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Femoral neck stress fracture a potentially disabling condition: a case report

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Femoral neck stress fracture represents a focal weakening of the bone often associated with a recent increase in activity level. Since plain film radiographs are initially normal, the clinical diagnosis is based solely on the history and physical examination. The consequence of a delayed diagnosis could result in a complete fracture or avascular necrosis of the femoral head. This paper includes a case report illustrating the important aspects of recognizing patients presenting with an underlying femoral neck stress fracture. The need for radionuclide bone scanning for the early diagnosis of this potentially disabling condition is stressed.
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KEY WORDS: hip, hip fracture, fractures (stress), radionuclide imaging, osteonecrosis.

La fracture de marche du col fémoral représente un affaiblissement en foyer de l'os, souvent associé à une augmentation récente du niveau d'activité. Comme les radiographies simples sont normales au début, le diagnostic clinique se base seulement sur les antécédents médicaux et sur l'examen physique. Le diagnostic tardif peut avoir pour conséquence une fracture compète ou une nécrose avasculaire de la tête du fémur. Cet article inclut une étude de cas mettant en relief l'importance de reconnaître les patients présentant une fracture de marche du col fémoral sous-jacente. Le nécessité d'une scintigraphie osseuse dans le diagnostic précoce de cet état potentiellement invalidant est mise en évidence.
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MOTS CLÉS : hanche, fracture de la hanche, fractures (de marche), image scintigraphique, ostéonécrose.

Introduction

Femoral neck stress fracture is an uncommon entity among the general population but it is more frequently seen in athletes and military recruits. According to Lloyd-Smith et al. stress fractures of the hip and pelvis account for 0.05 to 0.22% of running injuries and 3.2 to 4% of stress fractures in all athletes.[1] Similarly, in a 4 year prospective study of athletes from different sports, Fullerton et al. reported that femoral neck stress fractures comprised only 5% of 1,049 stress fractures of all types.[2]

Typically, the patient with femoral neck stress fracture presents with groin pain of insidious onset, often associated with a recent increase in the level of physical activity. It is common for initial plain film radiographs to be negative, delaying the diagnosis. Two of the potential consequences of a delayed diagnosis and continued stress on the involved area are complete displacement at the fracture site and avascular necrosis of the femoral head.

The aim of this paper is to review the diagnostic key factors regarding femoral neck stress fracture. It includes a case report illustrating the difficult challenge in making the diagnosis. Also, it demonstrates the need for radionuclide imaging in the early detection of these potentially disabling problems. A discussion is presented with emphasis on etiology, clinical presentation, radiological findings and management of femoral neck stress fractures.

Case report

A forty-three-year-old female was seen at the Canadian Memorial Chiropractic College Outpatient Clinic, with a three day history of left groin pain. She first noticed a mild twinge in the area of complaint while jogging. The pain progressively worsened throughout the day and over the next three days became severe in intensity. She described the pain as sharp but intermittent in nature, without any radiation into the leg. The pain was aggravated on rising from a seated position and intensified

