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The Early Outcomes of Anterior Cruciate Ligament Reconstruction Using Autologous Peroneus Longus Tendon in an Egyptian Cohort

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ABSTRACT

Background: Anterior cruciate ligament (ACL) reconstruction using autologous grafts continues to represent the gold standard for the management of ACL ruptures. In recent years, the autologous peroneus longus tendon (PLT) has gained significant attention as a viable graft alternative, attributed to its superior biomechanical properties, sufficient tensile strength and minimal donor-site complications making it a strong candidate for achieving optimal functional and clinical outcomes.

Patients and methods: This prospective clinical study assessed the early functional and biomechanical outcomes following arthroscopic ACL reconstruction using autologous PLT in adult Egyptian males. A total of 115 patients were included and evaluated using the International Knee Documentation Committee (IKDC) and the American Orthopaedic Foot and Ankle Society (AOFAS) scoring systems at 1, 3, and 6 months postoperatively. Dynamic footprint analysis was performed preoperatively and postoperatively to detect any alterations in foot biomechanics.

Results: IKDC scores demonstrated a statistically significant improvement throughout the follow-up period ($p < 0.001$). AOFAS scores showed an initial transient decline at one month, followed by near-baseline recovery at six months. Dynamic footprint analysis revealed no significant postoperative changes in foot biomechanics. Minor complications included localized edema (9.5%) and superficial infection (1.7%) with no recorded cases of nerve injury.

Conclusion: Autologous PLT graft represented a safe, reliable and efficient option for ACL reconstruction, providing significant improvement in knee stability and functional outcomes with minimal effect on donor-site function and ankle biomechanics.

Keywords: ACL reconstruction, PLT, IKDC, AOFAS, Arthroscopic surgery, Autograft.

INTRODUCTION

The anterior cruciate ligament (ACL) is a key stabilizing component of the knee joint that connects the femur to the tibia, functioning primarily to prevent anterior tibial translation and maintain rotational stability, thereby ensuring proper biomechanical alignment and smooth joint motion [(1)]. ACL injuries affect approximately 1.4%–1.7% of the adult athletic population annually, often leading to recurrent knee instability, secondary meniscal tears, reduced athletic performance and a heightened susceptibility to early-onset post-traumatic osteoarthritis [(2)].

Rotational instability is a defining characteristic of ACL insufficiency and surgical reconstruction remains the gold standard for restoring joint integrity, improving functional performance and mitigating long-term degenerative changes [(3)]. Numerous graft materials—autografts, allografts and synthetic substitutes—have been explored to replicate the anatomical and biomechanical attributes of the native ACL [(3)].

In recent years, the autologous peroneus longus tendon (PLT) has emerged as a viable alternative graft choice. It offers excellent tensile strength and structural stability, while maintaining normal ankle kinematics and gait function [(4)].

Furthermore, PLT exhibits excellent biological incorporation, with adequate graft length and diameter to meet reconstructive demands, while maintaining a low incidence of donor-site morbidity. These attributes collectively support its viability as a reliable alternative to conventional autografts, such as hamstring tendons or bone–patellar tendon–bone grafts [(3)].

Nonetheless, there remains concern that PLT harvesting may alter lower limb biomechanics or compromise foot stability. The dynamic footprint technique—an advanced quantitative assessment of plantar pressure distribution—provides an objective and reproducible means of evaluating pre- and post-operative functional outcomes, enabling clinicians to detect subtle biomechanical alterations following graft harvest [(5)].

MATERIALS AND METHODS

Study design and setting: This prospective interventional study was carried out at Helmia Military Hospital over a one-year period through the period from August 2022 to August 2023. The study included 115 adult Egyptian male patients who were diagnosed with isolated ACL injuries and met the predefined inclusion criteria for participation.**Inclusion criteria:** Adult males aged 18–45 years. MRI-confirmed isolated ACL rupture.

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No prior surgical intervention on the affected knee or ankle.

