



Endoscopic Proximal Hamstring Repair and Ischial Bursectomy Using Modified Portal Placement and Patient Positioning

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Abstract: Endoscopic management has become an effective method to repair proximal hamstring injuries. However, due to the complexity of such a procedure, the dissemination of the technique of endoscopic hamstring repair has occurred slowly among orthopaedic surgeons. This Technical Note with a video modifies previously described techniques and provides safer and more simplified endoscopic management of proximal hamstring injuries.

With the advent and further refinement of hip arthroscopy has come the endoscopic management of several pathologies that were previously treated with more invasive approaches.^{1,2} Dierckman and Guanche developed a technique that allows for the endoscopic management of proximal hamstring tears and chronic ischial bursitis and that reduces the morbidities associated with these larger open procedures.³

However, despite the benefits of endoscopic treatment for various injuries, these techniques remain elusive to many orthopaedic surgeons. The cases necessitate a level of experience that may not be available without rigorous training. The authors have developed modifications to endoscopic hamstring repairs that combine innovative patient positioning,

fluoroscopic guidance, and novel portal placement to allow safer access to the surgical field while also significantly decreasing the complexity of a challenging procedure.

Hamstring injuries are common in athletic populations and can affect all levels of athletes.⁴⁻⁸ There is a continuum of hamstring injuries that can range from musculotendinous strains to avulsion injuries.^{4,5} By definition, a strain is a partial or complete disruption of the musculotendinous unit.⁵ A complete tear or avulsion, in contrast, is a discontinuity of the tendon-bone unit. Most hamstring strains resolve with a variety of nonoperative modalities and do not require surgical intervention.⁴⁻⁸

The proximal hamstring complex has a strong bony attachment on the ischial tuberosity. Its footprint on the ischium is composed of the semitendinosus and long head of the biceps femoris beginning as a common proximal tendon and footprint, whereas there is a distinct and separate semimembranosus footprint.⁹ The semimembranosus footprint is just lateral (and anterior) to the crescent-shaped footprint of the common origin of the semitendinosus and long head of the biceps femoris.

The history of an acute injury usually involves a traumatic event with forced hip flexion and the knee in extension, as is classically observed in waterskiing.^{10,11} However, the injury can result from a wide variety of sporting activities that require rapid acceleration and deceleration.^{12,13}

Degenerative tears of the hamstring origin are more insidious in onset and are commonly seen as overuse injuries. The mechanism of injury is presumably

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repetitive irritation of the medial aspect of the hamstring tendon (typically along the lateral aspect of the tuberosity, where the bursa resides) ultimately causing an attritional tear of the tendon. Proximal hamstring tears can be categorized as complete tendinous avulsions, partial tendinous avulsions, apophyseal avulsions, and degenerative (tendinosis) avulsions.¹²

Commonly, athletes with proximal hamstring tendon tears describe a popping or tearing sensation with associated acute pain and bruising over the posterior hip.^{14,15} Occasionally, patients who present with either acute or chronic tears may complain of a pins-and-needles sensation in the sciatic nerve distribution, much like sciatica.^{15,16} This may be due to the acute compression of a hematoma in the proximity of the sciatic nerve or chronic scarring and tethering of the tendon to the nerve. Similarly, symptoms of ischial bursitis include buttock pain or hip pain, as well as localized tenderness overlying the ischial tuberosity. Additional symptoms of chronic ischial bursitis may also include tingling into the buttock that spreads down the leg.¹⁵

Partial hamstring origin tears, however, are more difficult to delineate. This is particularly the case in 2-tendon tears, which commonly have an associated musculotendinous junction injury to the third tendon. The most common situation is an avulsion of the common semitendinosus and biceps origin, with the semimembranosus remaining intact.⁸

Nonoperative treatment of proximal hamstring injuries is most commonly recommended in the setting of low-grade partial tears and insertional tendinosis. Initial treatment consists of active rest, oral nonsteroidal anti-inflammatory medications, and a physical therapy program.¹⁷ If the patient is unable to progress with this program, an ultrasound-guided corticosteroid injection may be used and has been shown to provide initial relief in up to 50% of patients at 1 month.¹⁸ Failure of nonoperative treatment of partial tears may benefit from surgical debridement and repair, similar to other commonly seen partial tendon tears (patella, quadriceps, and biceps).¹⁹

The development of endoscopic hamstring repair provides a minimally invasive and effective intervention to improve the management of proximal hamstring injuries and reduce the morbidities associated with open approaches. In a previously used technique, the footprint of the hamstring is methodically debrided from medial to lateral toward the known area of the sciatic nerve with the patient in a prone position. While this technique describes a method to identify and handle the sciatic nerve, due to the proximity of the nerve to the surgical field, the nerve nevertheless remains at risk for injury. The technique in this paper describes patient positioning that further protects the

sciatic nerve and introduces novel portal placement that simplifies suture management.