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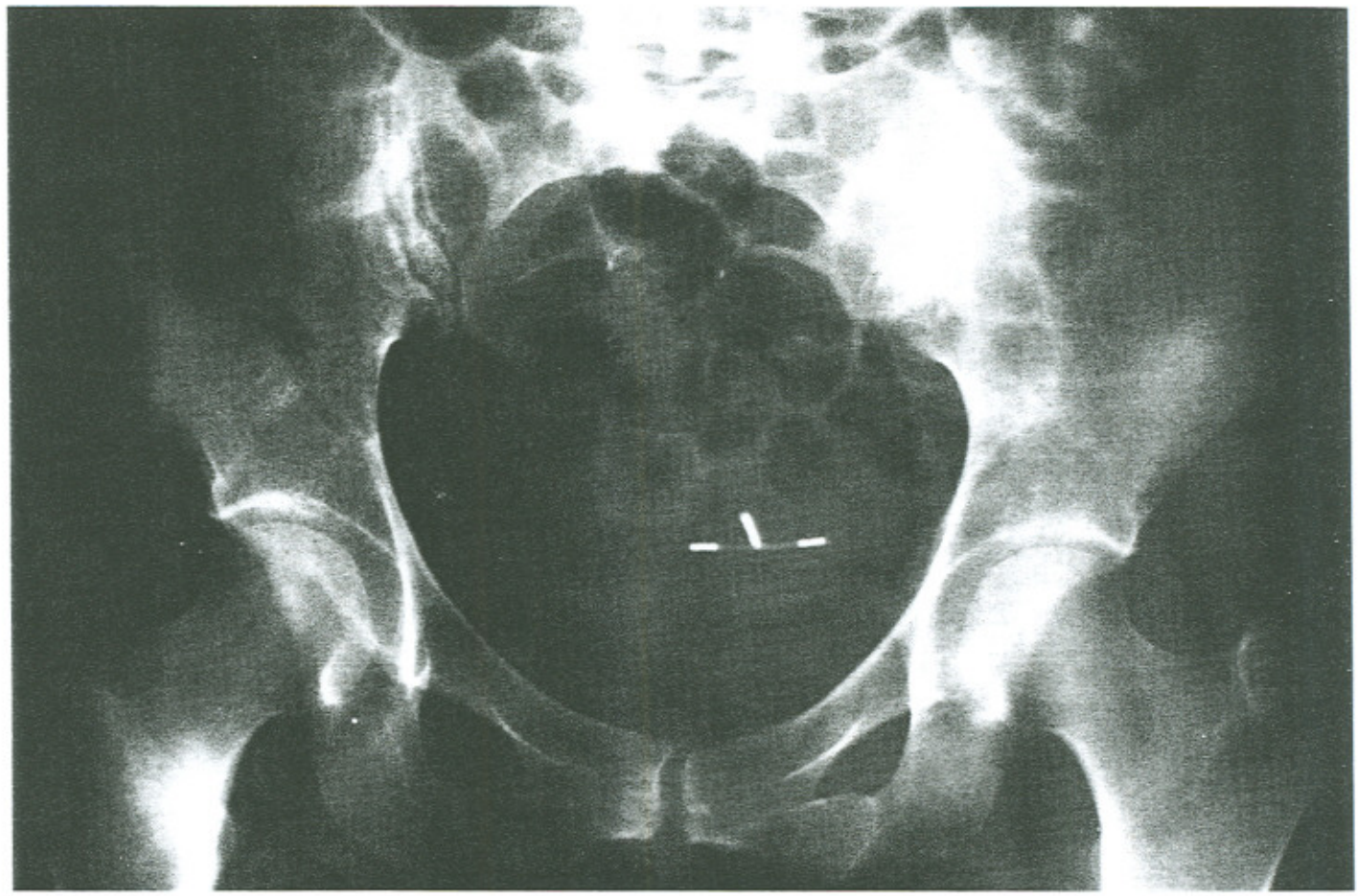

Figure 1. Normal left hip with ischiopubic synchondrosis growth variant in the left inferior pubic ramus. Note the cortical thickening along the inferior aspect of the right femoral neck.

during the first few steps of walking, after which it became bearable. The pain was relieved by rest. When questioned about her level of physical activity, she reported that six weeks previously she had started jogging an average 3 to 4 times per week for about 20 minutes each run. Past history revealed she had a similar episode of pain in the right hip approximately one and a half years prior. This was diagnosed by her physician as a psoas muscle strain which resolved with rest over a two month period. She was premenopausal and appeared in good general health. There were no past illnesses and she was not on any medication.

On examination, she presented with a shortened left stride. She was tender to deep palpation over the groin area of the left thigh. Passive and active ranges of motion of the left hip were painful at the end range of internal rotation and adduction. Resisted adduction and internal rotation of the left hip produced severe left groin pain. Longitudinal pressure applied along the left thigh with the knee approximated to the chest aggravated her groin pain. Muscle strength of the lower extremities was normal bilaterally, except for the hip flexors and adductors of the left hip which were decreased in strength. This was believed to be related to the pain experienced by the patient. There was no sign of fasciculation or muscle atrophy in the lower limbs. Reflexes were graded as normal bilaterally with no sensory deficit.

