Ectopic ossification in hip arthroplasty
A retrospective study of predisposing factors in 637 cases

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We investigated predisposing factors for the development of heterotopic ossification in a retrospective study of 637 hip arthroplasties, of which 484 were unilateral, 62 bilateral and 29 revision operations. The frequency of heterotopic ossification after a primary hip arthroplasty was 57 percent. In a univariate analysis, men, patients with hypertrophic arthrosis, and cemented arthroplasty were all at risk of developing heterotopic ossification. After a multivariate analysis, the male sex and the cemented arthroplasty remained as significant factors.

In bilateral operations, the contralateral side developed heterotopic ossification in 82 percent when the primary hip operation had already caused ossification. There was no increase in ossifications after the contralateral operation. Half of the revision operations had an increase of heterotopic ossification from 1 to 4 Brooker classes.

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Heterotopic ossification as a complication of hip arthroplasty has been reported in between 8 and 90 percent (Lazansky 1973, Rosendahl et al. 1977). Preoperative identification of the high-risk patients would make it possible to institute prophylactic therapy. The most effective prophylaxes are radiotherapy and the use of NSAIDs, notably indomethacin and ibuprofen. Predisposing factors for the development of heterotopic ossification include overweight, male sex, previous operations on the same hip, preoperative function restrictions, degree of arthrosis, heterotopic ossification on the contralateral side and the type of prosthesis (Jowsey et al. 1977, Ritter and Vaughan 1977).

These factors have previously been examined in a relatively small number of patients. We have evaluated these factors in a larger survey.

Patients and methods
All hemi- and total hip arthroplasty operations performed in the St. Joseph Hospital in Eindhoven between 1982 and 1989, have been investigated retrospectively. Of 967 operations, 330 were excluded from the analysis, 102 due to the use of indomethacin, 158 due to inadequate radiographic data, and 70 due to death of patients during the follow-up period. Our study therefore comprised 637 hip arthroplasties, of which 484 unilateral, 62 bilateral, and 29 revision operations.

The predisposing factors were investigated in patients who had a unilateral operation or the first operation of those with bilateral involvement. The contralateral hip in the bilateral group and the revision operations were investigated separately.

The preoperative diagnoses were divided into 6 categories (Table 1). The remaining group consisted of patients suffering from Bechterew’s disease, Paget’s disease, metastases, congenital dysplasia and acetabulum fracture.

Weight, sex, age, degree of arthrosis, previous operations on the same hip, preoperative function and postoperative complications, such as blood loss, infection, the occurrence of hematoma and dislocation, were recorded. The type of prosthesis, including the approach and the use of cement, heterotopic ossification in the contralateral hip, uni- and bilateral involvement and postoperative medication, were also recorded.

The degree of arthrosis was classified according to the biological reaction of the joint (Bombelli 1983). Of the 546 primary operations, 270 were on the left and 276 on the right side. The male:female ratio was 132/414 in primary arthroplasties and in 62 bilateral operations 15/47. The average age was 71 (28-97) years. The average weight for women was 69 (35-106) kg and for men 75 (50-105) kg.

Heterotopic ossification was classified by the authors according to Brooker et al. (1973) before medical data had been collected. Both hemi- and total hip prostheses were inserted by a dorsolateral approach.
The Protek prosthesis was used in all hemi-arthroplas-
tics as well as total hip arthroplasties.

The postoperative plan followed a strict schedule, 
anticoagulants were given by means of Sintromitis and 
the patient was mobilized after the fifth postoperative 
day. All available radiographs up to 1 year postopera-
tively were used. Follow-up data were recorded 6 
weeks, 6 months, and 1 year after the operation.

The accumulated data were processed statistically 
by the Medical Statistics Department of the Catholic 
University in Nijmegen. The various parameters were 
viewed in relation to the degree of heterotopic ossifi-
cations by means of Chi-square tests and/or Kendall 
correlation coefficients. A logistic regression analysis 
was done.

**Results**

The incidence of heterotopic ossification in the group 
of 546 primary hip operations was 57 percent with 36 
percent Brooker Class I–II and 21 percent Class III–IV. 
Heterotopic ossification was detected in the 
first 6 months and increased in the Brooker classification 
during the second half of the follow-up period (P < 0.004). 

Men formed ossification in 68 percent and women in 53 percent (P = 0.002). Men were more often repre-
sented in Classes III and IV than women, 36 percent 
and 16 percent, respectively; men had more Class IV 
ossification (P < 0.001).

Weight or age did not influence the development of 
heterotopic ossification. The 62 patients suffering 
from hypertrophic arthrosis showed a correlation 
between the preoperative hip function restrictions and 
the degree of heterotopic ossification (Kendall correla-
tion -0.25, P = 0.02). The remaining preoperative diag-
noses showed no correlation with heterotopic ossifica-
tions.

