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ORIGINAL RESEARCH

Posterior Cruciate Ligament reconstruction with peroneus longus tendon graft: 18 months follow-up

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ABSTRACT

Aim: The aim of this study to determine the Posterior Cruciate Ligament reconstruction with peroneus longus tendon graft.

Methods: 12 patients with chronic injury (> 6 months), Presence of an 'isolated' PCL were included in this study. The diagnosis of chronic ligament rupture was established with clinical examination and imaging (Magnetic resonance imaging, MRI). Post-operative functional outcome (IKDC, Modified Cincinnati, and Lysholm) were recorded 18 months after surgery with direct patient examination and a guided-interview by a single orthopaedic surgeon outside the surgical team.

Results: Mean IKDC score was 48.55±10.69 pre-operatively and 79.88±3 At 18 month's follow-up. Mean score of Modified Cincinnati was 49.66±9.69 pre-operatively and 80.69±3.98. Mean Lysholm score was 50.22±10.87 pre-operatively and 81.99±4.59 at 18 months follow-up. Single hop test and triple hop test after 18 months post operatively showed 96.17 ± 2.64 and 92.88 ± 2.67, respectively. Table 3 for the evaluation of donor site morbidity, ankle functional score is measured with AOFAS and FADI score. The mean of AOFAS score of donor ankle was 95.61 ± 1.97 and FADI score was 95.89 ± 1.78. Result of thigh circumference revealed no deference between injury site and contra lateral healthy site (p > 0.05). The mean circumference in 10 cm proximal to upper patellar bone was 43.55±5.66 at injury site and 44.58±3.69 at contra lateral healthy site. The mean circumference in 20 cm proximal to upper patellar bone was 50.33±3.96 at injury site and 51.78±4.19 at contra lateral healthy site.

Conclusion: Single bundle PCL reconstruction with peroneus long us tendon auto graft had improvement functional outcome (IKDC, Modified Cincinnati, Lysholm) and shown excellent ankle function and serial hop test result at 18 months evaluation.

Keywords: Posterior Cruciate Ligament, peroneus longus tendon graft.

INTRODUCTION

The incidence of isolated posterior cruciate ligament (PCL) rupture is low among cases of knee injury. However, in the absence of PCL, the knee will have abnormal kinematics, resulting in concomitant injury to other knee ligaments.[1] There are many graft options, either auto grafts or allografts, for use in PCL reconstruction. The ideal graft has anatomical properties that include an appropriate size, geometric shape, and tensile strength and a sufficient graft length. In addition to these anatomical features, graft fxation, fast graft incorporation, easy graft passage, and no harvest site morbidity are important aspects of an

ideal graft for PCL reconstruction[2]; however, these features also make it impossible to have an ideal graft for PCL reconstruction. Thus, surgeons have many options when considering possible grafts, such as the bone–patellar tendon–bone (BPTB), quadriceps tendon, and hamstring tendon (HT) graft[3,4] , each of which has its own shortcomings. BPTB enables bone-to-bone healing that might be completed by 4–6 weeks. This allows a faster return to physical activity than other grafts; however, BPTB can cause anterior knee pain, kneeling pain, tenderness over bone defects, patellar fractures, a weakened extensor mechanism, and the possibility of a short graft length for PCL substitution. The HT autograft resolves these BPTB shortcomings. It has excellent tensile strength, is easy to harvest, has sufficient graft length, and has a large surface area that promotes revascularization after graft implantation.[5] It has become one of the most popular grafts used in both ACL and PCL reconstruction. However, HT autografts have many disadvantages including saphenous nerve injury, less stiffness than the native ACL, a risk of residual muscle tearing (biceps femoris and semimembranosus), decreased fexion strength, decreased internal rotation strength, hypotrophy of the thigh, and an unpredictable graft size diameter. Due to the disadvantages of HT autografts, the peroneus longus tendon (PLT) is considered a new graft for PCL reconstruction.[6]

MATERIAL AND METHODS

This prospective study was carried out in the Department of Orthopaedic, IGIMS, Patna, Bihar, India Patient with PCL injury who underwent PCL reconstruction, from August 2019 to July 2020, after taking the approval of the protocol review committee and institutional ethics committee. The diagnosis of chronic ligament rupture was established with clinical examination and imaging (Magnetic resonance imaging, MRI).