Radiographic evaluation of the pelvis and left hip was performed (Figure 1). The left hip was normal. An ovoid cystic lesion measuring 3 cm by 2 cm was noted in the left inferior pubic ramus. This was felt to be a growth variant of the ischiopubic synchondrosis. Also, there was evidence of cortical thickening along the inferior aspect of the right femoral neck which was felt to be consistent with an old stress fracture.

The patient was diagnosed as having an acute psoas muscle strain with a differential diagnosis of femoral neck stress fracture. This was based upon her symptoms at presentation and the recent increase in activity level. A bone scan was scheduled at another health care centre. In the meantime, she was treated

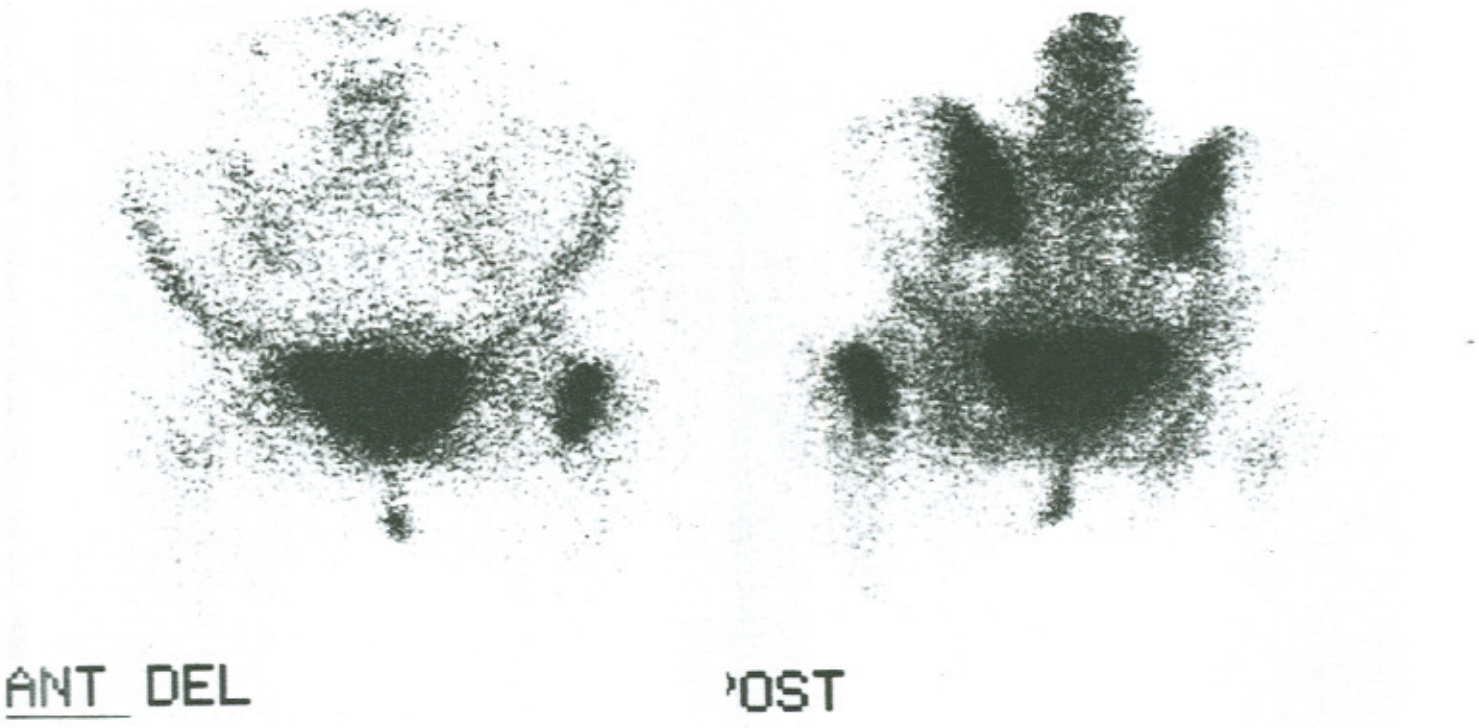

Figure 2. Technetium-99m scintigraphy, anterior and posterior images, demonstrate significant increased activity in the left proximal femur.

conservatively with cryotherapy, soft tissue massage, interferential current, passive hip mobilization, and stretching exercises. She was advised to rest from any physical activity. After the first week of therapy, the patient's condition worsened and she resorted to using a walking cane. Two days before the bone scan was scheduled, the patient slipped on a wet floor and twisted her left hip. This further aggravated her groin pain to the point where she required crutches for ambulation.

