

# Osteonecrosis of the knee

## Diagnosis and outcome in 40 patients

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Clinically suspected primary osteonecrosis of the knee was studied in 40 patients with repeated plain radiography and scintimetry, and the patients were followed for 1-7 years. Thirty-three patients had typical scintimetric and radiographic signs of osteonecrosis of either one of the femoral condyles, whereas 7 patients had only typical scintimetric findings, but never developed an osteonecrosis based on plain radiography. Because the scintimetric findings were identical to the other 33 knees

and because there is no other well-known localized disease in this region of the femoral condyle, we deemed that these 7 patients had probable osteonecrosis, but in an abortive form.

The scintimetries were prognostic during the second half year after onset. Thirty knees had a poor outcome—29 because of development of arthrosis, of which eight were treated with a knee arthroplasty and four with a proximal osteotomy.

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Spontaneous osteonecrosis of the knee was first described by Ahlbäck et al. (1968), and is still of unknown etiology. Radiographically, there is a subchondral radiolucent area usually surrounded by a sclerotic halo in the weight-bearing portion of the medial femoral condyle; further, there is a high focal uptake by radionuclide scintimetry. Characteristically, there is intense pain. The initially described cases were in the medial femoral condyle, but other investigators have reported the disease in the lateral femoral condyle and in the medial tibial plateau (Haupt et al. 1982, 1983, Lotke and Ecker 1983, Marmor 1984). The prognosis of the disease depends on the size of the lesion (Muheim and Bohne 1970, Lotke et al. 1982, Aglietti et al. 1983) and also on the pattern of the scintimetric uptake (Muheim and Bohne 1970, Greyson et al. 1982). The end stage is progressive arthrosis (Ahlbäck et al. 1968, Muheim and Bohne 1970, Bauer 1978, Rozing et al. 1980).

Radiographs may be normal for a long time and sometimes normal during the whole course of the disease (Lotke et al. 1977, Rozing et al. 1980, Haupt et al. 1983). Scintimetry is positive very early, and magnetic resonance imaging (MRI) is a helpful diagnostic tool (Pollack et al. 1987, Björkengren et al. 1990).

The aim of our study was to characterize the natural history of osteonecrosis of the knee.

## Patients and methods

In this study, osteonecrosis was defined as a condition with rapid onset and typical localization of pain and characteristic positive scintimetric uptake, whereas plain radiographs may fail to provide a diagnosis. The disease was followed in 40 knees in 40 consecutive patients (31 females and 9 males) in 1982-88. The mean age at onset was 67 (41-85) years. None of the patients had a history of cortisone consumption or a disease that is known to cause secondary osteonecrosis. All but 2 patients had taken different analgesics during the initial period of the disease, and 12/40 had received at least one intraarticular corticosteroid injection after the onset of symptoms and before the diagnosis was confirmed.

A medial meniscectomy was performed in 3 patients during the initial period of the disease. All but 5 patients were able to walk more than 2,000 meters without using support before the onset of the disease. The remaining 5 patients had a reduced walking distance due to reasons unrelated to the knee.

## Radiographic methods

Anteroposterior (AP) and lateral, single-leg, weight-bearing radiographs were taken at the initial visit and at follow-ups (Figures 1-3). The necrotic lesion was staged according to Aglietti et al. (1983) as

