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TOTAL HIP REPLACEMENT BY THE MÜLLER-CHARNLEY PROSTHESIS

A Follow-up Study of 238 Operations after 2 to 7 years

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A prospective study of 238 total hip replacements, with the Müller prosthesis, is presented. The complications in the total material and the results in 216 hips with follow-up times from 2 to 7 years are described. Eighty-four per cent of the hips were free from significant pain and 64 per cent had a total range of motion exceeding 160 degrees. Aseptic loosening of the femoral component, entailing reimplantation, has occurred in 6.7 per cent and, in addition, 9.2 per cent show radiological evidence of deterioration of the fixation of the femoral component. No deep infection has been encountered. None of the hips has ended as an excision arthroplasty.

Key words: hip joint surgery; infections in orthopaedic surgery; prophylactic antibiotics; total hip arthroplasty

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Four hundred and thirty-eight total replacements of the hip joint *ad modum* Müller have been performed at the Department of Orthopaedic Surgery, Central Hospital of Norrköping, Sweden, since 1969.

The design of the prosthesis and the operative technique have been described by Müller (1970).

The purpose of this paper is to present the results and complications of the first 238 operations and to show that deep infection may be avoided in a general hospital without special orthopaedic facilities if a heavy dose of prophylactic antibiotics is used.

PATIENTS AND METHODS

The operations were performed from December 1969 through September 1975. The follow-up times varied between 2 and 7 years with a mean follow-up time of 3 years and 9 months.

There were 238 operated hips in 207 patients; 131 were women and 107 men. The youngest patient was 40 and the oldest 81 years at operation. The mean age was 66 years (Table 1.)

A total of 216 hips in 187 patients were available for the follow-up examination. Four hips had been re-operated because of loosening less than 2 years after the original operation; 14 patients, two of whom were bilaterally operated, had died and two patients could not be traced.

The preoperative diagnoses were primary osteoarthritis in 170 hips, rheumatoid arthritis in 17 and osteoarthritis secondary to trauma, CDH or epiphyseolysis in 29.

In 30 hips various hip operations had been performed prior to the replacement (Table 2).

The replacement operations were made according to the original description by Müller (1970). The patients as a rule were mobilized on the third postoperative day and allowed to walk with two walking supports during the first 6 weeks. Prophylactic anticoagulants were not used.

The operation took place in a conventional operating theatre. From the start of the operation the patients received prophylactic antibiotics

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Table 1. Sex distribution and age at operation

Age (years)	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	Total
Women		3	9	12	26	37	25	17	2	131
Men	1	1	5	15	19	29	20	15	2	107
Total	1	4	14	27	45	66	45	32	4	238

Numbers include data for both operations in patients operated bilaterally.

Table 2. Previous operations

Intertrochanteric osteotomy	9
Osteosynthesis of hip fracture	7
Adductor tenotomy	4
Hemiarthroplasty	5
McKee-Farrar arthroplasty	2
Acetabuloplasty	1
Arthrodesis	1
Epiphyseodesis	1
Total	30

consisting of continuous infusion of 20 × 10^6 I.U. of penicillin/d for 3 days and penicillinase stable penicillin perorally for the following 11 days.

To evaluate the results, the patients were questioned and examined both preoperatively and at the follow-up examination and classified according to the numerical rating system described by Merle d'Aubigné & Postel (1954) and modified by Charnley (1972).

X-ray examination of the hips was initially performed in all patients who had an ESR exceeding 30 mm/h or who felt any discomfort in the hip, but later in the greater part of the material all hips have been radiologically examined.

To facilitate the assessment of walking, the material was divided according to Charnley (1972) into three categories: "A" denoting unilateral hip involvement and absence of other disabilities interfering with walking, "B" bilateral hip involvement and "C" presence of some other factor contributing to impaired walking. In the present series 38 patients belonged to category "A", 46 to category "B" and 103 to category "C".

