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A LONG TERM FOLLOW-UP OF MOORE ARTHROPLASTY IN FEMORAL NECK FRACTURES

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In 1943 Austin Moore presented his first metallic hip prosthesis (Moore & Bohlman 1943). Fourteen years later he reviewed a series of patients treated for various conditions with his new self-locking hip prosthesis (Moore 1957).

During the past 20 years experience has shown the Austin Moore arthroplasty to be an acceptable method for the treatment of femoral neck fractures (Furey et al. 1961, Hinchey & Day 1964, King et al. 1959, Mayo 1961). Long term follow-up studies are still rather few, however (Andersson et al. 1964, Andersson & Nielsen 1972, Barr et al. 1964, Danielsson 1965, Golden 1969, Hinchey & Day 1964, Jansen & Ruben Hansen 1965, Mayer & Sarkar 1964, Polyzoides 1971, Salvati & Wilson 1973, Whittaker et al. 1972), and the long term prognosis needs further evaluation.

The present study analyses the long term results for a period of from 2.5 to 10 years in 60 patients.

MATERIALS AND METHODS

During the period 1963 to 1969 arthroplasty was performed for femoral neck fractures in 169 cases. Of these patients 142 were females (84.0 per cent) and the average age was 77.2 years, 121 patients (71.6 per cent) being more than 75 years of age.

The operative procedure used was according to the instructions given by Austin Moore in 1957. Acrylic cement was not used. The prostheses were all of the short-stem type.

The arthroplasty was chosen as a primary operation in elderly patients only. Younger patients were treated with osteosynthesis. Physiological rather than chronological age determined the type of procedure to be employed. According to this, Moore arthroplasty was the primary operation in 140 patients, while unsuccessful conservative treatment was the indication in 11 patients and failure of osteosyn-

thesis in 18. Neither routine anticoagulants nor prophylactic local or systemic antibiotics were used.

A follow-up study (including clinical and roentgenological examinations) was possible in 60 patients with a mean observation time of 4.9 years. A total of 103 patients had died by the time of the survey, while six patients had moved away.

RESULTS

Mortality: 36 patients (21.3 per cent) died within 3 months of the operation. The life-table (Figure 1) demonstrates that the mortality in this series parallels that of a normal population of the same age and sex apart from the immediate high mortality following the trauma.

Besides this we found the high primary mortality rate to be due mainly to a high incidence of complicating illnesses preoperatively. A total of 76 of the patients (45 per cent) were suffering from major cardiopulmonary or cerebrovascular disorders.

General postoperative complications were found in 67 patients as

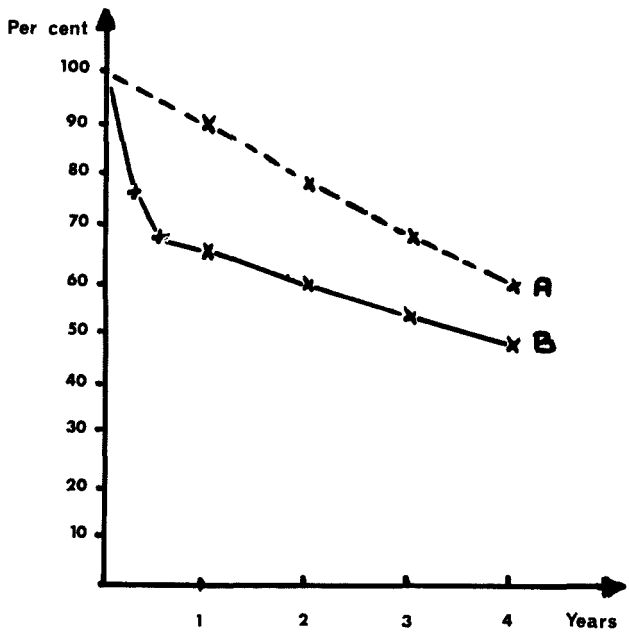

Figure 1. Life tables.

A: Normal population of same age and sex distribution as the patient material (according to experiences of mortality in the period 1956–60 in Denmark).

B: For the 154 patients with definite information about survival time.

Table 1. General postoperative complications in 67 out of 169 patients (39.6 per cent).

