Arch Orthop Trauma Surg (1994) 113:260–264

ORIGINAL ARTICLE

J. D. Rompe · P. Eysel · C. Hopf · J. Heine

Metastatic instability at the proximal end of the femur

Comparison of endoprosthetic replacement and plate osteosynthesis

Received: 20 November 1993

Abstract A retrospective study was performed of the surgical treatment of metastatic lesions of the proximal femur in 50 patients. In 25 consecutive cases a megaprosthesis was implanted; compound plate osteosynthesis was performed in another 25 consecutive patients. Indications for surgical treatment were pathological fractures or, for prophylactic treatment, lesions of the femoral cortex exceeding 2.5 cm in diameter or affecting half the diameter of the bone or more. In all patients capable of walking preoperatively mobility was regained. Immediate full weight-bearing stability was obtained in all patients. Group analysis showed that the functional rating of the hip joint was unchanged, i.e., good or excellent, in all patients with compound osteosynthesis, compared to only 68% in the endoprosthesis group. Pain relief was excellent or good in 84% and 88% respectively. Dislocation of the tumor prosthesis occurred in 3 patients. Closed reduction was possible in 2 cases. Local recurrence was higher in the patients undergoing plate osteosynthesis, as was the frequency of tumor-related implant failure. Postoperative survival averaged 14.7 months and 12.1 months respectively.

Introduction

When metastatic disease of the skeleton is detected the prognosis is generally fatal. Nevertheless, advances in cancer chemotherapy and radiotherapy have led to an increased life expectancy, making reconstructive procedures necessary in more and more patients, particularly when spine [21] and femur [21, 29] are involved.

In regard to the proximal part of the femur, considerable progress has been made in achieving secure fixation of the unstable region either by compound osteosynthesis with methylmethacrylate or by replacement with a stable megaprosthesis [25]. With these techniques, most patients can expect pain relief and resumption of their preoperative level of activity and ambulation.

We report on 50 consecutive patients with metastatic lesions of the proximal femoral region treated by prosthetic replacement or plate osteosynthesis, discussing the advantages and shortcomings of the two methods.

Patients and methods

The study was of 50 consecutive patients with metastasis-induced instability of the proximal third of the femur treated since 1987 either with implantation of a tumor prosthesis (group I) or with plate osteosynthesis (group II). To achieve two patient groups as homogenous as possible, patients with tumors other than of the breast and kidney were excluded from the study. Mean follow-up was 18.1 and 15.8 months respectively. The mean age was 54.7 (range 31–77) years in group I (4 men, 21 women) and 57.1 (range 38–78) years in group II (7 men, 18 women). Breast cancer predominated in both groups (20 and 16 cases respectively).

The majority of the patients in group I had intertrochanteric lesions, compared to the mostly subtrochanteric lesions in the second group. Seventeen patients (9 in group I and 8 in group II) presented with a pathological fracture of the proximal femur.

The preoperative evaluation included assessment of the overall state of the metastatic disease, life expectancy, pain, and function of the hip joint. Surgical indications were pathological fractures or, for prophylactic treatment, lesions of the femoral cortex exceeding 2.5 cm in diameter or affecting half the diameter of the bone or more. With regard to the Mirels [18] rating system, all patients selected for prophylactic stabilization had a score above 7 points. Failure of pain relief by ancillary radiation treatment was another reason for operative intervention.

Preoperative diagnostic imaging was confined to plain X-rays when a fracture had occurred, but bone scintigraphy was performed additionally in the other patients. Conventional or computed tomography were rarely performed mainly to look for destruction of the cortex and to pinpoint concealed fracture lines when there was no displacement of the fragments.

In group I pathological instability was treated by extralesional resection of the metastatic lesion (16 cases) with implantation of a long-stem prosthesis (Fig. 1) or by intralesional resection with prosthesis implantation (9 cases) when a pathological fracture had occurred; and by intralesional tumor exstirpation, mostly by curettage, followed by compound plate osteosynthesis in group II (Fig. 2).

