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CASE REPORT

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Subchondral insufficiency fracture of the femoral head after total knee arthroplasty in a patient with rheumatoid arthritis

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Abstract We report an 80-year-old woman with rheumatoid arthritis (RA) who was found to have subchondral insufficiency fracture of the right femoral head after total knee arthroplasty (TKA). Initially, plain radiographs showed no obvious changes, but magnetic resonance imaging (MRI) revealed an irregular, discontinuous, low-intensity band on T1-weighted images of the right hip. She underwent hemiarthroplasty of the hip. This report describes a rare case of subchondral insufficiency fracture of the femoral head after TKA in a patient with RA.

Key words Femoral head · Osteoporosis · Rheumatoid arthritis (RA) · Subchondral insufficiency fracture · Total knee arthroplasty (TKA)

Introduction

Rheumatoid arthritis (RA) is a destructive joint disease for which patients are usually treated with steroids, disease-modifying antirheumatic drugs (DMARDs), and nonsteroidal anti-inflammatory drugs. Total joint arthroplasty is useful surgery for RA patients. However, one of the complications of joint arthroplasty is insufficiency fracture if the bone quality is poor.

Insufficiency fracture of the femoral neck after total knee arthroplasty (TKA) is rare. McElwaine and Sheehan[1] reported seven cases of stress fractures of the femoral neck after TKA previously. Insufficiency fracture of the femoral head is an even rarer condition. Several authors reported that these patients are elderly,[2–4] obese,[5] or renal transplant recipients,[6] These patients have almost no traumatic history, and are treated conservatively[2,3] or surgically.[7,8] It is important to differentiate osteonecrosis from an insufficiency fracture, which may affect the treatment and management of the patient.

We describe here a rare case of insufficiency subchondral fracture of the femoral head after TKA in a patient with RA. After conservative therapy lasting 3 months, she underwent hip hemiarthroplasty. The patient's consent was obtained prior to submission of this case report.

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Case report

An 80-year-old woman with RA had a severe right knee pain. She was essentially able to walk only in the home and used a cane. At the age of 46 years, she had been diagnosed with RA and managed with an oral corticosteroid (prednisolone, 5 mg once daily) and an anti-inflammatory drug (diclofenac, 25 mg once daily). She had not been treated with DMARD therapy, but had controlled active inflammation. The status of the RA classified according to the Steinbrocker classification was Stage IV and Class III before knee surgery.[9] Her height was 143 cm, her weight was 43 kg, and her body mass index (21.4) was normal. She had no history of alcohol abuse.

Physical examination demonstrated an anatomic axis of 15° of valgus of the right knee (Fig. 1A). The right knee had a range of motion of 15° to 80°. The preoperative Knee Society knee and function scores were 37 and 31 (out of 100) points, respectively. Right TKA was performed on November 24, 2004.

After the surgery, the right knee had an anatomic axis of 4° of valgus and had a range of motion of 5° to 100° (Fig. 1B). She could walk comfortably using a cane. The postoperative Knee Society knee and function scores were 82 and 74 (out of 100) points, respectively.

Almost 10 weeks later, she developed mild right hip pain without any trauma. She had no hip pain prior to knee surgery. The pain increased gradually over the subsequent weeks, and she was referred to our hospital for evaluation and treatment.

She walked with a limp. The range of motion in the right hip was slightly limited with flexion of 110°, abduction of

