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# TOTAL HIP REPLACEMENT

## *A Ten-Year Follow-up of an Early Series*

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A 10-year follow-up study was made on a consecutive series of 93 patients who underwent hip replacement with a metal-to-metal prosthesis – Müller's so-called self-lubricating total hip prosthesis – during the years 1967–1970. Primarily 106 hips were operated on. One-third of the patients died within the 10-year period. Of the other two-thirds (63 patients/75 primarily operated hip joints), 38 (57 per cent) still had their primary prostheses and 29 had undergone reoperation. In 18 of the reoperations a new prosthesis was inserted and in 11 the extraction of the primary prosthesis was not followed by replacement.

All 63 surviving patients could be traced at the 10-year follow-up. The majority attended for personal examination, including evaluation of pain, walking ability and range of hip movement, and for radiography. In the group who had retained their primary prosthesis there was on the whole a rather good hip function – nevertheless in 75 per cent of these patients signs of loosening of the prosthesis were visible radiographically. Of the patients who had undergone reoperation, those with an exchange prosthesis had a better functional capacity than those who were left with a so-called Girdlestone-hip. Deep infection occurred in 8 per cent of the primary 106 cases. There was no onset of infection later than 4 years after the primary surgery.

*Key words:* arthroplasty; metal-to-metal prosthesis; hip; ten-year follow-up

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Before Charnley's principle of low-friction arthroplasty had been proved convincingly, prostheses with relatively large dimensions of the femoral head component and with both components made of metal were used in many orthopaedic centres. The so-called "self-lubricating total hip prosthesis" (diameter of femoral head component 42 mm) introduced by Müller (1966) had three plastic bearings in the socket to reduce friction.

This prosthesis was used at the Uppsala University Hospital for 106 primary arthroplasties in 93 patients during the years 1967–1970. Our early experiences of this prosthesis were reported in "Arthroplasty of the Hip" (Ed. G. Chapchal, 1973). Ten years have now elapsed since the last patient received this type of prosthesis. Although this prosthetic type as such is now of only historical interest, we considered it of value to make a follow-up study of this series of patients, with an observation time of at least 10 years, for two main reasons – firstly to look at the outcome for this group of patients, who were the first to be operated on by a method which was then essentially untested, and secondly to obtain a comparison group for studies of later series with improved techniques and newer prosthetic models.

## PATIENTS AND METHODS

The patients in this consecutive series were operated on between February 1967 and October 1970. A total of 106 prostheses were inserted in 93 patients. The mean age of the patients was 64 years, with a relatively wide

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*Table 1. Grading of functional status of the hip according to the numerical system of Merle d'Aubigné & Postel (1954) as modified by Charnley (1972, 1979)*

| Grade | Pain | Range of motion (degrees) | Walking ability |
|---|---|---|---|
| 1 | Severe and spontaneous | 0–30 | Bedridden or only able to walk a few meters |
| 2 | Severe on attempting to walk, prevents all activity | 31–60 | Walking distance very limited with or without a walking aid |
| 3 | Tolerable, permits limited activity | 61–100 | Limited but able to stand for long periods |
| 4 | Present only after activity, disappears quickly with rest | 101–160 | Long-distance walking possible but limited without aid |
| 5 | Slight or intermittent, decreasing with activity | 161–210° | Walks without aids but limps |
| 6 | No pain | More than 210° | Walks normally for age |

*Table 2. Grouping of the series for presentation of the results.*

| | | |
|---|---|---|
| Group I | Died during the observation period | 30 patients (31 prostheses) |
| Groups II–IV | Survived at least 10 years after operation | 63 patients (75 prostheses) |
| Group II | Primary prosthesis retained | 43 prostheses in 38 patients |
| Groups III–IV | Primary prosthesis removed | 32 prostheses in 29 patients* |
| Group III | Prosthesis exchanged | 21 prostheses in 18 patients |
| Group IV | Prosthesis removed without replacement | 11 hips in 11 patients |

* Four patients are included twice as they retained their primary prosthesis on one side.

range (36–83 years). The preoperative diagnosis was osteoarthritis in 68 per cent and rheumatoid arthritis (RA) or Bechterew's disease in 12 per cent; a further 17 per cent were post-traumatic (mostly necrosis of the femoral head following fractures of the neck of the femur) and the remainder had conditions resulting from congenital dislocation of the hip. At operation a lateral incision was used, as a rule without trochanteric osteotomy. The operating theatre was of conventional design, about 17 air changes/hour. The surgeons wore conventional clothing. No prophylactic antibiotics or anticoagulants were used. Postoperatively the patients wore an abduction splint in bed to prevent dislocation. The patients were mobilized after up to 1 week of bed rest. The length of stay in hospital was generally 3 weeks.

