Section: Orthopedics

Original Research Article

FUNCTIONAL OUTCOME AND DONOR SITE MORBIDITY IN ARTHROSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING PERONEUS LONGUS TENDON AUTOGRAFT: A PROSPECTIVE COHORT STUDY

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Abstract

Background: The anterior cruciate ligament (ACL) is the primary stabilizer against anterior translation of the tibia on the femur. In ACL injury, patient develops knee instability and pain. Anterior cruciate ligament reconstruction(ACLR) provides surgical restoration of the injured ACL using the placement of graft material. Hamstrings are one of the commonest grafts used for ACL reconstruction. Inadequate graft size, difficulty harvesting, loss of the synergistic muscles for ACL injured knees are some of the common issues associated with hamstrings. We studied the outcome of arthroscopic ACL reconstruction using peroneus longus tendon graft as an alternative graft source that obviates the above mentioned disadvantages of commonly used hamstring grafts. **Materials and Methods:** A prospective cohort study in 30 patients who underwent arthroscopic ACL reconstruction with peroneus longus tendon autograft. The patients were followed up for 12 months post-operatively. Functional scores were assessed using International Knee Documentation Committee (IKDC) score and Cincinnati Knee Rating System for knee and AOFAS (American Orthopaedic Foot and Ankle Society) Ankle-Hindfoot scoring and Visual Analogue Scale - Foot and Ankle (VAS-FA) for ankle. Also power of foot eversion and first ray plantarflexion were tested and recorded clinically by MRC (Medical Research Council) grading. **Result:** 30 patients fulfilled the inclusion criteria (23 male and 7 female patients). Follow-up period was 12 months. Mean IKDC score (81.80) and mean Cincinnati score (363.67) showed significant improvement at 12 month post-operative when compared to pre-operative scores which are 39.6 and 145.33 respectively (p value < 0.05). The mean pre and postoperative AOFAS score was 100.00 and 99.67 respectively at 12 month follow-up. The mean pre and postoperative VAS-FA score was 99.27 and 99.23 respectively at 12 month follow up (p value > 0.05). The 12 month postoperative power of eversion and plantarflexion were grade 5 in all patients. **Conclusion:** Signifanct improvement in knee functional outcome and no significant difference of functional status and muscle power pre operatively and postoperatively were found at the donor site following PLT graft harvest. Also the surgical procedure of graft harvest was simple with early wound healing and no complications postoperatively. Thus we conclude that peroneus longus tendon can be used safely as a graft for ligament reconstruction with no significant donor site morbidities.

INTRODUCTION

Arthroscopic reconstruction of knee ligaments is one of the most commonly performed surgeries currently across the world. In India, complete ACL tear constitutes nearly 86% of sports related injuries.[1] The selection of grafts for ligament reconstruction is an area where extensive research is conducted. Currently the most commonly preferred grafts for ligament reconstruction are bone-patellar tendon-bone graft (BPTB) and hamstring grafts.[2,3] Although

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the bone-patellar tendon-bone (BPTB) graft shares similarities with the femur-ACL tibia complex (FATC), with the added advantage of bone blocks that enhance graft attachment within the bone tunnels, however it is associated with donor site complications like anterior knee pain, patellar tendon rupture, patellar fracture.[4] Hamstring harvesting can cause damage to the saphenous nerve,[5] it can cause instability in cases of ACL with MCL grade 3 injury, risk of residual muscle tearing, decreased knee flexion strength, and decreased internal rotation strength.

Thus considering the various significant donor site morbidities associated with the most commonly used grafts, a different graft which is being used is the Peroneus Longus Tendon (PLT) graft. Peroneus longus autograft was found to have functional outcomes similar to hamstring graft and larger graft diameter compared to hamstring graft.[6-11]

There has been studies which evaluated the donor site morbidities and functional outcomes and concluded there was excellent functional outcomes and no significant donor site morbidities associated with peroneus longus graft harvest.[9] Also, there has been studies which have concluded that peroneus longus could not be recommended as a first option for ACL reconstruction due to decreased power of foot eversion and first ray plantarflexion and ankle instability.[10] Here, in this study we would like to evaluate the functional outcome and donor site morbidities that can occur following ACL reconstruction (ACLR) using peroneus longus tendon autograft.