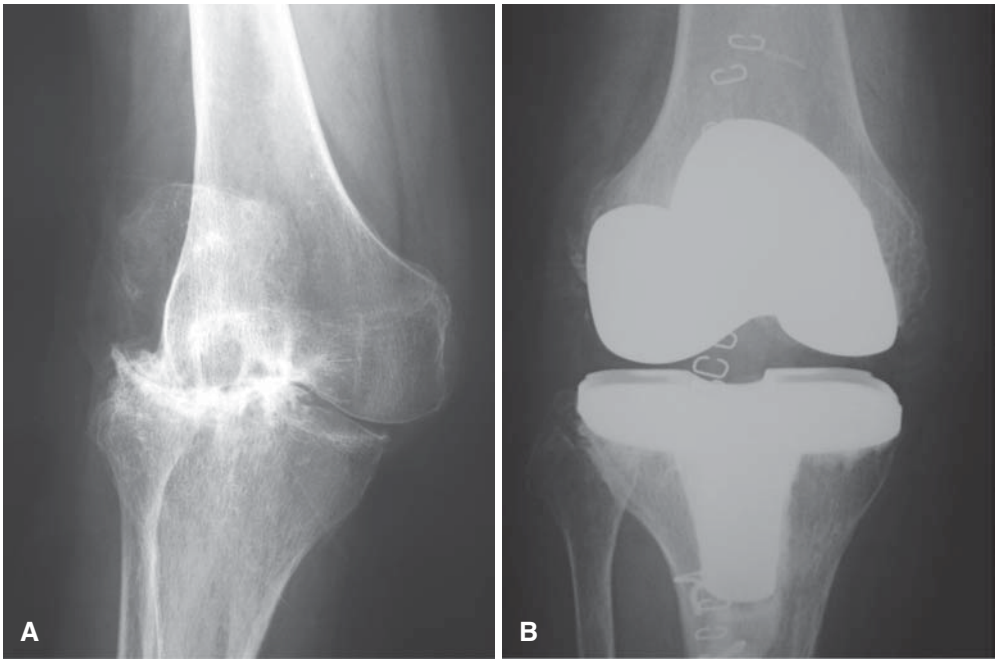

Fig. 1A,B. Anteroposterior radiographs of the right knee. **A** Before total knee arthroplasty (TKA). **B** After TKA

20°, adduction of 30°, external rotation of 30°, and internal rotation of 20°. No definite abnormal findings were observed on the initial plain radiograph. No evidence of osteonecrosis and a slight change in bone density were seen (Singh's Index,[10] grade 4). She was treated with anti-inflammatory drugs and weight-bearing was limited with use of a cane. However, 4 weeks later, because of the intractable severity of symptoms, she underwent radiography again. On the plain radiographs, a subchondral fracture line was observed at the superolateral portion of the femoral head. No joint space narrowing was seen (Fig. 2).

Magnetic resonance imaging (MRI) revealed a bon marrow edema pattern with a diffuse, low intensity on T1-weighted images (Fig. 3A) and high intensity on fat-suppression images from the superior portion of the femoral head to the intertrochanteric area (Fig. 3B). T1-weighted images also showed an irregular, low-intensity band with a well-delimited concave shape to the articular surface.

Based on the plain radiographs and MRI images, subchondral insufficiency fracture of the femoral head was considered. The patient underwent bone mineral density studies by dual-energy X-ray absorptiometry. In the left hip, the measurement was 0.505 g/cm^2 (70.7% of mean in young adults), indicating generalized osteoporosis. Laboratory tests, such as complete blood cell count, were almost within normal limits. Serum C-reactive protein was 0.7 mg/dl, and rheumatoid factor was 57 IU/ml. Bone scintigraphy was not done.

Conservative treatment, including bed rest and avoidance of weight bearing, was carried out. Despite 12 weeks of observation, the right hip pain was not resolved and the results on plain radiographs and MRI images showed no changes. No definite abnormal findings were detected on radiography or MRI in the acetabulum. Finally, she underwent right hip hemiarthroplasty with bipolar endoprosthesis on May 13, 2005, after which she became able to walk with a cane again (Fig. 4).

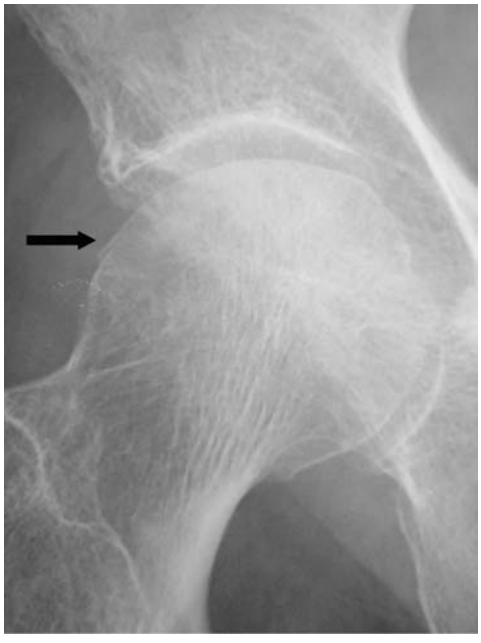

Fig. 2. An anteroposterior radiograph of the right hip 4 weeks after onset of pain showing a crescent sign (*arrow*) at the superolateral portion of the femoral head

