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Arthroscopically assisted anterior cruciate ligament reconstruction: Comparison of bone-patellar tendon-bone versus semitendinosus gracilis autograft

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Abstract
Anterior cruciate ligament (ACL) tear is the most common serious ligamentous injury to the knee joint. The ACL is the primary stabilizer against anterior translation of the tibia on the femur and is important in counteracting rotation and valgus stress. Anterior cruciate ligament deficiency leads to knee instability. This results in recurrent injuries and increased risk of intra-articular damage, especially the meniscus. The goals of the ACL reconstruction are to restore stability to the knee: allow the patient to return to normal activities, including sports; and to delay the onset of osteoarthritis with associated recurrent injuries to the articular cartilage and loss of meniscal functions. The bone-patellar tendon-bone graft and the hamstring tendon graft are the two commonly used auto grafts for reconstruction. This study is to compare the results of arthroscopically assisted ACL Reconstruction using Bone-Patellar Tendon-Bone (PTB) and Semitendinosus-Gracilis (STG) grafts. This study was conducted in Govt. Medical College Kozhikode from March 2014 to October 2015. During this period 40 cases of adult patients with ACL deficient knees were selected according to the inclusion criteria. This study aims to compare the results of Arthoscopically assisted ACL Reconstruction using Bone –Patellar – Bone and STG tendon grafts in terms of Post operative knee stability, Subjective knee functions, Patient satisfaction, Graft site morbidity and Range of motion. Results of our study clearly showed that both bone patellar tendon bone and hamstring tendon grafts could effectively improve knee stability and functions after Anterior Cruciate Ligament reconstruction. At follow up evaluation, both groups had similar subjectives outcomes. The outcome for patients in this study undergoing ACL reconstruction with a Hamstring tendon graft did not differ from that of patients with a Patellar tendon graft in term of clinical stability, range of motion and general symptoms. The hamstring tendon group also had lower graft harvest site morbidly, as demonstrated by less kneeling pain at 6 months and 1 year.

Keywords: Anterior cruciate ligament, hamstring tendon, bone patella bone tendon

Introduction
Anterior cruciate ligament (ACL) tear is the most common serious ligamentous injury to the knee joint. The ACL is the primary stabilizer against anterior translation of the tibia on the femur and is important in counteracting rotation and valgus stress. Anterior cruciate ligament deficiency leads to knee instability. This results in recurrent injuries and increased risk of intra-articular damage, especially the meniscus. The goals of the ACL reconstruction are to restore stability to the knee: allow the patient to return to normal activities, including sports; and to delay the onset of osteoarthritis with associated recurrent injuries to the articular cartilage and loss of meniscal functions. The bone-patellar tendon-bone graft and the hamstring tendon graft are the two commonly used autografts for reconstruction. During the past decade arthroscopically assisted techniques have been an accepted method of reconstructing the ACL.

Despite an abundance of literature on ACL reconstruction and its outcome, there are little data directly comparing hamstring tendon autograft and patellar tendon autograft to aid the patient and surgeon in selecting the appropriate graft.

There is little or no difference between bone-patellar tendon-bone and combined semitendinosus and gracilis hamstring tendon grafts in terms of the functional outcome after ACL reconstruction, despite greater laxity measurements in the hamstring tendon group

patients. This suggests that operating surgeon must decide how to select the appropriate graft for a patient. Graft choice, Surgeon experience, correct graft position, choice of the graft fixation, and postoperative rehabilitation confound the results of comparison of ACL reconstruction. Stiffness and strength tend to be slightly better with bone-patellar tendon–bone, but overall results are comparable. The advantages of arthroscopically assisted anterior cruciate ligament reconstruction include elimination of capsular incisions, decrease in trauma to the fat pad, avoidance of desiccation of the articular cartilage, better visualization of the femoral attachment, and a lower incidence of post –operative patellofemoral pain than with open reconstruction. The primary disadvantage of arthroscopically assisted technique is that the technique has a long learning curve and is a technically demanding procedure.

The bone-patellar tendon –bone and the hamstring tendon are the two most commonly used autografts for reconstruction. The bone-patellar tendon-bone autografts has been widely accepted as the gold standard for ACL reconstruction with a high success rate. However, donor site morbidities and extensor mechanism problems associated with the use of the bone –patellar tendon-bone have led to increasing popularity of the hamstring tendon graft which had advantages of low donor site morbidities, avoidance of extensor mechanism problems and cosmesis.

