

Endoscopic Harvest of Autogenous Gracilis and Semitendinosus Tendons



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Abstract: The hamstring autograft is one of the most popular grafts for anterior cruciate ligament (ACL) reconstruction. Although many techniques for arthroscopic ACL reconstruction using hamstring autografts have been invented, hamstring harvest techniques have not been focused. Hamstrings are harvested using an open technique that requires a 2- to 5-cm skin incision. In this Technical Note, we describe an endoscopic harvest technique of autogenous gracilis and semitendinosus tendon. This technique needs only a 1- to 1.5-cm skin incision and provides surgeons a sufficient view to safely harvest the hamstrings.

The hamstring autograft is one of the most popular grafts for anterior cruciate ligament (ACL) reconstruction because it is easily shaped according to surgeon preference. There are many kinds of ACL reconstruction procedures using hamstring autografts, including single bundle reconstruction,^{1,2} bi-socket reconstruction,³ double-bundle reconstruction,⁴ and allograft augmentation of hamstring autografts.⁵ Moreover, combined ACL and anterolateral ligament reconstruction techniques using hamstring autografts were recently developed.⁶⁻⁸

Despite the invention of such techniques, the development of a hamstring harvest technique has not occurred and not much has changed over several decades. Hamstring harvests are performed using an open technique that requires a 2- to 5-cm skin incision.^{1,4,9} Here we evaluated an endoscopic technique for

harvesting hamstring autografts. The present endoscopy technique not only results in a small skin incision length for hamstring harvest, it also provides surgeons a good view to safely dissect the fascial bands and accessory bands of the tendons and harvest the hamstrings. A summary of key steps is provided in [Table 1](#), whereas a summary of the technique is provided in [Video 1](#).

Technique

Patient Positioning

The present surgical technique is performed under general anesthesia with the patient in the supine position. A padded tourniquet is placed on the proximal thigh of the operative leg, which is positioned with a leg holder to keep the thigh horizontal; in the meantime, the contralateral leg is held by a well-leg holder with the hip flexed and abducted to provide a wide working space around the operative knee. The bed is lowered to allow the surgeon to harvest the graft while in a seated position. Alternatively, the leg can be kept on the operating table and placed into a figure four position. The operative knee is prepared and draped in a standard fashion. The necessary tools include a small retractor, forceps, curved pean, curved Kelly forceps, Metzenbaum scissors, mosquito curved pean, and a closed tendon stripper (Smith & Nephew Endoscopy, Andover, MA) ([Fig 1](#)). No special device is necessary.

Endoscopic Graft Harvest

Patella, patellar tendon, and tibial tubercle are marked to ensure accurate incision positioning. The pes anserinus is palpated and drawn along the proximal

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Table 1. Key Steps for Endoscopic Harvest of Autogenous Gracilis and Semitendinosus Tendon

Identify anatomic landmarks.
Tibial tubercle
Medial joint line
Gracilis tendon
Longitudinal skin incision: approximately 1 to 1.5 cm
3 cm medial to the tibial tubercle
On the proximal edge of the gracilis tendon
Bluntly dissect the subcutaneous tissue.
Transversely cut the sartorial fascia approximately 1 to 2 cm.
Lift the sartorial fascia using a small retractor.
Introduce a 30° 4-mm diameter arthroscope.
Identify and hook the gracilis and semitendinosus tendons using curved forceps.
Pull the tendons laterally to detach them from the tibial attachment.
Separate the gracilis and semitendinosus tendons.
Whipstitch the gracilis and semitendinosus tendons.
Pull the semitendinosus tendon and dissect the accessory tendinous band.
Insert arthroscope and dissect the dense fascia, adherent soft tissue, and accessory bands.
Harvest the semitendinosus tendon using the tendon stripper.
Pull the gracilis tendon and dissect the accessory tendinous band.
Insert arthroscope and dissect the dense fascia, adherent soft tissue, and accessory bands.
Harvest the gracilis tendon using the tendon stripper.
When the tendon stripper stops, reintroduce the arthroscope and reassess other fascial and accessory bands.
Prepare the graft.

edge of the gracilis tendon and the distal edge of the semitendinosus tendon. The skin is incised with a No. 15 scalpel. An approximately 1-cm-long longitudinal incision is made on the proximal edge of the gracilis tendon approximately 3 cm medial to the tibial tubercle (Fig 2). The subcutaneous tissue is bluntly dissected to the level of the sartorial fascia with the gauze grasped by the curved mosquito forceps.