Histologically, it was possible to trace a fracture area beneath the articular cartilage, which paralleled the articular surface. The fracture area was obscured by reparative bone callus. The repair tissue was present on both sides of the fracture line, including callus formation, fragmented bone trabeculae, and granulation tissue. The surrounding bone tissue was resorbed focally by active osteoclasts and was replaced by vascular granulation tissue. No infarcted region was present around the area of the subchondral fracture, although small segments of fractured bone trabeculae had undergone necrosis (Fig. 5).

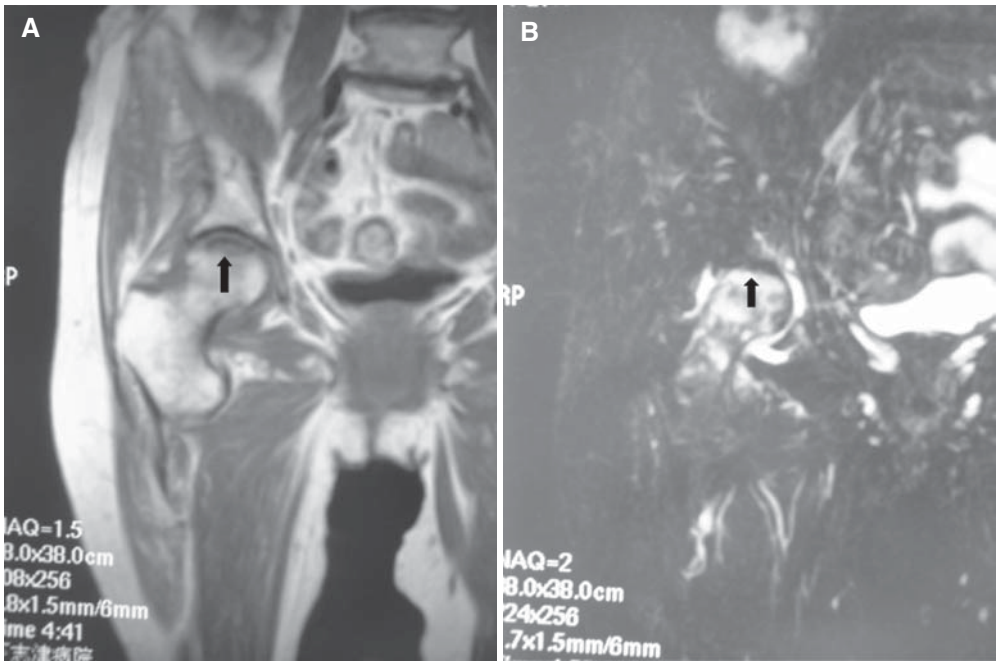

Fig. 3. **A** A T1-weighted magnetic resonance image showing a subchondral linear pattern of low signal intensity with a convex shape to the articular surface (*arrow*) (TR/TE: 450/15). **B** A fat-suppressed magnetic resonance image showing a subchondral linear pattern of low signal intensity with a convex shape to the articular surface (*arrow*) (TR/TE/TI: 5500/120/140)

Fig. 4. An anteroposterior radiograph of the right hip after hemiarthroplasty with bipolar endoprosthesis

