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A new classification for heterotopic ossifications in total hip arthroplasty considering the surgical approach

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Abstract We would like to introduce a new classification for heterotopic ossifications (HO) after total hip arthroplasty which also considers ossifications within the region of the surgical approach. Furthermore, we will point out the influence of the surgical approach on the rate of HO. We analyzed 75 cementless hip arthroplasties with consecutive HO in a prospective study. The operations were performed by three experienced orthopaedic surgeons using an identical stem and a standardized lateral approach. All patients followed an identical rehabilitation procedure. Clinical and radiological data were documented in a standardized way. We found a total of 40 HO. Only 24 could be exactly classified by the known methods. Our classification considers 3 regions and 4 grades and is relevant for all 40 HO. Electrocauterisation to dissect the muscles in the lateral approach reduced the rate of HO: overall 64.3% to 39.4%; clinically relevant ossifications were reduced to 3.0% from 16.7%. Our new classification considers all HO concerned with total hip arthroplasty, especially those localized in the intertrochanteric region. The rate of HO can be reduced by using electrocauterisation for muscle dissection in the lateral approach.

Introduction

The total rate of heterotopic ossifications (HO) after total hip arthroplasty (THA) ranges from 3% to 90% [1, 16, 20]. Especially in investigations focussed on the problem of HO, the rate is mostly above 60% [1, 16, 19]. The rate of clinically relevant HO with limitation of motion is also disappointing: 8.6% [13] to 22% [1].

Many different scoring methods have been introduced for the classification of HO: the BROOKER classification is commonly employed [5] (Table 1) as are several others [2, 7, 14]. They all analyse HO in the surrounding of the femoral neck without special regard to detailed localisation and are classified from the roentgenographic anteroposterior (AP) view. Recently, interest has increasingly focussed on the localisation. Kjaersgaard-Andersen et al. [10] differentiate a central and a lateral HO with regard to an imaginary borderline from the greater trochanter to the lateral edge of the acetabulum. DeFlitch and Stryker [6]

Table 1 Brooker classification

Score	Specification
Class 1	Islands of bone within the soft tissues about the hip
Class 2	Bone spurs from the pelvis or proximal end of the femur, leaving at least (1 cm) between opposing bone surfaces
Class 3	Bone spurs from the pelvis or proximal end of the femur, reducing the space between the opposing bone surfaces to less than 1 cm
Class 4	Apparent bone ankylosis of the hip

Table 2 New classification

Score	Specification
0	No heterotopic ossifications on anteroposterior (AP) and standard lateral view of the hip
Region	
I	Heterotopic ossifications strictly below the tip of the greater trochanter
II	Heterotopic ossifications below and above the tip of the greater trochanter
III	Heterotopic ossifications strictly above the tip of the greater trochanter
Grade	
A	single or multiple heterotopic ossifications smaller than 10 mm maximal extent without contact to pelvis or femur
B	Heterotopic ossifications larger than 10 mm without contact to the pelvis but possibly to the femur. No bridging from caudal to proximal from the greater trochanter
C	Heterotopic ossifications with bridging from the femur to the proximal part of the greater trochanter with no evidence of ankylosis
D	Ankylosis by means of firm bridging from the femur to the pelvis

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Fig. 1 a, b Heterotopic ossification (HO) (class IIA) not visible on the AP but on the lateral view. The imaginary line perpendicular to the neck of the prosthesis is marked

Fig. 2 Lateral view: HO only below the level of the tip of the greater trochanter. No HO in the area surrounding the neck (class IB)

Fig. 3 a, b HO with incomplete bridging from below the greater trochanter to the femoral neck (class IIC)

Fig. 4 a, b HO in the area surrounding the neck (class IIIB)

divide the space around the femoral neck into thirds (central, lateral and medial) referring to the Evarts modification of the Brooker Score [15].

At present, medication with non-steroidal anti-rheumatics, especially indomethacin [1, 2, 10, 12, 13, 20] or local radiation therapy [2, 3, 13, 18] is recommended in order to prevent HO. Medication has the disadvantage of systemical side-effects, and radiation is costly both in time and effort, and the patient has the additional problem of transport.