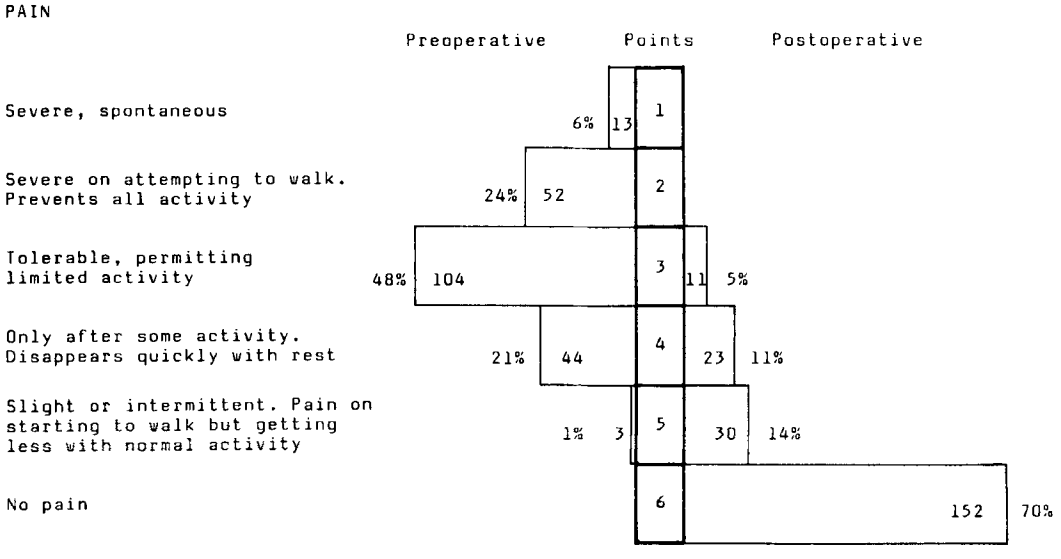

Figure 1. Numerical grading for pre- and postoperative pain in 216 total hip replacements.

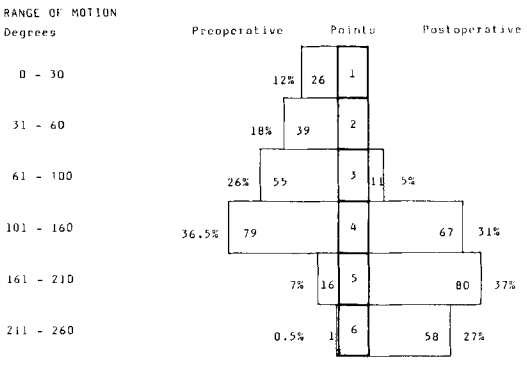

Figure 2. Numerical grading for pre- and postoperative total range of motion in 216 total hip replacements.

RESULTS

The results with reference to pain, range of motion and ability to walk are presented in Figures 1–3. Pain constituted the most important indication for arthroplasty and the relief of pain was the most striking effect of the operation (Figure 1). Before operation, pain was continuous at rest or induced by all movements or weight-bearing, causing considerable restriction of activity, in 78 per cent. After operation, 84 per cent of the hips were free from significant pain. Pain at night, disturbing sleep, was present in 69 per cent of the hips before and in 2 per cent after the operation. The use of analgesics because of hip pain is shown in Table 3. The average grade for pain was 2.9 before and 5.5 after the operation.

Table 3. Use of analgesics because of hip pain.

	Per cent of hips	
	Preop.	Postop.
Never	25	85
Occasionally	25	10
Regularly	50	5

The range of motion represents the sum of degrees of movement in all three standard directions (Figure 2). The average grading for motion was 3.1 before and 4.9 after the operation, corresponding to a sum of 85° and 180°, respectively. To get a reference material, we also measured the range of motion in the contralateral hip at the follow-up examination. In 81 asymptomatic hips the

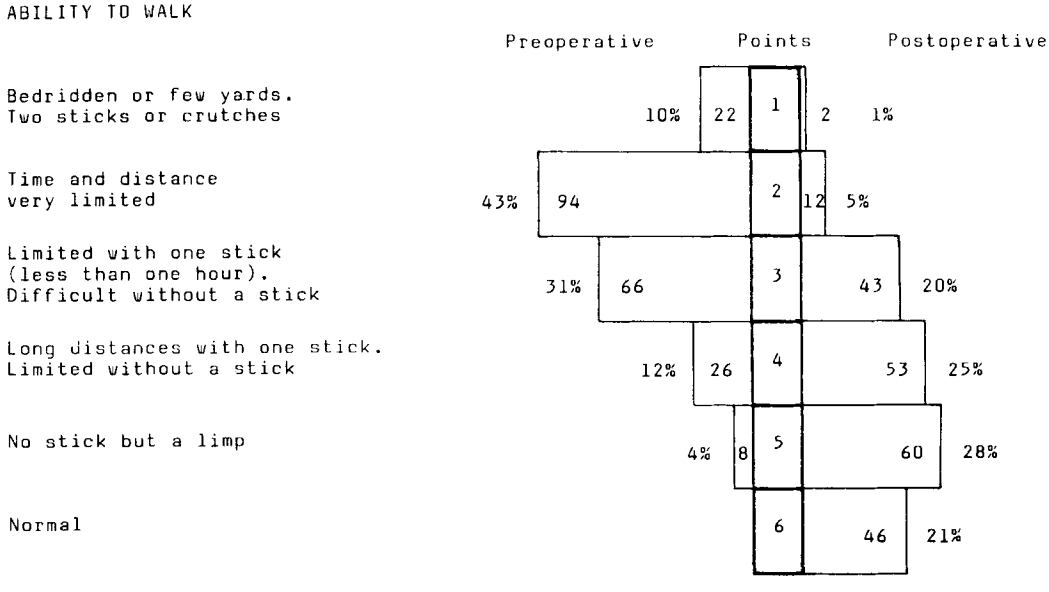

Figure 3. Numerical grading for pre- and postoperative walking ability in 216 total hip replacements.