Objectives to compare the results of Arthroscopically assisted ACL Reconstruction using Bone-Patellar-Bone (PTB) and Semitendinous- Gracilis (STG) tendon grafts in terms of

- Post operative knee stability
- Subjective Knee functions
- Patient satisfaction
- Graft site morbidity
- Range of motions

Materials and methods

The study included 20 patients who underwent bone-patellar tendon-bone autograft and 20 patients who underwent semitendinosis gracilis autograft between march 2014 and October 2015 at Govt. Medical college Kozhikode.

All patients who underwent single –incision arthroscopically assisted ACL reconstruction using either the bone-patellar tendon –bone or the hamstring autograft without extra-articular augmentation between march 2014 and October 2015 were reviewed.

Clinical diagnosis was made by positive Lachman, Anterior Drawer and Pivot shift tests. The indication for surgery was an ACL tear confirmed by clinical diagnosis in an otherwise healthy patient who experienced knee instability in daily activities or wished to maintain his or her pre –injury level of activities. The diagonosis was confirmed by preoperative MRI scans.

Exclusional criteria

- Contralateral ACL deficiency
- Bilateral ACL reconstruction
- Revision ACL surgery
- Previous knee operation
- Concomitant extra-articular reconstruction
- Concomitant medical illness or geographic constraint that precluded follow up evaluations. All operations were performed by the two surgeons.

The type of graft tissue used for reconstruction (bone-patellar-bone versus hamstring tendon autograft) was not randomized. Bone-patellar tendon-bone autografts were used for those who wished to return to highlevel activities and hamstring tendon autograft for those who had low -level activities or were concerned about cosmesis. The outcome testing in all cases was performed at the latest follow-up (at one year)

Surgical technique

The anterior cruciate ligament was reconstructed with a single –incision, arthroscopic assisted techniques. Prophylatic antibiotic, were given prior to the skin incision. The hamstring tendons were harvested through a small longitudinal anteromedial incision over the pes ancerinus insertion. The graft was then prepared for a quadrupled semitendinosis construct using the Acufex Graft Master Table.

The bone- patellar tendon-bone autograft was harvested via a longitudinal incision (usally 4-5 cm in length) over the patellar tendon. The graft was prepared in to a bone-patellar tendon-bone construct with the leading suture on the patellar side. The portals used for arthroscopy included the superomedial portal for gravitational inflow canula, high inferolateral for arthroscope and inferomedial for instruments.

The notch was prepared using a curette and motorized shaver until the over the- top position and femoral ACL footprint were clearly demonstrated.

The tibial stump was cleaned leaving a short amount of stump for reference and covering the graft. The tibial guide pin was inserted to the posterior half of the remnant using the Acufex-elbow –tipped tibial guide and tibial tunnel reamed according to the size of the graft. With the knee flexed at 90 degrees, a guide pin was passed through the tibial tunnel to the femoral tunnel position. The femoral tunnel was reamed according to the size of the graft.

Using a suture passing pin, the graft was passed through the tibial tunnel into the femoral tunnel and the suture passing pin passing out distal to the anterolateral skin of the thigh.

The fixation method for patellar tendon graft was a cannulated interference screw usually 7 x 25 mm. The femoral site was fixed at 120 degrees knee flexion with the screw guide pin passed through the inferomedial portal. After femoral fixation, tension was applied to the tibial bone block suture and the knee passed through several cycles of flexion –extension to pretension the graft. The tibial site was fixed at 20 degrees knee flexion. For femoral fixation of the hamstring graft, cannulated interference screw was used. The tibial site was also fixed with cannulated screw.

After the procedure, an intra-articular vacuum drain was placed through the inflow canula portal into the joint. The drain was removed at 24-48 hours postoperatively. The knee was placed in a compressive dressing and hinge knee bracelocked in full extension.

