Technical Note

Endoscopic-Assisted Hamstring Tendon Harvesting

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Abstract: Efficient hamstring tendon harvesting is a crucial part of anterior cruciate ligament reconstruction surgery using autografts. Harvesting of the gracilis and semitendinosus tendons is usually performed using an open approach, exposing the distal tibial attachment of the tendons at the pes anserinus and proceeding using a tendon stripper without direct tendon visualization. The success of the anterior cruciate ligament reconstruction surgery strongly depends, among other factors, on the preservation of the hamstring tendon length and integrity. Inadequate tendon release from their attachments and improper use of the tendon stripper, in addition to poor intraoperative visibility, may lead to premature tendon amputation, endangering the success of the operation. We describe an endoscopic-assisted technique of hamstring tendon harvesting that provides complete visualization of the tendons from the tibia attachment to the musculotendinous junction. The procurement of the tendons is completed under direct vision using any tendon stripper. This surgical technique offers a way to minimize complications that may arise during the standard open tendon harvesting techniques without additional visualization.

Preservation of the length and structural integrity of the hamstring tendons is essential in anterior cruciate ligament (ACL) reconstruction surgery using autografts. Open hamstring tendon graft harvesting is performed through a vertical or oblique skin incision located at the proximal anteromedial tibial surface overlying the pes anserinus. Surgical dissection of the pes anserinus, isolation of the tendons, and dissection and division of their fascial attachments depend on the tactile ability of the surgeon to perform blunt finger dissection with limited intraoperative visibility, which is usually confined to the pes anserinus area.[1] The musculotendinous junction of the hamstring tendons lies at the posteromedial aspect of the knee and is neither accessible nor visible with the standard harvesting techniques.

Graft harvesting may occasionally be a challenging and time-consuming procedure during which tendon quality and quantity may be compromised. Complications related to hamstring tendon harvesting are not uncommon and may reach 8.3%.[2] Although inadequate hamstring tendon harvesting is under-reported, it is not uncommon. Almazan et al.,[3] analyzing complications during primary ACL reconstruction, reported a 6.2% incidence of short graft harvest. More recently, Charalambous et al.[4] reported insufficient graft harvest in 3 of 50 cases of ACL reconstruction and advised for careful preoperative planning to avoid this adversity. The purpose of this paper is to describe an endoscopic-assisted technique for harvesting of the hamstring tendons under direct endoscopic vision.

Surgical Technique (With Video Illustration)

The technique we are describing is in use since 2008.[5,6] The study was approved by the Institutional Scientific Committee (approval number 289/2020). There are 2 methods to perform an endoscopic-assisted tendon harvesting technique. In Method 1, a dedicated instrument is used (Video 1) and this paper is focused on it. Alternatively, another method of hamstring tendon harvesting without the use of specialized instrumentation is described (Method 2).

Method 1

An instrument originally designed for endoscopically assisted decompression of the ulnar nerve is used (R.

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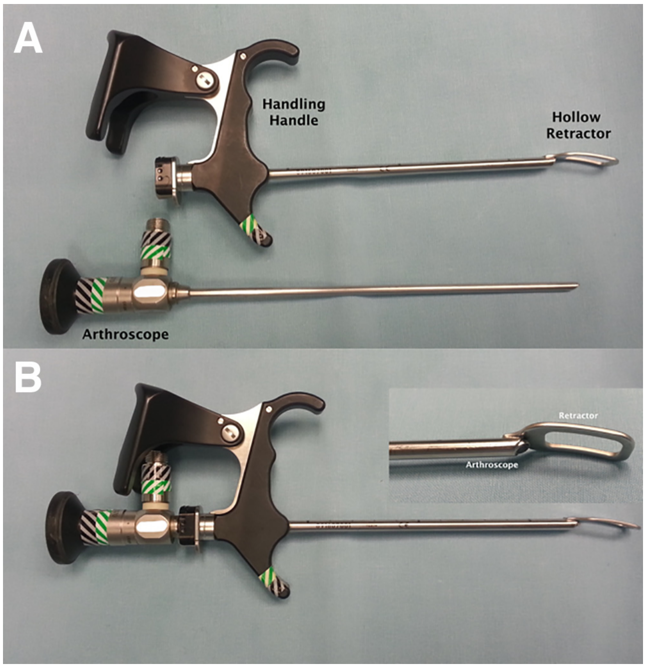

Fig 1. The optical dissector used to facilitate tendon harvesting comprises a handling handle at one end and a hollow, slotted retractor at its other end (A). A 30° or, preferably, a 70° arthroscope is placed into the sheath (B). This device supersedes the use of a retractor and is very useful for tendon dissection in tight spaces.

