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Arthroplasty

The effect of the nephrolith crusher on acrylic cement

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It was recently suggested in the literature that removal of acrylic cement during revision operations might be facilitated by first submitting the area in question to the effect of a nephrolith crusher. An experiment was performed to establish the effect of the crusher on bone cement. High-energy pressure waves generated by a Siemens Lithostar were aimed at sections of Sulfix-6 cement with a diameter of 26 mm and a thickness of 2.5 (\pm 0.2) mm. These sections were produced under high pressure (200 bars) to ensure low porosity. The crusher discharge tension was 18.1 kV, the number of pressure waves being 0, 100, 250, 500, 1,000, and 2,000, respectively.

No macroscopic or radiographic changes were observed. The target surface showed microscopic damage in a concentric area with a diameter of 8.5 (\pm 2.5) mm. The size of the individual injuries was variable, but did not exceed 0.1 mm. A correlation between number of shots and size of injury was not demonstrable. However, the number of injuries increased as more pressure waves were discharged. The resulting surface porosity was measured by quantitative microscopy and found to be maximally 4 percent after 2,000 pressure waves. The damage was also studied with a scanning electron microscope, which frequently revealed an annular or horseshoe shape surrounding an undamaged central part.

The conclusion is that the nephrolith crusher caused microscopic damage in a limited concentric area of sections of acrylic cement. The lesions were small in comparison with the pores normally observed in cement.

Periacetabular initial tensions due to implantation of screw cups and their influence on the normal tension pattern

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Acetabular screw cups are so designed that during implantation high tensions are generated in the bone to give the cup its primary stability. Although the initial tensions are bound to diminish due to relaxation of the bone, they remain present when weight bearing is resumed.

This study was designed to gain insight into the extent of initial tensions and their influence on the normal tension pattern. It encompassed *in vitro* experiments, as well as numerical analyses. The experiments were performed with screw cups of two types (but of the same shape): one consisted entirely of HDPE (cup I), whereas the other consisted of HDPE with a titanium backing (cup II). Both cup types were implanted in hemipelvises to which strain gauges were attached. The cup was then subjected to pressure in order to simulate the hip reaction force. At implantation the peak values of the tensions calculated for both cup types were virtually equal, suggesting that initial tensions depend more on the shape than on the flexibility of the cup. Upon exposure to the hip reaction force, the tensions, registered in cup I were at least twice as high as those in cup II (because the flexibility of the cup now did play a role).

Depending on the degree of difference in the directions of pull and pressure in the initial tensions and the other tensions, these tensions may enhance or diminish each other when superposed. In cup I this was expressed as a diminution in peak tensions, while in cup II the peaks increased. However, these changes did not ensure equality of the combined tensions in both cups. In cup I they remained about one and a half times as high as in cup II.

This tension pattern was confirmed in finite-element

simulations in these experiments. The findings show that the tensions generated in a bone by implantation of a screw cup are of the same order of magnitude as those resulting from normal weight bearing. This means that the initial tensions play a major role in the tension pattern surrounding a screw cup. Considerable intraspecimen variation was found in these initial tensions, and consequently actual results are in a sense unpredictable.

The influence of a head-neck prosthesis on the acetabulum: An experimental study in goats

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Protrusion of the acetabulum is one complication seen after implantation of a head-neck prosthesis. Although these prostheses have been in use for years, little is known about the reaction of cartilage and acetabular bone to weight-bearing contact with metal. The new trend of using bipolar head-neck prostheses has reemphasized the problem of protrusion. The aim of this study was to follow the effect of a head-neck prosthesis on acetabular cartilage and bone over a longer period. For this purpose, the right hip in 36 goats was replaced by a metal head-neck prosthesis, and a radiographic and histologic follow-up was made at intervals over a period up to 1 year using sequential fluorescence technique and microradiography.

