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Osteoid Osteoma of the Femoral Neck in Athletes: Two Case Reports Differentiating From Femoral Neck Stress Injuries

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The diagnosis of an intra-articular osteoid osteoma can be a challenging and lengthy process, with reports of delayed diagnosis of greater than 2 years. In the young, athletic patient with an atraumatic onset of groin pain, an overuse injury or muscle strain is the most likely etiology. However, an overuse injury of femoral neck stress fracture must be identified because of the potentially disastrous outcome of fracture completion. The similar clinical presentation of a femoral neck stress fracture and intra-articular osteoid osteoma of the femoral neck can further delay the diagnosis of the osteoid osteoma. In a patient with these differential diagnoses that do not improve with a period of nonweightbearing activity, a more intensive workup must ensue. The purpose of this case report is to describe the initial presentations, subsequent follow-up, and imaging findings leading to the diagnosis of osteoid osteoma as well as to differentiate an osteoid osteoma from femoral neck stress injuries.

Keywords: osteoid osteoma; femoral neck stress fracture; athletes; bone tumor

The diagnosis and treatment of osteoid osteoma are generally straightforward; however, there are anatomic locations of the tumor that may result in diagnostic confusion. The diagnosis of an intra-articular osteoid osteoma of the femoral neck can be a challenging and lengthy process, with reports of delayed diagnosis of longer than 2 years.[1,2] The differential diagnosis in the young, athletic patient with an atraumatic onset of groin pain should include the diagnosis of an overuse injury or muscle strain as the most likely cause.[1] One overuse injury associated with potentially disastrous outcomes is a femoral neck stress fracture due to the propensity for fracture completion.[19] Given that a completed femoral neck stress fracture may be associated with subsequent femoral head osteonecrosis and collapse, it should be aggressively pursued. Femoral neck stress fractures can begin in the proximal lateral femoral neck (a tension-sided stress fracture) or on the inferomedial cortex of the femoral neck (a compression-sided stress fracture). The biomechanical stability of the compression-sided femoral neck stress fracture leads to resolution with nonweightbearing and cessation of all activities.[19] Tension-sided femoral neck stress fractures are inherently unstable and are more likely to require percutaneous femoral neck pinning to obviate the risk of a completed femoral neck stress fracture. Radiographs, computed tomography (CT), magnetic resonance imaging (MRI), and bone scans may be used to diagnose a femoral neck fracture or alternate etiology. When a patient's symptoms do not improve with nonweightbearing activity, a more intensive workup must ensue.

The following cases outline the sequence of events surrounding 2 athletic male patients who developed hip pain doing a repetitive "squat" exercise.

CASE 1

A 29-year-old military policeman presented to the orthopaedic clinic with a complaint of deep, anterior, right-sided groin pain

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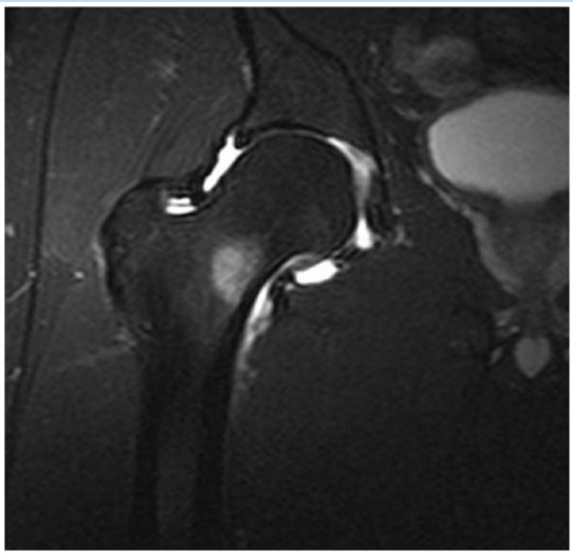

Figure 1. Coronal fat-suppressed, T2-weighted magnetic resonance image demonstrating focal semicircular area of increased signal (ie, marrow edema pattern) located within the medial aspect of the right femoral neck.

and posterolateral thigh pain for 3 months. The onset of pain occurred with a rigorous physical training session, which included repeated body-weight squats. Provocative activities included prolonged sitting, running, and walking.

His treatment course consisted of a period of activity modification and a trial of oral nonsteroidal anti-inflammatory drug (NSAID) therapy, which failed to improve his symptoms. Radiographs of his right hip were normal. MRI with intra-articular injection of contrast (magnetic resonance arthrography [MRA]) revealed high signal intensity (ie, marrow edema pattern) in the compression side of the femoral neck on the coronal short tau inversion recovery (STIR) and T2-weighted, fat-suppressed images (Figure 1). He was diagnosed with a femoral neck stress injury and was referred to the orthopaedic service.

