TREATMENT OF OSTEONECROSIS OF THE FEMORAL HEAD
BY DRILLING AND MUSCLE-PEDICLE BONE GRAFTING

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Sixty-one patients with 68 osteonecrotic femoral heads, at different stages of development, were treated surgically; their average age was 36 years. Necrosis followed a fracture in 43 hips and traumatic dislocation in three. It was idiopathic in 14, cortisone-induced in seven and associated with gout in one. The operation of multiple drilling, curettage of the necrotic bone and muscle pedicle bone grafting was performed in all. Chellectomy of the superolateral part of the femoral head and adductor tenotomy were added in cases of advanced necrosis. Of the several types of muscle pedicle used, tensor fasciae latae anteriorly and quadratus femoris posteriorly were preferred. Full weight-bearing was not permitted for five to six months.

The follow-up period varied from three to 12 years. Hip pain was regularly relieved and abduction and rotation of the joints were improved. Those with post-traumatic or idiopathic necrosis did better than those with cortisone-induced necrosis.

Since there are several aetiological factors in osteonecrosis, the pathomechanics vary from case to case. Though the ultimate fate of the necrotic femoral head is the same, the results of treatment may vary with the aetiology.

Operations which preserve the femoral head are to be preferred particularly in young patients. Intertrochanteric osteotomies such as varus osteotomy (Pauwels 1959), oblique varus rotational osteotomy (Merle d'Aubigné and Vaillant 1961), displacement osteotomy of McMurray (reported by Merle d'Aubigné et al 1965), valgus osteotomy (Maquet 1972) and transtrochanteric anterior rotational osteotomy (Sugioka 1978) were all designed to transfer the weight-bearing forces from the necrotic area to the cartilage on the healthy part of the femoral head. These operations can produce good results in the early stages of necrosis but when collapse has occurred, intertrochanteric osteotomies are not effective (Merle d'Aubigné et al 1965; Maistrelli et al 1988). The transtrochanteric osteotomy of Sugioka (1978) gave poor results because of difficulty with fixation of the osteotomy and delayed union (Saito, Ohzono and Ono 1988).

Core decompression in stages 1 and 2 of idiopathic femoral head necrosis gave good clinical results initially (Ficat and Arlet 1980), but the long-term results were poor (Hopson and Siverhus 1988). The use of a nonvascularised tibial (Phemister 1949) or fibular bone graft (Bonfiglio and Bardenstein 1958) may be useful in the early stages of necrosis but in later stages the results were bad (Bonfiglio and Bardenstein 1958; Dunn and Grow 1977). Subarticular curettage of the necrotic bone and its replacement by cancellous bone grafts fails to relieve pain or prevent progressive collapse of the femoral head (Merle d'Aubigné et al 1965; Saito et al 1988).

Meyers (1978) reported that fresh autologous iliac bone chips combined with a muscle-pedicile bone graft gave good results in stages 1 and 2 necrosis, but was unsatisfactory in stages 3 and 4. He reported encouraging results in the short term from the use of fresh osteochondral allografts for the replacement of the collapsed segment of the necrotic femoral head. Though pain and deformity were initially improved, vascularisation and incorporation of the allografts was poor (Bayne et al 1985). Free cancellous bone graft combined with a vascularised fibular graft (Jouet, Judet and Gilbert 1981) or a combination of osteotomy with a vascularised bone block (Ganz and Büchler 1983) are both technically difficult procedures and their indications are not yet established (Saito et al 1988).

Baksi (1983) reported encouraging results from multiple drilling and muscle-pedicile bone grafting in the treatment of the several stages of post-traumatic avascular necrosis of the femoral head. Pain was relieved in all cases but the range of hip movements was not improved, particularly in hips with advanced disease.

The object of this paper is to report the long-term results of the treatment of osteonecrosis of the femoral
head arising from several different causes. Multiple drilling and muscle-pedicled grafting were used in them all plus cheilectomy of the superolateral part of the femoral head and subcutaneous adductor tenotomy in some, particularly those with advanced disease.

PATIENTS

There were 61 patients with 68 osteonecrotic femoral head treated surgically; 46 had post-traumatic necrosis, of which 43 were after union of fractures of the femoral neck and three after traumatic dislocations of the hip. Nine patients had idiopathic necrosis (14 hips), and five had a history of systemic cortisone therapy (seven hips). One patient had osteonecrosis associated with gout.

The patients were aged 12 to 60 years (average 36). There were 35 males and 26 females. In 32 patients the right hip was affected and 22 in the left; in seven patients both hips were affected.

All patients complained of pain in the hip with activity and had a limp. Some had rest pain. In the early stages of necrosis only the terminal range of movements was limited. In more advanced stages, while there was usually at least 90° or more range of flexion, abduction and internal rotation were considerably restricted. The presence of a good range of movements in at least one direction was considered an important requirement for this femoral head preserving operation.

