

MSK Ultrasound Bites: Tips and Tricks

Diagnostic Musculoskeletal Ultrasound in the Evaluation of the Proximal Hamstrings at the Ischial Tuberosity

Robert C Manske, PT, DPT, MEd, SCS, ATC, CSCS, FAPTA^a, Chris Wolfe, PT, DPT, OCS, Cert MDT, Phil Page, PT, PhD, ATC, CSCS, CP-MSK, FACSM, Michael Voight, PT, DHSC, SCS, OCS, ATC, CSCS, FAPTA

Keywords: musculoskeletal ultrasound, hamstrings, ischial tuberosity, muscle tear, rehabilitation, dynamic imaging

<https://doi.org/10.26603/001c.158832>

International Journal of Sports Physical Therapy

Vol. 21, Issue 4, 2026

The hamstring muscle complex comprises several biarticular posterior thigh muscles. These muscles originate from the ischial tuberosity and attach distally to the knee. Hamstring muscle injuries are among the most common in the lower extremities of active individuals. Hamstring injuries follow a consistent pattern and medical history, including a sudden, explosive movement (sprinting, kicking, jumping, or lunging). The onset of pain is usually acute in the proximal posterior aspect of the upper thigh. Injured individuals may describe a “pop” or “snap” or a sensation as if someone kicked them in the back of the thigh. An accurate diagnosis of proximal hamstring overuse, partial tears, or ruptures is essential for appropriate treatment planning and optimizing patient outcomes. Diagnostic musculoskeletal ultrasound (MSKUS) offers a portable, real-time, and cost-effective alternative, gaining traction in rehabilitation and sports medicine settings. MSKUS has emerged as a valuable, non-invasive imaging modality for evaluating proximal hamstring injuries, including tendinopathy, muscle strains (partial tears), and ruptures. MSKUS is excellent at detecting changes in tendon and muscle composition and continuity. This manuscript will review the utility of MSKUS in evaluating proximal hamstring tendon and muscle injury, including anatomy, common injury patterns, sonographic techniques, and clinical implications for rehabilitation professionals. By integrating MSKUS into clinical practice, providers can improve diagnostic accuracy, enhance diagnostic confidence, monitor healing progression, and guide rehabilitation strategies to achieve optimal patient outcomes for those with hamstring injuries.

INTRODUCTION

Hamstring injuries may be among the most common injuries to the posterior thigh muscles in young, active individuals. All of the hamstring muscles attach proximally to the ischial tuberosity.¹ These injuries typically occur when the muscle goes through an eccentric contraction as part of dynamic movement, like sprinting or kicking, and is injured at the proximal myotendinous junction.^{2,3} The late portion of the swing phase of sprinting appears to be the most vulnerable position for the biceps femoris as the hamstrings produce a violent eccentric contraction to decelerate the forward-moving tibia.⁴⁻⁷

ANATOMY OF THE PROXIMAL HAMSTRING TENDONS

The proximal medial hamstrings consist of both the semitendinosus and semimembranosus, and the proximal lateral muscle, the biceps femoris, all of which originate on the ischial tuberosity.⁸ The biceps femoris long head and the semitendinosus muscle originate from a conjoint tendon at the medial posterior aspect of the ischial tuberosity, while the semimembranosus attaches more laterally and anteriorly.^{9,10}

The hamstring tendons and muscles are surrounded by connective tissue, including the fascia lata and the ischio-gluteal bursa, which reduce friction during hip extension and knee flexion. This proximal portion of the biceps femoris attachment and configuration allows the hamstrings to play a key role in generating powerful hip ex-

^a Corresponding Author:
Robert.Manske@wichita.edu

tension, controlling knee flexion, and stabilizing the pelvis during gait and athletic activity.¹¹

THE ROLE OF MSK ULTRASOUND IN TENDON AND MUSCLE EVALUATION

ADVANTAGES

- **Real-Time Imaging:** MSKUS allows dynamic evaluation of all the proximal hamstring tendons while the knee can be manipulated through the available range of motion.
- **High-Resolution Visualization:** MSKUS provides detailed images of the proximal hamstring tendons and their proximal enthesis at the ischial tuberosity.
- **Accuracy:** MSKUS has been proven to be both a valid and reliable method for examining hamstring architectural properties at rest.¹²⁻¹⁵
- **Accessibility and Cost-Effectiveness:** MSKUS is portable, widely available, and less expensive than magnetic resonance imaging (MRI).

