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THE MOORE VITALLIUM FEMORAL-HEAD PROSTHESIS IN FRACTURES OF THE FEMORAL NECK

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A follow-up is given of early and late results in 109 arthroplasties with the self-locking Austin T. Moore vitallium femoral head prosthesis in fractures of the femoral neck on 106 patients. Operative indication was usually fresh medial fracture of the femoral neck in an elderly woman, or its late complication. The surgery was performed in a unit for general surgery also engaged in pre- and postgraduate teaching activities. Many operations were performed by residents engaged in general surgery or orthopaedics. Point scores according to a modification of Merle D'Aubigné's classification showed excellent or at least good results in 81 per cent of the 69 mobile patients. Because of deteriorated general physical condition 11 patients were chronically bed-ridden. Five patients could not be reached. In three instances the prosthesis was removed. 21 patients died, three during the stay in hospital and 18 later for reasons not connected with the operative procedure. The mortality during 40 months of observation corresponded fairly well to that expected in the age group for the population as a whole.

Key words: Moore arthroplasty; femoral neck fracture

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Failures in nailing intracapsular fractures of the femoral neck are frequent even with the sliding nail. There is a frequency of technical failures (too long nail, too short nail etc.) of 16 per cent, non-union 8.6 per cent, avascular necrosis 17.2 per cent, and Girdlestone pseudarthrosis 3.7 per cent (Greenberg et al. 1973).

Endoprosthetic replacement of the femoral head in geriatric fractures of the proximal femur has been more and more accepted as a method-of-choice.

The superiority of the Moore prosthesis in clinical practice over the other devices once prevailing has been established by inter al. Hinchey & Day (1955) and Stinchfield et al. (1957). Moore & Bohlman's (1943) choice of vitallium in 1939 has stood well the test of time and strain.

The architecture of the prostheses has undergone much development since then. However, the composition designed by Moore (1951) has remained rather unchanged until now. The type of fixation, either endoprosthesis direct to bone or via cement to bone, has been widely discussed. Moore (1957) has not changed

his conceptions regarding the superiority of osteogenetically self-locking intramedullary fixation. Regarding operative techniques the problem has largely been the question of using either the Gibson incision or the southern exposure. Both types of technique can be said to have certain pros and cons.

Of main interest today are the late results, and especially what they are in more or less skilled hands. As we know, the main indication for operation has been a fresh fracture of the femoral neck, a traumatic condition, treated not infrequently by general surgeons. The operations in our series have been performed by residents and surgeons with a wide variety of operative skill and experience.

MATERIAL AND METHODS

Endoprosthetic reconstruction of the proximal end of the femur with the self-locking Austin T. Moore prosthesis was performed during the period 1965–1972 on 109 hip joints of 106 patients at the Department of Surgery, Oulu University Hospital, Finland. The majority of the patients were elderly females with fresh fracture of the femoral neck or late complications of same (Table 1 and 2).

Table 1. Sex and average age.

Sex	No. of cases	Age (years)
Females	85	72 (34–89)
Males	21	70 (41–88)
Total	106	71.5 (34–89)

Table 2. Diagnosis.

Fresh femoral neck fracture		85
pathological fracture	2	
Old femoral neck fracture		21
non-union	12	
avascular necrosis	7	
fatigue fracture with total dislocation	2	
		106

Table 3. Concomitant diseases and injuries.

Cardiovascular disease		50
heart failure	22	
coronary artery disease	13	
cardiac arrhythmias	7	
hypertension	7	
valvular defect	1	
Central nervous disease		16
arteriosclerosis	8	
hemiplegia	4	
parkinsonism	2	
apoplexia cerebri	1	
epilepsy	1	
Rheumatoid arthritis		9
Diabetes		8
Pulmonary disease		8
Urinary infection		7
Malignancy		5
Coincident fracture		3
Miscellaneous		23

Very few of the patients operated upon were in an uncomplicated general condition before the trauma and/or operation (Table 3). The majority preoperatively received medical attention, drug treatment and physical exercises (Table 4).

