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PARA-ARTICULAR OSSIFICATIONS AFTER PRIMARY PROSTHETIC REPLACEMENT *AD MODUM* AUSTIN T. MOORE

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The occurrence of para-articular ossifications after alloarthroplasties of the hip has been a recognized complication since the first announcement of the results of these procedures. In the past few years para-articular ossifications have been increasingly mentioned in papers concerning results of total hip replacement. However, there is a great variation in the information given of the frequency of ectopic ossifications and in the same way the clinical importance has so far only been sparingly elucidated.

It is the purpose of this study to describe the frequency and the clinical consequences of para-articular ossifications after primary prosthetic replacement using Austin T. Moore's technique in the treatment of medial fractures of the femoral neck.

MATERIAL AND METHODS

At the Department of Orthopaedic Surgery, Aarhus Municipal Hospital, the treatment of unstable medial fractures of the femoral neck in patients older than 60 years has been, since 1962, primary prosthetic replacement *ad modum* Moore.

The operative procedure has been Moore's posterior approach and inverted T-capsular opening. The femoral neck has been shaped either by chisel, Giglie's saw or by Stryker's reciprocating bone saw; and in no case was the capsule removed. Only Vitallium prostheses have been used.

The post-operative treatment involved bedrest for 3 weeks and weightbearing walking training 4 weeks after the operation. X-ray examination was performed routinely immediately after the operation, then monthly for the following 3 months and finally every 3 months until the follow-up period concluded 1–2 years later.

During the period January 1964–April 1967 a total of 127 patients (102 females

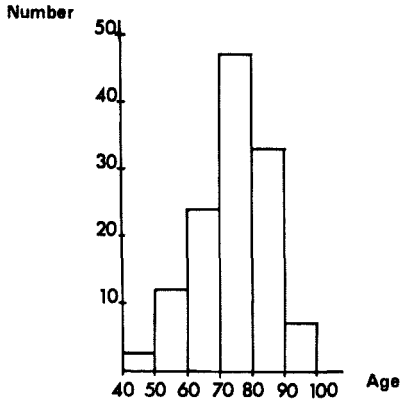

Figure 1. Age distribution.

and 25 males) have had a Moore prosthesis fitted as a routine treatment for unstable medial fractures of the femoral neck. Excluded are the patients suffering from severe osteoarthritis and rheumatoid arthritis.

The age distribution is shown in Figure 1. The oldest patient was 99 years of age and the youngest 49 at the time of operation, giving a mean age of 74.8 years.

The reason why 15 patients younger than 60 years were included was complicating disease, which made early mobilization desirable or gave difficulties in an attempt to nail.

The time which elapsed from admission until surgery is shown in Table 1. Fifteen patients died before discharge from the department; six of these died before the first radiographic examination 1 month after the operation. Sixty-two patients were followed in the outpatient clinic for 1–2 years after the operation. Forty-six patients were alive 5–7½ years postoperatively. Of these patients 40 (87 per cent) have been followed up. Four refused to co-operate and two were abroad. The para-articular ossifications were determined on review of all the supine anteroposterior roentgenograms of the hip that were available for the whole group of patients. All the films were studied by both authors.

The ossifications are classified in accordance with the following grading system:

Grade 0: no para-articular ossifications or exostose formations (Figure 2 A).
Grade I: small ossifications with largest diameter < 1.2 cm (Figure 2 B).
Grade II: middle-sized ossifications with diameter > 1.2 cm but no apparent bridge building (Figure 2 C).
Grade III: large ossifications bridging the space between femur and pelvis (Figure 2 D).

Table 1. Period from admission to the hospital until operation was performed.

