INTERTROCHANTERIC OSTEOTOMY FOR AVASCULAR NECROSIS OF THE FEMORAL HEAD

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Of 24 intertrochanteric osteotomies for avascular necrosis of the femoral head, 22 were followed up for an average of 63 months. Sixteen of the 22 cases had good or excellent results, including 5 of the 6 cases with Stage II disease and 11 of the 16 with Stage III changes. Success seemed to be inversely related to the size of the lesion. There were six major orthopaedic complications, but despite these we feel that the operation has a definite role in the treatment of the young active patient.

Avascular necrosis of the femoral head represents a tremendous challenge to the orthopaedic surgeon. Although the disease is associated with trauma, corticosteroid usage, alcoholism, renal failure, lipid abnormalities, haemoglobinopathies, caisson disease, chemotherapy, and several other medical conditions, its pathophysiology remains unknown. Several parameters such as increased intra-osseous pressure have been associated with it, but their exact relationship to the disease process is not clear (Ficat and Arlet 1980; Hungerford 1983). As a result, the disease usually has to be treated at its end-stage; and this is made particularly difficult by the fact that many of the patients with advanced disease are relatively young.

Cemented total hip replacement yields predictably satisfactory results for older patients, but at present it is not suitable for young patients or those with very active life styles (Chandler et al. 1981). Cementless hip replacement may be better, but this is not yet proven. Osteotomy is therefore an important joint-preserving operation in such cases. For osteoarthritis of the hip, osteotomy has a long history of consistently good results (Schneider 1980; Bombelli 1983; Miegel and Harris 1984; Reigstad and Grønmark 1984), especially when it is designed to alter the joint mechanics. However, the situation in cases of avascular necrosis is somewhat different. There is then a discrete and defined abnormality in the femoral head; osteotomy is designed to move this abnormal area to a different position in the joint. The most dramatic example of this is the transtrochanteric rotational osteotomy recently described by Sugioka (Sugioka 1978; Kotz 1981), but the lesion may also be repositioned by an intertrochanteric osteotomy (Kerboul et al. 1974; Wagner and Zeiler 1981; Willert, Buchhorn and Zichner 1981). In our series, intertrochanteric osteotomies were designed to move the abnormal part of the femoral head out from under the weight-bearing dome of the acetabulum. We have reviewed our results in the hope of better defining the role of this procedure for avascular necrosis.

MATERIALS AND METHODS

Between January 1975 and December 1983, 24 proximal femoral osteotomies were performed at the Good Samaritan Hospital for avascular necrosis of the femoral head. Two of the patients were lost to follow-up in the early postoperative period, so we report the remaining 22 patients. Their average age was 35 years (range 24 to 65 years) and there were 14 men and eight women in the study group. Average follow-up was 63 months (range 30 to 120 months).

The diagnosis of avascular necrosis had been made by the clinical history, physical examination, and radiological evaluation, which for the early patients included anteroposterior, true lateral and frog lateral radiographs. More recently, we used isotope scans and computerised tomography to help confirm the diagnosis. On the Ficat staging system (Ficat and Arlet 1980), six

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patients had Stage II avascular necrosis and 16 had Stage III changes.

Seven patients had a history of steroid treatment, for systemic lupus erythematosus in six and for the nephrotic syndrome in one. Five of these seven patients continued to require steroids after the osteotomy. One patient had a history of heavy alcohol intake and another had had chemotherapy for Hodgkin's disease. In the remaining 13 patients, no association could be found between potential risk factors and the development of avascular necrosis. All the patients with Stage II disease had had core decompressions which had provided biopsy proof of avascular necrosis. The time from core decompression to hip osteotomy varied from 11 months to five years. Six of the patients with Stage III disease had also had previous core decompression. The 10 other Stage III patients who had osteotomy without previous biopsy all had large lesions with femoral head collapse that had progressed to the point where core decompression was unlikely to yield a good result. The patients had varying degrees of pain at rest, but they all had severe pain on walking. To be considered for osteotomy, the patient had to have at least 90° of combined flexion and extension of the hip with at least 20° of combined rotation.

All the hips were evaluated at follow-up with a clinical rating system that allowed 50 points for pain, 25 for function and 25 points for range of movement (Table I). A score of 85 to 100 points was considered excellent, 75 to 85 good, and 65 to 75 fair, while less than 65 was unsatisfactory. All patients who later required hip arthroplasty were also considered to be failures of osteotomy.