When the Technetium-99m bone scan was performed, a significant increased activity in the intertrochanteric region of the left proximal femur (Figure 2) was noted. A small amount of increased activity was present along the medial aspect of the right femoral neck adjacent to the lesser trochanter. This was felt to be related to her previous episode of groin pain. As bone scans are highly sensitive but non-specific, plain film radiographs repeated the following day revealed an obvious displaced fracture at the base of the femoral neck (Figure 3). The femoral head was displaced into a mild varus deformity. The patient was sent via ambulance to the emergency department and underwent surgical stabilization of the hip that same evening (Figure 4).

Discussion

Femoral neck stress fractures can be easily missed if one relies solely on plain film findings to make the diagnosis. Of concern are the risks of the stress fracture progressing to displacement at the fracture site, avascular necrosis of the femoral head, and subsequent osteoarthritis.[1,3,4] Early recognition and treatment can reduce the incidence of displacement and resultant disability.[5] Therefore, any hip, groin, perineal, anterior thigh, or knee pain that is activity related, must be carefully assessed with an in-depth history, physical examination, x-ray and/or bone scan. A presumptive diagnosis of stress fracture can be made on historical and physical findings, but Technetium 99 imaging is the definitive test for ruling out or confirming the diagnosis.[1]

Etiology

Bone tissue undergoes continuous structural change beginning in the embryo and extending throughout adult life. This change involves the selective modelling and remodelling carried out by removal and deposition of bone.[6] A stress fracture occurs during the remodelling of normal bone when resorption of bone exceeds repair. During remodelling, normal bone is temporarily weakened by the rapid osteoclastic resorption, which is followed by slower osteoblastic replacement of osteonal bone.[8] As a result, the development of a stronger new matrix lags behind, weakening the area and making it susceptible to fracture.[7] Rest from physical stress allows repair remodelling to take place, preventing a complete fracture from occurring.[7,9]