His physical examination at the initial orthopaedic evaluation revealed a mild antalgic gait favoring his right lower extremity. The hip range of motion was 135° of flexion, internal rotation to 25°, and external rotation to 45°; all ranges were equal to those of the contralateral side. Internal rotation reproduced his pain. A logroll and active straight-leg raise reproduced pain in the deep anterior groin. He was diagnosed with a compression-sided femoral neck stress fracture and was initially treated with 3 months' toe-touch weightbearing (TTWB) with crutches.

Physical therapy began at 6 months for general lower extremity reconditioning and a walk-to-run program. His symptoms waxed and waned during his reconditioning phase. Provocative activities included stationary biking, running, and walking.

After 10 months, his symptoms had not completely resolved. A repeat MRI demonstrated a persistent nonspecific edema pattern

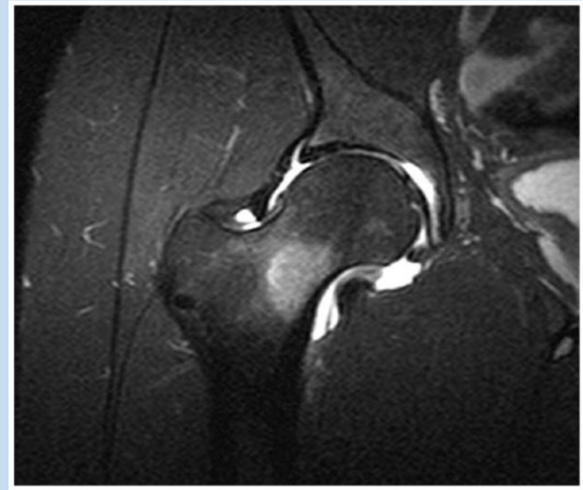

Figure 2. Coronal fat-suppressed magnetic resonance image 10 months after the onset of symptoms demonstrates an increase in extent of the high signal.

Figure 3. Noncontrast coronal computed tomography demonstrates a 4-mm lucency with tiny internal calcification and surrounding sclerosis adjacent to the medial cortex of the femoral neck.

on the compression side of the femoral neck (Figure 2). No abnormal rounded signal amidst the edema was present to suggest an osteoid osteoma. Further diagnostic imaging with a CT and a 3-phase bone scan demonstrated no uptake on initial phases, with mild diffuse increased uptake on delayed images in the right hip region. The CT scan revealed a 4-mm lucency with mild surrounding sclerosis within the anterior inferior cortex of the femoral neck (Figure 3), indicating an osteoid osteoma of the femoral neck.

The patient underwent an outpatient radiofrequency ablation of the lesion and was allowed graduated return to activity over an 8-week period. He reported a pain level of "0" (scale, 0-10) in his hip, with improvement of his symptoms with active range of motion and ambulation 1 week postprocedure. At 8 weeks postablation, the patient continued to report a pain level of 0, with no recurrence of symptoms with activities of daily living and military physical training.

CASE 2

A 17-year-old male cadet at the United States Military Academy presented to a direct-access physical therapy clinic with deep right lateral hip pain for a few weeks while lifting weights. The pain was in the right hip at the bottom of a squat. He was continuing to run and participate in physical education classes, though he rated his pain to be as high as an "8" (scale, 0-10) in recent days. He had no previous history of hip or lower back pain. On physical examination, he demonstrated anterior and deep right hip pain in the deepest part of a body-weight squat. All other objective tests and measures on initial examination were normal. The patient was instructed to avoid the deep squat position during his physical training over the next 2 weeks.

Four weeks later, his deep hip pain was unchanged except for occurring with other activities, especially high-intensity dynamic activities. His hip flexion was limited to 115° and internal rotation to 15° due to tightness and pain. A flexion, abduction, and external rotation (FABER) test was positive.[18] Belt mobilization treatment of the hip joint, specifically traction, provided relief.

At his 2-month follow-up, the condition had worsened: hip pain with hip flexion beyond 90° and pain with weightbearing activity causing an antalgic gait. At this time, a radiograph of the hip demonstrated only cranial acetabular retroversion (Figure 4). Fat-suppressed, T2-weighted images demonstrated a marrow edema pattern on the tension side of the femoral neck, which was felt to be consistent with a stress injury (Figure 5, a and b). He was maintained with TTWB for 3 months, with rehabilitation.

Six weeks later, he continued to have pain despite limited weightbearing. The anterior hip pain was aggravated with crutch ambulation and rotation of the hip, as well as prolonged sitting. His symptoms decreased with NSAIDs. Given his overall lack of improvement with rest and nonweightbearing activity, his previous diagnosis of stress fracture was questioned. Repeat radiographs of his hip were normal—a finding unusual for stress fracture as some evidence of healing would be expected at this time. Repeat MRA of the hip demonstrated a marrow edema pattern along the femoral neck, consistent with a stress injury.

