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PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF ARTHROSCOPIC ACL RECONSTRUCTION USING SEMITENDINOSUS TENDON GRAFT WITH A PERIOSTEAL STRIP FROM ANTEROMEDIAL TIBIA

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Abstract

Background: Semitendinosus tendon is considered one of the best grafts for ACL reconstruction. Only if the semitendinosus graft is inadequate in length or diameter the need for gracilis tendon occurs. Harvesting the semitendinosus tendon along with a 1.5 to 2 cm periosteal strip from anteromedial tibia will increase the graft dimensions. The purpose of this study is to assess the functional outcome of ACL reconstruction with this modified form of semitendinosus graft.

Materials and methods: Twenty patients with symptomatic ACL tear underwent arthroscopic ACL reconstruction using quadrupled semitendinosus tendon along with a strip of periosteum from the anteromedial tibia. No patient required gracilis tendon and all had a graft diameter of 8mm and above with a length greater than 7.5cm. Seventeen patients completed a period of one year follow up.

Results: The average preoperative score was 61.24 (S.D.=5.8). After surgery, the average Tegner Lysholm score at one year was 87.76 (S.D.=4.1). This shows a significant improvement in the score (p value <0.01). Fourteen of the 17 patients had the entire range of knee motion restored. Two of them had 20 degrees loss of flexion and one had a fixed flexion deformity of 5 degrees. Two patients had superficial infection which subsided with antibiotics. One patient had graft impingement which was noticed intra-

operatively and notchplasty was done. There was no graft failure for any of them.

Conclusion: Harvesting semitendinosus tendon along with a strip of periosteum from the anteromedial tibia will improve the dimensions of the graft making it sufficient for ACL reconstruction. This will decrease the need for gracilis tendon and the morbidity associated with its harvest

Keywords: ACL; Hamstring tendon; Semitendinosus; Gracilis

Introduction

Anterior cruciate ligament (ACL) reconstruction for an ACL deficient knee is being done for more than a century. All these years, there was a gradual evolution in both the surgical technique and the choice of the graft. The search for a perfect graft still continues. Hamstring tendon graft is a near perfect graft that is commonly used nowadays. Quadrupled semitendinosus and gracilis or a quadrupled semitendinosus alone, remains the choice of most of the arthroscopists. Average length of anterior cruciate ligament is 38mm and the average width is 11mm¹. An adequate graft for ACL reconstruction should be of 8mm thick and at least 7.5 to 8cm in length. A graft with a larger cross-sectional area provides more anteroposterior stability.² Isolated semitendinosus graft does not always satisfy this requirement, particularly in Indian population where the average height of the individual is less when compared to rest of the world population.³ This is when the need for gracilis tendon graft occurs. In our study, we harvested the periosteum of the medial surface of the proximal tibia along with the graft which gave us an extra 1.5 to 2 cm. Purpose of this study is to demonstrate how this small change in graft harvesting technique makes semitendinosus self sufficient and to study the functional outcome after ACL reconstruction with this modified semitendinosus graft at one year follow up.

Materials and methods

This is a prospective study done during October 2014 to May 2016 after obtaining approval from institutional ethical committee. Inclusion criteria were 1. isolated ACL injuries diagnosed clinically, radiologically

and arthroscopically 2. Young and middle aged, physically active motivated patients 3. Near normal range of motion and good quadriceps strength. Exclusion criteria were 1. Bony or osteochondral fractures 2. Other ligamentous injuries other than ACL and meniscus tear 3. Severe osteoarthritis 4. Previous knee surgery. Twenty patients met with the inclusion criteria. Clinical history, examination findings and the impressions from anterior drawer, Lachman and Pivot shift tests were accurately documented. Preoperative functional status was assessed using the Tegner Lysholm Knee score. Surgery was done in regional (spinal) anesthesia and under tourniquet control. All patients were operated by the first author. Initially a diagnostic arthroscopy was done through the standard anteromedial and anterolateral portals to confirm the diagnosis and to know the status of other intra-articular structures. Torn stump of the ACL was debrided and for unstable meniscus tear, partial meniscectomy was done. Then the ipsilateral semitendinosus tendon was harvested. An oblique skin incision was made 2cm medial and 3cm inferior to the tibial tuberosity. After dissection of the subcutaneous tissue, pes anserinus was palpated. Incision was made in the sartorius fascia to expose the semitendinosus tendon. Tibial insertion of the tendon was detached along with a 1.5 to 2 cm strip of tibial periosteum (Figure 1). After cutting the facial bands (vincula) between the semitendinosus and gastrocnemius, the tendon was harvested using a closed tendon stripper with the knee held in 90 degrees of flexion. Retained muscle and fatty tissues were removed from the graft. The graft was quadrupled and stitched using no. 2 Ethibond by Krackow technique (Figure 2). Finally