A uniform reaction of the acetabular cartilage and bone was seen. The cartilage rapidly showed a decrease in proteoglycan concentration and lost thickness. In the end, the deeper zones also lost their integrity. From the fossa and the acetabular rim, granulation tissue progressively replaced the cartilage. Six months after the operation, the contact surface with the head-neck prosthesis consisted of this pannus, with scattered islets of uncovered bone. The subchondral bone soon showed an increased cellular reaction with resorption, followed by apposition of new periosteal bone on the pelvic side of the acetabulum. This led to a protrusion found in each of the four goats killed 1 year after the operation.

The results of this study suggest the need of a reserved attitude as regards the use of head-neck prostheses in treating young patients.

C-reactive protein changes following total hip and knee replacements for rheumatoid arthritis, polymyalgia rheumatica, and arthrosis

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C-reactive protein (CRP) is a good laboratory parameter for assessing a postoperative course. In rheumatoid arthritis (RA) and polymyalgia rheumatica (PMR), the preoperative CRP value is often increased. In this study the CRP changes in autoimmune and nonautoimmune patients were studied after total hip (TH) or total knee (TK) replacement.

The patients were divided into four groups—viz., Group 1: TH, mainly for arthrosis (n 62); Group 2: TH for RA and PMR (n 16); Group 3: TK for arthrosis (n 17); and Group 4: TK for RA (n 16). CRP values were measured before the operation and on Days 1–7, 9, 11, and 14.

RA and PMR patients showed a higher preoperative CRP value (TH: $P < 0.05$; TK: $P < 0.001$) and a lower peak value after the operation (TH $P < 0.05$; Group 1: 135 ± 41.5 ; Group 2: 91 ± 31 . TK: $P < 0.001$; Group 3: 160 ± 31.5 ; Group 4: 103 ± 35.9). Peak CRP values were not influenced by age, height, duration of surgery, blood loss, medication, cementing, or type of anesthesia. Groups 1 and 2 differed in body weight: Group 1: 70 ± 14.5 kg; Group 2: 57.5 ± 14.5 kg, $P < 0.01$). Group 1 showed a significant correlation ($P < 0.05$, coefficient 0.328) between weight and peak CRP value. Six patients in Group 1 showed an increased preoperative CRP value; their CRP changes were identical to those observed in Group 2.

The differences in CRP changes found seem to have two causes: 1) the removal of a synovially irritated joint; 2) the autoimmune disease itself.

Deep infection of hip prostheses after 1-dose and 3-dose cefuroxim prophylaxis

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The safety of a single perioperative dose of cefuroxim (1,500 mg intravenously) in implantation of hip prostheses was tested in a randomized multicenter trial using 3-dose cefuroxim prophylaxis (1,500 mg intravenously, followed by 750 mg intravenously after 8 and 16 hours) as control. At 27 orthopedic centers, 3,074 hip prostheses were implanted according to the protocol from July 1986 through June 1988; 278 of these prostheses were excluded

on the basis of preset exclusion criteria. Of the remaining 2,796 prostheses, 145 were excluded owing to use of different antibiotics, wrong dosages, etc. Eligible for analysis were 2,651 hip prostheses, 1,327 of which were in the 1-dose group, while 1,324 were in the 3-dose group (groups were matched as to risk factors and other characteristics).

Results after a mean follow-up of 13 months were 11 infections in the 1-dose group (0.83 percent) and 6 in the 3-dose group (0.45 percent), the difference between the 1-dose and the 3-dose group in this respect being 0.38 percent (NS); but the 95 percent confidence interval of the difference may rise to maximally 0.9 percent more infections in the 1-dose group. The current incidence may thus be more than doubled, and this is why the safety of the 1-dose regimen cannot be confirmed with certainty at this time.

