Endoscopic Repair of Proximal Hamstring Tear With Double-Row Suture Bridge Construct

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Abstract: Hamstring strains account for 25% to 30% of all muscle strains and are an exceedingly common injury in the athletic population. Although proximal hamstring avulsion injuries occur less commonly than strains at the myotendinous junction, they are more severe and debilitating. Proximal hamstring avulsions do not respond well to conservative treatment and are more likely to require surgical intervention. Surgical repair of proximal hamstring avulsions is indicated when the injury fails to respond to conservative treatment, in cases of osseous avulsion with retraction, and in cases of tearing of all 3 hamstring tendons. Endoscopic repair of proximal hamstring avulsions is a promising technique to repair these injuries while reducing morbidity. We describe our technique for endoscopic proximal hamstring repair, which uses a double-row suture bridge construct to reattach the tendons to the ischial tuberosity.

The proximal hamstrings consist of the semimembranosus tendon and the conjoint tendon, made up of the biceps femoris and semitendinosus. All 3 hamstring tendons attach on the ischial tuberosity, with the semimembranosus tendon attaching more proximally and anteriorly than the conjoint tendon. These tendons are vulnerable to eccentric loading and are often injured by forced hip hyperflexion, ipsilateral knee extension, and accidental falls.[1] Although acute hamstring strains are one of the most common injuries in athletes, avulsion of the proximal hamstring from its insertion on the ischial tuberosity represents a distinct type of injury that is both more rare and more severe. Avulsion injuries represent just 12% of all hamstring injuries.[2] Unlike hamstring strains, most of which occur at the myotendinous junction and are successfully treated nonoperatively, proximal hamstring avulsions are more likely to require surgical intervention and an extended delay in return to sports and functionality.

Early surgical repair has been recommended for proximal avulsion injuries,[3] given that scar formation makes tendon mobilization and repair difficult in the chronic phase.[1] Indications for repair include symptomatic partial tears that do not respond to conservative treatment, osseous avulsion with retraction, and tearing of all 3 hamstring tendons with or without retraction.[3,4] Carmichael et al.[5] described an open repair technique involving reattachment of the tendons to the ischial tuberosity using suture anchors, after identifying and protecting the sciatic nerve. However, recent studies have shown that extra-articular structures can be accessed using endoscopic techniques to repair injuries that have traditionally required open surgery.[6-9] Endoscopic repair of proximal hamstring avulsions presents a promising alternative to open surgery because it has the potential to reduce morbidity while maintaining optimal outcomes. In this technical note, we present our endoscopic technique to repair a proximal hamstring avulsion injury using a double-row suture bridge construct.

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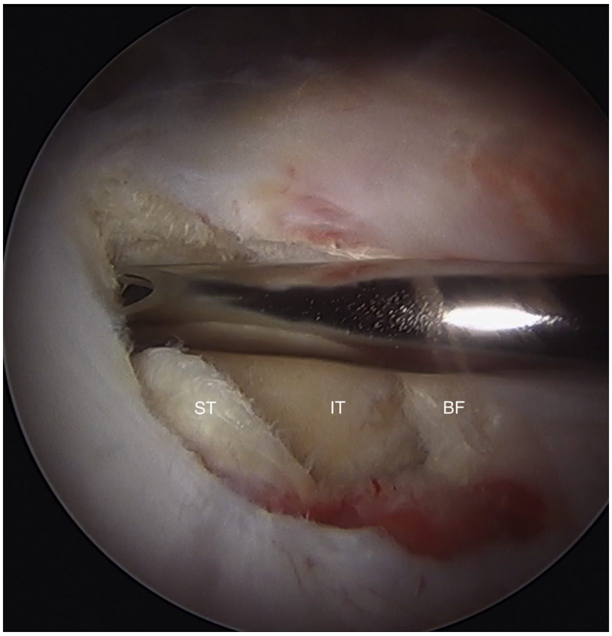

Fig 1. Right hip, patient in supine position. Endoscopic view of a hamstring (biceps femoris [BF] and semitendinosus [ST] muscles) tear at the proximal attachment. (IT, ischial tuberosity.)