The bump of sartorial fascia due to the underlying gracilis and semitendinosus tendons can be palpated using forceps. The gracilis tendon is located proximal relative to the semitendinosus tendon. An approximately 1- to 2-cm-long transverse cut of the sartorial fascia is gradually made using Metzenbaum scissors in line with the proximal border of the gracilis tendon. The sartorial fascia is lifted together with the underlying hamstring using a small retractor introduced through the sartorial fascia incision.

A 30° 4-mm diameter arthroscope is then introduced into the space between the superficial medial collateral ligament and the hamstring tendons through the same sartorial incision. No joint irrigation liquid is used during the tendon harvest. The subcutaneous fat tissue around the skin incision is spread and cut using scissors to obtain a clear arthroscopy view. Hamstring tendons can be observed at the back side of the sartorial fascia (Fig 3). Using a curved pean or curved Kelly forceps, the gracilis and semitendinosus tendons are dissected free from the sartorial fascia and then hooked and pulled back together outside the skin incision. The tendons are laterally pulled to detach them from the tibial attachment. Because the skin incision is approximately 3 cm medial to the tibial tubercle, the ends of the detached tendons come out of the skin. If the

tendons are retracted to inside the skin, the distal ends of the tendons are found arthroscopically and pulled back outside the skin using forceps.

The gracilis and semitendinosus tendons are carefully separated by cutting the intertendinous bands with the scissors. Each end of the tendon is whipstitched with a No. 2 nonabsorbable suture (Ethicon, Somerville, NJ). The semitendinosus tendon is pulled by the suture, after which point the first accessory tendinous band or fascial band of the semitendinosus tendon can be usually seen outside the skin and cut using scissors (Fig 4). Then, by looking with the arthroscope through the same skin incision, the dense fascia ensheathing the tendon that

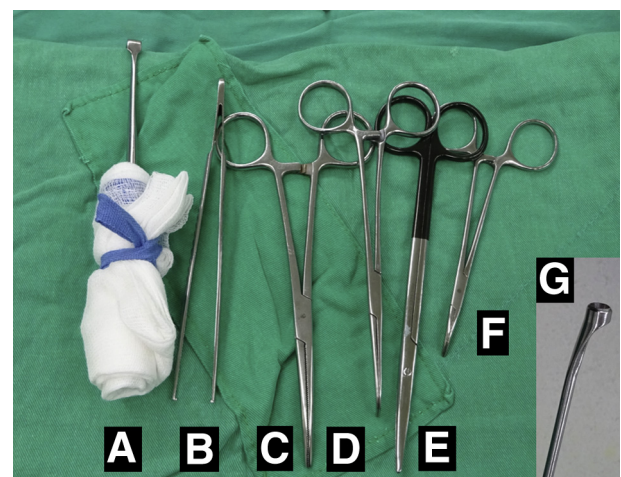


Fig 1. Tools. A, small retractor; B, forceps; C, curved pean; D, curved Kelly forceps; E, Metzenbaum scissors; F, curved mosquito forceps, G, closed tendon stripper.

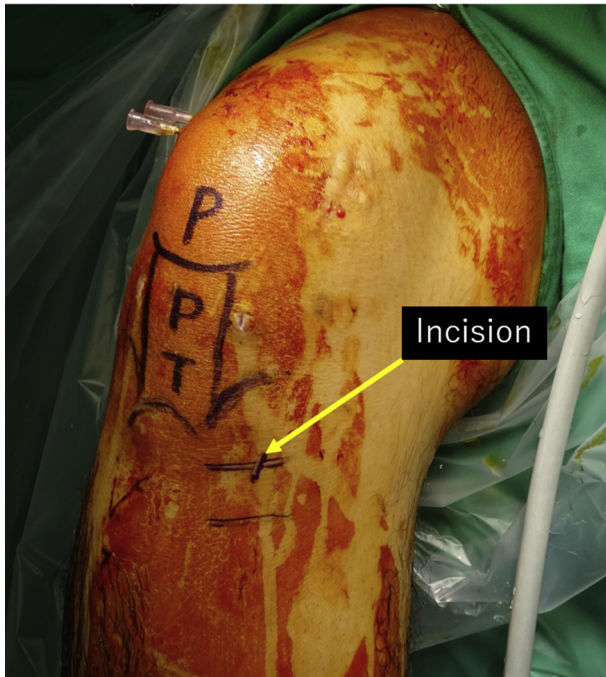


Fig 2. Intraoperative photograph (right knee) showing the location and size of the skin incision used for the endoscopic harvest of the gracilis and semitendinosus tendons. The patient is in the supine position. The operative leg is positioned with a leg holder to keep the thigh horizontal.