Days	1	2	3	4	5	6–10	10–20	20–30
No. of patients	50	42	18	7	3	3	2	2

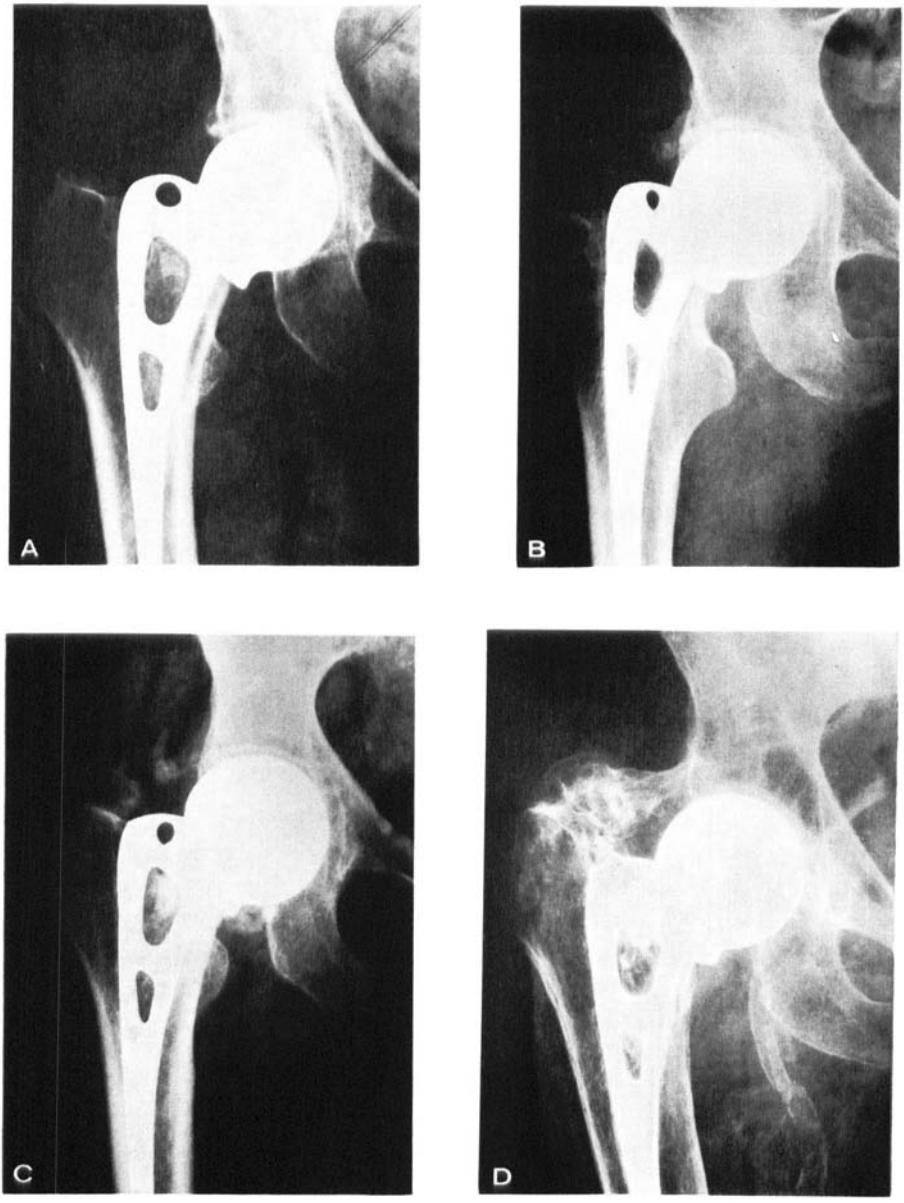

Figure 2. Characteristic examples of the grades of para-articular ossifications. A: grade 0; B: grade I; C: grade II; D: grade III.

Table 2. Results in 121 radiologically examined patients.

Para-articular ossifications according to grades	Number of patients		Percentage	
Grade 0	67		55	
„ I	36	54	30	45
„ II	11		9	
„ III	7		6	
Total	121		100	

RESULTS

The distribution of para-articular ossifications according to the above-mentioned grading system in the 121 patients with X-ray film available after surgery is shown in Table 2.