On the other hand, with continued physical stress, the slow

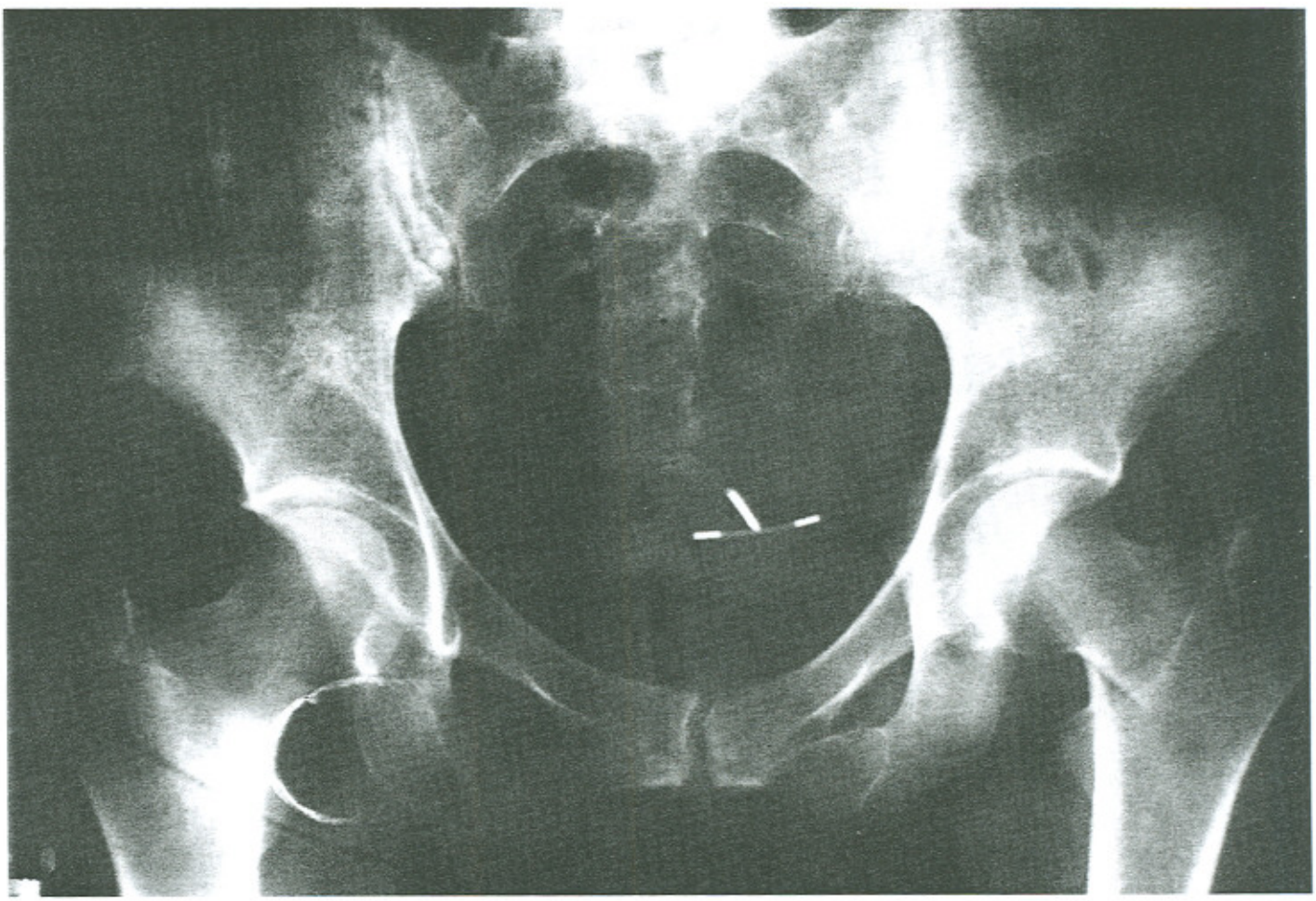

Figure 3. Complete, displaced femoral neck fracture with varus angulation of the femoral head.

replacement of bone is buttressed by reactive bone (i.e. periosteal callus, endosteal callus, or thickened trabeculae).[8] If the reactive bone is of inadequate strength for reinforcement, a break through the cortex may occur.[8] Usually the fracture is limited to one side of the cortex only, but if untreated or subjected to continued stress, it may become complete.[10]

A recent report suggests that the rhythmic, repetitive action of muscles on bone may produce sufficient forces to result in a stress fracture.[5] Another suggestion is that the loss of the normal shock absorbing effect of muscles when they become fatigued, cause abnormal stresses to be distributed in the bone, predisposing it to stress fracture.[2,5,7]

Other factors such as age, gender, race, body type, menopause, medication and underlying metabolic disorder may also play an important role in the development of stress fractures. These issues have not yet been addressed in the literature, but are worth consideration due to the natural tendency for bone tissue to continuously change throughout life.

Clinical presentation

An early diagnosis of stress fracture is dependent upon a high index of suspicion by the clinician. The patient's history is often the most valuable insight in making the presumptive diagnosis of femoral neck stress fracture. The two most important key factors to consider are: 1) "the absence of a history of injury"[11] and 2) the patient reporting a "recent change in activity levels".[1,3] As in this case, the patient began jogging six weeks prior to the onset of groin pain. It has been reported in the literature that added mileage, hill training, a change in footwear or even a change in running surfaces are often associated with femoral neck stress fractures.[8,9,12]

The predominant symptom of a stress fracture of the femoral neck appears to be groin pain.[1,2,4,5] Unfortunately, this non-specific pain pattern can also be manifested by other conditions, such as adductor tendinitis, osteoarthritis of the hip, fractured hip, psoas muscle strain, and referred pain from the male genitalia. The location of pain may be inconsistent, appearing, for