adheres to the soft tissue and other accessory bands that may impede tendon stripping is gently dissected using Metzenbaum scissors (Fig 5). After confirmation that

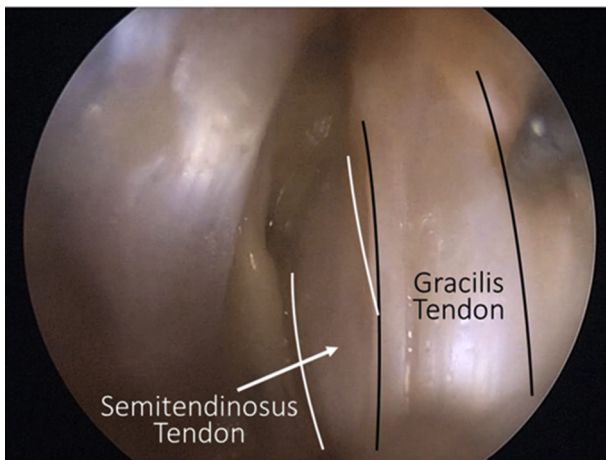


Fig 3. A 30° 4-mm diameter arthroscope is then introduced into the space between the superficial medial collateral ligament and the hamstring tendons through the incision. No joint irrigation liquid is used. The subcutaneous fat tissue is spread and cut using scissors to obtain a clear arthroscopy view. Hamstring tendons are visible at the back side of the sartorial fascia. Using a curved pean or a curved Kelly forceps, the gracilis and semitendinosus tendons are dissected free from the sartorial fascia. This figure shows anteromedial side of the right knee in the flexed position. Superficial medial collateral ligament is seen on the left side. Proximal of the knee is on the upper side.

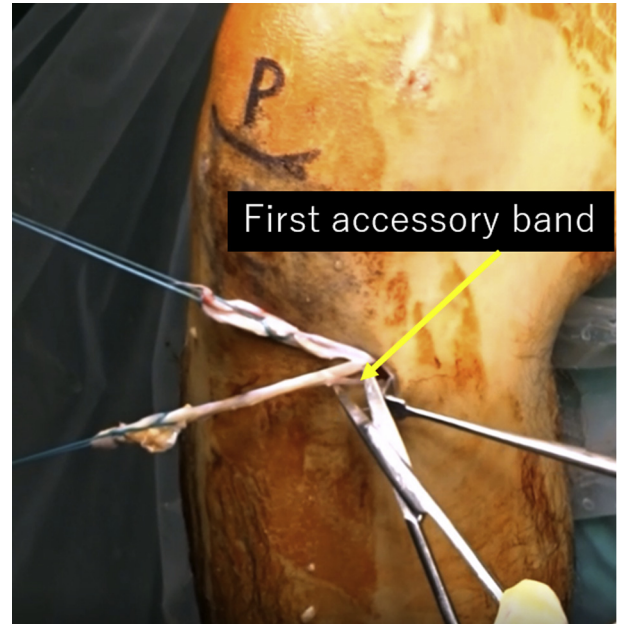


Fig 4. The gracilis and semitendinosus tendons are hooked and pulled back together outside the skin incision. The tendons are laterally pulled to detach them from the tibial attachment. The gracilis and semitendinosus tendons are carefully separated by cutting the intertendinous bands with the scissors. Each end of the tendon is whipstitched with a No. 2 nonabsorbable suture (Ethicon). The semitendinosus tendon is pulled by the suture, after which point the first accessory tendinous band of the semitendinosus tendon is visible outside the skin and cut using scissors. This figure shows anteromedial side of the right knee in flexed position.

both tendons can move smoothly, the tendons are harvested using a closed tendon stripper. Stable traction on the end of the tendon and stable pushing of the tendon stripper are important to smooth tendon release. Although our group usually harvests the semitendinosus tendon first, the gracilis tendon can be harvested first as well. When the tendon stripper stops, other dense fascia, fascial bands, and accessory bands should be reassessed and dissected arthroscopically (Fig 6). Surgeons can then reattempt to harvest the tendon (Fig 7).

The harvested hamstring graft can be prepared for the ACL reconstruction based on the surgeon's preference. We create the tibial tunnel from the same skin incision and perform single-bundle ACL reconstruction with a 4-stranded tendon graft. We then preserve the remnant whenever possible and affix the graft using absorbable interference screws (30-mm-long BIOSURE HA screw; Smith & Nephew Endoscopy) at the femoral and tibial tunnels.