Surgical Technique

The following is a detailed technique of the procedure shown in [Video 1](#). Appropriate table positioning is critical as it creates a variety of advantages for the surgeon. A standard operating table is rotated 180° to position the head of the table at the foot in relation to the patient. The patient is placed in the prone position after induction of anesthesia ([Fig 1](#)). The feet should hang freely over the foot of the operative table, and all prominences and neurovascular structures should be protected. The nonoperative leg is secured to the table using a safety strap. Care must be taken at this time to avoid excessive hip flexion, and adjustments should be performed as necessary. Hip flexion may decrease the volume of the subgluteal space and ultimately limit the endoscopic working environment. The table is then tilted approximately 15° toward the contralateral side. This places the inferior ramus in the same plane as the ischium. The operative extremity is then placed on a sterile, well-padded Mayo stand, and the operative leg is abducted approximately 45°. Fluoroscopy should enter from the opposite side of the operative extremity. The C-arm is centered over the ischium and arced slightly over the top of the patient. The combined 15°

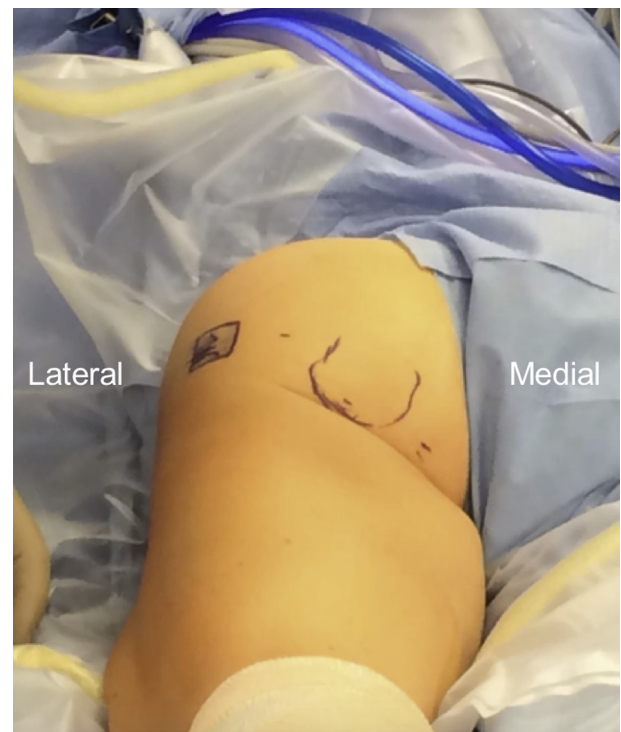


Fig 1. The patient is placed prone, with the ischium outlined and portals marked. The left hip is the surgical side, and the top of the picture is the head, while the bottom of the picture is the patient's foot.

tilt of the table and position of the C-arm creates an en face radiographic image of the ischium. The abduction of the operative extremity draws the sciatic nerve lateral to the ischium in a safer position as described by Kivlan et al.,²⁰ who demonstrated the dynamic nature of the ischiofemoral space during rotational movement of the hip joint. Abduction of the operative extremity also permits easier access to the medial portal compared with previous techniques and maintains the operative extremity in a more neutral or adducted position (Fig 2). The posterior aspect of the hip is then sterilized, with the surgeon ensuring that the leg and thigh are free so the extremity can be manipulated during the case. The surgeon then positions him-/herself ergonomically between the leg and operative table, which creates a more intuitive orientation for the surgeon in relationship to the anatomy.

