CHARNLEY LOW-FRICTION ARTHROPLASTIES OF THE HIP IN RHEUMATOID ARTHRITIS

A STUDY OF THE COMPLICATIONS AND RESULTS OF 378 ARTHROPLASTIES

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During the years 1971 to 1975, 378 Charnley low-friction arthroplasties of the hip were performed on 278 patients with rheumatoid arthritis. The average age at operation was thirty-nine years. The follow-up time ranged from one to six years (mean two and a half years). Forty per cent of patients were receiving steroids at the time of operation. The most common complications were loosening of the prosthesis (3.4 per cent), perforation of the femoral cortex and fracture. Deep infection occurred in 0.7 per cent, dislocation in 0.7 per cent, and thromboembolic episodes in 1.3 per cent. Ninety-five per cent of patients were free of pain at follow-up compared to 84 per cent who were severely handicapped by pain before operation. In addition, the increased mobility in 98.5 per cent of patients and their improved independence makes hip replacement a recommendable procedure in these patients.

In recent years, arthroplasty has become accepted by most surgeons as the only effective surgical method of treating rheumatoid arthritis of the hip.

A review of the literature reveals many reports of total hip replacement, but few of them deal exclusively with patients suffering from rheumatoid arthritis. Rheumatoid arthritic patients present special problems not encountered so frequently in other conditions commonly treated by total hip replacement.

It is the purpose of this paper to present the results of 378 Charnley low-friction arthroplasties in rheumatoid arthritic patients, operated upon at the Rheumatism Foundation Hospital, Heinola, Finland, from December 1970 to December 1975.

MATERIAL AND METHODS

During the five-year period 380 Charnley low-friction arthroplasties were performed on 280 patients with rheumatoid arthritis. The records of two patients were considered to be inadequate for the purpose of this review, leaving 378 low-friction arthroplasties in 278 patients. A hundred patients had bilateral arthroplasties. The study was prospective.

All patients had a definite diagnosis of rheumatoid arthritis according to the criteria of the American Rheumatism Association (Ropes *et al.* 1956, 1958). The mean duration of the systemic disease was seventeen years, with a range of one to fifty-one years.

There were almost four times as many women as men, due in part to the accommodation provided by the hospital, where at all times the ratio of women to men is approximately two and a half to one. Age at the time of operation ranged from eighteen to sixty-eight years, with a mean of thirty-nine years. The mean duration of hospital stay per arthroplasty was fifty-nine days, but in many cases other joints had been operated upon during the one hospital admission. Twenty-six hips (7 per cent) had been operated upon at least once previously. Beginning on the day of the operation and continuing for ten days, each patient received prophylactic antibiotics. Penicillin was used in all cases with exception of those with a proven penicillin sensitivity. One

hundred and fifty patients (40 per cent) were receiving steroids at the time of operation.

In an attempt to reduce thromboembolic complications the following measures were adopted. Throughout the hospital stay each patient received 2 grams of aspirin daily, elastic stockings were worn, and the foot of the bed kept continuously elevated. Physiotherapy for the chest and the legs was given before and after operation and all patients were mobilised out of bed, weight-bearing on the third day.

The operations were performed in one room which is reserved exclusively for joint replacements. The operating room had no special design features aimed at purifying the incoming air. It was built in 1951 and has remained essentially unchanged in design since that time. Arthritic involvement of the temporomandibular joints and of the cervical spine necessitated epidural anaesthesia being used in eighty patients (29 per cent). There were no cases of tetraplegia or sudden deaths as a result of anaesthesia.

Non-absorbent, wrap-around gowns were used by the operating staff. A standard lateral approach was used with osteotomy of the trochanter. The trochanter was reattached with two wires as recommended by Charnley in the earlier 137 operations. In the remaining 241 hips the method advocated by Ritter (1972) was used.

The mean duration of the operation was ninety minutes, with a range of fifty to 150 minutes. Blood loss recorded at operation and from the drains during the following forty-eight hours ranged from 1000 to 5200 millilitres, with a mean of 1700 millilitres.

Mobilisation out of bed began on the third day. Each patient was reviewed at six months, one year, two years and at two-year intervals thereafter. At each review the status of the patient was recorded according to the method of Merle d'Aubigné and Postel (1954). The shortest follow-up was twelve months and the longest six years, with a mean of thirty months.

COMPLICATIONS

There were no deaths in this series attributable to operation; although seven patients have since died, none of the deaths occurred within a year of operation.

There were five episodes (1.3 per cent) of deep venous thrombosis, and one of these patients developed

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a pulmonary embolism subsequently. All were receiving salicylic acid at the time of operation and were treated with oral anticoagulants. Their rehabilitation was not significantly affected.

