HETEROTOPIC OSSIFICATION IN TOTAL HIP ARTHROPLASTY : THE SIGNIFICANCE FOR CLINICAL OUTCOME

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This study evaluates 706 patients with 835 primary total hip replacements documented in a prospective fashion in a multicenter study with respect to correlation between heterotopic ossification (HO) and clinical outcome. Only patients without prophylaxis against HO entered the study. The mean clinical and radiological follow-up was 3.1 years (± 0.7). Heterotopic ossification was noted in 47% of all total hips replaced. It was graded as mild (Brooker I) in 29.1%, moderate (Brooker II) in 12.7%, and severe (Brooker III and IV) in 5.2%. All clinical parameters investigated were significantly affected with the increasing amount of heterotopic ossification. The strongest correlation was found in flexion range and spreading distance. Both factors were significantly decreased with higher degrees of ossification. The other clinical parameters investigated, walking capacity, limp, and use of analgesics, were altered to a lesser extent and only with higher degrees of heterotopic bone formation. Finally, patient satisfaction was significantly influenced by the degree of heterotopic ossification and dropped from almost 90% good or excellent patient satisfaction in the nonossification group to less than 30% in the group with severe ossification.

Keywords : prosthesis, heterotopic ossification, osteoarthritis, hip, functional results.
Mots-clés : prothèse totale, hanche, arthrose, ossification hétérotopique, résultats fonctionnels.

INTRODUCTION

The incidence of heterotopic bone formation (HO) after total hip replacement (THR) ranges between 8% and 87% in the literature (3, 14, 18, 30, 31, 41, 43, 57, 58). Several authors have described the radiological findings of heterotopic bone formation (8, 10, 12, 35, 47, 55) ; Brooker *et al.* in 1973 analyzed this problem systematically and introduced a classification of the radiological changes wich has become widely accepted (6). In their study, HO influenced the functional outcome of the surgery only in cases with a complete bony bridge (Brooker stage IV). Other studies also concluded that, except for a slight reduction in range of motion, heterotopic ossification does not significantly influence the outcome of THR (12, 24, 35, 44, 48).

While effective measures to prevent heterotopic bone formation are well documented (4, 11, 13, 15, 17, 19, 20, 22, 23, 26, 28, 32, 36, 46, 54, 59), their regular use remains unusual because of reported side effects (9, 38, 59) and the uncertainty about the clinical importance of heterotopic bone formation.

We investigated the prospectively documented clinical and radiological data of 835 primary total hip replacements performed without prophylaxis for HO in three European clinics to analyze the influence of heterotopic bone formation on the clinical outcome.

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MATERIALS AND METHODS

We evaluated data on 706 patients with 835 total hip replacements performed between 1985 and 1987. Preoperative and postoperative clinical and radiological data were prospectively documented using optically readable code-sheets from consecutive primary total hip replacements performed at three European centers (40). A minimum follow-up time of 2 years was required to enter this study. Only patients without prophylaxis against heterotopic ossification were evaluated.

Clinical and radiological follow-up averaged 3.1 years (± 0.7 years). The mean patient age at surgery was 64.2 years (± 8.7 years). There were 388 females (55%) and 318 males (45%) in the cohort. The classification system used for heterotopic ossification included four categories : group A, none (Brooker stage 0), goup B, mild (Brooker stage I), group C, moderate (Brooker stage II), and group D, severe (Brooker stage III & IV) (6). The classification was determined by an orthopedic surgeon from an AP and lateral xray of the hip.

The average patient height was 169 cm (± 11 cm), and the average weight was 72.7 kg (± 14.5 kg). Two hundred sixty-seven patients (37.8%) were diagnosed with obesity and 33 (4.7%) patients had insulin-dependent diabetes mellitus. One hundred eleven hips (13.3%) had undergone previous surgery, and 19 (2.3%) had an internal fixation device after a femoral fracture. The diagnosis was primary osteoarthritis in 631 cases (75.6%), developmental dysplasia of the hip in 81 cases (9.7%), rheumatoid arthritis in 22 cases (2.6%), idiopathic avascular necrosis in 27 cases (3.2%) and post-traumatic arthritis in 38 cases (4.6%). Other diagnoses included 7 hips with ankylosing spondylitis, 2 hips with Paget's disease, 4 hips after femoral neck fracture, 6 hips with cortisone-induced femoral head necrosis, 3 hips with previous arthrodesis, 2 hips with a history of tuberculous coxitis, and 12 with other secondary arthritis.

