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Scintigraphy in nontraumatic femoral head necrosis

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We performed serial ^{99m}Tc-MDP bone scintigraphy of nontraumatic femoral head necrosis in 14 hips of 10 patients. The uptake of isotope was decreased in the very early stage, and either variable or increased at the stage when symptoms appeared. A variable uptake changed to increased uptake in 3 of 10 patients, but there was no hip in which an increased uptake changed to a variable uptake. No relationship was demonstrated between the scintigraphic appearance of the femoral head and the pain and function of the hip.

Introduction

Bone scintigraphy may document repair of osteonecrosis before any clinical or radiographic signs appear (Cameron 1969, Crutchlow 1970, Holder 1982, Spencer & Maisey 1985). Before the repair stage the isotope uptake in the femoral head is defective (D'Ambrosia et al. 1978, Spencer & Maisey 1985). Bauer et al. (1980), Oda et al. (1980) and Strömqvist (1983) have reported the chronologic changes of the bone scintigraphic appearance in femoral head necrosis following hip fracture. We have examined the hips of 10 patients with nontraumatic necrosis of the femoral head repeatedly examined by bone scintigraphy.

Patients and methods

Fourteen hips of 10 patients with nontraumatic necrosis of the femoral head who had undergone ^{99m}Tc-MDP bone scintigraphic examination more than twice at Kyoto University Hospital from 1979 to 1985 were analyzed (Table 1). There were 8 males and 2 females, and their average age was 38 (22–78) years. Five patients had bilateral necroses. Total hip replacement was carried out on one of these hips (left hip of Case 1) before repeated scintigraphic examinations were performed and this hip was excluded. Anterior rotational intertrochanteric osteotomy was performed on two hips (right hip of Case 3 and left of Case 4) during the follow-up period. The etiology (Table 1) was steroid therapy in 4 patients, alcoholism in 3, hepatitis in 1, anticoagulant therapy in 1, and unknown in 2 patients. Case 4 was caused by both alcoholism and steroid therapy. Alcoholism was considered an etiologic factor when patients consumed more than about 500 ml of Japanese wine daily – the alcohol content of which is about 15 per cent more than 10 years. Anticoagulant therapy may have caused necrosis of the femoral head in our Case 9, a 78-year-old woman who was treated with 2 milligrams of Warfarin potassium daily for more than

Table 1. Ten patients with nontraumatic femoral head necrosis.

Case	Sex	Age	Side	Etiology
1	M	57	R + L	Alcohol
2	F	26	R + L	Steroids
3	M	51	R + L	Alcohol
4	M	38	R + L	Steroids & alcohol
5	M	21	L	Steroids
6	M	27	R	Idiopathic
7	M	28	R	Steroids
8	M	22	R + L	Hepatitis
9	F	78	R	Anticoagulants
10	M	30	R	Idiopathic

The right hip of Case 1 underwent total hip replacement before repeated scintigraphic examinations were performed, and he was not included.

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10 weeks. Radiographic diagnosis of the femoral head necrosis was made 10 months later. Although we could not detect any bleeding episodes or minor trauma in this patient's chart, hip joint tamponade might have been the etiology (Kloiber et al. 1983, Bauer 1985, Wingstrand et al. 1986).

Bone scintigraphy was performed twice in 6 patients, three times in 2 patients, and four times in 2 patients. Either 10 Ci or 15 Ci of ^{99m}Tc-methylenedisphosphonate was injected intravenously within 2 hours after labeling. Between 3 and 5 hours after the injection, the radioactivity in the hip joints was counted with a GE Maxicamera 400 AC-OT (General Electric) for about 100 seconds and photoscintimetry was produced. The scintigraphic appearance of the femoral head was classified into four types *normal*; *decreased*, where an area of defective isotope uptake appeared with little or no increased uptake; *variable*, where areas of increased and decreased uptake were combined, usually a central decreased area was surrounded by a circular increased one; *increased*, where a uniformly increased uptake was seen. The uptake of the intertrochanteric region was classified as either increased or normal because no hip showed defects in this area.

The scintigraphic appearance was compared with the radiographic stage evaluated (classified according to Inoue & Ono (1979)) within 3 weeks after scintigraphy. Clinical evaluation was carried out according to the hip scoring system of the Japanese Orthopaedic Association (Shima et al. 1971).