Post- operative care

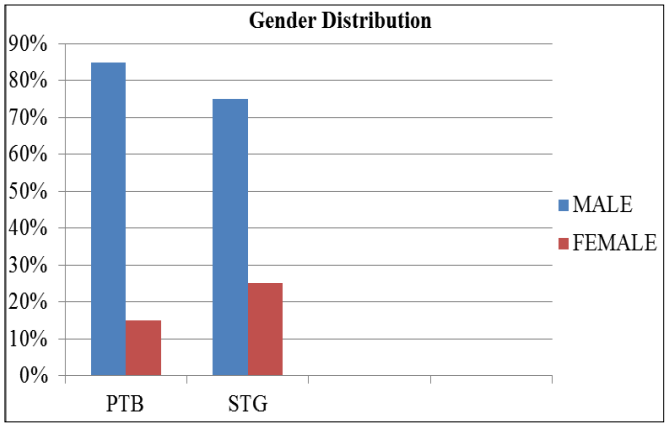
The knee brace was locked to allow 0-90 degrees knee motion on the second or third postoperative day and the patient was discharged. Weight bearing as tolerated was allowed with axillary crutches but delayed in patients with concomitant meniscal repair. Full weight bearing without support was allowed as soon as the patient were comfortable. The usual clinical follow- up included review at 10-14 days for wound inspection and suture removal, the brace set to 0-120 degrees at 4 weeks and removed at 6 weeks. Wall sliding semi-squats were allowed as early as possible. Bicycling was allowed at 2-3 months and general strengthening exercise continued. Returning to sports involving jumping, pivoting or side –stepping was prohibited until 9 months post operatively but with variable patient compliance.

Clinical evaluation

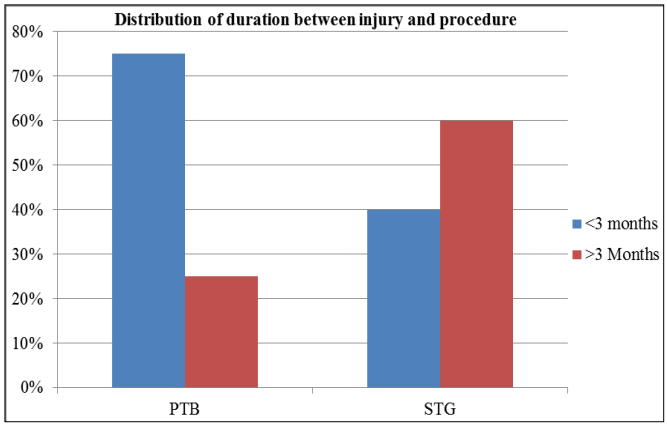
All patients were followed–up initially by the operating surgeon. All final clinical testings and evaluations were performed by the other independent surgeon from one year post –operation to eliminate potential bias. The evaluations included supine range of motions measurements with goniometer, effusion, joint line tenderness and patellofemora l crepitation, as well as checking for associated complications. Stability testing included the Lachman test, anterior drawer test, pivot shift test. Ligmentous laxity was graded as 1+(0-2mm), 2+(3-5mm), 3+(6-9mm), 4+ (>10mm). A single legged hop for distance was used for functional testing. The test was performed three times and averaged.

Results

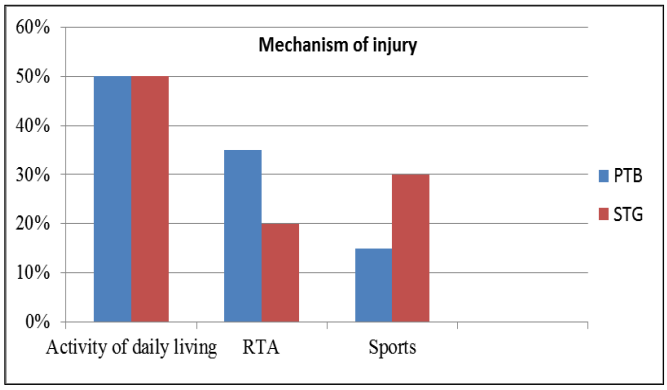
- Majority of study subjects were males (32 out of 40)