MATERIALS AND METHODS

This was a prospective cohort study conducted in Department of Orthopaedics in Bangalore Medical College and Research Institute, Bangalore and its attached hospitals for a time period of 18 months from August 2022 to January 2024 after obtaining approval and clearance from the institutional ethics committee.

Patients between the age of 18 to 50 years who were diagnosed to be having complete ACL tear based on clinical and MRI evaluation and who underwent arthroscopic ACL reconstruction were included in the study. The patients out of the above mentioned age group and those who had any pre existing ankle or foot morbidity as evidenced by preop AOFAS <95 and VAS-FA <95 have been excluded from the study. The patients underwent a preoperative evaluation of knee function with IKDC and Cincinnati scores and ankle function with AOFAS Ankle-hindfoot score and VAS-FA score. Also the muscle power of foot eversion and first ray plantarflexion by MRC power grading.

Surgical Procedure: The patient is positioned supine under spinal anesthesia and a high groin tourniquet was used in all patients. A thourough diagnostic arthroscopy was performed through standard anteromedial and anterolateral portals. After arthroscopic confirmation of ACL tear, the graft was harvested from the ipsilateral PLT.

Harvesting peroneus longus graft: A longitudinal skin incision of 2cm was made posterior to the lateral malleoli. After subcutaneous dissection, the peroneus longus and brevis tendons were identified. The PLT lies slightly posterior to the peroneus brevis tendon(PBT) at this area. Sural nerve and lesser saphenous vein and its tributaries comes in this area and one must be careful about it while dissecting. Whipstitches were applied on two ends and tendon cut in between. A closed tendon stripper was used to strip the tendon at musculotendinous junction taking care to avoid injury to the common peroneal nerve. The remaining distal portion of the tendon is sutured onto the peroneus brevis tendon. The graft is prepared , tripled and loaded onto a loop. The subcutaneous tissue closed with vicryl and skin closed with staples.

Tunnel preparation and graft fixation: Standard methods of femoral tunnel and tibial tunnel preparation was done. The graft was fixed to femoral aspect using endobutton fixation technique and tibial aspect with interference screws. Repeated knee flexion and extension (around 20–30 times) with sustained pull on the graft via the tibial tunnel was done for cyclical tensioning of the graft. The ports and the graft harvest site wounds are closed in layers.

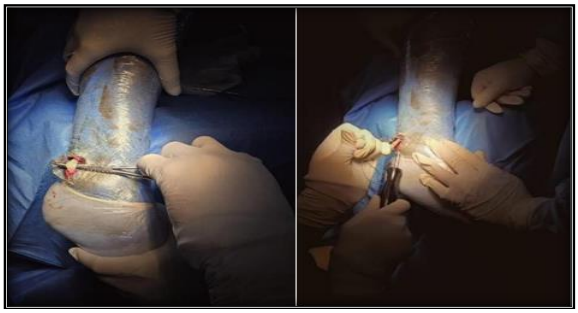

Figure 1: Surgical procedure showing harvest of PL tendon graft

Figure 2: Harvested and prepared graft

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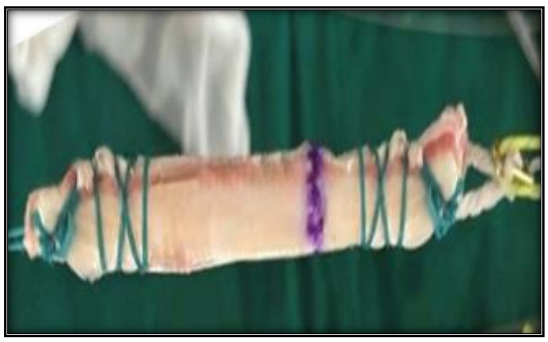