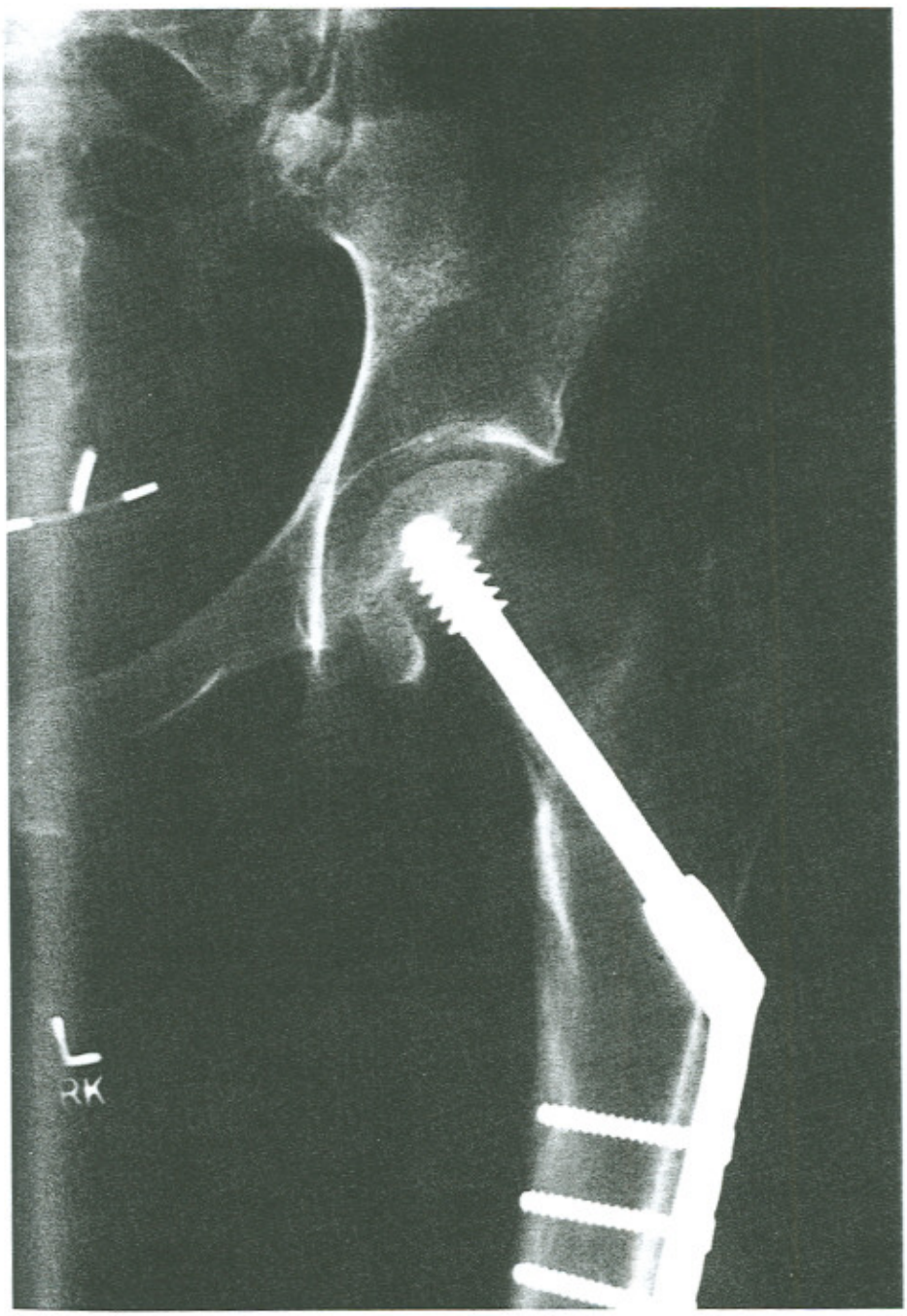

Figure 4. Post-surgical stabilization of the left hip.

example in the adductor region one day and the buttock the next.[13] Patients may also present with an "achy" hip, thigh or knee pain, noticeable on awakening in the morning, with some improvement with gentle activity.[14] However, continued weight bearing activity usually results in worsening of discomfort.[1,5,11,14] Accordingly, as seen in the case report, after walking a few steps the patient's groin pain improved but then got progressively worse.