Preoperative hospital stay was on average 5.0 days. All fresh fractures were primarily immobilized, usually by traction. The majority of the pseudarthroses and necrotic heads had been subjected to various procedures of nailing an average of 10 months before (Table 5). Nearly all the operations were performed in intubation general anaesthesia under the control of an anaesthetist.

The surgeons were evenly divided between residents and specialists in at least general surgery.

Table 4. Preoperative and postoperative medication.

Medication	Pre-oper.	Post-oper.*	Total
Heart and hypertensive disease medication	66	2	68
Sulfonamid	25	21	46
Antibiotics	16	37	53
Anticoagulant	6	7	13
Anabolic steroids	5	1	6

* postoperatively started.

Table 5. Time lapse between injury and Moore operation.

Diagnosis	No. of cases	Time
Fresh femoral neck fracture	85	5 days
Old femoral neck fractures (non-union, avascular necrosis)		
no earlier treatment	5	25 months
failure after treatment	16	10 months

The southern incision was most often utilized, followed by the Gibson incision (Table 6).

The postoperative rehabilitation included verticalization after 2.7 days on average and walking with aids after 5 days on average. Postoperative medication was needed in many patients (Table 4). Postoperative hospital stay was on average 11.74 days, the total hospitalization on average 16.96 days (Table 7). The follow-up examination was performed by the research group, personally in 69, by mail in five and according to hospital routine documentation in six cases. The total mortality rate was 19.8 per cent (Table 8).

In calculating the results the modified system of Merle D'Aubigné was used for summing up score points for mobility, pain and walking ability. However, independently of the total score, if pain was present to any considerable degree, the result was classified as one category worse than the total score otherwise indicated (Tables 9 and 10), special attention being paid to early and late complications and also to the classification of reasons of failure other than those belonging to the operated hip joint.

Table 6. Features of surgery.

Method of anaesthesia	
general	100
epidural	6
Surgeon	
specialist	49
resident surgeon	57
Exposure	
southern	83
Gibson	17
Watson-Jones	1
other	5

Mean duration of operation from the induction of anaesthesia to the extubation 1 h 50 min.

Table 7. Duration of stay in hospital and location of convalescence period.

Mean duration of stay in hospital	
preoperatively	5 days
postoperatively	12 days
total	17 days
Location of convalescence	
home	31 patients
old people's home	13 patients
hospital for chronic diseases	62 patients

Table 8. Follow-up series.

Follow-up		80 (75.5 per cent)
able to walk	69	
unable to walk from general disease	11	
prosthesis removal	3	
Follow-up contact lost		5 (4.7 per cent)
Deaths		21 (19.8 per cent)
Total		106 (100 per cent)

RESULTS

The late results after an average time of observation of 40 months were at least satisfactory in 92.7 per cent of the 80 patients whose general condition had remained good enough to permit independent walking and self-care (Table 11). Disability resulting from general diseases and advanced age prevented 11 patients from walking at all, despite good mobility without pain of the operated hip joint (Table 12). The results in the three patients with bilateral arthroplasty were all satisfactory or good.

Regarding mobility alone, the goniometric range of movements was able to be recorded exactly in 66 patients. The range of active and passive flexion was somewhat less than 90° in seven hip joints and 90° or more in the majority of the Moore joints (Table 13). With respect to pain alone, based on the patient's assessment, it was in two instances so severe that it substantially impaired gait.

Regarding walking ability, the major-

Table 9. Numerical evaluation of the hip joint according to d'Aubigné.

