# Does the Position of the Femoral Tunnel Affect the Laxity or Clinical Outcome of the Anterior Cruciate Ligament–Reconstructed Knee? A Clinical, Prospective, Randomized, Double-Blind Study

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**Purpose:** The aim of this study was to evaluate whether a change in the femoral graft insertion site between the 1-o'clock (high) and 2-o'clock (low) positions could change the laxity, the score on the 2000 International Knee Documentation Committee (IKDC) Knee Examination Form, or the score on the 2000 subjective IKDC Knee Evaluation Form in the anterior cruciate ligament (ACL)–reconstructed knee. **Methods:** The study was designed as a prospective, randomized, double-blind investigation. We randomized 30 patients to the low tunnel position group and 30 to the high tunnel position group. Four-stranded semitendinosus and gracilis single-bundle grafts were used. At follow-up, the patients were examined according to the IKDC evaluation form and the IKDC examination form. The exact measurements of laxity at 25° and 70° were performed by use of the Rolimeter (Aircast, Boca Raton, FL). Standardized radiographs were evaluated. **Results:** In total, 26 patients in the low tunnel position group and 25 in the high tunnel position group completed the study. At follow-up, we found no significant difference in the laxity at 25° and 70° or scores on the IKDC examination form. We found a significant difference in the scores on the IKDC evaluation form, favoring the low position, with a subjective score of 82.8 versus 70.4. **Conclusions:** A change in the femoral tunnel placement from 1 o'clock to 2 o'clock did not result in a detectable change in the sagittal laxity at 25° and 70°, on the pivot-shift test, or on the IKDC examination form scores. However, we found a significant difference between the two groups in the scores on the IKDC evaluation form, most evident in the subgroups dealing with the patient's subjective knee stability. We conclude that it is possible to improve the clinical result in 1-bundle ACL reconstruction by lowering the tibial tunnel angle and thereby lowering the femoral tunnel toward the 2-o'clock position. **Level of Evidence:** Level I, therapeutic prospective randomized trial. **Key Words:** Anterior cruciate ligament—Reconstruction—Femoral tunnel—Clinical—Randomized—Single bundle—Anterior laxity.

Discussion about the optimal placement of the anterior cruciate ligament (ACL) graft is ongoing. Placement ranging from the 11- to 1-o'clock position to a more posterior-lateral placement, such as the 10- or 2-o'clock position or even as low as the 9- or 3-o'clock position, is suggested.[1,2] Some surgeons are in favor of placing the graft in a high position (11 or 1 o'clock),[3,4] whereas others prefer a lower, more horizontal graft position (10 or 2 o'clock) on the femoral site.[5-7]

The natural ACL consists of an anterior-medial bundle stabilizing the knee mainly at 90° of flexion, whereas the posterior-lateral bundle stabilizes the knee between full extension and 30° of flexion,[8] and provides rotatory stability.[9] None of the bundles in the natural ACL is found to be isometrically placed.[2]

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There seems to be evidence of reducing rotatory laxity by lowering the femoral insertion from the 11- or 1-o'clock position to the 10- or 2-o'clock position.[9] Investigations of the relevance of the femoral insertion of the ACL have been done in cadaveric studies.[1,9,10]

To our knowledge, no clinical, prospective, randomized studies describing the effect of changing the femoral tunnel placement have been published. The aim of this study was to evaluate whether a change in the femoral graft insertion from a high position (11 or 1 o'clock) to a low position (10 or 2 o'clock) could change the sagittal laxity, result in a difference in the pivot-shift test, and yield further postoperative clinical or subjective findings after ACL reconstruction. We did not expect to find a difference in the laxity but did expect to find a difference in the pivot-shift test and in the International Knee Documentation Committee (IKDC) subjective score, as a result of the expected better control of the rotational stability, when lowering the femoral insertion site.

## METHODS

This clinical study was designed as a prospective, randomized, double-blind investigation. The study was carried out from June 2003 to March 2005 at 2 locations in Denmark, the Randers Central Hospital and Ringsted Central Hospital.

Surgery was performed in 20 patients at the Central Hospital of Ringsted and in 40 patients at the Central Hospital of Randers. All operations were performed by experienced orthopaedic surgeons specializing in ACL reconstruction surgery or under the supervision of one of these surgeons. A total of 3 surgeons were involved in the 60 operations in this study.

Randomization was done by the sealed-envelope method. The envelope was opened in the operating room after the initial arthroscopy of the knee was performed to ensure that all inclusion criteria were met. The patients and the doctor who did the follow-up examination were unaware of the randomization result until after the investigation of the study was fulfilled. The postoperative and follow-up evaluations, including both clinical and radiologic examinations, of patients at both hospitals were done by the same investigator (C.F.J.).

The study was approved by the local ethics committees of Aarhus and Vestsjaelland, Denmark.

### Inclusion Criteria

Patients with an isolated unilateral ACL injury were eligible to be included in the study. They had to be aged between 18 and 60 years.

### Exclusion Criteria

The exclusion criteria were as follows: earlier reconstruction surgery in the injured knee, osteochondral lesions with a grade of more than 2 according to the modified Outerbridge classification, meniscal lesions involving more than half of the meniscus and meniscal refixation, and patients with rheumatoid diseases.

### Groups

**Low-Positioned ACL:** The entry point of the tibial tunnel was placed at the anterior edge of the medial collateral ligament, resulting in an oblique tibial tunnel, allowing the surgeon to reach a low femoral tunnel entrance equivalent to the 2-o'clock position.

**High-Positioned ACL:** The entry point of the tibial tunnel was placed centrally between the anterior part of the medial collateral ligament and the medial edge of the tibial tuberosity, resulting in a steeper tibial tunnel to be able to reach the 1-o'clock femoral position.

### Surgical Technique

After initial arthroscopy, the patients were randomized to either a low or high femoral tunnel. Four-stranded semitendinosus and gracilis grafts were harvested from the ipsilateral knee. The femoral tunnel was drilled transtibially. In case of randomization to the low-positioned femoral tunnel, the entry of the tibial tunnel was placed at the anterior edge of the medial collateral ligament, resulting in an oblique tibial tunnel, allowing the surgeon to reach a low femoral tunnel entrance equivalent to the 2-o'clock position. In case of randomization to the high-positioned femoral tunnel, the entry point of the tibial tunnel was placed centrally between the anterior part to the medial collateral ligament and the tibial tuberosity, resulting in a steeper tunnel through which a higher femoral tunnel entrance could be drilled.

The tibia guide was set in all cases at 50° when preparing the tibial tunnel. The graft was secured with 2 Rigidfix pins (DePuy Mitek, Raynham, MA) in the femoral tunnel. Tibial fixation was done with the Intrafix system (DePuy Mitek) with the knee in near-full extension and with a traction force of 30 lb.