A
cute hamstring strains are one of the most common
injuries in athletes, and the majority are successfully
treated with nonoperative measures.1,2,21 However, prox-
imal hamstring avulsions from the ischial tuberosity are a dis-
tinct type of injury. They are increasingly recognized as need-
ing surgical intervention, leading to a delay in return to sport
and to long-lasting functional impairments when not treated
appropriately.2,8,10-14,19,20,22 Early case reports and anatomic stud-
ies show positive results from surgical repair of proximal ham-
string injuries. For surgical repair, early diagnosis is critical to
facilitating a successful outcome and preventing long-term func-
tional impairment.

Ishikawa et al10 made the first such report of surgical repair
in 1988—specifically, 2 cases of proximal hamstring tendon
avulsions. Reported rates of return to preinjury levels have
ranged from 88% to 100%, but each study included a small
number of case reports.4,7,10,11,14-16 A repaired hamstring tendon
may be almost as functional as the uninjured hamstring (88%
to 91% on Cybex testing).11,16 Surgical repair of proximal
hamstring injuries may lead to improved functional
outcomes.2,8,10-14,19,20,22

Proximal hamstring tendon anatomy, injury classification,
and repair techniques have been detailed in previous
publications.6,9,17,18 Anatomic studies have shown that the
proximal hamstrings consist of a conjoint tendon (biceps
femoris and semitendinosus) that inserts posterior and inferior
on the ischial tuberosity to the more proximal-anterior
semimembranosus tendon. In considering the need for a surgi-
cal repair of the proximal hamstring tendons, injury classifica-
tion is important, given that some injury patterns can be suc-
cessfully treated nonoperatively.

The surgical procedure can be divided into 3 steps: patient
positioning and surgical exposure, tendon repair, and postoper-
ative protocol.

OPERATIVE TECHNIQUE

Patient Positioning and Surgical Exposure

The patient is placed in the prone position on the operating
room table, with all bony prominences padded and with the
table flexed 20° (Figure 1). A transverse incision is made in the gluteal crease of the
affected leg, directly inferior to the ischial tuberosity (Figure 2).
A transverse incision is preferred to a traditionally described longitudinal incision, because of improved cosmesis and accessibility to the avulsed tendons. If inferior dissection is warranted to retrieve retracted tendons, this incision can be extended by making a T limb down the back of the thigh.

The incision is dissected to the gluteal fascia, which is incised transversely while taking care to avoid injury to the posterior femoral cutaneous nerve. This provides access to the gluteus maximus muscle.

When the muscle fibers of the gluteus maximus are exposed, the dissection is carried out longitudinally by splitting the muscle fibers in line with their length. This is accomplished by locating a raphe that is in line, and just inferior to, the ischial tuberosity at palpation. This will expose the hamstring fascia in which the hamstring tendons are located.

A longitudinal incision is made in the hamstring fascia. Typically, hematoma and/or serous fluid in an acute setting will be expressed. In more chronic settings, a layer of fibrous tissue (scar), or pseudosheath, can lie over the ruptured coalescence of the hamstring tendons and so give the appearance of intact tendons. This layer must be incised to expose the avulsed tendons.

Care should be taken to protect the sciatic nerve, which in chronic cases may become adherent and scarred to the area of injury. Staying within the hamstring fascia, or pseudosheath, is an important component in the protection of the sciatic nerve (Figure 3).

**Tendon Repair**

The sciatic nerve should be protected by gentle lateral blunt retraction. After the tendons have been exposed and the tear pattern identified, the fibrotic tissue on the ends of the tendons should be debrided to normal tissue (Figures 4 and 5). Care should be taken not to remove an excessive amount of tissue, because doing so may shorten the tendon.

The tendons are mobilized and tagged with heavy suture for traction. The ischial tuberosity is identified, as is the hamstring insertion on its inferolateral aspect. A periosteal
Figure 5. Open repair: avoid removing excessive amount of tendon tissue to avoid shortening the tendon.

Figure 6. Hamstring repair: sutures passed through tendon in X-like formation.

Figure 7. Hamstring repair: sutures tied, inferior to superior.

elevator, rongeur, and curette are used to expose the anatomic origin of the tendons, which will denude the bone and so provide for direct tendon healing to bone. Motorized burrs should not be used because they may cause iatrogenic injuries to the sciatic nerve. The semimembranosus tendon is located anterior and lateral to the conjoint tendon (composed of the long head of the biceps femoris and the semitendinosus tendons). 17

Five suture anchors are placed into the ischial tuberosity, in an X-shaped configuration, by drilling perpendicular to the facet of the hamstring origin. Care is taken not to plunge through both cortices of the tuberosity. The authors prefer bioabsorbable suture anchors with abrasion resistant suture (2.8 mm x 18.0 cm, BioRoc EZ, Dupuy Mitek, Raynham, Massachusetts). The sutures are then passed through the tendon in a similar X-like fashion, using horizontal mattress sutures (Figure 6). The Bunnell, modified Kessler, and modified Mason-Allen stitches are not used because they bunch up the tendon at the bony interface and thus shorten the tendon.

At this point, the knee is flexed 30° to 60° to take tension off the proximal hamstring before finalizing the repair. The sutures are then tied, from the inferior position to the superior (Figure 7).

After repair, the gluteus fascia is closed. A postoperative hip-knee orthosis is used to limit hip flexion to 15° to reduce stress on the tendon repair. Knee motion is not restricted in the orthosis.
Postoperative Protocol

The first phase of rehabilitation lasts 6 weeks. The patient is kept at touch down weight bearing for 2 weeks and is advanced to 25% weight bearing over the following 3 weeks. This allows slight hip and knee flexion but limits the stress at the repair site. Passive range of motion of the knee and hip begins at 2 weeks, and active hip range of motion begins at 4 weeks. Hip range of motion is advanced 10° each week after surgery in the hip-knee orthosis until the end of the first phase.

The second phase starts with full weight bearing at 6 weeks postoperatively. Gait training is initiated. Passive and active range of motion is progressed. Isotonic exercises and aquatherapy are begun within a limited range, avoiding terminal range of hip flexion (more than 110°). At 8 weeks, isotonic strengthening is begun and dynamic training is advanced. At 10 weeks, an isometric strength evaluation is performed at 60° of knee flexion.

The final phase of rehabilitation begins at 10 weeks postoperatively. Dry-land jogging is initiated with continued strengthening. A full isokinetic evaluation at 60°, 120°, and 180° is performed and then compared to that of the uninjured leg. Sport-specific activities are emphasized and return to play permitted when isokinetic testing on the repaired leg is 80% of the unaffected side. This typically occurs between 6 and 9 months.

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