A lateral approach to the hip was used in 512 cases (61.3%), an anterolateral approach in 121 cases (14.5%) and a posterior approach in 202 cases (24.2%). A femoral osteotomy was performed in 41 cases (4.9%) mainly in developmental dysplasia of the hip (37 cases). A trochanteric osteotomy was performed in 82 cases (9.8%). Of these 52 (6.2%) were chevrons and 30 (3.6%) were planar. The femoral component was cemented in 612 cases (73.2%), and the acetabular component was cemented in 687 cases (82.3%). Operative time for a single primary THR was less than 90 minutes in 515 cases (61.7%), 90 minutes to 135 minutes in 187 cases (22.4%), 135 minutes to three hours in 122 cases (14.6%), and greater than three hours in 11 cases (1.3%). The difficulty of the procedure was graded by the surgeon with 282 easy (33.8%), 325 standard (38.9%), 121 difficult (14.5%), and 107 very difficult (12.8%). Postoperatively 87 hips developed hematomas ; of these 41 were graded as superficial.and 46 as deep.

To determine the effect of HO on the outcome of primary THR, the following clinical parameters were defined and documented : pain was reported by the patient as none, mild, moderate, or severe ; the presence of a limp without a walking aid was graded as absent, slight, moderate, or severe ; walking capacity without support was documented as less than 10 minutes, 10 to 30 minutes, 31 to 60 minutes, or greater than 60 minutes. The use of analgesics was reported as none, occasional, or regular ; flexion capacity of the hip was graded as less than 30°, 31° to 70°, 71° to 90°, and greater than 90° ; similarly, abduction was measured using the intermalleolar spreading distance as less than 30 cm, 31 to 60 cm, 61 to 80cm, and more than 80 cm ; finally the patients rated the final outcome of the THR as poor, moderate, good, or excellent.

Data were stored and analyzed using the Qualicare™ computer software (Qualidoc AG, Trimbach, Switzerland), a fully automated patient outcome analysis package. The Chi-square test of independence (significance level : p-value < 0.05) was used to evaluate dependence in categorical and grouped numerical data.

RESULTS

Following primary THR 47.0% of patients showed HO and were placed in grade I (29.1%), grade II (12.7%), and in grade III and IV (5.2%) according to the classification of Brooker (fig. 1).

In evaluating clinical outcome the presence of heterotopic ossification was noted to affect all of the documented parameters (Chi-square : pain : 0.0001, walking capacity : 0.033, flexion : 0.0001, spreading : 0.0001, analgesics : 0.0048, limp : 0.0335, patient evaluation : 0.0001) (table I). Flexion capacity and intermalleolar spreading distance showed already in group B a significant difference compared to group A (table I, fig. 2, 3). Pain, walking capacity, use of analgetics and patients evaluation were significantly influenced starting in group C ossifications (table I, fig. 4, 5, 6, 7 respectively) and limp did not become significantly affected until group D (table I, fig. 8).

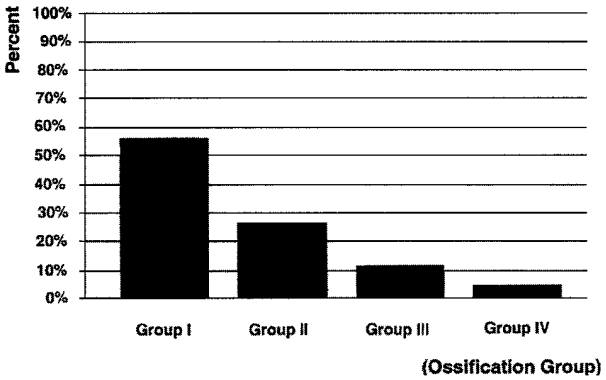
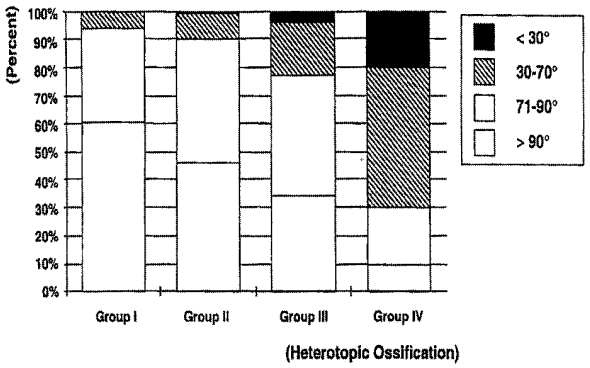


Fig. 1.