Results

The type of the scintigraphic appearance of each of the 14 femoral heads was plotted in relation to the time elapsed since coxalgia appeared (Figure 1). All except one of the femoral heads finally had either increased or variable isotope uptake by the time the coxalgia appeared (Figure 1). The right hip of Case 4 was exceptional as both radiographs and scintigraphs were normal even 14 months after the symptoms appeared. After 43 months, however, the uptake was increased and the hip was classified radiographically as Stage II. A defective uptake was noticed in the left hip of Case 3 six months before symptoms appeared. Anterior rotational intertrochanteric osteotomy was performed in two hips, but the uptake of the femoral heads were not changed by the operation.

The scintigraphic appearances of the 15 hips with normal radiographs (Stage I) were defective in one, normal in three, and variable in 10. On the other hand, the scintigraphic appearance of the 22 hips with at least some changes radiographically were either increased or variable (Table 2). The intertrochanteric region was consistently normal in eight hips and increased in three hips. There

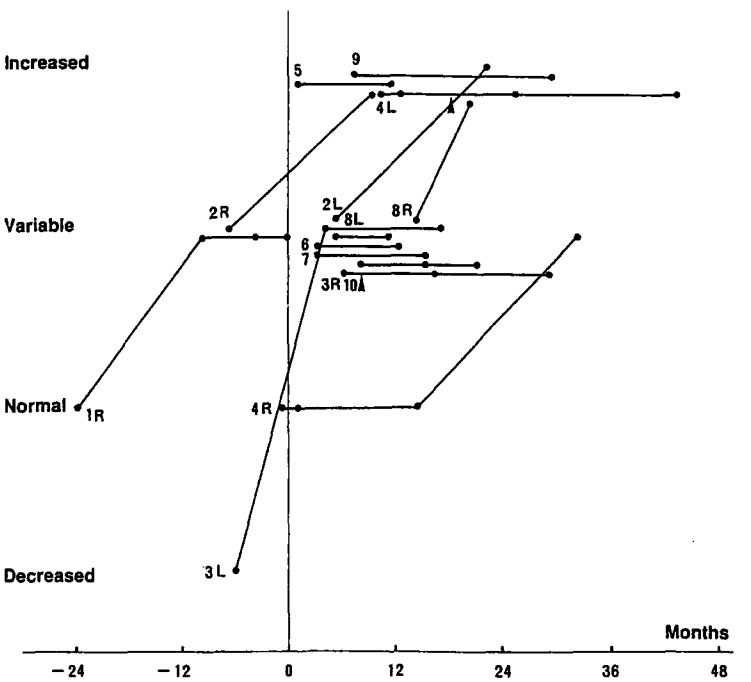


Figure 1. Serial changes of the scintigraphic appearance of the femoral head. The number represents the case number shown in Table 1. Symptoms started at time 0. Arrowheads show the time when anterior intertrochanteric osteotomy was performed.

Table 2. Relationship between the radiographic stages and scintigraphic appearances

Stage	Decreased	Normal	Variable	Increased	Total
I	1	3	10	0	14
II	0	0	6	3	9
III	0	0	2	6	8
IV	0	0	3	1	4
Total	1	3	21	10	35

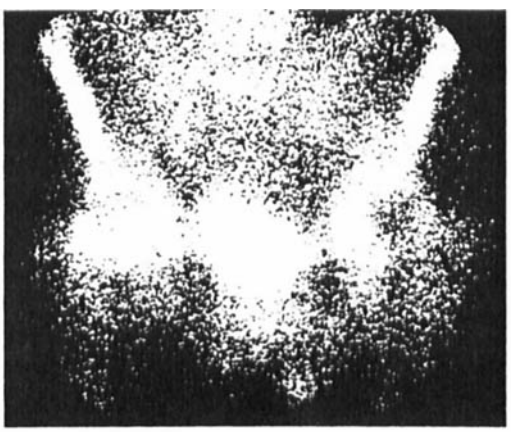
was no case with increased uptake in this region before symptoms appeared.

We divided the hips into two groups: one with finally increased and one with finally variable uptake, excluding hips that were operated on during the survey and hips not accurately examined. We found no difference in pain and function between the two groups.

