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RESULTS AFTER ARTHROPLASTY OF THE HIP WITH MOORE'S PROSTHESIS

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Ever since Austin T. Moore inserted the first femoral shaft endoprosthesis in 1940, there has been great interest in this type of treatment of pathological conditions of the hip joint. By gaining further experience the pattern of indication has become more limited and thus, instead of mainly treating osteoarthritis of the hip, medial fractures of the femoral neck have been treated either primarily or because of complications of the fracture. Many authors mention the value of this method, but the time of observation is often short and the criteria give rise to subjective evaluation. The purpose of this paper is not only to report on the long-term results, functional as well as radiographical, but also to deal with surgical and late complications.

MATERIAL AND METHODS

During 1961-1967, Moore's prosthesis was implanted in 117 patients at the Orthopaedic Clinic, Central Hospital of Borås, Sweden.

Of these patients 103 were females and 14 males (88/12 per cent). The ages of the patients varied between 20 and 92 years (mean age 70 years). The number of cases in each age group is tabulated in Table 1. The indications for surgery are shown in Table 2.

In this paper "fresh fracture" refers to fractures treated with a prosthesis within the first month following the accident. Pseudarthrosis and avascular necrosis of the femoral head have been amalgamated, as it is sometimes difficult to differentiate between these conditions.

All the operations were performed under general anaesthesia. The Gibson incision was used in all cases except one, in which the approach was that of Smith-Petersen.

The post-operative treatment involved bedrest with traction in abduction and

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Table 1. Number of patients in each age group.

> 50	5
50-59	17
60-69	30
70-79	44
80 <	21

medial rotation for 1-2 weeks, followed by exercises on a skating-board. The patients remained in bed for 3 to 4 weeks, during which time they were given anti-coagulants to prevent thromboses. The patients were then allowed up with a walking aid, but not until 2 months had elapsed was maximum weight-bearing permitted.

The mean time of hospitalization at the Orthopaedic Clinic was 6 weeks (3-17). 65 patients (55 per cent) were treated in after-care wards or nursing homes. Physiotherapy in the patient's home was recommended only in exceptional cases. The patients used walking aids according to their own desires and requirements.

Eleven patients (10 per cent) were readmitted for intensive physiotherapy on 13 occasions. Five patients (4 per cent) required further surgery. Of these two were operated with arthrodesis, one with the girdlestone procedure, one with a total hip replacement, and one with a change of prosthesis.

At the time of examination 86 patients (74 per cent) were alive. Of these 77 (90 per cent) have been followed up. Two patients had been revised and 7 patients could not be followed up because of old age and their mental condition. The time of observation varied between 1.7 and 8.6 years (mean 4.9 years).

Criteria, originally formed by M. Shephard (1954) and modified by Öhman et al. (1969) have served as a basis for the assessment of the results. In order to improve the statistical analysis, a further revision has been made (Table 3). The assessment has been based on the occurrence of pain, the range of movement (measured on active movements according to Gade, 1947) and functional activity. The patient's own impression has been dealt with separately as it is difficult to assess. The results have been classified in three groups: good, acceptable and poor.

The radiographic appearance of the hip, to which Iselin (1967) amongst others attached importance, has not been used as a basis for the total assessment, but instead it has been utilized in attempting to explain any failures. Much attention has been given both to the original size of the prosthesis, its position and fit, and

Table 2. Indications for surgery.

Pathological condition	No. of patients	Per cent
Osteoarthritis	12	10
Failed cup prosthesis	4	3
Failed Judet prosthesis	1	1
Pseudarthrosis and necrosis	77	66
Fresh fracture	23	20

Table 3.

