

# Spontaneous osteonecrosis of the knee. Treatment and evolution.

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## ABSTRACT

We performed a retrospective study on 21 patients affected by unilateral spontaneous osteonecrosis of the femoral condyle. Fifteen were women and 6 men. Their average age was 66.9 years. In ten cases the onset of pain was sudden, with a clear previous history of trauma in two of them. Gait pain, effusion, and joint locking were the most frequent clinical symptoms. At the time of diagnosis, 7 patients presented with grade I necrosis, 8 grade II, 1 grade III, and 5 grade IV, following Koshino's classification [11]. The average percent-age of osteonecrosis was 36.8%.

Six patients underwent conservative treatment with physical exercises and nonsteroidal anti-inflammatory drugs. We performed arthroscopy alone in 4 patients, arthroscopy and drilling in 8, valgus high tibial osteotomy in 2, and total knee arthroplasty in 1. The overall results after an average follow-up of 41 months were excellent and good in 76.2% of the cases, fair in 14.3%, and poor in 9.5%. An associated medial meniscus tear was found in half of the patients who underwent surgery. In patients diagnosed with grade III and IV osteonecrosis, no increase in the percentage of necrosis was observed.

## KEY WORDS

Spontaneous osteonecrosis. Femoral condyle.

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## INTRODUCTION

Spontaneous osteonecrosis of the medial femoral condyle was first described as a distinct nosologic entity by Ahlback and colleagues in 1968 [2]. Two main theories of the etiology of osteonecrosis have been identified: a vascular arterial insult and trauma, but neither has been definitely proved [1, 13, 17, 19]. The typical patient is a woman over 60 years old, with sudden onset of pain on the medial aspect of the knee. Initially, the pain is worse at night, and physical examination reveals tenderness on the medial condyle, mild effusion, and occasional locking of the knee. In the early stages, when radiographs are entirely normal, the best diagnostic methods are technetium-99m scintigraphy and magnetic resonance imaging (MRI) [6, 7].

Several papers have been published devoted to the treatment of this condition [5, 8, 13–15, 19]. It is generally accepted that in the early stages conservative treatment is the best option, while in more advanced cases, high tibial osteotomy and knee prosthesis (unicompartmental or total) are most frequently used [5, 8, 13, 19]. Drilling of the femoral condyle has been tried extensively in an attempt to revascularize the necrotic bone, but the results are not encouraging [1, 12, 19]. The purpose of this paper has been to evaluate the results of the different treatment modalities and to identify the factors which could predict the final result.

## PATIENTS AND METHODS

Of 28 patients affected by idiopathic unilateral spontaneous osteonecrosis of the knee, we studied 21 (15 women and 6 men) with a mean age of 66.9 (range 46–91) years and a mean follow-up of 41 (range 9–96) months. Seven patients were excluded from the study due to incomplete evolution. At the time of diagnosis, we divided the patients into four groups according to Koshino's staging system [11]:

- Stage I: Pain with normal radiographs and positive scintigraphic uptake.
- Stage II: Area of subchondral radiolucency in weight-bearing area, with distal sclerosis. Arthroscopy reveals no changes or slight flattening on the convexity of the condyle.
- Stage III: Calcified plate with a radiolucency surrounded by a definite sclerotic halo. There is collapse of the subchondral bone.
- Stage IV: Osteoarthritic changes with narrowing of the joint space, osteophyte formation, and sclerosis.

We measured the area of necrosis using Lotke's method [13], calculating the ratio in the anteroposterior view between the necrosis and the width of the condyle. In symptomatic patients with normal radiographs, we used technetium-99m scintigraphy as a diagnostic test and in some patients we also performed MRI and computed tomography (CT) scan. The choice of treatment depended on the clinical and radiological findings.

Conservative treatment consisting of weight-bearing relief, anti-inflammatory medication, and straight leg-raising exercises was advised in patients with mild symptoms and grade I lesions, or small lesions (< 30%).

Arthroscopic saline washout was performed in patients with grade I lesions and severe pain and swelling, and arthroscopy plus drilling in grade II and III lesions without varus deformity.

High tibia valgus osteotomy was indicated for knees with varus deformities secondary to collapse of the medial femoral condyle and degenerative changes of the medial compartment.

Finally, total knee arthroplasty was our treatment of choice for very elderly patients with a low level of activity, presence of instability, flexion contractures, or degenerative changes in the lateral compartment.

