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Heterotopic ossification following internal fixation or arthroplasty for displaced femoral neck fractures: a prospective randomized study

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Abstract One hundred hips in 99 patients of 75 years or older, with a displaced femoral neck fracture, were studied for heterotopic ossification (HO). The patients were randomized to either internal fixation or total hip arthroplasty (THA). In the THA group HO was found in 32 of 45 hips compared with 1 of 39 in the internal fixation group ($P<0.0012$). The frequency of HO after THA corresponds well with findings in other studies on patients receiving THA for osteoarthritis. In cervical fractures the surgical procedure of total hip replacement seems to be a prerequisite for HO, indicating that the procedure itself is more important than the patient's age and the diagnosis. Severe symptoms due to HO were found in only one patient. HO following THA for a femoral neck fracture is of little clinical importance and prophylaxis is unnecessary.

Résumé Nous avons étudié la fréquence des ossifications hétérotopiques (OH) dans 100 hanches chez 99 patients âgés de 75 ans ou plus, avec une fracture déplacée du col du fémur. Les patients ont été randomisés pour un traitement soit par fixation interne soit par arthroplastie totale de la hanche. Dans le groupe des arthroplasties on a trouvé 32/45 hanches avec des ossifications et 1/39 dans le groupe fixation interne ($P<0.0012$). La fréquence des ossifications après arthroplastie correspond à celle retrouvée dans les cas de coxarthrose. Dans les fractures cervicales la procédure de remplacement prothétique paraît être une condition préalable à la survenue d'ossifications, en indiquant que la procédure elle-même est plus importante que l'âge et le diagnostic. Des symptômes graves dus aux ossifications ont été retrouvés seulement chez un patient. Les ossifications hétérotopiques après

une prothèse totale de la hanche pour fracture du col du fémur ont peu d'importance et la prophylaxie est inutile.

Introduction

Heterotopic ossification (HO) is a common and well-documented complication following hip arthroplasty [2, 5, 8, 11]. Widely differing incidence rates have been reported, from very high (90%) after Moore arthroplasties for femoral neck fractures [15] to the low incidence of 5% after Charnley arthroplasties for osteoarthritis [6]. This variation may be due to different criteria for patient selection, different classification systems used and different follow-up periods. A high incidence (52–84%) of this complication has been confirmed in studies focused on HO, including control groups in clinical trials for the prophylactic effect of different nonsteroidal anti-inflammatory drugs (NSAID) or irradiation [1, 10, 12, 17]. To our knowledge, the rate of HO after surgery for femoral neck fractures has not been reported earlier, except for the report by Rosendahl et al., [15]. As an attempt to investigate the importance of factors such as age, diagnosis and type of surgery, we measured the incidence of HO after surgery in patients from 75 years of age, randomized to either total hip arthroplasty (THA) or osteosynthesis for femoral neck fractures. A second aim was to evaluate whether prevention of HO should be recommended for this category of patients.

Patients and methods

From September 1994 to April 1997, 100 hips in 99 patients, 75 years or older, who were admitted with displaced femoral neck fractures were randomly assigned to undergo either osteosynthesis or THA. Osteosynthesis was performed with two parallel and percutaneously inserted screws (Olmed; Olmed Medical AB, Uppsala, Sweden) after closed reduction and with the aid of two-plane fluoroscopy. Total hip arthroplasty was performed with a cemented prosthesis (Lubinus IP; Link, Hamburg, Germany), by using a dorsolateral approach. To be included in the study each patient needed to meet the following criteria: be ambulatory prior to the

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Table 1 Age and sex distribution of patients studied

Treatment	Number of hips	Age (years)	Females
Osteosynthesis	50	83.7 (75–96)	34 (68%)
Arthroplasty	50*	83.8 (75–101)	40 (80%)
Total	100	83.8	74 (74%)

*One female patient was randomized twice to THA and is presented as two hips

trauma, have no contradictions to major surgery, have no signs of known malignancy of significance and no signs of rheumatic joint disease. Mental impairment was not a criterion for exclusion. Sequentially numbered opaque envelopes were used for the randomization procedure. The local ethics committee approved the study.

Age and sex distributions of the patients are shown in Table 1. There were no significant differences between the groups. One patient was randomized twice to arthroplasty. She was fully recovered after the first operation and has been regarded in the study as two different cases. The mortality rate after 1 year was 22% (11/49) in the THA group and 30% (15/50) in the osteosynthesis group. Postoperatively, three patients in the osteosynthesis group continued their NSAID medication. No other patients were treated with NSAID. Another three patients, two in the THA group, used low-dose cortisone pre- and postoperatively due to rheumatoid polymyositis.

