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**Femoral head necrosis treated with vascularized iliac crest graft**

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**Abstract** We reviewed 24 hips with avascular necrosis of the femoral head in 24 patients treated with vascularized iliac bone grafts 12 years after operation. In 7 patients the necrosis was classified as Ficat Stage II and in 17 patients as Stage III. Eight patients showed poor results. In 6 hips with fair results, moderate progression of the necrosis was noted at 3 to 8 years postoperatively. In 5 hips showing good results, slow progression with incipient signs of arthrosis were noted 8 years after surgery. In the remaining 5 patients with excellent results, no evidence of progression was noted 9 to 14 years postoperatively. The method described is recommended for treatment in the Ficat Stage II and early Stage III, when necrosis does not yet involve the complete femoral head.

**Résumé** Nous avons examiné 24 hanches sur une période de 12 ans après traitement chirurgical de la nécrose avasculaire de la tête fémorale par greffe pédiculaire vascularisée de la crête iliaque. Des résultats médiocres ont été obtenus chez huit sujets. Une progression modérée de la lésion a été observée 3 à 8 ans après l'opération dans le cas de 6 hanches pour lesquelles d'assez bons résultats ont été rapportés. De bons résultats ont été rapportés pour 5 hanches ou la lente progression de la lésion avec des signes débutants d'arthrose a été observée 8 ans après l'intervention chirurgicale mais, aucune n'exigeait le remplacement articulaire. Aucune progression n'a été observée 9 à 14 ans après l'opération chez 5 sujets pour lesquels d'excellents résultats ont été rapportés. La méthode décrite est recommandée pour le traitement au système Ficat stade II et premier stade III quand la nécrose n'implique pas encore la tête fémorale entière.

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**Introduction**

A number of attempts at improving vascularisation of the necrotic femoral head have been reported in the recent years. The aim of treatment is to preserve the viability of the femoral head for as long as possible, and prevent collapse of the head. The aim of our prospective study was to evaluate the treatment of femoral head necrosis using a vascularized iliac crest bone graft.

**Materials and methods**

Twenty-four patients (24 hips) operated upon between January 1984 and January 1989 were studied. Ten patients had bilateral involvement of the femoral head. The selection criteria used for surgery were Ficat Stages II & III. There were 23 men and one woman, aged 25 to 55 (average 38) years.

Twelve patients had idiopathic necrosis of the femoral head; in 8 the necrosis was due to alcohol abuse, 2 patients had post-traumatic necrosis and in 2 necrosis was induced by long-term steroid therapy. The duration of the symptoms before operative treatment was 5 to 17 months (average 12) months. The Ficat radiological staging system was applied, as it was the most useful staging system at the time of the study. Stage II radiological involvement was established in 7 patients and Stage III in 17 patients.

Preoperative angiography was not used. In six patients evaluated by angiography 2 to 4 weeks postoperatively, normal patency of the transposed artery was noted.

The patients were followed up for 9 to 14 years (average 12.2) on a yearly basis. The Ficat radiological staging system was also used to evaluate the success rate of the operation, and the following criteria were also used:

- Poor result: collapse of the femoral head occurring within 3 years postoperatively.
- Fair result: collapse of the femoral head 3 to 8 years postoperatively.
- Good result: no progression of the disease for 8 years postoperatively; followed later by slow, radiologically documented, progression of necrosis associated with discomfort after walking long distances.
- Excellent result: no radiological progression of necrosis for 9 to 14 years postoperatively.

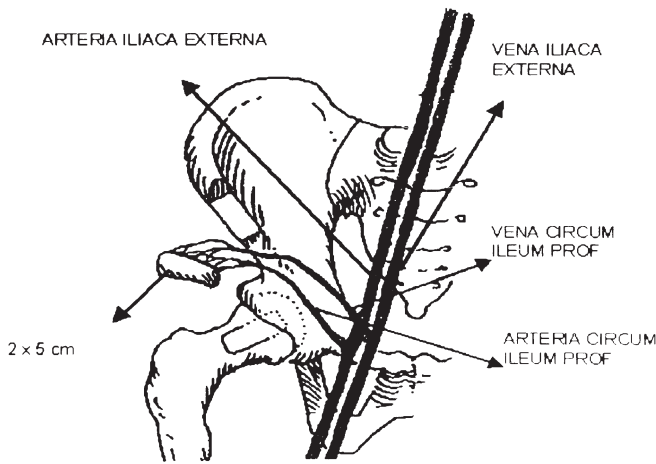


Fig. 1 Diagram of operative technique

Surgical technique

The hip joint was exposed through an anterior approach. In the first 5 patients, a straight longitudinal incision was used; later this was modified to a lateral curved incision, thus preserving the cutaneous blood supply.

The deep circumflex iliac artery and its concomitant vein were exposed from the point of their origin from the external iliac artery and vein, to the inner aspect of the iliac crest. A bone graft measuring 2x4-5 cm was cut from the antero-cranial aspect of the iliac crest. The hip capsule was opened anteriorly, so that the capsular arteries were left undisturbed. Some cortical bone on the femoral neck was removed. The necrotic ischaemic bone of the femoral head was excised through a channel measuring 2x4-5 cm created in the femoral neck. A thin shell of subchondral bone was left in place.

The cartilage of the femoral head was inspected with the head in situ. If it was depressed, we tried to elevate it from within the head, together with the subchondral bone in order to restore the shape of the femoral head.