Score	Pain	Mobility	Walking
0	Very severe continuous pain.	Ankylosis with bad position of the hip.	Unable to walk.
1	Very severe pain, preventing sleep.	Clinical ankylosis with little or no deformity.	Only with crutches.
2	Severe pain on walking. Inhibited in all work.	Flexion 0–40°. Abduction 0° or slight deformity.	Only with 2 sticks.
3	Tolerable pain interfering with work.	Flexion 0–60°.	Less than 1 hour with stick. Very difficult without stick.
4	Only pain after walking. Subsides on resting.	Flexion 0–80°. Able to lace shoes.	1 stick for long distances. Limited without stick
5	Negligible and intermittent pain, not interfering with work.	Flexion 0–90°. Abduction $< 25°$.	A slight limp without a stick.
6	No pain.	Flexion $> 90°$. Abduction $> 25°$.	Normal.

ity could satisfactorily perform all daily activities. In nine cases there were moderate to severe restrictions.

Early complications (Table 14)

Three patients (2.7 per cent) died during hospital stay, two of them very early and one after 4 weeks, of blood disease.

Deep infection in three patients (2.7 per cent) led to removal of the prosthesis and spontaneous Girdlestone joints in all instances.

Dislocation of the Moore head occurred twice, both times in patients with pseudarthrosis from fatigue fracture resulting in atrophy of the acetabular rim (1.8 per cent) (Figure 1). Reposition by closed manoeuvres was performed with subsequent immobilization in internal rotation and abduction for 4–8 weeks with plaster cast. No further treatment was needed and the prognosis was favourable.

Accidental fractures of the proximal femur occurred five times during insertion of the prosthesis. Treatment consisted of prolonged immobilization. The fractures healed well. In none of the

Table 10. System of classification of end-result on the basis of total score modified by pain thresholds.

End-result	Score	Criterion
Poor	0–7	pain 0–2
Fair	8–12	pain >3
Good	13–16	pain >4
Excellent	17–18	

Table 11. End-results in 69 patients with Moore endoprosthesis of the hip joint (excluding 11 cases with inability to walk as a result of general disease, Table 12).

Poor (including 3 cases with prosthetic removal)	5	(7.3 per cent)
Fair	8	(11.6 per cent)
Good	35	(50.7 per cent)
Excellent	21	(26.2 per cent)
Total	69	(100 per cent)

Table 12. Debilitating reasons for inability to walk in followed-up bed-ridden patients with Moore's prosthesis.

Sex	Age	Disease	Mobility score of the hip	Pain score	Gait score
female	61	arthritis rheumatoides	6	6	0
female	59	arthritis rheumatoides	4	6	0
female	84	hemiplegia	6	6	0
male	51	hemiplegia	6	4	0
female	67	parkinsonism	6	6	0
female	70	apoplexia cerebri	4	4	0
male	66	vertigo	5	6	1
female	84	dementia senilis	6	6	0
female	84	dementia senilis	6	5	0
female	85	dementia senilis	5	5	1
female	67	stylus femoris post amputationem	6	6	0

Table 13. Score at follow-up of 66 patients with endoprosthesis.*

Score	Mobility score of the hip No. of cases	Gait score No. of cases	Pain score No. of cases
0	–	1	–
1	1	2	–
2	–	2	2
3	1	4	2
4	5	27	14
5	9	10	16
6	50	20	32

* excluding 3 patients with endoprosthesis removal and 11 patients with inability to walk as a result of general disease (Table 12).

Table 14. Intraoperative and early postoperative complications (in 106 cases).

Fracture or fissure of the femur		5
"Superficial" infection		4
"Deep" infection*		3
Luxation of prosthesis		2
Thrombosis		7
Peroneal analysis		1
Deaths		3
Gastrointestinal bleeding	1 month	
Infarctus cordis	4 days	
Embolia pulmonum	1 day	
Decubitis (heel)		1

* in every case prosthesis was removed later.

cases did the prosthesis have to be removed and the prognosis was always good. In one case malrotation of the prosthesis (anteposition) was noted postoperatively as a result of technical failure (Figure 2).

Occasional cases of superficial infection (3.7 per cent), deep thrombosis (0.9 per cent), decubital ulcer of the heel (3.7 per cent) and peroneal paralysis (0.9 per cent) did not affect the good prognosis.

