International Journal of Nursing and Health Care Research

Faisal MA, et al. Int J Nurs Health Care Res 5: 1313.

www.doi.org/10.29011/2688-9501.101313

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Research Article

Evaluation of the Clinical Outcome of Arthroscopic Posterior Cruciate Ligament Reconstruction with Peroneus Longus Tendon

Md. Ali Faisal[1*], Abu Zaffar Chowdhury [2], Indrojit Kumar Kundu[3], Chowdhury Iqbal Mahmud[4], Md. Yousuf Ali [5], Sunjida Parven Runa[6], Md. Sarwar Rahman[7], Md. Alamgir Sikder[7], Md. Mohoshin Sarker[7] , Md. Abdul Alim[8], Md. Motaher Hossain[9]

[1]Associate Professor, Arthroscopy and Arthroplasty Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[2]Professor of Arthroscopy and Arthroplasty Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[3]Orthopaedics and Arthroplasty Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[4]Arthroscopy and Arthroplasty Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[5]Spine Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[6]Department of Pedodontics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[7]Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[8]National Nutrition Services, Institute of Public Health Nutrition, Dhaka, Bangladesh

[9]Ministry of Housing and Public Works, Government of Bangladesh

[*]**Corresponding author:** Md. Ali Faisal, Associate Professor, Arthroscopy and Arthroplasty Unit, Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka, Bangladesh

Citation: Faisal MA, Chowdhury AZ, Kundu IK, Mahmud CI, Ali M Y, et al. (2022) Evaluation of the Clinical Outcome of Arthroscopic Posterior Cruciate Ligament Reconstruction with Peroneus Longus Tendon. Int J Nurs Health Care Res 5: 1313. DOI: 10.29011/2688-9501.101313

Received Date: 20 June, 2022; **Accepted Date**: 06 July, 2022; **Published Date**: 11 July, 2022

Citation: Faisal MA, Chowdhury AZ, Kundu IK, Mahmud CI, Ali M Y, et al. (2022) Evaluation of the Clinical Outcome of Arthroscopic Posterior Cruciate Ligament Reconstruction with Peroneus Longus Tendon. Int J Nurs Health Care Res 5: 1313. DOI: 10.29011/2688-9501.101313

Abstract

The posterior cruciate ligament is the essential stabilizer of the knee. The purpose of this study is to evaluate the functional outcome and donor site morbidity after PCL reconstruction using the peroneus longus tendon (PLT) autograft. Patients who fulfilled the inclusion criteria were included in this study. They underwent PCL reconstruction using peroneus longus tendon autograft. Clinical outcomes were evaluated with the Lysholm score, the International Knee Documentation Committee (IKDC), and the serial hop test (single-hop test and triple hop test) 2 years after surgery. Donor site morbidity assessment was done by the FADI (Foot and Ankle Disability Index) and the AOFAS (American Orthopaedic Foot and Ankle scoring system). Eighteen patients fulfilled the inclusion criteria (16 males and 2 females). Significant improvement in functional score ($p < 0.05$) was found two years after surgery. The mean score of IKDC was 45.61 ± 10.29 pre-operatively; 80.24 ± 7.72 post-operatively, Lysholm score was 46.11 ± 13.27 pre-operatively; 79.55 ± 8.42 post-operatively. FADI and AOFAS at donor site ankle were 91.30 ± 4.55 and 92.65 ± 3.85, respectively. Significant improvement was seen in the serial hop test. Peroneus longus tendon autograft used in PCL reconstruction had improved functional outcome.

Keywords: Posterior cruciate ligament; PCL reconstruction; Peroneus longus tendon autograft; Lysholm score; International Knee Documentation Committee (IKDC)

Introduction

The Posterior Cruciate Ligament is the largest & strongest ligament in the human knee and the primary posterior stabilizer in flexion [1]. In acute knee injuries, the incidence of isolated Posterior Cruciate Ligament (PCL) rupture is low. Abnormal knee kinematics may result from PCL rupture and increase the risk of subsequent injury to other knee ligaments. Patients with isolated grade I, II, or Grade III PCL rupture with mild symptoms and low demand can be treated non-surgically. PCL reconstruction surgically is the treatment of choice in a patient with symptomatic grade III PCL injury or if concomitant injuries to other knee ligaments occur [2]. The purpose of PCL reconstruction is to restore knee stability and to prevent the development of osteoarthritic changes in the knee joint [3].

