

## Original Article

# Endoprosthesis in paraplegics with periarticular ossification of the hip

SWJ Becker<sup>\*1</sup>, K Röhl<sup>1</sup> and F Weidt<sup>1</sup>

<sup>1</sup>Centre for Spinal Injuries, BG Trauma Centre, Halle Saale, Germany

**Study design:** Clinical study.

**Objectives:** To evaluate indications of hip endoprosthesis in periarticular ossifications.

**Setting:** A Spinal Cord Injury Centre in Germany.

**Methods:** Clinical examination, X-ray control.

**Results:** Surgery of periarticular ossification (paraosteoarthropathy, POA) either involves simple resection of the ossification or removal of the hip. The latter has an impact on the sitting posture with concomitant increased pressure sore risk. Nevertheless the hip is biomechanically important in paraplegics. We are investigating the outcome of total hip replacement (THR) in patients with ankylosis due to periarticular ossification. Six hip replacement cases seen in follow-up of up to 24 months showed no loosening, with good mobility of the joint. We follow a strict perioperative POA prophylaxis, which resulted in each case reporting only a slight recurrence (Brooker 1–2) without any loss of functional mobility.

**Conclusion:** In ankylotic hips with mobility/social/hygenic problems we favour a hip replacement in cases with osteoarthritis or high risk of osteoporotic fracture. A replacement of the joint should be preferred to a Girdlestone operation.

*Spinal Cord* (2003) 41, 29–33. doi:10.1038/sj.sc.3101387

**Keywords:** periarticular ossification; hip endoprosthesis; joint replacement; spinal cord injury

## Introduction

Paraosteoarthropathy (POA) is one of the most mysterious and disabling complications after para- or tetraplegia. The fact that its origin is still not entirely known is reflected by the different synonyms of this disease: periarticular ossification, myositis circumscripta, neuroarthropathy, paraarticular osteoma, ankylosing pelvospondylitis and neurogenfibromyopathy. However, the clinical course is uniform; once the ossification is complete, the result is a total ankylosis of the joint. This reduces the capability of ambulation significantly.<sup>1</sup> In the case of ossification of the lower extremities, the patient runs an increased risk of pressure sores and UTI because of hygienic difficulties/catheterisation problems.<sup>2,3</sup>

### Material and methods

We performed a clinical study of paraplegic patients with POA, to observe the outcome of hip preserving and replacing operative procedures. The patients were evaluated pre- and postoperatively at 6 month intervals with X-rays and clinical examination, including passive ROM (range of motion (see Table 1)).

In joint preserving procedures, we removed the POA via an anterior or lateral incision. In joint replacing procedures, we removed the POA and implanted a cemented total hip prosthesis with a semi captive cup. The preoperative choice of hip preserving and removing procedures is based upon the mobility of the joint, hence in cases with a mobility >50° flexion we generally try to preserve the joint.

### Surgical technique

All of the treated cases showed a severe (grade 4 POA after Brooker) of the hip (see Table 1). The localisation of the POA was on the anterior, lateral and posterior aspect of the joint. We therefore performed a double-incision technique, with the patient in a supine position. The anterior incision was used to identify the vessel/nerve bundle and to dissect the POA along the rectus femoris muscle. After completion of the anterior resection, a standard lateral approach with muscle identifying technique (partial resection of medial gluteal muscle, identifying and deinsertion of minimal gluteal muscle) was performed followed by POA resection and standard THR implantation. The operation was completed with separate reinsertion of the minimal and medial gluteal muscles. In order to avoid recurrence to POA we treated all cases with a

\*Correspondence: SWJ Becker, Centre for Spinal Injuries, Berufsgenossenschaftliche Kliniken Bergmannstrost Merseburger Str. 165, D-06112 Halle/Saale, Germany

**Table 1** Patients and outcome

Age (years)/ Sex	ASIA	Time of operation after primary injury (months)	POA pre-op	POA at follow-up	ROM flexion pre-op	ROM flexion at follow-up	Follow-up (months)
23, male	C	6	4	2	<10°	90°	24
57, male	B	26	4	1–2	60°	100°	12
52, male	D	26	4	1	<10°	80°	12
52, male	D	27	4	1	<10°	80°	12
23, male	B	14	4	1	<10°	100°	6
41, male	B	12	4	1	<10°	80°	6

preoperative radiation of 6 Gray and a postoperative 6 weeks course of NSAIDs (indomethacin).