LIMITATIONS

- **Operator Dependency:** MSKUS requires skill and experience for accurate interpretation of findings. The ability to sonograph tendons and their respective muscles is largely influenced by the operator and the availability and technical considerations of state-of-the-art equipment.
- **Depth Limitations:** Visualization is usually not a problem; however, in some individuals, a curvilinear probe may be indicated due to depth.
- **Artifacts and Shadows:** Bone and calcifications may create image artifacts, requiring adjustments in transducer positioning and frequency.

SONOGRAPHIC TECHNIQUE FOR EVALUATING THE PROXIMAL HAMSTRINGS

EQUIPMENT SETUP

- **Transducer Type:** Because of the depth of the proximal hamstring tendon and muscle, a standard high-frequency, linear array transducer between 5-15 MHz is normally utilized. However, in some individuals with more adipose tissue or larger muscle mass, depth may require a lower-frequency curvilinear probe to obtain depth.^{10,15,16}
- **Patient Position:** The patient is in sidelying with the knees and hips slightly flexed, or in the prone position with the feet over the edge of the table.
- **Dynamic Assessment:** A passive or active movement of knee flexion and extension can be applied during ultrasound assessment to evaluate for proximal hamstring contractile and excursion properties.

EXAMINATION PROTOCOL

NORMAL SONOGRAPHIC APPEARANCE

The starting point for examining the proximal hamstring tendon and muscle is at the osseous landmark – the ischial tuberosity.^{12,13,17-19} The ischial tuberosity can almost always be palpated, giving the examiner a perfect location to begin their scan. The proximal hamstring can be scanned in both the long axis (LAX) and the short axis (SAX). In the LAX view, depending on the probe width and size, one should start proximally to visualize the hyperechoic reflection of the bony cortex of the ischial tuberosity, with its large acoustic shadow underneath. In LAX, the proximal hamstring tendon fibers of the long head of the biceps femoris and the semitendinosus conjoint tendon should be easily seen coming off the attachment of the ischial tuberosity with a clear hyperechoic fibrillar structure running distally from the insertion site on the anterior lateral origin of the ischial tuberosity. The semitendinosus fibers can be easily seen as they reach the ischial tuberosity directly. Lateral to the hamstring muscle complex, the sonographer will see the sciatic nerve that appears as a fascicular, flattened structure that descends between and deep to the long head of the biceps femoris and semimembranosus tendon.¹ The probe can be turned 90 degrees for viewing in the SAX. If the probe is moved slightly distally in the SAX view, the biceps femoris will appear as a triangular shape. As the examiner moves distally along the biceps muscle belly, the size will decrease until it appears to disappear. In both views, some toggling may be required to reduce anisotropy.

PATHOLOGIC FINDINGS IN LATERAL PROXIMAL HAMSTRING TENDON AND MUSCLE INJURY

- **Disruption of fibrillar pattern** in partial tears and ruptures. Proximally, it is important to determine if the injury is a free-tendon injury or purely a myotendinous injury.²⁰
- **Associated effusion.**
- **Calcifications** of the tendon near the enthesis sites.
- **Bony avulsions** and or retracted tendons from ruptures or avulsion fractures.^{2,21}

CLINICAL IMPLICATIONS FOR REHABILITATION PROVIDERS

MSKUS provides real-time feedback for rehabilitation professionals, facilitating early diagnosis and intervention. Key applications include:

- **Early Detection of Injury / Accurate Injury Grading:** MSKUS can quickly differentiate between a tendinopathy versus a strain, or more severe tendon rupture or muscle tear, to help guide treatment planning.
- **Dynamic Functional Testing:** Rehabilitation professionals can use MSKUS during physical therapy sessions to monitor recovery and assess tendon and muscle function dynamically. Serial MSKUS imaging

aids in assessing muscle healing and remodeling to help with readiness for rehabilitation progression.

