OSTEONECROSIS OF THE HIP TREATED BY INTERTROCHANTERIC OSTEOTOMY

A FOUR- TO 15-YEAR FOLLOW-UP

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We have reviewed the results of 106 intertrochanteric osteotomies performed for osteonecrosis of the femoral head. The average age at operation was 47.5 years. At two years from operation 71% of the hips had a clinically satisfactory result and at final follow-up, an average of 8.2 years after operation, 58% continued to have excellent or good rating. Twenty-four hips had needed total replacement or arthrodesis because of pain.

Patients aged less than 55 did better than those operated on after that age, and hips with an idiopathic or post-traumatic aetiology did considerably better than alcohol-induced or steroid-induced cases. In view of these findings we believe that in the younger adult, in the absence of metabolic bone disease or advanced joint destruction, intertrochanteric osteotomy should be considered for the treatment of osteonecrosis.

It is now generally accepted that, in selected cases, Pauwel's intertrochanteric osteotomy is a satisfactory surgical option in the management of osteoarthritis of the hip, particularly in younger patients (Pauwels 1959, 1976; Langlais, Roure and Maquet 1979; Weisl 1980; Bombelli 1983; Santore and Bombelli 1983). Very little is known however, of the results of Pauwel's procedures for osteonecrosis, as only a few short term and small series have been reported in the English literature. In 1965 Merle d'Aubigné et al. reported on the use of varus or varus rotational osteotomies for idiopathic osteonecrosis; in their 59 patients 79% had excellent or good results when the procedure was performed in the early stages of the disease. However, no direct mention was made of the average follow-up and the figures suggest that 70% of their cases had been followed for less than three years. Kerboul et al. (1974) from the same institution later reported on 39 patients followed for five years; 60% were still free from pain. Although the results tended to deteriorate with time, the factors that were found to influence the clinical results were the size and position of the necrotic segment. More recently Wagner and Zeiler

(1981) have reported their results with varus and valgus osteotomies but they did not provide details of the length of follow-up. Discomfort was present in only 10 of the 69 hips re-examined. Unsatisfactory results were attributed to an excessively large necrotic area, advanced pre-operative arthritic changes and a varus osteotomy.

Despite these encouraging early results, intertrochanteric osteotomy for osteonecrosis has not become popular in the English speaking world. At our institution we have used this operation in the treatment of osteonecrosis since 1969. The purpose of our retrospective study was to review the long-term results in an attempt to determine the clinical and radiographic factors which may influence the final outcome.

PATIENTS AND METHODS

Between 1969 and 1980, 119 intertrochanteric osteotomies were performed for osteonecrosis of the hip in the Orthopaedic Department of the Busto Arsizio General Hospital in Italy. The indications for osteotomy were disabling pain with radiographic evidence of at least a Stage II osteonecrosis according to the Marcus, Enneking and Massam (1973) staging system. Osteotomy was not performed if the arc of flexion of the hip was less than 60° or if the hip lacked enough adduction or abduction for the desired valgus or varus correction.

During 1984, the patients were invited to return for a follow-up examination and 106 hips (98 patients) were reviewed. The remaining patients had either died or could not be traced. Follow-up ranged from a minimum of four years to a maximum of 15 years (mean 8.2 years) for 102 of the hips (94 patients). The remaining four hips

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(four patients) had been revised to a total hip arthroplasty before the four-year mark had been reached. Eighty-three of the patients were examined personally by the authors and the rest were studied through questionnaires, charts and recent radiographs. There were 76 men and 22 women; the average age at the time of operation was 47.5 years (range 18 to 77 years). Eight of the patients had bilateral staged procedures with at least six months between the operations.

Aetiology. The aetiology of the osteonecrosis is included in Table I. Of the 14 steroid-induced cases eight had had long term steroid therapy; the others had had short term but high dosage therapy. Twenty hips qualified without doubt as alcohol-induced osteonecrosis; the patients either had obvious signs of chronic alcohol intoxication or a long history of abnormal alcohol intake. In the 32 hips with osteonecrosis secondary to trauma, bone necrosis had followed a major injury, either a healed femoral neck fracture or a traumatic hip dislocation; 21 of these 32 hips had had prior hip surgery consisting of internal fixation of a femoral neck or acetabular fracture (20), or open reduction of a posterior dislocation of the hip (1). Other definite causes of osteonecrosis were found in one patient who had sickle cell anaemia and in another with post-irradiation osteonecrosis. In the remaining 38 hips, no aetiological factor could be identified; this group was therefore labelled as idiopathic. None of the patients in this study had had a core decompression before the intertrochanteric osteotomy but one patient had had an unsuccessful medial displacement osteotomy two years before undergoing a valgus extension procedure.