Perforation of the femoral shaft by the stem of the prosthesis occurred on five occasions. In one case after removal of an internal fixation plate, the prosthesis perforated at the site of a previous drill hole. Another patient, with perforation of the femoral cortex, now has a loose prosthesis and some pain but declines a further operation. The remaining three perforations occurred in patients with juvenile rheumatoid arthritis who had

Deep infection occurred in three patients, one early, the other two at thirty and twenty-four months respectively. The early deep infection developed within a few days of operation, and cultures of the wound grew Gram-positive cocci. Large doses of antibiotics were given and at reoperation the hip was drained and a closed irrigation suction drainage system was set up. The acute infection subsided but within a few months a sinus developed in the thigh. This has continued to drain intermittently for six years. The patient refuses to have the prosthesis removed. The patient in whom infection developed at thirty months has since died of a

Fig. 1

Fig. 2

Fig. 3

Figure 1—Radiograph of both hips taken before operation, showing protrusio acetabuli. Figure 2—Radiograph taken on the fifth day after operation showing a Charnley low-friction arthroplasty of the left hip. Figure 3—Radiograph taken one year after operation, showing loosening of the femoral component. The translucent area around the upper end of the femoral component is clearly seen. Non-union of the greater trochanter is also present.

hypoplasia of the upper femur. Fractures occurred during the operation on three occasions, one per-trochanteric and two supracondylar. All occurred at the time of the dislocation of the hip. Two were internally fixed at the time and the arthroplasty completed, while the third had a delayed internal fixation two weeks later.

The acetabular floor required reinforcing with wire mesh on six occasions; all of these patients had marked protrusion and a very thin pelvic floor.

There were three dislocations, two occurring four weeks after operation, both of which were reduced by closed methods. One of these has since developed a moderate degree of ectopic bone formation. The third patient required reoperation to replace an acetabular cup which had been inserted too vertically. In addition to the three dislocations one patient had a minor degree of subluxation on occasions, but this was not sufficiently troublesome to warrant reoperation.

Two large haematomas required drainage. They were operated on more than three years ago and so far are free of trouble.

There were three cases of superficial wound infection. Two of these occurred three years ago, the other is almost five years since operation. All these have so far had a good result with no evidence of deep infection.

myocardial infarction; no necropsy was performed. The third patient presented with progressive pain, and at operation to remove the prosthesis a sinus was found leading to the acetabular component; swabs taken at operation grew *Staphylococcus aureus*.

There was radiological evidence of loosening (Figs. 1 to 3) in thirteen hips (3.4 per cent) and two of these patients also had clinical signs of loosening. One had the prosthesis removed. A new acetabular component was not fitted due to the large defect in the acetabular floor which would have required a long reconstructive procedure. The other patient refused a further operation to replace the acetabular cup.

In one patient the Charnley stainless steel prosthesis was replaced by a Stanmore titanium type because of metal sensitivity and subsequent loosening. She remains free of trouble fourteen months later.

Marked ectopic bone formation occurred in five patients, severe enough to cause progressive reduction in the range of movement; in one case ankylosis occurred.

One patient has a painful hip for which no explanation can be offered.

Bony union of the trochanter failed to occur in seventy-two hips (19 per cent). The Charnley method gave a non-union rate of thirty-seven of 154 hips (24 per

cent), whereas with the Ritter method it was thirty-five of 224 hips (15 per cent). Radiographs of thirty-three hips (9 per cent) showed the trochanter displaced cranially by more than two centimetres. There did not appear to be any association between non-union of the trochanter and the overall functional result.

RESULTS

Pain. Pain was the chief indication for operation in the majority of cases. Figure 4 shows the distribution of hips in each pain grade before and after operation. Before operation 314 hips (84 per cent) were in Grades 1, 2 or 3

bone formation, in one there was both clinical and radiological evidence of loosening of the prosthesis and one has an as yet unexplained painful hip.

Mobility. Lack of mobility was considered to be the second indication for operation (Fig. 5). When grading rheumatoid patients for mobility it must be remembered that the changing state of other joints of the lower limbs can affect mobility or the ability to measure it, for better or for worse. Nevertheless, before operation, 242 hips (64 per cent) had a composite range of movement less than 100 degrees, whereas on review only six hips (1.5 per cent) were thus restricted. Two of these patients had

Fig. 4

Grading for pain before and after operation: Grade 1, spontaneous severe pain; Grade 2, no activity because of pain; Grade 3, tolerable pain limiting activity; Grade 4, pain only after some activity; Grade 5, pain slight or intermittent; Grade 6, no pain.

