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Tunnel Location and Two-Year Clinical Outcomes after the Anatomical Rectangular Tunnel Anterior Cruciate Ligament Reconstruction with a Bone Patellar-Tendon Bone Graft

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Summary:
This study showed that 1) by identifying arthroscopic landmarks, the entire femoral tunnel aperture and at least 75% of the tibial tunnel aperture area were located inside the anatomical attachment areas in the 3-D CT evaluation after anatomic rectangular tunnel (ART) ACLR using a BTB graft; 2) clinical outcomes were satisfactory both subjectively and objectively in more than 95% of the patients.

Abstract:

Purpose

Based on the anatomical studies showing the ACL attachment areas are surrounded by the bony landmarks, it is our surgical policy to precisely create tunnels inside the anatomical attachment areas after careful removal of ACL remnants to identify the landmarks. This study aimed to elucidate tunnel locations and clinical outcomes after anatomic rectangular tunnel (ART) ACL reconstruction (ACLR) using a bone-patellar tendon-bone (BTB) graft.

Methods

Sixty-one patients with primary unilateral ACL injury were included. They were 40 males and 21 females with a mean age of 23 years (range: 14–48 years). Rectangular tunnels of 5 × 10 mm were created inside the femoral/tibial ACL attachment areas. A BTB graft was harvested and the bone plugs were shaped into a rectangular parallelepiped to snugly fit the tunnels. For the femur, an aperture fixation was performed with an interference screw after the tendon–bone interface was adjusted to the femoral tunnel aperture. For the tibia, a pullout fixation was performed with the Double Spike Plate and a screw under an initial tension of 10–20 N. Postoperatively, using 3-dimensional computed tomography (3-D CT) images, the proportion of the tunnel apertures to the anatomical attachment areas was evaluated at 3 weeks. The clinical outcomes were evaluated at 2 years.

Results

The 3-D CT evaluation showed the entire tunnel aperture was geographically located inside the anatomical attachment area in all the patients for the femur and in 70% patients for the tibia. In the remaining 30% patients, 15.1% ± 4.5% (6.2%–22.2%) of the tibial tunnel aperture area was medially deviated from the medial intercondylar ridge, whereas no deviation was observed in the anterior, posterior or lateral directions. In sum, at least 75% of the tibial tunnel aperture area was located inside the anatomical attachment area in all the patients. The International

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Knee Documentation Committee (IKDC) subjective assessment showed that all the patients were classified as 'normal' or 'nearly normal'. The Lachman test and pivot-shift test were negative in 99% and 95% of the patients, respectively. No patients showed a loss of flexion/extension exceeding 5°. The mean side-to-side difference of the anterior laxity at the maximum manual force with a KT-1000 Knee Arthrometer was 0.2 ± 0.9 mm, with 95% of the patients ranging from -1 to +2 mm. No significant correlation was detected between the medial deviation of the tibial tunnel aperture from the anatomical attachment area and the side-to-side difference of the anterior laxity (rho = 0.101, P = 0.428) or the IKDC subjective assessment (rho = 0.037, P = 0.810).

Conclusion

By arthroscopically identifying the bony landmarks, the entire femoral tunnel aperture and at least 75% of the tibial tunnel aperture were located inside the anatomical attachment areas. With these properly-created tunnels, the ART ACLR resulted in satisfactory outcomes both subjectively and objectively in more than 95% of the patients.