Figure 3: Tripled graft loaded onto endobutton

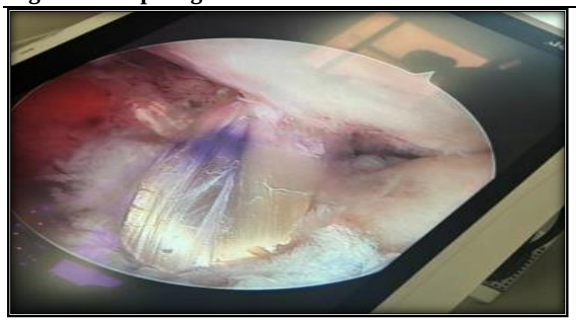

Figure 4: Arthroscopic image of reconstructed ACL with PL tendon graft

Immobilization with extension knee brace and limb elevation was done in the immediate post-op period. Intravenous antibiotics were given post-operatively for 5 days. Wound was inspected on 2nd and 14th post-operative day. Postoperatively, staples were removed at 2 weeks and standard rehabilitation protocol was followed. The functional outcome was evaluated at 6 weeks, 3 months, 6 months and 12 months postoperatively using International Knee Documentation Committee (IKDC) score and Cincinnati Knee Rating System and donor site morbidity using AOFAS Ankle-Hindfoot score, VAS-FA score and the MRC power grading of foot eversion and plantarflexion .

Statistical Analysis: The collected data were entered in Microsoft Excel and analysed with IBM SPSS Statistics for Windows. The data were analysed in the form frequency, percentage, mean, standard deviation, median and interquartile range. The mean pre-operative and post-operative values for IKDC score, Cincinnati Knee rating system, AOFAS Ankle-Hindfoot score, VAS-FA score and MRC power grading were compared using Repeated measures of Anova and p value of less than 0.05 was considered as statistically significant.

RESULTS

We included 30 patients in our study, among which 23 were male and 7 were female patients with a mean age of 27.2 +/- 5.1 years. The mode of injuried were road traffic accidents (RTA) 16 (53.3%), fall while playing sports 11 (36.6%) and self fall 3 (10%). (Table 1). We followed up the patients at 6 weeks, 3 months, 6 months, and 12 months. The results at 12 months was used for the statistical tests and final assessment. Post-operative mean IKDC score was 82.4 at 12 month which was significantly more than the pre-operative value of 39.6 ($p<0.05$). Post-operative mean Cincinnati score was 363.6 at 12 month which was significantly more than the pre-operative value of 145.3 ($p<0.05$). The preoperative mean AOFAS was 100 and postoperative at 12 month followup was 98.7. The preoperative mean VAS-FA was 98.53 and 12 month postoperatively was 98.00. The study showed that the p value of AOFAS and VAS-FA was >0.05 preoperatively and postoperatively, indicating that there is no statistically significant difference in ankle function. The MRC power grading of eversion and plantarflexion were restored to grade 5 in all patients at 12 months. This indicates that there was no significant donor site morbidity in patients who underwent ACL reconstruction using peroneus longus tendon autograft. Also the wound healing was normal in all patients with no surgical site infection in any of the patients at the donor site. There were no neurological complications noted in any of the patients.

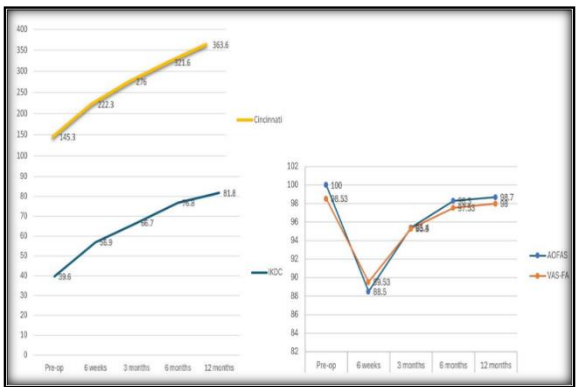

Chart 1: Mean Preoperative and follow-up scores of IKDC, Cincinnati knee rating system, AOFAS and VAS-FA Score of the patients

Table 1: Preoperative and follow-up scores of IKDC score, Cincinnati knee rating system, AOFAS and VAS-FA Scores of the patients.