Attention has been paid to the surgical procedure itself as an influencing factor in recent years. Long operations, traumatic procedures and haematoma increase the rate and grade of HO [1, 13, 18, 19]. Horwitz et al. [9] found different ossification rates when employing a lateral approach (45%) and the Charnley osteotomy (20%).

With the aim to reduce HO and to facilitate postoperative rehabilitation after THA, we introduced a new lateral approach [4] in our clinic in 1992. Surprisingly, we found most HO in a particular localisation ventral of the intertrochanteric region. This contrasts with the results of other investigations [1]. We discovered that these ossifications are often only visible in a lateral view and not in the standard AP view, and that the common scoring methods neglect this localisation of HO completely.

Herein, we would like to introduce a new classification which is relevant to all HO concerned with total hip arthroplasty, especially HO within the area of the surgical approach (Table 2). For this classification, we separated

the region above the greater trochanter from the region below by an imaginary line through the tip of the greater trochanter perpendicular to the neck of the prosthesis (Fig. 1). The classification is simple and consists of three regions (I, II, III) and four grades (A–D). Thus, eight different types of HO are theoretically possible (Figs. 1–4). In this paper we intend to demonstrate the utility of our classification on the basis of a prospective study. This classification also provides evidence concerning the success of a simple method for reducing HO.

Materials and methods

At the Orthopaedic Clinic and Polyclinic of the University of Cologne we started a prospective study of THA in July 1992 [17]. All patients were 60 years old or younger with idiopathic or secondary coxarthrosis, rheumatoid arthritis, femoral head necrosis, pseudarthrosis or fracture of the femoral neck. They were able to use walking aids adequately. They were provided with the cementless CENOS hollow stem (ARTOS) and the Mecring threaded acetabular cup (Johnson & Johnson). No other kind of cementless hip prosthesis was used except for computer-designed stems for anatomically altered femurs. Only three experienced orthopaedic surgeons performed all the operations and used a standardized lateral approach. The rehabilitation programme was identical in each case. The patients' clinical and radiological data were collected upon discharge and 3, 6, 12 and 24 months postoperatively in a routine fashion.

For this investigation we analysed 81 consecutively implanted CENOS hollow stems with a postoperative check-up period of at least 6 months. One patient died and 5 missed the postoperative check-ups. The investigation is therefore based on the results of 75 hips.

Due to the specific localisation of HO, we modified the surgical procedure after 1 year. In the first 42 cases we separated the ventral muscles from the intertrochanteric region with a scalpel or rasp. In the following 33 we employed electrocauterisation, leaving the periosteum unharmed.

We did not carry out any standardized prophylaxis with indomethacin or other recommended non-steroidal anti-inflammatory drug (NSAR) for prophylaxis of HO. In 26 cases we prescribed diclofenac for 7–14 days. Four patients with HO of the contralateral side received radiotherapy.

Table 3 Brooker classification of study hips ($n = 75$)

	n
Class 1	19 (25.3%)
Class 2	5 (6.7%)
Class 3	0 (0.0%)
Class 4	0 (0.0%)

Table 4 New classification of study hips ($n = 75$)

Region		Grade		Classification	
0	35 (46.7%)	0	35 (46.7%)	0	35 (46.7%)
I	16 (21.3%)	A	3 (4.0%)	IA	0 (0.0%)
				IB	16 (21.3%)
II	20 (26.7%)	B	28 (37.3%)	IIA	1 (1.3%)
				IIB	10 (13.3%)
III	4 (5.3%)	C	9 (12.0%)	IIC	9 (12.0%)
				IIIA	2 (2.7%)
		D	0 (0.0%)	IIIB	2 (2.7%)
				D	0 (0.0%)

Results

We found a total of 40 HO. Only 4 of them were located strictly above the tip of the greater trochanter; 16 were strictly below the tip, and 20 spread out from below the tip of the greater trochanter to the top.

The classification of the 24 hips with ossifications in the surrounding area of the femoral neck according to Brooker is given in Table 3. Our new classification encompassing all 40 ossifications is given in Table 4.