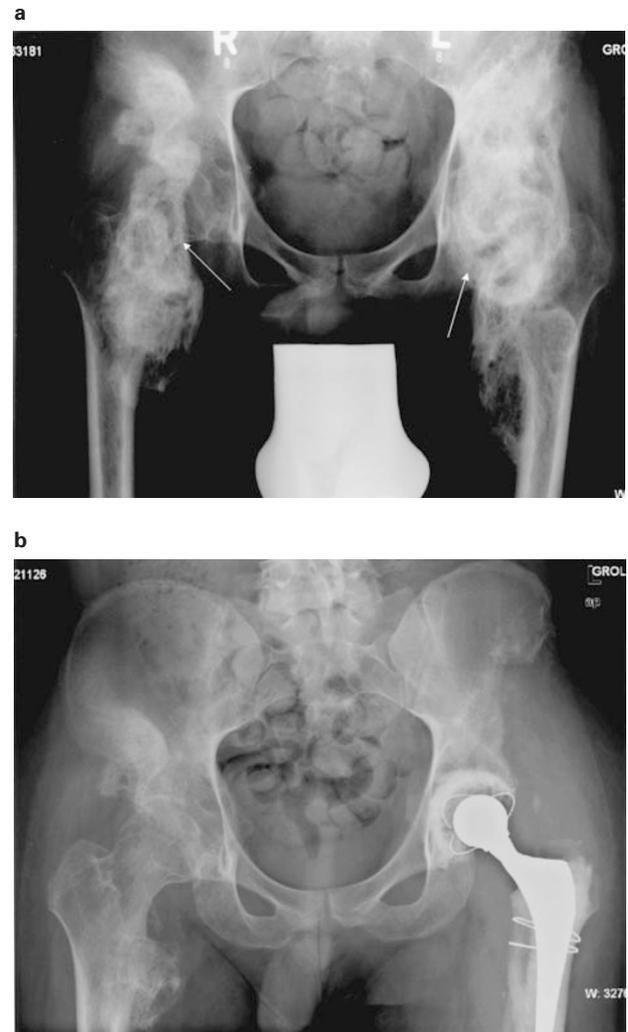
## Results

Between 1998 and 2000 we treated 144 patients with acute para- or tetraplegia. Out of these, 19 patients showed a POA of the hip. No cases received POA prophylaxis after the injury. Twelve cases were effectively treated with physiotherapy due to a POA < grade II after Brooker.<sup>4</sup> In those cases an operative procedure was avoided. However, seven patients did not respond to physiotherapy and developed a complete joint ankylosis with a grade 4 ossification after Brooker within 6 months of the injury. All of the patients were paraplegics. A simple resection of the POA was performed in two cases. Two patients showed bilateral ossification; in one of those cases we performed a simple excision of the POA on one side and implanted a prosthesis on the contralateral side (see Figure 1a,b). Overall we implanted an ipsilateral prosthesis in four cases, and a bilateral prosthesis in one case (see Figure 2a,b). All patients received the perioperative prophylaxis as mentioned above. The mean age of the THR group was 39.4 years (23–57 years) of the POA group 38 J. Interestingly all patients were male.

The follow-up period was 6–24 months, the results of the THR group are shown in Table 1. The ROM of the hip joint was satisfactory in all cases, without gross deterioration at follow-up. Both patients with simple POA resection showed 90° flexion at follow-up (12 and 24 months). In the case with bilateral ossification and unilateral prosthesis the ROM of the prosthetic joint (100°) was slightly better than that of the preserved joint (90°) on follow-up. Both groups showed no difference in the recurrence of POA, and in no cases, caused a loss of mobility. No post-op infections occurred, no prosthetic loosening was seen on follow-up. All cases reported a full mobilisation in a wheelchair, without hygienic problems or pressure sores and were furthermore able to be mobilised in a standing frame.