INCLUSION CRITERIA

- Chronic injury (> 6 months)
- Presence of an ‘isolated’ PCL
- No previous ligamentous surgery

EXCLUSION CRITERIA

The presence of a posterolateral and/or posteromedial lesion 12 patients were included in this study. The functional score of the patient were assessed before the surgery and 18 months after the surgery with International Knee Documentation Committee (IKDC) score, Modified Cincinnati Rating System, Lysholm scale, and serial hop test. Donor site morbidity was assessed with American Orthopaedic Foot Ankle Society score and Foot Ankle Disability Index. Thigh circumference measured in 10 cm and 20 cm superior to upper pole of patellar bone in injury site and contra lateral healthy site.

METHODOLOGY

A single senior knee surgeon performed all of the PCL reconstruction procedures. The procedure was performed under general anaesthesia with the patient in supine position. After brief clinical examination under anaesthesia, padded tourniquet was applied in proximal thigh of the affected knee. Anterolateral and anteromedial arthroscopic portals were used for diagnostic arthroscopy. After the diagnosis of PCL rupture is confirmed arthroscopically, PLT autograft was harvested from the ipsilateral ankle. With the knee in full extension, an approximately 3-cm longitudinal incision was made approximately 2–3 cm above and 1 cm behind the lateral malleolus. The incision was carried through the skin and sub- cutaneous tissue. After incision of the superficial fascia, peroneus longus and peroneus brevis tendon were identified in the surgical field.

After division of the peroneus longus tendon 2–3 cm proximal to the lateral malleolus, the distal part of the tendon was sutured to the peroneus brevis tendon with side to side suture. Then the peroneus longus tendon was stripped proximally with a tendon stripper and stopped at the level of 4–5 cm from the fibular head to prevent peroneal nerve injury.

Synovial and fat-like tissue on the femoral attachment of the PCL remnant was removed carefully to expose the fibers of PCL bundles. The PCL remnants were preserved. The femoral tunnel was placed at 8–10 mm from anterior or distal medial femoral articular margin on a continuous line with the junction of the roof and medial wall of the intercondylar notch. A 2.0 mm Kirschner wire was inserted through the reamer as a guide wire. Over drilling was done with a 5 mm diameter drill (ConMed©, USA) using the anterolateral portal. A 2.4-mm pin passed through the femoral tunnel, and reamed using cannulated drill in accordance with graft diameter at the distal portion until 30 mm depth of femoral tunnel.

A posteromedial portal was created under direct vision. The PCL tibial attachment site was completely exposed. A guide pin was inserted through the anteromedial incision within the distal center portion of tibial insertion of PCL, which comes into contact with the posterior edge of retro spinal surface. The tibial hole was made in accordance to graft diameter. A 2.4-mm (blunt leading end) pin was inserted through this hole. A pullout suture was threaded in a retrograde fashion. Using this, the 4-strand hamstring graft pulled through the femoral hole. Proximal femoral fixation obtained with a button (Graftmax®, ConMed©, USA). Button was flipped outside the medial cortex of the femur. Then, graft was grasped and pulled tightly out of the anterior tibial hole, and a 25–35 mm bioabsorbable screw was inserted at 90° knee flexion while maintaining anterior drawer pull of the tibia.

The knee was immobilized for 4 week with brace in full extension. Ambulation with non-weight bearing protocol was initiated on the second postoperative day. Quadriceps isometric exercise and straight leg raising exercise initiated after 2 week. Protected ROM was gradually increased from 0 to 90° flexion starting from the fourth week. After 8 weeks, progressive knee flexion from 90° to full ROM was exercised gradually. Partial weight bearing was permitted after 4 weeks. Full weight bearing with hamstring-strengthening exercises was permitted after 8 weeks and active knee ROM should progress to complete flexion and extension. Patients usually returned to their normal daily activity and were allowed to exercise on a stationary bike or standing on a single leg starting at 5 months postoperatively. Light sports activities began at 6 months. After 12 months, the patients is evaluated with serial hop test (single hop test and triple hop test) and then cleared for sport activities if the result is good.

FUNCTIONAL OUTCOME

Post-operative functional outcome (IKDC, Modified Cincinnati, and Lysholm) were recorded 18 months after surgery with direct patient examination and a guided-interview by a single orthopaedic surgeon outside the surgical team. Donor site morbidity was evaluated with measurement of ankle functional score using AOFAS and FADI score. Serial hop test was assessed at 18 months after surgery.