Surgical Technique

Patient Positioning and Portal Placement

The patient is brought into the operating room, where general anesthesia is performed in the supine position. The patient is then placed in the prone position, all bony prominences are padded, and the lower extremity is prepared and draped in standard fashion. The posterior aspect of the hip is accessed via 2 working portals in the gluteal fold—direct posterior and posterolateral, which are located 2 cm medial and 2 cm lateral, respectively, to the palpable ischial tuberosity. Care is taken to avoid the neurovascular structures at risk during portal placement: the sciatic nerve, which runs approximately 1.2 cm lateral to the ischial tuberosity; the posterior femoral cutaneous branch, which travels laterally in the gluteal fold; and the inferior gluteal nerve and artery, which lie 5 cm proximal to the ischial tuberosity deep to the gluteus maximus.

A switching stick is first used to perform blunt dissection through the gluteus maximus muscle and create a submuscular plane. After this, a 30° arthroscope is inserted in the posterolateral portal under fluoroscopic visualization. After the posterolateral portal is established, a posteromedial portal is accessed under fluoroscopic visualization using the same technique. Fluoroscopy and blunt dissection are used to avoid damage to the sciatic nerve and ensure that all instruments are placed correctly.

Hamstring Tendon Repair

Video 1 shows our endoscopic proximal hamstring repair technique. After the 2 portals are established, soft-tissue dissection is performed around the ischial tuberosity to locate the tendinous insertion of the semitendinosus, semimembranosus, and biceps femoris (Fig 1). The semitendinosus and the long head of the biceps femoris share a common, crescent-shaped origin, whereas the semimembranosus originates from a distinct spot lateral and anterior to this location. An oscillating shaver is then used to identify the tear and access the underlying ischial tuberosity (Fig 2). In cases of a complete tear, the tendons will have retracted distally, and there is occasionally a large hematoma that requires evacuation. Care is taken to avoid damaging the sciatic nerve because it may be obscured by the hematoma. Once the tear has been identified, a tissue-penetrating device is used to pass a suture through the lateral aspect of the hamstring insertion and is retrieved through the longitudinal split opening. A snap is then used to tension this suture on the skin, providing retraction, thus improving access and visualization. This process is repeated medially. At this time, a shaver and

Fig 2. Right hip, patient in supine position. Endoscopic view showing creation of a pilot hole in the ischial tuberosity (IT) using an arthroscopic punch and, subsequently, a threaded tapping device for the purpose of future anchor placement.

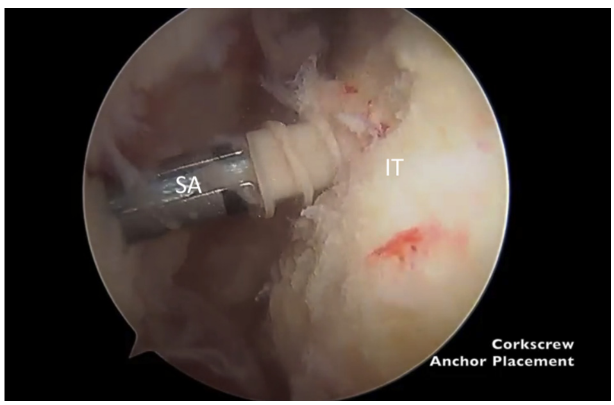

Fig 3. Right hip, patient in supine position. Endoscopic view showing placement of a 5.5-mm PEEK suture anchor (SA) into the ischial tuberosity (IT).