J. D. Rompe (✉) · P. Eysel · C. Hopf · J. Heine
Department of Orthopedics,
Johannes Gutenberg-University Hospital,
Langenbeckstrasse 1, D-55131 Mainz, Germany

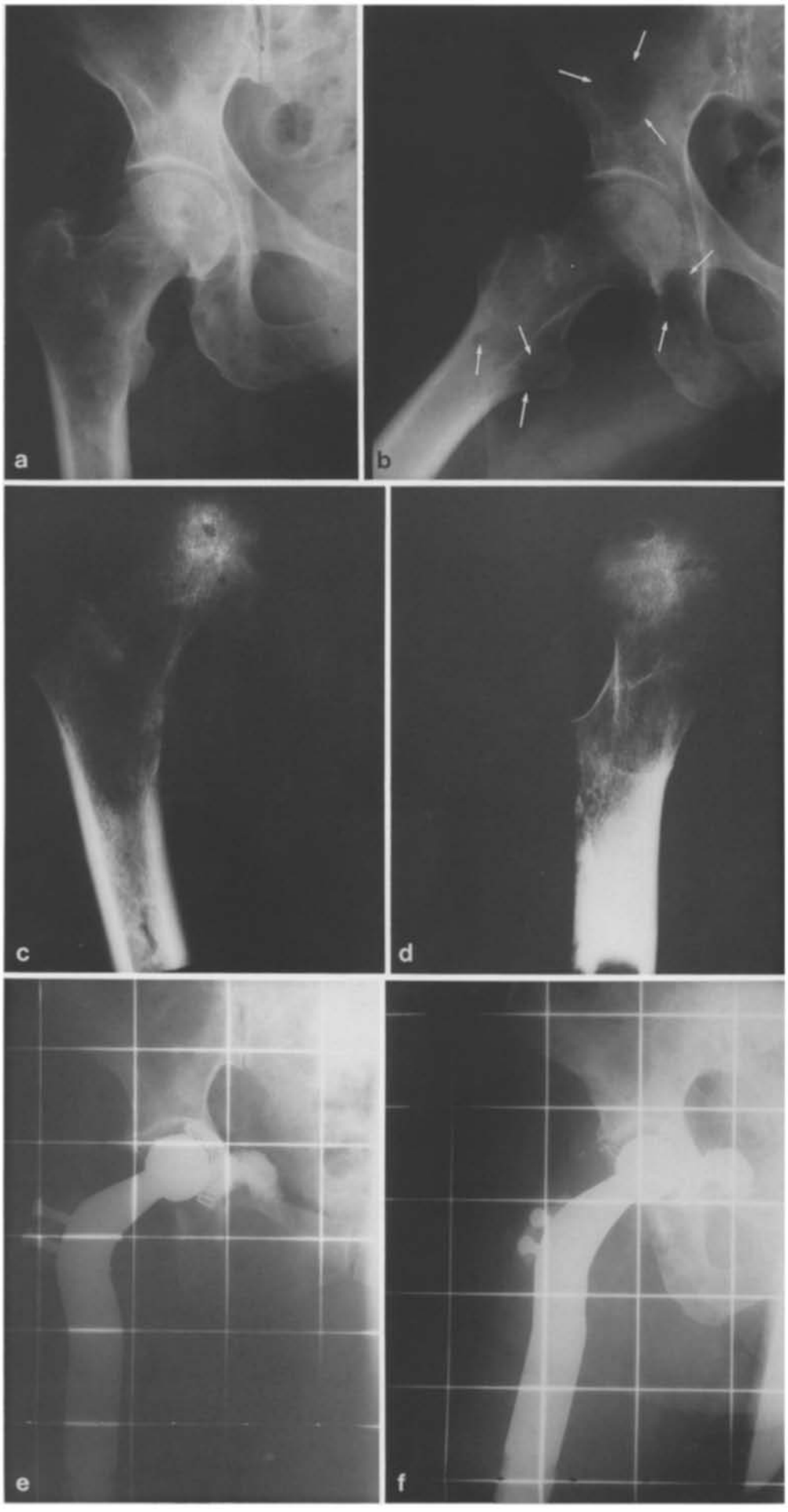

Fig. 1 a–f A 43-year-old woman suffering from breast cancer. **a, b** Peritrochanteric metastatic lesions of the right femur. **c, d** X-rays of the resected femur. **e, f** X-rays of the implanted tumor prosthesis. Postoperative radiotherapy was administered to the pelvic region

