Technical Note

Lateral Meniscus Replacement Using Peroneus Longus Tendon Autograft

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Abstract: Nowadays, several techniques are available for preserving the lateral aspect of the knee after meniscectomy; meniscus transplantation is the gold standard, and meniscus scaffold implantation is an effective alternative. However, meniscus transplantation is technically difficult and has many potential complications, whereas scaffolds resorb over time. Autografts are commonly used for labroplasty in shoulder and hip surgeries. We attempted to adapt this technique to the knee, using autografts for meniscus replacement. In this report, we describe a meniscus-replacement technique, using a peroneus longus autograft, for lateral meniscus deficits. This technique significantly simplifies the procedure and is cost effective, and thus can be considered as an alternative technique for preventing osteoarthritis of the lateral aspect of the knee.

The high risk for early osteoarthritis progression after lateral meniscectomy is well known. Several surgical procedures are available to prevent the risk of progression, including allograft transplantation, collagen meniscus implants, and implantation for the prevention of osteoarthritis. The disadvantages of meniscus allograft implantation are the difficulty of the surgical procedure, allograft failure, potential risk of infection, and disease transmission. Collagen meniscus implants show progressive graft resorption over time. Recently, there has been a tendency to adapt ideas from shoulder surgery to knee surgery and vice versa. Autografts are commonly used for labroplasty in shoulder and hip surgeries. The idea here was to adapt this technique to the knee—from labroplasty to meniscoplasty using an autograft. Most techniques describe meniscus transplantation with a bone block; however, some recent studies have confirmed that meniscus transplantation without a bone block is possible. This, too, can be an argument for using a tendon autograft as a soft-tissue transplant.

Autografts of the peroneus longus tendon are becoming popular in knee surgery for reconstruction of the anterior cruciate ligaments (ACLs) and posterior cruciate ligaments. In this report, we aimed to describe a meniscus-replacement technique, using a peroneus longus tendon graft, for lateral meniscus deficits. To optimize the surgical technique, we adapted some steps from shoulder surgery.

Surgical Technique (With Video Illustration)

Diagnostic Arthroscopy and Meniscus Rim Preparation

The procedure is performed with the patient in the supine position on the operating table with a tight tourniquet, and the knee is flexed to 90°. After diagnostic arthroscopy with standard portals, the meniscus footprint is prepared with a shaver and a diamond rasp (Smith & Nephew, Andover, MA). The remaining meniscus tissue is resected to the red zone as described by Spalding et al. The parameniscus is prepared for bleeding stimulation with a meniscal rasp. Finally, the length of the native meniscus is approximately measured with a graduated probe or ruler.
Peroneus Longus Graft Harvesting and Preparation

In a regular situation, the tendon is harvested from the same leg. Through a 3-cm incision, the peroneus longus is identified (Fig 1). The distal part of the peroneus longus is sutured to the peroneus brevis with 3 simple stitches and cut proximally. The proximal part of the tendon is sutured with 4 Krakow stitches. The peroneus longus is then harvested carefully, avoiding peroneus nerve injury. The wound is then closed following standard procedures.4

After being harvested, the peroneus longus tendon is sutured on the preparation table by suturing 2 to 3 cm from each end with nonabsorbable sutures. The borders of the intra-articular parts of the graft are marked with VICRYL absorbable sutures (Ethicon, Somerville, NJ) or with a marker, which was measured during the stage of diagnostic arthroscopy. One side of the tendon is sutured by 3 different-colored traction sutures at equal intervals, starting from the middle of the tendon, where the first traction suture is placed with a lasso loop.7 The second and third traction sutures are placed midway between the central one and the VICRYL marks (Fig 2). The graft diameter is measured with a sizer.

Bone Tunnel Preparation for Graft Roots

Intra-articular graft insertion tunnels are located as described by Spalding et al.3 For anterior horn bone tunnel preparation, the tip of a tibial aimer is positioned anterior to the lateral tibial spine and just lateral to the ACL. The bullet of the guide passes through a 1-cm incision localized 1 cm lateral to the tibial tuberosity and 2 to 3 cm distal to the joint level (Fig 3B).

For the posterior horn, the tip of the tibial aimer is positioned just posterior to the ACL, between the tibial spines. The bullet of the guide is located 3 cm below the...
Guided pins are inserted through the aimers. The bone tunnels are drilled using a classic drill or retro-drilling device. The size of the drill should be equal to the graft diameter.

**Graft Passage**

Shuttling sutures of 2 different colors are inserted into the joint through the tunnels and are pulled through the anterior lateral portal (Fig 4A). The sutures that are fixed to the ends of the graft are connected to the shuttling sutures on the graft, which is then inserted into the joint (Fig 4B).

**Graft Fixation**

After insertion, the anterior and posterior ends of the graft are inserted through the tunnels until the level of the VICRYL marks. Through a 1- to 2-cm lateral incision, the traction sutures are caught with a bird beak grasper, and the sutures are fixed onto the capsule (Fig 5). After fixation of the traction sutures, the posterior horn of the lateral meniscus is routinely fixed with FAST-FIX 360 sutureing devices (Smith & Nephew) (Fig 6). The anterior horn and meniscus body are fixed with additional multiple sutures, using a regular outside-in technique. At the end of the procedure, the graft roots are fixed with suture buttons, knotless anchors, or interference screws at the surgeon’s discretion (Fig 7). Table 1 and Video 1 summarize the steps of the procedure.