A 3-mm low signal focus surrounded by a 1- to 2-mm rim of enhancement suggested a nidus of osteoid osteoma within the cortex of the anterior subcapital femoral neck (Figure 6). This subtle finding was not evident on previous imaging, likely because of the administration of intravenous gadolinium, which has been reported to increase nidus conspicuity.[10] The CT demonstrated 3 × 9–mm lucency within the anterolateral subcapital cortex with faint surrounding sclerosis and periosteal

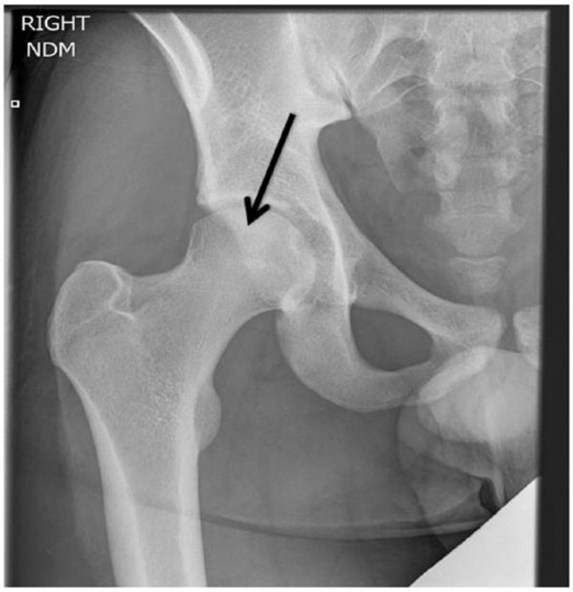

Figure 4. Anteroposterior radiograph demonstrates cranial acetabular retroversion.

reaction (Figure 7), which corresponded with his MRI findings and was consistent with an osteoid osteoma. There were no findings consistent with a healing fracture, which decreased the likelihood of chronic stress injury diagnosis.

He underwent radiofrequency ablation at the regional facility. He continued physical therapy with crutch walking and gradual return to full activity in a 3-month period.

After 1 month, he had a pain-free gait without crutches, pain-free single-leg hop test, and single-limb stance bilaterally. He had soreness with flexion to 90° and extremes of internal and external rotation. The acute pain he had earlier had resolved.

At 3 months postablation, he had progressed to functional athletic movements, including light jogging, and had no pain with hip flexion or full body-weight squats. Nine months postablation, he had resumed all prior activities without symptoms. He passed his Army Physical Fitness Test and returned to full participation in intramural athletics.

DISCUSSION

These 2 cases are unique because they present the challenge of diagnosing a relatively rare condition with signs and symptoms that mimic a common condition in the athletic patient population. It is routine to diagnose stress injuries "until proven otherwise" because of the morbidity associated with missing the diagnosis. We have a high index of suspicion for femoral neck stress injuries because of our patient population's high level of activity. Additionally, close MR images should be scrutinized for an area of circumscribed signal or cortical irregularity amidst a marrow edema pattern in the hip to detect subtle osteoid osteomas. In the athletic and military populations, stress

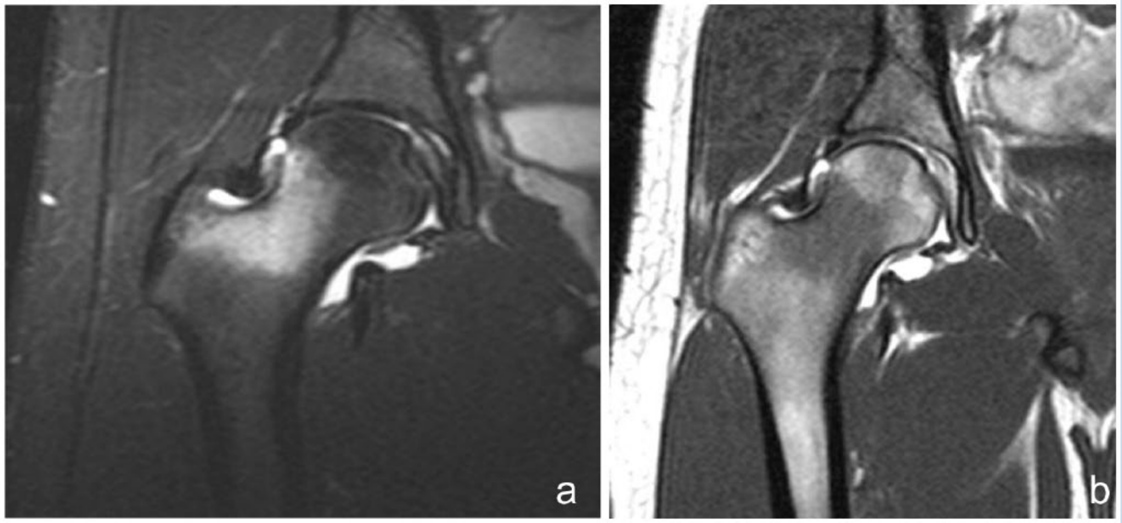

Figure 5. (a) Coronal fat-suppressed, T2-weighted magnetic resonance image shows a large area of increased signal in the superolateral femoral neck. (b) Coronal T1-weighted magnetic resonance image demonstrates a large area of poorly defined decreased signal centered in the superolateral femoral neck.