The technical goal at operation was to rotate the lesion in the femoral head out from under the weight-bearing dome, having used multiple radiographic views to define the location of the necrotic area. Eleven of the 22 patients had a varus osteotomy, nine had varus/flexion, one patient had varus/extension, and one had a valgus/flexion. None had a trochanteric advancement. The fixation devices were compression screws with sideplates in three and fixed angle blade plates in 19. Closed suction drainage was used, but removed by 48 hours in all cases. Since 1978, for 17 of the 22 cases, prophylactic antibiotics were given for 24 to 48 hours postoperatively.

RESULTS

At the most recent follow-up, 16 patients (73%) had good or excellent results and were very satisfied with the operation and six patients had had a hip arthroplasty. The average pre- and postoperative scores are given in Table II. Five of the 6 patients with Stage II disease and 11 of the 16 patients with Stage III avascular necrosis had good or excellent results. Of the six failures, five had total hip replacement and one had resurfacing, but three of them had had satisfactory results for five years, six years and seven-and-a-half years respectively. Of the seven patients on steroids, four had needed arthroplasty.

The successful patients had an average pre-operative flexion of 106° and an average postoperative flexion of 97°, with extension of −2° and −5°. The average arc of rotation was 35° before operation and 28° at follow-up, while abduction was 31 and 28° respectively. None of these changes in the range of movement were statistically significant. Clinically, seven patients had a mild limp and two a moderate limp. One of the patients with a good result uses a walking aid because of pain in the contralateral hip.

Survivorship analysis. Our results were used to generate a Kaplan-Meier survivorship curve (Kaplan and Meier 1958), which is shown in Figure 1. This suggests that the

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Table I. Rating system for patients before and after intertrochanteric osteotomy for avascular necrosis of the hip. A normal hip scores 100 points

<table>
<thead>
<tr>
<th>Pain at rest</th>
<th>Pain on weight bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Mild</td>
<td>Mild</td>
</tr>
<tr>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Marked</td>
<td>Marked</td>
</tr>
<tr>
<td>Totally disabled</td>
<td>Totally disabled</td>
</tr>
</tbody>
</table>

Function 25 points

<table>
<thead>
<tr>
<th>Limp</th>
<th>Distance walked</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Slight</td>
<td>6-20 blocks</td>
</tr>
<tr>
<td>Moderate</td>
<td>2-5 blocks</td>
</tr>
<tr>
<td>Severe</td>
<td>Indoors</td>
</tr>
</tbody>
</table>

Walking aid

None 5
Cane, long walks 4
Cane, full time 2
Crutch 0

Movement 25 points

<table>
<thead>
<tr>
<th>Flexion/extension</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 or greater</td>
<td>45 or greater</td>
</tr>
<tr>
<td>90–110°</td>
<td>30–45°</td>
</tr>
<tr>
<td>80–90°</td>
<td>20–30°</td>
</tr>
<tr>
<td>Less than 80°</td>
<td>10–20°</td>
</tr>
<tr>
<td></td>
<td>Less than 10°</td>
</tr>
</tbody>
</table>

Fig. 1

Kaplan-Meier curve for the results of 22 intertrochanteric osteotomies for avascular necrosis of the hip. Failure is defined as a score of less than 60 points or the need for hip arthroplasty.
chances of a satisfactory result at five years are nearly 80\%, but that by 100 months, this had fallen to near 40\%.

**Radiographic results.** Before operation all the patients had at least 2 mm of joint space both on their anterolateral and lateral radiographs. In the immediate postoperative radiograph the joint space either remained the same or increased slightly in all patients. The necrotic lesion was measured in both the anteroposterior and lateral planes in all patients (Fig. 2). The sum of these two measurements has been termed the necrotic angle (Kerboul et al. 1974; Wagner and Zeiler 1981). In the successful cases the average necrotic angle was 190°; the average necrotic angle in the patients that failed was 240° (Figs 3 and 4). Only one patient who failed had a necrotic angle of less than 200° and in only two cases were successful results obtained when the necrotic angle was greater than 200°. All of the patients with Stage II disease had necrotic angles less than 200°. In four of the six failures, the femoral head had collapsed at the time of a rapid increase in the patients symptoms, but in the remaining two cases which had hip arthroplasty, the postoperative radiographs had remained stable.