The ossifications had reached their final size within 3 months after the operation in all cases except four. In two cases grade I ossifications arose later than 3 months after the operation, but it is possible that these ossifications could have been pointed out earlier had better X-ray techniques been used. The remaining two patients had deep infections and later developed ossifications of grade III.

The localization of all the ossifications and the mutual per cent distribution is shown in Figure 3. Table 3 shows the frequency of post-operative complications in the four groups.

Bone absorption with settling of the prosthesis more than 5 mm was found in 31 patients (26 per cent). There was no significant correlation between the occurrence of para-articular ossifications and the tendency for bone absorption (Table 4). No correlation could be found between the shaping method—saws or chisel—and the ossifications.

Table 3. The ossification grades in relation to complications.

	Number of patients	Infection	Haemorrhage	Dislocation
Grade 0	(67)	4	5	1
„ I	(36)	3	2	1
„ II	(11)	2	0	0
„ III	(7)	4	5	1
Totals	(121)	13	12	3

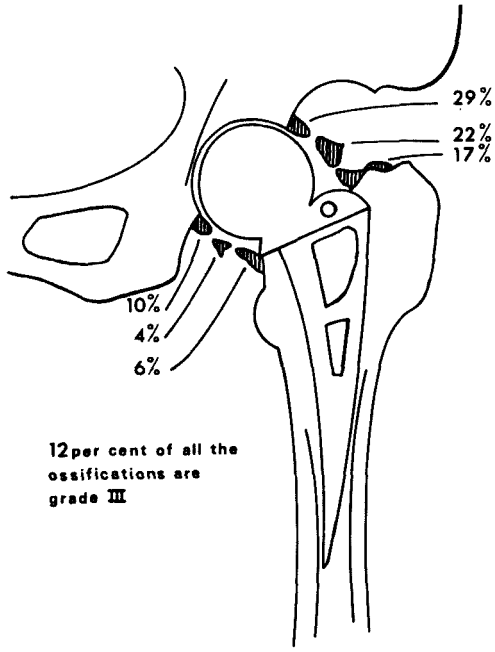

Figure 3. Localization of grade I and grade II para-articular ossifications.

Follow-up examination

At the re-examination (5–7½ years postoperatively) the para-articular ossifications did not have a significantly changed X-ray configuration from the time of the final examination in the outpatient clinic 1–2 years after the operation. Thus, except for the four previously-mentioned patients, no changes in the extent of the ossifications from the roentgenograms 3 months after the operation were observed.

The patients examined were represented in the four groups, accord-

Table 4. The four ossification grades in relation to bone absorption.

	Number of patients
Grade 0	14
„ I	10
„ II	5
„ III	2
Total	31

Table 5. Results at the follow-up study in 40 patients according to the grade of para-articular ossifications represented.

	Number of patients	Ability to walk			Hip mobility			Information about pain		
		with or without 1 stick	with 2 sticks or crutches	inability to walk	> 211°	161–210°	< 160°	without pain	pain on walking	pain at rest
Grade 0	23	17	5	1	9	11	3	12	10	1
Grade I	13	11	2	0	4	6	3	6	6	1
Grade II	2	1	1	0	0	1	1	2	0	0
Grade III	2	0	1	1	0	0	2	1	0	1
Totals	40	29	9	2	13	18	9	21	16	3

The hip mobility is calculated as the sum of degrees of passive movement: extension/flexion—abduction—adduction—internal rotation and external rotation.

ing to the degree of para-articular ossifications, in the same ratio as the total material (Table 5). There was no characteristic correlation between the size of the ossifications and the hip joint function, except for the considerable limitation of movement, which was found in the cases with grade III ossifications.