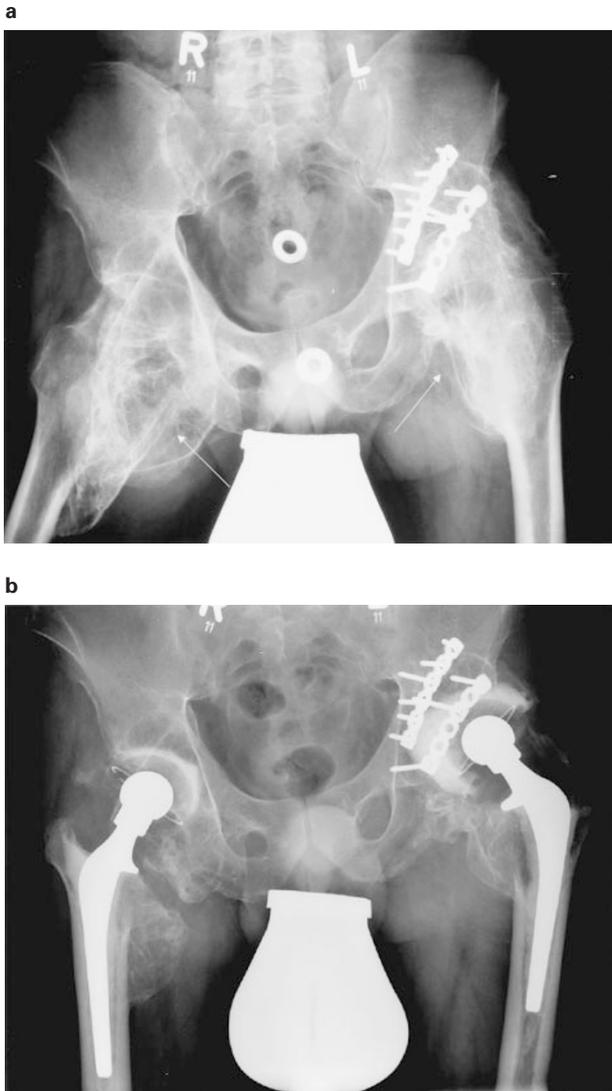
## Discussion

Periarticular ossifications in paraplegics occur most often in the hip joint.<sup>5</sup> Severe (grade 4) ossification of



**Figure 1** (a) Male, 23 years, paraplegia ASIA B, bilateral POA grade 4 after Brooker (arrows), pre-operation. (b) Same patient after resection right hip, THR left hip X-ray, 6 months after THR

the hip is fortunately a rare finding,<sup>6</sup> as is also shown in our study, but nevertheless has an important influence on the rehabilitation of a paraplegic patient. The hip is typically fixed in external rotation and slight flexion. The degree of the flexion might vary, leaving the patient sometimes unable to use a wheel-



**Figure 2** (a) Male, 52 years, paraplegia ASIA D, left side acetabular fracture, but bilateral POA grade 4 after Brooker (arrows). (b) Same patient after bilateral THR, X-ray 1 year after operation

chair. However, multiple studies have shown that impaired ROM of the hip causes a disturbed sitting posture and therefore an increased risk of pressure sores.<sup>1-3</sup> Therefore it is important to mobilise the joint to increase ROM, so the main goal should be the mobilisation of the hip. This treatment regime is not restricted to the hip alone, all joints profit from either soft tissue release or resection of the ossification. To reach this goal, joint replacements of other joints may be helpful and necessary.

In our study (see Table 1), five out of six cases showed a flexion ROM of less than 10° and no rotation or ab/adduction capacity, as such those patients did have a total ankylotic joint (see Figure 2a,b). The surgical treatment of POA can be restricted to removal of the POA and prophylactic measures.