a no.5 Ethibond was used to make a crisscross loop at the ends of the graft. Length of all the grafts were 7.5 to 8 cm and all the grafts had a diameter of 8mm and above. Tunnels were made with the help of appropriate jigs and reamers after identifying the anatomical footprints. Graft was fixed to the tunnels using titanium interference screws. Finally after fixation, graft was checked for laxity and impingement. Postoperatively we followed a standard rehabilitation protocol. In the early postoperative days, patients were advised to do range of motion exercises and isometric quadriceps exercises. Patients were mobilized early and allowed to do closed chain exercises. Strength and proprioceptive training were given later. Patients were discharged at the fifth post-operative day and were followed up at the end of 2 weeks, 1st month, 3rd month, 6th month and 1 year. After 3 months weight resisted exercises were started. Cutting, pivoting and sports activities were allowed only after 8 months. Progress of the patient was assessed by the range of motion gained, presence of pain, gait, quadriceps strength and bulk. At the end of one year functional outcome was measured using the Tegner Lysholm Knee Score, range of motion of the knee and the amount of laxity as graded with anterior drawer and Lachman test. Comparison was made between the preoperative and postoperative functional status using the Tegner Lysholm knee score and the laxity tests results. Statistical analysis was done using SPSS software version 20. Paired student t test was used to compare the difference between preoperative and postoperative Tegner Lysholm scores.

Results

Out of the 20 patients, 3 were lost during follow up. The remaining 17 patients completed the one year follow up. Mean age of the patients was 39 years with a range of 23 to 56 years. Twelve were male and five were female. Right knee was injured in 10 patients and the rest had their left knee injured. Twelve were sports related injuries (3- cricket, 7- football, 1- kabaddi and 1- hockey), 4 were vehicular accidents and 1 occurred during daily routine activity. Eleven of them presented between 2 to 6 months after injury and the rest presented between 7 to 12 months after injury. Seven patients had an associated medial meniscus tear, 4 had lateral meniscus tear, 2 had both the meniscus tear and 1 had a grade 2 cartilage damage of the medial femoral condyle. Partial meniscectomy was done for meniscal injury. Cartilage changes needed a mild debridement. Pre and postoperative difference in the amount of laxity as graded through anterior drawer and Lachman test is shown in table 1. With respect to Tegner Lysholm knee score 2 had excellent result, 14 had good and 1 had a fair result. This was a very good improvement when compared to preoperative functional status where 12 had a preoperative score of < 65 (poor functional status) and 5 had a score between 65 and 83 (fair). Mean preoperative Tegner Lysholm score was 61.24 (S.D.=5.8). Mean postoperative Tegner Lysholm score at one year follow-up was 87.76 (S.D.=4.1) which was a significant difference (P value<0.01), as observed with Paired Student t test. Fourteen of the 17 patients had regained the entire range of knee motion when compared to the contralateral normal knee. Two had 20 degrees loss of flexion and one had a fixed flexion deformity of 5

degrees. Two patients had a superficial infection which subsided with antibiotics and antiseptic dressing. One patient had graft impingement which was detected intra-operatively and a notchplasty was done.

Discussion

Arthroscopic reconstruction of anterior cruciate ligament using patellar tendon graft was considered the gold standard procedure for symptomatic ACL deficient knee. Though it has good mechanical strength and bone to bone healing potential it has some limiting factor – anterior knee pain⁴, pain on kneeling, patellofemoral articular lesions⁵, loss of knee extension⁶⁻⁸ and weakening of quadriceps muscle power.⁹⁻¹² These complications started the search for a new graft for ACL reconstruction, when the hamstring tendon graft turned out to be the answer. But the cross- sectional area and maximal tensile load of the semitendinosus is less than the patellar tendon graft and a normal ACL.¹³⁻¹⁴ To avoid these shortcomings tripling and quadrupling of the hamstring tendon was done. Gradually hamstring tendon graft became a favorite substitute with lesser donor site morbidity. Hamstring tendon graft is known to produce equally good results when compared with patellar tendon graft.¹⁵⁻¹⁷ But hamstring tendon graft is not entirely free of complications. There are few issues which come in to the picture when using a hamstring tendon graft. First one is injury to the saphenous nerve. Saphenous nerve is a sensory nerve branching off from the femoral nerve in the thigh. It passes through the adductor canal and then divides into two branches – infrapatellar branch and the sartorial branch. Infrapatellar branch travels from medial to lateral

and supplies the skin over the medial aspect of proximal tibia. This branch is usually damaged while making an incision to harvest the graft. This injury can be avoided by making an oblique incision parallel to the nerves instead of the traditional vertical incision which runs perpendicular to the nerves.^{18,19} The sartorial branch lies close to the gracilis on the deep surface of Sartorius crossing the gracilis lateral to medial, at a point 11.8cm from its insertion. Due to its proximity, this nerve is damaged more often when the gracilis tendon is harvested. So if semitendinosus alone is sufficient gracilis harvest can be avoided and the chances of injury to the sartorial branch of saphenous nerve can be reduced. Second concern with the usage of hamstring tendon graft is the weakness of knee flexion. But the literature evidence is mixed and still this is a debatable topic. But there are few evidences that showed that flexion weakness is less if gracilis is preserved.²⁰⁻²² This can be important for patients who involve in sporting activities where knee flexion strength is important. Therefore it will be better if we spare the gracilis and use only the semitendinosus tendon as graft for ACL reconstruction.