The cavity of the femoral head was partly packed with autologous cancellous bone on a vascular pedicle. Further bone graft was then introduced beneath the rectus femoral muscle into the bed of the femoral neck and head. The graft was always firmly secured in place and additional screw fixation was not required (Fig. 1). All operations were performed by two surgeons (an orthopaedic and a plastic surgeon). Passive hip movement, as pain allowed, was started 3 to 4 days postoperatively. Full weight bearing was allowed 6 months later.

Results

At the latest follow-up examination, 8 patients had a poor result, 6 patients showed fair results, 5 patients had good results, and 5 patients showed excellent results. Patients in Ficat Stage II preoperatively had better survival rates of the affected femoral head than Stage III patients (Table 1).

The group with poor results comprised of 2 patients with post-traumatic necrosis, one patient with steroid-induced necrosis, one patient with idiopathic necrosis and 4 patients with necrosis due to alcohol abuse.

The group with fair results comprised of 2 patients with necrosis due to alcohol and 4 patients with idiopathic necrosis. Preoperatively these patients had Ficat Stage

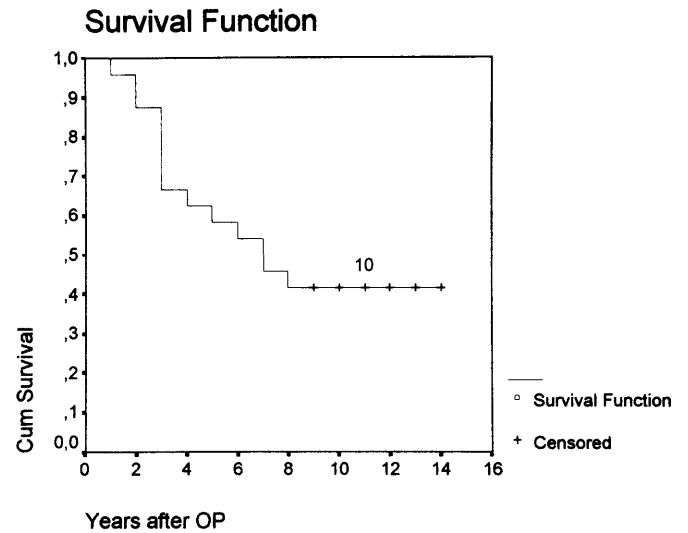


Fig. 2 Kaplan-Meier survival curve; percentage of surviving hips

Table 1 Relationship between preoperative Ficat stage and results of surgery

Ficat	No of hips	Excellent	Good	Fair	Poor
II	7	5	2	—	—
III	17	—	3	6	8

III lesions with depressed cartilage of the femoral head without demarcation; and in these patients the results remained unchanged 3 years postoperatively. During the ensuing years, however, the disease progressed, so that prosthetic replacement was required within 8 years.

In the group with good results 2 patients had Ficat Stage II, and 3 Ficat Stage III lesions. They were free of symptoms for 8 years postoperatively, after which they began to experience pain and demonstrated slight progression of necrosis, and radiological signs of osteoarthritis (Figs. 3, 4).

The results were also evaluated by the survival curve analysis, where the end point of progression was regarded as Ficat Stage IV necessitating total hip replacement. The survival curve analysis of the initial group showed that the risk of failure was highest within the first three years after surgery; the final percentage of surviving hips being approximately 40% (Fig. 2).

In three patients skin necrosis developed on the lateral side of the incision. Later the incision was modified to avoid this complication. There were no other complications.

Discussion

Several approaches to revascularisation of the necrotic femoral head have been proposed, ranging from the in-



**Fig. 3** **A** preoperative radiograph of a 49-year-old man with Stage II lesion of the left hip. **B** 8 years postoperatively, and **C** 11 years postoperatively: relatively good maintenance of joint congruity

**Fig. 4A-D** Preoperative radiograph of a 46-year-old man with Stage III lesion of the left hip: **A** ventrocranial, **B** dorsocranial segment of the left femoral head; slightly depressed femoral head, some progressive degeneration 9 years after surgery. **C** 13 years after primary surgery; and **D** lateral view

sersion of an artery alone to the use of a bone graft attached to its nutrient artery [4, 6, 8, 11].

Our results suggest that long follow-up may be needed for proper evaluation of the results of surgery for aseptic femoral head necrosis. During the first 3 years postoperatively, only one third of our patients deteriorated to a point requiring total hip replacement. Between 3–8 years postoperatively gradual progression to the same end-point was noted in a further 1/4. Between 8 and 14 years, another 1/5 of the group started to progress, however none led to the point requiring hip replacement. In the remaining, the process is still arrested after the same period.

We are aware of three other studies of the same surgical technique. Leung [10] reported 21 operated hips followed up for 4–12 years; he had 52% good and 48% poor results, which is similar good to our findings. Iwata et al. [7] reported good results in 74% of 23 hips; however, their follow-up was only 1–6 years. Rindell et al. [12] obtained good results in 55% of their 22 patients, followed for an average of 5 years.

Core decompression is a simpler procedure for the treatment of femoral hip necrosis, however the reports of its value are controversial. Ficat [3] reported 133 hips with good results in 79%, poor results in 21% for stages I and II with a follow-up from 5–17 years.

Similar results were obtained by Steinberg [13], Fairbank et al. [2], and Warner et al. [14]. Camp and Calwell [1], with a follow-up of 18 months and Hopson and Siverkus [5] reported a failure rate of 60% with this method. Koo et al. [9] with a follow-up of 24 months were unable to detect any difference in the time to collapse of the necrotic head in stages I, II and III of Steinberg. The method described is recommended for treatment in the Ficat Stage II and early Stage III when necrosis does not yet involve the complete femoral head.

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