Radiographic Tibial Tunnel Assessment After Anterior Cruciate Ligament Reconstruction Using Hamstring Tendon Autografts and Biocomposite Screws: A Prospective Study With 5-Year Follow-Up

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Purpose: To radiographically assess the tibial tunnel up to 5 years after anterior cruciate ligament (ACL) reconstruction using hamstring tendon autografts and biocomposite interference screws. **Methods:** Fifty-one patients underwent anatomic single-bundle ACL reconstruction with metal interference screws in the femur and biocomposite interference screws in the tibia. Standardized digital radiographs with weight-bearing anteroposterior and lateral views of the index knee were taken in the early postoperative period and at 2 and 5 years postoperatively. Of 51 patients, 40 (78%) underwent radiographic assessment on all 3 occasions. Subjective and objective clinical assessments were obtained preoperatively and at the 5-year follow-up. **Results:** The mean follow-up period was 65 months (±3.9 months), with a minimum of 59 months. The width of the tibial tunnel on the anteroposterior view was 9.4 mm (±1.4 mm) in the early postoperative period and 9.2 mm (±1.5 mm) at 5 years ($P = .64$). The corresponding widths on the lateral view were 9.6 mm (±1.5 mm) in the early postoperative period and 9.0 mm (±1.4 mm) at 5 years ($P = .014$). In 33 of 40 patients (83%) the width of the tibial tunnel had decreased on 1 or both views at 5 years compared with the early postoperative period. The study group had improved significantly at the 5-year follow-up compared with the preoperative assessments in terms of the KT-1000 arthrometer laxity tests (MEDmetric, San Diego, CA), pivot-shift test, Tegner activity scale, and Lysholm knee score ($P < .001$). No correlations were found between the tunnel widths and the KT-1000 assessment. **Conclusions:** In 83% of patients, the width of the tibial tunnel had decreased on 1 or both radiographic views at 5 years compared with the early postoperative period after ACL reconstruction using biocomposite interference screws. **Level of Evidence:** Level II, prospective study.

Anterior cruciate ligament (ACL) reconstruction using interference screws and autologous hamstring tendon grafts is a widely performed surgical procedure with excellent clinical outcomes in terms of knee laxity, functional tests, and patient-reported outcome measures (PROMs).[1,2] Metallic interference screw fixation has traditionally been a common method that contributes to a stable rigid fixation.[3] However,

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disadvantages associated with the use of metallic interference screws have been reported. Laceration of the graft during screw insertion, artifacts during subsequent magnetic resonance imaging (MRI), and complicated revision surgery are some of them.[4-6] This has led to the development of biodegradable interference screws consisting of various substances such as polyglycolic acid (PGA), poly-p-dioxanone, and copolymers of polyglycolic acid–polylactic acid (PGA-PLA), as well as polymers such as poly-L-lactic acid (PLLA) and poly-D-lactic acid (PDLA).[7,8] The potential benefits of biodegradable screws are a pullout force and stiffness comparable with those of metallic screws, together with the fact that they should undergo degradation and, in the long term, be replaced by bone tissue.[9] Despite this, adverse effects of biodegradable screws, such as screw breakage during insertion, soft-tissue reactions, the absence of osteoconductivity, and bone tunnel enlargement, have been reported in the literature.[6,9]

In the past decade, biocomposite materials have been introduced to enhance the osteoconductive properties of implants. For instance, β tricalcium phosphate (β-TCP) has been added to biodegradable polymers. Theoretically, biocomposite implants are supposed to degrade over time but more rapidly than biodegradable implants and, as a result of their osteoconductivity, result in faster graft incorporation, as well as bone formation in the tunnel, and thereby, reduced tunnel width. Biocomposite screws are also MRI compatible in the event of another knee injury.[10-13] In terms of tibial tunnel enlargement or narrowing after use of biocomposite screws, the reported results in the literature are divergent.[14] Tunnel narrowing and reduced tunnel wall sclerosis with signs of screw incorporation have been reported; on the other hand, no tunnel narrowing and the presence of remains of the screws have been seen years after the surgical procedure.[15-18]

The purpose of this prospective study was to radiographically assess the tibial tunnel width up to 5 years after ACL reconstruction using hamstring tendon autografts and biocomposite interference screws. The hypothesis was that no tibial tunnel enlargement would be found 5 years after ACL reconstruction.

Methods

Patients

The patients in this study were a subset from a previous study by Karikis et al.[19] Between March 2008 and September 2009, 105 patients were randomized to either the single-bundle (SB) group (n = 52) or the double-bundle (DB) group (n = 53) and underwent surgery. The patients in the SB group were included and followed up prospectively with radiographs directed toward the tibial tunnel, up to 5 years after surgery, in the present study. As a result, 51 patients were allocated in this study (Fig 1). The study group consisted of unselected patients without regard to age (if ≥18 years), weight, height, sex, or activity level. The inclusion criteria were patients aged 18 years or older with a unilateral ACL injury at the time of the index injury. The exclusion criteria were a concomitant posterior cruciate ligament injury, medial or lateral collateral ligament laxity greater than 1+, previous major knee surgery, or a contralateral ACL injury before the date of the index operation. One patient who sustained a contralateral ACL injury before the date of the index operation, but after the preoperative clinical tests, was kept in the radiographic part of the study but not in the side-to-side clinical assessments. Patients fulfilling the inclusion criteria were consecutively asked to participate in the study. The indication for surgery was failed nonsurgical treatment or participation in pivoting sports in which nonsurgical treatment was regarded as an inferior treatment option.

Surgical Techniques

Standard anterolateral and anteromedial portals were established perioperatively. Associated intra-articular injuries, such as meniscal ruptures and chondral lesions, were addressed at the time of the index operation. The femoral and tibial ACL footprints were identified, in addition to the lateral intercondylar and bifurcate ridges. ACL remnants were resected. The semitendinosus and gracilis tendons were harvested with an open tendon stripper, through a 3-cm longitudinal incision at the pes anserinus, on the anteromedial aspect of the proximal tibia. The ACL graft consisted of 4-stranded semitendinosus and gracilis tendons.

The femoral tunnel was addressed first according to the method of Järvelä.[20] However, the femoral drill hole was placed somewhat anteriorly and somewhat distally to their placement. On the tibial side, the center of the tunnel was placed in line with the anterior horn of the lateral meniscus. The tibial tunnels were drilled by use of a tibial elbow aimer and a fluted reamer. All the bone tunnels were drilled 0.5 mm larger than the diameter of the respective grafts, which were between 7.5 and 8.5 mm. Metal interference screws (RCI; Smith & Nephew, Andover, MA) were used for femoral graft fixation.[19] For tibial fixation, we used biocomposite interference screws, 9 × 25 mm, made of self-reinforced poly-levo (96%)/dextro (4%)–lactide/β-TCP [SR-PL(96)/D(4)LA/β-TCP] (77% PLDLA and 23% β-TCP) (Matryx; ConMed Linvatec, Largo, FL) (Fig 2). Tibial fixation was performed at 10° to 20° of knee flexion. In all cases the tunnels were placed anatomically in accordance with the knowledge of anatomic ACL reconstruction available in 2008 and 2009 when the surgical procedures were performed.[20]

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