Fig. 5

Grading of mobility before and after operation: Grade 1 is 0–30 degrees; Grade 2 is 31–60 degrees; Grade 3 is 61–100 degrees; Grade 4 is 101–160 degrees; Grade 5 is 161–210 degrees; Grade 6 is more than 210 degrees.

and the patients were thus very disabled. On review, 359 hips (95 per cent) could be classed as having little or no pain; thirteen hips (3 per cent) had some pain on beginning activity only, and can be classified as satisfactory. The remaining four patients had enough pain to be classified as having a poor result. Of these four patients, one had a deep infection, one severe ectopic

marked ectopic bone formation, one had a deep infection and the general condition of one patient had deteriorated so badly that she was confined to a wheelchair.

Range of movement (extension–flexion). Table 1 shows the ranges of movement. Before operation 188 hips (50 per cent) had a range of movement less than 60 degrees

whereas on review 352 hips (94 per cent) had a flexion range greater than 60 degrees. Only five hips on review had not improved their range of movement. A flexion contracture greater than 30 degrees was present before operation in sixty-two hips (17 per cent), whereas on review only one patient had a flexion contracture of 45 degrees. This patient had severe ectopic bone formation.

Table I. Range of movement (extension-flexion)

Degrees of movement	Number of hips				
	Before operation*		After operation†		
	Number	Per cent	Number	Per cent	
Flexion range	<30	89	24	5	1.3
	30-60	99	26	19	5
	>60	186	50	352	94
Flexion contracture	<30	312	83	375	99.7
	30-60	49	13	1	0.3
	>60	13	4		
Totals	374		376		

*4 hips not recorded †2 hips not recorded

DISCUSSION

For the patient, relief of pain is the single most important factor after operation, and other factors, such as increased mobility and function, are of secondary importance. In this respect our results (95 per cent free of pain) compare favourably with those of others (Welch and Charnley 1970; Poss *et al.* 1976). The improvement in the quality of life resulting from the increased mobility (98.5 per cent of patients had a composite range of movement greater than 100 degrees postoperatively) is not so obvious as in osteoarthritic patients. Nevertheless, the increased independence, even if only around the home, was a bonus to the rheumatoid patient. One patient in this series has lost most of her mobility due to rapidly progressive arthritis in the other joints of the lower limb, though she remains free of pain. This highlights the need to assess and to try to predict the number of joints likely to require operations, and to consider also the age and general condition of the patient.

Deep infection beneath the fascia and involving the implant is one of the most serious complications of total hip replacement. Previous reports (Arden, Taylor and Ansell 1970; Charnley 1972; Harris, Lightowler and Todd 1972; Todd, Lightowler and Harris 1972; Freeman, Lee and Bayson 1973) have noted an increased susceptibility to postoperative infection in rheumatoid patients. In the series reported by Freeman *et al.* (1973) a fivefold increase was noted when compared with osteoarthritic patients. Our results (0.7

per cent deep infection) are in agreement with those of Welch and Charnley (1970) (0.7 per cent deep infection) and Poss *et al.* (1976), who reported an equal incidence of infection in rheumatoid and osteoarthritic patients. In these series 66 per cent and 20 per cent of patients respectively were receiving steroids at the time of operation, a factor that would be expected to increase the incidence of infection. A comparable 40 per cent of patients in our series were receiving steroids. Our results, we feel, justify the use of prophylactic antibiotics in the absence of other preventative measures. Other series (Coventry *et al.* 1974; Welch, Taylor and Wynne 1974; Collis and Steinhaus 1976) have reported equally good results without the use of special measures such as ultra-violet light or sterile air enclosure systems. Apart from antibiotic prophylaxis the following points in this series are perhaps important. No patient with an overt infection was admitted to the hospital, and any patient developing infection within the hospital was strictly isolated. In addition, the hospital is not geographically connected to any general hospital and changes in the staff of the operating room are infrequent.

Many reports (Mallory 1973; Hall 1974; Burton and Schurman 1975; Cruess, Bickel and von Kessler 1975; D'Ambrosia, Shoji and Heater 1976; Downes 1977) have appeared recently supporting the theory of haematogenous infection in late infected cases. Harris *et al.* (1972) have reported late infection in rheumatoid patients more than thirty-six months after operation, and in the series reported by Poss *et al.* (1976) the two infections seen more than two years after operation were both in rheumatoid patients. D'Ambrosia *et al.* (1976) have postulated that the rheumatoid hip is more susceptible than others to haematogenous seeding of organisms. As it is also susceptible to spontaneous septic arthritis (Kellgren *et al.* 1958; Rimoin and Wennberg 1966; Baum 1971; D'Ambrosia, *et al.* 1976) antibiotics should perhaps be given (*British Medical Journal* 1977) to rheumatoid patients after total hip replacement each time any infection occurs which is likely to lead to bacteraemia.