Orthopedic tumors

A multifocal giant-cell tumor with metastases

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In 1974, Wouters was one of the first to report on the treatment of a giant-cell tumor by curettage and cemented bone graft. This therapy is now being widely used. The woman Wouters treated had a remarkable history—1963: grade 2 giant-cell tumor of the right proximal tibia treated with curettage and bone graft; 1968: grade 2 giant-cell tumor of right distal femur treated with curettage and a cemented bone graft; 1986: grade 2–3 giant-cell tumor of the right distal tibia treated with curettage and a cemented bone graft; 1986: first recurrence of right distal tibial giant-cell tumor treated with curettage and cemented bone graft; 1987: second recurrence right distal tibial giant-cell tumor treated with lower leg amputation; 1987: lung metastases of grade 2–3 giant-cell tumor; giant-cell tumor (recurrence) right proximal tibia; giant-cell tumor (recurrence) right distal femur; new localization of giant-cell tumor in right femoral shaft. *Treatment:* laser coagulation, chemotherapy, upper leg amputation. Death occurred in 1988.

Both multifocality and metastatic growth of giant-cell tumors are regarded as rare. Their combination in this female patient—not without historic importance—prompted this report.

Treatment of juvenile bone cysts by intracavitary injections of methylprednisolone acetate

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A juvenile bone cyst is a benign skeletal lesion that requires treatment in view of the risks of pathologic fractures. Methylprednisolone acetate has been used at the Leiden University Hospital since 1982. Of 19 patients treated (mean age 11 years), 11 were first presenters, whereas 8 had a recurrence following curettage and a bone graft or corticosteroid medication elsewhere. The proximal humerus was the most common site (12 instances), followed by the proximal femur (4). The diaphyseal humerus, proximal tibia, and calcaneus were each involved once. Pathologic fractures (24) developed in 15 patients. The cyst was percutaneously approached with the aid of two needles; after assessment of the fluid, the cavity was filled with contrast medium to determine the number of compartments and their communications. Clear, slightly pulsating fluid, and filling of the cavity with contrast medium are pathognomonic. In the cavity, 120 mg Depomedrol was left in situ. Depending on the response, another injection followed after 2–3 months.

At follow-up, 17 patients were found cured, including 16 after less than 6 months' treatment with three or fewer injections; 3 of these patients, however, had a recurrence (after 9, 12, and 14 months), and were definitely cured after a repeat injection. Two patients are still under treatment. We observed no refractures and no complications from the Depomedrol treatment. Two patients showed partial epiphysiodesis resulting from a previous curettage.

Conclusion: In view of the excellent results and the absence of complications, treatment of juvenile bone cysts with Depomedrol injections is recommended.

Osteoid osteoma and osteoblastoma

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Twenty-three patients with an osteoid osteoma and 3 with an osteoblastoma were followed up over a period of 1–10 years on the basis of clinical, radiologic, and pathologic-anatomic information. The mean age of the patients at the time of primary therapy was 19 years. Circumscribed localized pain was indicated by 20 and nocturnal pain by 15 patients. Salicylate medication reduced the pain in 14 patients. The mean preoperative duration of symptoms was 14 months. Localizations were the hand (6), forearm (1),

humerus (3), vertebral column (4), femur (5), and lower leg (7). Conventional radiography, tomography, and bone scan clinched the diagnosis in 20 of the cases. Primary therapy was intracapsular excision in all the cases.

Results: Local recurrence was seen in 1 patient with an osteoid osteoma and in 2 patients with an osteoblastoma; the treatment consisted of marginal excision. All the patients were asymptomatic at the time of follow-up. The pathologist confirmed the diagnosis in 22 cases. Mechanical damage to the resected specimen was the principal cause of the discrepancy between clinical and pathologic-anatomic diagnoses.

Conclusion: Intracapsular excision proved to be an effective therapy for osteoid osteoma, whereas marginal excision was the treatment of choice for osteoblastoma.