STATISTICAL ANALYSIS

Paired *t*-test was used for comparisons of IKDC, Modified Cincinnati, and Lysholm score from preoperative assessment to 15 month follow-up. Statistical significance was accepted at a *p*-value of < 0.05. FADI, AOFAS, and serial hop test were shown descriptively.

RESULTS

12 patients were included in this study. The group consisted of 9 men and 3 women. All patients had chronic injuries with a mean time from original injury to reconstruction of 9

months. The injuries occurred during a sports activity in 5 patients and during a motor vehicle accident in 7 patients. Table 1.

Table 1: basis parameter

Basic parameter	Number	%
Age		
Below 20	2	16.67
20-30	6	50
Above 30	4	33.33
SEX		
MALE	9	75
FEMALE	3	25
SITE OF INJURY DEXTRA	6	50
SINISTRA	6	50
INJURY MECHANISM		
TRAFFIC INJURY	7	58.33
SPORT	5	41.67
GRAFT DIAMETER	8.59 ± 0.77 mm	

During the period of the study, 15 patients underwent single bundle PCL reconstruction. 3 patients were excluded because of concomitant meniscal injury. 12 patients fulfilled the inclusion criteria and underwent single bundle PCL reconstruction with peroneus longus auto graft. At 18 months follow up, there were 12 patients who consist of 9 males and 3 females. Intraoperatively, graft diameter was measured and recorded, with the result shows mean diameter of 8.59 ± 0.77 mm (range 7.5–10 mm).table 1.

FUNCTIONAL OUTCOME

There were significant diferences between the preoperative and 18 months postoperative score in IKDC, Modified Cincinnati, and Lysholm score (p <0.05), as shown in table 2. Mean IKDC score was 48.55±10.69 pre-operatively and 79.88±3. at 15 month follow-up. Mean score of Modified Cincinnati was 49.66±9.69 pre-operatively
and 80.69±3.98 at 15 month follow-up. Mean Lysholm score was 50.22±10.87 pre-operatively and 81.99±4.59 at 15 monnth follow-up. There were significant deference between pre-operative and 15 monnth post-opera- tive score in IKDC, Modified Cincinnati, and Lysholm tests (p < 0.05) with majority of the patient with PCL injury reconstructed with per- oneus longus tendon had improvement results. Table 2.

Functional outcome	Pre-Operative	Post-Operative	P-value
	MEAN±SD	MEAN±SD	
IKDC	48.55±10.69	79.88±3.66	0.000
MODIFIED CINCINNATI	49.66±9.69	80.69±3.98	0.001
TEGNER-LYSHOLM	50.22±10.87	81.99±4.59	0.000

Single hop test and triple hop test after 18 months post operatively shown 96.17 ± 2.64 and 92.88 ± 2.67, respectively. Table 3. For the evaluation of donor site morbidity, ankle functional score is measured with AOFAS and FADI score. The mean of AOFAS score of donor ankle was 95.61 ± 1.97 and FADI score was 95.89 ± 1.78.

Table 3 Serial hop test

	MEAN±SD
SINGLE HOP	96.17 ± 2.64
TRIPLE HOP	92.88 ± 2.67

THIGH CIRCUMFERENCE

Result of thigh circumference revealed no difference between injury site and contra lateral healthy site ($p > 0.05$). The mean circumference in 10 cm proximal to upper patellar bone was 43.55±5.66 at injury site and 44.58±3.69 at contra lateral healthy site. The mean circumference in 20 cm proximal to upper patellar bone was 50.33±3.96 at injury site and 51.78±4.19 at contra lateral healthy site.

Table 4 Thigh circumference

	Injury Site	**Contralateral Site**	
	MEAN±SD	MEAN±SD	P value
10cm Thigh Diameter	43.55±5.66	44.58±3.69	0.41
20cm Thigh Diameter	50.33±3.96	51.78±4.19	0.62

DISCUSSION

Knee function deterioration might occur following nonoperative treatment in high-grade PCL injury. Therefore, PCL reconstruction is needed in high-grade PCL injury. PLT has been used in many orthopaedic surgeries and might be considered an auto graft for PCL reconstruction. PLT auto grafts have comparable tensile strength to HT auto grafts. PCL reconstruction requires longer grafts for reconstruction. Currently, we use HT auto graft, but it results in higher morbidity to the patient, such as deterioration of adductor hip strength, decreased is kinetic knee fexion, and decreased extensor and fexor of knee strength. Due to the disadvantages of the HT, the PLT was used as the auto graft outside of the knee region. [7,8]