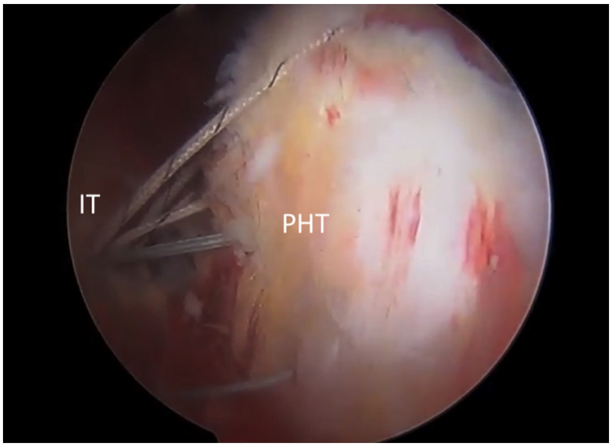

Fig 4. Right hip, patient in supine position. Endoscopic view showing the anchor with 4 suture limbs in the ischial tuberosity (IT) and the mattress configuration of sutures passed through the proximal hamstring tendon (PHT).

radiofrequency device can be used to remove any redundant tissue along the tendon and tuberosity, further defining the tear.

A 5.5-mm arthroscopic burr is used to create a healthy bleeding bone surface and encourage tissue repair at the anatomic footprint of the ischium. An arthroscopic punch and, subsequently, a threaded tapping device are used to create a pilot hole for suture anchor placement (Fig 2). Percutaneous portals are then created using a spinal needle under direct fluoroscopic visualization to insert double-loaded 5.5-mm PEEK (polyether ether ketone) Corkscrew anchors (Arthrex, Naples, FL) through the tendon and into the ischial tuberosity (Fig 3). Each anchor contains 4 suture limbs that are passed through either side of the tendon edge using a horizontal mattress configuration (Fig 4). Additional anchors are inserted in the same fashion.

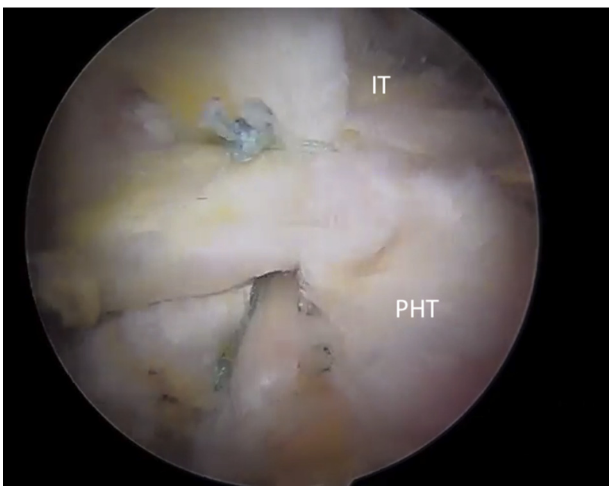

Fig 5. Right hip, patient in supine position. Endoscopic view showing the final repair construct of the proximal hamstring tendon (PHT) and ischial tuberosity (IT).

Between 2 and 4 anchors may be used depending on the size of the tear and size of the ischial tuberosity. All sutures are shuttled through the tendon using a tissue-penetrating device that ensures full-thickness passes along the hamstring tendon, and the sutures are tied in a mattress fashion. All sutures are passed, tensioned, and tied with a knot pusher to secure the tendon to the tuberosity. The longitudinal split is closed and the hamstring is secured (Fig 5).

Postoperative Rehabilitation

Postoperative rehabilitation begins with toe-touch weight-bearing restrictions, avoiding positions of repair tension (e.g., hip flexion and knee extension) and preventing active hamstring motion for 4 to 6 weeks after surgery. Patients are instructed to ambulate with crutches, with a knee orthosis. An extension stop is set on the knee orthosis and gradually brought to full extension over a period of 4 to 6 weeks. Knee flexion can be left open to allow for ease of transition between sitting and standing.

Advancements in hip and knee motion, as well as increased weight bearing, begin at 4 to 6 weeks after surgery. Very light hamstring concentric motion may begin at 6 weeks. Core and pelvic strengthening may also ensue at this time. Concentric strengthening is permitted after 8 weeks, and eccentric strengthening may be initiated at 3 months postoperatively. Light jogging, light short sprints, and closed-chain plyometrics begin between 3 and 6 months postoperatively. Sport-specific drills and activities begin at 4 to 6 months after surgery, with return to competitive sports after 6 months.