But one has to consider that ankylosis and ossification are always enhancing local osteoporosis because the fixed joint most often does not allow normal wheelchair or standing frame mobilisation. Thus, the local osteoporosis is considerably increased. This may lead to severe osteoporosis of the head of femur, which may not tolerate weight bearing once the 'protective' ossification is removed. On the other hand, a local excision may damage the blood supply to the head of the femur. To avoid the osteonecrosis, it is therefore advisable to dissect the tissue carefully and locate the circumflex femoral vessels. As described by Rossier,<sup>6</sup> the POA is always extraarticular, but may be attached to the capsule of the hip. Therefore it may be difficult to preserve the capsule of the hip joint. It may also be difficult to define the border of the POA, resulting in an occasional injury to the neck of the femur with consecutive increased fracture risk. Sometimes the preoperative X-rays give a clue about the osteoporosis of the head of the femur. If in any doubt, the hip joint can be explored surgically and the degree of the osteoporosis assessed intraoperatively. In cases in which we decided intraoperatively on the implantation of a prosthesis, the head turned out to be totally osteoporotic with severe subchondral osteolysis and preservation of just the outer surface of the head. This situation can be compared to a balloon filled with liquid surrounded by a thin outer surface. Regarding the two incision technique, the general lateral approach does not affect any muscle which may later be needed to cover a pressure sore. The incision is carefully chosen so it will not split or damage the tensor fasciae latae muscle. Should a defect of the greater trochanter develop later on, this muscle can still be used. Also the lateral vastus muscle is spared and can be used later on. The anterior incision may damage the rectus anterior, however, this muscle is in general not used for flap procedures.

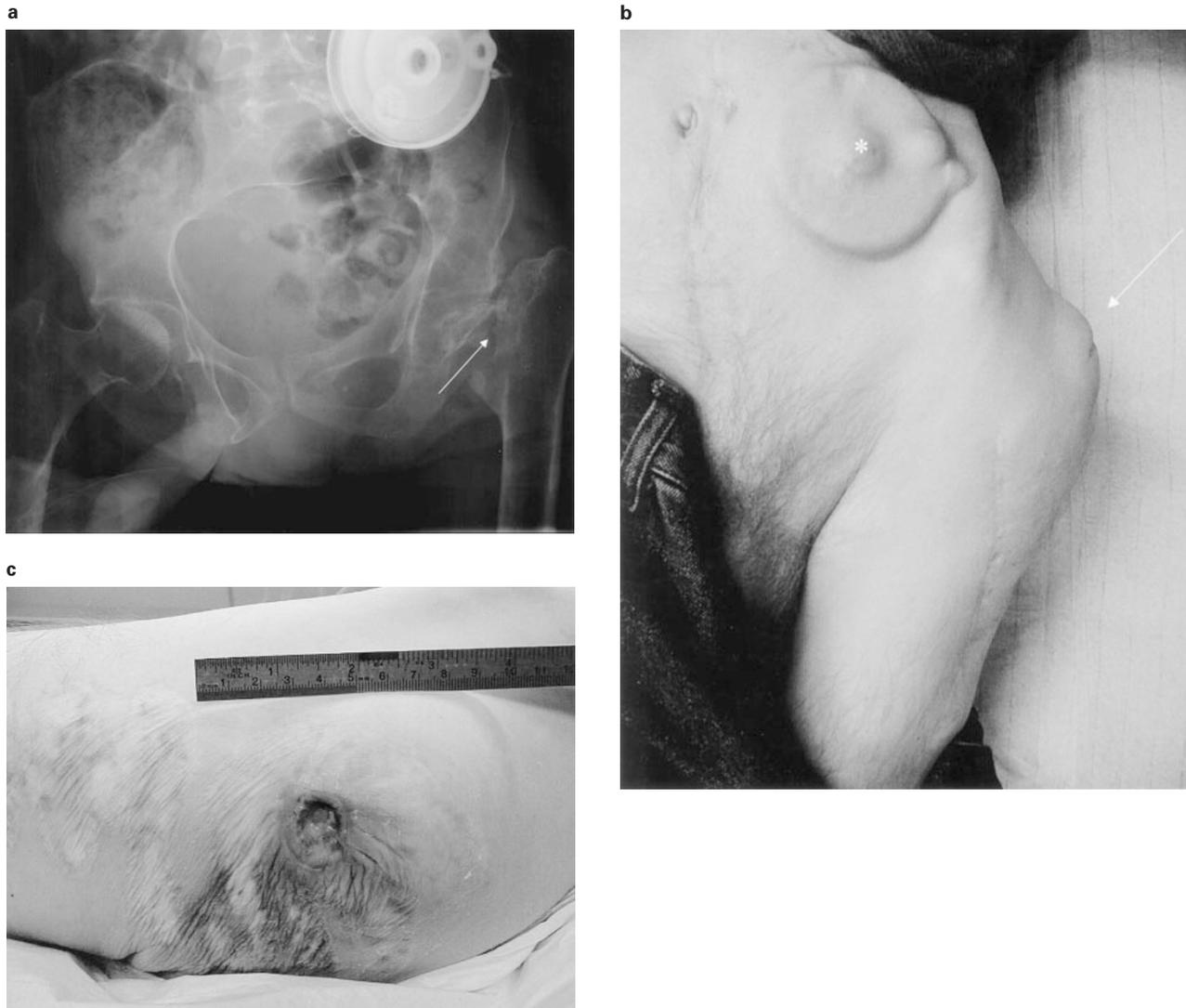
*So why should we not perform a simple resection of the joint without implantation of a prosthesis?*