Wolf GmbH, Knittlingen, Germany), called the optical dissector. This instrument is designed with a “handling” handle at one end and a hollow retractor at the other end (Fig 1 A and B). A 30° or, preferably, a 70° arthroscope is inserted into the sheath of the device to facilitate endoscopic vision. The patient is positioned on the operating table in the supine position, usually without the use of a tourniquet. A padded thigh post and a L-shaped footrest allow the knee to be positioned at 90° of flexion. A vertical or oblique 3- to 4-cm long skin incision is performed, centred over the pes anserinus, between the tibial tubercle and the posteromedial edge of the tibia. The pes anserinus fascia is opened bluntly and elevated using a small Kocher clamp and the distal attachments of both the semitendinosus and the gracilis tendons are isolated using a cotton tape. The optical dissector is inserted into the pes anserinus with the surgeon holding the device with one hand elevating the pes and the subcutaneous tissue. The medial collateral ligament is clearly identified by its white, dense fibers running in a vertical direction, crossed by the hamstring tendons. The gracilis tendon crosses the medial collateral ligament at a 70° to 80° angle. The surgeon is using with the other hand a 20-cm long Metzenbaum scissors to palpate the fascial attachments and divide them under direct endoscopic vision (Fig 2). At the same time, the assistant applies longitudinal traction to the tendon with a blunt hook or the cotton tape, facilitating fascial band exposure and tendon liberation. The Metzenbaum scissors are used with their curved end toward the tendon to avoid inadvertent tendon injury. The entire tendon length is visualized from the tibial attachment to the musculotendinous junction, where several bands may exist that hinder advancement of the tendon harvester. Resistance at the muscle—tendon junction may be due to the presence of fascial bands. All tendon bands and attachments are divided under direct vision. Occasionally, large vessels are encountered, which can be coagulated. The gracilis tendon enters the respective muscle belly through a fascial arcade, which is palpable but difficult to dilate blindly (Fig 3A). If the fascial arcade is narrow, it can be released under direct vision to facilitate insertion of the tendon stripper (Fig 3 A and B). Next, the assistant holds the optical dissector, and the surgeon applies tendon traction while inserting the tendon stripper (Fig 4). The stripper is pushed proximally into the muscle belly aiming at the inferior ischiopubic ramus. When an open tendon stripper is used, no rotation is allowed to avoid disengagement or tendon injury. The whole length of the gracilis tendon is harvested and wrapped in an antibiotic-soaked sponge.

The next step is harvesting of the thicker and stronger semitendinosus tendon. The tendon is visualized and a blunt hook is passed around it. The semitendinosus tendon has usually 2 main bands; one is distal and close to the skin incision and the other proximal, connecting the tendon with the fascial overlying the medial head of the gastrocnemius. Failure to release the latter, broad and strong band, may lead to graft amputation. The optical dissector is inserted into the surgical wound

Fig 2. In a left knee, with the head on the left side of the photograph, the optical dissector (OD) is inserted within the pes anserinus following the course of the hamstring tendons. A blunt hook (H) or a cotton tape is passed around each tendon and used to apply longitudinal traction. All fascial and tendon attachments are dissected under direct vision using a pair of Metzenbaum scissors (M). Occasional bleeders can be cauterized using a diathermy.