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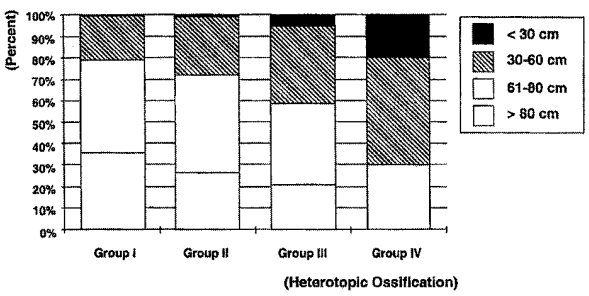
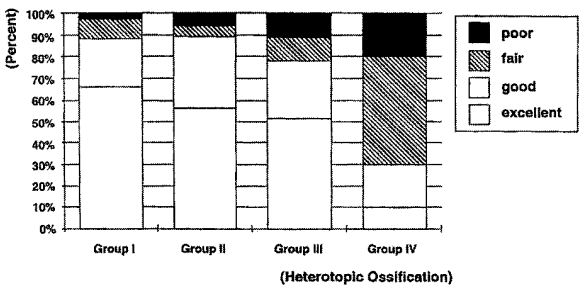


Fig. 3.



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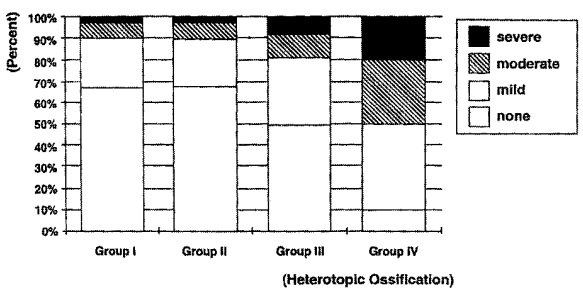

Fig. 5.

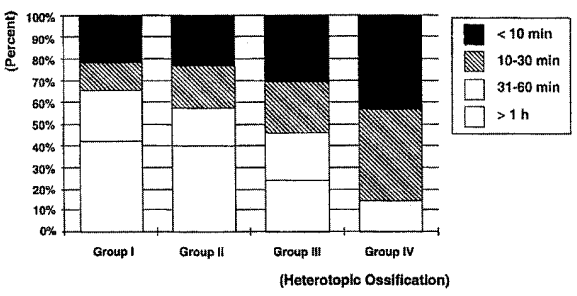

Fig. 6.

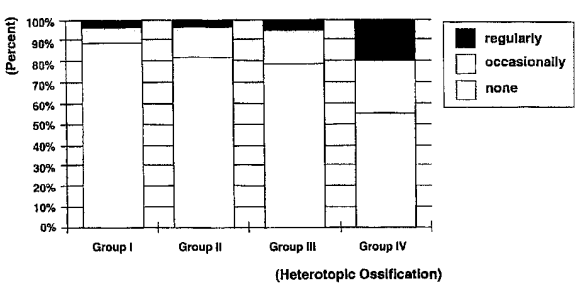

Fig. 7.

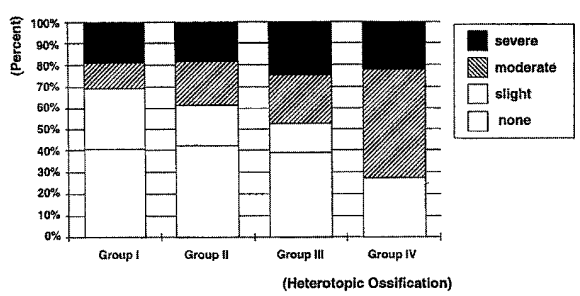

Fig. 8.

Table I

	group I vs II	group I vs III	group I vs IV
flexion capacity	0.0073	0.0001	0.0001
spreading distance	0.0290	0.0017	0.0001
patients evaluation	0.0820	0.0120	0.0001
pain	0.7254	0.0220	0.0001
walking capacity	0.3720	0.0433	0.0330
analgetics	0.1430	0.0488	0.0048
limp	0.6831	0.1023	0.0335

DISCUSSION

There are endogenous and exogenous factors which affect the prevalence of heterotopic bone formation (2, 18, 33, 41, 52, 56, 57). The reported incidence of heterotopic ossification may vary due to interobserver variability in interpreting the radiograph, to different radiographic projections, inconsistent follow-up times, and patient selection (3, 18, 35, 41, 43, 45, 57) ; but all authors agree that HO after total hip replacement is a frequent complication. In this study the incidence of HO was 47% after 3.1 years follow-up time with 17.9% rated as Brooker grade II or higher ; however there is only limited information published about the clinical significance of HO.

Brooker *et al.* (6) noted no effect of HO on the Harris hip score unless there was bony ankylosis. Ahrengart and Lindgren (2) found that hips with HO have decreased mobility and weaker abductor force but increased muscle force in flexion and extension. Soballe *et al.* (51) reported a significant decrease of flexion capacity in patients with marked HO, and Morrey *et al.* (39) found motion to be most affected by HO after the lateral approach.