Postoperatively, 27 hips dislocated, 8 became 
infect ed and in 11 cases a hematoma developed. None 
of these complications had an effect on the develop-
ment of heterotopic ossification. Blood loss during or 
after the operation also had no relation to heterotopic 
ossification. In 31 cases with previous operations on 
the ipsilateral hip, 10/17 with trochanter osteotomy 
and 7/14 with osteosynthesis developed ossification.

There was no difference between a hemi-arthro-
plasty and total hip arthroplasty with regard to the 
development of heterotopic ossification. However, the 
uncemented total hip arthroplasty developed less het-
erotopic ossification (P = 0.02, Table 2). Out of 62 
bilateral operations, 32 developed heterotopic ossifica-
tion in the index as well as the contralateral hip, 14 did 
not develop heterotopic ossification in either operation. 
In the 29 revision operations there was an 
increase in the Brooker classification in 16. The multi-
variate analysis of primary hip operations showed sig-
nificance for sex (P = 0.002), type of arthroplasty (P = 0.02) and length of follow-up (P < 0.001).

<p>| Table 1. Preoperative diagnosis and heterotopic ossification according to Brooker in primary arthroplasties |
|---------------------------------------------------------------|-------------------|-----------------|-------------------|</p>
<table>
<thead>
<tr>
<th>Diagnosis</th>
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<th>III–IV</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Hypertrophic arthrosis</td>
<td>24</td>
<td>19</td>
<td>19</td>
<td>62</td>
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<tr>
<td>Primary arthrosis</td>
<td>118</td>
<td>95</td>
<td>47</td>
<td>260</td>
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<td>Femoral neck fracture</td>
<td>77</td>
<td>58</td>
<td>39</td>
<td>174</td>
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<td>Osteonecrosis</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>6</td>
<td>8</td>
<td>1</td>
<td>15</td>
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<tr>
<td>Other diagnoses</td>
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<td>5</td>
<td>0</td>
<td>10</td>
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<tr>
<td>Total</td>
<td>238</td>
<td>194</td>
<td>114</td>
<td>546</td>
</tr>
</tbody>
</table>

<p>| Table 2. Type of prosthesis and heterotopic ossification according to Brooker in primary arthroplasties |
|---------------------------------------------------------------|-------------------|-----------------|-------------------|</p>
<table>
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<th>Prosthesis</th>
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<th>III–IV</th>
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<td>Hemiarthroplasty</td>
<td>51</td>
<td>31</td>
<td>15</td>
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<td>Cemented total arthroplasty</td>
<td>167</td>
<td>154</td>
<td>94</td>
<td>415</td>
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<tr>
<td>Uncemented total arthroplasty</td>
<td>20</td>
<td>9</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>238</td>
<td>194</td>
<td>114</td>
<td>546</td>
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<tr>
<td>Percentage</td>
<td>43</td>
<td>36</td>
<td>21</td>
<td>100</td>
</tr>
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</table>

<p>| Table 3. Brooker classification of heterotopic ossification in bilateral hip arthroplasties |
|---------------------------------------------------------------|-------------------|----------------|-------------------|</p>
<table>
<thead>
<tr>
<th>2nd hip</th>
<th>None</th>
<th>I–IV</th>
<th>Total</th>
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<tbody>
<tr>
<td>1st hip</td>
<td>14</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>I–IV</td>
<td>7</td>
<td>32</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>41</td>
<td>62</td>
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</table>
Discussion

Taking into account the large variety of percentages of heterotopic ossifications reported in the literature, our finding of 57 percent does not seem extreme (Lazansky 1973, Rosendahl et al. 1977). Earlier studies have shown that there is no indication of a correlation between heterotopic ossifications and age, weight, postoperative complications and an ipsilateral operative history or a fracture (Lazansky 1973, DeLee et al. 1976, Ritter and Vaughan 1977, Hierton et al. 1983, Pedersen et al. 1989).

Our finding that ossification occurred less often in uncemented arthroplasties should be interpreted with caution; the number of uncemented cases was rather small. The data in the literature often point in a different direction (Hartwig et al. 1989, Kjaersgaard-Andersen et al. 1990). The risks are considerably higher in those patients who have developed heterotopic ossifications after their first hip operation; the contralateral hip developed heterotopic ossifications in 82 percent, confirming DeLee et al.'s (1976). The application of prophylaxis should be useful in males and in use who have developed heterotopic ossifications after a primary operation and who have to be operated on the contralateral or ipsilateral side. Possibly a hereditary aspect is also involved (Nollen 1986).

References