Radiological follow-up included standard anterior-posterior and lateral projections after 3, 12 and 24 months. All roentgenograms were studied and re-evaluated by one radiologist. HO was classified according to Brooker et al. [5].

For statistical analyses the unpaired Student's *t*-test was used for parametric data, chi-square and Fischer's exact test for non-parametric values. *P*-values less than 0.05 were considered significant.

Results

Sixteen patients, 5 in the THA and 11 in the osteosynthesis groups respectively, dropped out of the study due to death, sickness, reoperation or refusal to participate further in the study. Thus, 84 hips were roentgenologically examined at least once at a minimum of 3 months postoperatively.

HO in the THA group was found in 32 of 45 of the patients in at least one of the investigations (Table 2). Only one patient (1/39) in the osteosynthesis group developed HO ($P < 0.0012$). He had a grade I HO at 3 months, which progressed to grade II by the 1-year follow-up examination in combination with a non-union of the fracture. In the THA group, 38 were examined at 3 months, 11 of 38 of whom were found to have an aggravated form of HO at later examinations. All 10 men in the THA group developed HO compared with 22 of 35 of the women ($P < 0.02$). There was no difference in age between those who developed HO compared with those who did not.

Severe HO (grade III+IV) was seen in 4 of 45 in the THA group. The three patients with grade III HO were pain-free and had still normal ranges of motion at 2 years postoperatively. Their Harris Hip scores at 2 years were 71–85. Severe clinical symptoms in the THA group were limited to one mentally impaired pa-

Table 2 Heterotopic ossification after THA (no. of hips). Roentgenological assessment according to Brooker et al. [5] at 3 months and more than 1 year postoperatively

Grade according to Brooker	0	1	2	3	4	no information
3 months postoperatively.	12	19	5	2	0	12
>1 year postoperatively.	11	8	13	3	1	14

tient who developed complete stiffness in the hip due to grade IV HO. At follow-up, he did not seem to suffer from pain. None of the patients who were on NSAID medication developed HO, but so did one of the patients in the THA group who was on cortisone.

Discussion

One weakness in our study was the number of patients lost at follow-up, although this is to be expected in this age group. The mechanism behind HO seems to be multi-factorial. It is common in the hip region following THA and acetabular fractures but rare in other locations. In this study HO was rare when the fracture was treated with osteosynthesis but was common following THA. Although bone marrow components are seeded in the wound during THA, in contrast to closed reduction and pinning of intracapsular hip fractures, we believe our results support the idea that soft tissue trauma is a more important factor for the development of HO.

Individual predisposition is probably more important for development of severe HO after THA than surgical factors such as approach and technique [2, 9]. Associated patient factors are male sex, hypertrophic osteoarthritis and ectopic bone formation after previous surgery. Male sex and age over 60 years were shown to be special risk factors in a review of 392 Charnley cases [9] as was being a female over the age of 65 years in combination with other risk factors [3]. We found male sex to be an obvious risk factor.

In our study, the incidence of HO after THA for femoral neck fractures in patients older than 75 years (71%) was comparable to the incidence after THA for osteoarthritis in younger patients, where the average age was 70 years (74%) [18]. Those patients were operated on at the same department, using the same surgical approach and implant design. However, the rate of severe HO (grade III+IV) was around, or less than, half when compared with other studies where the incidences were 15–22% [3, 4, 12]. Our results show that the incidence does not decrease with age and also indicate that femoral neck fractures are equally important as an etiological factor as osteoarthritis and that the amount of soft tissue trauma is the main surgical factor at least for development of mild forms of HO.

The clinical symptoms of severe HO, after THA due to osteoarthritis, have been referred to as lesser gain in range of motion postoperatively [1, 2, 11]. Many patients

with osteoarthritis have a limited range of motion preoperatively, which differs from the situation in fracture patients. This may explain why all three patients in our study with grade III HO had acceptable ranges of motion.

It has been shown that irradiation and NSAID prophylaxis can prevent or reduce the amount of HO after THA [7, 10, 13, 14, 18]. The risks of NSAID-related gastrointestinal adverse events, which may even be fatal, increase with age [16]. The awareness of these side effects has grown during the last decade. Today, most clinicians would probably agree that NSAID prophylaxis should only be recommended for those who are considered to be at risk of developing severe HO [11]. Our conclusions are that HO following THA for a femoral neck fracture, despite frequent occurrence, is of little clinical importance for this category of patients and that NSAID prophylaxis can and should be restricted.

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