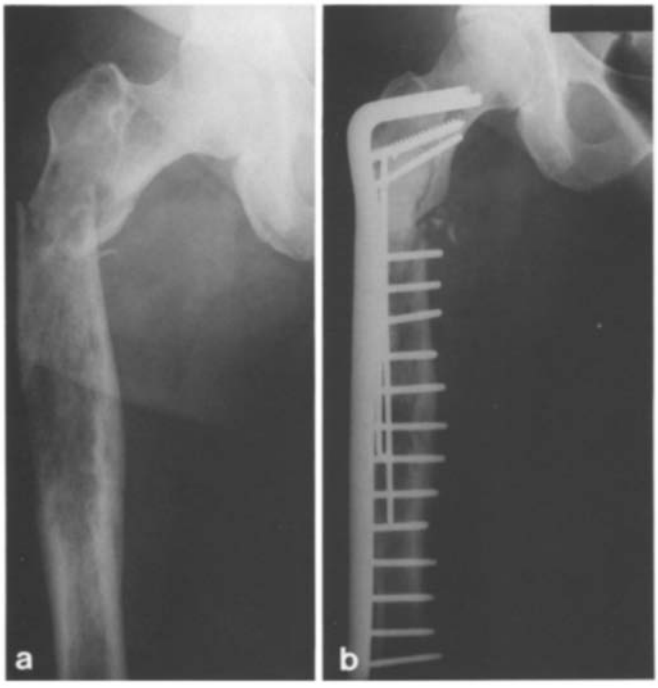

Fig. 2 **a** A 56-year-old patient with a pathological fracture of her proximal femur. **b** Reduction of the dislocated fragments with compound osteosynthesis (plate, K wires, polymethylmethacrylate). Postoperatively the primary malignancy was identified as hypernephroma

In the patients in whom resection of the trochanteric region was found necessary, an adjustable Müller tumor prosthesis (Protek) was implanted. The muscles inserting at the major trochanter, preserved with or without a bone shelf, were screwed onto the tumor stem.

Ancillary oncologic treatment, i.e., chemotherapy and/or radiation therapy, was regarded as unavoidable after the palliative operations and was carried out in all intralesionally operated patients.

Statistical analysis was performed with Student's test, the Wilcoxon test, and Fisher's exact test.

Results

The mean operating time amounted to 149 min (range 110–180 min) in the prosthesis group (group I), and the mean perioperative blood loss was 1.7 l (range 0.9–4.2 l). The corresponding values in group II were 105 min (range 80–150 min) ($P < 0.01$) and 1.7 l (range 0.9–3.6 l).

Postoperative survival time averaged 14.7 months (range 1–48) and 12.1 months (range 1–30), with 4 patients in each group still alive. Sixty percent and 40%, respectively, were alive at 1 year after surgery, and 12% versus 4% at 2 years.

Pain relief was rated according to Enneking [2] 3 months postoperatively. Excellent results were achieved in 3 cases (12%) in group I and 5 cases (20%) in group II, and good results in 12 patients (60%) in each group. Seven patients (28%) in group I and 5 (20%) in group II had a fair outcome. Three patients (12%) in each group had a poor outcome.

Range of motion was also evaluated according to the Enneking [2] classification, meaning measurement of active motion of the hip joint in all planes, the rating being the sum of these movements. Three months postoperatively, excellent results were gained in 20% and good results in 68% of the prosthesis group, while fair results were observed in 12%. No Trendelenburg sign was observed in 5, a compensated in 12 and compensated with a cane in 8 patients. Compared to these results, function was better in the patients who had undergone compound osteosynthesis, with excellent results in 48% ($P < 0.05$) and good results in 52%. Three patients had a compensated Trendelenburg sign.