Two of the most widely used graft in PCL reconstruction are BPTB auto graft and hamstring tendon auto graft. Compared to other type of graft, BPTB have the advantage of faster return to sport related to its bone-to-bone tunnel healing. The disadvantage of BPTB including presence of tendon proliferation and fat pad fibrosis that can result in infrapatellar contracture syndrome. BPTB harvesting also carries substantial risk of anterior knee pain, kneeling pain, loss of motion, and risk of patellar fracture.[9]

Presence of kneeling pain or anterior knee pain might be more disturbing in certain group of patient than other. This is especially true in group of patient who frequently kneel as part of their daily activity, whether it is related to religious activity or tradition. Corry et al.[10] compared the clinical outcome and donor site morbidity of patient with isolated ACL rupture who underwent ACL reconstruction with ham- string tendon and patellar tendon. From the patellar tendon group, about 55% patient had anterior kneeling pain in the first year that improved to about 31% in the second year, compared to just 6% in the hamstring group both in the first and second year. A meta-analysis in 2015 by Xie et al.[9] compared the use of BPTB and hamstring tendon auto graft, this study showed that the risk ratio for anterior kneeling pain was 1.71 in favour of hamstring tendon, while the risk ratio for kneeling pain was 2.05, also in favour of hamstring tendon. While the percentage of kneeling pain is considered low in the hamstring group compared to the BPTB group, it can be catastrophic if it occur in patient who could not tolerate any kneeling pain.

Hamstring tendon auto graft has many advantages compared to BPTB and is gaining popularity in PCL reconstruction. The use of hamstring tendon in PCL re- construction also showed good clinical outcome. Chan et al.[11] evaluated the clinical outcome of PCL reconstruction with hamstring tendon during 3–5 years follow up and found significant improvement in knee function, activity level, IKDC classification, Lysholm scores, and muscle strength. Some disadvantages of hamstring tendon auto graft harvesting including saphenous nerve injury, thigh hypotrophy, and hamstring muscle power reduction. Some study also showed inconsistent graft diameter after hamstring tendon harvesting, with most of times the diameter is too small. The relatively small diameter of hamstring tendon might predispose to increased rerupture rate and revision rate after PCL reconstruction. Recent

biomechanical study showed that hamstring graft with diameter of 6 mm or 7 mm have significant lower load to failure compared to graft with greater diameter, this study also mentioned a possibility that hamstring graft may not be as strong as previously appreciated in older study.[12] These disadvantages drove some author to evaluate the use of other source of auto graft as an alternative to hamstring graft in cruciate ligament re- construction.

Previous biomechanical study that compared the tensile strength of peroneus longus tendon, hamstring tendon, patellar tendon, and quadriceps tendon showed that the tensile strength of peroneus longus was comparable to hamstring tendon, and was significantly stronger than patellar tendon and quadriceps tendon.[13] In this study, we found that the mean of peroneus longus graft diameter was 8.59 ± 0.77 mm . Previous study stated that graft diameter of more than 8 mm had lower failure rate in ACL reconstruction, with the likelihood of revision rate was 0.82 lower with increasing 0.5 mm in range 7.0–9.0 graft diameter.[14] The result of this study showed that PCL reconstruction with PLT had significant improvement with good clinical outcome in 18 months follow up based on IKDC, Modified Cincinnati, and Lysholm scores. This result shows that PLT auto graft can be used in single bundle PCL reconstruction with good functional outcome of the patient at 18 months follow up. Test for evaluating knee function using single hop test and triple hop test also show good results, which is greater than 90%.

Angthong et al.[15]stated that there were some possible donor site morbidity with peroneus longus tendon harvesting. The potential donor site morbidity including ankle function deterioration and concern of ankle instability. In this study, ankle function is measured with AOFAS and FADI score. The result shows that the function of donor ankle was excellent even after harvesting of peroneus longus tendon. This finding is probably related to intact peroneous brevis muscle that will maintain ankle eversion function.

CONCLUSION

Single bundle PCL reconstruction with peroneus longus tendon autograft had improvement functional outcome (IKDC, Modified Cincinnati, Lysholm) and shown excellent ankle function and serial hop test result at 18 months evaluation.

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