The average duration of symptoms before operation was 18.8 months.

Osteonecrosis was diagnosed by clinical, radiological and histological criteria. Clinical evaluation, pre- and postoperatively, employed the hip rating system of the Hospital for Special Surgery (Salvati and Wilson 1973) which measures pain, walking, range of movement and muscle power. Each function scores from 0 (worst) to 10 (normal).

Radiological assessment of the stages of osteonecrosis was done according to Marcus, Enneking and Massam (1973). One hip was stage 1, 11 were stage 2, 23 stage 3, 19 stage 4, 11 stage 5 and three were stage 6.

The diagnosis of osteonecrosis was histologically confirmed in all cases by examination of the subarticular bone obtained from the femoral head during the operation. CT scanning was used to demonstrate structural alterations in the trabecular pattern of the necrotic area (see Fig. 6b).

METHODS

Multiple drilling and curettage of the necrotic area of the femoral head and muscle-pedicled bone grafting was employed in all hips (Baksi 1983). Cheilectomy of the superolateral part of the femoral head and adductor tenotomy were added for hips in stages 4 to 6.

The muscle-pedicled bone grafts used in this series
were from four sources. In 32 cases, a quadratus femoris muscle-pedicle bone graft (Meyers, Harvey and Moore 1973) was used; in 10 the gluteus medius and in five the sartorius formed the muscle pedicle (Baksi 1983). Tensor fascia lata (TFL) muscle-pedicle grafts were used in 21 cases, in which the necrotic area was limited to the front of the head or involved a very large area.

**Technique of tensor fascia lata muscle-pedicle bone graft.**
With the patient in the supine position and a small sandbag behind the buttock of the affected side, an incision is made from a point about 7.5 cm behind the anterior superior iliac spine, along the outer lip of the iliac crest. It curves downwards, with its concavity directed posteriorly, to the level of the base of the greater trochanter (Fig. 1, inset).

The groove between sartorius and TFL is identified and the deep fascia overlying TFL is raised. An incision is then made in the muscle fibres of the TFL, in their direction, 2.5 cm behind the anterior edge of the muscle (Fig. 1). The isolated anterior fibres of TFL are elevated and its deeper fibres, found intermingled with those of the underlying gluteus minimus, are sectioned. A segment of the iliac crest 2.5 cm long and 2.5 cm broad is osteotomised and retracted down, keeping its attachment to the anterior fibres of the TFL intact (Fig. 2). The muscle-pedicle bone graft so prepared gets its blood supply from the superior gluteal artery and the ascending branch of the lateral circumflex femoral artery.

The exposed gluteus minimus muscle is erased from the outer surface of the ilium and retracted down, and the straight and reflected heads of rectus femoris are sectioned. Next, the anterior capsule of the hip is opened, using an inverted T-shaped incision. The synovium, which is often oedematous and congested in cases of cortisone-induced or idiopathic necrosis, is excised. Marginal osteophytes are trimmed from the femoral head and, in advanced stages of necrosis, cholecotomy of the superolateral aspect of the femoral head is performed medial to the limit of the acetabular margin (Fig. 3). This improves the range of abduction and rotation of the hip.

The articular surface of the femoral head is examined for alteration of its colour and contour, for erosion and for softening. A pit with undermined edges is made in the anterosuperior articular surface of the femoral head close to the neck (Figs 2 and 3). Through this pit multiple holes are drilled. Usually the necrotic area is sclerotic but in some it is friable. In four of our cases loose sequestra were removed. A small notch is cut at the margin of the pit (Figs 2 and 3) to accommodate the muscle belly of the pedicle and to prevent it being stripped off the graft during impaction. Splitting the inferiorly retracted gluteus minimus muscle belly facilitates easy placement of the TFL graft into the necrotic bed without tension.

The cut margins of the capsule and the gluteus minimus muscle are then repaired to secure the graft. The wound is closed in layers over a suction drain. If needed, subcutaneous adductor tenotomy is done at the end of the operation. The foot is fitted with a boot with an anti-rotation bar.

**Aftercare.** Assisted hip movements are encouraged early in the postoperative period. Vigorous hip movements are started at four weeks with the patient still in bed. Crutch walking, non-weight-bearing on the affected leg, is allowed from five to six weeks. Full weight-bearing does not begin before five to six months after the operation. In patients with cortisone-induced necrosis an even longer delay is required. In bilateral cases a wheelchair is used during the period of non-weight-bearing.

**RESULTS**

The follow-up period varied from three to 12 years (average 86 months). Clinical improvement was most rapid when good postoperative physiotherapy was available. The patients' gait improved considerably and in many it became normal.