First of all, we have to consider the muscle forces around the hip. If a para- or tetraplegic patient is suffering from spasticity, the muscle forces are dislocating the femur cranially and dorsally, as seen typically in dysplastic hips.<sup>7</sup> Furthermore, the muscle forces of the adductors will cause an adduction, and as a consequence, the patient will develop local pressure points, either laterally over the greater trochanter, or dorsally. Further differences of a hip resection between a walking and a paraplegic patient have to be considered. In a Girdlestone situation on a walking person, the major aim of the physiotherapy treatment is to centralise the femur whilst preserving a range of motion, so that the femur is creating a neoarthrosis with the acetabular roof. In cases with femoral neck fracture, a centralisation does not occur, because the necrotic fragment will impair a centralisation of the femur. In those cases either a THR or an excision of

this fragment may be performed. The postoperative physiotherapy is supported by external braces to centralise the femur. In a wheelchair bound patient these braces cannot be applied. The sitting posture in the wheelchair, with both legs in adduction, is dislocating the femur laterally, resulting again in pressure sores. This condition can be compared to neglected femoral neck fractures with consecutive dislocation of the femoral head (see Figure 3a–c). The hip prosthesis is centralising the joint whilst allowing an optimal range of motion. Because we use a semi-captive cup, the risk of dislocation may be reduced. Our limited patient number is of course not sufficient to provide hard data, and this approach has to be validated in several years whether to be superior to THR without semi-captive cups. Nevertheless we recommend to strictly follow the postoperative treat-

ment rules of a THR, avoiding rotational and adduction manoeuvres until the sixth postoperative week.

Intraoperative blood loss is a minor concern in our opinion, if we compare our results between simple removal of the POA and removal+implantation of a THR. Blood loss of course occurs during simple POA resection, an average of 2100 mls have been described.<sup>3</sup> We are routinely using a cell-saver during the operation. In our study, the blood loss in cases with a POA resection was on average 3000 mls with 700 mls retransfused, in cases with a THR 3375 mls with 770 mls retransfused. Postoperative blood loss is mainly due to the large open spongiose bone areas caused by the removal of the POA. In a cemented total hip, the additional open spongiose surface of the femoral shaft and the acetabulum is closed with



**Figure 3** Male, 41 years, paraplegia ASIA A. (a) Fractured neck of femur (arrow) and dislocation of the left hip. (b) Note adduction of leg and protrusion of proximal femur laterally in supine position (arrow), baclofen pump (\*). (c) Recurrent pressure sores grade 5b (Daniel/Seiler) left hip

cement and is not the reason for an increased postoperative blood loss. The only major difference is the operation time, which is longer in cases with combined POA resection and THR (220 min compared to 180 min in cases with simple resection).

All of our patients profited from the intervention. The patients with simple resection showed a good postoperative ROM, which can be compared to a long-term study showing good results after POA resection regarding sitting posture and ROM.<sup>2,8</sup> We cannot compare our results in the prosthetic group, because so far no studies about the outcome of primary THR after POA in paraplegics have been published. Several studies focused on THR in patients with cerebral palsy<sup>9,10</sup> and showed a dislocation risk of 10–26%, loosening risk of 5–20% and risk of POA recurrence of 53–58%. However, semi captive cups were not used in those studies, so we should expect improved dislocation rates in our series. In our group, no loosening was seen after a still limited follow-up. We expect loosening rates to be higher than in a non-constrained prosthesis in walking patients, but we do not think a higher loosening rate should dominate the decision on a total hip replacement in paraplegic patients. However, even if a long-term study eventually shows a higher loosening risk, either a revision can be performed or the prosthesis can be explanted, leaving the patient in the same situation as after primary hip resection, but having so far profited from the benefits of a good sitting posture and lower pressure sore risk.