The influence of the muscle dissection with or without cauterisation is shown in Table 5.

Discussion

With the available so far scoring methods only 4 of our HO can be adequately classified, and an additional 20 can be classified when neglecting ossifications within the area surrounding the intertrochanteric region (Table 3). Therefore, it appears useful to define a score which classifies all HO related to the lateral Bauer approach (Table 4), which is very similar to the Hardinge and McFarland approach [8, 11] used in Anglo-American countries.

Referring to the Brooker classification, the rate of HO is comparatively low (32%). All HO were classified in the clinically irrelevant classes 1 and 2 [1, 13]. This result is satisfactory.

Table 5 Heterotopic ossification in relation to electrocauterisation (EC)

Brooker classification									
	n	0		1		2		3	4
Without EC	42	25 (59.5%)		12 (28.6%)		5 (11.9%)		0 (0.0%)	0 (0.0%)
With EC	33	26 (78.8%)		7 (21.2%)		0 (0.0%)		0 (0.0%)	0 (0.0%)
New classification – region									
	n	0		I		II		III	
Without EC	42	15 (35.7%)		10 (23.8%)		15 (35.7%)		2 (4.8%)	
With EC	33	20 (60.6%)		6 (18.2%)		5 (15.2%)		2 (6.1%)	
New classification – grade									
n	0	A		B		C		D	
Without EC	42	15 (35.7%)		1 (2.4%)		18 (42.9%)		8 (19.0%)	0 (0.0%)
With EC	33	20 (60.6%)		2 (6.1%)		10 (30.3%)		1 (3.0%)	0 (0.0%)

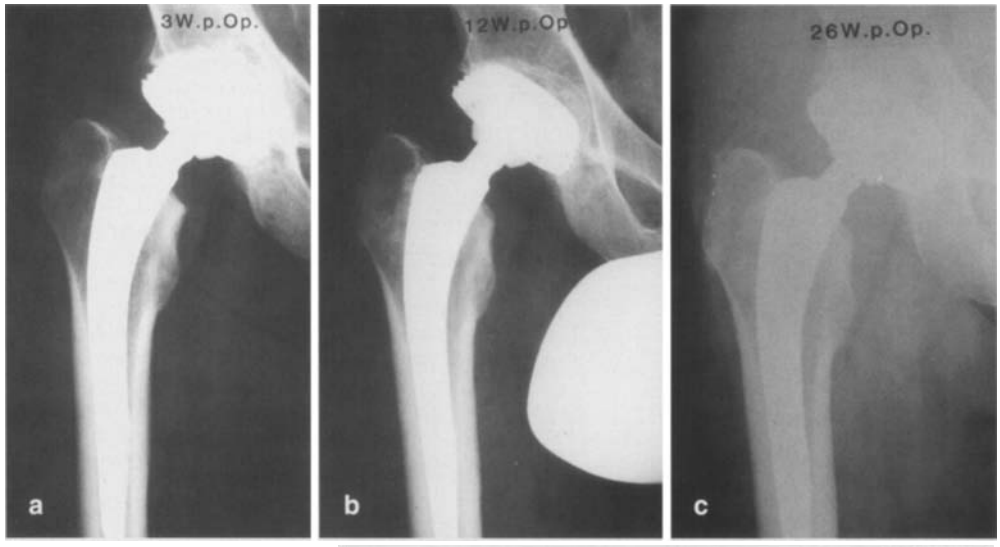


Fig. 5 a–f Development of HO starting in the intertrochanteric region (finally class IIB)

