A Retrospective Review of Bone Tunnel Enlargement After Anterior Cruciate Ligament Reconstruction With Hamstring Tendons Fixed With a Metal Round Cannulated Interference Screw in the Femur

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Purpose: To assess bone tunnel enlargement after anterior cruciate ligament (ACL) reconstruction with the use of hamstring tendons fixed with a round cannulated interference (RCI) screw in the femur. **Methods:** A consecutive series of 30 ACL reconstructions performed with hamstring tendons fixed with an RCI screw in the femur and with staples via Leeds-Keio ligament in the tibia was retrospectively reviewed. The clinical outcome was evaluated through the Lysholm score. Anterior instability was tested by Telos-SE (Telos Japan, Tokyo, Japan) measurement. The location and angle of each femoral and tibial tunnel were measured with the use of plain radiographs, and bone tunnel enlargement greater than 2 mm detected any time 3, 6, 12, and 24 months postoperatively was defined as positive. Each factor (location and angle of the tunnels, sex, affected side, age, Lysholm score, and Telos-SE measurement) was compared between enlarged and nonenlarged groups. **Results:** Positive enlargement of the bone tunnel (>2.0 mm) was observed in 36.7% (11 of 30) on the femoral side and 33.3% (10 of 30) on the tibial side, and in 6 knees of both sides. Half of patients (15 of 30) had an enlarged tunnel on the femoral or the tibial side until 1 year postoperatively. In most cases, enlargement reached maximum at 6 months postoperatively. Female patients tended to have an enlarged tunnel, especially on the femoral side ($P < .05$). Tunnel enlargement was not correlated with location and angle of the tunnels. Moreover, no difference was found in Lysholm score and Telos-SE measurement between enlarged and nonenlarged groups, although the nonenlarged group tended to exhibit higher Lysholm score and lesser instability. **Conclusions:** Bone tunnel enlargement of the femoral or tibial side was observed in half of patients (6 in both sides, 5 only in the femur, and 4 only in the tibia) after ACL reconstruction was performed with a hamstring tendon fixed with an RCI screw. Female patients had a greater chance for enlargement of the femoral tunnel than did males. This enlargement had no significant impact on patient activity and on anterior instability of the knee 1 year after surgery. **Level of Evidence:** Level IV, Therapeutic case series. **Key Words:** Knee—Anterior cruciate ligament (ACL)—Hamstring—Bone tunnel enlargement.

Intra-articular anterior cruciate ligament (ACL) reconstruction is a well-established surgical treatment for patients with functional instability of the knee. However, several studies have shown bone tunnel enlargement of the tibia and femur after surgery. Tunnel enlargement has been reported in ACL reconstruction performed with the use of bone–patellar tendon–bone (BPTB) autografts,[1-4] BPTB allografts,[1,2,5-7] Achilles tendon allografts,[7,8] and hamstring (HS) grafts.[9,10]

The cause of this tunnel enlargement is unclear but is thought to be probably multifactorial.[11] Although

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biological and mechanical factors are considered to be crucial, no precise methods have been used to solve this problem.

As a graft material for reconstruction, BPTB autograft was most popular for many years.[12] However, BPTB technique has several disadvantages, including anterior knee pain, pain on kneeling, and weakness on knee extension.[10] The HS graft is used increasingly because it is associated with an easier harvesting technique, less donor site morbidity, reduced pain, and easier rehabilitation.[13]

So far, no reports have described bone tunnel widening after ACL reconstruction with the HS autograft fixed with a round cannulated interference (RCI) screw (Smith & Nephew, Tokyo, Japan) in the femur and with staples in the tibia. We have chosen this technique to avoid patellofemoral problems and anterior knee pain after BPTB reconstruction. We have been using this interference screw system to fix the graft to the femur because the point of fixation for the HS graft in this technique is usually close to the original insertion site of the ACL. More precisely, the point of fixation with an EndoButton technique (Smith & Nephew Endoscopy, Andover, MA) is located at the extracortical surface of the lateral femoral condyle and is considered to be distant from the original insertion site.[12] The goals of this study are (1) to evaluate bone tunnel enlargement after ACL reconstruction performed with fixation of HS tendons with an RCI screw, and (2) to look into factors that may be correlated with enlargement. Our hypothesis here is that graft tunnel motion would be eliminated by anatomic fixation with an RCI screw, at least in the femur.

METHODS

A consecutive series of 28 patients (30 knees) who underwent ACL reconstruction with the use of an HS autograft fixed to the femur with an RCI screw was retrospectively reviewed. Over a period of 4 years, patients underwent arthroscopic primary ACL reconstruction performed by a senior surgeon (Y.N.); the follow-up period lasted longer than 2 years. A revision case was excluded. No infection was reported. The group consisted of 12 male knees and 18 female knees, and 15 right knees and 15 left knees; average age at the time of surgery was 24.4 years (range, 15 to 47 years). Concomitant surgery was partial meniscectomy for 5 knees, meniscal repair for 2, partial meniscectomy of the medial meniscus and repair of the lateral meniscus for 1, partial meniscectomy of the lateral meniscus and repair of the medial meniscus for 1, osteochondral autogenous transfer for 1, and partial meniscectomy and osteochondral autogenous transfer for 1.

The semitendinosus-gracilis tendon was harvested through an anteromedial longitudinal tibial incision at the pes anserinus, and a piece of tendon, usually about 25 to 30 cm long, was acquired. Three or four polyester braided sutures were placed on each end of the graft, and Leeds-Keio artificial tape (LK20; Yufu, Tokyo, Japan) was fixed to a loop created at the distal end of the graft. Once prepared, graft diameter was measured, and tunnels were drilled accordingly. The tibial tunnel was drilled at a 40° angle to the long axis of the tibia. The femoral drill hole was aimed at the proximal isometric point (10:30 o'clock position in the right knee) and was created through an anteromedial portal to the depth of 2.5 cm. An adequate intercondylar notchplasty was performed if necessary. After the graft had been positioned, an RCI screw made with titanium alloy was inserted over a guidewire through an anteromedial portal with the knee joint at maximum flexion. At the tibia, the artificial tape of the graft was fixed extracortically with 2 staples in a belt-buckle way under maximum manual tension at 90° of knee flexion. About 1.5 to 2.5 cm of the proximal portion in the tibial tunnel was filled with HS tendons. Patients began active range of motion (ROM) exercise 3 days after the operation was performed, partial weight bearing was allowed 1 week after the operation, and after 4 weeks, full ROM and full weight bearing were allowed. Jogging was recommended at 3 months, and full return to sports activity was permitted at 6 to 9 months, according to the sport. Follow-up evaluation 1 year after surgery assessed clinical outcome with use of the Lysholm score, Lachman's test, and the pivot-shift test; anterior instability was measured with Telos-SE (Telos Japan, Tokyo, Japan).

Extent of tunnel widening was calculated with the use of radiographs taken at 3, 6, 12, and 24 months postoperatively, as was previously described.[10] Anteroposterior and lateral radiographs of the knee were taken in full extension with the patient in the supine position. A constant distance of 100 cm was maintained from the x-ray beam source to the film. Bone tunnel diameters on anteroposterior and lateral radiographs were measured as the distances between 2 sclerotic margins at the widest diameter perpendicular to the longitudinal axis of both tunnels. If the margins of the bone tunnel were difficult to identify on immediate postoperative radiography, the tunnel size drilled at initiation of surgery was used.[3,9,13] Bone tunnel