DISCUSSION

Para-articular ossifications after prosthetic replacement *ad modum* Austin Moore have been found in this material in 45 per cent of 121 patients (Table 2). The evaluation of the roentgenograms has been made in such a way that all degrees of calcific shadows are included from the smallest ones, which occur as beak-shaped exosthoses or detached

shadows, to those of enormous size, apparently bridge-building bone formations.

This material confirms that ossifications of considerable size can be seen after deep infection. However, no direct correlation between deeper infection or haematoma and ectopic ossifications is shown. There is no correlation between a tendency for bone absorption and formation of para-articular ossifications.

Moore & Lunceford (1960) reported that excessive proliferation of bone is seen in a few cases after fitting of a self-locking hip prosthesis.

Charnley (1972) postulated that a "notable degree of ectopic ossification" is found in 5 per cent of cases after total hip replacement and only affects the mobility to a small degree.

Brooker et al. (1973) set up a grading system in which class I and II corresponds to grade II in this study. According to their classification ossification occurred in 21 per cent of the cases and only 2 per cent developed bone formations affecting the mobility.

Nollen & Slooff (1973) reported a frequency of para-articular ossifications of approximately 50 per cent in 155 patients following total hip replacement according to Müller & MacKee's technique. Only some of the patients with the largest ossifications had limitation of mobility.

Anderson & Nielsen (1972) studied the results, after arthroplasty of the hip using Moore's prosthesis, according to the various indications for surgery. They found ossifications in 41 out of 77 patients, but did not mention whether these affected the functional results.

Thomassen et al. (1974) found that disabling conditions after a Moore prosthetic replacement were caused by other diseases, and no correlation between hip function and ossifications was mentioned.

In the follow-up examination in this study we found two patients (5 per cent) with grade III ossifications that might have been responsible for a poor hip function. Otherwise the majority of the ossifications in our cases were small and seemingly without any clinical importance.

There seems to be a good correlation between the communications about frequency and clinical importance of ectopic ossifications after hip replacement and para-articular ossifications after Moore prosthetic replacement in the treatment of medial fractures of the femoral neck.

SUMMARY

This study concerns the frequency of para-articular ossifications after primary prosthetic replacement *ad modum* Austin T. Moore in the

treatment of unstable fractures of the femoral neck. In 121 patients who were X-rayed after surgery ossifications were found in 45 per cent of the cases. Patients that preoperatively had severe coxarthritis or rheumatoid arthritis are excluded. Two thirds of the bone formations described were very small and without clinical importance. About 20 per cent of the ossifications were of a considerable size, but no clinical consequences could be demonstrated. About 12 per cent of the ossifications—6 per cent of all the patients in this study—were large, and only in this group could a compromised hip function be found. It seems as the process of ossification is limited to the first 3 post-operative months.

There is a good correlation between the communications regarding ectopic bone formation after total hip replacement and the frequency found in this study.

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REFERENCES

Andersson, G. & Nielsen, J. M. (1972) Results after arthroplasty of the hip with Moore's prosthesis. *Acta orthop. scand.* **43**, 397–410.

Brooker, A. F., Bowerman, J. W., Robinson, R. A. & Riley, L. H. (1973) Ectopic ossification following total hip replacement. *J. Bone Jt Surg.* **55**-A, 1629–1632.

Charnley, J. (1972) The long-term results of low-friction arthroplasty of the hip performed as a primary intervention. *J. Bone Jt Surg.* **54**-B, 61–76.

Moore, A. T. & Lunceford, E. M. Jr. (1960) The self-locking hip prosthesis in osteoarthritis of the hip and other conditions. *Amer. J. Orthop.* **2**, 155–160.

Nollen, A. J. G. & Slooff, T. J. J. H. (1973) Para-articular ossifications after total hip replacement. *Acta orthop. scand.* **44**, 230–241.

Thomassen, H., Espersen, J. O. & Øster, A. (1974) Prosthetic replacement a.m. Austin Moore in the treatment of femoral neck fracture. *Acta orthop. scand.* (In press.)

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