Model used for follow-up (According to Öhman et al. 1969)												
I	Pain	0-5										
II	Mobility	0-100										
III	Function	0-28										
Assessment of marks												
Marks	0	1	2	3	4	5	6	7	8	9	10	11
Pain	0	1	2	3	4	5						
Mobility	70<	69-50	49-35	34-20	19-10	9-0						
Function	0-1	2-3	4-5	6	7	8-9	10-11	12-13	14-15	16-18	19-21	22-28
Assessment results												
	Good		Acceptable		Poor							
Function	0-3		4-7		8-11							
Pain	0-1		2-3		4-5							
Mobility	0-1		2-3		4-5							
Totals	0-4		5-10		11-21							

also to any changes arising in the late post-operative period. As there was difficulty in obtaining comparable radiographs, a detailed statistical analysis of the series could not be carried out.

None of the patients were operated on by any of the authors who performed this investigation.

RESULTS

As seen in Table 5, the overall results were good or acceptable in 74 per cent. In differentiating the results with reference to pain, mobility and function, the functional results were the least favourable. There was no difference in results in relation to age or sex. The results did not vary with the surgeon.

On the whole the assessment of the patient and surgeon agreed (level of significance 99 per cent, Table 4). The patient who, despite good results from the surgeon's point of view, stated his condition to be poor, could only refer to a slight limp.

The results of the fresh fracture group were better than those of the pseudarthrosis and necrosis group (Table 5). The poorest results were

Table 4. Relation between Surgeon's assessment and patient's assessment (No. of patients).

Surgeon's assessment	Patient's own assessment			Total
	Good	Acceptable	Poor	
Good	27		1	28
Acceptable	17	5	7	29
Poor	7	1	12	20
Total	51	6	20	

Table 5. Clinical results at follow-up.

	Good %	Acceptable %	Poor %
Pain	62	29	9
Mobility	65	25	10
Function	42	39	19
Overall	36	38	26
Osteoarthritis	10	40	50
Pseudarthrosis, necrosis	40	35	25
Fresh fracture	47	40	13

Table 6. Results in relation to time of observation.

Years of observation	No. of patients	Good	Accept.	Poor	Dead	Not exam.	Proportion dead/alive
2-4	54	17	16	8	8	5	0.17
5-8	63	11	13	12	23	4	0.36
Total	117	28	29	20	31	9	0.26

found among the patients who were operated upon for osteoarthritis of the hip; the replacements of the Cup and Judet prostheses were included in this group. The differences are statistically significant (level of significance 95 per cent).

In relation to the time of observation there are, as shown in Table 6, variations in the results. When the groups are classified in times of observation lasting between 2 and 4, and 5 and 8 years, respectively, the results obtained in the longest observed group are poorer. This applies even when excluding patients operated on for osteoarthritis or unsuccessful Cup or Judet procedures.

Complications

Table 7 gives details of the complications which are classified as operative and late. A dreaded complication in endoprosthetic treatment,

Table 7. Operative and late complications.

Operative	No. of patients
Fracture of the femur	2
Fracture of the trochanter	3
Dislocation of prosthesis	4
Superficial infection	11
Thrombophlebitis	2
Pulmonary embolism	3
Peroneal nerve palsy	2
Prosthetic stem outside femur	1
Late	28
Late pain	18
Late dislocation	1
Severe swelling of leg	1
	20

Table 8. Mortality rate in different diagnoses.

Diagnosis	No. of patients	Total no. of patients	Per cent
Osteoarthritis	2	17	12
Pseudarthrosis and necrosis	20	77	26
Fresh fracture	9	23	39

deep infection, was not observed in this investigation. Late pain refers to pain arising 6 months or more post-operatively.

Mortality Rate

The mortality rate during the time of hospitalization was 2 per cent (two patients). Both patients died of myocardial infarction about 3 weeks after the operation. The indications for operation were in one case recent fracture and in the other necrosis of the femoral head. The one-year mortality rate was 4 per cent.

The mortality rate at the time of investigation, 26 per cent, corresponded to that expected in our particular age groups. The cause of death in these patients seemed to have no connection with the surgical treatment (Table 8).