Local recurrence of tumor, detected either by plain X-rays, tomography, or scintigraphy, was observed in 3 of 16 patients (18.8%) treated extralesionally and in 4 of 9 patients (44.4%) treated intralesionally with a prosthesis. In patients in group II the recurrence rate was 48%. Of the extralesionally operated patients non required reoperation, to maintain the stability of the implanted constructs, compared to 3 of the intralesionally treated patients.

Complications were frequent in the postoperative period. The most serious events encountered were two cases of small pulmonary embolism, both of which were successfully managed with immediate administration of high-dose heparin. In two patients in each treatment group deep vein thrombosis of the lower leg occurred. Wound healing was protracted in three cases in group I and two in group II, making a revision operation necessary in one patient of each group. There was one case of intraoperative fracture of the femoral shaft in the prosthesis group.

Displacement of the prosthesis was observed in three cases. An average of 5 (range 1–8) weeks had passed since the operation. The reason was a – forbidden – uncontrolled hip flexion of more than 60° in all cases. Closed reduction succeeded in two cases; one patient had to be reoperated on.

Discussion

Metastatic bone disease need not necessarily be regarded as terminal [22]. The benefits of early fixation of pathological long-bone instability are therefore unquestioned [5, 31]. Various procedures have been recommended depending on the location of the fracture and the extent of bone destruction. For the hip region, the failure of pathological fractures to unite, the short life expectancy of the patients, and the compromise of the stability of a fixation due to the weakened bone often make prosthetic replacement a more sensible choice than PMMA-augmented osteosynthesis [12, 21, 29]. However, for cases where subtrochanteric instability predominates, plate osteosynthesis or intramedullary nailing are well established techniques [1, 5–8, 14].

Pain relief is the main goal of palliative surgery of the proximal femur and can be achieved in the vast majority of patients [1, 6, 13, 15]. Our data support these reports,

making pain radiation therapy a second choice as it produces a decrease in mechanical properties for weeks [26].

A sufficient restoration of hip function may be reached by all procedures [25] if the bone proximal and distal to the zone of instability is of sufficiently good quality to hold the device [4]. Methods of evaluation of functional outcome differ considerably, but ability to walk is a common criterion and achieved in 60%–100% [1, 9, 16, 19, 28]. We adopted the guidelines of Enneking [2], focusing on the active range of motion in all planes. Good and excellent results were observed in all patients with a plate osteosynthesis, compared to 88% of those with an implanted prosthesis. Focusing on excellent results only, plate osteosynthesis granted 50% excellent results, compared to only 20% after total hip replacement ($P < 0.05$).

Resection of the proximal femur and replacement by a tumor prosthesis implies refixation of the detached pelvitrochanterian muscles, in order to maintain their important functions for locomotion and stabilization against limping. According to Schreiber et al. [23], providing a stable linkage between the muscle groups that form a continuous sleeve around the femoral shaft is of higher value for functional outcome than stable fixation of the pelvitrochanterian muscles to the prosthesis itself. This is of special interest in regard to the prevention of displacement of the artificial hip joint, a complication reported in up to 30% of patients [11, 24, 32]. To impede posterior dislocation, the acetabular component is implanted in a strictly neutral position in our patients. Additionally, we advocate positioning the leg in internal rotation for the duration of hospitalization. Flexion exceeding 60° is prohibited for 3 months after the operation, meaning that a wedge-shaped seating aid is required in the sitting position.

Notwithstanding these precautions, we were confronted with three displacements, two of which were reducible without surgical intervention. On the other hand, there was no implant failure in the prosthesis group, whereas three plate osteosyntheses cut through due to progressive metastatic loss of bone stock, i.e., local recurrence of tumor. This problem has been described earlier [9, 17, 27, 30], with failure rates as high as 23% in proximal femoral lesions fixed with a compression screw or nail plate [31]. Load-sharing devices such as a Zickel nail or double plate osteosynthesis [3] are more durable methods of fixation, and Karachalios et al. [10] reported no implant failure with locked reconstruction rods. In our department intramedullary splintage is generally rejected for fear of disseminating tumor cells to more distal parts of the femur, as was demonstrated by Marsden et al. [17].