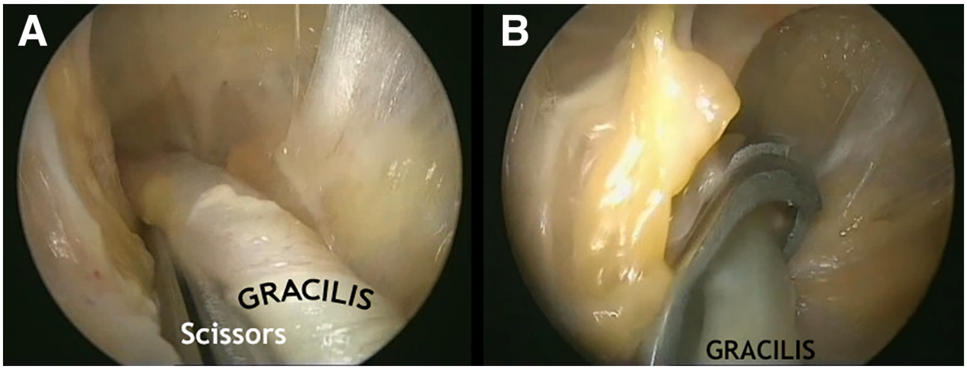

Fig 3. Endoscopic dissection and harvesting of the gracilis tendon in a left knee. The tendon is dissected from the distal tibial attachment to the proximally located musculotendinous junction under direct vision using a pair of Metzenbaum scissors (A). Palpation around the tendon is accomplished with the scissors and fascial bands are divided under direct vision. In this case, an open tendon stripper is inserted and advanced proximally until the tendon is harvested under direct endoscopic visual control (B).

following the semitendinosus tendon while the assistant applies steady traction. Both fascial bands are recognized und dissected under direct vision (Fig 5 A-C). The musculotendinous junction of the semitendinosus tendon is visualized, and the entrance of the tendon is enlarged. The tendon stripper is inserted and pushed towards the musculotendinous junction in line with the tendon aiming towards the ischial tuberosity. Advancement of the stripper into the muscle belly is accompanied by steady traction applied to the tendon via the hook until the tendon is liberated. Finally, the tendons are freed and cut at their distal insertion. Alternatively, the distal tibial attachments of the hamstring tendons can be released to use a closed tendon stripper.

Method 2

Alternatively, to avoid the use of the optical dissector, a Langenbeck retractor with a 15-cm long blade is inserted in the pes anserinus sheath, and the assistant elevates the pes anserinus sheath and the subcutaneous tissue facilitating tendon exposure (Fig 6). The retractor is used to create space, leaving only the hamstring tendons at the deeper aspect of the surgical wound. The assistant applies longitudinal traction to the tendon with a hook to assist in the exposure of the fascial bands. The surgeon inserts a 30° or, preferably, a 70° arthroscope into the pes anserinus without its sheath along the course of the gracilis tendon. The scope is held in contact with the retractor to improve viewing stability. Further dissection is performed with a pair of long Metzenbaum scissors, freeing all fascial bands under direct vision until the musculotendinous junction. The tendon stripper is then inserted, and the tendon is harvested under direct vision. The same procedure is repeated to harvest the semitendinosus tendon. This technique is feasible only in patients with minimal amount of subcutaneous fat and it is more difficult and time consuming. A major problem with this method is that the arthroscope fogs immediately when it is inserted in the surgical wound. Warming the scope by inserting it in sterile, warm saline delays fogging.

At the end of the harvesting procedure, the skin is infiltrated with a long-acting local anesthetic, which is also injected deep into the wound using a Tieman catheter. Closure of the skin incision is performed in layers using absorbable sutures.

Discussion

Efficient harvesting of the hamstring tendons is a prerequisite for the effective ACL autograft reconstruction procedure since the success of the reconstruction

Fig 4. In a left knee, to facilitate tendon harvesting the tendons, the assistant holds the optical dissector (OD), and the surgeon manipulates the tendon hook (H) and a closed tendon stripper (S) in this case. The tendon stripper should be directed toward the proximal tendon attachment which differs between the gracilis and the semitendinosus tendons. Note that in the photograph, the direction of the stripper is not yet appropriate.