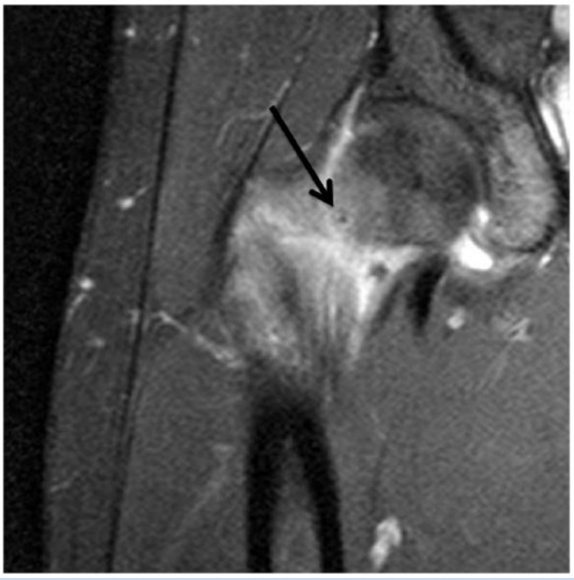

Figure 6. Coronal fat-saturated, T1-weighted image after intravenous administration of contrast demonstrates a targetoid appearance reflecting an osteoid osteoma in the posterior femoral neck, with the low internal signal reflecting the mineralized nidus.

Figure 7. Noncontrast axial computed tomography image demonstrates approximately 9 × 2–mm lucency with marginal sclerosis at the posterior cortex of the femoral neck: the osteoid osteoma.

fractures are a common occurrence.[20,24] Any athlete who engages in frequent, repetitive activities may develop stress fractures. Repetitive weightbearing activities such as marching and running are among the most frequently reported causes of stress fractures in the lower extremity.[13]

Femoral neck stress fracture injuries are of particular concern in runners and the military trainee, accounting for 1.0% to 7.2% of all stress fractures.[11,21] Delayed diagnosis can result in delayed union, nonunion, or femoral head avascular necrosis.[4] This obviously can be a devastating injury if not treated appropriately[23]; 60% of athletes who sustained a displaced femoral neck stress fracture failed to return to preinjury activity levels.[12]

With the potential long-term effects from sustaining a femoral neck stress fracture, whenever this diagnosis is suspected, nonweightbearing activity with axillary crutches should be initiated and diagnostic imaging obtained.[3] Radiographs are typically unremarkable early on.[7] MRI is the most comprehensive method to evaluate for stress fracture being both highly sensitive (86% to 100%) and specific (100%).[7,14,15,22] A bone scan may be useful early on because of high sensitivity (74% to 84%); however, lower specificity can result in a number of false positives.[9]

The overall prevalence of osteoid osteoma is rare, but it is the most common cause of persistent dull pain, worse at night, in the first 3 decades of life, and responsive to treatment with salicylates.[8] The most common location of the lesion is the proximal femur,[16] typically in men in their second and third decades of life.[6] The lesion is a small (<2 cm) lytic lesion with a variably calcified central nidus; it is embedded in a thickened cortex if juxtacortical or surrounded by sclerosis if intramedullary.[16] The nidus has a high concentration of prostaglandins responsible for the pain.[5,17] CT-guided percutaneous radiofrequency ablation is a minimally invasive, highly effective treatment of osteoid osteomas.[25]

There are numerous challenges to diagnosing osteoid osteomas in the young, athletic population. The clinical features are similar to stress injuries of the hip, and the intra-articular lesions are difficult to identify on radiographs.[8] Although the classic MRI appearance of an osteoid osteoma is a focal low-signal nidus, the nidus is frequently not identified and can demonstrate variable signal on all pulse sequences as well as variable enhancement.[10] MRI frequently demonstrates nonspecific bone marrow edema,[8] which is similar to the appearance of femoral neck stress injuries. The lack of improvement with limited weightbearing was a significant factor in the ultimate diagnosis. This clinical finding should lead to a CT to identify the nidus of the osteoid osteoma.

CONCLUSION

For the athletic patient with a clinical and imaging-suggested femoral neck stress fracture that fails to respond to nonweightbearing treatment, a CT scan should be obtained to evaluate the femoral neck.

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