Discussion

Hamstring strains account for 25% to 30% of all muscle strains[10] and are an exceedingly common injury in the athletic population. Although most hamstring injuries respond to conservative treatment within 2 weeks, avulsions of the hamstring tendons off the ischial tuberosity are much more uncommon and debilitating injuries than those that occur at the myotendinous junction or muscle belly. The mechanism of

Table 1. Advantages and Disadvantages of Endoscopic Proximal Hamstring Repair

Advantages
Less invasive technique with fewer, smaller surgical incisions
Decreased blood loss
No requirement for gluteus maximus retraction
Closer visualization of tendon pathology, including partial tears
Disadvantages
Possibility of fluid extravasation, which may impair early rehabilitation
Longer surgical time
Injury to neurovascular structures from portal placement
Steep learning curve and high technical skill required

Table 2. Pearls and Pitfalls of Endoscopic Proximal Hamstring Repair

Identifying both tear timing (acute vs chronic) and morphology (partial vs complete) is important. A trial of conservative treatment is warranted for partial tears prior to surgery. Chronic cases with extensive retraction and scarring may not be amenable to endoscopic repair.
Familiarity with the anatomic origins of the hamstrings is crucial to avoid important neurovascular structures. Because the gluteal fold is not often explored endoscopically, mastery of endoscopic and arthroscopic principles is necessary to avoid complications.
The patient should be carefully placed in the prone position and all bony prominences should be adequately padded to avoid any complications associated with positioning.
All portals should be established using fluoroscopic guidance or direct visualization, aiming lateral to medial to avoid plunging into the sciatic nerve. We advise using a cannulated technique.
Failure to identify and be aware of the sciatic nerve during all portions of the case can lead to devastating neurologic injury. The nerve must be protected throughout the procedure.
A burr should be used to remove cortical bone and create a healthy surface to facilitate healing.
Additional portals must be placed for suture management. Using a cannula reduces the risk of mishandling or soft-tissue interposition, facilitating efficient suture passage and knot tying.
Weight bearing must be protected in the first 6 weeks postoperatively, at which point physical therapy can begin. Care must be taken to avoid excessive hip or knee extension, which can compromise the integrity of the repair.

injury is usually eccentric contraction of the hamstring muscle complex with the knee extended and the hip in hyperflexion. Patients will complain of sharp pain in the proximal thigh, and swelling and hematoma will develop over the next 48 hours. However, the diagnosis of proximal hamstring injuries is often delayed, and they can lead to significant functional impairment and time away from sports.

Although proximal hamstring avulsions have traditionally been managed with open repair, endoscopic management of extra-articular hip pathology has emerged as an effective alternative to open procedures for extra-articular structures as principles of hip arthroscopy have become refined. This article details our technique for endoscopic repair of proximal hamstring avulsion injuries. Table 1 outlines the advantages and disadvantages of our technique, and Table 2 lists salient pearls and pitfalls. Performing this procedure endoscopically provides superior visualization of abnormal hamstring pathology, both from magnification with the camera and from the elimination of prolonged retraction of the gluteus maximus, which is required during an open technique. This allows surgeons to more closely characterize tendon pathology and perform precise debridement and repair. Furthermore, endoscopic surgery is minimally invasive and requires smaller surgical incisions, leading to decreased blood loss.

There are also disadvantages to an endoscopic technique that must be considered. Such procedures are more technically demanding and require advanced suture manipulation skills. As such, the long learning curve of this technique can be prohibitive, leading to longer operative times and increased risk to surrounding neurovascular structures. Familiarity with endoscopic surgery is crucial to achieving optimal outcomes with this technique.

In conclusion, endoscopic techniques to repair proximal hamstring avulsion injuries represent a promising development to benefit patients with reduced morbidity. Further study is needed to compare our technique with the traditional open procedures.

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