Survival time is more dependent on the histological type of the primary tumor than on the surgical procedure. With regard to pathological fractures of the proximal femur, survival rates vary between 5.6 months [13] and 14.5 months [15]. Our own results were within this range, revealing no significant prolongation of survival time after an extralesional procedure.

Conclusion

The benefits of early surgical treatment of pathological fractures of the proximal end of the femur are striking. Restoration of hip function together with pain relief can be achieved in the majority of patients. Prosthetic replacement offers the possibility of extralesional resection of the infiltrated bony region, allowing full weight-bearing during the immediately postoperative mobilization of the patient, at the expense, however, of the range of motion and of the risk of displacement. In cases of subtrochanteric lesions preservation of the hip joint was possible by performing compound plate osteosynthesis. Despite the fairly limited extent of tumor removal, with a corresponding rate of local tumor recurrence and implant failure, life expectancy was not shown to be significantly shorter than after extralesional procedures. Thus, intralesional, hip-preserving surgery with internal fixation devices should be performed whenever possible in patients with metastatic instability of the proximal third of the femur.

Acknowledgement Statistical analysis was performed by Prof. G. Hommel of the Institute of Medical Statistics, Johannes Gutenberg University, Mainz.

References

1. Broos PLO, Rommens PM, Vanlangenaker MJU (1992) Pathological fractures of the femur: improvement of quality of life after surgical treatment. Arch Orthop Trauma Surg 111:73–77
2. Enneking WF (1987) Limb salvage in musculoskeletal oncology. Churchill Livingstone, New York, pp 5–16
3. Friedl W (1992) Chirurgische Therapie von Skelettmetastasen und pathologischen Frakturen der unteren Extremität. In: Ewerbeck V, Friedl W (eds) Chirurgische Therapie von Skelettmetastasen. Springer, Berlin Heidelberg New York, pp 171–189
4. Galasko CSB (1974) Pathological fractures secondary to metastatic cancer. J R Coll Surg Edinb 19:351–362
5. Ganz R, Isler B, Mast J (1984) Internal fixation technique in pathological fractures of the extremities. Arch Orthop Trauma Surg 103:73–80
6. Habermann ET, Sachs R, Stern RE, Hirsch DM, Anderson WJ (1982) The pathology and treatment of metastatic disease of the femur. Clin Orthop 169:70–82
7. Harrington KD (1982) New trends in the management of lower extremity metastases. Clin Orthop 169:54–61
8. Isler B (1990) Chirurgische Maßnahmen bei metastatischen Läsionen des Extremitäten- und des Beckenskelettes. Unfallchirurg 93:449–456
9. Joyce MJ, Makley JT, Sauer J (1991) Pitfalls in the management of metastatic disease of the femur. In: Langlais F, Tomeno B (eds) Limb salvage. Springer, Berlin Heidelberg New York, pp 701–709
10. Karachalios T, Atkins RM, Sarangi PP, Crichlow TPKR, Solomon L (1993) Reconstruction nailing for pathological subtrochanteric fractures with coexisting femoral shaft metastases. J Bone Joint Surg [Br] 75-B:119–122
11. Knahr K, Kotz R, Plattner E, Salzer M (1979) Endoprothesenimplantation nach Resektion maligner Extremitätengeschwülste. Z Orthop 117:967–973
12. Krebs H (1978) Management of pathologic fractures of long bones in malignant disease. Arch Orthop Trauma Surg 92:133–137