Time	Pre Operative	6 weeks	3 months	6 months	12 months
IKDC	39.6	56.9	66.7	76.8	81.8
Cincinnati	145.3	222.3	276	321.6	363.6
Mean AOFAS	100.0	88.5	95.4	98.3	98.7
Mean VAS-FA	98.53	89.53	95.3	97.53	98.00

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DISCUSSION

Arthroscopic ACL reconstruction has become a widely practiced surgical procedure, particularly due to the growing involvement in contact sports. This technique has seen a significant rise in popularity, offering an effective approach for managing ACL injuries.

The success of ACL reconstruction largely depends on the choice of graft, with key biomechanical factors such as strength, length, and stiffness playing a vital role in the decision. Researchers have explored different graft options for arthroscopic ACL reconstruction, including autografts, allografts, and synthetic alternatives, each with its own set of advantages and disadvantages.[2]

Autografts are commonly chosen for primary ACL reconstruction because of their ubiquitous availability, better biologic incorporation, carry no risk of disease transmission, and offer superior biocompatibility. In contrast, allografts, while beneficial for reducing surgical time and avoiding donor site complications, present a higher risk of disease transmission, less effective biological incorporation, and limited availability in developing nations. Allografts do, however, provide abundant graft material, which can be particularly advantageous in complex cases such as multi-ligament reconstruction or revision surgeries.[7]

For ACLR autografts, common choices include Bone Patellar Tendon Bone (BPTB) grafts, Hamstring tendon (HT) grafts, Quadriceps tendon grafts, Peroneus longus tendon grafts (PLTG), Tensor fascia lata grafts, Iliotibial band grafts. BPTB and Hamstring tendon grafts are the most frequently used due to their biomechanical properties, which provide long term stability to the knee joint. BPTB graft shares similarities with the femur-ACL tibia complex (FATC), with the added advantage of bone blocks that enhance graft attachment within the bone tunnels, potentially allowing for a faster return to sports and has been considered the gold standard for the reconstruction of ACL. However, with the advent of hamstring tendon (HT) autograft, the use of BPTB graft has declined due to the association of significant donor site morbidity like anterior knee pain, patellar tendon rupture, patellar fracture4. Hamstring grafts have gained widespread acceptance as soft tissue grafts due to their excellent stiffness and tensile load properties, improved fixation techniques, and reduced harvest site morbidity. These grafts provide adequate stability and yield high patient satisfaction scores. However, the hamstring muscle plays a crucial role in protecting the reconstructed ACL from anterior translation forces during quadriceps contraction and can lead to weak knee flexion and cause an imbalance in quadriceps-hamstring dynamics18. Hamstrings being dynamic stabilizers on the medial side, there is a concern while choosing hamstring graft in patients with multi ligamentous injury, especially those with medial collateral ligament injury.

Since the novel approach by a KerImoGlu et al. in 2008, various studies have investigated the potential of the peroneus longus tendon as a graft choice for primary ACL reconstruction11. Peroneus longus provides the higher tensile strength than quadrupled Hamstring as seeing in a study by Shi et al.[12] In 2012 Cao HB et al. conducted a study to investigate two key aspects of using the peroneus longus tendon (PLT) in anterior cruciate ligament (ACL) reconstruction i.e, the effectiveness of PLT as a graft for ACLR and the clinical outcomes for the ankle joint following PLT harvest. Their research led to the conclusions that the peroneus longus tendon can serve as an effective graft option for ACL reconstruction and harvesting the PLT does not significantly impact ankle joint function.[13] Rhatomy et al. in their study compared the outcomes of ACL reconstruction using two different autograft types: Hamstring tendon and Peroneus longus tendon. The results showed that patients who underwent ACL reconstruction using peroneus longus tendon grafts (PLTG) achieved excellent functional outcomes, as measured by IKDC, Modified Cincinnati, and Lysholm scores, had larger graft diameters and the outcomes for PLTG were comparable to those of patients who received quadrupled hamstring tendon grafts. Also, these patients experienced no donor site morbidity at the one year follow-up mark.[14]