After discharge from hospital the patients were checked as required during the first 6 months postoperatively. Annual follow-ups were then made 1–5 years after operation and a final follow-up took place after an observation time of at least 10 years.

At these examinations a standardized grading system was used to evaluate some basic factors including pain, walking ability and range of motion (for details see Table 1). In the following the term "functional state" refers to these three evaluations.

At the 10-year follow-up all patients could be traced, and of the 63 surviving patients the majority (85 per cent) attended for a personal examination – clinical and radiographic – and the rest were interviewed by telephone or by letter.

*Follow-up.* For presentation of the results, the series was divided into the groups shown in Table 2 (see also Figure 1).

## RESULTS

The intraoperative and early postoperative complications and the findings at an early follow-up have been presented elsewhere (Almby & Hierton 1973).

### *Group I. Died*

During the observation period (February 1967 to October 1980) 30 patients died, representing 31 operated hip joints. Two of them died during the primary postoperative period (one following

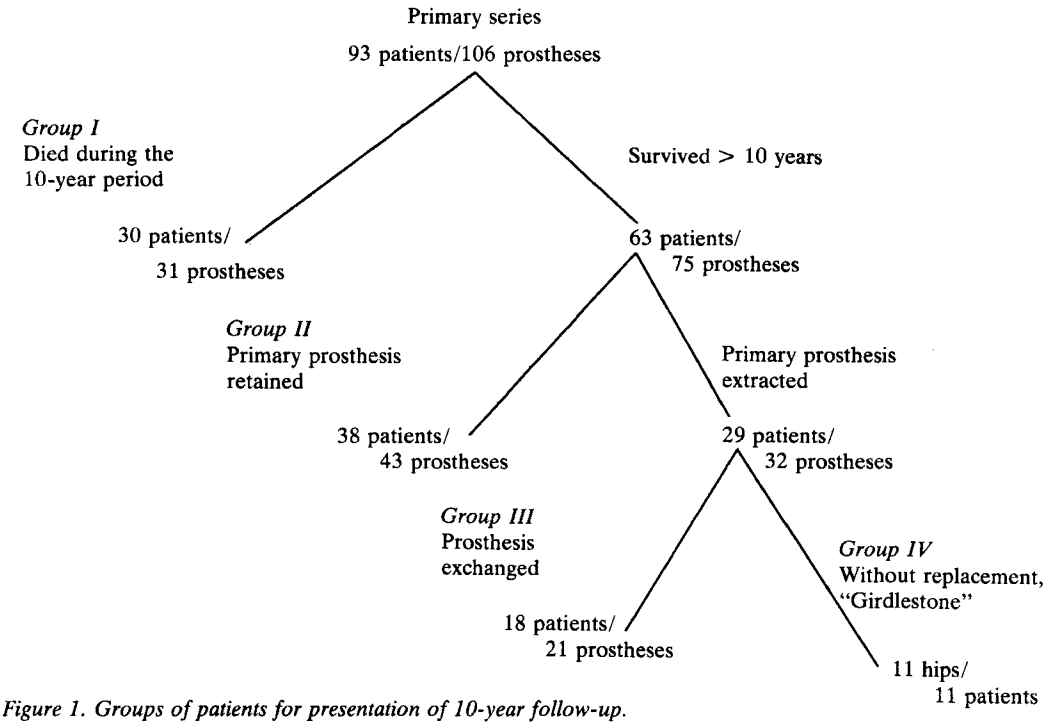


*Figure 1. Groups of patients for presentation of 10-year follow-up.*

pulmonary embolus and one following ileus). Two patients died of later complications of the hip operation, one after reoperation, of haemorrhagic and renal complications, the other of late infection with septicaemia. The remaining 26 patients died of diseases not related to the hip operation.