13. Lane JM, Sculco TP, Zolan S (1980) Treatment of pathological fractures of the hip by endoprosthetic replacement. J Bone Joint Surg [Am] 62-A: 954–959
14. Levine AM, Russell TA, Taylor JC, LaVelle DG, Bosse MJ (1989) Treatment of metastatic lesions of the femur with locked intramedullary rod fixation. Proceedings of 56th Meeting of the American Academy of Orthopaedic Surgeons, Las Vegas, p 124
15. Levy RN, Sherry HS, Siffert RS (1982) Surgical management of metastatic disease of bone at the hip. Clin Orthop 169: 62–69
16. Lewis MM, Chekofsky KM (1982) Proximal femur replacement for neoplastic disease. Clin Orthop 171: 72–79
17. Marsden FW, Hale DG, Sullivan JA, Findlay MPM (1991) Treatment of metastatic disease involving the proximal femur and hip joint. In: Langlais F, Tomeno B (eds) Limb salvage. Springer, Berlin Heidelberg New York, pp 689–696
18. Mirels H (1989) Metastatic disease in long bones. Clin Orthop 249: 256–264
19. Poigenfürst J, Marcove RC, Miller TC (1968) Surgical treatment of fractures through metastases in the proximal femur. J Bone Joint Surg [Br] 60-B: 743–756
20. Rompe JD, Eysel P, Hopf C, Heine J (1993) Decompression/stabilization of the metastatic spine. Cotrel-Dubousset instrumentation in 50 patients. Acta Orthop Scand 64: 3–8
21. Rompe JD, Eysel P, Hopf C, Heine J, Schaub T (1993) Der Einsatz der Tumorprothese bei sekundär-neoplastischer Destruktion des proximalen Femurendes. Z Orthop 131: 446–451
22. Santori FS, Ghera S, Manili M, Vitullo A, Erriquez A (1991) Surgical treatment of bone metastases. In: Langlais F, Tomeno B (eds) Limb salvage. Springer, Berlin Heidelberg New York, pp 757–762
23. Schreiber A, Exner GU, Hochstetter AR (1991) Muscle reattachment – especially the gluteal muscles – after proximal femoral resection and replacement by tumor prosthesis. In: Langlais F, Tomeno B (eds) Limb salvage. Springer, Berlin Heidelberg New York, pp 395–398
24. Sim E (1990) Hüfttumorprothese – Indikation in einem unfallchirurgischen Schwerpunktkrankenhaus und Ergebnisse. Unfallchirurgie 16: 291–298
25. Sim FH (1988) Operative treatment: general considerations. In: Sim FH (ed) Diagnosis and management of metastatic bone disease. Raven Press, New York, pp 161–170
26. Sugimoto M, Takahashi S, Toguchida J, Kotoura Y, Shibamoto Y, Yamamuro T (1991) Changes in bone after high-dose radiation. J Bone Joint Surg [Br] 73-B: 492–497
27. Tomiczek H, Wruhs O (1987) Indikation und Anwendung der Verriegelungsnagelung bei pathologischen Oberschenkelschaftfrakturen. Unfallchirurg 90: 67–72
28. Veth RP, Nielsen HK, Oldhoff J, Schraffordt Koops H, Mahta D, Oosterhuis JW, Kamps WA, Goeeken LN (1989) Megaprostheses in the treatment of primary malignant and metastatic tumors in the hip region. J Surg Oncol 40: 214–218
29. Veth RP, Nielsen HK, Oldhoff J, Schraffordt Koops H, Oldhoff J, Hoekstra HJ, Mehta D, Willemse PHB, Goeeken LN, Oosterhuis JW, Verkerke GJ (1991) Use of megaprosthesis in the treatment of metastatic bone disease. In: Langlais F, Tomeno B (eds) Limb salvage. Springer, Berlin Heidelberg New York, pp 697–699
30. Windhager R, Ritschl P, Rokus U, Kickinger W, Braun O, Kotz R (1989) Die Rezidivhäufigkeit von intra- und extraläsional operierten Metastasen langer Röhrenknochen. Z Orthop 127: 402–405
31. Yazawa Y, Frassica FJ, Chao EYS, Pritchard DJ, Sim FH, Shives TC (1990) Metastatic bone disease. Clin Orthop 251: 213–219
32. Zichner L, Heipertz W (1981) Der Ersatz des proximalen Femurendes. Z Orthop 119: 102–110