Transarticular invasion of iliopelvic sarcomas into the sacrum

Radiological analysis of 47 cases

Toshifumi Ozaki[1], Norbert Lindner[1], Axel Hillmann[1], Thomas Link[2] and Winfried Winkelmann[1]

Joint cartilage functions as a barrier against the extension of bone tumors. However, transarticular invasion by iliopelvic sarcomas across the sacroiliac (SI) joints into the sacrum sometimes occurs. We made a radiological analysis (CT and/or MRI) of 47 bone sarcomas which originated in the ilium and extended nearly to the SI joint. 8 of 17 chondrosarcomas and 3 of 30 other sarcomas (2 of 23 Ewing's sarcomas and 1 of 7 osteosarcomas) invaded the sacrum through the SI joint.

Departments of [1]Orthopaedics and [2]Radiology, Westfälische Wilhelms-University, 48129 Münster, Germany.
Correspondence: Dr. T. Ozaki, Department of Orthopaedic Surgery, Okayama University Medical School, Okayama 700, Japan. Tel +81 86 223-7151. Fax -9727
Submitted 96-10-11. Accepted 97-03-01

Although intraarticular invasion of bone sarcomas is sometimes reported (Simon and Hecht 1982, Sato et al. 1993), the frequency of transarticular infiltration by pelvic sarcomas is unknown. We analyzed the frequency and characteristics of the transarticular sacral invasion by iliopelvic sarcomas.

Patients and methods

We treated 38 chondrosarcomas, 29 Ewing's sarcomas, and 7 osteosarcomas of the pelvis between 1991 and 1995. All patients underwent surgical resection of the tumors. Plain radiographs were available in all patients, CT in 69 patients, and MRI in 70 patients. Tumor site and sacral invasion were evaluated before any preoperative treatment with radio- or chemotherapy. The site where the tumor originated was defined as the most severely affected portion of the pelvis. Out of 38 chondrosarcomas, 19 originated in the ilium, 12 in the acetabulum, and 7 in the pubis or ischium. In this study, 17 of the iliac chondrosarcomas were included, 2 in the lateral part of the ilium were excluded. Of the 29 Ewing's sarcomas, 24 originated in the ilium, 1 was located at the lateral side of the pelvic wing and was excluded. Thus 23 cases were included. All 7 osteosarcomas originated in the ilium and were included. In this way, we selected 17 chondrosarcomas, 23 Ewing's sarcomas, and 7 osteosarcomas which originated in the ilium and infiltrated close to the sacroiliac (SI) joint. All cases had been examined by CT (3) or MRI (4) or by both (40). The average age of the patients was 30 (7–76) years. The grading of sarcomas was done according to Enneking et al. (1980). There were 6 low-grade intracompartmental (IA) and 1 low-grade extracompartmental (IB) chondrosarcomas. There were 1 high-grade intracompartmental (IIA) and 9 high-grade extracompartmental (IIB) chondrosarcomas. All 23 Ewing's sarcomas had been stage IIB. All 7 osteosarcomas were high-grade lesions, 1 intracompartmental (IIA) and 6 extracompartmental (IIB).

We defined the transarticular infiltration as an involvement of the opposing bones of the joint according to Abdelwahab et al. (1991); the cartilage and bone on the opposite side of the joint is invaded by the tumor from the other side, according to the findings on CT and/or MR images. All patients underwent surgery, and tumor infiltration was identified histologically in all cases but one with Ewing's sarcoma. In this case, radiologic findings were convincing and the histologic absence of tumor most probably was explained by the preoperative radiation and chemotherapy.

Results

8 of 17 cases of chondrosarcomas, 2 of 23 Ewing's sarcomas, and 1 of 7 osteosarcomas invaded the sacrum through the SI joint. 1 Ewing's sarcoma invaded the sacrum not through the joints but extraskel-

Sacral invasion by iliopelvic sarcomas

Value	n	Sacral invasion +	Sacral invasion −	P-value [a]
Diagnoses				
Chondrosarcoma	17	8	9	0.004
Ewing's sarcoma or osteosarcoma	30	3	27	
Grade				
Low	7	1	6	0.5
High	40	10	30	
Extraskeletal protrusion				
+	39	10	29	0.4
−	8	1	7	

[a] chi-square test

etally. The infiltration rate of chondrosarcomas was significantly higher than that of osteosarcomas or Ewing's sarcomas (Table).

1 of 7 stage I chondrosarcomas and 7 of 10 stage II chondrosarcomas invaded the sacrum ($p = 0.05$, chi-square test). If all tumors were analyzed together including osteosarcomas and Ewing's sarcomas, 1 of 7 stage I (low-grade) lesions and 10 of 40 stage II (high-grade) lesions invaded the sacrum (not significant).