Deep venous thrombosis with pulmonary embolism is the chief cause of death after hip replacement, the pulmonary embolism rate being between 1 and 2 per cent (Evarts and Feil 1971; Coventry, Nolan and Beckenbaugh 1973; Harris *et al.* 1974). Various agents and methods have been employed in prophylaxis (Salzman, Harris and DeSanctis 1971; Coventry *et al.* 1973; Harris *et al.* 1974; Kakkar, Corrigan and Fossard 1975) and equally variable results reported. Our low incidence of thromboembolic episodes (1.3 per cent) is attributed to a combination of the following measures: acetylsalicylic acid in all cases, movements of the lower limbs in bed and out of bed on the third day after operation, elevation of the foot of the bed, and the wearing of elastic stockings.

Certain complications are more frequently encoun-

tered during hip replacement operations when these are performed on rheumatoid patients (Poss *et al.* 1976). Secondary osteoporosis and a previous operation on the hip were responsible for most of the intraoperative complications in this series. Perforation of the femoral cortex by the tip of the prosthesis occurred on two occasions in the region of previous screw holes. On the other three occasions perforation was due to failure to appreciate completely the narrow hypoplastic upper femur in patients with juvenile rheumatoid arthritis. If in doubt we recommend that a custom-made prosthesis or a Nippon-type prosthesis be used. All the intraoperative fractures occurred at time of dislocation of the joint; in cases where it is anticipated that dislocation will be difficult, we recommend that the femoral neck be divided as high as possible and the femoral head removed in a retrograde manner. Fracture of the acetabular floor, even in those cases with a very thin floor, can be avoided if very gentle reaming is performed. It is interesting that none of the six patients who required reinforcement of the pelvic floor have since suffered from a loose prosthesis.

Dislocation, if occurring soon after operation and not due to a technical error, responds satisfactorily to closed methods of reduction. In rheumatoid patients, however, there is a decreased capacity to repair the rent in the newly forming capsule (Welch and Charnley 1970) and hence a longer period of abduction is theoretically necessary after reduction of the hip. Our dislocation rate of three cases (less than 1 per cent) falls well within the range of 1 to 3 per cent reported in most series.

Radiological signs of loosening in thirteen hips (3.4 per cent) are a disturbing feature of this review; few other reports have included a significant number of femoral loosening. They appear from twelve months to fifty months from the time of operation. Welch and Charnley (1970) in a series of comparable size report less than 1 per cent overall and do not mention femoral loosening, whereas Stuhmer (1976) reports a 4.3 per cent loosening rate. Poss *et al.* (1976) reporting on 716 total hip arthroplasties, 275 of them in rheumatoid patients, recorded only one case of loosening. We feel that our figure (3.4 per cent), although high, is nevertheless a reflection of the osteoporotic nature of

the bone in rheumatoid patients. In the absence of clinical signs it seems unjustifiable to reoperate and replace a prosthesis in a rheumatoid patient. This group of patients will be followed up very closely in future in order to record their progress and are a potential source of future trouble.

We have classified one patient as sensitive to metal. She showed signs of loosening and had a strongly positive chrome cobalt skin sensitivity test. Revision of the hip prosthesis using a titanium one and similar revision of the ipsilateral knee prosthesis resulted in a good result fourteen months later. There is, however, the possibility, as reported by Elves *et al.* (1975) that the loosening led to the sensitivity and not vice versa. On this problem there appears to be little consensus of opinion, and its existence is not even recognised in some large series of metal on plastic prosthesis (Welch and Charnley 1970; Poss *et al.* 1976).

Ectopic bone formation in rheumatoid patients would appear to be much less of a problem than in osteoarthritic patients. Our incidence (1.3 per cent) is similar to that reported by Welch and Charnley (1970). The reported predominance in males with osteophytic formation (DeLee, Ferrari, and Charnley 1976; Ritter and Vaughan 1977) makes the possibility of a high incidence less likely in a predominantly female group of patients with rheumatoid arthritis.

Functionally, the lack of bony union with the trochanter does not appear to affect the overall mobility of the rheumatoid patient. A non-union rate of 19 per cent is unusually high but may in part be explained by the large number of patients in this series with acetabular protrusion. Arai (1975) showed that after a Charnley arthroplasty there is a two and a half times greater tendency for avulsion of the greater trochanter in rheumatoid hips with acetabular protrusion. He related the avulsion to an increase in the power of abduction after the operation.

This review emphasises some complications which we feel can be partly attributed to the nature of the rheumatoid disease. Despite these complications we feel that low-friction arthroplasty can be offered to rheumatoid patients with a high expectation of a good result, giving relief of pain and increased mobility and hence a greater independence.

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