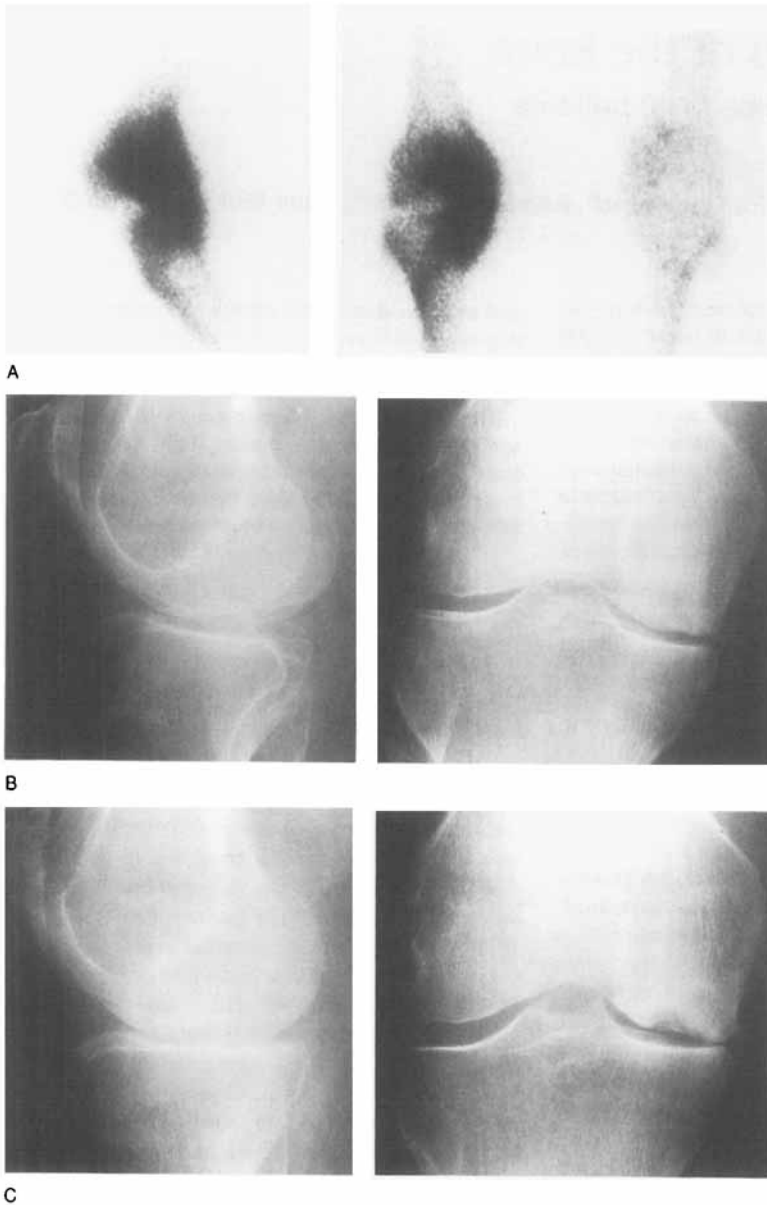


Figure 1 (Case 39). A 74-year-old woman had a sudden onset of medial pain in the right knee while ascending stairs. Plain radiographs after 6 days were normal.

A. Scintimetry after 1 month shows an increased uptake of the isotope in the medial part of the joint in both frontal and lateral projections.

B. After 2 months: A typical osteonecrosis is seen in the medial femoral condyle. The lesion is identified earlier on the AP than on the lateral projection.

C. After 6 months: Increased radiographic changes. In the AP projection, it is easy to define the osteonecrosis, whereas in the lateral projection it is more difficult.

modified from Koshino et al. (1979): 1 = normal, 2 = flattening of the affected weight-bearing portion of the condyle, 3 = typical lesion that consists of an area of radiolucency of variable size and depth surrounded proximally and distally by some sclerosis, 4 = the radiolucent area is surrounded by a sclerotic halo and the subchondral bone has collapsed and is visible as a calcified plate, 5 = secondary degenerative changes with subchondral sclerosis of both femur and tibia, and also some erosion.

The area of the necrotic lesion was measured by using two methods.

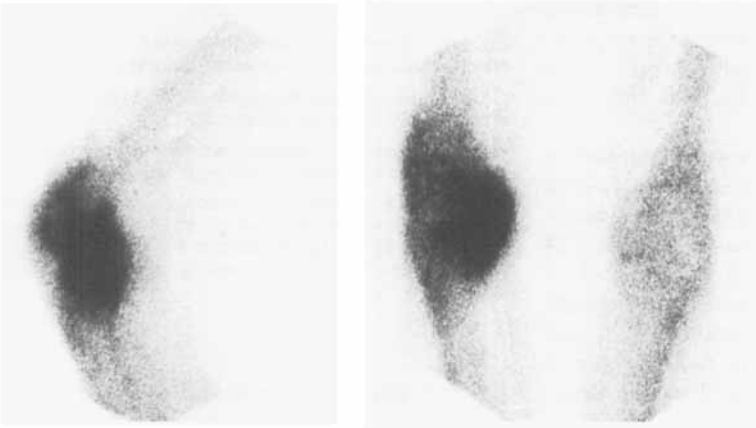
1. Multiplying the greatest width in the anteroposterior view by the greatest length in the lateral view (Muheim and Bohne 1970).

2. The AP width of the lesion expressed as a percentage of the width of the involved femoral condyle on the AP radiograph (Lotke et al. 1982).

The arthrotic changes were graded according to the classification of Ahlbäck (1968) from Stage 1 (narrowing of at least half of the joint space) to Stage 5 (bone attrition of more than 1 cm and often subluxation).



A



B

Figure 2 (Case 29). A 72-year-old man with a history of right knee osteonecrosis starting 7 months earlier.