Extraskelletal hemangiomas of the musculoskeletal system

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Hemangiomas in the soft tissue of the musculoskeletal system are fairly rare and may pose diagnostic problems to the (orthopedic) surgeon. In view of their benign nature, however, overdiagnosing is to be avoided, but a diagnosis should be quickly clinched by an adequate investigation. The data on 19 patients found to have hemangiomas of the soft tissues of the musculoskeletal system and treated for this reason were studied in an attempt to establish a guideline to the above-mentioned problem. The patients were 11 males and 8 females aged 23 (6–46) years. Pain was the principal symptom, and swelling had in most cases persisted from a few months to 10 years. Two groups were distinguished: 1) juxtaarticular hemangiomas, often with recurrent hemarthrosis as the principal symptom; 2) hemangiomas mostly localized in the muscles, often along the entire muscle belly. The condition is often misdiagnosed (as apparent also in this series). All except 4 patients were seen by other specialists who diagnosed conditions other than hemangioma. Apart from clinical findings, important diagnostic aids are digital subtraction angiography (arterial and venous), CT-scan (with contrast medium if necessary), and Magnetic Resonance Imaging (MRI). In their conventional form, these three techniques all provide images highly characteristic of hemangiomas. In this series, radical resection proved to be the treatment of choice (as is also indicated in the literature).

Pigmented villonodular synovitis

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Pigmented villonodular synovitis (PVS) is a rare, diffuse, or focal affection of joints, bursae, or tendon sheaths. Clinical and pathologic-anatomic data were used in a follow-up study of 17 patients, most of whom had received primary therapy elsewhere. The follow-up period ranged from 1 to 11 years; the mean age was 34 years, and the mean duration of preoperative symptoms was 4.5 years. Localizations were hand (3), wrist and elbow (2), hip (4), ankle (2), and knee (6 instances). Only in 5 patients was PVS initially suspected.

Treatment was by (sub)total synovectomy or marginal excision; an endoprosthesis was implanted in four instances. In difficult cases especially the CT-scan and MRI proved to have good predictive value.

Five of the 17 patients developed recurrence (one or several). These patients were treated by marginal or wide excision, sometimes combined with radiotherapy. Eight patients developed severe degenerative changes in joints.

Hemarthrosis, soft-tissue swelling, increased triglyceride values, a positive bone scan, and radiographic evidence of cysts in the nonweight-bearing plane should raise a suspicion of PVS. Immediate treatment is indicated in view of the grave risk of destruction, especially in the diffuse form of PVS.

Surgical treatment of pathologic fractures of the vertebral column

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Eighty-seven patients with a pathologic fracture of the vertebral column have been treated since 1979. Indications for an operation were 1) compression of the spinal cord, cauda equina, or a nerve root caused by a bone fragment or tumor; 2) severe pain despite conservative measures; 3) unstable fracture with imminent spinal cord compression. All the patients with thoracolumbar metastases were bedridden; none had paraplegia.

A decompressive laminectomy was performed in 4 cases in 1979, with success in 1. Subsequently anterior dural compression was treated with anterior decompression, laminectomy being reserved for posterior or posterolateral compression. Stabilization: cervical column above C4: dorsal fixation with an occipito-cervical plate and cement; C4–7, lesions on one level: anterior spondylodesis; multiple level lesions: dorsal fixation with

rectangle and cement. Thoracolumbar spine: anteriorly with a vertebral prosthesis or, for multiple levels, a modular prosthesis and cement. In cases with expected survival exceeding 1 year and after replacement of more than one vertebral body, dorsal spondylolysis was added.

Complications were postoperative progressive paraplegia (2), infections (2), death (1), subsidence of an osteoporotic vertebra (1), loosened anterior cervical construction (1), and chylothorax (1 case).

Results: No pain in 88 percent, and pain alleviated in 12 percent. Neurologic improvement in 80 percent of the cases; 80 percent of the patients were discharged from the hospital as ambulatory patients.

Synovial sarcoma

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A long follow-up study (5–35 years) was performed on 55 patients with a synovial sarcoma. The 5-year survival was 27 percent (65 percent of the patients died within 1 year). A local recurrence was found in 20 patients, and metastases developed in 42 patients, usually hematogenous, but in 3 lymphogenous. Histologic parameters (specifically the ratio between epithelioid and fibrosarcomatous cell groups and the number of mitoses) as well as clinical parameters (size, localization, and spread of tumor growth, age and sex, therapeutic methods used) were correlated with final results. Favorably prognostic factors proved to be female gender, a tumor of less than 5 cm in diameter and limited to one anatomic compartment. Adequate surgical treatment (radical excision or wide excision combined with adjuvant therapy) proved to be the principal determinant of survival. Surgical treatment of lung metastases extended life.