Among different types of autografts, hamstring autograft is one of the most common grafts used in PCL reconstruction. The advantage of Hamstring graft is easy harvesting and less donor site morbidity than Bone-Patellar-Tendon-Bone (BPTB) autograft. BPTB may allow a faster return to sports but carries potential disadvantages of anterior knee pain, kneeling pain, and loss of motion [4]. Hamstring tendon autograft has some disadvantages like unpredictable graft size, possible reduction of hamstring muscle power, and thigh hypotrophy [5]. Peroneus longus tendon autograft was already used [6,7] for PCL reconstruction [8-10], and most of the studies showed promising results with minimal donor site morbidity. Peroneus longus tendon autograft has comparable tensile strength compared to hamstring tendon that was being shown in some previous biomechanical studies [11]. PCL is composed of 2 principal bundles: (a) anterolateral (AL) and (b) posteromedial. The ligament is highly stout; the average length is 38 mm, and the diameter is 13 mm [12], and it is the primary restraint to posterior tibial translation.

PCL reconstruction arthroscopically follows some principles such as identifying the accurate injury, tunnel placing accurately & preparing anatomical graft insertion sites, strong graft material, mechanical tensioning of the graft, fixation of the graft and optimum post-operative rehabilitation program [13].

Materials and Methods

This study was a retrospective study of patients with PCL injury who underwent PCL reconstruction between January 2018 and December 2019 at Bangabandhu Sheikh Mujib Medical University. The diagnosis was established with clinical examination, imaging (magnetic resonance imaging, MRI) & arthroscopically. The inclusion criteria were (1): chronic injury (>6 months), (2): the presence of an 'isolated' PCL lesion [also including the presence of slight verus/valgus instability], and (3): History of no ligamentous surgery. Eighteen patients fulfilled the inclusion criteria and were included in this study. All the patients had chronic injuries with a mean time from injury to the operation of 8 months (range 6-24 months). All the patients were followed up at three months, six months & nine months and finally at 24 months.

The functional score was assessed preoperatively and 2 years postoperatively with International Knee Documentation Committee (IKDC) score, Lysholm score and serial hop test. Donor site morbidity was evaluated with American Orthopaedic Foot Ankle Society Score and Foot Ankle Disability Index.

Statistical Analysis

All the data were compiled and sorted correctly and the quantitative data were analysed statistically using Statistical Package for Social Science (SPSS-26). The results were expressed as a percentage and mean ± SD and $p < 0.05$ were considered as the level of significance.

Surgical Technique

All patients were diagnosed clinically, radiologically by MRI,

and arthroscopically during surgery. The same surgeon performed all surgeries. The surgical procedure was performed arthroscopically.

Graft Harvesting Procedure

After incision of the superficial fascia, peroneus longus and peroneus brevis tendon were identified. After the 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. 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 common peroneal nerve injury.

Femoral Tunnel

We prefer a femoral guide system. The femoral tunnel was placed at 8-10mm from the anterior or distal medial femoral articular margin on a continuous line at the junction of the roof and medial wall of the intercondylar notch. The position should be 1 o'clock position in the right knee and 11 O'clock position in the left knee. 2.0mm Kirschner wire was inserted through the reamer as a guidewire. Over drilling was done with a 5mm diameter drill through the anterolateral portal. Then a 2.4-mm pin was passed through the femoral tunnel and reamed using a cannulated drill bit, which was in accordance with harvested graft diameter at its distal portion until 30mm depth of the femoral tunnel. (Figure1)

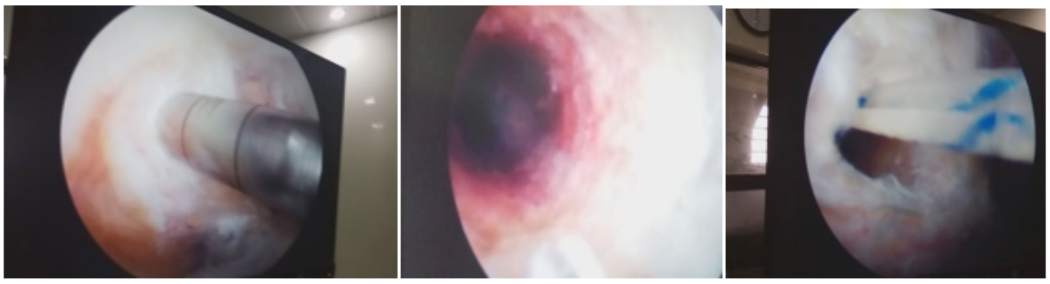

Figure 1: Per-operative figure shows arthroscopic preparation of femoral tunnel.