Exclusion criteria: Multi-ligamentous knee injuries. Skeletally immature patients. Radiographic or MRI evidence of degenerative or arthritic knee changes.

Operative Technique: All procedures were performed arthroscopically using autologous peroneus longus tendon grafts**.** The PLT was harvested through a 2 cm longitudinal incision located approximately 2 cm proximal to the lateral malleolus (Figure 1). The graft was prepared and fixed using an adjustable cortical loop device on the femoral side and an interference screw on the tibial side.

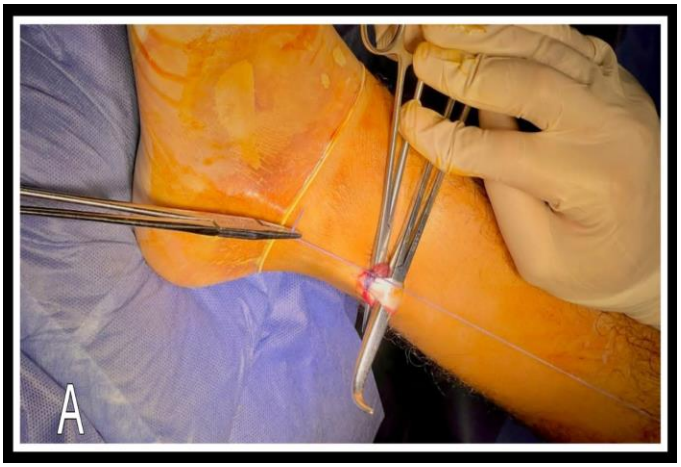

Figure (1): peroneus longus tendon harvesting.

Residual ACL fibers were debrided to clearly identify the native femoral and tibial footprints.

- **Femoral tunnel preparation:** The femoral footprint was delineated using radiofrequency ablation and a shaver. A femoral guide was used to identify the central footprint before drilling the femoral tunnel over a guide wire.
- **Tibial tunnel preparation:** The tibial footprint was defined under arthroscopic visualization. After clearing the distal stump, a tibial guide was positioned, and the tibial tunnel was drilled through an anteromedial incision.
- The prepared graft was then passed through both tunnels (Figure 2), tensioned and fixed with the femoral end button and tibial interference screw.
- Final arthroscopic assessment ensured full knee extension without graft impingement. A suction drain was placed, and all portals were closed in standard fashion.

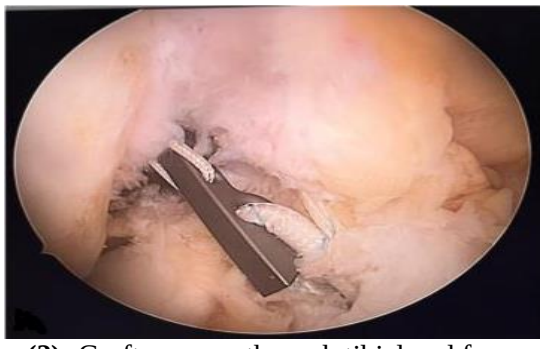

Figure (2): Graft passage through tibial and femoral tunnels.

Postoperative care and follow-up: All patients followed a **standardized Melbourne rehabilitation protocol**, provided in printed form to ensure adherence. Functional outcomes were assessed monthly for six months using the **IKDC** score and the **American Orthopaedic Foot and Ankle Society (AOFAS)** score to evaluate knee and ankle function, respectively.

At six months postoperatively, all patients underwent **MRI evaluation** of the knee to assess graft integrity and **dynamic footprint analysis** to evaluate potential alterations in foot biomechanics following PLT harvest.

Ethical approval: Ethical approval was obtained from The Ethical Committee of Armed Forces Collage of Medicine prior to study initiation. All participants' caregivers provided written informed consent after receiving a detailed explanation of the study objectives, procedures and potential risks. The entire research process was conducted in strict accordance with the principles outlined in The Declaration of Helsinki ensuring the highest ethical standards for research involving human subjects, including respect for autonomy, confidentiality and the protection of participants' rights and welfare.