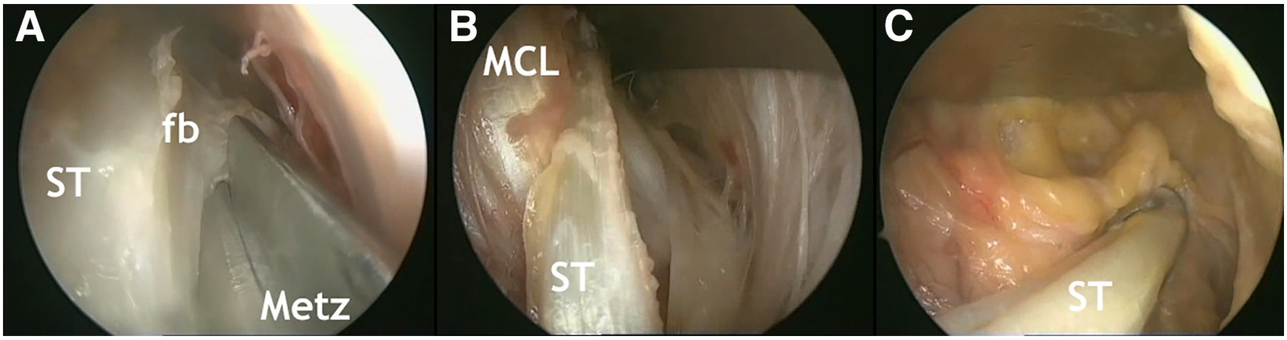

Fig 5. Endoscopic dissection and harvesting of the semitendinosus tendon (ST) are generally more demanding due to the presence of a strong posteromedial fascial band attaching it to the medial head of the gastrocnemius muscle fascia. In this case the ST tendon in a left knee is visualized and the fascial band (fb) is divided with the scissors (Metz) (A). Once liberated from its attachments, the ST tendon is freely movable, and the medial collateral ligament (MCL) is clearly visible (B). The tendon harvester is inserted and the tendon is harvested under endoscopic visual control (C).

depends on the quality and length of the harvested tendons. Using the endoscopic technique described in this Technical Note, the fascial attachments of the tendons are not only palpated but also visualized and released under direct endoscopic guidance.

The technique presented has a relatively flat learning curve and can be performed with or without the use of the optical dissector (Table 1). When we started using the procedure, the tendon harvesting time was longer than 30 minutes, but decreased to less than 10 minutes after the first 15 cases. The endoscopic-assisted approach is straightforward once the surgeon becomes familiar with the endoscopic anatomy of the hamstring tendons. The length of skin incision is kept short because extensive blunt and finger dissection of the tendons is not necessary, and the ability of the surgeon to verify the location of the hamstring tendons and especially their fascial bands and attachments is greatly enhanced. It is noteworthy that the fascial tendon bands between the hamstring tendons and the surrounding tissues present significant anatomic variability as regards their presence, dimensions, and localization.[1]

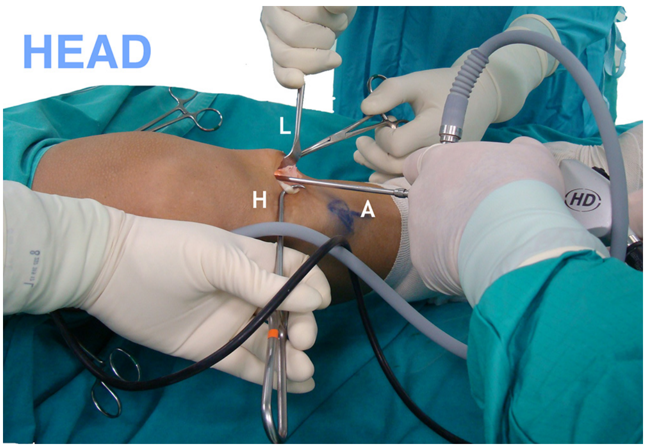

Fig 6. Method 2. In this variation, endoscopic-assisted tendon harvesting can be accomplished without the use of dedicated instrumentation. In a right knee, a long Langenbeck retractor (L) is inserted into the pes anserinus, elevating the fascia and the subcutaneous tissue. A 70° arthroscope (A) without its sheath is inserted into the wound parallel to the tendon and longitudinal tendon traction is applied with a blunt hook (H). Tendon dissection is performed with a 20-cm long Metzenbaum scissors (not shown) and harvesting is completed with a tendon stripper.