Cardio-pulmonary diseases	29
Phlebo-thrombosis	16
Pulmonary embolism	11
Acute arterial occlusion	2
Cerebral diseases	3
Prolonged fever	5
Decubitus ulcer	11
Miscellaneous	5

listed in Table 1. (Included are only those of real severity.) Of the eleven patients with pulmonary embolism, this was fatal in five.

Local complications following surgery are shown in Table 2.

Wound infection healed in all eight cases. The prosthesis was removed in two of the five patients with osteitis, whereas three died with persisting infection (but not as a result of it).

Besides these complications, two patients suffered spiral trochanteric fractures and three patients developed diaphyseal femoral fractures at the tip of the prosthetic stem. In all but one of these cases a new relevant trauma caused the fracture.

Roentgenological findings at follow-up: Osteolysis at the tip of the prosthetic stem was seen in six cases, but in no case had the stem penetrated through the cortical bone. In seven cases osteolysis was found along the whole prosthetic stem. In five of these there was, however, marked ossification in the fenestres of the prosthesis. Thus only two were classified as loose prosthesis. Calcification in the soft tissues around the head of the prosthesis was a common finding (26 cases = 43.3 per cent).

Migration of the prosthetic head was encountered in ten cases (16.7 per cent)—in five of these migration amounted to more than 15 mm. Protrusion through the acetabular roof was not seen in any case.

Table 2. Local complications in 37 out of 169 patients (21.9 per cent).

Minor femoral neck fractures	17
Failure of prosthetic position	2
Dislocation of the hip	1
Wound infection	8
Osteitis	5
Peroneal paralysis	4

Table 3. Settling—Osteolysis along prosthesis.

	Normal X-ray	Osteolysis along prosthesis
Settling 0–20 mm	43	2
Settling >20 mm	4	11

Settling of the prosthesis was found in 29 cases (48.3 per cent). In 15 patients this amounted to more than 20 mm. As shown in Table 3 settling was significantly ($P < 0.001$) correlated to the existence of osteolysis along the prosthesis, while settling was significantly ($P < 0.001$) diminished in cases of marked ossification in the prosthetic fenestres (Table 4).

Clinical follow-up: Three decisive factors determine the final result. They are pain, mobility of the hip joint and walking capacity (Table 5).

Statistical analysis (χ^2-test) of our results revealed no significant correlation between pain and the roentgenological finding of pre-existing coxarthrosis, minor peroperative fractures of the femoral neck, short length of the femoral neck, calcification in the soft tissues, sclerosis along the prosthetic stem or migration of the prosthetic head. Hip mobility was not significantly correlated to any of these roentgenological findings either.

Reduced hip mobility, however, correlated significantly ($P < 0.05$) to osteolysis along the prosthesis (Table 6) and to settling of the prosthesis of more than 20 mm (Table 7).

Contractures of the hip joint were encountered in 19 patients (31.7 per cent). Mainly flexion or external rotation contractures were seen. They all amounted to a few degrees only and did not affect activity. Contractures were not significantly correlated either to pain or to roentgenological changes. The existence of contractures was not significantly related to disablement caused by other diseases either. Walking capacity was significantly impaired in cases of insufficiency of the

Table 4. Settling—Ossification in prosthetic fenestres.

	No visible ossification	Marked ossification
Settling 0–20 mm	11	34
Settling >20 mm	12	3

Ossification: clearly visible bone formation in fenestres.

Table 5. Clinical observations at follow-up of 60 patients.

Pain	
No pain	34
Minimal pain (not affecting activity)	8
Moderate pain (affecting activity, analgetics regularly)	10
Severe pain (affecting activity seriously)	7
Pain preventing activity or sleep	0
No information	1
Mobility of the hip	
Flexion more than 90° / Abduction more than 25°	25
Flexion 0–90° / Abduction less than 25°	7
Flexion 0–80°	12
Flexion 0–60°	10
Flexion 0–40°	2
Clinical anchylosis (correct anatomic position)	4
Clinical anchylosis (faulty anatomic position)	0
Walking capacity	
Walking distance	
more than 1500 m	14
500–1500 m	10
200–500 m	10
75–200 m	12
not able to walk (i.e. less than 75 m)	19
Walking aids	
unaided or one cane	29
two canes or crutches	12
few steps with human aid	11
not able to walk	8

quadriceps muscle ($P < 0.001$) as shown in Table 8, while insufficiency of the gluteus medius muscle as seen in 36 patients (60 per cent) could not be related to reduced walking ability.