Statistical analysis

Data were collected manually and subsequently entered into a computer for statistical analysis using **SPSS** software version 22.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were expressed as mean ± standard deviation (SD), while qualitative variables were summarized as frequencies and percentages. Inferential statistical analyses were conducted using the t-test and ANOVA for quantitative data and the Chi-square test for categorical variables as appropriate. All confidence intervals were established at 95% and the level of statistical significance was determined based on the *p*-value, where $p > 0.05$ was considered not statistically significant.

RESULTS

Table (1) showed that the mean age was 28.7 ± 3.2 year, also males were more affected than females 75.6% and 24.4% respectively (Figure 3).

Table (1): The mean age of the studied patients

Age (years)	28.7 ± 3.2
Sex	
Male	75.6%
Female	24.4%

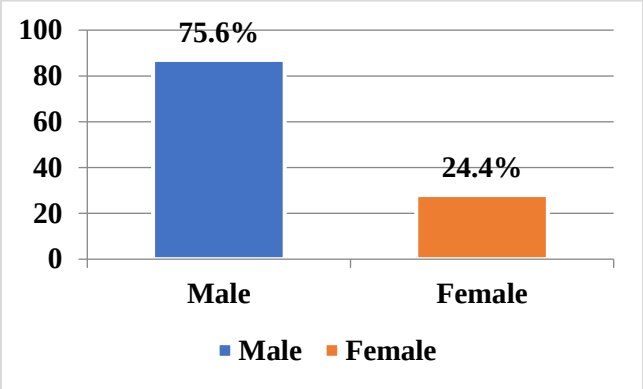

Figure (3): Sex distribution.

Table (2) showed that 43.5% had left side while 56.5% had right side affection.

Table (2): Injured side

Injured side	
Left	50 (43.5%)
Right	65 (56.5%)

Table (3) showed that mean graft diameter was 8.14 ± 0.58 & Mean graft length was 104.91 ± 4.96 mm.

Table (3) Graft size and length

Graft diameter and length (mm)	
Graft diameter	8.14 ± 0.58
graft length	104.91 ± 4.96

Figure 4 shows that mean IKDC score was 52.98 ± 5.66, 81.54 ± 2.21, 84.66 ± 1.61,85.17 ± 1.15 Preoperative, after one month, after three months and after 6 months respectively. Data was statistically significant as P value was ≤ 0.001.

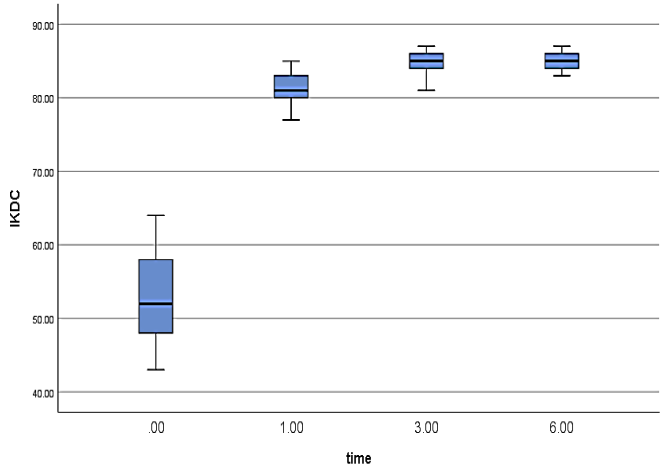

Figure (4): Boxplot of IKDC score

Table (5) showed that mean AOFAS score was 96.02 ± .84, 91.9 ± 4.04, 93.58 ± 3.91 and 95.23 ± 2.95 preoperative, after 1 month, after 3 months and after 6 months respectively.