Late complications (Table 15)

Loosening of the prosthesis occurred twice (1.5 per cent). This painful complication always gave rise to re-operation (Figure 3). Protrusion of the Moore head into the acetabulum was an occasional radiographic finding (3.7 per cent). Pain seemed to be related to this complication. The simple radiological finding of bone resorption (5.0 per cent) around the stem was rather symptomless and does not necessarily seem to indicate poor fixation.

Calcifications in the soft para-articular tissue (10.0 per cent) could not be correlated with any particular symptoms.

In some instances a study of the radiographic sequence shows spontaneous

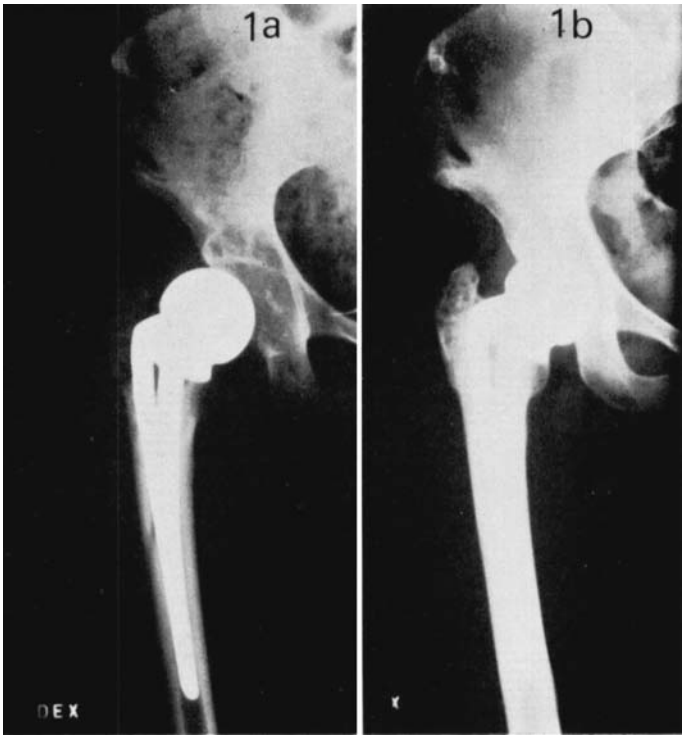

Figure 1. a) Early postoperative dislocation of the Moore head was treated by closed reposition under anaesthesia and immobilization with plaster spica for 8 weeks.
b) No recurrence of dislocation at follow-up.

long-term movement downwards of the prosthesis. This seems to come to a standstill when the prosthetic neck reaches the level of the minor trochanter. This was a symptomless phenomenon without any indication of loosening of the fixation.

The most serious late problem is inadequate fixation of the prosthesis. Lunceford (1965) found it in 0.8 per cent of the operations and Hinchey & Phillip (1964) only in the case of deep infection. Loosening of the prosthesis has been the reason for pain leading to reoperation in 1.5 per cent of our operations. The reason may be that insertion of bone chips into the holes of the stem was neglected, or that there was too large a reaming cavity or some other technical error. It has not been possible to trace adequately the mechanism in our two patients.

Table 15. Late complications (in 80 followed-up patients).

Loosening of the prosthesis	2 (2.50 per cent)
Protrusion into acetabulum	3 (3.75 per cent)
Para-articular calcifications	8 (10.00 per cent)
Bone resorption around the stem	4 (5.00 per cent)

Stability has been achieved after spongious bone filling of the stem cavity and reinsertion of the prosthesis with a larger stem. This rare complication has not affected the ultimate prognosis. Protrusion of the Moore head into the acetabulum is painful, but reoperation is not practical. If needed, one should reckon with a total hip replacement. Radiological evidence of bone resorption around the stem, calcifications in the para-articular tissue and the strange almost unnoticeable migration of the prosthesis until its neck settles down against the minor trochanter have seemingly little if any clinical significance.