For surgically treated patients, we determined whether a medial meniscal tear was also present. The final result was evaluated following Ordoñez et al. [17]: (a) excellent, close to normal function, no pain and active life; (b) good, 90 deg flexion, and mild occasional pain; (c) fair, less than 90 deg flexion, mild pain, and limited gait; and (d) poor, constant pain, limping, and very limited function.

## **RESULTS**

The typical sudden onset of pain was found in 9 patients. Physical examination revealed mild joint effusion in 13 patients and locking in 9. There were only two patients with a previous history of trauma. At the time of diagnosis, 7 patients presented with grade I necrosis, 8 grade II, 1 grade III, and 5 grade IV, following Koshino's classification [11]. The mean percentage of necrosis was 36.8% (range 0%, in Koshino's grade I necrosis, to 57%). In patients with grade I necrosis, diagnosis was done with scintigraphy (Fig.1) in 2 patients, MRI (Fig.2) and scintigraphy in 2 patients, and retrospectively after the appearance of radiographic signs in follow-up visits in 3 patients.

Six patients (28.6%) were treated conservatively by weight-bearing relief, anti-inflammatory medication, and straight leg-raising exercises, 8 (38.1%) by arthroscopy plus drilling, 4 (19%) by arthroscopic saline washout and debridement, 2 (9.5%) by high tibia valgus osteotomy, and 1 by total knee arthroplasty. We observed an associated medial meniscal tear in 8 of the 15 surgically treated patients. The percentage of necrosis at final follow-up was 39.4% (Table 1). At final evaluation 15 patients remained at their initial radiographic grade of necrosis, 5 worsened, and in 1 case with an initial grade IV necrosis treated by tibia valgus osteotomy we observed a radiographic improvement to grade II necrosis (Fig.3).

The overall results were excellent in 6 cases (28.6%), good in 10 (47.6%), fair in 3 (14.3%), and poor in 2 (9.5%) (Table 2). Of the 2 poor results, one was initially treated conservatively, and then a unicompartmental knee prosthesis was implanted at another institution. The other patient underwent arthroscopy plus drilling without improvement, and has recently undergone high tibia valgus osteotomy. Of the 5 patients with an initial percentage of necrosis greater than 40%, 1 achieved a good result, 2 a fair result, and 1 a poor result; the final one was initially treated by total knee arthroplasty with an excellent result 92 months after surgery.

## DISCUSSION

Osteonecrosis of the knee joint can be spontaneous or produced by the use of steroid drugs. Recently, there have been reports of femoral condyle necrosis after meniscectomy [20] and anterior cruciate ligament reconstruction [4]. The exact cause of spontaneous osteonecrosis is unknown, although a traumatic and a vascular etiology have been proposed [1, 12, 19]. Regarding the vascular theory, it seems difficult to conceive of a single vascular arterial insult as the cause of bone necrosis due to the rich blood supply to the femoral condyles coming from the superior genicular arteries, the middle genicular artery, and several intraosseous arteries, with many anastomoses between them. The most widely accepted theory is an increase in bone marrow pressure that occludes bone microcirculation, which is contained in an unexpandable compartment [1]. In our series, there was a previous history of trauma in 2 of the 21 patients. The association between medial meniscus tears and osteonecrosis has been well established in the literature [5, 6, 8, 16]. In 8 of the 15 surgically treated patients, we confirmed a meniscal lesion. There were also 2 patients with signs of meniscal lesions who were conservatively treated (Table 1).