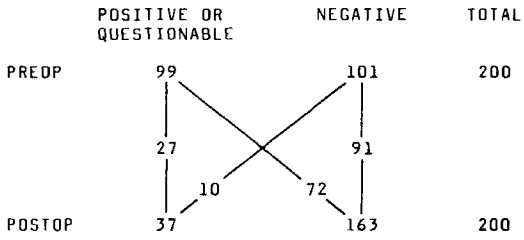

Figure 4. Trendelenburg's sign before and after 200 total hip replacements (see text), showing the numbers changing from each preoperative to each postoperative group. Figures refer to numbers of hips.

average grade for range of motion was 5.6 (grade 4 in two, grade 5 in 27 and grade 6 in 52 hips).

For walking capacity, the preoperative ratings were in the lower three grades in 84 per cent of the hips, whilst the postoperative ratings were in the upper three grades in 74 per cent as shown in Figure 3, which accounts for the whole material. In category "A" the corresponding figures are 77 per cent and 100 per cent, respectively. For the nine patients in category "B" who have had bilateral replacements, the improvement is equally striking, the average rating for walking capacity increasing from 2.5 before the first operation to 5.0 after the second.

Trendelenburg's test was performed pre- and postoperatively in 200 hips (Figure 4). Sixteen hips could not be properly tested preoperatively because of pain or contractures and were excluded from the total material. In 72 out of 99 hips with a positive Trendelenburg's sign, it became negative after the operation. At the follow-up examination 81.5 per cent of the hips had a negative Trendelenburg's sign.

Table 4 contains data concerning the activities of daily living. None of the 38 patients in category "A" and only six out of 29 patients with bilateral replacements stated at the follow-up examination that they had difficulty climbing stairs.

At the time of operation (first operation for bilateral cases) 32 patients were at work or had been on sick-leave for less than 6 months but at follow-up only 18 patients were still at work.

Complications

In the total number of 238 hip replacements the following complications have occurred.

General complications. There were three deaths during the postoperative period, 5, 22 and 44 days after the operations. Two deaths resulted from cardiac insufficiency and one from pulmonary embolism. Deep venous thrombosis was diagnosed in five patients, two of whom also had signs of minor pulmonary embolism. All were successfully treated by anticoagulants.

Local complications. There have been no deep infections, either early or late.

There has been one femoral shaft fracture, occurring during repositioning of the femoral head prosthesis. The fracture was treated by cerclage fixation and healed uneventfully.

Table 4. Activities of daily living in 187 patients before and after total hip replacement. Figures refer to numbers of patients.

	Climbing Stairs		
	Without difficulty	With difficulty	Cannot manage
Preoperative	57	98	32
Postoperative	148	34	5
	Putting on socks and tying shoes		
Preoperative	35	94	58
Postoperative	116	47	24

Postoperative bleedings, wound haematomas and superficial wound ruptures have occurred after ten operations but have not led to further complications.

In one hip which was earlier osteotomized and where a trochanteric osteotomy was done at the replacement operation, a purulent infection in the trochanteric region appeared after 2 years. Simultaneously a septic arthritis developed in the knee joint. Both infections probably were manifestations of haematogenous spreading from an infected wound in the foot. After wound drainage, extraction of the trochanteric wires and antibiotic treatment, the infection healed. At the follow-up examination, 3.5 years later, there were no signs of deep or superficial infection.

Aseptic loosening of the femoral head prosthesis, necessitating reimplantation, has occurred in 16 hips. In the earliest reimplantations, Müller femoral prostheses were used, and after two of these procedures loosening recurred. Reimplantation was then carried out with insertion of straight long-stem femoral prostheses. Among the other 14 reimplantations, there have been no other major local complications and no further case of repeated loosening. Cystic erosions of the femoral cortex as described by Harris et al. (1976), were seen in two of the hips with loosening of the femoral part. At the reimplantations, there have been no other medullary cavities including the lytic areas were thoroughly curetted and multiple samples submitted for bacteriological and histological examination. No evidence of infection was present, the patients are pain-free 1 year after the reimplantations and radiologically there are no signs of loosening or of recurrence of the erosions.

In all femoral prosthesis loosenings, the separation has taken place between metal and cement, whereas the cement has been firmly attached to the bone except in the most proximal part, where it is often fragmented. Fractures of femoral prostheses have occurred twice, and in both cases the implants had loosened before fracturing.