Table (5): AOFAS score

AOFAS score	
Preoperative	96.02 ± 1.84
1 month	91.9 ± 4.04
3 months	93.58 ± 3.91
6 months	95.23 ± 2.95
P value	<0.001

Table (6) showed that there were 15 cases had complications: 11 cases had foot edema, 2 patients had graft site infection, 1 patient had wound dehiscence and 1 patient had exaggeration of the medial foot arch.

Table (6): Postoperative Complications

Total complication rate	15 (13.04%)
Graft site infection	2(1.7%)
Foot edema	11(9.5%)
Wound dehiscence	1 (0.87%)
Injury of the superficial peroneal nerve	0
Exaggeration of the medial foot arch	1 (0.87%)

Figure (5) showed that insignificant changes were noted when comparing the preoperative dynamic foot print to 6 months post-operatively. Data were statistically insignificant as P value was > 0.05.

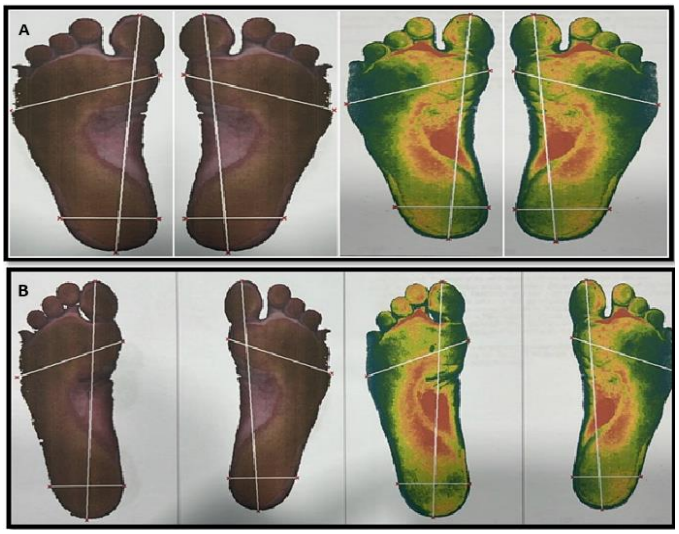

Figure (5): (A) Preoperative dynamic foot print, (B) Post-operative dynamic foot print at 6 months.

DISCUSSION

ACL serves as one of the principal stabilizing components of the knee joint, playing a crucial role in preserving both anteroposterior and rotational stability. Reconstruction of the ACL continues to represent the gold standard for managing ACL-deficient knees, aiming to restore joint functionality, enhance biomechanical balance, and prevent the development of secondary degenerative changes such as osteoarthritis. In recent decades, substantial progress has been made in refining surgical techniques, improving fixation methods, and expanding graft selection options for ACL reconstruction, all contributing to better functional outcomes and long-term joint preservation [6].

Although the hamstring tendon autograft continues to be among the most commonly employed graft choices for ACL reconstruction, its use is not without limitations. Challenges such as variability in graft diameter, postoperative decline in knee flexion strength and the potential for saphenous nerve injury during tendon harvesting have been recurrent concerns. These drawbacks have encouraged the investigation of alternative autograft sources that could provide comparable or superior biomechanical strength while minimizing donor-site morbidity. Among these, the PLT has emerged as a promising option, offering favorable graft dimensions, excellent tensile properties and minimal functional compromise at the donor site [7].

The present study was designed to assess the early functional outcomes of ACL reconstruction utilizing an autologous PLT graft with particular emphasis on postoperative knee stability and donor-site biomechanical performance within a six-month follow-up period. This prospective interventional investigation enrolled 115 patients with clinically and radiologically confirmed ACL ruptures who underwent reconstruction using the PLT autograft at Hylmia Military Hospital. The study aimed to determine the graft's efficacy in restoring knee function while evaluating potential alterations in ankle or foot biomechanics following tendon harvesting, thereby providing a comprehensive assessment of both joint recovery and donor-site safety.