**Complications.** There were six major orthopaedic complications. One compression screw lost fixation in the distal fragment in the early postoperative period, and revision to a fixed angle blade plate was supported in a spica cast for six weeks. The osteotomy healed and has given a good result at 64 months. A second patient had suboptimal fixation and also required a spica cast for six weeks before the osteotomy healed uneventfully. There were three cases of delayed union, defined as having no evidence of healing at five months. All were successfully treated by autogenous bone grafting without changing the fixation device. One patient suffered a superficial wound infection that resolved after 10 days of appropriate antibiotics.

Medical complications were limited to the genito-urinary tract, with two cases of urinary retention that resolved spontaneously and one successfully treated urinary tract infection.

**DISCUSSION**

The overall results show that 73\% were satisfactory at a minimum 30 months follow-up. This is consistent with previous reports of intertrochanteric osteotomies for avascular necrosis of the hip (Kerboul et al. 1974; Wagner and Zeiler 1981; Willert et al. 1981). Patients with less advanced and smaller lesions had consistently better results, but three of the six patients who eventually failed and required total hip replacement had had at least five years of satisfactory function from their osteotomy. Given the rapid technical advances in arthroplasty and the young age of the patients, the authors feel that these patients obtained significant benefit from the osteotomy.

Also, in no case did the osteotomy compromise the eventual technical result of the total hip replacement.

The average necrotic angle of the patients who failed was 240° as against 190° in the patients with successful results. We therefore agree with others (Kerboul et al. 1974; Wagner and Zeiler 1981) that 200° seems to be the maximum necrotic angle that can be accommodated successfully with an intertrochanteric osteotomy.

Four of the six patients who failed underwent significant collapse of their femoral heads after the osteotomy and one of the other two had an extremely large lesion (necrotic angle 250°), which, in retrospect, was probably too large to be satisfactorily handled by this procedure. The other failed patient had a relatively small (160°) Stage II lesion and the cause of failure is not clear. Although four of the seven failures had been on steroids, the numbers are small and the lesions were of large size in three of them, so it is impossible to implicate steroids as a risk factor in our series.

**Table II. Results in 16 successful cases of intertrochanteric hip osteotomy**

<table>
<thead>
<tr>
<th>Stage of disease</th>
<th>Number of cases</th>
<th>Score*</th>
<th>Flexion/extension</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pre-op</td>
<td>Review</td>
</tr>
<tr>
<td>II</td>
<td>5</td>
<td>48</td>
<td>82</td>
<td>109°</td>
</tr>
<tr>
<td>III</td>
<td>11</td>
<td>40</td>
<td>80</td>
<td>103°</td>
</tr>
</tbody>
</table>

*See Table 1

The relatively high incidence of a limp at follow-up could be related to the fact that all but one patient had a varus component in their hip osteotomy, though none had had a trochanteric advancement. The technical difficulty of these bi- and triplanar procedures are reflected by the fact that five patients required re-operation or spica casts.

In summary, intertrochanteric hip osteotomy for avascular necrosis has given 73\% of satisfactory early results. The indications for osteotomy include a good pre-operative range of movement and a necrotic angle of less than 200°. The surgery is technically demanding and has a high complication rate, but we feel that it has a definite role in the treatment of the young active patient. It is also clear, however, that this role must be continuously re-evaluated as the results of other joint-preserving procedures and the long-term results of cemented and cementless arthroplasty become available.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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Figures 2a and 2b - The pre-operative lesion in a patient with idiopathic avascular necrosis. The necrotic angle is obtained by adding the angles measured on anteroposterior and lateral views. Figures 2c and 2d - At 75 months postoperatively there is a good clinical result, but the radiographs show a narrowed joint space under the dome of the acetabulum.

Figures 2a and 2b - The pre-operative lesion in a patient with idiopathic avascular necrosis. The necrotic angle is obtained by adding the angles measured on anteroposterior and lateral views. Figures 2c and 2d - At 75 months postoperatively there is a good clinical result, but the radiographs show a narrowed joint space under the dome of the acetabulum.

A steroid-dependent woman who had a varus/flexion osteotomy. Figures 3a and 3b - At 29 months, there was an excellent clinical result; the radiographs show an excellent joint space. Figures 3c and 3d - At 70 months, degenerative changes are seen in the lateral aspect of the joint and there is some femoral head collapse. The patient experienced rapidly increasing symptoms and soon required a total hip replacement.

Radiographs of a patient with idiopathic avascular necrosis. Figures 4a and 4b - Soon after a varus/flexion osteotomy. Figures 4c and 4d - At 26 months the clinical result was good. Figures 4e and 4f - At 58 months there is significant femoral head collapse and degenerative changes. There were incapacitating symptoms which necessitated total replacement.
REFERENCES


