MR imaging of the quadratus femoris: Anatomic considerations and pathologic lesions

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Learning objectives

Demonstrate cadaveric and MR anatomy of the quadratus femoris

Demonstrate differential signal characteristics of lesions of the quadratus femoris than can produce hip pain

Background

Given the ever-increasing use of MR imaging (with or without MR arthrography) in the evaluation of hip pain, one must be aware of subtle and less common abnormalities that may mimic both intra- and extra-articular hip disease. Recently, lesions of the quadratus femoris have been implicated as a cause of hip pain. Thus, it is important to be familiar with the normal anatomy of the quadratus muscle and to be able to accurately diagnose the cause of signal abnormalities of the quadratus femoris.

Imaging findings OR Procedure details

Gross anatomy

The quadratus femoris muscle is situated along the posterior aspect of the hip joint and, as the name suggests, has a quadrangular (somewhat rectangular) appearance. Its origin is at the inferolateral margin of the ischium along the anterior portion of the ischial tuberosity just anterior to the origin of the hamstring tendons. Its insertion is along the posterior medial aspect of the proximal femur along the quadrate tubercle along the posterior intertrochanteric ridge. (Fig 1-3) The muscle has a somewhat striated appearance with the fibers running along the horizontal (axial) plane and being more closely opposed along the femoral end of the muscle and more loosely arranged and with more interspersed fat along the ischial aspect.

Anteriorly, the quadratus femoris is bordered by the obturator externus while posteriorly it is bordered by fat and the sciatic nerve. (Fig 4-7). Superiorly, the quadratus femoris is bordered by fat and the inferior gemellus and inferiorly it is bordered by the adductor magnus. (Fig 4-7)
Innervation and function

The quadratus femoris is innervated by a small branch off the sacral plexus. Specifically, it derives its innervation from L4, L5, and S1. The nerve to the quadratus femoris exits the pelvis through the greater sciatic notch, travels inferiorly along the anterior border of the gemelli and the obturator internus, and enters the quadratus muscle along its anterior surface. This same nerve can give rise to a small articular branch.

The quadratus femoris acts as an adductor and external rotator of the hip.

MR imaging anatomy:

The quadratus femoris is easily identified on axial, sagittal and, depending on slice thickness, coronal images of the hip.

The muscle is often best evaluated on axial images where its origin, insertion, and anterior and posterior relationships can be evaluated. (Fig 2,3) The tendinous origin along the ischium may appear broad based and fasciculated and is best located by searching along the ischial tuberosity just anterior to the hamstring tendons. Its insertion onto the posteromedial femur is characterized by a convergence of the muscle fibers toward a narrower attachment when compared to the origin. (Fig 2, 3, 5, 6) Note the hamstring tendons just posterior to the quadratus femoris origin and the sciatic nerve along the posterior margin of the quadratus femoris muscle. Sagittal images can also show these same relationships as well as the inferior gemellus superiorly and the sciatic nerve posteriorly. (Fig 7)

Injuries and MR imaging signal abnormalities of the quadratus femoris

Lesions of the quadratus femoris have not been reported with great frequency in the English literature. Based on the literature, the most common primary lesions of the quadratus femoris are myotendinous strains (or partial tears) of the quadratus femoris and impingement of the belly of the quadratus femoris. Lesions of the quadratus femoris appear to me more common in middle aged and older women and typically present with hip posterior gluteal or groin pain with or without a clear inciting event. The pain may radiate along the posterior thigh, possibly due to irritation of the closely apposed sciatic nerve which travels along the posterior aspect of the muscle.

As with most muscle strains in other parts of the body, a strain of the quadratus femoris muscle appears as edema centered along the myotendinous junction of the quadratus
femoris muscle with or without associated fluid. This is most commonly seen along the distal myotendinous junction along the poster-medial aspect of the proximal femur. Strains of the quadratus femoris are best seen on axial and sagittal fat suppressed fluid sensitive sequences such as STIR, fat suppressed proton density, or fat suppressed T2 weighted sequences. (Fig. 8) On axial and sagittal images, tears can manifest as edema and fluid posterior to the lesser trochanter.