A. A small, but typical, osteonecrosis of the medial femoral condyle with Stage 3 secondary arthrosis. The lesion is best seen on the AP projection.

B. Scintimetry performed 23 days before the radiographs in A shows major isotope uptake by both the medial femoral and the medial tibial condyle. The uptake is easy to identify on both the frontal and the lateral projection.

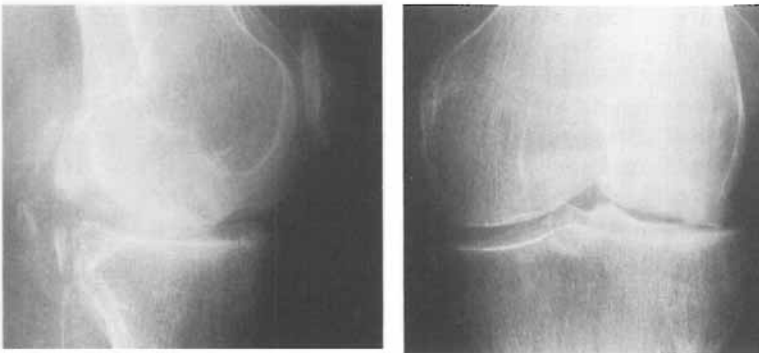


Figure 3 (Case 35). An 83-year-old woman showing a major lateral osteonecrosis in her left knee with secondary arthrosis that is almost Stage 2. The lesion engages the posterior part of the condyle and is well visible on the AP and lateral projections.

### Scintimetry

One or, in most instances, several scintimetric examinations were performed in all the patients by injecting  $^{99m}\text{Tc}$  methylene diphosphonate. The images were recorded (frontal and lateral views) with a parallel-hole collimator gamma camera 2-4 hours after injection (delayed bone scan).

### Results

The onset of pain was sudden in 34 patients and gradual in 6 patients. Twenty-nine of the 34 patients with sudden onset could recall the exact moments and the activity that immediately preceded the onset. Three patients had a history of simultaneous pain in both the knee and the calf, which soon became localized to the knee. Phlebography was performed for 2 of these patients, and was normal. At onset, half of the group had a history of moderate to severe

pain at rest that was continuously disturbing during the day and night. Only 1 out of 4 patients had no pain at rest; their predominant symptom was pain while walking.

The intensity of the pain was moderate to severe, and it occurred immediately from the first step and continued during walking in 39 of the 40 patients. The walking distance was greatly reduced, and in 24 patients it was 50-100 meters. The mean distance of walking about 1-2 months after onset was 200 (50-1,000) meters. Pain was more pronounced when ascending and descending stairs. Twenty-seven of the 40 patients had a history of swelling of the knee. None of the patients complained of restriction of movement, locking, sense of instability, or deformity. The patients sought medical attention 3 (1-16) weeks after onset of symptoms, and they were observed for 3 (1-7) years.

The mean duration from the onset of symptoms to the first radiographic examination was 34 (2-240) weeks, and the initial radiographs revealed osteonecrosis in 19 knees. Of the remaining 21 knees, 14 showed a radiographic lesion with a mean of 28 (4-84) weeks from the first negative radiograph, whereas seven knees were only scintimetrically positive. Ultimately, a typical lesion had developed in 33 knees. The lesion was associated with the development of a calcified plate in 10 knees, osteophytes in 19 knees, tibial sclerosis in 21 knees, a tibial bone defect in two knees, and periosteal new bone formation in seven knees. Loose bodies were found in eight knees.

In 10 patients, the disease was either cured or symptoms improved without the development of arthrosis during the follow-up period (Group A; Figure 4). Twenty-nine of the cases developed arthrosis of at least Ahlbäck stage 1. One patient was followed for 3 years and had persistent pain, but no radiographic arthrosis. This patient was subsequently operated on with arthrotomy and drilling. Of the remaining 29 failures, 12 were operated on during the follow-up period. Four had an osteotomy and 8 an arthroplasty. Five of these were unicompartmental and three total knee arthroplasties. Thus, there were 17 nonoperated on patients with gonarthrosis. They were allocated to group B1 (the 8 nonoperated on patients with arthrosis and mild symptoms) and group B2 (the 22 either operated on or nonoperated on patients with major symptoms of gonarthrosis).