Unlike previous techniques that begin with medial and lateral portal placement, this technique begins with a midcentral portal.³ The midcentral portal is created under fluoroscopic guidance using an 18-gauge spinal needle for localization. The ischium is palpated with one hand. With the other hand, the needle is directed through the gluteal fold in line with the ischium taking care to note the oblique nature of the ischium. Once the needle encounters the ischium, the position is checked with fluoroscopy and the portal is created. It is critical that the tip of the needle be centered on the ischium from both a superior-inferior and medial-lateral location. Once the portal is created, a cannula is placed. Using tactile sensation, the cannula is passed into the subgluteal space and swept medial to lateral over the ischium. This should create a small pocket within the subgluteal bursa to allow for establishment of the

medial portal. One should avoid sweeping lateral to the ischium, as this may put the sciatic nerve at risk. A 30° arthroscope is then inserted in the midcentral portal.

The medial portal is established using direct endoscopic needle localization. The portal should be approximately 4 cm medial and 2 cm superior in relation to the midcentral portal and can be adjusted to provide ideal access to the proximal hamstring. Once the location is confirmed, the needle is subsequently replaced with a Wissinger rod. It is critical to maintain a constant force while advancing the Wissinger rod through the gluteus maximus fascia. Failure to penetrate the gluteus maximus fascia will result in poor endoscopic pressure control leading to turbulent flow and poor hemostasis. The boundaries of this endoscopic space are hypervascular and will continue to bleed if principles of arthroscopy are not maintained. Cannulas must be placed deep through the gluteus maximus fascia to help with hemostasis and prevent development of soft tissue bridges.

The prominence of the ischial tuberosity is identified, and the medial and lateral borders are located. Beginning with the center, the ischium is delineated using a combination of electrocautery and a reciprocating shaver. The subgluteal bursa is debrided, and the subgluteal plane is developed. One must ensure the superior aspect of the ischium is identified before further exposure is performed. Any remaining fibrous attachments between the ischium and the gluteus muscle are released, staying along the central and medial portions of the ischium to avoid any damage to the sciatic nerve.

Next the lateral portal is established using direct endoscopic needle localization. Safe placement is

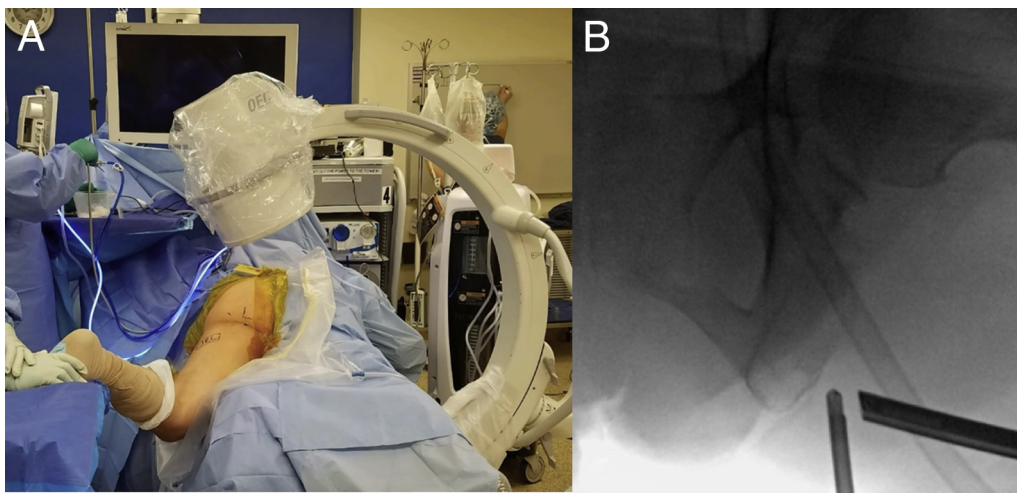


Fig 2. The operative extremity (A) is abducted and placed on a well-padded sterile Mayo stand. This position increases the distance of the ischiofemoral space and draws the sciatic nerve away from the ischium to permit a safer working field. The operating table is tilted 15° toward the contralateral side, and the C-arm is centered over the ischium and arced slightly over the top of the patient, creating an en face radiographic image (B) of the ischium. The cortices of the ischium are well delineated, allowing accurate and safe placement of portals. The patient is prone, and the left hip is the affected hip.