Since several cases of bilateral femoral neck stress fractures have been reported,[15] it is important to question the patient about painful episodes in the opposite hip. On reviewing the presented case, the plain film radiographs and bone scan were

highly suggestive of an old stress fracture of the right hip which most likely correlated with her episode of pain one and a half years prior.

Physical findings may include an antalgic gait, tenderness on palpation over the anterior aspect of the hip, and in the inguinal area[4] or pain with fist percussion over the greater trochanter.[5,11,14] There may also be pain and/or limitation of motion at the extremes of hip motion, particularly during internal rotation,[4,5] as seen in our case report. Generalized weakness of the muscles acting on the hip secondary to either pain or disuse atrophy may be seen.[1,7] In the event that the stress fracture progresses to a complete displaced fracture, the patient's presentation would be characterized by shortening and external rotation of the affected leg with pain in the hip.[16] Surprisingly enough, after suffering a complete displaced femoral neck fracture, our patient actually walked into the office with the aid of a cane and had only a slight limp.

Radiographic findings

Radiological findings depend on the site of the fracture and the age of the injury at the time of imaging. Devas described two distinct types of femoral neck stress fractures: compression and transverse.[17] The compression type involves the lower border of the femoral neck, the calcar region. In this area, cortical bone predominates and a thin cortical lucency may be the first sign followed by localized cortical thickening (Figure 5). This type rarely progresses to complete fracture. The tension or transverse type of stress fracture involves the superior neck where cancellous bone predominates (Figure 6). Here, the stress fracture may be seen as a thin zone of sclerosis. This type more often progresses to a complete fracture which tends to occur perpendicular to the lines of stress in the femoral neck.[7]

Plain film radiography is frequently negative in the early phases of a stress fracture, and definitive findings may not develop for as long as 2–4 weeks after the onset of pain.[5,11,12,18] Technetium 99 imaging may delineate the problem 1–3 weeks before radiographic changes are apparent.[2] Prather et al.[18] compared scintigraphy to conventional radiographs in 42 patients clinically suspected of having stress fractures. They noted an average duration of 26 days from the onset of symptoms to plain film radiographic confirmation, while the scan findings were positive an average of 15 days from the onset of symptoms. Furthermore, there were no false negative bone scans while the false negative rate for radiographs was 71 percent. Other authors have since repeated these results.[1,12]

Consequently, radionuclide imaging appears to be the definitive diagnostic test for stress fractures in the presence of normal plain film radiographs. Stress fractures generally have a characteristic appearance on a bone scan. They appear as longitudinal foci of increased activity which are usually confined to the cortical surface. Bone scans are highly sensitive and provide early confirmation of clinically suspected femoral neck stress fracture.[2,5,8,14,18] It is important to keep in mind, however, that other disorders such as trauma, infection and neoplasm, all result in increased uptake of radionuclide material and many mimic stress fracture.[12] Therefore, in the presence of a positive bone scan, x-rays should be obtained. While much less sensitive than bone scans, plain film x-rays are highly specific as to the nature of the lesion.[18]

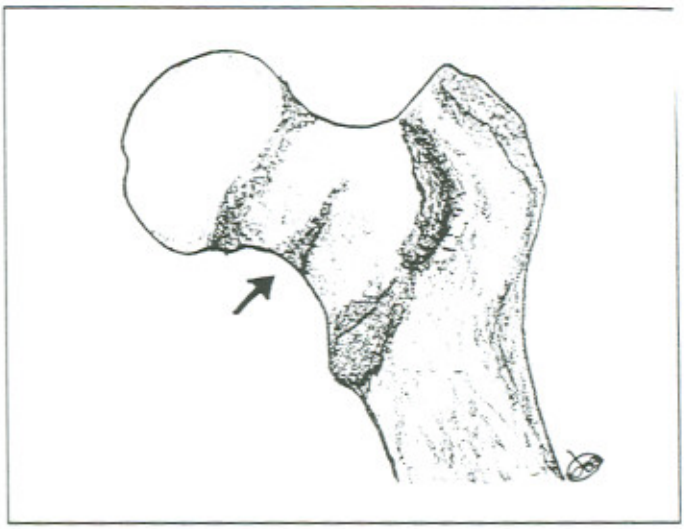

Figure 5. Compression type of femoral neck stress fracture.