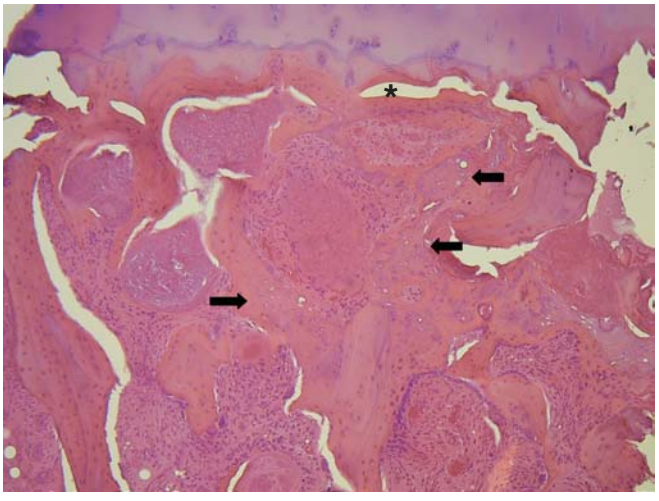

Fig. 5. A photomicrograph obtained from the subchondral fracture area showing various types of repair tissue, including fracture callus (*arrows*) and granulation tissue. The fracture line can be seen at the subchondral bone area (*asterisk*) (H&E, ×100)

No evidence of osteonecrosis characterized by zone formation could be seen in any part of the femoral head. The synovium demonstrated mild hyperplasia, minimal mononuclear cell infiltration, and development of granulation tissue.

Discussion

In this report, we describe an extremely rare case of insufficiency subchondral fracture of the femoral head after TKA in a patient with RA. We are not aware of any previously published report describing such a case.

Total joint arthroplasty, such as TKA, or total hip arthroplasty, is very useful surgery for RA patients with joint destruction. Following surgery, many of these patients are free of pain and resume activity at a much higher level than preoperatively. Although secondary osteoporosis is often seen in RA, one of the complications in joint arthroplasty is insufficiency fracture.

Insufficiency fractures of the femoral neck after total knee arthroplasty are also rare. McElwaine and Sheehan[1] reported cases of stress fractures of the femoral neck after TKA. Fipp[11] reported that these fractures occurred 3–16 months after TKA and almost always on the ipsilateral side.

Patients are usually older than 60 years, with no history of trauma. However, the etiology of this condition was not mentioned and is still unknown.

Insufficiency subchondral fractures of the femoral head are rarer. Soubrier et al.[12] reported that subchondral fractures of the femoral head account for 3% of all insufficiency fractures. Several reports also indicated that patients are usually elderly women[2–4] or obese.[5] These patients have almost no history of trauma and are treated conservatively[2,3] or surgically.[7,8] It is important to differentiate osteonecrosis and transient osteoporosis from an insufficiency fracture, which may affect the treatment, prognosis, and management of the patient.

Subchondral fracture of the femoral head is a common complication in cases of osteonecrosis and is generally thought to be the cause of the symptoms. The signs and symptoms of fracture secondary to osteonecrosis and of insufficiency fracture are probably similar. Acute joint space narrowing and collapse are also seen occasionally in osteonecrosis and insufficiency fracture, although most patients with osteonecrosis are in their early forties, or have taken corticosteroids.

The radiographic differentiation between osteonecrosis and insufficiency fracture is somewhat confusing.[5] In the cases reported previously,[13,14] such a differentiation was made based mainly on the MRI characteristics. These authors suggested that the presence of a low-signal intensity line was characteristic of trabecular fracture and could distinguish an insufficiency fracture from osteonecrosis, which would demonstrate a well-delimited focal lesion.

Transient osteoporosis of the hip is a self-limiting syndrome affecting young patients. On radiographs, no evidence of focal bone loss or subchondral collapse is seen. Magnetic resonance imaging shows a diffuse and homogeneous decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images, without localized lesions.[15]

Therefore, it seems that histopathological differentiation between these two lesions is important.[16] Microscopically, osteonecrosis is characterized by the presence of a zone comprised of necrotic, reparative, and viable tissue. On the other hand, in insufficiency subchondral fracture, the area consists of fracture callus and granulation tissue along both edges of the fracture line. Sometimes, histopathological differentiation between these two conditions is still confusing because all fractures will ultimately lead to some bone marrow edema and necrosis.

Cases diagnosed clinically as subchondral insufficiency fracture of the femoral head should be examined carefully. The prognosis of subchondral insufficiency fracture may depend on a number of variables, including the degree of osteopenia, activity, weight and the extent of fracture, as well as treatment.[17] The initial treatment of an insufficiency fracture should be immobilization, and because anti-inflammatory drugs are expected to suppress the healing response, their use is not recommended. As the patient reported herein had RA, she was treated with anti-inflammatory drugs and weight-bearing was reduced with the use of a cane. With this treatment, her condition worsened steadily and she eventually underwent hip hemiarthroplasty.

