



Research paper

A comparative study on functional outcome of ACL reconstruction: Quadriceps versus hamstring tendon autograft



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ABSTRACT

Introduction: There are various soft tissue graft options available for anterior cruciate ligament reconstruction. This study aims to compare the functional outcome following anterior cruciate ligament reconstruction between quadriceps tendon and hamstring tendon autografts.

Hypothesis: There was no significant difference in functional outcome of anterior cruciate ligament reconstruction between quadriceps and hamstring tendon autografts at two years follow up.

Methods: Out of total 96 patients in our study, 48 patients included in quadriceps tendon autograft group and remaining 48 patients included in hamstring tendon group. Both group of patients were treated by same surgeon, with similar fixation methods and criteria for functional outcomes includes IKDC scores and clinical assessment of stability at 2 years follow up.

Results: Preoperative IKDC scores in quadriceps and hamstring tendon group are 56 and 58 respectively. Out of 48 patients in quadriceps tendon group 4 patients lost for follow up and out of 48 patients in hamstring tendon group 6 patients lost for follow up at 12 weeks. At 2 year follow up IKDC scores in quadriceps tendon group is 114 in 40 patients and 100 in 4 patients (mean IKDC score 113), in hamstring tendon group is 119 in 38 patients and 113 in 4 (mean IKDC score 118) with p value > 0.05 (p = 0.97) showing no statistical significance.

Conclusion: Our study shows no statistical significant difference between quadriceps and hamstring tendon autograft groups at 2 years follow up following anterior cruciate ligament reconstruction. This shows our hypothesis was correct.

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1. Introduction

Ligament injuries around knee are most common sports injuries.^{1,2}

ACL is one of the most common injured ligament in the knee joint which shows good results after ligament reconstruction.

Most common mechanism of injury causing ACL tear is non-contact combined valgus- and internal-rotation trauma.³

Various types of grafts are available for ACL reconstruction which includes BTB graft, hamstring grafts, quadriceps grafts and allografts.

Several studies in the literature compared BTB autograft with

hamstring autograft. Anterior knee pain and kneeling pain shown to be less in hamstring autograft patients.^{4,5}

Other studies compared BTB autograft with quadriceps autograft which showed no significant difference in knee stability and functional outcomes except anterior knee pain more in BTB patients.^{6,7}

Quadriceps tendon autograft was first introduced by Blauth⁸ and further studied by Stabuli et al.^{9,10}

There are few studies in the literature comparing the quadriceps tendon autograft with hamstring autograft.

Our objective of the study was to compare knee stability and functional outcome after ACL reconstruction with quadriceps tendon autograft and hamstring autograft.

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2. Material and methods

Between 2010 and 2012 out of 234 ACLR done 96 patients who accepted are included in our study.

Age of the patients in our study between 20 and 50 years, both male and female are included.

Unilateral isolated ACL injured are included.

No previous surgeries in the involved knee.

No significant deformities of knee.

Single bundle method of ACL reconstruction using either hamstring tendon autograft or quadriceps tendon autograft is included.

No associated major comorbidities limiting postoperative rehabilitation protocol.

Randomization was done into two groups. Group A: autologous quadriceps tendon graft and Group B: autologous hamstring tendon grafts. Randomizer was blinded to which graft will be used. After history, clinical examination and MRI confirmation, first patient was allotted to group a and second patient to group b in simple alternate method of randomization.

All surgical procedures done by single surgeon (senior author). Except for type of graft all other factors remained same in surgery.

3. Surgical procedure

Patient positioned supine on the operation table under anaesthesia. Examination under anaesthesia done to assess and confirm type of ligament injuries and to confirm the diagnosis.

Tourniquet applied and pressure kept at 350 Hg. Thorough scrubbing done with savlon and betadine scrub and painting done with betadine solution followed by sterile draping.

In group A: Ipsilateral quadriceps tendon graft obtained by a 10 cm long mid line supra patellar incision starting at superior pole of patella shown in Fig. 1, skin and deep fascia cut in same line to expose q-tendon, width and length measured with a scale, width being 9 mm and length being 10 cm, first two parallel incisions were made in q-tendon width being 9 mm and interval between rectus and vastus intermedius tendons is separated by a blunt instrument one and half inch proximal to superior pole of patella and continued distally and proximally until 10 cm length is made sure then rectus tendon was divided sharply with knife at superior pole of patella and with ethibond no.5 sutures through it held strong and storz Q-grafter introduced and by pulling on the ethibond sutures and pushing the grafter till 10 cm length by guillotine action the graft is cut and withdrawn through the wound as shown in the Fig. 2.