Wound Closure

The wound is closed using conventional skin sutures. The final wound for the hamstring harvest is approximately 1 to 1.5 cm long (Fig 8).

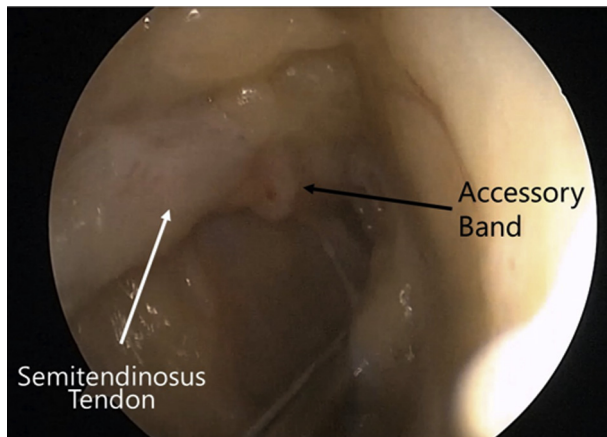


Fig 5. The dense fascia ensheathing the tendon that adheres to the soft tissue and other accessory bands that may impede tendon stripping are arthroscopically dissected using Metzenbaum scissors. This figure shows anteromedial side of the right knee in the flexed position. Proximal of the knee is on the right upper side.

Discussion

In this Technical Note, we described endoscopic autogenous hamstring harvest for ACL reconstruction using the gracilis and semitendinosus tendons. Because the hamstring autograft has a reduced incidence of patellofemoral crepitation, kneeling pain, and extension loss,^{10,11} it is among the most common grafts for ACL reconstruction. The hamstrings can also be used in other ligament reconstruction procedures, including the elbow¹² and the ankle¹³⁻¹⁵ ligaments.

Recent evidence indicates that larger hamstring graft diameters are associated with increased tensile strength

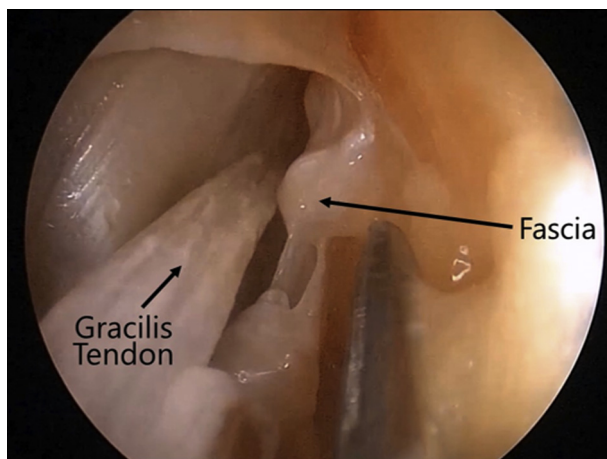


Fig 6. After confirmation that both tendons can move smoothly, the tendons are harvested using a closed tendon stripper (Smith & Nephew Endoscopy). When the tendon stripper stops, other dense fascia, fascial bands, and accessory bands should be reassessed and dissected arthroscopically. This figure shows anteromedial side of the right knee in the flexed position. Proximal of the knee is on the right upper side.

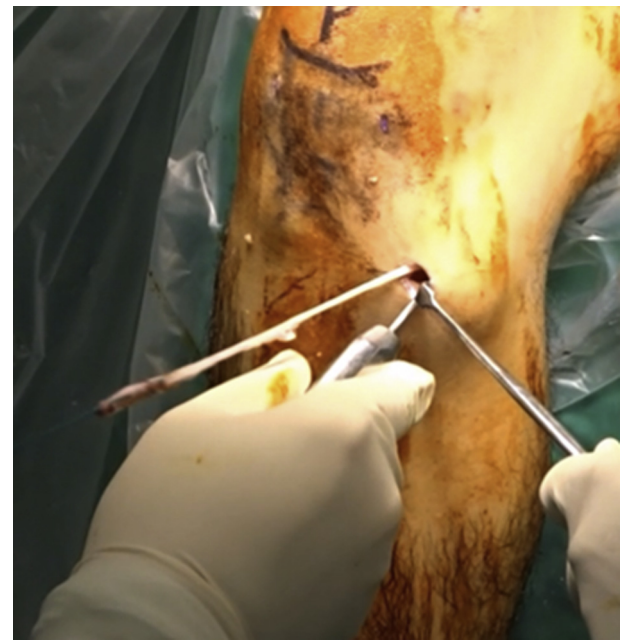


Fig 7. The gracilis tendon is harvested using the closed tendon stripper. This figure shows anteromedial side of the right knee in the flexed position.

and a reduced risk of graft failure,^{16,17} and secure harvest of the hamstrings is a critical issue. A clear understanding of the anatomy of the hamstring tendons and saphenous nerve course is obviously necessary.