- Guided Interventions: Ultrasound imaging assists in precision-guided dry needling or injections, such as corticosteroids for inflammation.
- Patient Education: Real-time imaging serves as a visual aid to explain the nature of the injury and set realistic expectations for recovery.

LIMITATIONS AND CHALLENGES

Despite its advantages, MSKUS cannot entirely replace MRI for complex cases, especially when examining the origin at the ischial tuberosity.²² Additionally, the expertise required for optimal imaging techniques limits its immediate adoption across all rehabilitation settings.

CONCLUSION

Diagnostic MSKUS is an increasingly valuable tool for evaluating proximal hamstring disorders at the ischial tuberosity, offering portable, real-time, high-resolution imaging that can improve diagnostic accuracy and confidence in rehabilitation and sports medicine settings. When paired with a sound understanding of proximal hamstring anatomy, typical injury patterns, and proper scanning technique, MSKUS can help clinicians differentiate tendinopathy, partial tears, and ruptures; monitor healing over time; and better individualize rehabilitation progression and patient education. Although MSKUS remains operator dependent and may not fully replace MRI in more complex presentations, its accessibility and ability to provide dynamic assessment make it a practical adjunct for guiding clinical decision-making and supporting optimal return-to-sport outcomes.

Published: April 01, 2026 CDT.

© The Author(s)

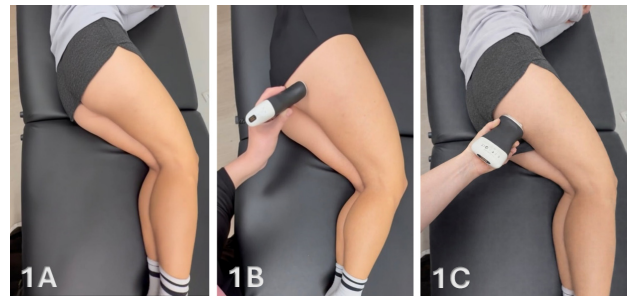


Figure 1A: Patient Positioning

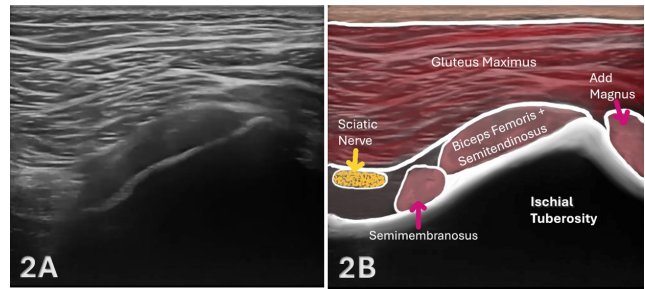
The patient is positioned in side-lying with the involved limb uppermost. The hip is slightly flexed and the knee is placed in mild flexion to create gentle tension across the proximal hamstring origin while allowing access to the inferior gluteal fold and proximal posterior thigh for transducer placement over the ischial tuberosity. Imaging is typically performed at rest, although dynamic knee flexion may be used to enhance tendon fiber definition and assist in differentiating the semimembranosus from the conjoint tendon. Prone positioning with the feet hanging slightly over the edge of the examination table may also be used as an alternative to provide passive tension across the hamstring complex.

Figure 1B: Transducer Placement for Proximal Hamstring Tendon in SAX

For short axis (SAX) imaging, a high frequency linear transducer is placed transversely over the ischial tuberosity, which serves as the primary osseous landmark. In larger or more muscular individuals, a curvilinear transducer may be required to achieve adequate depth penetration. The transducer should be swept medial-to-lateral and proximal-to-distal to evaluate the full extent of the tendinous complex. Regular heel-toe angulation is essential to maintain perpendicular insonation and minimize anisotropy.