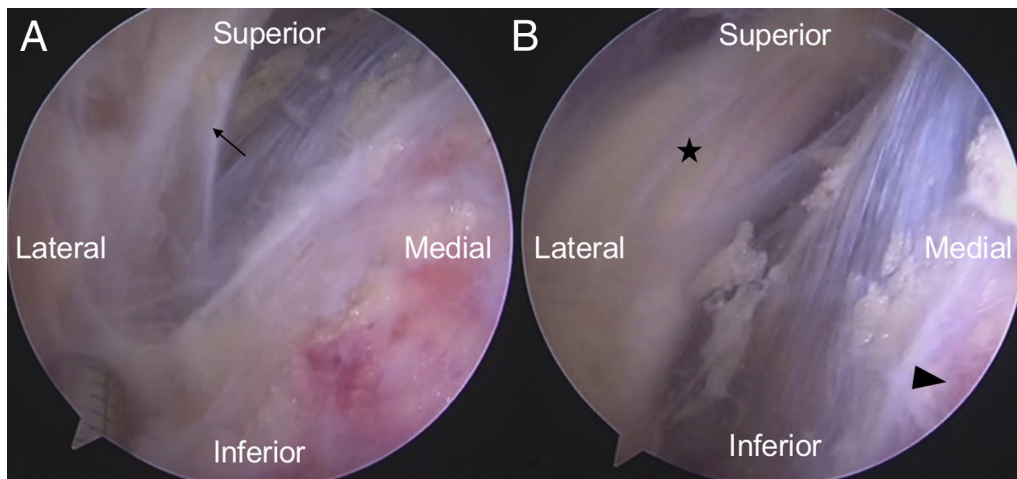


Fig 3. During debridement of the subgluteal space, a veil tissue specified by the arrow in panel A is encountered lateral and posterior to the ischium and is a harbinger for the posterior femoral cutaneous nerve and the sciatic nerve. The sciatic nerve (B) identified by the star is clearly visible with debridement and gentle retraction of the subgluteal tissue. With the operative extremity in the abducted position, the sciatic nerve is protected several centimeters from the lateral border hamstring origin labeled by the arrowhead. The orientation is labeled.

usually 4 cm lateral and 2 cm superior to the midcentral portal. The final position should optimize access to the entire ischium and subgluteal bursa. The lateral portal is established in a similar fashion to the medial portal. The dissection continues anteriorly and laterally toward the known area of the sciatic nerve to identify the lateral aspect of the ischium (Fig 3).

At this point, the sciatic nerve may be dissected. It should be stressed that adequate hemostasis is paramount before dissection of the sciatic nerve is performed. A veil of adipose tissue will be encountered, which harbors the posterior femoral cutaneous nerve and sciatic nerve. The nerve is expected to be safely located several centimeters lateral to the ischium with the hip abducted. This tissue is carefully freed using a Wissinger rod. Very careful and methodical release of any soft tissue bands is then undertaken in a proximal to distal direction to mobilize the nerve and protect it throughout the exposure and repair of the hamstring tendon (Fig 4).

With the nerve identified and protected, the tip of the ischium is identified. The tendinous origin is then inspected to identify any obvious tearing. In acute injuries, the tear is often obvious and the tendon is retracted distally. In these cases, there is occasionally a large hematoma that requires evacuation. It is especially important to protect the sciatic nerve during this portion of the procedure, because it may be obscured by hematoma.³

Once the area of pathology is identified, the hamstrings' origin can be longitudinally split in line with the remaining fibers. This area can be identified through palpation because there is typically softening over the detachment, making the tissue ballotable

against the ischium. The hamstring footprint is then undermined, and the lateral ischial wall is debrided with a reciprocating shaver. The devitalized tissue is