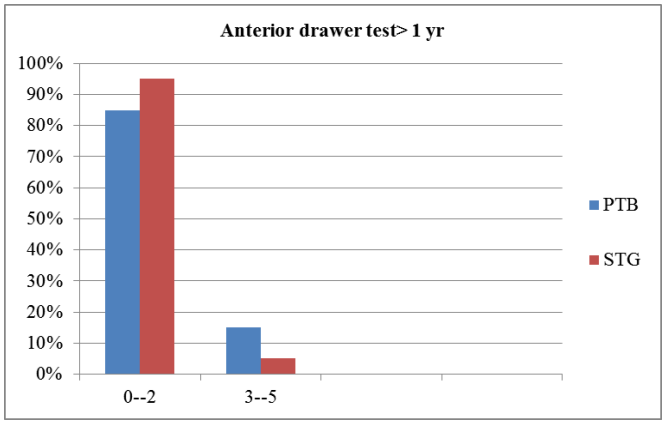
- Mean age was 29.75 years in PTB and 27.75 years in Hamstrings group.
- There is a significant risk of associated with ACL deficient knees among group who under went surgery 3 months after injury than those who underwent before 3 months.



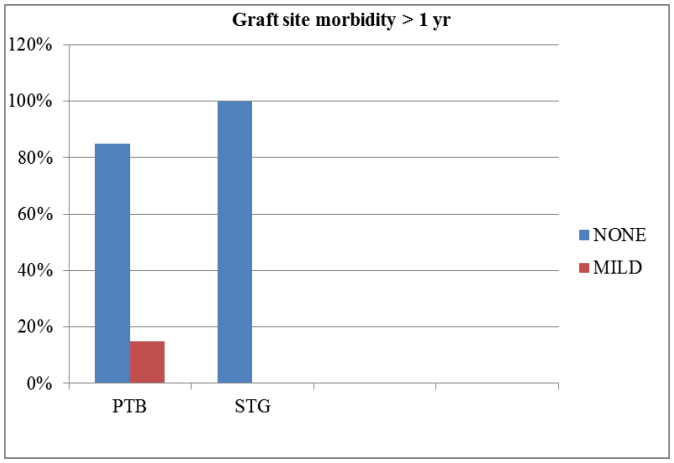
- Only 7 patients had isolated ACL injury.
- Right side was affected in 23 patients left side in 17 patients.
- Most common mechanism of injury was activities of daily living in 20 patients. Road Traffic Accidents in 11. Sporting activity in 9 patients.



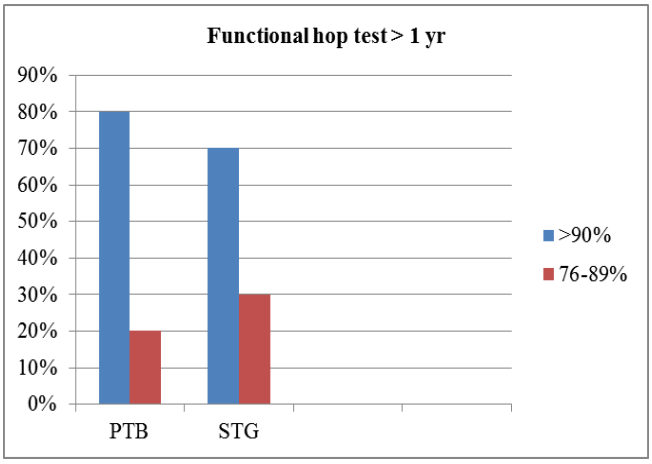
- 75% were able to do strenuous activities like physical work in PTB group compared to 50% in Hamstrings group after surgery.
- About 5% in each group had knee effusion after 6 months of surgery. None had knee joint effusion after 1 year of surgery in both groups.
- 70% of PTB group and 85%of STB group had less than 3 degrees of extensor lag after 6 months .30% of PTB group and 15%of STB group had 3-5 degrees of extensor lag after 6 months.
- Only 10% in PTB and 5% of STG group had extensor lag in the range of 3-5 degrees one year after surgery.
- 80% PTB group and 90% STG group had 0-5 degrees lack of flexion after 6 months. 20% of PTB and 10%STG group had 15 degrees lack of flexion after 6 months. Only 10% in PTB group and 5% in STG group had lack of flexion at the range of 6-15 degrees one year after surgery.
- Only 15%in PTB and 5% in STG group had ACL laxity in the range of 3-5mm one year after surgery by anterior drawer test.