In the current study, the mean diameter of the harvested PLT graft was 8.14 ± 0.58 mm, while the mean graft length measured 104.91 ± 4.96 mm. These dimensions were clinically significant as graft size has a direct impact on postoperative stability, fixation strength and long-term functional outcomes. When compared with previously published data, the PLT graft dimensions in this study closely align with those reported in prior research, including mean values of 8.3 ± 0.08 mm in diameter and 85 ± 0.4 mm in length [8]. Furthermore, **Rhatomy *et al.*** [9] observed that the PLT graft demonstrated a significantly greater mean diameter (8.8 ± 0.7 mm) than the hamstring tendon graft (8.2 ± 0.8 mm, $p = 0.012$) [9]. These findings reinforce the suitability of the PLT as a robust and biomechanically reliable autograft for anterior cruciate ligament reconstruction, offering sufficient strength and length for secure fixation and optimal clinical outcomes.

Functional outcomes were evaluated using the **IKDC** scoring system. The current study demonstrated a significant improvement from a mean preoperative score of 52.2 to 91.2 at six months postoperatively ($P< 0.001$). This improvement is consistent with the findings of **Kusumastuti *et al.*** [10] who reported a statistically significant increase in the IKDC score from 55.26 ± 12.76 preoperatively to 96.69 ± 3.36 postoperatively **(**$p < 0.05$) in a cohort of 75 patients who underwent ACL reconstruction using autologous PLT.

Donor-site morbidity was assessed using the **AOFAS** scoring system. A transient decrease in AOFAS scores was observed postoperatively, followed by recovery to near-baseline values at six months. The mean AOFAS scores were 96.02 ± 0.84 preoperatively, 91.9 ± 4.04 at one month, 93.58 ± 3.91 at three months, and 95.23 ± 2.95 at six months. These findings align with **Vijay *et al.*** [7] who reported excellent ankle function (AOFAS: 96.43 ± 3.13) at one year postoperatively with no significant postoperative deterioration.

Static and dynamic footprint analysis was conducted preoperatively and six months postoperatively to assess potential alterations in foot biomechanics following PLT harvesting. Among the 115 patients, 114 (99.1%) demonstrated no significant changes in either static or dynamic footprints. Only one patient (<0.5%) exhibited a lateral shift in the center of pressure associated with a mild increase in the medial arch height, however this was not associated with any clinical symptoms or gait disturbance.

Postoperative complications were documented in 15 patients (13%), encompassing 11 cases of transient foot edema, 2 instances of superficial graft-site infection, 1 case of wound dehiscence, and 1 case of accentuated medial foot arch. Importantly, no occurrences of vascular injury, neurological deficit, or graft failure were identified throughout the follow-up period. The majority of complications were mild, self-limiting and successfully managed with conservative treatment. These findings are consistent with previously published data of **Kusumastuti *et al.*** [(10)] who observed transient neuropraxia in 4% of patients at six months postoperatively, with complete resolution and no long-term morbidity. Collectively, these outcomes affirm the safety profile of the peroneus longus tendon as an autograft, demonstrating minimal donor-site morbidity and a low incidence of postoperative complications.

Overall, these findings support the use of the peroneus longus tendon as a viable autograft for ACL reconstruction, offering comparable or superior graft characteristics and clinical outcomes to traditional autografts, with minimal donor-site morbidity.

CONCLUSION

The current study confirmed that anterior cruciate ligament (ACL) reconstruction utilizing an autologous peroneus longus tendon (PLT) represents a safe, effective and dependable alternative to conventional hamstring tendon autografts. The use of the PLT graft resulted in a marked enhancement of knee joint stability and overall functional recovery, while preserving donor-site integrity and maintaining normal ankle kinematics without clinically significant biomechanical disturbances. These outcomes underscore the potential of the peroneus longus tendon as a strong and versatile autograft choice for ACL reconstruction, particularly within the Egyptian population, where it demonstrated excellent postoperative performance, minimal morbidity and consistent functional restoration.

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DISCLOSURE

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