Arthrometric Stability of Horizontal Versus Vertical Single-bundle Arthroscopic Anterior Cruciate Ligament Reconstruction

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Abstract: The anteroposterior (AP) stability of standard anterior cruciate ligament (ACL) reconstruction, referred to as “vertical,” was compared with that of a modified femoral position, referred to as “horizontal,” which is lower than and anterior to an operative knee at 90° flexion. Two consecutive series of 50 patients underwent vertical and horizontal arthroscopic single-bundle ACL reconstruction, respectively. For vertical reconstruction, the clock position was chosen, placing the graft at 10:30 in right knees and 1:30 in left knees, 1 to 2 mm anterior to the posterior femoral cortical cortex and at the back of the resident ridge. In the horizontal reconstruction, the transplant replaced the original ligament insertion at approximately the 9:30 o’clock position in right knees and the 2:30 o’clock position in left knees, approximately 2 mm in front of the posterior femoral cortical cortex. One year after surgery, the results of stabilometric evaluation revealed good performance after horizontal transplant. The mean clinical results changed from 1.0 (±1.3) mm for vertical to 0.7 (±1.3) mm for horizontal reconstruction. [Orthopedics. 2014; 37(5):321-324.]

Materials and Methods
This was a retrospective analysis of data collected prospectively 1 year after surgery. Neither randomization nor blinding was used. The main outcome was defined as AP tibial translation expressed in millimeters at 1-year follow-up.

Two consecutive series of patients who underwent vertical and horizontal arthroscopic single-bundle ACL reconstruction, respectively, were compared. Institutional review board approval was not required because the 2 techniques were both routinely performed as standard care during the defined period.

Inclusion and Exclusion Criteria
Fifty patients per group were admitted to the study according to the following criteria:
• Surgeries were performed by the senior author (M.D.).
• Revision cases, patients who refused to undergo routine follow-up evaluations, and patients presenting significant...
medical problems were excluded.

- A single-bundle reconstruction with duplicated autologous semitendinosus-gracilis graft was chosen, with the graft harvested from the ipsilateral knee.
- A femoral tunnel was created using the transtibial technique.\(^{19}\)
- Femoral and tibial fixations were homogeneous in all patients.
- Patients were available for evaluation 1 year after surgery.

**Surgical Technique**

Informed consent was obtained from each patient before surgery and before the transtibial surgical technique was performed. To perform the horizontal grafts, the tibial tunnel entry point was more medial than with standard techniques, allowing adequate anatomical placement of the femoral side. On the tibial plateau, the exit point of the tibial tunnel was slightly more anterior in the horizontal reconstruction (Figure 1A) than in the vertical reconstruction (Figure 1B), still avoiding a conflict with the intercondylar notch. The tibial drill angle was performed under guidance (Acufex Director Drill Guide; Smith & Nephew, Andover, Massachusetts) at 50°. The knee was flexed at 80° to 90°.

The grafts were at least 7 mm in diameter. They were fixed with a femoral endobutton (15 mm) and a bioabsorbable tibial screw at least 1 mm larger than the diameter of the tibial tunnel.

The 2 techniques employed different femoral tunnel positions. For vertical reconstruction, the graft was placed at the 10:30 o’clock position in right knees and at the 1:30 o’clock position in left knees, 1 to 2 mm from the posterior femoral cortical cortex and at the back of the resident ridge. For horizontal reconstruction, the transplant replaced the original ligament insertion at approximately the 9:30 o’clock position in right knees and the 2:30 o’clock position in left knees; the graft was 2 mm from the posterior femoral cortical cortex, positioned at the back of the resident ridge (Figure 2, Figures 3A-3B).

All of the study participants were prospectively examined 1 year after surgery. Demographic data for the 2 groups of patients were extracted from surgical reports and case histories. Stabilometric data were collected prospectively using the KT-1000 arthrometer (MEDmetric Corp, San Diego, California).\(^4\)

**Statistical Analysis**

Between-group differences were analyzed for significance using the unpaired \(t\) test (normal distributions) or the Mann-Whitney \(U\) test (skewed distributions). Associations among variables were tested using the chi-square test or Fisher’s exact test. Statistical analysis was performed using GraphPad Prism version 5.00 (GraphPad Software, San Diego, California). A 95% confidence level (\(P<.05\)) was used to identify statistically significant results.

**RESULTS**

The 2 groups did not differ regarding age, sex, or associated procedures (Table 1). One patient originally chosen for the vertical study group was replaced in the series after suffering a lesion of the neo-ACL 10 months after surgery due to a major new trauma sustained during a contact sport. This patient had a 2.5-mm, side-to-side KT-1000 arthrometer reading 6 months after the original vertical reconstruction. One year after surgery, the results of stabilometric evaluation indicated that both reconstruction methods achieved substantial stability (Table 2). The KT-1000 values did not differ significantly between the 2 groups, although the horizontal group’s mean value was lower than the vertical group’s mean value (0.7±1.3 mm and 1.0±1.3 mm, respectively).

At final follow-up, all patients demonstrated a complete articular range of motion compared with the contralateral knee, with no loss of extension.

**DISCUSSION**

This study showed that horizontal graft positioning...
is equivalent to vertical graft positioning regarding AP stability. In most cases, the trans-tibial technique allows for the desired end result of correct femoral positioning through the increased medialization of the entrance of the tibial tunnel. In the context of complications, an anterior-medial approach or an out-in approach may be chosen for correct femoral tunnel positioning. In this study, patients who underwent other surgical approaches were excluded to allow for uniformity at follow-up.

One year after surgery, the graft has reached its biological assessment. Failures and major laxities, if present, are revealed at this time, confirming Salmon et al11 reporting that 1 year is an adequate time frame for evaluation.

Objective evaluation using the KT-1000 arthrometer showed a 0.3-mm difference between the 2 techniques, with an average translation of 1.0 (±1.3) mm in the vertical group vs 0.7 (±1.3) mm in the horizontal group; therefore, no statistically significant difference was observed. It can be argued that no significance could be observed because the high variability of KT-1000 values resulted in higher standard deviations, since knee laxity differs greatly among individuals. It is hypothesized that this variability may be reduced by comparing larger groups of patients. Cain and Clancy4 believed that vertical graft placement resulted in restoration of normal AP stability with a negative result on Lachman examination, but might not produce a stable knee in rotation, noted by a positive pivot shift. The current authors’ research does not consider rotational results, instead highlighting a minor trend (although not significant) in AP stability that appears to favor the horizontal ACL reconstruction technique. This study has several limitations. Patient recruitment and allocation were neither blind nor random. Anteroposterior stability was tested, but no data were collected regarding residual rotational instability. Groups were limited regarding size and length of follow-up. Future studies need to compare differences in stability, cost, surgical time, and learning curve among standard single-bundle, horizontal single-bundle, and double-bundle ACL reconstructions.

**CONCLUSION**

This study showed a mean difference of 0.3 mm, which was not statistically significant, in KT-1000 arthrometer readings of inferior AP translation between the horizontal group and the vertical group. Currently, evidence is lacking to suggest that this technical variance be adopted as the standard of care in single-
bundle ACL reconstruction procedures.

REFERENCES