In our study the presence of HO had a negative impact on all prospectively documented outcome parameters. We found a highly significant correlation between the grade of ossification and postoperative flexion capacity and intermalleolar spreading distance (fig. 2, 3). Both of these factors already became significant in Brooker grade I ossifications compared to the group without heterotopic ossification and continued to worsen as the degree of HO increased.

Ritter and Vaughan (48), Ahrengart (1, 3), and Kroman *et al.* (34) documented no direct correlation between heterotopic bone formation and hip pain. In contrast our data showed that patients with mild or severe pain increased from Brooker grade 0 to grade III and IV ossifications from less than 10% to more than 50% (fig. 5).

Also the remaining factors like walking capacity, use of analgesics, and limp were affected, but to a lesser extent or only at higher degrees of heterotopic bone formation (table I). Walking capacity and the use of analgesics became statistically significant by grade II and deteriorated further in grade III and IV (fig. 6, 7). There was no study in the literature analyzing these factors in correlation to HO with wich to compare our results. Concerning the limp tendency after THR with HO, Ahrengart and Lindgren (2) reported no significant influence. We also found no significant correlation between HO and limp in grade I and II, but patients with a grade III and IV all showed a Duchenne's limp with over 70% rated as moderate or severe (fig. 8).

Finally patient satisfaction was highly significantly influenced by the degree of heterotopic ossification and dropped from almost 90% good or excellent patient satisfaction in grade 0 to less than 30% of similar evaluation in grade III and IV. Interestingly, there was already a significant difference in the rating between the patients in grade 0 and II (table I, figure 4).

This study demonstrates that heterotopic ossification has a striking impact on the clinical outcome in total hip replacement. We recommend routine screening to use radiotherapy (15, 20-23, 29, 49, 54) or drugs (4, 7, 9, 13, 17, 25-27, 32, 37, 46, 53) as preventive measures in patients at risk to develop heterotopic ossification (1, 3, 33, 41, 42, 45, 50, 57).

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SAMENVATTING

S. EGGLI, J. RODRIGUEZ, R. GANZ. Heterotope ossificatie na totale heupprothese: de betekenis voor de klinische outcome

Deze studie evalueert 706 patiënten met 835 primaire heupprothesen prospectief gedocumenteerd in een multicenterstudie om de correlatie tussen heterotope ossificatie (HO) en klinisch resultaat. Enkel patiënten zonder profylaxie werden in de studie opgenomen. De gemiddelde klinische en radiologische follow-up was 3,1 jaar (± 0.7) In 47% werd een HO vastgesteld In 29.1% was het licht (Brooker I), matig (Brooker II) in 12.7% en ernstig in 5.2% (Brooker III en IV). Alle onderzochte kliniche parameters waren significant gecorreleerd met

de toename van de HO, vnl heupflexie en uitbreiding van de HO. De andere parameters zoals wandelafstand, manken en gebruik van analgetica waren ook gecorreleerd maar in mindere mate. Uiteindelijk was ook de patiënt satisfaction significant beïnvloed met de graad van HO : van 90% goed en uitstekende in de groep zonder HO tot minder dan 30% in de groep met ernstig HO.

RÉSUMÉ

S. EGGLI, J. RODRIGUEZ, R. GANZ. Ossifications hétérotopiques après prothèse totale de hanche : Influence sur le résultat clinique.

Ce travail rapporte l'évaluation de 706 patients qui ont subi au total 835 arthroplasties primaires par prothèse totale, étudiées de façon prospective dans le cadre d'une étude multicentrique pour rechercher d'éventuelles corrélations entre les ossifications hétérotopiques et le résultat clinique. Les patients étudiés n'avaient reçu aucun traitement préventif contre les ossifications. Le suivi clinique et radiologique a été en moyenne de 3,1 ans (± 0,7). Des ossifications hétérotopiques ont été notées dans 57% des hanches opérées. Elles ont été classées comme discrètes (Brooker I) dans 29,1% des cas, modérées (Brooker II) dans 12,7% et majeures (Brooker III et IV) dans 5,2%. Tous les paramètres cliniques étudiés étaient affectés de façon significative à mesure que les ossifications hétérotopiques prenaient de l'importance. La corrélation la plus forte a été notée avec l'amplitude de flexion et l'écart intermalléolaire en abduction : leurs valeurs étaient réduites de façon significatives en présence d'ossifications importantes. Les autres variables cliniques étudiées, périmètre de marche, boiterie, recours aux analgésiques, étaient affectées à un moindre degré et seulement en présence d'ossifications très importantes. Enfin, le degré de satisfaction du patient était influencé de façon significative par l'importance des ossifications hétérotopiques : dans le groupe sans ossification, il y avait près de 90% de résultats subjectifs bons ou excellents, et ce chiffre tombait à moins de 30% dans le groupe avec ossifications importantes.