- 15%in PTB and 5%in STG group had ACL laxity in the range of 3-5mm after one year of surgery by Lachman test.
- 30% of PTB group had patellofemoral pain after 6 months and none of the STG group had this pain. At the end of one year after surgery none of both groups had patellofemoral pain.
- 15% of PTB group had graft site morbidity after one year and none in the STG group



- 65% of PTB group and 60% of STG group were able to do 90% and more single leg functional hop test after 6 months and 80% of PTB group and 70% of STG group were able to do the test one year after surgery.



Discussion

40 patients were included in the study. There were20 patients in the BPTB group and 20 patients in the hamstring group. The mean age in PTB graft group is 29.75 years and in STG graft is 27.75 years. Majority were males 32, and 8 were females. There is significant difference between duration of injury and procedure done.

More number of Late group (>3months) had associated injuries. Manual Lachman and anterior drawers tests were used for stability testing. There were no difference in the number and the distribution of grading of instability in both groups.

Results of our study clearly showed that both bone-patellar tendon –bone and hamstring tendon grafts could effectively improve knee stability and functions after anterior cruciate ligament reconstruction. At follow-up evaluation, both groups had similar subjective outcomes.

In a similar study, Corry *et al*. [1] found that the two grafts did not differ in terms of clinical stability, range of motion and general symptoms. The hamstring tendon group also had a lower graft harvest site morbidity. In the study of arthroscopic anterior cruciate ligament reconstruction with bone-patellar tendon –bone graft, Akgun *et al*. [2] found that the best result could be obtained if the reconstruction was done in the sub acute period between 3-5 weeks post injury. The patients in the bone-patellar tendon-bone group would have more desire to return to sports activity or higher functional demand than in the hamstring group, therefore higher expectation. Donor site morbidity is a major drawback of the bone-patellar tendon-bone graft. All patients in the bone-patellar tendon–bone group of the present study had experienced a disturbance of anterior knee sensation which continued for a period of time although it returned to normal within one year of the follow-up period. In contrast, there was no sensory disturbance in the hamstring group. The hamstring group had also presumably better cosmesis.

There have been many prospective randomized control studies comparing the two groups published in recent years. Results from these studies showed that the two groups had similar outcomes at the 2-5 year period.

On the contrary, with similar prospective randomized comparisons, Beynnon, *et al*. [3] found that after three years of follow-up, the objective results of anterior cruciate ligament reconstruction with a bone-patellar tendon-bone were superior to those of reconstruction with a two –strand semitendinosus –gracilis tendon graft with regard to knee laxity, pivot shift grade, and strengths of the knee flexor muscle. However, the two groups had comparable results in terms of patient satisfaction, activity level, and knee functions. Results from our study and these prospective randomized studies are conflicting but there was a trend toward similar final outcomes.

In 2001, Yunes, *et al*. [4] were the first to report a meta-analysis conducted from controlled trials of patellar tendon versus hamstring tendons for ACL reconstruction.

They found that the patellar tendon patients had a greater chance of attaining a statically stable knee and nearly a 20% greater chance of returning to pre injury activity levels. They concluded that although both techniques yielded good results, patellar tendon reconstruction led to higher postoperative activity levels and greater static stability than hamstring reconstruction.

In 2003, using the same and extended numbers of controlled trials, Freedman, *et al*. [5] found that the rate of graft failure in the patellar tendon group was significantly lower and a significant higher proportion of patients in the patellar tendon group had a side-to-side difference of less than 3mm on KT -1000 arthrometer testing than in the hamstring tendon group. There was a higher rate of manipulation under anesthesia for lysis of adhesions and of anterior knee pain in the patellar tendon group and a higher incidence of hardware removal in the hamstring tendon group. They concluded that patellar tendon autograft had a significantly lower rate of graft failure and resulted in better knee stability and increased patient satisfaction compared with hamstring tendon autografts. However, patellar tendon autograft reconstruction resulted in a increased rate of anterior knee pain.

Conclusion

The outcome for patients in this study undergoing ACL reconstruction with a hamstring tendon did not differ from that of patients with a patellar tendon graft in terms of clinical stability, range of motion, and general symptoms. The hamstring tendon group also had lower graft harvest site morbidity, as demonstrated by less anterior knee pain at 1 year.

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