Radiographic Findings

As mentioned above, the possibility of assessing these changes is limited, owing to the lack of completely comparable views. Therefore, only cases with typical changes and with a displacement of the



Figure 1.
Acetabular protrusion.



Figure 2. Loose prosthesis. Note clear zone round the prosthetic stem.



Figure 3. Sliding of prosthesis into femur.

prosthesis of at least 5 mm, as detected on the views which could possibly be compared, have been included. Depression of the prosthesis into the femur was found in 27 patients. Protrusion into the pelvis was observed in 7 patients. In all cases of protrusion there was also evidence of sinking of the stem into the femur. Signs of a loose prosthesis in the femoral shaft with a clear zone around the prosthesis were found in 25 cases. In 17 cases the prosthesis was found to be both depressed and loose. Calcification and ossification could be found periarticularly in 34 cases, and in the trochanteric region in 7 cases.

Rehabilitation

One purpose of this investigation has been to try to assess the extent of rehabilitation of patients who have had Moore arthroplasties. As the mean age of the patients is high, their capacity for work will not primarily serve as a guide, but instead the question of help required from other people or institutions will prevail. The facilities and structure of the community will have an effect on this. Table 9 illustrates that 20 per cent could manage without any aid from other people, and as many as 89 per cent could remain in their own home. The results of the 11 per cent who were treated in an institution were poorer than

Table 9. Assessment of Social milieu.

	No. of patients	Per cent
Own accommodation without help	15	20
Own accommodation with help	53	69
Pensioner's home	8	10
Hospital	1	1

Table 10. Walking aids.

Walking aids	No. of patients
0	14
1 stick	40
1 crutch	9
1 trestle	3
2 crutches	7
2 trestles	1
Cannot walk outside	3
	77

those of the patients treated in their home (level of significance 95 per cent). Eight patients (10 per cent) depended on help for their hygienic requirements, and 58 patients for their necessary purchases.

Walking Aids

The patients had not been encouraged to use walking aids. It is obvious from Table 10 that many patients strongly felt the need for them.

Limping

Only 5 patients walked without limping at the time of observation (6 per cent). An attempt was made to differentiate between Trendelenburg limping, depending on muscular insufficiency, and limping caused by shortening and therefore compensable by heightening of the shoe. However, this proved complicated as both these phenomena occurred simultaneously.

A shortening of 1–2 cm, measuring from the superior anterior iliac spine to the medial malleolus, was seen in 60 patients (78 per cent). The shortening occurred more frequently in those patients operated upon during the period 1961–1964 than in those during the period 1965–1967 (level of significance 99 per cent). As the technique of operation has remained unchanged between 1961 and 1967, this may be a sign that the prosthesis tends to become displaced with the passage of time. The radiographic findings support this idea.

Positive or undecided Trendelenburg limping was observed in 78 per cent.

DISCUSSION

Results

The variation in the results depending on the indication is well known. The poor results associated with osteoarthritis have been ascribed to the changes in the acetabulum. Now that total replacement of the hip is available, there no longer seems to be any indication for the use of femoral shaft prosthesis in this condition. The more satisfactory results in primary replacement for femoral neck fracture, in comparison with the results of replacement for the secondary complications of this fracture, are nowadays of greater practical importance. We believe that in our series this was due to the fact that persistent

necrosis of the femoral head results in impaired shape and surface of the acetabulum and that pseudarthrosis of the femoral neck results in impaired condition of adjacent bone and soft tissues. The prerequisite for a satisfactory result seems to be an intact acetabulum and a comparatively good preoperative mobility.

The results in patients with a short time of observation were better than those in patients with a longer time. It is difficult to state definitely if this is a sign of gradual impairment as the patients had aged and their general condition had become poorer. The results did not vary with age but were less satisfactory in patients who had another disease at the same time. Weigert (1969) found that impairment of the results could be directly related to arthrosic changes in the acetabulum, existing at the time of operation. A prospective investigation at fixed intervals would be desirable in order to survey the prognosis.

