Heterotopic ossification after total knee arthroplasty

54/615 cases after 1–6 years' follow-up

Christof P Rader, Thomas Barthel, Matthias Haase, Matthias Scheidler and Jochen Eulert

We found heterotopic ossifications in 54 (9%) of 615 cases after total knee arthroplasty. The largest ossifications were located in the anterior distal femur. In 12 cases smaller ossifications were found in other knee regions. The development of heterotopic ossification showed a positive correlation with hypertrophic arthrosis and a negative correlation with rheumatoid arthritis. We propose a new 3-grade classification which refers only to the anterior distal femoral region.

Grade III heterotopic ossifications occurred in 4 patients (4 knees) who had clinical symptoms; 2 were successfully reoperated with removal of the ossifications. Prophylaxis should be considered in patients with marked hypertrophic arthrosis or marked periosteal damage to the anterior distal femur.

Orthopedic Department of the University of Würzburg, 11 Brettreich St., D-97074 Würzburg, Germany
Tel +49 931-803 0. Fax -803 225
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Heterotopic ossification (HO) after total knee arthroplasty (TKA) is generally not regarded as clinically relevant and the reported incidence varies (Booth and King 1979, Lovelock et al. 1984, Figgie et al. 1986, Harwin et al. 1993).

We studied the incidence, location, size and need for treatment of HO after TKA.

Patients and methods

We evaluated retrospectively the clinical and radiographic data of 615 TKA (57 bilateral) implanted in 558 patients (438 women). The average age of the patients was 70 (48–92) years. The mean follow-up period was 28 (12–72) months.

The diagnosis was arthrosis (507 knees), rheumatoid arthritis (73 knees), medial osteonecrosis (21 knees), aseptic loosening after unicondylar medial arthroplasty (8 knees), psoriatic arthritis (4 knees) and arthrosis after chondromatosis (2 knees).

A Press Fit Condylar (PFC) TKA was implanted in 575 knees, a Microloc TKA in 40 knees (both types of prostheses from Johnson & Johnson Orthopedics, Norderstedt, Germany). With the PFC model, all patellar and tibial components were cemented. In 511 cases, the femoral component was inserted without cement. With the Microloc prostheses, 6 tibial components, 19 femoral components and 21 patellar components were uncemented, whereas all other components were cemented. A medial parapatellar approach was used.

The postoperative follow-up examinations took place after 3 months, 12 months and then annually. Clinical evaluation was based on the "knee and function score" recommended by the American Knee Society (Insall et al. 1989). The radiographic evaluation of HO was based on the comparison of preoperative and postoperative radiographs. HO was classified according to Figgie et al. (1986) and to a new classification system that we proposed (Table 1). The preoperative and the immediate postoperative radiographs were compared with those at the 3-month follow-ups and those at the latest follow-up to distinguish HO from dispersed bone particles and remains of osteophytes. The preoperative radiographs were used to evaluate osteophytes medially, laterally, anteriorly, posteriorly and patellofemorally (Goel and Sharp 1991). The presence of osteophytes was classified from 0 to 3 in each compartment. Knees with grades I–III osteophytes were classified as hypertrophic arthrosis. Apart from the basic clinical data, the use of NSAIDs, steroids and aspirin was recorded.

For statistical evaluation, the Student's t-test, F-test and the chi-square-test were used.

Results

HOs were found in 54 (9%) of the 615 TKA (Figure

Presence of HO in 615 TKA using two classification systems

	Figgie et al. (1986) cases (%)	Our classification cases (%)	
Class 0	561 (91)	561 (91)	No HO
Class I	15 (2)	41 (6)	Largest HO <5 cm^2 in lateral or ap. radiographs or HOs in other knee regions
Class II	39 (7)	9 (2)	Largest HO >5 cm^2 in lateral or ap. radiographs in extensor apparatus or near femur[a]
Class III	0 (0)	4 (1)	Largest HO >5 cm^2 at extensor apparatus and near the femur[a]

[a]Sessile on the femur. Ap.anteroposterior.

1). The largest HOs were all situated in the anterior distal femoral region (Figures 2 and 3). Smaller HOs were also found in other areas of the knee in 12 cases. 41 HOs were grade I, 9 grade II, and 4 were classified as grade III (Table).