The gracilis and semitendinosus tendons contact each other via the intertendinous bands at an average of 3.18 to 3.6 cm from the tibial crest^{18,19} and become distinct at a more medial point.²⁰ Introducing the arthroscope 3 cm medial to the tibial crest is a reasonable approach to easily identifying the 2 tendons. Too medial an incision will make it difficult to create the appropriate tibial tunnel for the transtibial femoral tunnel creation of the ACL reconstruction and make it dangerous to



Fig 8. The right knee is extended on the table. The wound is closed using conventional skin sutures. The final wound for the hamstring harvest measures approximately 1 to 1.5 cm. Proximal of the knee is on the right side of the picture.

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
A longitudinal skin incision is made approximately 3 cm to the tibial tubercle to avoid the intertendinous bands and enable the easy identification of the gracilis and semitendinosus tendons.	The skin incision is so small that it may be very difficult to create 2 tibial tunnels for double-bundle anterior cruciate ligament reconstruction.
The use of a small skin incision and blunt dissection of the subcutaneous soft tissue prevent damage to small nerves.	This technique is relatively difficult and has a steep learning curve. However, surgeons can expand the skin incision and convert to a conventional open harvest procedure when necessary.
No joint irrigation liquid is used during the tendon harvest.	
A clear understanding of the anatomy of the hamstring tendons and course of the saphenous nerve is necessary to ensuring a safe hamstring harvest.	
The arthroscope can be inserted deeply to allow the surgeon to identify the more proximal fascial and accessory bands.	
When the tendon stripper stops, the surgeon should use it to reassess other fascial and accessory bands.	

destroy the medial tibial plateau due to the shallow angle of the tibial drilling course.

Saphenous nerve injury may cause hypoesthesia, dysesthesia, painful neuroma and reflex sympathetic dystrophy, anterior knee pain, and kneeling pain.²¹ The saphenous nerve exits from the adductor canal and divides almost immediately into its sartorial and infrapatellar branches.²² The sartorial terminal branch travels vertically toward the medial knee behind the sartorius. It pierces the fascia between the sartorius and gracilis tendons and travels distally. The infrapatellar branch of the saphenous nerve (IPBSN) travels to the anterior side of the knee.^{23,24} Sanders et al.²⁴ reported sartorial terminal branch isolated injuries at a rate of 23%. Iatrogenic damage to the sartorial terminal branch is thought to be related to the passage of the stripper during the gracilis tendon harvest. Assessment of the proximal part with the arthroscope might reduce its incidence. The IPBSN has been more frequently injured, ranging from 12% to 88%.^{21,25,26} This evidence indicates that it is very difficult to completely avoid IPBSN injury. Therefore, the smaller skin incision is a good alternative to reduce the incidence and area of IPBSN injuries.

Tuncay et al.²⁷ reported a high incidence of the fascial band between the semitendinosus and gastrocnemius. The mean distance from the insertion of the semitendinosus to the fascial band was 7 cm. Candal-Couto and Deehan¹⁹ found that accessory bands have high variability and were seen between tendons, connecting to the popliteal fascia, sartorius, gastrocnemius, and pretibial and superficial fascia. Moreover, accessory bands usually originated more than 10 cm proximal to the insertion site of the semitendinosus and gracilis tendon. Because the arthroscope is thinner and longer than fingers, it is easy to insert it more proximally and identify those accessory bands.

This report has several limitations. First, the present skin incision is so small that it is not suitable for double-bundle

ACL reconstruction.⁴ Second, this procedure is technically demanding. However, surgeons can expand the incision and convert to conventional open procedure anytime when difficulty is encountered. Third, although this technique theoretically has possible advantages that reduce nerve injury, premature hamstring amputation, postoperative scar tissue, anterior knee pain, and the incidence of skin infections, no evidence has so far been reported from a comparative study; thus, future studies are necessary to prove our hypothesis. A summary of pearls and pitfalls is provided in Table 2.

This endoscopic harvest technique of the autogenous gracilis and semitendinosus tendons provides surgeons a smaller incision, higher safety, and greater reproducibility.

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