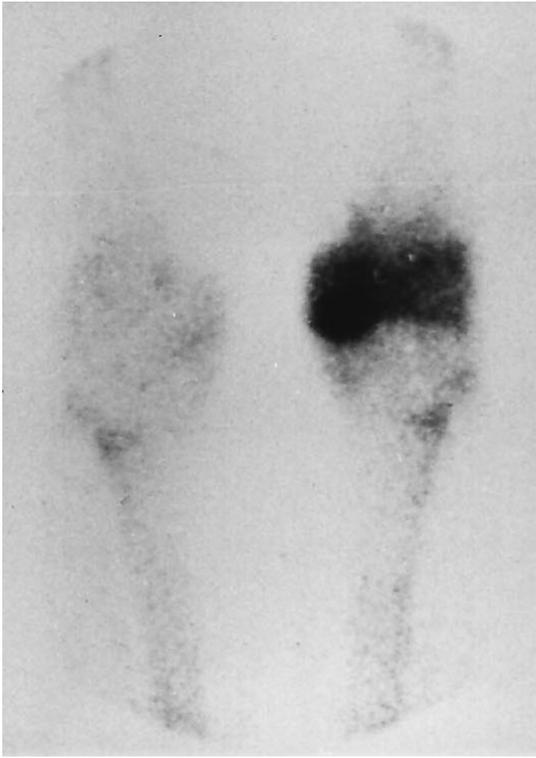
In 1970, Muheim and Bohne were the first to report prognostic factors in osteonecrosis [16]. There is a positive correlation between the size of the lesion and the development of secondary osteoarthritis [3], which is more frequent when the necrotic area is greater than 3.7 cm<sup>2</sup> or 40% of the femoral condyle [12]. In our series, patients with a necrotic area greater than 40% had worse results than the other patients. In patients with radiographic grades III or IV, the percentage of necrosis did not change. This could be related to the fact that the extent of necrosis is determined in the early stages of disease. Once necrosis has been established, the later radiographic changes are degenerative.

Treatment of osteonecrosis is controversial in the literature. We favour conservative treatment for those patients with mild symptoms. Core decompression by drilling of the femoral condyle has not led to good results in some series [1, 12, 19]. In our experience, 6 of 8 patients achieved a good or excellent result with this treatment. We think that drilling achieves the best results in the early stages of osteonecrosis with constant night pain. We cannot draw conclusions on the efficacy of high tibia valgus osteotomy, since we have treated only two patients; however, both patients had an excellent result, as reported by others [1, 11, 12, 17, 19]. Some authors [8, 14] recommend fresh osteochondral allografting for lesions greater than 3.5 cm<sup>2</sup>. Unlike Marmor [15], we have not seen good results with unicompartmental arthroplasty, and we agree with other authors [1, 5, 10, 18, 19] that a total knee prosthesis is preferable in medial femoral condyle osteonecrosis.

## REFERENCES

- 1) Aglietti P, Insall JN, Buzzi R, Deschamps G (1983) Idiopathic osteonecrosis of the knee: aetiology, prognosis and treatment. *J Bone Joint Surg [Br]* 65: 588–597
- 2) Ahlbäck S, Bauer GCH, Bohne WH (1968) Spontaneous osteonecrosis of the knee. *Arthritis Rheum* 11: 705–733
- 3) Al-Rowaih A, Björkengren A, Egund N, Lindstrand A, Wingstrand H, Thorngren KG (1990) Size of osteonecrosis of the knee. *Clin Orthop* 287: 68–75

- 4) Athanasian EA, Wickiewicz TL, Warren RF (1995) Osteonecrosis of the femoral condyle after arthroscopic reconstruction of a cruciate ligament. Report of two cases. *J Bone Joint Surg [Am]* 77: 1418–1422
- 5) Bergman NR, Rand JA (1991) Total knee arthroplasty in osteonecrosis. *Clin Orthop* 273: 77–82
- 6) Björkengren SK, Al-Rowaih A, Lind-strand A, Wingstrand H, Thorngren K, Petterson H (1990) Spontaneous osteonecrosis of the knee: value of MR imaging in determining prognosis. *AJR* 154: 331–336
- 7) Brahme SK, Fox JM, Ferkel RD, Friedman MJ, Flannigan BD, Resnick DL (1991) Osteonecrosis of the knee after arthroscopic surgery: diagnosis with MR imaging. *Radiology* 178: 851–853
- 8) Convery FR, Meyers MH, Akeson WH (1991) Fresh osteocondral allografting of the femoral condyle. *Clin Orthop* 273: 139–145
- 9) Hubbard MJS (1996) Articular debridement versus washout for degeneration of the medial femoral condyle. A five year study. *J Bone Joint Surg [Br]* 78: 217–219
- 10) Insall J, Aglietti P (1980) A five-to-seven-year follow-up of unicondylar arthroplasty. *J Bone Joint Surg [Am]* 62: 1329–1337
- 11) Koshino T (1982) The treatment of spontaneous osteonecrosis of the knee by high tibial osteotomy with and without bone drilling of the lesion. *J Bone Joint Surg [Am]* 64: 47–58
- 12) Lotke PA, Ecker ML (1988) Osteo-necrosis of the knee. *J Bone Joint Surg [Am]* 70: 470–473
- 13) Lotke PA, Abend JA, Ecker ML (1982) The treatment of the necrosis of the medial femoral condyle. *Clin Orthop* 171: 109–116
- 14) Marco F, López-Oliva F, Fernández-Arroyo JM, Pedro JA de, Pérez AJ, León C, López Durán L (1993) Osteochondral allografts for osteochondritis dissecans and osteonecrosis of the femoral condyles. *Int Orthop* 17: 104– 108
- 15) Marmor L (1993) Unicompartmental arthroplasty for osteonecrosis of the knee joint. *Clin Orthop* 294: 247–253
- 16) Muheim G, Bohne WH (1970) Prognosis in spontaneous osteonecrosis of the knee: investigation by radionuclide scintimetry and radiography. *J Bone Joint Surg [Br]* 52: 605–612
- 17) Ordóñez JM, Sánchez V, López F, Munuera L (1987) Osteonecrosis evolucionadas del cóndilo medial del fémur. *Rev Ortop Traum* 1: 27–32
- 18) Ritter MA, Eizember LE, Keating M, Faris PM (1991) The survival of total knee arthroplasty in patients with osteonecrosis of the medial condyle. *Clin Orthop* 267: 108–114
- 19) Rozing PN, Insall J, Bohne WH (1980) Spontaneous osteonecrosis of the knee. *J Bone Joint Surg [Am]* 62: 2–7
- 20) Santori N, Condello V, Adriani E, Mariani PP (1995) Osteonecrosis after arthroscopic medial meniscectomy. *Arthroscopy* 11: 220–224