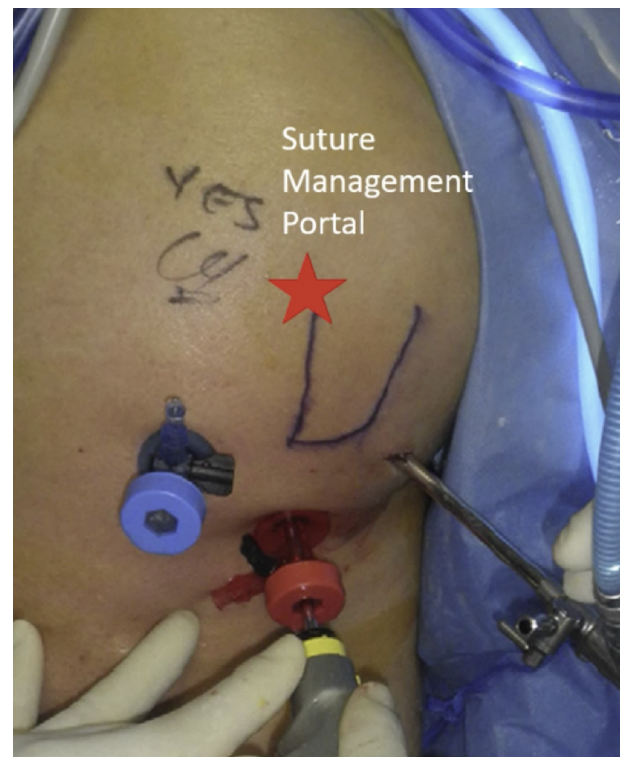


Fig 4. The superior management portal is placed approximately 5-6 cm superiorly and in line with the midcentral portal. This portal allows for easier suture management as well as retrieval in the case of a retracted full-thickness tear. The patient is prone, and the left hip is the affected hip. Superior, medial, lateral, and inferior are at the top, right, left, and bottom of the figure, respectively.

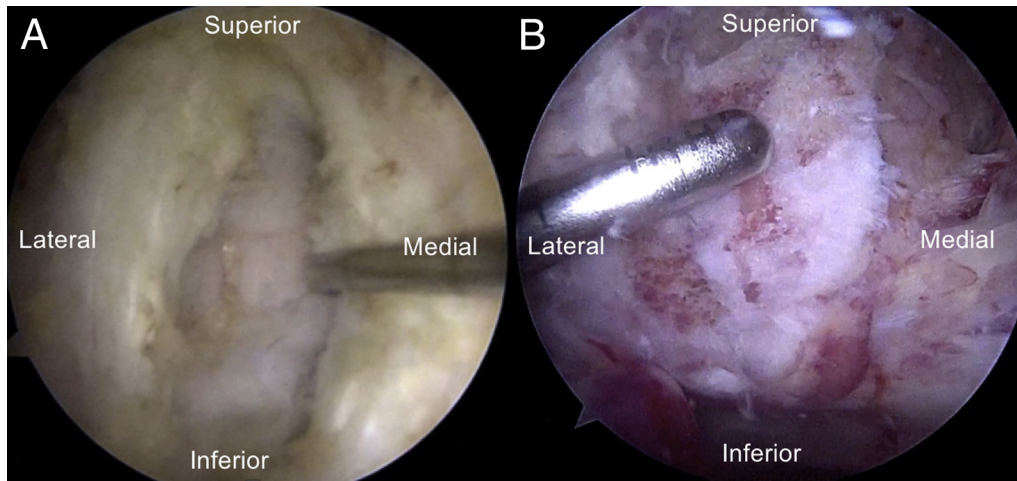


Fig 5. Often there is a partial-thickness tear (A) present. A longitudinal split is made in line with the tendon fibers, and the bare ischium below is identified. The ischium must be denuded to bleeding bone (B) with reciprocating shaver to promote healing once the tendon is approximated and repaired. The orientation is labeled with the camera in the midcentral portal, and the working portals are the medial and lateral portals.

removed, and a bleeding cancellous bed is created in preparation for tendon repair (Fig 5). In the scenario of full-thickness tears, the tendon may be retracted. When retrieving the tendon distally, the medial femoral circumflex artery must be identified and safely protected (Fig 6).

After the medial, lateral, and midcentral portals are established, the ischium is delineated, and the sciatic nerve is protected, the final suture management portal is then created (Fig 4). The portal is placed superior and directly in line with the midcentral portal. The portal is established percutaneously after satisfactory location is confirmed with endoscopic needle localization. While the medial, lateral, and midcentral portals can be ambidextrously used as either working or visualization portals, the primary function of the superior management portal is for ease of suture management, as seen in the video. It may also aid in reducing retracted full-thickness tears.

Together, these portals may be used for insertion of double- or triple-loaded suture anchors, as well as suture management. Any variety of suture-passing devices including antegrade and retrograde passers can then be used for the repair according to personal preference (Fig 7).

The width of the ischium tapers as the bony anatomy continues deep toward the obturator ring. One must be mindful not to penetrate the medial and lateral walls of the ischium during anchor placement. In addition, the ischium can be fractured if anchors are placed too far superiorly.