On the graft master table q-tendon graft was cleaned of any residual muscle fibers and both ends were tubularized to get a rounded appearance and graft diameter and length were measured.



Fig. 1. Skin marking for quadriceps graft harvest.

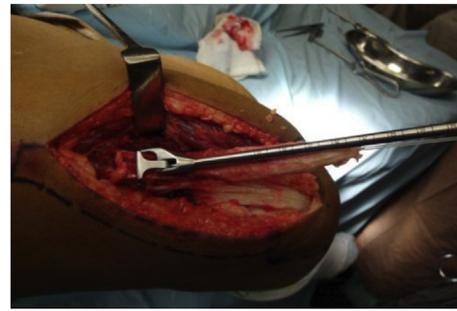


Fig. 2. Harvesting the quadriceps graft.

Though 10 cm was harvested we found in all cases the final length to be only 8.5 cm–9.0 cm and final diameter to be 8.5 mm–9.0 mm.

Routine arthroscopy was performed and any meniscal tears were excised and using storz fixed angle tibial zig a guide wire was passed from outside into intra articular point on medial slope of medial tibial spine through the remnant stump of native ACL equidistant between anterior and posterior horns of lateral meniscus.

Incremental reaming was done with cannulated reamers till the tunnel diameter reached the graft diameter. Through an accessory medial portal a separate guide wire was passed into the joint flexed 90 deg, into the femoral land mark below resident's ridge avoiding pcl and medial femoral condylar surface and incremental reaming with cannulated reamers was done till femoral tunnel reached graft diameter.

Graft is passed through the tibial tunnel, across the joint into femoral tunnel until 20–25 mm graft is in femoral tunnel and distal graft tip is seen at outer mouth of tibial tunnel.

While holding lead sutures and trailing sutures tightly stability and range of motion of joint was checked and femoral end was fixed first with measured size megafix c.p.(beta tri calcium phosphate and PLLA fenestrated smooth threaded interference screw - storz) using torque screw driver (storz) and arthroscope is removed from joint, once again stability and rom checked and while distal trailing sutures were tightly held by a trained assistant with limb in 5 deg external rotation tibial side graft tunnel fixation was done using similar IFS (storz) and final check was done to see stability, disappearance of anterior draw and pivotshift. No extra cortical or suspensory fixation was used in any case.

All wounds were closed, sterile dressing was done, sterile cylindrical roller cotton was applied and crepe bandage was done and after deflating the tourniquet a temporary long leg brace was applied. and patient was shifted to surgical post op care unit for observation. Antibiotic prophylaxis was used in all patients.

In group B: Ipsilateral semitendinosus and gracilis grafts were



Fig. 3. Harvesting hamstring tendon graft.



Fig. 4. Hamstring graft preparation.

harvested as shown in the Fig. 3 and prepared as shown in the Fig. 4 and rest of surgical procedure was same.

First post op day patient was made to walk full weight bearing and with brace which was discarded after one week. Suture removal was done on 10th post op day in all cases and accelerated rehabilitation protocol was followed. post op exercises rehabilitation was supervised by the surgeon and qualified sports medicine physiotherapist.

Follow up was at 3 weeks, 6 weeks, 12 weeks, 6 months, one year and two years.

At 3 weeks weight resisted hamstring and isometric q-strengthening was started, activities of daily living were started and patient was allowed to go to work and at 9 weeks proprioceptive exercises were started at 9 months patients were allowed to go to recreational sports activity with care.

At 12 weeks, 6 months, one year and two years all clinical instability tests, single leg stance time, radiographic laxometry were done and functional assesment done with IKDC scoring system.

4. Results

At 12 weeks in quadriceps tendon group out of 48 patients 4 were lost for follow up and in hamstring group out of 48 patients 6 were lost for follow up.

Clinical stability subjective and tested in quadriceps graft group 32 stable, 12 complained of fear of instability but no anterior draw positive and radiographic instability absent, in hamstring graft group 38 stable and 4 complained of instability not confirmed by tests.

IKDC functional assessment scores: Preop IKDC scoring in quadriceps group is 56 and in hamstring group is 58, post op IKDC scoring at 6 months in quadriceps graft group 92 (in 30 patients) 87 (in 14 patients) and in hamstring graft group 96 (in 38 patients) 90 (in 4 patients), at one year in quadriceps graft group score is 114 (40 patients) 100 (4 patients), at two years scores were same. See Table 1.