Tibial Tunnel

We prefer a tibial drill guide system. PCL tibial attachment site was wholly exposed. Insertion of the guide through the anteromedial portal was done and passed it through the notch. Guide tip was placed 10-12 mm below the joint line in the PCL facet. A drill guide was oriented approximately 60º to the articular surface of the tibia (starting just inferior and medial to the tibial tuberosity). Arthroscopy aids in the proper positioning of the drill guide before and during drilling. The guide pin should exit posteriorly at the physeal scar area. The tibial hole was made in accordance with graft diameter. A 2.4-mm (blunt leading end) pin was inserted through this hole. A pull out suture was threaded in a retrograde fashion. Using this, the 2-strand peroneus longus tendon pulled through the femoral hole. Proximal femoral fixation was obtained with a button/ bio-absorbable screw.

Then, the graft was grasped and pulled tightly out of the anterior tibial hole, and a 25-35mm bio-absorbable screw was inserted at 90^{O} knee flexion while maintaining anterior drawer pull of the tibia. (Figure 2)

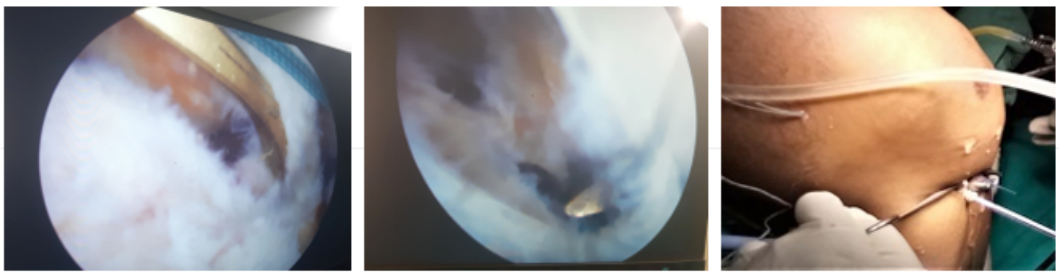

Figure 2: Per-operative figure shows arthroscopic preparation of tibial tunnel and anterior tibial graft fixation with bio-absorbable screw.

Results

During the study, eighteen patients underwent PCL reconstruction. Among them, sixteen were male & two were female. All the patients who fulfilled the inclusion criteria underwent single-bundle PCL reconstruction with peroneus longus autograft. All the patients were assessed by an independent examiner before surgery and postoperatively at 6 months, 12 months, and then annually clinically (Posterior Drawer test, Sag sign), Lysholm Score, and IKDC Score.

Variable	Mean	Max	Min
Age	32	49	21
Sex			
Male	16		
Female	02		
Injury mechanism			
Traffic injury	17		
Sports injury	01		

Table 1: Variables.

Functional Outcome

Significant differences were found between the preoperative and 2 years postoperative IKDC & Lysholm score ($p<0.05$), in the majority of the patients with PCL injury reconstructed with peroneus longus tendon, having improved results, as shown in Table 2. The mean IKDC score was 45.61 ± 10.29 (range 32.40–66.50) pre-operatively and 80.24 ± 7.72 (range 72.20–86.60) at two years follow up. The mean Lysholm score was 46.11 ± 13.27 (range 35.00–68.00) pre-operatively and 79.55 ± 8.42 (range 72.0–90.0) at two years follow up. Single hop test and triple hop test preoperatively and after 24 months post-operatively showed 94.40 ± 3.65 and 92.60 ± 1.38, respectively. (Table 3).

	Pre-operative	Post-operative	Significance
	Mean	Mean	
IKDC	45.61 ± 10.29	80.24 ± 7.72	0.005
Lysholm	46.11 ± 13.27	79.55 ± 8.42	0.001

Table 2: Functional Outcome.

	Mean	SD	MIN	MAX	Normality
SINGLE HOP	94.40	3.65	90	100.00	0.576
TRIPLE HOP	92.60	1.38	88	96.00	0.631

Table 3: Serial hop test.