Technique and indications. The osteotomies were performed or supervised by the senior author in all cases,

Fig. 1

Diagram of valgus-extension osteotomy combined with a hinged osteotomy of the greater trochanter. The excised wedge of bone is placed in the pocket created in the trochanter in order to lengthen the abductor lever arm. The intact congruent medial aspect of the femoral head functions as a fulcrum and a new centre of movement.

Fig. 2a

Fig. 2b

Radiographs of a woman with a central localised form of post-traumatic osteonecrosis in a concentric head. Figure 2a - After a varus-extension osteotomy. Figure 2b - At 40 years of age, 50 months after surgery, she has only occasional discomfort during activity, a slight limp and almost a full range of hip movement.

Fig. 3a

Fig. 3b

Radiographs of a man with painful idiopathic osteonecrosis of the left hip diagnosed at 36 years of age. Figure 3a - There is collapse of the femoral head with a large necrotic segment. Figure 3b - Eight years after a valgus-extension osteotomy he continues to have an excellent rating with a good range of movement.

using the technique he has previously described (Bombelli 1983), with an anterolateral approach and an anterior capsulotomy for direct visualisation of the affected area. The operations were performed using either the 90° or the 130° AO blade-plate fixation device. The iliopsoas was released in all cases, and a hinged osteotomy of the greater trochanter was performed in the valgus procedures in order to increase the abductor lever arm (Fig. 1). None of the varus operations had distal transfer of the greater trochanter. There were 25 varus and 81 valgus osteotomies.

The rationale for choosing the type of osteotomy was based entirely on the radiographic appearance of the hip, i.e., the location, size and stage of the disease

process. A concentric femoral head with a Stage II or III grading and a necrotic segment of less than 160° with sparing of an arc of at least 20° of the lateral aspect of the femoral head (Kerboul et al. 1974) were prerequisites for a varus type of correction (Fig. 2). In all the remaining cases a valgus osteotomy was performed, as this allowed the more commonly intact congruent medial aspect of the femoral head to bear the load, with enlargement of the weight-bearing surface even in the presence of collapse (Fig. 3). Thus the load on the affected superolateral aspect of the femoral head was reduced with further reduction in articular load being obtained by the iliopsoas release combined with the hinged osteotomy of the greater trochanter (Fig. 1).

The varus corrections were measured on the anteroposterior radiographs and ranged from 15° to 35° (average 26°) while the valgus correction ranged from 20° to 40° (average 32°). All but nine of the valgus procedures had a combined extension correction of the femoral head which measured between 5° and 40° (average 27°) on the frog leg lateral radiograph. An extension correction averaging 18° was added to the varus procedures in all but five cases; in these five a flexion correction of between 10° and 30° was combined with the varus osteotomy. The object of adding an extension correction in the other cases was to remove the necrotic segment, which usually lies in an antero-supero-lateral position, from the sharp anterior margin of the acetabulum and the anterior acetabular wall, which is the area under the greatest mechanical load (Rydell 1966) (Fig. 4).

Posterior rotation of the femoral head also provides increased congruity as the largest diameter of the head moves toward the largest diameter of the acetabulum (Bombelli 1983) and also corrects any flexion deformity of the hip (Fig. 4). Anterior rotation (flexion osteotomy) was reserved for the few cases where the necrotic

Fig. 4

Posterior rotation of the femoral head effectively moves the necrotic segment away from the anterior rim and wall of the acetabulum where the peak loads are concentrated. It also allows for increased contact areas as the largest diameter of the head rotates toward the largest diameter of the acetabulum.

segment was found to be quite small and confined to the anterior half of the femoral head. Only in these circumstances was it possible to clear the sharp anterior margin of the acetabulum.