Case 3. A 51-year-old man came to us in December 1978 complaining of right hip pain, limping, and he could not walk more than 100 meters without resting. He was an alcoholic and had been treated for acute hepatitis at the age of 43. His hip symptoms appeared in September 1978 on the right side and 1 year later on the left side. Radiography (April 1979) showed a slightly irregular density in the left femoral head, but the right femoral head was normal. The first scintigraphy (March 1979) showed variable uptake on the right side and decreased uptake on the left asymptomatic side. A second scintigraphy performed in January 1980, half a year after anterior rotational intertrochanteric osteotomy, showed unchanged uptake in the right femoral head, but increased uptake in the trochanteric region due to the osteotomy. On the left side, however, the uptake was variable. The findings were unchanged 1 year later (Figure 2). At this time, radiography of the right hip was still normal. In the latest follow-up in February 1985, the patient complained of severe pain in the right hip, but only moderate pain on the left side in spite of a slight collapse of the femoral head.

Discussion

The decreased isotope uptake in the femoral head represents the ischemic state and shows that no reactive bone formation has started yet. Once reparative new bone formation occurs, an area of



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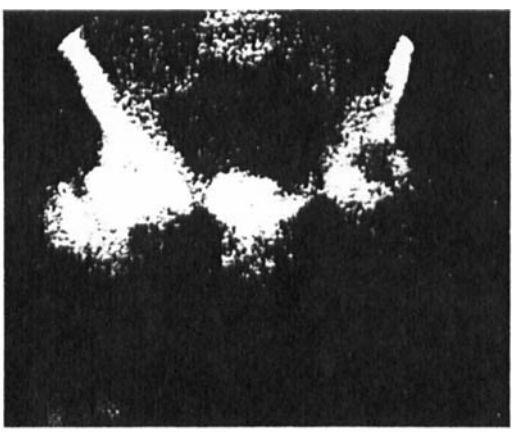

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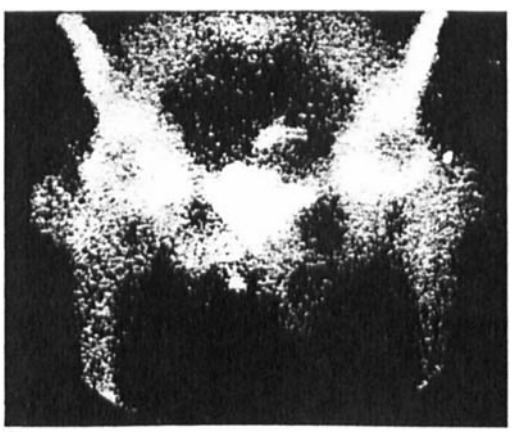

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Figure 2. Case 3. 51-year-old man with bilateral femoral head necrosis.
A. Variable isotope uptake of the right femoral head and decreased uptake of the left femoral head 6 months after (right) and 6 months before (left) symptoms began.
B. Variable isotope uptake of both femoral heads with increased uptake in the right and normal uptake in the left intertrochanteric region 8 months later.
C. Variable isotope uptake of both femoral heads with normalized uptake in the intertrochanteric region on the right side a year later.

increased isotope uptake surrounding the defective uptake results (Strömqvist 1983). If the area of necrotic bone is small, this area is overlapped by the region of increased uptake and not detected. Thus, there might be a false impression of increased activity. However, when the necrotic area is large enough, the overlap is limited and the scintigraphic appearance may be variable. This tended to change into a uniformly increased uptake because necrotic bone was replaced by newly formed reparative bone. This may take a long time, for replacement of the necrotic bone is very slow (Greiff et al. 1980).

We found no difference in pain and function between patients with variable or increased uptake. Symptoms may be influenced by many factors without a direct relationship to the scintigraphic appearance, radiographic findings, or size of necrosis.

Moon et al. (1968), using ^{18}F, reported a case of femoral head necrosis with normal uptake. Spencer (1985) found that only a minority of his cases showed scintigraphic abnormal findings before symptoms began. Thirteen out of 14 hips in our study were scintigraphically abnormal after coxalgia appeared and in three of the four hips already before symptoms made their debut. We believe that scintigraphy may be a useful tool in diagnosing femoral head necrosis in the very early incipient stage, even when there are no symptoms, although a normal scintigraphic finding does not necessarily rule out the diagnosis. The necrosis usually appears bilaterally, and hence the symptomless hip can also be evaluated.

Increased isotope uptake in the intertrochanteric region was found in seven of the 14 hips. For this reason, a simple quantification by calculation of a femoral head-to-intertrochanteric region ratio may be an unreliable method for evaluating the femoral head.

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