Donor site morbidity: Evaluation of donor site morbidity and functional ankle score was measured with AOFAS and FADI scores. The mean AOFAS score of the donor's ankle was 92.65 ± 3.85 (range 90.0-100.0), and the FADI score was 91.30 ± 4.55 (90.0-100.0). See Table 4**.**

	Mean	SD	MIN	MAX	Normality
FADI	91.30	4.55	84	100.00	0.900
AOFAS	92.65	3.85	88	100.00	0.543

Table 4: Donor site morbidity.

Discussion

The mean age of this study group was 32 ± 6.8 (21-49) years, Rhatomy et al. [20] in his study group treated by Posterior cruciate ligament reconstruction with peroneus longus tendon, shown mean age 29.1 ± 8.6 (18–45) years.

In this study, total number of patients were 18 (16 males and 2 females), we found mean IKDC 45.61 ± 10.29 pre-operatively and 80.24 ± 7.72 post-operatively with a significant P-value. Lysholm score was improved from preoperatively 46.11 ± 13.27 to post-operatively 79.55 ± 8.42. Setyawan et al. [19] in year 2019, among his study on 15 patients (11 males and 4 females) for Posterior Cruciate Ligament reconstruction with peroneus longus tendon graft found mean score of IKDC was 47.58 ± 11.75 pre-operatively and 78.17 ± 4.52 post-operatively. Lysholm score was 49.26 ± 11.54 pre-operatively and 80.20 ± 5.04 post-operatively which are very much comparable. Rhatomy et al. in year 2020 found mean score of IKDC was 49.8 ± 10.3 pre-operatively and 81.3 ± 5.8 post-operatively; Lysholm score was 50.7 ± 10.0 pre-operatively and 83.2 ± 5.8 post-operatively in a comparative study of Posterior cruciate ligament reconstruction with peroneus longus tendon versus hamstring tendon focused on functional outcome and donor site morbidity.

Other parameters in this study like Single hop test and triple hop test after 24 months post operatively was 94.40 ± 3.65 and 92.60 ± 1.38, respectively; Setyawan et al. shown Single hop test and triple hop test 95.73 ± 3.08 and 91.86 ± 1.92, respectively at final follow up which is also comparable. Single hop test and triple hop test also show good results & it is greater than 90%. The clinical outcome of PCL reconstruction was evaluated by Chan et al. [14].

In this study, ankle function is measured with AOFAS and FADI score, and the result shows that the role of the donor's ankle was excellent even after harvesting of peroneus longus tendon. The mean AOFAS score of the donor's ankle was 92.65 ± 3.85 (range 90.0-100.0), and the FADI score was 91.30 ± 4.55 (90.0-100.0). whereas Setyawan et al. found the mean of AOFAS score of donor

ankle was 94.46 ± 2.56 (range 90.0-100.0) and FADI score was 94.80 ± 2.42 (90.0-100.0); Rhatomy et al. also found the mean of AOFAS score of donor ankle was 94.6 ± 3.1 (range 90.0-100.0) and FADI score was 95.1 ± 2.6 (90.0-100.0). Both are comparable with this study.

Angthong et al. [10] stated that there was some possible donor site morbidity with peroneus longus tendon harvesting. This finding is due to the intact peroneus brevis muscle that maintains ankle eversion. A previous study revealed peroneus brevis is a stronger ankle evertor, and after peroneus longus harvesting, it maintains the eversion power of the ankle [18].

For these disadvantages of hamstring tendon autograft, some authors were interested in evaluating the other source of autograft as an alternative to hamstring graft in cruciate ligament reconstruction. K.Y. Phatama et al. showed that the tensile strength of peroneus longus was comparable to hamstring tendon and was significantly stronger than patellar tendon and quadriceps tendon [17]. This study showed the same significant outcome.

with hamstring tendon during 3-5 years follow up in which significant improvement in knee function, activity level, IKDC classification, Lysholm scores, and muscle strength was reported. Saphenous nerve injury, thigh hypotrophy, and hamstring muscle power reduction are the disadvantages of hamstring tendon autograft harvesting [5,15], which can be avoided by the use of PLT.

Conclusion

Peroneus longus tendon autograft used in PCL reconstruction had improved functional outcome (IKDC, Lysholm) and shown excellent ankle function and serial hop test result at two-year evaluation and can be encouraged as a graft of choice.

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