In our opinion the correct fit of the prosthesis is of great importance for the final result. When using the Moore prosthesis, the centre point of the head of the prosthesis should lie on the same level as the tip of the trochanter, corresponding to the transverse axis of the hip joint. By this definition, the prosthesis was fitted in too low a position in approximately two-thirds of the patients, which may partially explain the high occurrence of the Trendelenburg phenomenon. The choice of a femoral head of the correct size is imperative. Too small a head causes pressure atrophy in the centre of the acetabulum, whereas too large a head results in circular atrophy of the acetabular edges. The size of the head should be accurately measured (Deyerle 1967, Huggeler 1968), and before inserting the prosthesis into the femur it should first be tried in the acetabulum.

Complications

The two femoral shaft fractures which arose during the operation both occurred in connection with reduction. They were treated conservatively. The fact that fractures often occur in connection with reduction has been pointed out in the literature by Anderson et al. (1964), Love Jr. (1963) and Deyerle (1967), and indicates that care should be taken at this part of the operation.

The late pain is indeed of interest. Attempts to analyse this type of pain have been made by, *inter alios*, Hinchey & Day (1964), Barr et al. (1964), Anderson et al. (1965), Harris (1966) and Huggeler (1968). Radiographic changes showing protrusion into the acetabulum, de-

pression of the prosthesis in the femoral shaft or signs of poor fixation of the prosthesis in the femoral shaft seem to be connected with late pain (Furey 1961, Barr et al. 1964, Anderson et al. 1965, Danielsson 1965, Deyerle 1967). In order to prevent complications of this type from arising, the importance of a good operative technique is re-emphasized. Deyerle (1967) has thoroughly analysed different technical problems in connection with the operation and suggested improvements. Harris (1966) and Deyerle (1967) further recommend weight-relief for 2-3 months. Weight-relief during this period, however, complicates mobilization of the patient, and several authors (Love 1963, Huggeler 1966, Petersen 1967, Goodwin 1968) achieved good results with early weight-bearing. On the other hand, a long-life use of supporting devices seems adequate, as this improves the joint mechanism (Blount 1965). Moore (1957), Lunceford (1958), Thompson (1959), Danielsson (1965), Harris (1966), Weigert (1969) and others recommend this, and in the future our patients will be encouraged to that effect. In order to prevent loosening of the prosthesis, cementation is recommended by many authors (Charnley 1964, Huggeler 1968, Friedebold 1969, Follacci 1969). Cementation undoubtedly has many attractive biomechanical advantages. However, it is not within the compass of this paper to discuss whether or not bone cement should be used.

SUMMARY

On the basis of a series of patients treated homogeneously with the use of Moore's prosthesis, an attempt has been made to study late results and complications. The results vary primarily with the indication for surgery. Patients operated on for osteoarthritis or sequelae after previous operation for osteoarthritis, definitely revealed poorer final results. This procedure cannot be recommended here.

The results became less favourable with increased time of observation, but the magnitude and composition of the series do not allow any definite conclusions. Radiographic changes with acetabular protrusion, depression of the femoral shaft and loose prosthetic shafts seem to increase with the time of observation and may perhaps be the cause of deteriorating results. A certain restraint in younger patients seems justifiable. The value of a good operative technique is emphasized and a life-long use of a stick is recommended.

The mortality rate does not exceed that expected within this age group.

Complications are discussed, primarily operative, e.g. fracture of the femur and dislocation of the prosthesis, but also late complications, and various reasons for late pain are analysed. Limping and positive Trendelenburg symptoms constitute a rule rather than an exception.

The technique, which nowadays has become routine in orthopaedic clinics, can be recommended especially in the treatment of complications caused by fractures of the femoral neck. Although this paper does not intend to deal with the primary treatment of fractured of femur, results suggest that if replacement is to be used the sooner the better. The late results should be subject to further study.

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