In 18 knees (3 grade III, 4 grade II, 11 grade I), the ossification originated at the resection line of the anterior distal femur (Figure 1). After the first 3 postoperative months, no radiographic enlargement of HO was found in any case.

In HO grade III (n 4) using our classification, 2 patients had grade 3 and 2 patients grade 2 osteophytes at the patellofemoral joint. There was a correlation between hypertrophic arthrosis of grades 2 and 3 at the patellofemoral region and grade II and grade III HOs (F-test, $p = 0.04$).

There was no statistically significant difference in gender distribution (chi-square test, $p = 0.8$). With the "knee and function score", no significant difference could be found between knees with or without HO (Student's t-test, $p = 0.3$).

Only HO grade III knees, our classification, showed a decrease in the mean knee score from 37 (23–45) before primary surgery to 17 (11–28) before revision surgery or after 1 year postoperatively (Student's t-test, $p = 0.04$). 4 patients had pain and dysfunction of the extension apparatus, especially on climbing stairs. The range of motion was, on average, 70° with maximal pain in flexion 3 months postoperatively. No extension deficit was observed.

In 2 patients, the HO was removed and indomethacin, 50 mg twice daily, was successfully given to prevent the recurrence of HO for 14 days postoperatively. In the other 2 patients, surgery was not performed because of massive heart problems and a postthrombotic syndrome.

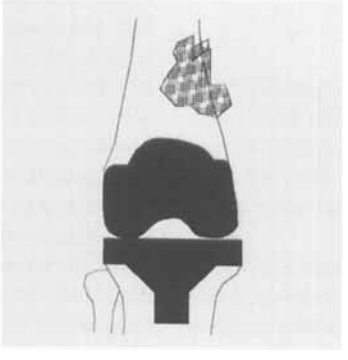
349 of 615 cases were given NSAIDs, steroids or aspirin for more than 2 days within the first 2 postoperative weeks; 25 (7%) developed HOs. 266 cases received no medication and devel-

Figure 1. Schematic picture.

HO grade I at the distal anterior femur.

Grade II.

Grade III in the extensor mechanism and close to the femur.



Grade III.

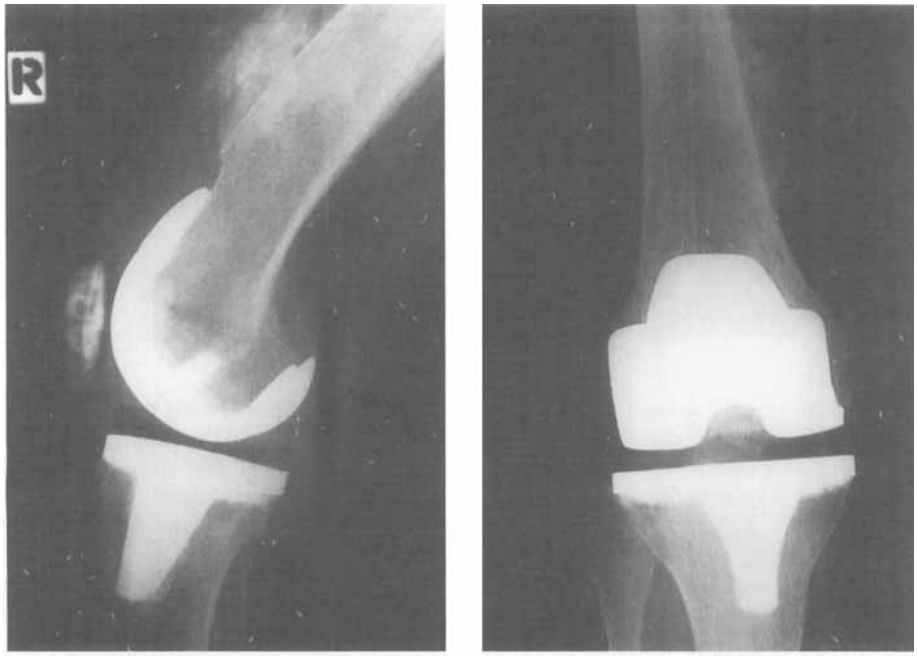


Figure 2. A 77-year-old woman with HO grade III one year after implantation. Deep resection in the cortical bone of the distal anterior femur for the femoral component.