It is noteworthy that hips free of pain show a high correlation ($P < 0.001$) to the existence of marked ossification in the prosthetic fenestres, this also significantly ($P < 0.05$) correlated to hips with a good range of motion (Table 9). We have not, however, been able to determine the conditions which make for painful hips after arthroplasty in our material.

The final results of the clinical examination were classified according to the criteria adopted by the American Academy of Orthopedic

Table 6. Reduced hip mobility—Osteolysis along prosthesis.

	Normal X-ray	Osteolysis along prosthesis
Flexion normal	38	6
Flexion reduced >25°	9	7
Abduction normal	28	1
Abduction reduced >20°	19	12

Table 7. Reduced hip mobility—Settling of prosthesis.

	No settling (0–20 mm)	Settling more than 20 mm
Flexion normal	37	7
Flexion reduced >25°	8	8
Abduction normal	27	2
Abduction reduced >20°	18	13

Table 8. Impaired walking capacity—Quadriceps muscle insufficiency.

	Sufficient quadriceps (strength 4–5)	Insufficient quadriceps (strength 0–3)
Walking more than 200 m	20	9
Walking less than 200 m	6	24

One patient with femoral amputation was unable to walk for that reason.

Table 9. Painless hips with good mobility—Ossification in prosthetic fenestres.

	No visible ossification	Marked ossification
No pain	9	33
Pain	13	4
Flexion normal	13	31
Flexion reduced >25°	10	6
Abduction normal	6	23
Abduction reduced >20°	17	14

Ossification: Clearly visible bone formation in fenestres.
One patient was not able to give information about pain.

Table 10. Results classified according to the American Academy of Orthopedic Surgeons.

Excellent	Slight or no pain Mobility 75 per cent of normal Walking not affected	18
Good	Minimal pain Mobility 50 per cent of normal Walking with one or two canes	13
Fair	Moderate pain Mobility less than 50 per cent Walking with human aid	26
Poor	Bound to wheel-chair or bed-ridden	3

The criteria for the classification are listed in the table.

Surgeons (Goodwin 1968). In Table 10 we have classified the results as fair in patients disabled from unrelated diseases if the hip was painless and with a good range of movement. One result was classified as poor since the prosthesis had to be removed as a result of infection.

Apart from the classification according to pain, hip mobility and walking capacity we have analysed the material with respect to reduction of vitality for our patients during the observation period. This is determined by increasing age of the patients, by simultaneously occurring but unrelated diseases, and by fracture complications. As shown in Table 11 the vitality of 29 out of 60 patients (48.3 per cent) decreased, but only in two cases was this due to the hip arthroplasty.

DISCUSSION

Long term results after Moore arthroplasty have generally been acceptable. Excellent and good results have generally been achieved in 60–70 per cent of cases (Hinchey & Day 1964, Jansen & Ruben Hansen 1965, Polyzoides 1971, Salvati & Wilson 1973). However, the number of poor results varies considerably and has ranged from 6–8 per cent (Polyzoides 1971, Salvati & Wilson 1973) up to 22–26 per cent (Andersson & Nielsen 1972, Whittaker et al. 1972). Fifteen per cent poor results seems to be about average (Barr et al. 1964, Golden 1969, Hinchey & Day 1964, King et al. 1959, Mayer & Sarkar 1964).

The results in our series thus show good correlation with the results given in previous publications.

Table 11. Reduction of vitality at follow-up of 60 patients.

Preoperatively		At follow-up: Unreduced working capacity	Slightly reduced working capacity	Unreduced daily activity	Nursing home patient
Unreduced working capacity	23	13	4	4*	2
Slightly reduced working capacity	9		2	6	1
Unreduced daily activity	22			10	12*
Nursing home patient	6				6
Total number	60	13	6	20	21

Unreduced daily activity = able to manage personal needs independently but unable to work.

Reduced vitality as shown at the right side of the crossline was found in 29 of 60 patients, but was in only two cases (in groups marked *) due to the hip arthroplasty.