**Fig. 1** Bone scintigraphy in the acute phase of osteonecrosis showing a very high uptake of technetium-99m localized in the medial femoral condyle.



**Fig. 2** Magnetic resonance imaging (MRI) clearly showing the osteonecrotic lesion.



**Fig. 3a** Grade IV osteonecrosis of the medial condyle.



**Fig. 3b** After high tibia valgus osteotomy, we observe a radiographic improvement to grade II necrosis

**Table 1.** Patients' data and result of treatment (*MM* medial meniscus, % percentage of condyle necrosis, *Arthr* arthroscopy, *Drill* drilling, *TKA* total knee arthroplasty)

Case/sex	Age (years)	Lesion MM	RX stage and % pretreatment	RX stage and % posttreatment	Treatment	Result	Follow-up (months)
1/F	66	+ <sup>a</sup>	I	II (13)	Conservative	Fair	24
2/M	66	-	III (22)	III (22)	Conservative	Good	24
3/M	46	+ <sup>a</sup>	I	I	Conservative	Good	9
4/F	72	-	IV (43)	IV (43)	Conservative	Poor	19
5/F	62	-	II (37)	II (37)	Conservative	Good	20
6/F	58	-	I	I	Conservative	Good	19
7/F	81	+	II (56)	II (56)	Arthr+Drill	Good	68
8/M	57	+	I	II (56)	Arthr+Drill	Excellent	30
9/M	91	-	II (20)	II (30)	Arthr+Drill	Good	32
10/F	76	+	II (28)	II (28)	Arthr+Drill	Good	64
11/F	75	-	IV (57)	IV (57)	Arthr+Drill	Fair	44
12/F	75	-	I	III (46)	Arthr+Drill	Excellent	35
13/F	81	+	II (30)	II (30)	Arthr+Drill	Good	37
14/F	63	+	II (22)	II (33)	Arthr+Drill	Poor	9
15/M	69	-	II (34)	IV (51)	Osteotomy	Excellent	84
16/M	47	+	IV (36)	II (28)	Osteotomy	Excellent	52
17/F	64	+	I	IV (50)	Arthroscopy	Good	44
18/F	65	-	I	I	Arthroscopy	Excellent	53
19/F	61	+	IV (21)	IV (21)	Arthroscopy	Good	96
20/F	57	-	II (42)	II (46)	Arthroscopy	Fair	68
21/F	71	-	IV (67)	IV (67)	TKA	Excellent	92

<sup>a</sup> Signs of meniscal lesion without arthroscopic confirmation

**Table 2.** Overall results

Results	N° of patients	Percentage
Excellent	6	28,6
Good	10	47,6
Fair	3	14,3
Poor	2	9,5
Total	21	100