Core Injuries Remote from the Pubic Symphysis

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KEYWORDS

• Core • Muscle • Injury • Athlete • Imaging • MRI • Ultrasound

KEY POINTS

- The *core* refers to the central musculoskeletal system of the torso (including the lower thorax, abdomen, pelvis, thoracolumbar spine, and proximal thighs) and plays an essential role in both static stabilization and dynamic function.
- Core injuries remote from the pubic symphysis are important, potentially overlooked considerations in both athletes and active nonathletes.
- MR imaging is often the modality of choice for assessing core injuries given its superior soft tissue contrast. Specialized imaging protocols tailored to the area of interest should be used when assessing for core injury.
- Large field-of-view (FOV) MR imaging of both the affected and unaffected sides may increase conspicuity of subtle edema or asymmetry, whereas focused small FOV images of the affected side provide improved spatial resolution to better characterize an abnormality.
- Ultrasound often plays an adjunctive role in evaluating and potentially treating core injuries.

INTRODUCTION

The *core* in most general terms refers to the central musculoskeletal system of the torso and plays an essential role in both static stabilization and dynamic function. Anatomically, the core includes the musculoskeletal structures of the lower thorax, abdomen, pelvis, thoracolumbar spine, and proximal thighs. The importance of the midline pubic plate and rectus abdominis-adductor aponeurosis for core stability and function has been previously described.[1,2] Core injuries remote from the pubic symphysis, however, are additional, potentially overlooked considerations in both athletes and active nonathletes and are often similar in presentation and pathophysiologic mechanism. This article presents an overview of commonly encountered injuries involving the core anatomy remote from the pubic symphysis.

MR imaging is often the modality of choice for assessing core injuries given its superior soft tissue contrast. Specialized imaging protocols tailored to the area of interest should be used when assessing for core injury. For most injuries involving the central core, it is prudent to use imaging in 3 planes using both traditional fluid-sensitive sequences, including short tau inversion recovery (STIR) and T2 fat-suppression (FS), and anatomic sequences, including T1 and proton-density (PD) non-FS. As another general guideline, large FOV imaging of both the affected and unaffected sides should be included, which may increase conspicuity of subtle edema or

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asymmetry. Focused small FOV images of the affected side provide improved spatial resolution to better characterize the abnormality. As with all imaging studies, each MR imaging examination should be tailored to a patient's specific clinical scenario. In addition to MR imaging, ultrasound often plays an adjunctive role in evaluating and potentially treating core injuries. Initial work-up for many injuries often includes standard radiographs to evaluate for acute osseous pathology. The utility of each modality as it relates to particular core injuries is described in greater detail in each subsection.

In addition to reviewing core musculotendinous injuries away from the pubic symphysis, this article covers several specific clinical syndromes and their relevant imaging features. Although core injuries may be found in all patient populations, they are most relevant in young, active individuals and athletes. The importance of core strengthening and conditioning for both performance and injury prevention is of great interest to athletes and trainers and is the subject of entire books and physiatry programs.

MUSCULOTENDINOUS INJURIES

The most commonly encountered core injury in clinical practice is a muscle strain in the torso or proximal thighs. Muscles in the lower thorax susceptible to injury include the intercostal, serratus anterior, and proximal external oblique muscles. The major muscles of the abdominal wall include the rectus abdominis, transversus abdominis, internal oblique, and external oblique muscles. Important muscles about the lower spine include the quadratus lumborum, multifidus, erector spinae, and psoas major, among other paraspinal muscles. Muscles in the proximal thigh are manifold and can be subdivided into groups based on function, including hip flexion, extension, adduction, abduction, internal rotation, and external rotation.

The most commonly used grading system for muscle strains among radiologists includes 3 grades of injury based on characteristic MR imaging features.[3] Grade 1 strains are characterized histopathologically by mild inflammatory cell infiltration, edema, and swelling, possibly with disruption of the endomysium or perimysium connective tissues. MR imaging findings of grade 1 strains include interstitial muscle edema with or without associated hemorrhage but with preservation of normal muscle architecture (**Figs. 1** and **2**). Grade 2 and grade 3 strains are characterized by partial or complete tears of the musculotendinous unit, respectively, with possible defect or retraction of torn muscle fibers (**Figs. 3–6**). Higher-grade muscle strains frequently demonstrate associated intramuscular hemorrhage by imaging. Acute muscle strains tend to occur at the myotendinous junction, where the muscle-tendon complex is weakest and there is higher concentration of tensile forces.[3–5] Complete musculotendinous avulsions occur at origin or insertion attachment sites to the bones.

Acute muscle strains are almost invariably managed conservatively. Although standard therapy once focused on rest, ice, compression, and elevation (RICE) therapy, the benefits of immobilization, compression, and elevation are uncertain. Some clinicians now advocate for early mobilization and rehabilitation for low-grade muscle strains, which may reduce scarring and accelerate healing response. Management has also been expanded to include nonsteroidal anti-inflammatory drugs (NSAIDs) and other adjunctive therapies.[6] Direct intramuscular injections of NSAIDs and corticosteroids have been used with success in high-level athletes, providing

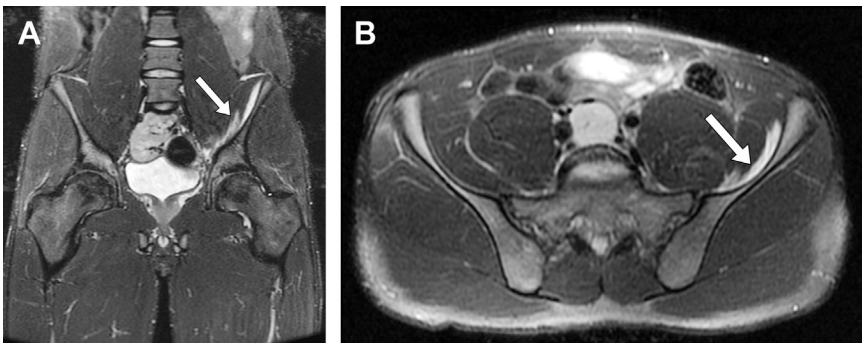

Fig. 1. Iliacus muscle strain in a 16-year-old male soccer player with left groin pain. (*A*) Coronal STIR and (*B*) axial T2 FS MR images demonstrate feathery edema within the left iliacus muscle belly without disruption of muscle fibers (*arrows* [*A*, *B*]), consistent with a grade 1 strain.