

Introduction

The anterior cruciate ligament (ACL) is critical for knee stability, and its reconstruction is one of the most common orthopedic procedures worldwide. However, despite advancements in surgical techniques, ACL reconstruction failures remain a significant concern, with tunnel misplacement being a primary contributor. This study aims to evaluate the radiological positioning of ACL tunnels and investigate their clinical correlation, focusing on the impact of tunnel placement on postoperative outcomes. With proper tunnel positioning being vital for achieving optimal graft tension and minimizing the risk of complications, this research seeks to provide a comprehensive analysis of the relationship between tunnel placement errors and clinical results, including knee function, stability, and patient recovery. Through this investigation, we hope to enhance surgical precision and improve patient outcomes in ACL reconstruction.

Aim of the work

The aim of this study was to evaluate the radiological positioning of tunnels in anterior cruciate ligament (ACL) reconstruction and examine their clinical correlation. Specifically, the research seeks to analyze how variations in tunnel placement affect postoperative outcomes, including knee function, stability, and overall recovery, with the goal of providing insights into the importance of accurate tunnel positioning for improving ACL reconstruction success.

Patients and Methods

This prospective study involved 30 adults who underwent arthroscopic ACL reconstruction at El-Hadra University Hospital between August 2023 and December 2024. Inclusion criteria required patients aged 18-40 years with isolated ACL injuries, undergone at least 2 months of preoperative physiotherapy. Exclusion criteria included associated injuries, previous surgeries, or osteoarthritis. The surgical procedure was performed using a standard anatomical single – bundle trans-portal technique, with peroneus longus tendon graft harvesting. Postoperatively, patients followed an accelerated rehabilitation program, and both clinical and radiological evaluations were conducted 6 months after surgery. Outcomes were assessed based on knee function (IKDC score), range of motion, graft laxity, and radiological evidence of tunnel position and degenerative changes.

Results

The study found that 70% of patients achieved ideal outcomes following ACL reconstruction, with significant improvements in knee function, stability, and range of motion. The majority of patients (90%) reported minimal loss of flexion and extension, with less than 5° difference from the contralateral knee. Clinical assessments, including the International Knee Documentation Committee (IKDC) subjective evaluation, showed high functional scores, indicating restored knee function in most individuals. The radiological evaluation revealed that tunnel misplacement was a key factor affecting clinical outcomes, particularly in patients with non-ideal tunnel positioning, where complications such as graft tension and knee instability were more common. Additionally, the results highlighted the importance of accurate femoral and tibial tunnel placement in ensuring proper graft alignment and function. In patients with non-ideal tunnel positioning, 40% demonstrated abnormal knee instability, while 30% exhibited limitations in flexion or extension. These individuals also showed poorer IKDC scores and higher rates of postoperative stiffness and pain. The study suggests that meticulous attention to tunnel placement is crucial for optimizing the functional and clinical outcomes of ACL reconstruction, as deviations from the ideal positioning significantly compromise recovery and graft function.

Table 1: Association between tunnel position parameters and clinical outcomes in non-ideal group.

Clinical Outcome	PFT	ATT	MTT	LFT	GIA
Knee Pain	0.072	0.031*	0.219	0.108	0.067
Laxity	0.018*	0.069	0.081	0.351	0.367
Limited Flexion	0.042*	0.016*	0.451	0.273	0.388
Limited Extension	0.290	0.073	0.388	0.067	0.173

Mann-Whitney test was used; (p) probability value, (*) significant if ≤ 0.05 .

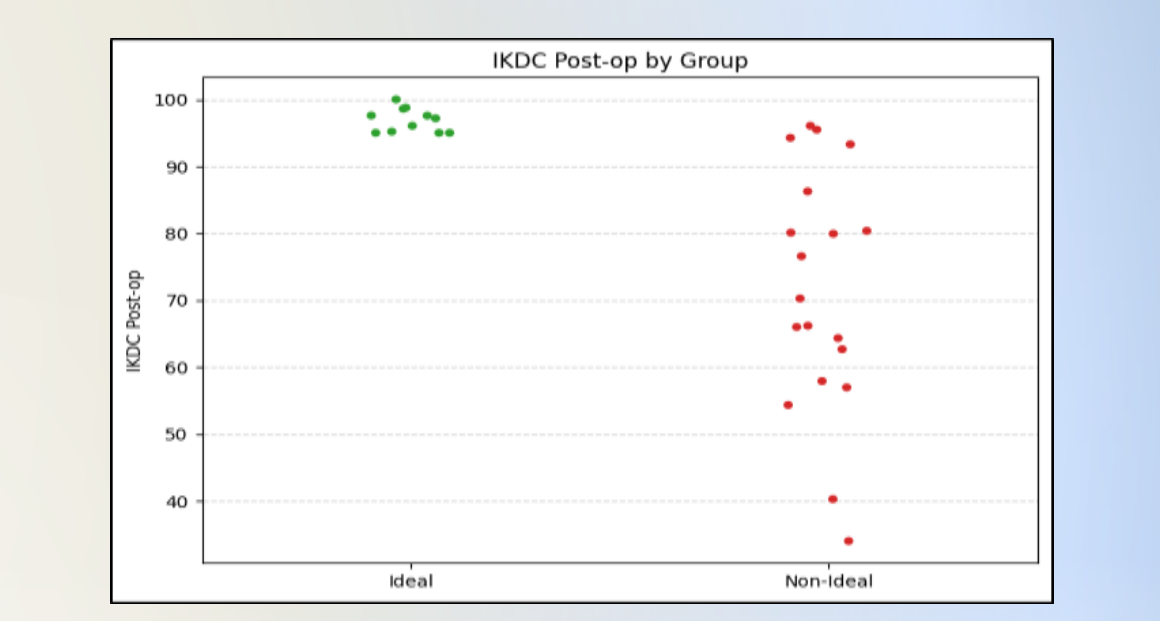


Figure 1: Distribution of postoperative IKDC scores in ideal and non-ideal tunnel position groups.

Conclusion

In conclusion, the study emphasizes that accurate tunnel positioning during ACL reconstruction is critical for optimal clinical outcomes. Misplacement of the femoral and tibial tunnels can lead to increased risk of knee instability, graft tension issues, and postoperative complications such as stiffness, pain, and limited range of motion. The findings highlight the need for precise radiological assessment and careful surgical planning to avoid suboptimal tunnel placement, which is associated with poorer functional recovery and higher rates of failure. The results underline the importance of achieving anatomically accurate tunnel positions to enhance graft stability and improve long-term patient outcomes after ACL reconstruction.