In addition to the reoperated hips, the X-ray examinations have revealed sinking of the femoral prosthesis exceeding 2 mm or a separation of the cement from the upper part of the stem exceeding 2 mm in 22 hips in which symptoms are absent or too slight to justify reoperation.

No loosening of the acetabular component has been detected.

DISCUSSION

The results in this series correspond well with those presented in earlier reports (Charnley 1970, Patterson & Selby-Brown 1972, Goldie 1977, Visuri et al. 1977).

It should be noted that 14 hips with femoral prosthesis loosenings, all in grades 3 and 4 for pain at the follow-up examination (Figure 1), have later been successfully reoperated.

The improvement with regard to range of motion (Figure 2) is less impressive than the effect on pain. However, it is doubtful whether grade 6 should be regarded as a normal value for range of motion of the hip joint in these patients. Charnley (1972) states that the normal range of motion in a patient 60 years of age is "anything over a total of 260 degrees", but in the present material, with a mean age of 70 years at the time of the follow-up examination, the range of motion in asymptomatic, non-operated hips exceeded 210 degrees, which is the lower limit for grade 6, in only 64 per cent of the hips.

The superiority of total hip replacement over intertrochanteric osteotomy, which is in some patients an alternative method of surgical treatment for hip osteoarthritis, is mostly attributable to the restoration of hip motion which can be achieved by total replacement. In this series, postoperative motion was 100 degrees or less in only 5 per cent of the hips, which can be compared with 55.5 per cent (Goldie et al. 1973) and 44 per

cent (Olsson 1974) reported in follow-up studies after intertrochanteric osteotomies.

The observations concerning the general physical capacity of the patients show that, generally speaking, total hip replacement does not allow the patient to return to work, but it greatly reduces his dependence upon other persons in activities of daily living.

Deep infection is a serious threat to the success of arthroplasty with joint replacement and it is encouraging to find that the programme of antibiotic prophylaxis used in this series has proved to be effective, so that none of the operated hips has ended as an excision arthroplasty. Benson & Hughes (1975) reported an infection incidence of 5.3 per cent in 321 hip arthroplasties, performed in general operating theatres, used by a variety of surgical specialities. As shown in several reports it is possible to reduce the frequency of deep infections to the magnitude of 1–2 per cent by prophylactic use of antibiotics (Carlsson et al. 1977, Fitzgerald et al. 1977, Visuri et al. 1977) or by improved aseptic conditions in the operating-room environment (Charnley 1970, Brady et al. 1975). A series of 252 total hip replacements, followed for 2 to 5 years, without any deep infections, has been presented by Collis & Steinhaus (1976), who stress the importance of strict operating-room discipline to limit contamination.

Aseptic loosening of the prosthesis was reported in 4.8 per cent of 369 hip replacements of various types by Goldie (1977), in 2.1 per cent of 189 Brunswik hip replacements by Visuri et al. (1977) and in 8 per cent of 1042 McKee-Farrar hip replacements by Dandy & Theodorou (1975). Marmor (1976) reported ten hips with varying stages of femoral loosening in a series of 160 Charnley hip replacements. In the present series, 16 of the total number of 238 hips (5.7 per cent) required reoperation for aseptic femoral prosthesis loosening. In addition, 22 hips (9.2 per cent) show radiological signs of deteriorated femoral prosthesis fixation. In these hips symptoms are absent or slight and in some of them probably a subsidence into a new, stable position has taken place, as described by Weber & Charnley (1975). On the other hand, aseptic loosening may become increasingly frequent after longer observation times as demonstrated by Beckenbaugh & Ilstrup (1978) who found evidence of femoral component loosening in 4.5 per cent 1 year after the operation and in 24 per cent after an average follow-up time of 5.5 years in 255 hip replacements. They also state that although most of the patients with roentgenographic evidence of loosening are asymptomatic, further breakdown of the fixation of the femoral component may ately cause trouble.

Varus position and insufficient medial cement support of the proximal part of the femoral component have been pointed out as factors that may result in loosening (Nolan et al. 1975, Bocco et al. 1977, Galante et al. 1975). In our material, a preliminary study of the radiographs indicate that these factors are responsible for the majority of femoral component loosenings. The curved design of the Müller prosthesis stem facilitates its insertion without osteotomy of the greater trochanter but it makes valgus positioning more difficult or even impossible, especially in femora with narrow medullary canals. Where it can be placed in valgus, on the other hand, there will be a loss of support at the calcar femorale. In the continued study of our series, including clinical and radiological examination after a minimum follow-up time of 5 years, special attention is being given to the further clinical and radiological course of arthroplasties with femoral component loosening and the possible factors responsible for this complication.

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