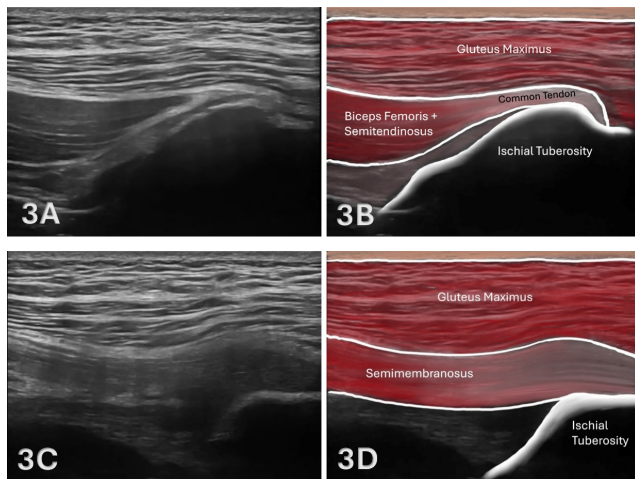
Figure 1C: Transducer Placement for Proximal Hamstring Tendon in LAX

For long axis (LAX) imaging, the transducer is rotated 90 degrees so the marker faces proximally and aligned parallel to the tendon fibers over the ischial tuberosity. In this orientation, the conjoint tendon appears as a triangular or gently curved hyperechoic structure attaching along the medial aspect of the ischial tuberosity. The semimembranosus tendon inserts more laterally and more deeply and may require firm lateral transducer pressure or a slightly oblique lateral approach for optimal visualization due to its curved course along the ischium. The fibrillar architecture of the tendon should be uniform and continuous as it transitions distally into the myotendinous junction. Dynamic knee flexion may be used to tension the tendon and improve visualization of fiber continuity. Bilateral comparison is recommended to assess for asymmetry in tendon thickness or echotexture.



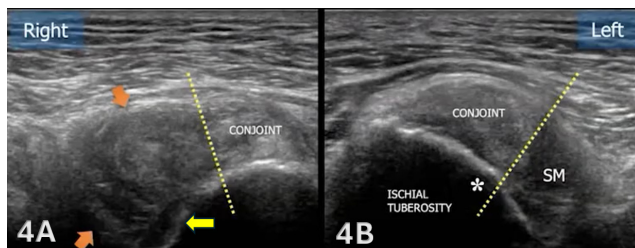
Figures 2A and 2B: Normal Proximal Hamstring Tendon in SAX

In SAX imaging, the ischial tuberosity serves as the central osseous landmark and appears as a hyperechoic cortical interface with posterior acoustic shadowing. From medial to lateral, the proximal hamstring complex is organized into the conjoint tendon—formed by the semitendinosus and long head of the biceps femoris—followed by the deeper and more lateral semimembranosus tendon. In transverse orientation, the conjoint tendon appears as a relatively superficial hyperechoic structure separating the medial semitendinosus from the lateral biceps femoris, while the semimembranosus occupies a deeper and slightly more lateral or anterior position at its origin and often demonstrates a recognizable aponeurotic component. The sciatic nerve lies lateral and deep to the conjoint tendon and should be routinely identified, demonstrating normal fascicular architecture without enlargement or distortion. A normal proximal hamstring origin demonstrates homogeneous echogenicity and preserved fibrillar organization, with typical SAX tendon thickness measuring approximately 4–6 mm for the conjoint tendon and 5–7 mm for the semimembranosus, and symmetry compared with the contralateral side. There should be no separation of fascial planes, hypoechoic clefts, fiber discontinuity, or peritendinous fluid collections suggestive of tear or hematoma.



Figures 3A through 3D: Normal Proximal Hamstring Tendon in LAX

In LAX imaging, the normal proximal hamstring origin demonstrates a uniform fibrillar echotexture with parallel hyperechoic fibers inserting smoothly onto the ischial tuberosity. The cortical margin of the ischium should appear smooth and well-defined without irregularity. The conjoint tendon lies superficial and medial, while the semimembranosus tendon occupies a deeper and slightly more lateral position at the origin. The proximal hamstring origin measures approximately 4–6 mm in thickness at the ischial attachment, although mild physiologic variation may occur depending on patient size and activity level. There should be no focal hypoechogenicity, fiber discontinuity, or peritendinous fluid. Because the semimembranosus inserts more deeply and laterally, adequate depth of visualization and subtle lateral transducer pressure may be required to clearly delineate its fibers. Assessment should include tendon thickness, enthesis integrity, and side-to-side comparison to identify subtle abnormalities or asymmetry suggestive of early tendinopathy.



