruciate ligament reconstruction: a multicenter orthopaedic outcomes network (MOON) Cohort Study. *Arthroscopy J Arthroscop Related Surg.* 2013;29(12):1948-53.
24. Alkhalaf FN, Hanna S, Alkhalidi MS, Alenezi F, Khaja A. Autograft diameter in ACL reconstruction: size does matter. *SICOT J.* 2021;7:23-9.
25. Jurkonis R, Gudas R, Smailys A. Influence of graft diameter on functional outcomes after anterior cruciate ligament reconstruction: a prospective study with a 1-year follow-up. *Int Med J Exper Clin Res.* 2018;24:4339.
26. Bedi A, Maak T, Musahl V, O'Loughlin P, Choi D, Citak M, et al. Effect of tunnel position and graft size in single-bundle anterior cruciate ligament reconstruction: an evaluation of time-zero knee stability. *Arthroscopy J Arthroscop Related Surg.* 2011;27(11):1543-51.

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