To reduce hamstring tendon harvesting morbidity, various types of tendon strippers have been used, minimally invasive techniques employed,[7] and various skin incision orientations or locations. An endoscopic technique for hamstring tendon harvesting has been described by Yeh et al.[8] They are using common surgical tools and a 30° arthroscope, which is inserted into the pes anserinus through a small, 1- to 1.5-cm long skin incision, which is similar to the Method 2 in our paper. In our experience, it is necessary to create sufficient viewing and working space and this is achieved

Table 1. Pears and Pitfalls

Pearls
- Use of a tourniquet is not necessary
- Coagulation of all bleeders is possible with the endoscopic technique under direct vision
- Harvesting is performed in 45°-60° of knee flexion with the knee in a figure of four position
- High knee flexion (>100°) is avoided to prevent reduction of the available surgical viewing space
- The arthroscope is soaked in warm saline to avoid lens fogging and vision hampering
- Use of antifogging surfactant solutions and warming devices is also possible
- The tendon stripper should be directed towards the proximal insertion of the respective hamstring tendon

Pitfalls
- The skin incision should be centered at the upper border of the pes anserinus, especially in oblique incisions
- Insufficient longitudinal tendon traction leads to inadequate release
- Skin dimpling over the medial gastrocnemius muscle is an indication of inadequate fascial band release

Table 2. Advantages and Disadvantages

Advantages
- Fast, reliable, safe, and efficient technique
- Flat, not steep, learning curve
- Useful in large patients with limited ability for blunt finger dissection around the posteromedial edge of the tibia
- Reduces complications such as bleeding and tendon amputation
- Improved cosmesis due to the short length of the incision and the reduced need for vigorous wound retraction
- Can be used with both vertical and oblique skin incisions
- Conversion to the traditional open tendon harvesting technique is possible

Disadvantages
- A specialized optical dissector is necessary
- Use of a 70° endoscope is recommended
- Familiarization with the endoscopic anatomy of the hamstring tendons and the Medial collateral ligament is needed
- Surgical training is necessary

with the optical dissector or a long Langenbeck retractor. Visualization is significantly improved using a 70° arthroscope, while with the 30° arthroscope cannot provide sufficient visualization around the posteromedial edge of the tibia. Finally, insertion of the arthroscope into the surgical wound in close proximity with the skin flaps is almosty certainly followed by lens fogging, hampering endoscopic vision. Warming the arthroscope using sterile warm saline of antifogging surfactant solutions is be useful (Table 2).

Conclusions

The described endoscopic-assisted hamstring tendon harvesting technique allows visualization of both hamstring tendons from the tibial insertion to the musculotendinous junction. Dissection and tendon harvesting is performed under direct endoscopic vision avoiding procurement of an inadequate tendon graft.

References

1. Olivos-Meza A, Suarez-Ahedo C, Jiménez-Aroche CA, et al. Anatomic considerations in hamstring tendon harvesting for ligament reconstruction. *Arthrosc Tech* 2020;9:e191-e198.
2. Hardy A, Casabianca L, Andrieu K, Baverel L, Noailles T, Junior French Arthroscopy Society. Complications following harvesting of patellar tendon or hamstring tendon grafts for anterior cruciate ligament reconstruction: Systematic review of literature. *Orthop Traumatol Surg Res* 2017;103:S245-S248.
3. Almazan A, Miguel A, Odor A, Ibarra JC. Intraoperative incidents and complications in primary arthroscopic anterior cruciate ligament reconstruction. *Arthroscopy* 2006;22:1211-1217.
4. Charalambous CP, Kwaees TA, Lane S, Blundell C, Mati W. Rate of insufficient ipsilateral hamstring graft harvesting in primary anterior cruciate ligament reconstruction [published online April 14, 2021]. J Knee Surg. doi:10.1055/s-0041-1726421.
5. Yiannakopoulos C. Endoscopic-assisted hamstring tendon harvesting in ACL reconstruction. Description of a new technique. *Oral Presentation, 3rd Biennial Congress of the Greek Arthroscopy Association, Crete* June 25-28, 2009.
6. Yiannakopoulos C, Tzanakakis N, Chatzikomninos I, Aggelis K. Endoscopic-assisted harvesting of the hamstring tendons. Description and validation of a new surgical technique. *Knee Surg Sports Traumatol Arthrosc* 2016;24:S115-S435 (suppl 1).
7. Colombet P, Graveleau N. Minimally invasive anterior semitendinosus harvest: A technique to decrease saphenous nerve injury. *Arthrosc Tech* 2016;5:e139-e142.
8. Yeh WL, Chen JM, Liu CH, Tsai PJ, Higashiyama R, Takaso M. Endoscopic harvest of autogenous gracilis and semitendinosus tendons. *Arthrosc Tech* 2018;7:e1019-e1024.