Once all of the sutures are passed through the tissue of the avulsed hamstring, the sutures are tied and a solid repair of the tendon is completed (Fig 8). In

general, 1 suture anchor is recommended per centimeter of detached tendon.³

Postoperatively, the patient is fitted with a hinged knee brace that is fixed at 90° of flexion for 4 weeks and instructed to maintain non-weight bearing. The brace will serve to restrict excursion of the hamstring tendons and protect the repair. At 4 weeks, the knee is gradually extended about 30° per week to allow full weight bearing by 6 to 8 weeks.³

Physical therapy is initiated at this point, with the initial phase focused on hip and knee range of motion. Hamstring strengthening is begun at 10 to 12 weeks,

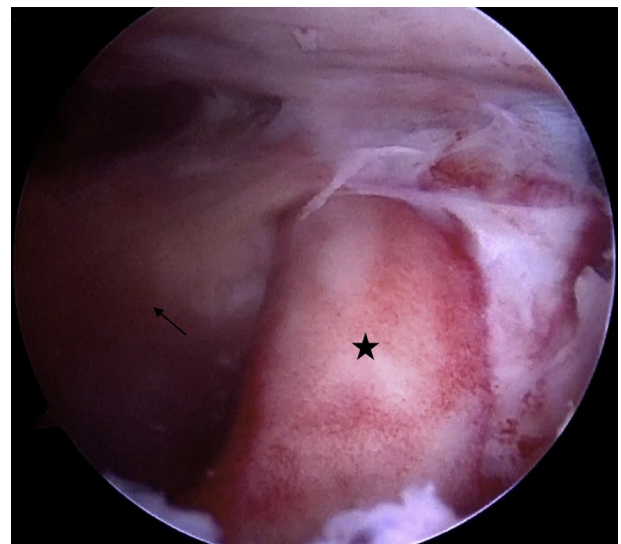


Fig 6. When retrieving distally retracted tears, one must identify the medial femoral circumflex artery (star) and quadratus femoris (arrow).

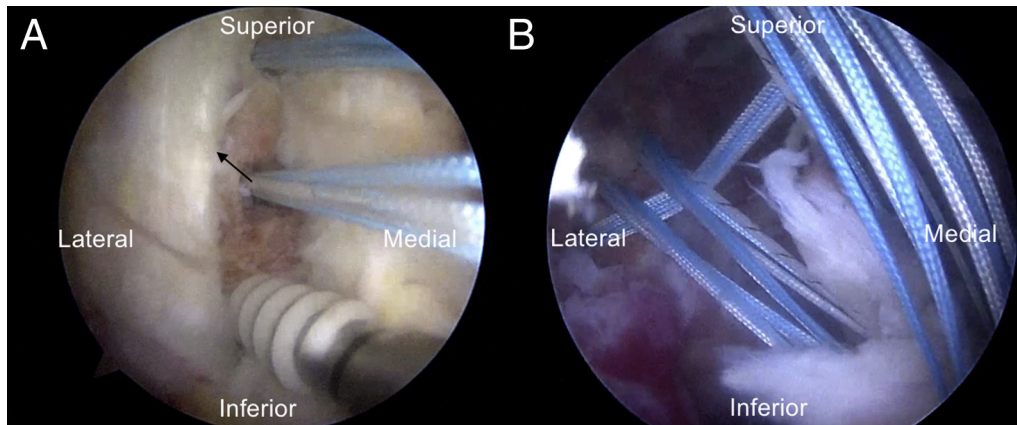


Fig 7. (A) Anchors are shown being placed in a longitudinal fashion in line with the tendon in preparation for a side-to-side repairs of a partial-thickness tear. During anchor placement, sutures limbs are brought through the superior management portal (B) to maintain an orderly surgical field. It can also be used as a viewing portal or a working portal to help retrieve a distally retracted tear. The left hip is the surgical hip with the camera in the midcentral portal and the medial portal used as the working portal.

predicated on full range of motion and a painless gait pattern. Full, unrestricted activity is allowed at approximately 4 months.³

Discussion

Historically, the surgical approaches to hamstring repairs have received limited attention because it is not often encountered in orthopaedic training. Those patients with partial tears and chronic bursitis comprise an even smaller percentage of patients with hamstring problems, with few clinical studies available.²¹ With the advent of hip arthroscopy, further development of techniques has allowed us to explore the use of the arthroscope in many previously uncharted areas. As techniques in endoscopic hamstring repair become refined and available to more surgeons, it will eventually become as conventional as an open repair.³