Figures 4A and 4B: Proximal Hamstring Tendinopathy and Micro-tearing in SAX

Figures 4A and 4B demonstrate the right proximal hamstring origin, showing a normal-appearing conjoint tendon at the ischial tuberosity. In contrast, the semimembranosus tendon (orange arrows) appears thickened with focal irregularity at its insertion on the ischial tuberosity. A small anechoic region (yellow arrow) at the enthesis suggests focal micro-tearing or partial fiber disruption. Figure 4B demonstrates the contralateral (left) proximal hamstring origin, which shows a normal conjoint tendon and semimembranosus insertion with preserved fibrillar architecture and normal tendon thickness. Comparison with the uninvolved side highlights the asymmetric thickening and focal structural changes of the semimembranosus tendon on the symptomatic side.

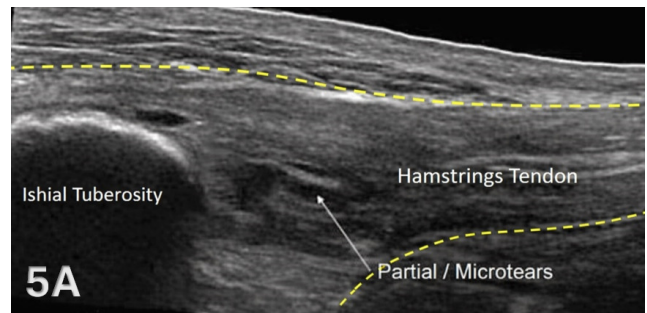
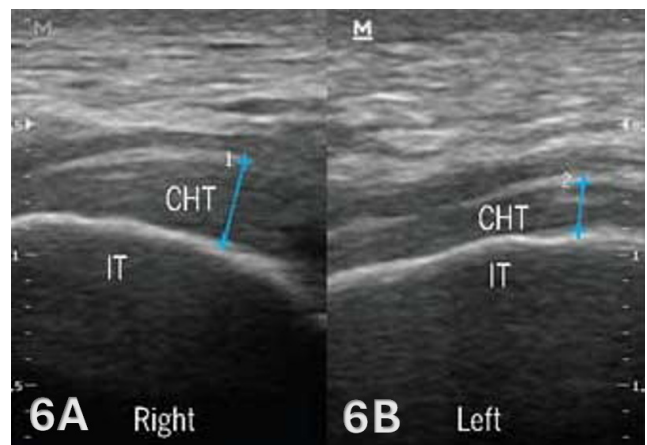


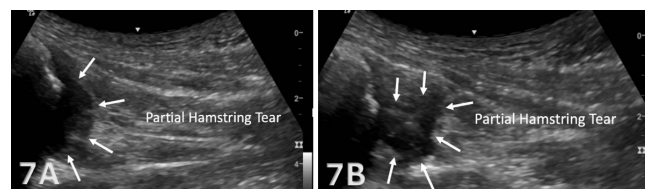
Figure 5A: Proximal Hamstring Tendinopathy with Partial Fiber Disruption in LAX

LAX ultrasound imaging of the proximal hamstring origin demonstrates a thickened tendon at the ischial tuberosity with loss of the normal organized fibrillar architecture. Hypoechoic regions within the tendon near the enthesis represent areas of partial tearing or micro-tearing consistent with proximal hamstring tendinopathy. The cortical surface of the ischial tuberosity is visualized as a hyperechoic curved interface with posterior acoustic shadowing. Superficial tendon fibers continue proximally along the course of the hamstring musculature, while deeper fibers anchor at the osseous insertion. These findings are characteristic of chronic degenerative changes at the proximal hamstring tendon insertion.



