Hamstring Injuries

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Hamstring injury is one of the more common sports-related injuries, and its incidence is increasing as middle-aged patients continue to be physically active. The hamstring muscle complex consists of the biceps femoris, semitendinosis, and semimembranosus muscles. The long head of the biceps and the semitendinosis arise from a common, conjoined tendon at the ischial tuberosity. The semimembranosus originates just anterior and lateral to the conjoined tendon (Figure 1A). The short head of the biceps originates from the lateral linea aspera before joining the long head of the biceps to insert distally on the fibular head. The semitendinosis inserts on the medial proximal tibia, and the semimembranosus has a complex insertion on the posterior tibia and posteromedial joint capsule at the knee.[1]

"The best prognostic indicator for patients with clinically suspected hamstring injury is a normal imaging study."

Hamstring injuries may be proximal, central, or distal in location.

Proximal hamstring injuries involve the tendon or bone at the origin of the hamstrings. Proximal injuries include tendinosis, partial or complete tendon tear, and apophyseal injury with or without osseous avulsion. Tendinosis is usually seen as a thickened tendon of heterogeneous signal on magnetic resonance imaging (MRI). Partial-thickness tears show focal high-signal fluid within a portion of the tendon or fluid interposed between the tendon and a portion of its osseous origin (Figures 1B, 1C). A complete tendon tear, which occurs infrequently, is seen as a loss of continuity of the tendon with fluid interposed between tendon and osseous origin or between disrupted portions of the tendon. Torn hamstring tendons may be retracted and lax (Figure 2). The sciatic nerve lies in close proximity to the hamstring origin. Proximal hamstring injuries may lead to pain in a sciatic distribution and may simulate nerve root compression clinically.[2]

The ischial apophysis normally appears between ages 13 and 15 and may persist up to age 25. Avulsion of the ischial apophysis by the action of the hamstrings is the most common avulsion fracture of the pediatric pelvis. A subacute healing apophyseal avulsion may have an appearance suggestive of an aggressive neoplasm. An avulsed apophysis may also fail to unite, and at times a large osseous mass requiring excision may develop (Figure 3).

Distal hamstring injuries involve distal tendons and their insertions. These injuries are rare, little addressed in the literature, and not discussed further here.

Central hamstring injuries consisting of muscle strains are the most common injuries of the hamstring complex and usually involve the proximal or distal musculotendinous junctions. Muscle strains at the epimysium or within the muscle belly distant from the musculotendinous junction may also occur. The biceps muscle is the most commonly involved. The etiology of these hamstring injuries is

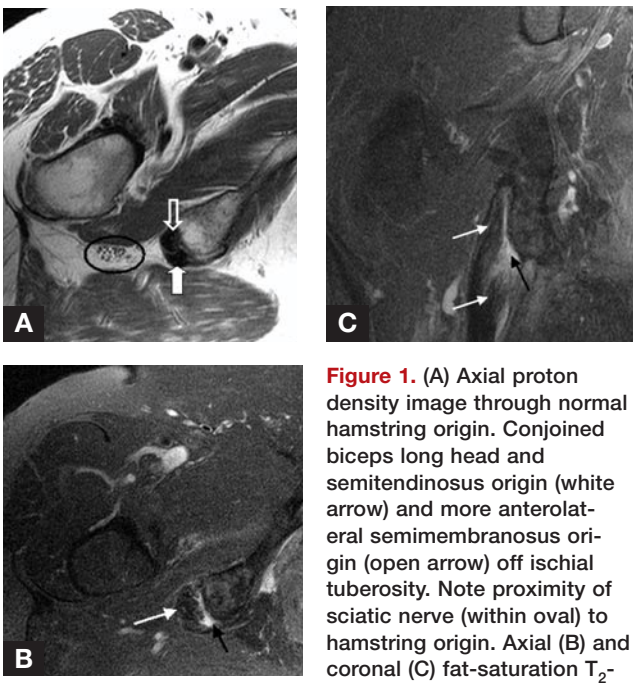

Figure 1. (A) Axial proton density image through normal hamstring origin. Conjoined biceps long head and semitendinosus origin (white arrow) and more anterolateral semimembranosus origin (open arrow) off ischial tuberosity. Note proximity of sciatic nerve (within oval) to hamstring origin. Axial (B) and coronal (C) fat-saturation T_2-weighted images show fluid (black arrow) between the ischial tuberosity and a portion of the hamstring tendons at their origin (white arrow) consistent with a chronic partial tear. The heterogeneous signal within the tendons indicates underlying tendinosis. Subtle marrow heterogeneity at the tuberosity marrow indicates chronic enthesopathic change.