The mean size of the lesion according to Lotke et al. (1982) was 22 (13-28) percent in Group A, 28 (20-39) percent in Group B1, and 39 (22-68) percent in Group B2. The lesions were smaller in

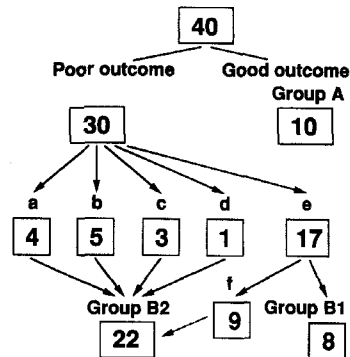


Figure 4. The clinical outcome and surgery performed in the 40 patients.

Group A: Patients with osteonecrosis where the disease was either cured or improved—without development of arthrosis.

Group B1: Nonoperated on patients judged as failures due to arthrosis—with only minor symptoms.

Group B2: Operated on patients and nonoperated on patients failed because of arthrosis—with major symptoms.

a osteotomy; b unicompartmental arthroplasty; c total arthroplasty; d arthrotomy and drilling; e 17 nonoperated on patients with failure due to arthrosis; f 9 of the failed nonoperated on patients with major clinical symptoms indicating surgery.

Group A as compared with Groups B ( $P < 0.01$ ), and similarly in Group B1 compared with Group B2 ( $P < 0.05$ ). Measurements according to Muheim and Bohne (1970) could not be done adequately in Group A because of difficulties in identifying the lesion on the lateral projection. In Group B1 the mean value was 3.8 (1.6-5.7) cm<sup>2</sup> and in Group B2, 8.2 (4.1-14.9) cm<sup>2</sup> ( $P < 0.05$ ). Five of the 7 patients who never became radiographically positive had a clinically and radiographically successful outcome, and only 2 developed arthrosis. The patients' age at the time of onset of symptoms correlated with the clinical and radiographic results ( $P < 0.001$ ).

In scintimetry, all the knees showed high, localized uptake in the medial femoral condyle (37 knees) or in the lateral femoral condyle (three knees). The mean ratio of scintimetry performed during the whole observation period (91 investigations) was 3.2 for Group A and 4.4 for Groups B ( $P < 0.05$ ). The mean ratio of scintimetry performed during the first year (41 investigations) was 3.7 for Group A and 5.8 for Groups B ( $P < 0.05$ ). The mean ratio during the first 6 months (25 investigations) was 4.9 for Group A and 6.6 for Groups B (not significant). The mean ratio during the period 7 to 12 months (16 investigations) was 2.1 for Group A and 4.5 for Groups B ( $P < 0.02$ ). During the period after 1 year (36 investigations), the mean

value for group A was 2.3 and 3.0 for Groups B (not significant).

In the last follow-up examination, the arthrosis was Stage 1 in 15 patients, Stage 2 in 7 patients, Stage 3 in 5 patients, and respectively Stages 4 and 5 in 2 patients.

## Discussion

More than 20 years ago, Ahlbäck et al. (1968) drew attention to a specific painful condition in elderly patients and named it spontaneous osteonecrosis of the knee. This finding has been confirmed by several researchers (Muheim and Bohne 1970, Lotke et al. 1977, Ahuja and Bullough 1978, Rozing et al. 1980, Aglietti et al. 1983, Houpt et al. 1983). The pain is usually characterized by sudden onset, is sharp, is mostly medial, and is initially severe. Apart from pain on weight bearing, three fourths of the patients have pain at rest. This intense early pain gradually decreases during the first few months after onset.

The early diagnosis may be difficult; and in 3 of our patients the initial symptoms resembled calf thrombosis, but phlebography was negative (Strau et al. 1988).

The true incidence of the disease is probably higher than is thought to date. The reason for this assumption is that early radiographs are always negative in osteonecrosis. The typical presenting symptoms and the isotope findings of high, localized uptake at the affected site (Al-Rowaih et al. 1990) should differentiate osteonecrosis from other painful knee conditions.

We have chosen to define the diagnosis without positive radiography, as have others (Lotke et al. 1977, Greyson et al. 1982, Houpt et al. 1983); we rely on clinical findings and scintimetry. Two of our radiographically negative patients developed medial gonarthrosis and had a similar outcome as initially radiographically positive patients.

Our experience is that Lotke's (1982) diagnostic method is advantageous in early disease when the lesion is usually best seen on the AP radiographs, but not well on the lateral radiographs. The explanation could be overlapping of the intercondylar area of the tibia or of the other femoral condyle. There was a correlation between the outcome and the initial size of the lesion, and a lesion equal to or larger than 40 percent seems to have a poor prognosis. However, even small lesions may subsequently become arthrotic. MRI has been shown to be accurate in defining the extension of the lesion (Pollack et al. 1987, Björkengren et al. 1990), and it should preferably be used to confirm the diagnosis.

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