Surgical repair of proximal hamstring ruptures has its inherent risks. With open methods, superficial as well as deep wound infections can occur due to the proximity to the perineal region. With the endoscopic technique, this possibility is substantially lessened. In addition, the 3 main nervous structures at risk of iatrogenic injury are the posterior femoral cutaneous, inferior gluteal, and sciatic nerves.^{19,22} The sciatic nerve is in close proximity to the ischial tuberosity, running along its lateral aspect. However, the dynamic nature of the ischiofemoral space during rotational movement of the hip joint can further protect the sciatic nerve. Hip abduction of the operative extremity during the endoscopic technique as described above drapes the nerve further away from the ischium, thus protecting even more during surgery (Table 1).²⁰

A concern unique to the endoscopic approach is fluid extravasation into the pelvis as a result of the fluid used in the distension of the potential space around the hamstring tendon. Every effort should be made to regularly check the abdomen for any evidence of abdominal distension. Likewise, any unusual blood pressure decreases may be due to fluid compression from retroperitoneal extravasation. In general, an attempt should be made to maintain the fluid inflow pressures as low as is feasible for adequate visualization, and an attempt should be made to

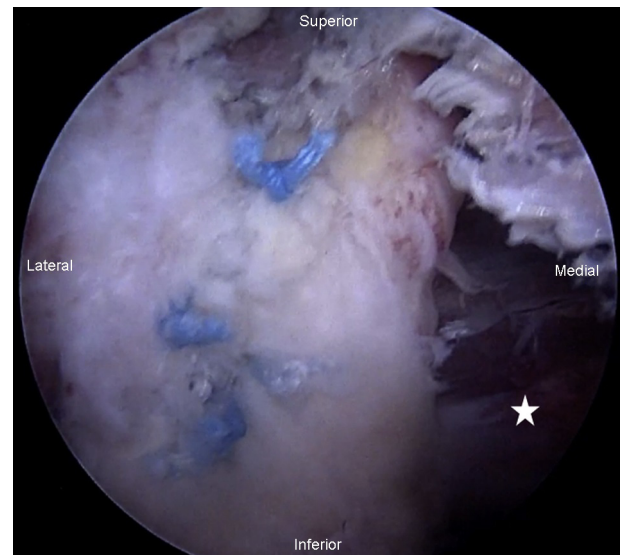


Fig 8. In this endoscopic image a full-thickness tear is successfully repaired to its origin. The quadratus femoris (star) is seen as it courses from the lateral border of the ischium. The left hip is the surgical side and viewed from the midcentral portal.

Table 1. Pearls and Pitfalls of the Technique

Pearls	Pitfalls
Proper patient position, including abduction of the hip 45° decreases risk to the sciatic nerve and increases ease of access of medial portal.	Failing to establish portals in proper orientation and trajectory.
Maintain adequate visualization and hemostasis throughout the case.	Failing to obtain adequate visualization of footprint.
Establish footprint for appropriate reapproximation of tendon repair.	Failing to maintain suture management while repairing the tendon.
Use of an additional superior portal to ease suture management.	
Compliance of postoperative instructions while tendon is healing.	

keep track of fluid ingress and egress volumes to ensure that extravasation is avoided.³ Extravasation is monitored using the Stryker Neptune Waste Management System (Kalamazoo, MI) with outflow ports that are measured by the circulating nurse. The nurse calculates the net difference between ingress and egress values every 15 minutes. This will allow detection of any gross fluid extravasation. Other risks of this endoscopic approach include neurovascular injury as described above, steep learning curve, sitting pain, and rerupture. If issues arise that cannot be treated during the endoscopic approach, conversion to an open procedure is recommended.

The adaptability of this technique invites a wide variety of skill levels, especially newcomers who may have a low threshold to convert to an open case. The authors recommend endoscopic visualization initially. If the pathology cannot be safely treated endoscopically, simple conversion to open repair can be completed by connecting portal sites. Despite improved visualization endoscopically (especially in patients with large body habitus), chronic full-thickness 3-tendon tears with retraction of the sciatic nerve may necessitate an open procedure (Table 2).

Table 2. Advantages and Disadvantages of the Technique

Advantages	Disadvantages
Additional portal for suture management.	Steep learning curve.
Reproducible technique for complex procedure.	Strict patient compliance with postop restrictions required during healing phase.
Patient positioning to decrease risk to neurovascular structures.	Technically demanding for inexperienced hip arthroscopists.
Less invasive compared with traditional open procedure.	

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