The mean age at operation of the whole group of deceased patients was 70 years. The mean length of survival after operation was about 5 years. Twenty-four patients died with the original prosthesis still *in situ* and the other six underwent secondary operation for exchange or removal of the prosthesis (aseptic loosening in four cases, infection with loosening in one case and shaft perforation in one case).

Group I did not differ as regards sex distribution, diagnosis or preoperative functional state from the series as a whole. The results of the postoperative evaluation of pain, walking ability and range of motion as long as these patients attended follow-ups were essentially similar to those in the whole series at the early follow-up (presented in 1973). Thus, 88 per cent had a grade of 4–6 for pain at the last examination before death, compared with 94 per cent for the whole series at the 1973 follow-up. The total range of hip motion amounted to >100° in 88 per cent (90 per cent in the whole series).

*Group II. Ten-year survivors with the primary prosthesis retained*

This group comprised 38 of the total of 63 surviving patients, and represented 43 prostheses. Seventy-five primary prostheses were inserted in those patients surviving 10 years – that means 57 per cent (43/75) were retained during the 10-year observation period. The mean age of group II patients at the time of operation was 61 years. The sex distribution and preoperative diagnosis and functional capacity of this group reflected well those of the whole series.

*Function at 10-year follow-up:* In order to study any changes with respect to pain, walking ability and range of motion, the findings at the 2 (–3)-year and 5 (–7)-year follow-up examina-

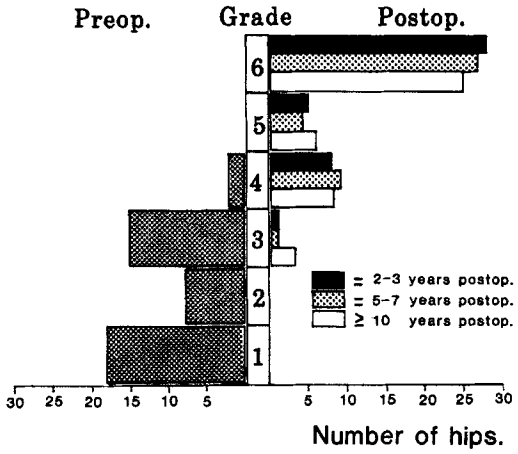


*Figure 2. Assessment of PAIN. Group II: 38 patients/43 retained primary prostheses.*

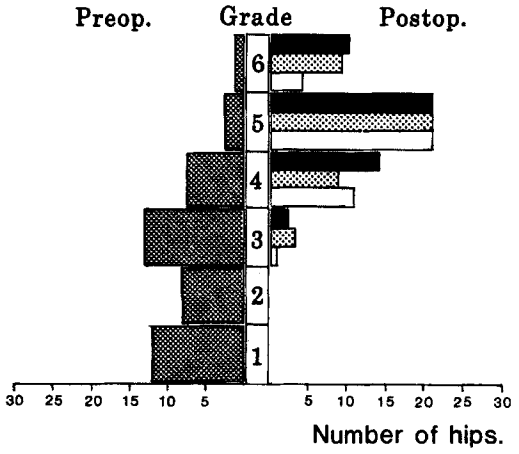


*Figure 4. Range of HIP MOTION. Grade 1 = 0–30°. Grade 6 ≧ 210°. Group II: 38 patients/43 retained primary prostheses. Symbols as in Figure 2.*

tions were recorded and compared with the 10-year follow-up (Figures 2–4).

*Pain:* As seen in Figure 2, the rating remained strikingly stable over the years and there were only slight changes in the direction towards a somewhat lower grade. The number of hips in the group with acceptable pain relief (grade 4–6) constituted more than 90 per cent of all hips at all follow-ups.

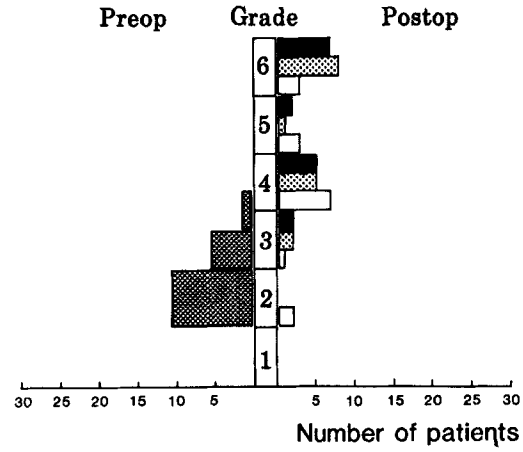


*Figure 3. Assessment of WALKING ABILITY. Group II, category A: 16 patients with unilateral hip involvement. Symbols as in Figure 2.*

*Walking ability:* The walking ability was only evaluated in 16 patients in this group, with unilateral hip involvement (category A in Charnley's classification). The result is seen in Figure 3.