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Am J Orthop. 2008;37(11):583-585.

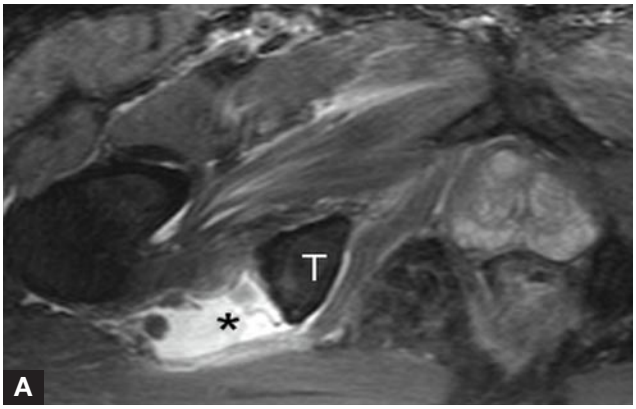

Figure 2. (A) Axial fat-saturation T_2-weighted image shows complete avulsion of the hamstring tendons off the ischial tuberosity (T) with bright fluid (*) where tendons have been avulsed and retracted. (B) Sagittal fat-saturation T_2-weighted image shows a retracted and lax tendon (arrows) avulsed off the ischial tuberosity. Retracted tendon and muscles are surrounded by bright fluid (*). Femur (F).

Figure 3. Chronic avulsion injury of the ischial tuberosity is noted (*); incidental note is made of avascular necrosis of the left femoral head.

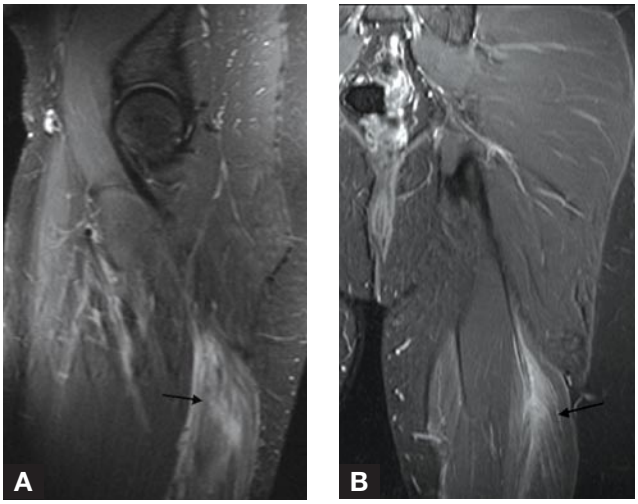

Figure 4. Sagittal (A) and coronal (B) fat-saturation T_2-weighted sequence shows high-signal, "feathery" appearance of a grade I strain of the biceps femoris muscle (arrow).

multifactorial. All hamstring muscles with the exception of the short head of the biceps bridge 2 joints. This biarthroidal configuration increases the chance of injury. The tibial branch of the sciatic nerve supplies all hamstring muscles with the exception of the biceps short head, which is supplied by the peroneal branch of the sciatic nerve. This dual pattern of innervation may lead to asynchrony of muscle contraction and may contribute to injury. Injury typically results from eccentric muscle contraction, but other factors contributing to injury may include prominence of type II muscle fibers in the hamstrings, age, fatigue, leg-length discrepancies, muscular imbalances, and failure to properly prepare for athletic endeavors. Individuals with previous hamstring injuries, particularly individuals who do not allow adequate recovery time, have an increased incidence of reinjury.[3]

Muscle strains are graded both clinically and radiographically. On MRI, grade I injuries have a high-signal-intensity, "feathery" appearance on fluid-sensitive sequences within the muscle with no gross structural damage. High-signal bright fluid is seen interdigitat-