We furthermore recommend a perioperative POA prophylaxis. The benefit of indomethacin and single-dose radiotherapy is widely known,<sup>11</sup> recently both therapies also have proven to be of benefit in prophylaxis of paraplegic patients.<sup>12,13</sup> A pre-operative radiation should be performed on the same day as the operation. This precaution is reducing the bleeding complications because of a reactive vasodilatation 8 h after radiation. It is therefore advisable to perform the operation well before this time limit. In our study all cases showed a recurrence of POA grade 1 or 2 after Brooker, however this recurrence did not change the functional outcome. This can be compared to the above named studies, which showed a high recurrence risk, but no significant impact on the ROM. The radiation is performed anteriorly so as to avoid skin necrosis either laterally or dorsally with a consecutive risk of pressure sores as described by Speed.<sup>3</sup>

Until now we still lack an optimal prophylaxis to avoid POA after trauma. Therefore the surgical treatment remains necessary but challenging. Although

each case has to be assessed individually, we feel that an aggressive treatment with THR is indicated, even in young patients (see Figure 1a,b), in order to avoid the consequences of a Girdlestone situation. Even a Girdlestone situation might be reversed to a prosthesis, but once a pressure sore has invaded the joint and caused infection, the treatment options regarding implantation of a prosthesis are very limited.

In conclusion we recommend the use of a total hip replacement, as a well established method in orthopaedics, in para- or quadriplegic patients to avoid further complications and loss of independence.

## References

- 1 Röhl K, Weidt F, Becker S. Behandlungsstrategien heterotoper Ossifikationen der oberen Extremitäten bei Rückenmarkverletzten. *Trauma Berufskrankh* 2000; **2**: 358–363.
- 2 Subbarao JV, Garrison SJ. Heterotopic Ossification: Diagnosis and management, current concept and controversies. *J Spinal Cord Med* 1999; **22**: 273–281.
- 3 Speed J. Heterotopic Ossification. *eMedicine Journal*, 2001, Volume 2, Number 6.
- 4 Brooker AF et al. Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg Am* 1973; **55**: 1629–1632.
- 5 Gerner HJ. *Die Querschnittlähmung*. Berlin: Blackwell Wissenschaft, 1992; p 113ff.
- 6 Rossier AB et al. Current facts of para-osteo-arthropathy (POA). *Paraplegia* 1973; **11**: 38–78.
- 7 Becker S et al. Biomechanical aspects in femoral osteotomies for hip dysplasia in adults. *J Bone Joint Surg Br* 1998; **80** (Suppl): B1–B9.
- 8 Meiners T, Abel R, Bohm V, Gerner HJ. Resection of heterotopic ossification of the hip in spinal cord injured patients. *Spinal Cord* 1997; **35**: 443–445.
- 9 Root L, Goss JR, Mendes J. The treatment of the painful hip in cerebral palsy by total hip replacement of hip arthrodesis. *J Bone Joint Surg Am* 1986; **68**: 590–598.
- 10 Buly RL et al. Total hip arthroplasty in cerebral palsy. Long-term follow-up results. *Clin Orthop* 1993; **296**: 148–153.
- 11 Hofmann et al. General short-term indomethacin prophylaxis to prevent heterotopic ossification in total hip arthroplasty. *Orthopedics* 1999; **22**: 207–211.
- 12 Banovac K, Williams J, Patrick L, Haniff Y. Prevention of heterotopic ossification after spinal cord injury with indomethacin. *Spinal Cord* 2001; **39**: 370–374.
- 13 Sautter-Bihl ML, Hultenschmidt B, Liebermeister E, Nanassy A. Fractionated and single-dose radiotherapy for heterotopic bone formation in patients with spinal cord injury. A phase-I/II study. *Strahlenther Onkol* 2001; **177**: 200–205.