*Range of motion:* Also in this respect the findings were fairly constant at the different follow-up examinations (Figure 4). The range of motion amounted to more than 100° in more than 90 per cent of the hips.

*Aseptic loosening:* At radiography of 39 hips in this group (4 were not available for examination) definite signs of loosening were observed in 20 hips and loosening was suspected in a further 6 hips. When only one of the components had loosened, this was more often the acetabular component (12 cases as opposed to 7 with loosening of the femoral head component). In 7 hips both components were loose.

These signs of loosening occurred in 15/20 hips after the 5-year follow-up; in 6 hips the time of loosening could not be determined exactly.

The types of loosening are shown in Table 3 and Figures 5 and 6. At that time cement without barium was used in most cases. The zone between cement and bone therefore could not be evaluated in detail.

*Table 3. Radiographic signs of loosening (aseptic) in 26/39 hips at the 10-year follow-up.*

| Acetabular component | | Femoral component | |
|---|---|---|---|
| Tilting | 7 | Settling | 5 |
| Protrusion | 9 | Resorption of calcar | 8 |
| Displacement cranially | 7 | Shaft perforation | 1 |
| | | Displacement cranially | 2 |

*Table 4. Reasons for changing prostheses. n = 21*

| Reason | No. of prostheses | | | Remarks |
|---|---|---|---|---|
| | Men | Women | Total | |
| Fracture of femur | 0 | 1 | 1 | Intraoperative complication |
| Fracture of prostheses | 4 | 0 | 4 | Patients working |
| Loosening with infection | 1 | 1 (+1?) | 2 (+1?) | One case not definitely verified |
| Aseptic loosening | 5 | 8 | 13 | |
| | | | Total 21 | |

*Group III. Primary prosthesis exchanged (21 hips in 18 patients)*

The mean age of these patients at the primary arthroplasty was the same as that of the patients who retained their primary prostheses (61 years). The sex distribution was also the same and corresponded to that of the whole series. On the other hand, the diagnosis osteoarthritis was more predominant in this group than in group I and in the original material (16/18 patients = 89 per cent, as against 68 per cent in the whole series).

*Reasons for changing prostheses:* These reasons are given in Table 4. As seen in Table 4, aseptic loosening predominated as the reason for changing the prostheses. Fracture of the prosthesis occurred in 4 men, all of whom had been gainfully employed either full-time or part-time since the primary operation.

The clinical symptom caused by loosening was invariably pain on weight-bearing.

*Time of changing prostheses:* In cases of aseptic loosening the mean survival time of the primary prosthesis was 6 years, with a range over the entire observation period (1–10 years). At the time of the 10-year follow-up 4/21 secondary prostheses showed signs of aseptic loosening.

*Function after change of prosthesis:* Concerning pain and range of motion at the 10-year follow-up (10 years after the primary operation) the number of hips in grades 4–6 was smaller than in the group who had retained their primary prosthesis – 75 and 93 per cent, respectively, for pain and 71 and 98 per cent for range of hip motion. The walking ability was acceptable (grade 4–6) in only 52 per cent of 21 cases with both unilateral and bilateral hip involvement.

*Group IV. Prosthesis removed without replacement (Girdlestone-hip). n = 11 hips/11 patients*

The mean age of these patients was 59 years, i.e. somewhat lower than in the two previous groups. This is probably attributable to 2 patients in the group who were operated on at a comparatively young age (45 and 51 years) for Bechterew's disease and necrosis of the femoral head, respectively. The sex distribution and the preoperative diagnosis and function corresponded to those of the original series.