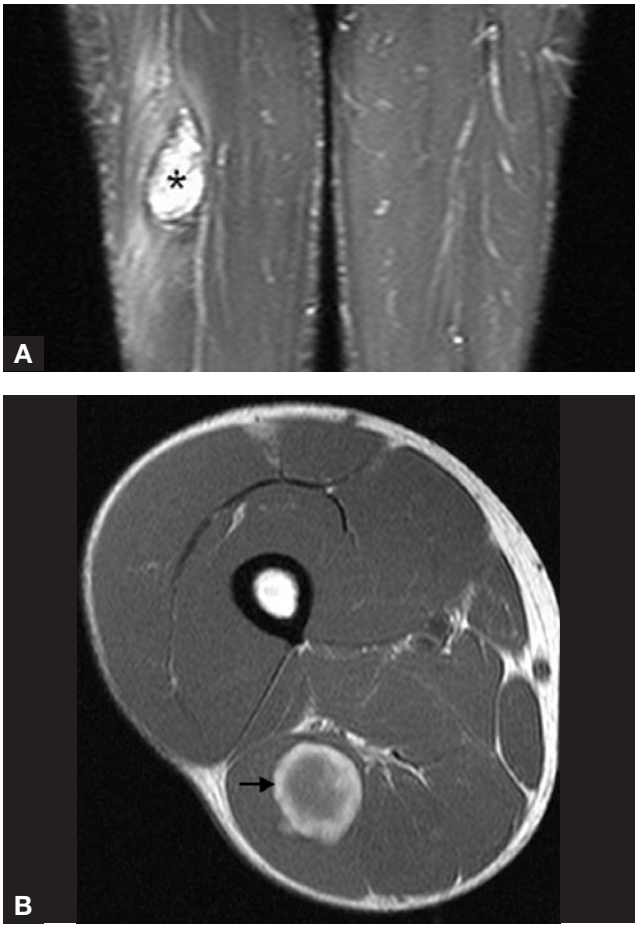

Figure 5. (A) Coronal fat-saturation T_2-weighted image shows a focal, elliptically shaped bright fluid collection (*) in the biceps muscle consistent with a grade II muscle strain surrounded by a bright-signal, "feathery"-looking grade I muscle strain. (B) Axial T_1-weighted image shows the lesion with a bright, high-signal-intensity periphery (arrow) consistent with evolving hemorrhage. The images are consistent with a grade II muscle strain and intramuscular subacute hematoma of the biceps.

ing between muscle fibers (Figure 4). Grade II injuries are seen as a partial disruption in muscle fibers characterized by focal intramuscular fluid collections (Figure 5). Grade III injuries involve complete disruption of the involved muscle. MRI and ultrasound are equally able to grade these injuries acutely, though MRI is better for serial follow-up studies and is much less examiner-dependent.[4] Longitudinal length and cross-sectional area of the muscle injury, best measured with MRI, are imaging predictors of the time required for an athlete to return to competition.[4,5] A strain involving more than 50% of the cross-sectional area of a muscle correlates well with a convalescence of more than 6 weeks.[6] The best prognostic indicator for patients with clinically suspected hamstring injury is a normal imaging study.

Author's Disclosure Statement

The author reports no actual or potential conflict of interest in relation to this article.

References

1. Beltran J, Matityahu A, Hwang K, et al. The distal semimembranosus complex: normal MR anatomy, variants, biomechanics and pathology. *Skeletal Radiol*. 2003;32(8):435-445.
2. Street CC, Burks RT. Chronic complete hamstring avulsion causing foot drop. A case report. *Am J Sports Med*. 2000;28(4):574-576.
3. Brooks JH, Fuller CW, Kemp SP, Reddin DB. Incidence, risk, and prevention of hamstring muscle injuries in professional rugby union. *Am J Sports Med*. 2006;34(8):1297-1306.
4. Connell DA, Schneider-Kolsky ME, Hoving JL, et al. Longitudinal study comparing sonographic and MRI assessments of acute and healing hamstring injuries. *AJR Am J Roentgenol*. 2004;183(4):975-984.
5. Slavotinek JP, Verrall GM, Fon GT. Hamstring injury in athletes: using MR imaging measurements to compare extent of muscle injury with amount of time lost from competition. *AJR Am J Roentgenol*. 2002;179(6):1621-1628.
6. Pomeranz SJ, Heidt RS Jr. MR imaging in the prognostication of hamstring injury. Work in progress. *Radiology*. 1993;189(3):897-900.