Semitendinosus tendon is longer and thicker than gracilis. The average cross- sectional area of gracilis and semitendinosus as found by Park et al²³ in their study with 296 patients were 1.5mm ± 0.2 and 2.2mm ± 0.3. A quadrupled semitendinosus graft will definitely have a greater diameter than a quadrupled graft with both gracilis and semitendinosus. But the issue with isolated semitendinosus tendon graft is we may not be able to achieve the desired length in all cases. Females, particularly short individuals are known to have a short hamstring

tendon length.²⁴ Not only the diameter but also the length of the graft is also equally important to provide a stable fixation and good bone to tendon healing. An 8cm lengthy graft will be sufficient for a proper ACL reconstruction. Triple stranded semitendinosus graft will provide adequate length, but a diameter of 8mm is not always possible. A quadrupled semitendinosus graft will have adequate diameter, but the length can be an issue sometimes.

Till date there is no clear cut evidence to show any association between inadequate graft size and poor functional outcome following ACL reconstruction. Also 'inadequate graft size' does not find a place in the list of causes for graft failure. But there are two studies which depicted some interesting findings. In their retrospective study of 263 patients Mariscalco et al²⁵ found that smaller graft diameter is a predictor of poorer functional outcome. In that study revision surgery was needed in none of the 64 patients with grafts greater than 8 mm in diameter whereas 14 of the 199 patients (7.0%) with grafts 8 mm in diameter or smaller required revision. Similarly Magnussen et al²⁶ also made a similar conclusion from

their study of 256 patients where failure rate was more when the graft size was less than 8mm.

In our study we harvested the semitendinosus tendon along with a strip of periosteum from the anteromedial tibial cortex. This lengthens the graft by 1.5 to 2 cm which brings the total length to about 30 to 32 cm. A quadrupled graft will have a length of 7.5 to 8 cm with a diameter not less than 8mm. This small change in graft harvest method made semitendinosus sufficient in terms of length and diameter in all the cases. Fixation of the graft using an aperture fixation device like the interference screw used in our study will require a more lengthy graft when compared to a suspensory loop fixation. Still there was no requirement for gracilis tendon in any of the cases. Till date, there is no other study which focused on this modification in semitendinosus graft harvest technique and the outcome following ACL reconstruction with such a modified graft. In the 17 patients whom we followed there was no failure due to insufficient graft length or strength. All of them went back to their original profession and by the end of one year most of them got involved in recreational sporting activities.

Functional outcome was satisfactory with 2 patients had an excellent Tegner Lysholm score, 14 had good and only one had a fair outcome. Objective tests for laxity also showed significant difference after surgery. No one had any symptoms related to saphenous nerve injury.

Limitations

There are few limitations in our study. Number of patients and duration of follow up is limited. Comparison with combined semitendinosus and gracilis graft was not done. Measurement of laxity was done manually using the tests for laxity rather than with a KT 1000 arthrometer.

Conclusion

Harvesting semitendinosus tendon along with a strip of periosteum from the anteromedial tibia makes the graft sufficient in terms of length and diameter. Reconstruction of ACL with this semitendinosus tendon provides satisfactory result. With this small change in the semitendinosus harvest technique, the need for gracilis tendon graft can be reduced and also the complications that arise with harvesting both the hamstring tendons.

Table 1: Table showing the results of preoperative and postoperative Anterior drawer and Lachman test

	Positive tests			Negative tests
	Grade 1	Grade 2	Grade 3	
Preoperative Lachman test	0	2	15	0
Postoperative Lachman test	1	0	0	16
Preoperative Anterior drawer test	0	4	13	0
Postoperative Anterior drawer test	1	0	0	16

Figure 1

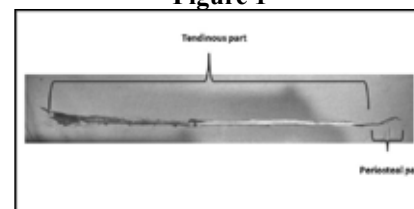


Figure 2

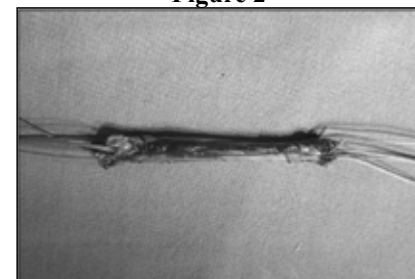


Figure 3

Figure legends

Figure 1: Figure showing a semitendinosus tendon harvested along with a strip of periosteum from the anteromedial tibia

Figure 2: Quadrupled semitendinosus tendon graft prepared using Ethibond sutures

Figure 3: Post operative plain radiograph showing the position of interference screws in anteroposterior and lateral views

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