*Reason for extraction:* In 6 patients the reason for extracting the prosthesis was aseptic loosening. Because of advanced osteoporosis and/or bone

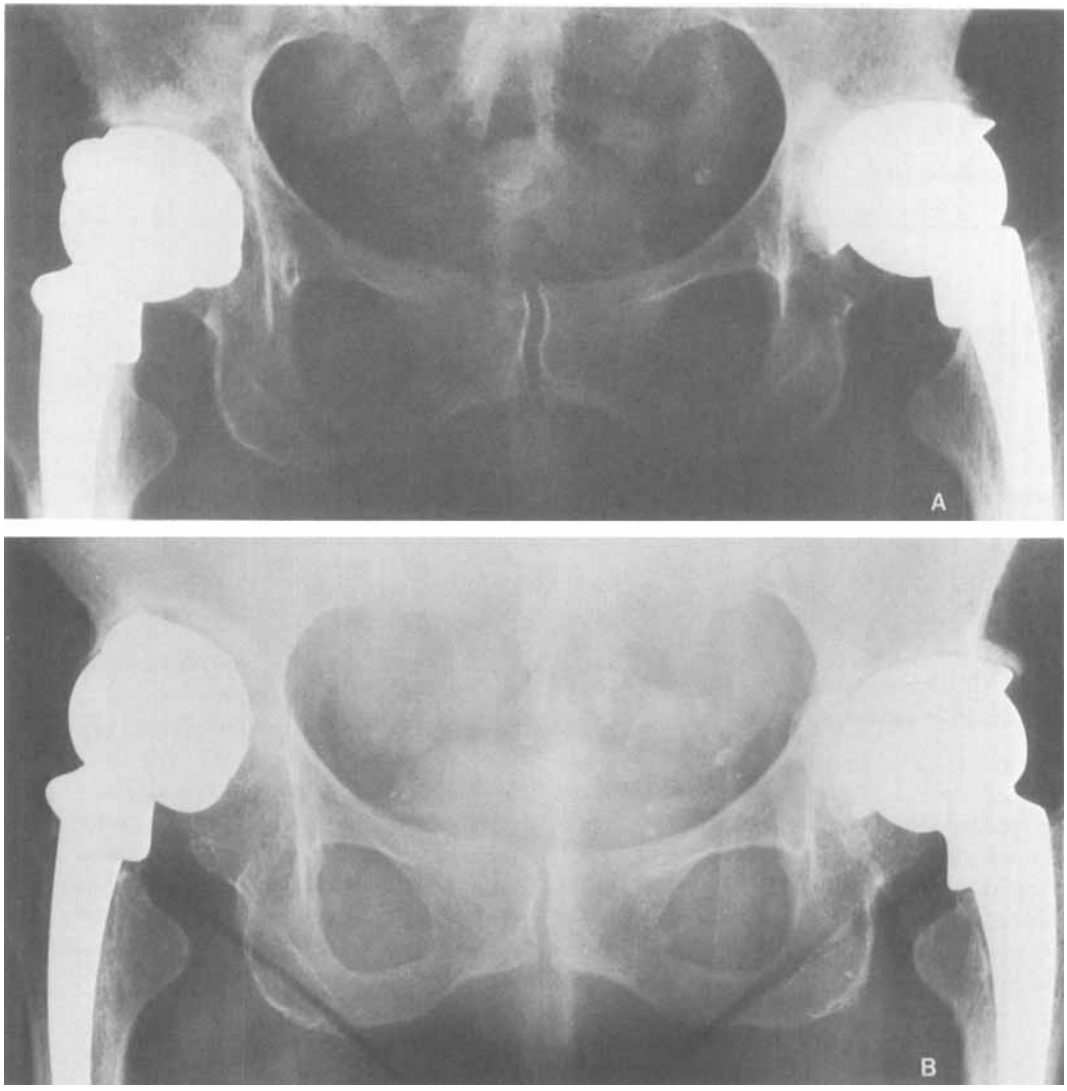


*Figure 5. Bilateral hip replacement for secondary osteoarthritis (CDH) in a 51-year-old woman. Preoperative classification 1 – 2 – 2.*

*A. Right: One year postoperatively. Left: Three years postoperatively. Classification: Right and left 6 – 4 – 5.*

*B. Right: Ten years postoperatively. Tilting of socket. Left: Twelve years postoperatively. Position of prosthesis unchanged. Actual classification: Unchanged on both sides.*

defects insertion of a new prosthesis was not considered advisable. In five cases the prosthesis was removed because of loosening in the presence of infection; in two of these cases the prosthesis had been changed previously (Table 4).