After-care. All patients were walking (with a walker) by the fourth postoperative day and progressed to two crutches with partial weight bearing by two weeks. They were advised to use two sticks for six months and subsequently one, which was usually discontinued by 10 months.

RESULTS

The Harris rating system was used to score each hip pre-operatively and at follow-up (Harris 1969). A rating of 90 to 100 was considered excellent, 80 to 89 good, 70 to 79 fair, and less than 70 was considered poor. The overall clinical effect of the osteotomy was rated satisfactory if excellent or good scores (80 or more) had been achieved, no walking aids were required and a range of at least 70° of flexion was present. All the remaining hips were rated as unsatisfactory. The chi-square test was adopted for the statistical evaluation of the results, with $(n - 1)(k - 1)$ degrees of freedom, where n equals the number of outcomes and k the number of variables.

The average pre-operative score was 46 points (range 34 to 65) while the average final follow-up score was 81 (range 39 to 99). Twenty-five hips (23%) were graded as excellent, 37 (35%) were good, 21 (20%) fair and 23 (22%) poor. The overall results at different postoperative periods of time also were assessed. At two years 76 hips (71%) had a satisfactory result, at four years 70 (68%) while at final follow-up 62 (58%) had a satisfactory rating. A steady deterioration was therefore observed over the course of time (Fig. 5).

Analysis of clinical factors (see Table I). Although a better response was seen in women, in patients weighing less than 60 kg, and in hips which had undergone a valgus correction, these differences did not reach statistical significance. However, patients aged less than 55 had a significantly better outcome than those who were 55 or more. Those with an idiopathic or traumatic aetiology also did significantly better than the others; this may be explained by the fact that in steroid and alcohol-induced osteonecrosis there is usually more extensive involvement of the femoral head, a high incidence of bilateral cases and osteoblastic activity tends to be depressed (Dalén and Feldreich 1974; Johnell, Nilsson and Wiklund 1982). The age and aetiology factors were also analysed together, to see if any combination influenced the final results. An idiopathic or traumatic aetiology was present in 69% of the hips of patients aged less than 55, and in 54% of those over 55; this difference is not statistically significant.

Analysis of radiographic factors (see Table II). The radiographic staging method reported by Marcus, Enneking and Massam (1973) was adopted; patients

Fig. 5

Unsatisfactory results according to the number of years of follow-up.

Table I. Results according to pre-operative factors and type of procedure

Pre-operative factors and procedure	Number of hips	Result - number and per cent		Statistical significance
		Satisfactory	Unsatisfactory	
Sex				
Male	82	47 57	35 43	NS
Female	24	15 63	9 37	
Age				
<40 years	26	20 77	6 23	p < 0.001
40-55 years	56	36 64	20 36	
> 55 years	24	6 25	18 75	
Weight				
<60 kg	34	22 65	12 35	NS
60-80 kg	58	34 59	24 41	
> 80 kg	14	6 43	8 57	
Aetiology				
Idiopathic	38	26 68	12 32	p < 0.005
Post-traumatic	32	24 75	8 25	
Alcohol	20	7 35	13 65	
Steroids	14	4 29	10 71	
Other	2	1 50	1 50	
Type of osteotomy				
Varus	25	14 56	11 44	NS
Valgus	81	48 59	33 41	

treated in the early stages had significantly better results than those treated later in the disease process. Focal size was measured using Kerboul's method (Kerboul et al. 1974), which consists of measuring the arc of the surface involved by the necrotic cone in the anteroposterior and lateral films of the head and adding these two angles together; hips with less than 200° responded significantly better than those with over 200°. Radiographs of 98 hips were also assessed pre-operatively according to the Singh osteoporosis index (Singh, Nagrath and Maini 1970); hips with low-grade osteoporosis of the proximal femur had significantly better results than those with advanced changes. The clinical outcome was also significantly better in patients who had unilateral rather than bilateral involvement.

In addition, the hips were assessed for the presence and grade of osteoarthritis before and after osteotomy

Fig. 6

Degree of degenerative change at various stages. A total of 106 hips were reviewed up to four years, and 90 at the final review.