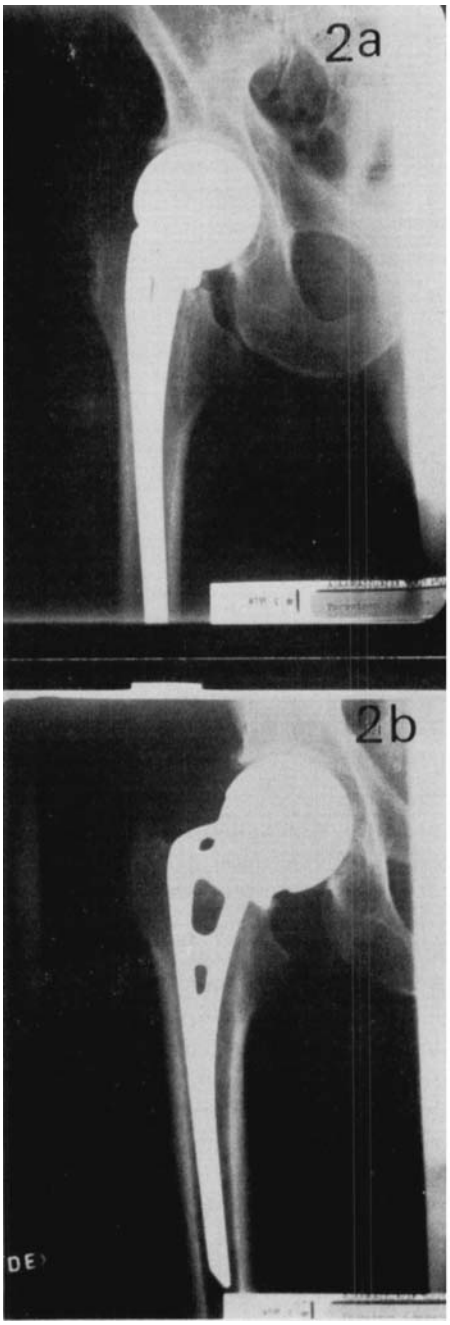

Figure 2. a) A case of malinsertion of the stem. b) Spontaneous derotation during early verticalization into the neutral position. Good late result.

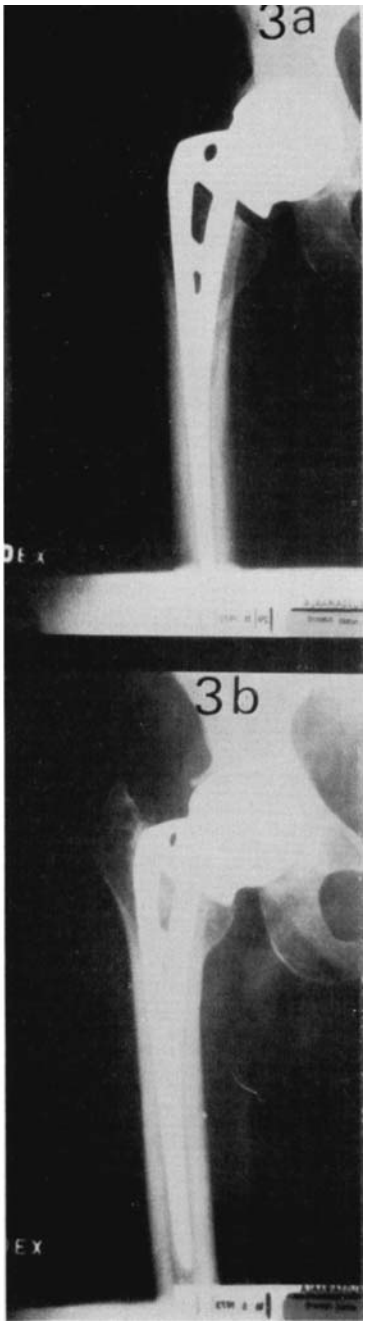

Figure 3. a) The cause of pain in this old female was diagnosed to be loosening of the prosthesis. b) After filling stem cavity with bone chips and reinsertion of a Moore head with larger stem good fixation was gained. Good late result.