The average time of extraction was 3 years after the first operation in men and almost 5 years in women.

*Function at follow-up:* Seven out of 11 patients in whom the primary prosthesis had been removed without replacement reported acceptable pain

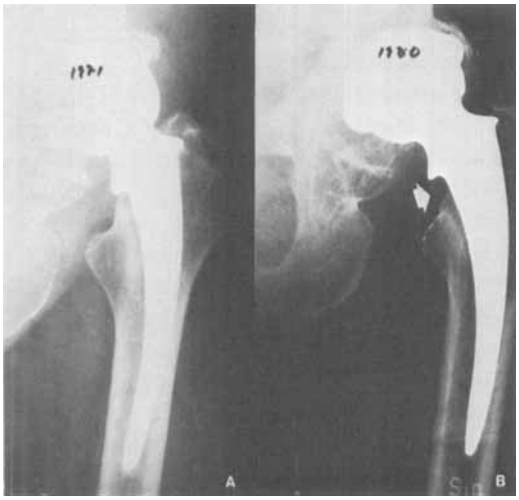

*Figure 6. Total hip replacement for osteoarthritis in 1968. Woman, 68 years of age. Preoperative classification 1 – 2 – 3.*
*A. Three years postoperatively. Classification 6 – 4 – 6.*
*B. Twelve years postoperatively. Classification 3 – 4 – 5. Note resorption of the femoral calcar.*

relief (grade 4–6), – i.e. just under two-thirds, compared with more than 90 per cent in the group with a retained primary prosthesis. Exactly the same number had a range of motion exceeding 100° (grade 4–6), while only 4/11 had acceptable walking function (grade 4).

*Infection (whole series):* In the whole series of patients deep infection after the primary hip operation occurred in 9 hips; only in 2 of these did the infection have its onset at an early postoperative stage – in the others it became evident 1–4 years after the operation. The symptoms in the latter cases were progressive pain with signs of loosening, and in 4 cases fistula formation. No infection first manifested itself later than 4 years after operation (Table 5). Thus, with a 10-year follow-up, all in all infection occurred in about 8.5 per cent of the primary operations. In a further 2 cases infection developed after secondary operations for loosening which initially was of an aseptic nature.

*Table 5. Infection after the primary arthroplasty. n = 9*

| Initials | Sex | Onset of infection. Time after operation | Symptoms/course | Measure |
|---|---|---|---|---|
| E.F. | F | Immediately postop. | Wound infection<br>Healed (?)<br>Late loosening | Revision<br><br>Exchange 7 years postop. |
| E.H. | F | 2 months postop. | Pain-fever<br>ESR raised<br>Loosening | <br><br>Extraction 2 months |
| B.S. | F | 1 year | Pain-loosening | Extraction 2 years.<br>New prosthesis 10 years |
| E.F. | F | 3 years | Pain-loosening | Extraction.<br>Septicaemia – died |
| A.A. | F | 4 years | Fistula-loosening | Extraction |
| E.T. | M | 1 year | Pain-loosening<br>Fistula<br>Loose secondary prosthesis | Exchange 2 years |
| A.P. | M | 1 year | Pain-loosening<br>Pain-loosening | Exchange 2 years<br>Extraction 8 years |
| L.W. | M | 1.5 years | Abscess-fistula | Extraction 2.5 years |
| E.B. | M | 4 years | Fistula-loosening | Refused reoperation |

## DISCUSSION

Only about half of the 10-year survivors still had their primary prosthesis (43/75 = 57 per cent). Since the group of deceased patients did not deviate from the original series in any important respect, apart from their higher mean age at operation, there is no reason to believe that the frequency of prosthesis loosening would have been of any different order of magnitude in that group (if they had lived to the 10-year follow-up), and the figure 57 per cent is therefore probably valid for the whole series. Dobbs (1980), who calculated the survivorship for metal-to-metal prostheses on the basis of a material of 173 Stanmore prostheses, found that the percentage of prosthesis survival 10 years after the primary operation was 57.8 per cent. The correspondence with Dobbs' figure is thus striking. If, in our group of deceased patients, the actual number of retained primary prostheses is calculated, a figure of 80 per cent is obtained at a mean patient survival time of 5 years. Again this is in accordance with Dobbs' finding – thus, he reported 81.3 per cent surviving prostheses in the interval 4–5 years after operation.