The recently described entity of impingement of the quadratus femoris muscle manifests as crowding of the fibers of the muscle belly in the space between the ischium (and/or hamstring tendons) and the posteromedial femur. The associated edema is typically centered within the muscle belly at the site of maximal impingement. (Fig. 9,10) This is in contradistinction to the edema in myotendinous strains which is typically seen along the distal myotendinous junction. Impingement of the quadratus femoris is best assessed on axial images where the location of the edema can be accurately localized. In addition axial images provide a better assessment of the relationship of the muscle belly to the surrounding structures. Although muscle fibers orientation can be seen on fat suppressed imaged, the orientation is typically better seen on images without fat suppression.

Although at first glance it may be difficult to distinguish between a strain and impingement, careful analysis of the location of the edema and the configuration of the muscle fibers and surrounding structures can aid in differentiating between the two entities.

Finally, other entities can also affect the quadratus femoris. There have been case reports of tendonitis of the quadratus femoris presenting as hip pain. In addition, one may get denervation of the quadratus femoris (Fig 11) in the absence of a tear. This is presumed to be the result of an injury or lesion of the neural branch from the sacral plexus that innervates the quadratus femoris. Finally, one may see signal abnormalities (e.g. edema) that can be seen following new or intense activities. (Fig 12)

Images for this section:
Fig. 1: Normal anatomy: axial gross anatomy. QF quad femoris; arrow: origin; arrowhead: insertion; asterisk: obturator externus; circled: sciatic nerve; I: ischial tuberosity; Double arrow: hamstring origin; F: femur
Fig. 2: Normal anatomy: axial T1 weighted cadaveric MR. QF: quad femoris; arrow: origin; arrowhead: insertion; asterisk: obturator externus; circled: sciatic nerve; I: ischial tuberosity; Double arrow: hamstring origin; F: femur
Fig. 3: Normal anatomy: axial T1 weighted clinical MR. QF: quad femoris; arrow: origin; arrowhead: insertion; asterisk: obturator externus; circled: sciatic nerve; I: ischial tuberosity; Double arrow: hamstring origin; F: femur
Fig. 4: Normal anatomy: coronal gross anatomy. QF: quadratus femoris; arrow: inferior gemellus; I: ischium; F: femur
**Fig. 5:** Normal anatomy: coronal T1 weighted cadaveric MRI. QF: quadratus femoris; arrow: inferior gemellus; I: ischium; F: femur
**Fig. 6:** Normal anatomy: coronal T1 weighted clinical MRI. QF: quadratus femoris; arrow: inferior gemellus; I: ischium; F: femur
Fig. 7: Normal anatomy: 3 sagittal T2 weighted clinical MRI images (from medial to lateral). QF: quadratus femoris origin (1), belly (2), insertion (3); long arrow: inferior gemellus; I: ischium; H: hamstring origin; arrowheads: sciatic nerve
**Fig. 8:** Partial tear quadratus femoris: Axial fat suppressed T2 weighted MRI shows partial tear (grade II strain) of the quadratus femoris (arrow). Tears appear to be more frequent near the femoral end of the muscle. F: femur; I: Ischium
**Fig. 9:** Impingement of quadratus femoris: Axial T1 (left) and fat suppressed T2 (right) images show crowding of the fibers and edema in the fibers (arrows) of the quadratus femoris. These are the typical findings in impingement of quadratus femoris. F: femur; I: Ischium; Circle: sciatic nerve
**Fig. 10:** Impingement of quadratus femoris: Axial T1 (left) and fat suppressed T2 (right) images show crowding of the fibers and edema in the fibers (arrows) of the quadratus femoris. These are the typical findings in impingement of quadratus femoris. F: femur; I: Ischium; Circle: sciatic nerve
**Fig. 11:** Atrophy of the quadratus femoris: axial T1 weighted image shows complete atrophy of the quadratus femoris (QF?). Arrowhead: intact QF tendon insertion; Asterisk: obturator externus; F: femur; I: ischium; circle: sciatic nerve; double arrow: hamstring origin.
Fig. 12: Exercise induced edema: coronal (a) and sagittal (b,c) fat suppressed proton density weighted sequences demonstrate increased signal (arrows) in both quadratus femoris muscles, right greater than left, in this young woman who presented with progressive buttock pain and sciatica after beginning a new exercise regimen consisting of intensive spinning (stationary cycling) classes.
Conclusions:

MR imaging can elegantly demonstrate the normal anatomy and pathological conditions of the quadratus femoris.

Strains and impingement are the two most common primary lesions of the quadratus femoris. These two entities can be differentiated at MR imaging by carefully analyzing the location of edema and the configuration of the muscle fibers.

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References