The diagnosis of subchondral fracture of the femoral head is made primarily on the basis of sequential clinical features, radiography, and MRI. The significance of recognizing this condition histopathologically is to provide an awareness of and an etiology for a type of acute-onset arthritis in the elderly, which has been unknown previously, or has been diagnosed incorrectly as osteonecrosis. Clinical differentiation between these two conditions is important, as their diagnosis and treatment may be different.

References

1. McElwaine JP, Sheehan JM. Spontaneous fracture of the femoral 31/03/06neck after total replacement of the knee. J Bone Joint Surg Br 1982;64-B:323–5.
2. Bangil M, Soubrier M, Dubost JJ, Rami S, Carcanagues Y, Ristori JM, et al. Subchondral insufficiency fracture of the femoral head. Rev Rheum 1996;63:859–61.
3. Rafii M, Mitnick H, Klug J, Firooznia H. Insufficiency fracture of the femoral head: MR imaging in three patients. Am J Roentgenol 1997;168:159–63.
4. Yamamoto T, Bullough PG. Subchondral insufficiency fracture of the femoral head: a differential diagnosis in acute onset of coxarthrosis in the elderly. Arthritis Rheum 1999;42:2719–23.
5. Motomura G, Yamamoto T, Miyanishi K, Shirasawa K, Noguchi Y, Iwamoto Y. Subchondral insufficiency fracture of the femoral head and acetabulum; a case report. J Bone Joint Surg Am 2002;84-A:1205–9.
6. Ikemura S, Yamamoto T, Nakashima Y, Shuto T, Jingushi S, Iwamoto Y. Bilateral subchondral insufficiency fracture of the femoral head after renal transplantation. Arthritis Rheum 2005; 52:1293–6.
7. Hagino H, Okano T, Teshima R, Nishi T, Yamamoto K. Insufficiency fracture of the femoral head in patients with severe osteoporosis. Report of 2 cases. Acta Orthop Scand 1999;70: 87–9.
8. Yamamoto T, Bullough PG. The role of subchondral insufficiency fracture in rapid destruction of the hip joint; a preliminary report. Arthritis Rheum 2000;43:2423–7.
9. Steinbrocker O, Traeger CH, Batterman RC. Therapeutic criteria in rheumatoid arthritis. JAMA 1949;140:659–62.
10. Singh M, Nagratz AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. J Bone Joint Surg Am 1970;52-A:457–67.
11. Fipp G. Stress fracture of the femoral neck following total knee arthroplasty. J Arthroplasty 1988;3;347–50.
12. Soubrier M, Dubost JJ, Boisgard S, Sauvezie B, Gaillard P, Michel JL, et al. insufficiency fracture. A survey of 69 cases and review of the literature. Joint Bone Spine 2003;70:209–28.
13. Fujioka M, Kubo T, Nakamura F, Shibatani M, Ueshima K, Hamaguchi H, et al. Initial changes of non traumatic osteonecrosis of femoral head in fat suppression images: bone marrow edema was not found before the appearance of band patterns. Magn Rason Imaging 2001;19:985–91.
14. Yamamoto T, Dicarlo EF, Bullough PG. The prevalence and clinicopathological appearance of extension of osteonecrosis in the femoral head. J Bone Joint Surg Br 1999;81-B:328–32.
15. Potter H, Moran M, Schneider R, Baasal M, Sherman C, Markisz J. Magnetic resonance imaging in diagnosis of transient osteoporosis of the hip. Clin Orthop 1992;280:223–9.
16. Yamamoto T, Schneider R, Bullough PG. Subchondral insufficiency fracture of the femoral head: histopathologic correlation with MRI. Skelet Radiol 2001;30:247–54.
17. Yamamoto T, Takabatake K, Iwamoto Y. Subchondral insufficiency fracture of the femoral head resulting in rapid destruction of the hip joint; a sequential radiographic study. Am J Roentgenol 2002;178:435–7.