Discussion

False-positive MR-findings of tumors invading a joint have been reported (Schima et al. 1994). In this study, however, we used a strict definition of joint invasion requiring that the cartilage and bone of both sides of the joint were invaded by the tumor. Furthermore, in all but 1 case, transarticular spread of the tumor was verified by the histologic examination.

There is probably no room for including the false-positive cases of transarticular invasion. There are several reports on sarcomas with SI joint invasion (Zatsepin 1981, Shirkhoda et al. 1984, Buirski et al. 1986, Abdelwahab et al. 1991, Adelman et al. 1991). However, most of them comprise small series of cases that lack radiological and histological information and the exact rate of SI joint infiltration of pelvic tumors is unknown. According to the radiological report by Abdelwahab et al. (1991), sacral invasion has been eported in only 11 iliopelvic sarcomas: 6 chondrosarcomas, 1 osteosarcoma, and 1 Ewing's sarcoma.

We found transarticular invasion through the SI joint in 11/47 of the iliopelvic sarcomas, mainly in chondrosarcomas. The higher sacral infiltration rate in chondrosarcoma than in Ewing's sarcoma or osteosarcoma of the ilium has not been explained. This phenomenon may be related to two factors. First, the age of the patients influences the sacral invasion of sarcomas. Starting in the fourth decade, arthrotic changes occur in the SI joints (Sahin 1930). With advancing age, bony ankylosis develops, allowing tumors to cross the joint. Above the age of 50 years, more than half of the SI joints are ankylotic (Sahin 1930).

Secondly, the character of the tumor and the pattern of the extension may also influence the SI joint invasion. There are no objective data on the hardness of chondrosarcoma, Ewing's sarcoma, or osteosarcoma. However, conventional chondrosarcoma produces extracellular chondroid matrix and is subjectively hard. Ewing's sarcoma is mainly composed of tumor cells with very little extracellular stroma and has a soft consistency (Dahlin and Unni 1986). Chondrosarcoma grows slowly without symptoms, expands into the bone and finally penetrates the cortex (Huvos 1991). Thus chondrosarcoma could destroy bones and penetrate through the joint cartilage. On the other hand, Ewing's sarcoma grows very fast along the haversian canals, without complete destruction of the bone, producing diffuse porosity of the cortical bone (Campanacci 1990); it seems to have little potential to penetrate and destroy joints or cartilage.

References

Abdelwahab I F, Miller T T, Hermann G, Klein M J, Kenan S, Lewis M M. Transarticular invasion of joints by bone tumors: hypothesis. Skel Radiol 1991; 20: 279-83.

Adelman H M, Wallach P M, Flannery M T. Ewing's sarcoma of the ilium presenting as unilateral sacroiliitis. J Rheumatol 1991; 18: 109-11.

Buirski G, Ratliff A H C, Watt I. Cartilage cell-containing tumors of the pelvis: a radiological review of 40 patients. Br J Radiol 1986; 59: 197-204.

Campanacci M. Ewing's sarcoma. In: Bone and soft tissue tumors. (Ed. Campanacci M). Springer-Verlag, New York 1990: 509-38.

Dahlin D C, Unni K K. Ewing's tumor. In: Bone tumors. (Eds. Dahlin D C, Unni K K). General aspects and data on 8542 cases. 4th ed. Thomas, Springfield 1986: 322-36.

Enneking W F, Spanier S S, Goodman M A. A system for the surgical staging of musculoskeletal sarcoma. Clin Orthop 1980; 153: 106-20.

Huvos A G. Ewing's sarcoma. In: Bone tumor. Diagnosis, treatment, and prognosis. 2nd ed. (Ed. Huvos A G). W B Saunders, Philadelphia 1991: 523-52.

Sahin D. A critical analysis of the anatomy and the pathologic changes of the sacro-iliac joints. J Bone Joint Surg (Am) 1930; 12: 892-910.

Sato K, Miura T, Nakanishi K, Sugiura H. Specific mechanism of the knee joint preventing tumor invasion. Acta Orthop Scand 1993; 64: 320-2.

Schima W, Amann G, Stiglbauer R, Windhager R, Kramer J, Nicolakis M, Farres M T, Imhof H. Preoperative staging of osteosarcoma: efficacy of MR imaging in detecting joint involvement. Am J Roentgenol 1994; 163: 1171-5.

Shirkhoda A, Brashear H R, Zelenik M E, Burke D C. Sacral abnormalities. Computed tomography versus conventional radiography. J Comput Assist Tomogr 1984; 8: 41-51.

Simon M A, Hecht J D. Invasion of joints by primary bone sarcomas in adults. Cancer 1982; 50: 1649-55.

Zatsepin S T. Conservative operations for pelvic bone tumors. Int Orthop 1981; 4: 259-68.