oped HOs in 29 cases (11%). Rheumatoid arthritis was less common (chi-square test, $p = 0.00001$) in patients with HO. Only 2 of the 73 patients with rheumatoid arthritis showed grade I HOs. However, all patients with rheumatoid arthritis had taken NSAIDs or steroids within the first 2 postoperative weeks. After exclusion of the patients with rheumatoid arthritis from the 349 patients with medication, 276 patients remained. There were 52 patients with HO, 23 with medication and 29 without medication (chi-square test, $p = 0.4$). No patient with grade III ossifications took any of the above-mentioned medications. 4 of 9 patients with grade II HO took NSAIDs.

Discussion

The reported incidences of HO after primary TKA differ widely: Figgie et al. (1986) found 42%, Lovelock et al. (1984) 10%, Harwin et al. (1993) 4% and we found an HO rate of 9%. Many HOs are overlooked, since the large tibial and femoral components may obscure the ossifications.

We observed no difference in occurrence of HO in men or women. Harwin et al. (1993), however, found HOs only in women. In contrast, HO after total hip arthroplasty (THA) is distinctly commoner in men (DeLee et al. 1976, Hartig et al. 1989).

In rheumatoid arthritis, there are common features between the occurrence of HO after THA (Nollen and Slooff 1973, Ahrengart 1991) and after TKA; the patients are less likely to develop HO. One explanation may be that many of these patients take NSAIDs and steroids.

The process of ossification after THA starts immediately postoperatively and reaches a maximum after 32–48 hours (Ayers et al. 1986, 1991). Nollen and Slooff (1973) found bone formation after THA after 2 to 3 weeks in all patients who developed HO later on. We noted no evidence of increased HO after the 3-month follow-up.

The number of patients in the studies reported by Figgie et al. (1986) and Harwin et al. (1993), i.e., 115 and 158 cases retrospectively, were probably too small to reveal clinically relevant problems caused by HO. Both authors arrive at the same conclusion: "HO after TKA is a self-limited process requiring neither prophylaxis nor specific therapy." In our study, there were patients with very substantial problems caused by HO, and in whom surgery was, indeed, indicated.

A classification of HO should focus on the functional impairment of the patients correlated with radiographic data. Patients with our grade III had symptoms which indicated surgery. The definition of our HO grade III is bone formation in the quadriceps muscle and close to the femur, severely affecting the

Figure 3. A 69-year-old woman with HO grade II without symptoms two years after implantation.

extensor apparatus. Grades I and II were distinguished on the basis of HO-size and functional involvement of the extension apparatus (Table, Figure 1), yet there was no statistical difference regarding the knee and functional scores or range of motion.

There was a correlation between the occurrence of HO grades II and III in our classification and hypertrophic arthrosis (patellar joint), just like that seen after THA (DeLee et al. 1976, Blasingame et al. 1981, Goel and Sharp 1991).

According to the classification by Figgie et al. (1986), 1 patient with HO class I would have needed revision (Table 1). The classification by Figgie et al. (1986) is not oriented towards dysfunction and pain. We see no prognostic difference between classes I and II in Figgie's classification. Spur formation on the tibia, femur and the patella is not a sufficient reason for therapy. Small HOs in other regions of the knee were observed by us in only 12 of 615 TKAs in addition to the HO in the anterior, distal region of the femur. Bony ankylosis (class III according to Figgie et al. (1986)) was not seen.

A classification of Harwin et al. (1993) with 6 HOs into 5 grades refers to HO in the anterior, distal femoral regions, just like our classification. However, for grading of especially the more severe HOs, only lateral, no anterior-posterior, radiographs should be used, since HOs situated anterolaterally or medially, obscured by the femoral prosthesis or the bone, cannot be classified. 6 of our HOs could not be classified according to Harwin et al. (1993) for this particular reason.

HOs originating at the site where the anterior femoral osteotomy meets the femoral cortex (Figure 1) were an important starting point in 18 cases. One reason for the development of more severe HO may be the damage to the periosteum at this location.

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