Table II. Results according to pre-operative radiographic appearance of hips

Pre-operative radiographic appearance	Number of hips	Result – number and per cent		Statistical significance
		Satisfactory	Unsatisfactory	
Stage				
II–III	42	30 71	12 29	p < 0.05
IV	37	21 57	16 43	
V–VI	27	11 41	16 59	
Size of focus				
< 200°	70	46 66	24 40	p < 0.05
> 200°	36	16 44	20 56	
Singh index				
Grade 5–6	37	28 76	9 24	p < 0.005
Grade 3–4	32	21 66	11 34	
Grade 1–2	29	10 34	19 66	
Contralateral hip disease				
Unilateral	76	50 66	26 34	p < 0.02
Bilateral	30	12 40	18 60	

(Kellgren and Lawrence 1957) (Fig. 6). Regression of the arthritic changes was seen in only five hips with moderate or marked osteoarthritis; in the vast majority the radiographic grade of degenerative changes increased with the passage of time. However, in many cases patients continued to have a satisfactory clinical rating despite obvious radiographic deterioration. Radiographic evidence of healing of the necrotic segment was seen in only 16 hips, all within the Stage II and III subgroups; in these hips the size of the focus was less than 200° and all had a satisfactory outcome.

Further operations. Four hips with unsatisfactory results had been revised to a total hip arthroplasty at four years, while at final follow-up 17 hips had required replacement and seven had required arthrodesis. The implant had been removed in eight hips, in six for painful bursitis, in one for infection and in another for repositioning.

Eight of the patients with bilateral involvement had bilateral osteotomies; four of these were later revised to total hip arthroplasties. An additional 10 contralateral

procedures were performed in the bilateral group, nine total hip replacements and one arthrodesis. Therefore, at final follow-up 18 of 98 patients required contralateral hip surgery for a total of 22 procedures.

Complications. There were no deaths associated with the osteotomies. Local complications included one deep infection, one peroneal nerve palsy which recovered, one malpositioned blade which penetrated into the joint, two haematomas and nine delayed unions. All the cases of delayed union eventually healed without re-operation, the slowest taking 13 months to join. Two patients were diagnosed as having had pulmonary emboli post-operatively.

DISCUSSION

This review has shown that the results of intertrochanteric osteotomy are better if the patient is younger, the aetiology is idiopathic or traumatic, the necrosis is not in an advanced stage, the bone is of good quality, and only one hip is involved. It also supports the suggestion that osteotomy is more advantageous when the area of necrosis is relatively localised.

The literature is confusing with regard to the type of osteotomy indicated. Several authors have advocated a varus osteotomy, the intention being to put the intact lateral margin of the femoral head well into the acetabulum (Merle d'Aubigné et al. 1965; Kerboul et al. 1974). Others have recommended a valgus osteotomy (Maquet 1972; Wagner and Zeiler 1981). In our series a varus osteotomy was less commonly used because in most of our patients the position and extent of the necrotic segment left only a small lateral femoral segment, which often was not intact. Kerboul et al. (1974) reported better results in varus osteotomies when pre-operative radiographs showed sparing of at least 20° of the lateral aspect of the femoral head. Valgus osteotomy, on the other hand, often allows for a considerable enlargement of the weight-bearing surface (Fig. 1). The medial or "capital drop" osteophyte which is often present can also function as a fulcrum, removing the load from the superolateral region (Bombelli 1983). We strongly believe that for osteonecrosis as for osteoarthritis of the hip, the type of osteotomy should not be predetermined but should depend on the pre-operative radiographic appearance.

In view of our results and because the results of total hip replacement in young patients have not so far been encouraging (Chandler et al. 1981), we believe that in selected cases of osteonecrosis intertrochanteric osteotomy is a valid joint-sparing alternative. A recent report has in fact revealed that patients who undergo total hip replacement for osteonecrosis have an overall failure rate four times greater than that of patients with osteoarthritis who undergo this procedure (Cornell, Salvati and Pellicci 1985). In older patients, however, joint replacement is clearly a better alternative.

The results of intertrochanteric osteotomy may not

be permanent, but in younger adults, in the absence of metabolic bone disease or advanced joint destruction, the improvement can be expected to last for a sufficient period of time to make the procedure worthwhile. If revision later becomes necessary, the outcome of total replacement does not seem to be affected by the previous osteotomy (Benke, Baker and Dounis 1982).

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