Radiological improvement was judged by diminution of density of the necrotic portion of the femoral head; return to normal density of the pre-operative rarefied areas (particularly in early cortisone-induced (see Figs 6a and 6c) and idiopathic disease); restoration of the normal trabecular pattern; disappearance of the crescent sign; healing of cystic areas and of the fracture line within the necrotic area or between it and the healthy bone; improvement in the shape of the femoral head, particularly after cholecytectomy; and improvement of the radiological joint space.

The following criteria were used to grade the results:
- Excellent: no pain in the hip, little or no functional restriction, a hip rating of 32 to 40 points and a femoral head which looked radiologically normal or had healed stage 1 to 4 lesions, with improvement in its shape.
- Good: no pain in the hip, walking normal or only slightly restricted, some limitation of movements or function, a hip rating of 24 to 31, radiologically healed stage 3 to 5 lesions with improvement in the shape of the femoral head, but slight flattening or early asymptomatic degenerative changes in the hip.
- Fair: intermittent mild pain in the hip, particularly during walking, moderate limitation of movements, a hip rating of 16 to 23, little radiological evidence of healing or slight flattening of the femoral head, and evidence of mild to moderate degenerative changes in the hip.
- Poor: constant pain, ankylosis of the hip, a hip rating of 15 or less, no radiological healing, mild to moderate flattening of the femoral head, and moderate to advanced degenerative changes.

The results at latest follow-up in the different stages of necrosis are shown in Figure 4. There were 21 hips (31%) classified as excellent (Figs 5 and 6), 36 (53%) were good, seven (10.3%) were fair and four (6%) were poor. Improvements in hip rating averaged 8.5 points at the latest follow-up.
Some patients had satisfactory clinical results despite the lack of radiographic improvement or the presence of early degenerative changes in the hip. Apart from the cases with stages 5 and 6 necrosis, who had osteoarthritis pre-operatively, degenerative changes developed in six instances (11.1%). The incidence was less in those treated by cheilectomy of the femoral head. Patients graded as having only a fair result could nevertheless manage their routine daily activities and none has required a further operation.

DISCUSSION

When necrosis affects the anterosuperior part of the head we use the TFL muscle-pedicle graft usually and the sartorius graft occasionally. The TFL graft appears to be better vascularised than the sartorius graft and is therefore preferred, particularly if the necrotic area is extensive. If the necrotic area is posterior we use either a quadratus femoris or a gluteus medius muscle-pedicle graft.

The TFL and the sartorius pedicles provide grafts with a cortical element which is stronger than those based on the quadratus femoris or the gluteus medius in which the graft is mostly of spongy bone.

The actual necrotic area which needs to be removed is often much smaller than the radiographs suggest and can usually be repaired with the muscle-pedicle graft alone. The radiologically dense zone surrounding the necrotic area is usually viable and is seen to bleed during drilling. It appears dense because new bone has been laid down on dead trabeculae. Overzealous curettage of this dense area is therefore injudicious. Too radical curettage and the packing of the large resultant defect with free iliac bone chips in addition to a muscle-pedicle bone graft, as reported by Meyers (1978), or to a vascularised fibular graft, as reported by Judet et al. (1981), may be the reason for their unsatisfactory results. If curettage leaves only a thin shell of weak subchondral bone the head is likely to collapse and free bone grafts only add more necrotic bone (Merle d’Aubigné et al. 1965). The anterosuperior part was the commonest site of necrosis and flattening of the femoral head and this deformity developed or increased postoperatively in about 10% of all our cases. In those with idiopathic necrosis the incidence of postoperative collapse was about 14%, which is much less than the 39% reported by Saito et al. (1988) in hips treated with free iliac crest grafts.

Pain relief was regularly achieved immediately after operation and was probably due to decompression by drilling and curettage of the necrotic area. Movements of the hip also improved postoperatively, due to relief of pain and to the effects of capsulotomy, cheilectomy and adductor tenotomy. Even in the presence of a deformed

![Histogram showing postoperative results in different stages of necrosis.](image)

Fig. 4

**Fig. 4**

**Fig. 5a**

**Fig. 5b**

**Fig. 5c**

a) Radiograph of a man aged 42 years with painful avascular necrosis (stage 4) 26 months after fracture of the neck of the femur; the hip score was 22. b) Four weeks after multiple drilling, TFL muscle-pedicle bone grafting, cheilectomy and adductor tenotomy, with the graft shown by arrows. c) Eight years later there is healing of the necrotic area and no further deterioration. Clinically the result was excellent (hip score 36).
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Fig. 6a

Fig. 6b

Fig. 6c

femoral head, this method of treatment can give symptomatic relief and delay the need for total joint replacement.

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REFERENCES


Ganz R, Büchler U. Overview of attempts to revitalize the dead head in aseptic necrosis of the femoral head: osteotomy and revascularization. Hip 1983; 296-305.