Statistical analysis: The mean IKDC scores in both the groups

were analysed with chi square test with p value 0.05 considered significant. In this study p value is 0.93 at 6months follow up and 0.97 at 1 year and 2 years follow up which shows no statistical significance (p value > 0.05) between two groups.

Clinical instability tests Lachman test, anterior drawer test, pivot shift test done, single leg stance time, radiographic laxometry were done at each follow up visits. No symptomatic instability or clinical instability seen in all patients in both groups.

In muscle strength assessment quadriceps tendon graft patients exhibited extension weakness with loss of terminal 10 deg extension (active) by six months q-power returned with full extension, did not correlate with IKDC scoring hamstring tendon graft patients immediate post op period -weakness of knee flexor power was present in all patients upto 12 weeks, recovered by 6 months, did not correlate with IKDC scoring.

5. Discussion

In our study data showed no significant difference the two groups in terms of functional outcome scores and knee stability with two years follow up.

Study conducted by sof u et al.¹¹ reported that a quadrupled hamstring tendon autograft is superior to a central quadriceps tendon-patellar bone graft. They believe quadriceps tendon diameter and strength decreases greatly after harvest and these changes leads to increased biomechanical strength on reconstructed ligament in the early stages of healing causing earlier elongation. This leads to instrumental laxity measurement findings poor in QT than HT group.

Kim et al.¹² reported mean side to side difference in 28 patients for single bundle quadriceps reconstruction was 2.64 mm.

E Cavaignac et al.¹³ reported that QT graft in ACL reconstruction leads to equal or better functional outcomes than does the use of an HT graft, without affecting morbidity which differs with Sofu et al.¹¹ results.

Lee et al.¹⁴ reported similar knee joint stability and functional outcomes in anatomic ACL reconstruction using the QT graft as compared with the double bundle hamstring tendon autograft and additionally better flexor muscle strength recovery was found in patients QT graft. There are certain limitation of this study as it uses double bundle technique in hamstring graft patients.

In our study extensor weakness with loss of terminal 10° extension in quadriceps tendon group and flexor muscle weakness in hamstring tendon group was only for short period which improved in all cases of both the groups with no morbidity after six months. There were no revision surgeries due to infections and graft failures in both the groups at two years follow up.

Using hamstring tendon autograft (either ST alone or both ST and gracilis) shows hamstring strength deficits of between 3% and 27% compared with non-operated limb, indicating that hamstring strength deficits persist despite successful completion of rehabilitation.¹⁵

Table 1

Comparison of IDKC scores in both groups with corresponding p values.

| | Quadriceps group IKDC score | Hamstring group IKDC score | P value |
|----------|-----------------------------|----------------------------|---------|
| Pre op | 56 | 58 | |
| 6 months | 92 (30 patients) | 96 (38 patients) | 0.93 |
| | 87 (14 patients) | 90 (4 patients) | |
| | 90 (mean score) | 95 (mean score) | |
| 1 year | 114 (40 patients) | 119 (38 pts) | 0.97 |
| | 100 (4 patients) | 113 (4 pts) | |
| | 113 (mean score) | 118 (mean score) | |
| 2 years | 113 (mean score) | 118 (mean score) | 0.97 |

Nakamura N et al.¹⁶ reported that loss of flexor strength following the harvest of the hamstring tendons may be more significant than has been previously estimated.

Lee et al.¹⁷ 2004 reported the quadriceps muscle power is not compromised despite sacrificing part of the tendon. Our results show recovery with a mean of 82% of contralateral side at 1 year, and 89% at 180°/second at 2 years.

The mean cross-sectional area of a 10-mm wide quadriceps tendon graft is 64 mm², which is significantly larger than the 37 mm² of the patellar tendon, so it can presumably reproduce the broad anatomic insertion of the native ACL to the tibia.¹⁷

The ultimate failure load of the quadriceps tendon–bone complex was measured at 2173 ±618N compared with the 1953 ±325 N of the bone–patellar tendon–bone complex.^{18,19}

Systemic review by Slone et al. showed that use of QT atograft for ACL reconstruction is safe, reproducible and versatile graft that should be considered in future studies of ACL reconstruction.²⁰

There are certain limitations in our study first was the midterm follow up of 2 years, long term studies needed for better analysis. Second other functional outcome scores were not evaluated.

6. Conclusion

In our study we found that there was no significant difference in functional outcome and knee stability in patients of ACL reconstruction in between quadriceps and hamstring tendon auto grafts. Weakness in muscle strength in both the procedures was seen only short term and improved in all cases with no morbidity within 6 months. So both the grafts can be suitable choice for ACL reconstruction based on surgeon choice and expertise.

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