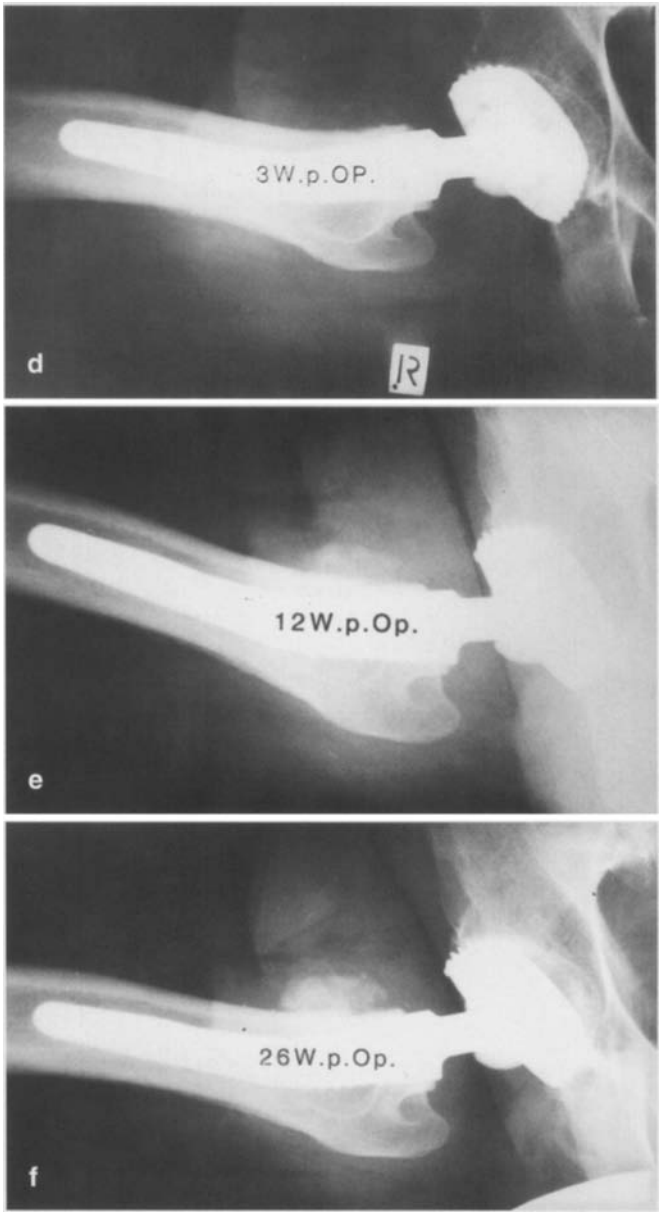
A further reduction of this rate could be achieved by the simple use of electrocauterisation for the muscle separation, which fell to 21% in class 1 and 0% in classes 2–4 (Table 5). This result is comparable to that of radiation therapy with rates of 21%–38% [3]. Only Seegenschmidt et al. [18] found a rate of 8.5% ossification after radiation.

The new classification shows the actual rate of ossification at over 50% (Table 4). In fact, 16 are located exclusively in the intertrochanteric region, which is clinically irrelevant, and an additional 3 are grade A with ossifications smaller than 10 mm. Thus, 21 HO (28%) are of possible clinical relevance. Furthermore, this rate can be reduced by electrocauterisation to a satisfying 21% located in the possibly clinically relevant regions II and III.

Due to the fact that only 4 HO are exclusively located in the area surrounding the femoral neck, we can assume that in most cases the ossification starts within the area of the surgical approach. This is also visible in the radiological check-up up to 6 months (Fig. 5). In our opinion, we must therefore use a classification which considers the overall rate of HO including the intertrochanteric region, especially when testing methods to reduce HO.

Our investigation shows that the use of electrocauterisation is a very simple but effective method to reduce ossification in the area of the surgical approach (regions I and II, reduction from 59.5% to 33.4%; Table 5). The overall rate of HO is reduced by this simple method from 64.3% to 39.4%. The clinically relevant HO (grades C and D) are reduced from 16.7% to 3%. No further significant reduction of HO can be achieved by using Diclofenac.

In conclusion, in our opinion a new classification for hterotopic ossification (HO) after total hip arthroplasty (THA) is mandatory, as otherwise the intertrochanteric region, where most of the HO are located, is neglected when using the lateral approach. This region is probably not important for the clinical outcome after THA, but it initiates HO which can spread to the area surrounding the femoral neck and lead to limitation of hip function. Based on this new classification we can prove the positive effect of



muscle separation in the intertrochanteric region by using electrocauterisation.

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