**Discussion**

It is well known that the risk of early osteoarthritis after lateral meniscectomy is greater than that after the medial procedure. Even after partial meniscectomy of the discoid lateral meniscus, there is radiographic evidence of progression to high-grade osteoarthritis, as demonstrated in a study with a minimum follow-up of 5 years. To prevent the development of osteoarthritis, several techniques are described in the scientific
**Fig 4.** Graft passage through the tunnels. (A) Shuttling sutures connected to the anterior and posterior part of the transplant seen in a model (A1). Extra-articular view of the right knee. The blue shuttling suture is passed through the posterior tunnel, the green shuttling suture is passed through the anterior tunnel (A2). (B) Sutures connected to the anterior and posterior part of the transplant pass through the tunnels seen in a model (B1) and in an extra-articular view of the right knee (B2).

**Fig 5.** Fixation of the traction sutures with shoulder penetration grasper through the capsule in an outside-in direction. (A) Fixation of the anterior part of the transplant in a model (A1) and in an intra-articular view of the right knee from the standard anterior medial portal (A2). (B) Fixation of the body and posterior part of the transplant in a model (B1) and in an intra-articular view of the right knee from the standard anterior lateral portal (B2). *Suture grasper; **remnants of anterior horn.
literature, including meniscus transplantation, which is the gold standard treatment for postmeniscectomy syndrome. Nevertheless, the procedure is technically complicated and expensive. The main technical difficulty is the meniscus size mismatch between the donor and recipient. This procedure is also traumatic because it requires bone-block adaptation into the joint. Moreover, there is residual pain, and recovery after meniscus transplantation and returning to professional sport is slow and sometimes impossible. In addition, there is always the possibility of transplantation failure. Finally, in some countries, allograft transplantation may produce legal complications as well.

Another treatment option is meniscus scaffold implantation. Long-term results of the procedure are positive, but some studies have described constant meniscus scaffold resorption. Moreover, collagen scaffold implantation can only be performed for partial replacement of the meniscus.

Recently, practitioners started using tendon autografts to replace the labrum in the hip and shoulder joints. Tendon autografts have several undeniable benefits.
advantages: (1) there is no immunologic reaction, (2) recovery is relatively fast, (3) it is possible to replace the entire meniscus, (4) it is suitable for every size of meniscus, (5) the autograft can be used in countries in which using allografts is impossible, and (6) the autograft is more cost-effective. Nevertheless, semitendinosus and gracilis tendon autografts are not acceptable because the diameter of the tendon is insufficient to replace the resected part of the meniscus in most of the cases.

Use of the peroneus longus tendon autograft for lateral meniscus replacement is possible because the size and biomechanical characteristics of the peroneus longus tendon autograft are similar to that of the native meniscus, making this transplantation procedure promising and safe. The suggested technique is easier in comparison with allotransplantation of the meniscus. It uses standard preparation and harvesting

Table 2. Advantages and Disadvantages of This Technique

| Advantages                                      | Disadvantages                                      |
|------------------------------------------------|---------------------------------------------------|
| Cost-effective                                 | Potential resorption risk                          |
| No immunologic reaction                        | Fiber direction differs from that in the natural meniscus |
| No disease transmission                        | Requires a high degree of surgical skill           |
| Standard preparation and harvesting techniques  | The possibility of donor-site morbidity exists      |
| Can be performed using standard, known techniques and shoulder and knee instrument sets | The possibility of using this technique for professional athletes is under consideration |
| Size measurement is not critical because excess tissue can be easily resected or passed through the tunnel | Graft biomechanical characteristic (130-150 megapascal in average) is sufficient for the anticipated compression load |

Table 3. Pearls and Pitfalls

| Pearls                                      | Pitfalls                                           |
|---------------------------------------------|----------------------------------------------------|
| Accurate debridement of the recipient zone  | Osteoarthritic changes in the lateral part and cartridge deficit are contraindications to this technique |
| The bone tunnel divergence and position for graft roots are critical | Accurate protection of posterior–lateral neurovascular structures is critical |
| For solid fixation, all methods of meniscus suturing are required (outside-in, inside-out, all inside) | |
| Shoulder-penetration graspers make this technique easier and reproducible | |

The main indications for our procedure are similar to allograft transplantation and meniscus scaffolds implantation: lateral pain syndrome after lateral meniscectomy in young patients without significant osteoarthritic changes. It is possible to perform this procedure for patients with nonsignificant malalignments and stable knee. The contraindications of the procedure are obesity, synovial disease, inflammatory arthritis, and previous joint infections.

There is a potential risk of morbidity at the donor site, and although there is the theoretical possibility of peroneus nerve injury, limp, or collapsed arch, Rhatomy et al. and Shi et al. have described that the frequency of complications is low with this technique. Furthermore, the technique has several limitations. It has a potential resorption risk; and the direction of the fibers in the graft differs from that in the meniscus; thus, the use of this technique in professional athletes is unknown. Moreover, the procedure requires a high degree of surgical skill.

Tables 2 and 3 summarize the advantages and disadvantages and pearls and pitfalls, respectively, of our technique. The outcomes of the first 2 cases in which this technique was performed were positive (Fig 8), and the length of follow-up was 6 to 10 months; thus, we are able to conclude that the technique can be used and improved.
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Fig 8. (A) Sagittal plain MRI of the right knee before meniscus replacement. (B) Sagittal plain MRI of the right knee 3 months after meniscus replacement. (MRI, magnetic resonance imaging.)