Hypertrophic overgrowth of osteophytic bone, which is known from the earlier days of Moore-operations when arthrotic joints were operated, has not been encountered.

DISCUSSION

Overall mortality after osteosynthesis of fresh fractures of the femoral neck is generally high and totals one-third of the patients in the sixth year postoperatively (Greenberg et al. 1973). This depends on the geriatric condition of the patients operated upon, which is for example also the aetiological reason for fractures of the proximal end of the femur. Opinions on this matter are, however, controversial. Exceptionally low mortality, morbidity and infection rates are reported after percutaneous Knowles pinnings of fractures of the femoral neck (Arnold et al. 1974).

Mortality rates after prosthetic replacement vary widely according to various series reported: 14 per cent/6 months (Hinchey & Phillip 1964); 36 per cent/2 years (Hansen & Spotoft 1966); 25 per cent/2 years (Jansen & Hansen 1966); 41 per cent/6 months (Hunter 1969); 26 per cent/4.9 years (Andersson & Nielsen 1972); 11.3 per cent/6 months (Arnold et al. 1974). Comparison of series is very difficult and not very meaningful because of large differences in medical and social pecularities.

Overall mortality is even said to correspond to that expected in the age group (Andersson & Nielsen 1972). It would perhaps be of value to have some sort of mortality index derived from regional information. The 19 per cent mortality in our series during the first 40 months can be compared with an average expected mortality rate for the population of the country as a whole of about 21 per cent calculated from statistical data. Primary in-hospital mortality in our series (3/109) lies close to that (2/117) in Andersen & Nielsen's (1972) and that (3/132) in Campbell et al.'s (1960) series. Two of our patients died early for reasons probably related to the operative stress, and one after a month of gastrointestinal bleeding of unknown cause. Intraoperative mortality should be no problem if preoperative anaesthesiological screening is made routine.

Regarding early local problems, the most serious complication, which affects the prognosis very unfavourably, is deep infection. The incidence seems to be from 1 per cent to 3 per cent of the operations (Campbell et al. 1960, Hinchey & Phillip 1964, Danielsson 1965, Lunceford 1965). This is analogous to what we encountered. Most often the end result, Girdlestone's pseudarthrosis, has to be accepted. Removal of the prosthesis and medical treatment as a rule cures the infection. A trial with deep incisions and continuous drainage and massive doses of antibiotics may sometimes be worthwhile, but this treatment should not be prolonged.

All other types of usual early complications are prognostically not so bad and can be handled more easily. Dislocation of the prosthesis can usually be treated by closed reposition and immobilization with plaster. Fractures of the proximal femur can be immobilized without removal of the prosthesis but require prolonged immobilization in plaster without weightbearing until consolidation.

Superficial infection, thrombosis and decubital ulcers are not specifically related to this operation and they do not, if properly treated, have any influence on the good prognosis. Peroneal paralysis must be taken into account if the southern exposure is used and the surgeon should avoid undue lesions to the ischial nerve.

Summarizing the features one could state that Moore's prosthesis 1) eliminates pseudarthroses and necroses of the femoral head with late arthrosis, 2)

permits early weightbearing, 3) makes nursing easier and returns the patients to the activities of daily life rather smoothly, 4) avoids cementing risks, 5) includes few possibilities of complications which endanger the ultimate favourable results as regards locomotion, and 6) is an operation with wide safety margins for technical errors and serious postoperative morbidity and possibly has no negative influence upon life expectancy, in comparison with the total population.

Geriatric traumatology increases in volume. Total rehabilitation in old age has to be dealt with in a decentralized manner, i.e. primarily in regional and municipal institutions, which should also have responsibilities for long-term care and treatment of chronic illness.

The Moore arthroplasty will more and more be an operation handed over to the general surgeon engaged in treating fresh injuries. If mortality and morbidity can be kept within present limits, as we are sure they can, the indication for operation even in the hands of surgeons less trained than the orthopaedist can be expanded to include most geriatric intracapsular fractures of the femoral neck, except those in patients bedridden as a result of debilitating disorders.

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