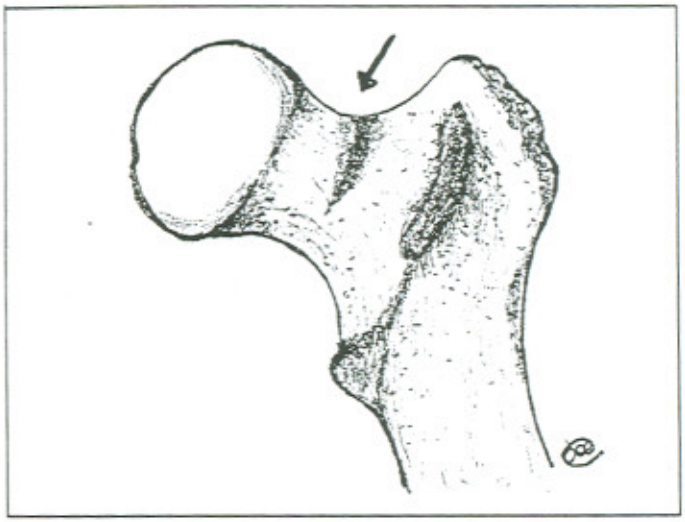

Figure 6. Tension or transverse type of femoral neck stress fracture.

Due to the potential risks associated with stress fractures, any delay in making the proper diagnosis can be devastating since repeated micro-trauma may accentuate the progression of the stress fracture. A prime example is seen in the case reported above. In the interval between the time the patient first presented and her bone scan (10 days later), she unfortunately slipped on a wet floor and suffered a complete fracture through an already weakened area.

Management

Compression type femoral neck stress fractures are treated conservatively because they are unlikely to displace.[5] Excellent results have been reported with a variety of approaches, including no treatment, bed rest followed by progressive weight bearing, and crutch weight bearing.[5] Rest allows the reparative phase of bone remodeling to catch up to the resorptive phase.[8] Treatment must vary with individuals, but athletes and joggers are advised to refrain from any training that is stressful to the hip for several months[5] and encouraged to use alternative methods (e.g. swimming) to maintain their cardiovascular fitness level.

Unlike compression, the transverse type femoral neck stress fracture is considered a surgical emergency whether it is displaced or not, since its natural history is to undergo progressive displacement.[5,17,19] Recognition and surgical treatment with internal fixation before displacement occurs reduces the potential for fracture and the subsequent development of avascular necrosis of the femoral head.[5] To illustrate the seriousness of this, Cady et al. followed 11 patients who were treated for displaced femoral neck fractures and reported that only 3 healed without a varus deformity, non-union of the fracture or avascular necrosis. At follow-up, none of the 11 patients had a normal hip and all had received permanent or partial disability compensation.[20]

Another important part of the treatment regimen is rehabilitation. Throughout the treatment, painless activities such as swimming or weight training should be continued to maintain the overall muscular tone and cardiovascular fitness level. Resuming weight-bearing activities is recommended only when the radiographs show bony union across the fracture line.[21] Accordingly, the patient should attempt a slow progressive return to their previous level of physical activity while monitoring any signs of discomfort in the hip.

Conclusion

Our case report demonstrates the importance of early diagnosis of femoral neck stress fracture due to the potential risk of progressing to a complete fracture. Suspicion of a stress fracture should be considered in physically active patients, especially in those who have no history of injury and have recently increased their activity level. If the initial radiographs are negative but a stress fracture is clinically suspected, radionuclide bone scanning should be ordered to confirm the diagnosis. Follow-up radiographs, scheduled 2–4 weeks after the initial injury will often demonstrate the stress fracture. Meanwhile, the patient should rest and avoid any activity stressful to the hip joint until a femoral neck stress fracture has been ruled out.

Furthermore, when the patient has been diagnosed with a soft tissue injury and does not respond to conservative measures within a specified period of time, a careful re-examination of the initial diagnosis is indicated. Early recognition and treatment of femoral neck stress fractures can reduce the incidence of displacement of these fractures and resulting disability.

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