The use of peroneus longus tendon for primary arthroscopic ACL reconstruction has sparked debate among surgeons with concerns revolving around potential donor site complications and its in vivo performance compared to the established hamstring tendon graft, warranting further study. Angthon et al. in their study, which involved 24 patients, observed decreased eversion power in 16.7% of patients, reduced first ray plantar flexion power in all patients, and varus talar tilt showing laxity in 8.4% of patients. Based on these results, the authors concluded that they cannot recommend PLT as the primary graft choice for ACLR due to the observed functional deficits at the donor site. The researchers suggested that PLT might still be considered as an alternative option in specific situations, such as, after other graft options have been exhausted, in cases requiring multiple tendon grafts, for patients with multi-directional knee instability, or in specific trauma scenarios like knee dislocation.[8]

Here in this study we have used four scoring systems. IKDC score and Cincinnati knee rating system was used to assess the Knee functional outcome. AOFAS Ankle-Hindfoot and Visual Analogue Scale - Foot and Ankle score were used to assess donor site morbidity. Comparing the pre-op and 12 months post-op values, we find that there is significant differences in knee functional outcome scores while there is no significant differences in ankle function scores. Also the MRC power grading was done for foot eversion and first ray plantarflexion which are the two main action of the Peroneus Longus, and the

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12 month postoperative evaluation showed that all patients had a grade 5 power in both these actions. The eversion is also carried out by peroneus brevis which may take up the action of Peroneus Longus Tendon and the plantarflexion is also carried out by other muscles like tibialis posterior. Also there has been evidence in MRI studies that showed regeneration of PLT.[15]

We assessed function and muscle strength using only clinical methods, as our patient group did not consist of high-demand individuals like professional athletes or dancers. For this population, a satisfactory functional score along with a grade 4 or 5 strength rating was deemed as good outcome.

The surgical procedure proved to be efficient, uncomplicated, and direct, with our average graft harvesting time, from initial incision to closure, ranging between 7 to 10 minutes. None of the patients had any adverse outcomes such as ankle instability, loss of movement, weakness or nerve injury. All patients had resumed back to their pre-injury activities satisfactorily. The peroneus longus tendon was technically easier to identify and harvest. Peroneus brevis is deeper and muscular around the region, thus easily differentiating itself from superficial and tendinous peroneus longus.

Potential nerve injuries related to this procedure include damage to the common peroneal nerve, which may occur during tendon stripping. This can be avoided by limiting the stripper's passage to below a certain level. The sural nerve, located posterior to the PLT, is another nerve at risk and can be safeguarded during dissection.

The limitations of our study is that, we relied exclusively on clinical evaluation and functional scoring, which, while suitable for the general population, may not apply to high-demand individuals like professional athletes or dancers, who were not included in our sample. Furthermore, with a follow-up period of only 12 months, further research with longer-term follow-up is required to fully understand the long term outcomes.

CONCLUSION

Our study results support the use of peroneus longus as a viable graft option for Anterior Cruciate Ligament reconstruction in select patient groups with significant improvement in knee functional outcome and no significant difference of pre operative and postoperative functional status and muscle power at the donor site following PLT graft harvest. This graft choice offers several advantages of ease of harvest, an excellent post-operative functional outcome, early wound healing, cosmetically appealing results and no complications postoperatively. The peroneus longus tendon presents a valuable alternative thus potentially expanding the graft options available to surgeons and patients in ACL reconstruction procedures with no significant donor site morbidities.

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