Dobbs considers that the probable cause of aseptic loosening is a mechanical factor, namely the breakdown of interdigitations between cement and bone, as is evidenced by the fact that the loosening increases with time after the operation. This was confirmed in our series by the finding that three-quarters of the loosenings observed radiographically in retained primary prostheses became visible after the 5-year follow-up. These loosenings will give rise to symptoms during the following 10-year period and lead to decisions concerning exchange operations.

Of the 43 retained primary prostheses, 26 showed signs of loosening at radiography. Of the 32 exchanged prostheses in our series, 18 were changed because of aseptic loosening. Thus during the 10-year period varying degrees of loosening without infection were demonstrated in 44/75 prostheses = 59 per cent, a figure which considerably exceeds those reported previously for metal-to-metal prostheses (e.g. McKee & Chen 1973, Dandy & Theodorou 1975, Visuri et al. 1977); the latter reports concern shorter observation times, however, and radiography had not always been performed.

The above discussion also applies in principle to metal-to-plastic prostheses, but Dobbs gives these a median survival time three times as long (34.5 as against 11.8 years). A high frequency of loosening has been reported by some authors, however, including Beckenbaugh & Ilstrup (1978) from the Mayo Clinic. They found radiographically visible loosening of the femoral component (Charnley prosthesis) in 24 per cent of 333 consecutive cases followed for 4–7 years, that were essentially asymptomatic at the time of follow-up. Lindberg (1981) found loosening, in most cases with symptoms, in 36 per cent of a series of 166 hips provided with a Brunswick prosthesis and followed up for about 6 years after operation.

Apart from the frequency of aseptic loosening, it is also of interest in a long-term study to follow the patients' "functional" situation, as reflected by pain, range of motion in the hip, and walking ability. This applies irrespective of whether the patient has retained his primary prosthesis or not, and whether or not a functioning exchange prosthesis has been obtained. It is evident from our study that a retained primary prosthesis gives fairly stable function over the years. No gradual functional deterioration seems to take place. It seems, rather, to be a question of all-or-nothing, that is, the prosthesis functions essentially without any trouble – even if there are signs of loosening at the X-ray examination – up to the day when it begins to cause serious symptoms.

The evaluation of secondary prostheses revealed, as expected, a somewhat lower proportion of patients with acceptable function (grade 4–6) than among those who had retained the primary prosthesis. However, in three-quarters of the hips that were reported, acceptable pain relief and good mobility were achieved. A secondary operation because of loosening thus may restore an acceptable degree of function. This has recently been demonstrated convincingly in a report by Carlsson and associates (1980).

Not unexpectedly, the small group of patients who underwent removal of the prosthesis without insertion of a new one had the poorest results,

especially with respect to walking function, which was acceptable in only about one-third of these patients. A similar limitation of the walking ability has been reported by many authors in such series (among others, Clegg 1976, Lindequist & Josefsson 1978, Ahlgren et al. 1980, Petty & Goldsmith 1980). Neither do all get full pain relief, and therefore an extraction without replacement with a new prosthesis must be regarded as a last resort. It is worthy of note that in our Girdlestone patients aseptic loosening was the reason for extraction in several patients due to severe bone resorption. Early diagnosis of loosening and exchange of prosthesis is recommended in order to avoid such a high degree of bone resorption.

By today's standards the frequency of infection in our series was impermissibly high, but this must be seen in relation to the resources of that time (first operative series, conventional operating rooms, conventional clothing, principle of avoidance of antibiotic prophylaxis). Similar figures in comparative materials have been reported from London by Hughes & Benson (1976), 5.3 per cent, and from New York by Wilson and collaborators (1972), 11 per cent. The value of antibiotic prophylaxis is illustrated in a study from Norrköping, Sweden (Olsson et al. 1979), where in a series of hips treated surgically in conventional operating theatres, but with antibiotic prophylaxis, no infection occurred during a mean observation period of approximately 4 years. After this length of time no late infections occurred in our series. The observation by many authors that most deep infections occur after the immediate postoperative stage was confirmed by our study. The probable reason for this is considered to be low-virulent (possibly anaerobic) infections. The possibility of late haematogenously spread infections must also be borne in mind, as recently demonstrated by Stinchfield and collaborators (1980).

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