Roentgenological findings at long term follow-up have been described by only a small number of authors (Andersson et al. 1964, Andersson & Nielsen 1972, Barr et al. 1964, Danielsson 1965, Polyzoides 1971, Whittaker et al. 1972). Thus, settling has been noted in 17 per cent of cases by Andersson et al. (1964) and in 90 per cent by Polyzoides (1971). The usual figure lies around 35 per cent (Andersson & Nielsen 1972, Barr et al. 1964, Whittaker et al. 1972). The degree of setting has not been stated, however. We found the settling to be of no importance for the mobility of the hip unless it amounted to more than 20 mm as found in 25 per cent of our patients.

Osteolysis along the prosthetic stem was found by Andersson et al. (1964) in 6 per cent of cases. Andersson & Nielsen (1972) and Whittaker et al. (1972) noted 32 per cent. These authors have interpreted the osteolysis as a sign of looseness of the prosthesis, and the latter suggested this as a cause of pain. We found osteolysis in 22 per cent of the patients, but in our series it was not correlated to pain. On the contrary we found ossification in the fenestres of the prosthesis to be convincingly ($P < 0.001$) related to freedom from pain.

Migration was described by Whittaker et al. (1972) in 24 per cent of

cases after 5 years. Andersen & Nielsen (1972) and Polyzoides (1971) found the same frequency of migration as in our material (17 per cent). Our series does not reveal migration to be pertinent to pain or hip mobility.

No detailed information concerning hip mobility at long term follow-up is available. We found 78 per cent of our patients to have sufficient flexion of the hip (0–80°) to be able to put on shoes. Hip mobility was significantly impaired ($P < 0.05$) in cases of osteolysis along the prosthesis as well as in the case of settling. On the other hand we found good hip mobility as well as reduced pain significantly ($P < 0.05$ and $P < 0.001$) correlated to marked ossification in the fenestres of the prosthesis, and we also found that ossification diminishes settling ($P < 0.001$). Thus we believe that it is very important to employ prostheses with fenestres that can be filled with bone chips.

As regards walking capacity King et al. (1959) indicated that 61 per cent could walk using one or no cane while 21 per cent needed two canes. Harris (1966) found, however, that 65 per cent needed two canes or crutches. Among our patients 48 per cent were able to walk using one or no cane, 20 per cent needed two canes or crutches, while 40 per cent were able to walk more than 500 m. In our series walking ability was significantly ($P < 0.001$) reduced by insufficiency of quadriceps muscular function.

In our opinion Moore arthroplasty has proved to be an acceptable method for the treatment of femoral neck fractures in elderly patients. As many as 73 per cent had an acceptable range of hip motion, 40 per cent managed walking distances of more than 500 m and 70 per cent had minimal or no pain. Although 15 (25 per cent) of these elderly patients became nursing home patients the decrease in vitality can be directly related to the hip arthroplasty in only two cases.

SUMMARY

Moore arthroplasty was performed for medial femoral neck fractures in 169 patients.

The mortality rate was 21.3 per cent within 3 months. The general postoperative complication rate (39.6 per cent) was dominated by cardiopulmonary (17.2 per cent) and thromboembolic (16.0 per cent) events. Of local complications, wound infection was found in 4.7 per cent and osteitis in 3.0 per cent of cases.

A total of 60 patients were followed up with a mean observation time

of 4.9 years. Of these, 8.3 per cent sustained femoral fractures during this period.

The results classified according to the criteria of the American Academy of Orthopedic Surgeons showed 52 per cent excellent or good, 43 per cent fair and 5 per cent poor results.

The roentgenological finding of settling or osteolysis along the prosthesis was significantly correlated to reduced hip mobility. Ossification in the prosthetic fenestres gave significantly diminished settling, and was correlated to better hip mobility and less pain.

In our opinion, Moore arthroplasty has proved to be an acceptable method for the treatment of femoral neck fractures in elderly patients, as 73 per cent had an acceptable range of motion, 40 per cent managed walking distances of more than 500 m and 70 per cent had minimal or no pain. Although 25 per cent became nursing home patients, this reduction of vitality could be related to the hip arthroplasty in only two cases.

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