Figures 6A and 6B: Proximal Hamstring Conjoint Tendon Tendinosis in LAX

In Figure 6A, LAX ultrasound imaging of the proximal hamstring origin (CHT) demonstrates a thickened tendon at the ischial tuberosity (IT) with loss of the normal, organized fibrillar echotexture. The tendon appears relatively hypoechoic compared with the surrounding tissue, findings consistent with proximal hamstring tendinopathy. The cortical margin of the ischial tuberosity remains intact without evidence of avulsion, while the increased tendon thickness and altered echogenicity suggest chronic degenerative changes at the enthesis. This pathology is compared to the normal contralateral left hamstring conjoint tendon shown in Figure 6B.



Figures 7A and 7B: Proximal Hamstring Tendon Avulsion in LAX

LAX ultrasound images in Figures 7A and 7B demonstrate a proximal hamstring tendon avulsion at the ischial tuberosity. The normal fibrillar architecture of the proximal hamstring origin is disrupted, with a hypoechoic defect adjacent to the osseous insertion consistent with partial tendon avulsion and surrounding fluid or hematoma. The arrows highlight areas of fiber discontinuity and separation from the ischial tuberosity.



REFERENCES

1. Becciolini M, Bonacchi G, Bianchi S. Ultrasound features of the proximal hamstring muscle-tendon-bone unit. *J Ultrasound Med*. 2019;38(5):1367-1382. doi:[10.1002/jum.14804](https://doi.org/10.1002/jum.14804)
2. Beltran L, Ghazikhanian V, Padron M, Beltran J. The proximal hamstring muscle-tendon-bone unit: a review of the normal anatomy, biomechanics, and pathophysiology. *Eur J Radiol*. 2012;81(12):3772-3779. doi:[10.1016/j.ejrad.2011.03.099](https://doi.org/10.1016/j.ejrad.2011.03.099)
3. Linklater JM, Hamilton B, Carmichael J, Orchard J, Wood DG. Hamstring injuries: anatomy, imaging, and intervention. *Semin Musculoskelet Radiol*. 2010;14(2):131-161. doi:[10.1055/s-0030-1253157](https://doi.org/10.1055/s-0030-1253157)
4. Liu H, Garrett WE, Moorman CT, Yu B. Injury rate, mechanism, and risk factors of hamstring strain injuries in sports: A review of the literature. *J Sport Health Sci*. 2012;1(2):92-101. doi:[10.1016/j.jshs.2012.07.003](https://doi.org/10.1016/j.jshs.2012.07.003)
5. Kenneally-Dabrowski CJB, Brown NAT, Lai AKM, Perriman D, Spratford W, Serpell BG. Late swing or early stance? A narrative review of hamstring injury mechanisms during high-speed running. *Scand J Med Sci Sports*. 2019;29(8):1083-1091. doi:[10.1111/sms.13437](https://doi.org/10.1111/sms.13437)
6. Chumanov ES, Heiderscheit BC, Thelen DG. Hamstring musculotendon dynamics during stance and swing phases of high-speed running. *Med Sci Sports Exerc*. 2011;43(3):525-532. doi:[10.1249/MSS.0b013e3181f23fe8](https://doi.org/10.1249/MSS.0b013e3181f23fe8)
7. Kujala UM, Orava S, Järvinen M. Hamstring injuries. Current trends in treatment and prevention. *Sports Med*. 1997;23(6):397-404. doi:[10.2165/00007256-199723060-00005](https://doi.org/10.2165/00007256-199723060-00005)
8. Miguel-Pérez M, Iglesias-Chamorro P, Ortiz-Miguel S, et al. Anatomical relationships of the proximal attachment of the hamstring muscles with neighboring structures: from ultrasound, anatomical and histological findings to clinical implications. *Diagnostics*. 2024;14(16):1725. doi:[10.3390/diagnostics14161725](https://doi.org/10.3390/diagnostics14161725)
9. van der Made AD, Wieldraaijer T, Kerkhoffs GM, et al. The hamstring muscle complex. *Knee Surg Sports Traumatol Arthrosc*. 2015;23(7):2115-2122. doi:[10.1007/s00167-013-2744-0](https://doi.org/10.1007/s00167-013-2744-0)
10. Lee RKL, Griffith JF, Ng AWH, Hung ELK. Sonographic examination of the buttock. *J Clin Ultrasound*. 2013;41(9):546-555. doi:[10.1002/jcu.22088](https://doi.org/10.1002/jcu.22088)
11. Williams MA, Naffaa L. Ischial tuberosity avulsion fracture mimicking calcified mass on plain films: a case report. *Cureus*. 2024;16(1):e53165. doi:[10.7759/cureus.53165](https://doi.org/10.7759/cureus.53165)
12. Kellis E, Galanis N, Natsis K, Kapetanios G. Validity of architectural properties of the hamstring muscles: Correlation of ultrasound findings with cadaveric dissection. *J Biomech*. 2009;42(15):2549-2554. doi:[10.1016/j.jbiomech.2009.07.011](https://doi.org/10.1016/j.jbiomech.2009.07.011)
13. Palmer TB, Akehi K, Thiele RM, Smith DB, Thompson BJ. Reliability of panoramic ultrasound imaging in simultaneously examining muscle size and quality of the hamstring muscles in young, healthy males and females. *Ultrasound Med Biol*. 2015;41(3):675-684. doi:[10.1016/j.ultrasmedbio.2014.10.011](https://doi.org/10.1016/j.ultrasmedbio.2014.10.011)
14. Kositsky A, Gonçalves BAM, Stenroth L, Barrett RS, Diamond LE, Saxby DJ. Reliability and validity of ultrasonography for measurement of hamstring muscle and tendon cross-sectional area. *Ultrasound Med Biol*. 2020;46(1):55-63. doi:[10.1016/j.ultrasmedbio.2019.09.013](https://doi.org/10.1016/j.ultrasmedbio.2019.09.013)
15. Sahinis C, Kellis E, Dafkou K, Ellinoudis A. Reliability of distal hamstring tendon length and cross-sectional area using 3-D freehand ultrasound. *Ultrasound Med Biol*. 2021;47(9):2579-2588. doi:[10.1016/j.ultrasmedbio.2021.05.025](https://doi.org/10.1016/j.ultrasmedbio.2021.05.025)
16. Bianchi S, Brasseur J, Morvan G. Muscles. In: *Musculoskeletal Ultrasound*. Lippincott Williams & Wilkins; 2013:254-257.
17. Tosovic D, Muirhead JC, Brown JMM, Woodley SJ. Anatomy of the long head of biceps femoris: An ultrasound study. *Clin Anat*. 2016;29(6):738-745. doi:[10.1002/ca.22718](https://doi.org/10.1002/ca.22718)
18. Bengtzen RR, Ma OJ, Herzka A. Point-of-care ultrasound diagnosis of proximal hamstring rupture. *J Emerg Med*. 2018;54(2):225-228. doi:[10.1016/j.jemermed.2017.11.027](https://doi.org/10.1016/j.jemermed.2017.11.027)
19. Burke CJ, Bencardino J, Adler R. The potential use of ultrasound-magnetic resonance imaging fusion applications in musculoskeletal intervention. *J Ultrasound Med*. 2017;36(1):217-224. doi:[10.7863/ultra.16.02024](https://doi.org/10.7863/ultra.16.02024)

20. Pollock N, Patel A, Chakraverty J, Suokas A, James SLJ, Chakraverty R. Time to return to full training is delayed and recurrence rate is higher in intratendinous ('c') acute hamstring injury in elite track and field athletes: clinical application of the British Athletics Muscle Injury Classification. *Br J Sports Med.* 2016;50(5):305-310. doi:[10.1136/bjsports-2015-094657](https://doi.org/10.1136/bjsports-2015-094657)

21. Stevens MA, El-Khoury GY, Kathol MH, Brandser EA, Chow S. Imaging features of avulsion injuries. *Radiographics.* 1999;19(3):655-672. doi:[10.1148/radiographics.19.3.g99ma05655](https://doi.org/10.1148/radiographics.19.3.g99ma05655)

22. Zissen MH, Wallace G, Stevens KJ, Fredericson M, Beaulieu CF. High hamstring tendinopathy: MRI and ultrasound imaging and therapeutic efficacy of percutaneous corticosteroid injection. *Am J Roentgenol.* 2010;195(4):993-998. doi:[10.2214/AJR.09.3674](https://doi.org/10.2214/AJR.09.3674)