Surgical treatment of Ewing's sarcoma

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The prognosis of Ewing's sarcoma has improved significantly since the introduction of chemotherapy. Due to the resulting increase in survival, local recurrences following radiotherapy constitute an increasing problem. This prompted an evaluation of the results of radiotherapy as well as of local surgical treatment of patients registered in

the files of the Bone Tumor Commission. The period 1975–1986 was chosen because during this period all the patients (n 103) were given some form of chemotherapy (follow-up 2–11 years). Excluded patients were those with metastases at the time of diagnosis and those with atypical Ewing's sarcoma (n 27). Data on 23 patients were incomplete. The study concerned 53 patients: 21 with centrally localized tumors (in the pelvis in 9 cases), 15 with proximal, and 17 with distal extremity tumors. In December 1988, 25 of these 53 patients were alive. Patients with distal extremity tumors had a more favorable prognosis than those with tumors localized elsewhere. Patients given local surgical treatment (en-bloc resection in 10 and amputation in 3 cases) had a better prognosis than those given radiotherapy. Local recurrence was observed once after surgery and nine times after radiotherapy. Accounting for age, localization, loss of function, reconstruction, and rehabilitation, the findings support the current view that local surgical treatment is to be preferred.

Skeletal chondrosarcoma: Grading, treatment, and prognosis

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A follow-up study of 230 classical chondrosarcomas from the files of the Bone Tumor Commission shows a predominant influence of tumor recurrence on the prognosis. A favorable prognosis based on histologic grading can be totally destroyed by inadequate treatment. When a chondrosarcoma is suspected, it is of paramount importance, regardless of the tumor localization, to perform careful staging using the most sophisticated aids. Next, the diagnosis is to be confirmed by biopsy (taking into account surgical possibilities of adequate treatment after confirmation of the diagnosis). Any treatment classified as wide or radical may be regarded as adequate, with a very small risk of recurrence. The prognosis is good and depends solely on the development or nondevelopment of metastases—a factor related to the histologic degree of malignancy. Limb-salvaging operations that can be classified as wide are therefore justifiable in the treatment of chondrosarcomas of any grade. The findings warrant the conclusion that the only reliable treatment of a chondrosarcoma is en-bloc resection of the tumor with a wide or radical margin.

Risk factors in osteosarcoma: A multifactorial risk analysis of 450 patients

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A retrospective study of the prognostic significance of clinical, radiographic, surgical, and pathologic-anatomic characteristics of osteosarcoma was performed with the aid of multifactorial analysis (Mantel-Cox regression test) of 450 patients with an osteosarcoma treated at several centers between 1960 and 1987. Each risk factor was first tested individually for significance, and subsequently all the factors of prognostic significance for survival or interval until recurrence were analyzed step by step. The beta survival rate was then used as a basis for a scoring system calculated per patient.

The findings indicate that the following factors are of importance for survival: stage (Enneking), LDH, alkaline phosphatase, skip metastases, osteoblastic tumor characteristics, localization, and chemotherapy. The same factors (with the exception of alkaline phosphatase) are of importance for recurrence, with, in this case, the operative technique as an additional factor.

This scoring system permits a more accurate prediction of survival and interval until recurrence than can be achieved with the current systems.

chemotherapy before and after the operation. After resection, reconstruction with the aid of endoprostheses followed in all the cases.

Results: At follow-up, 3 patients with an osteosarcoma or malignant fibrous histiocytoma and 1 patient with a chondrosarcoma had died from metastases. Of the remaining patients with a primary bone tumor, 21 had shown no signs of tumor activity since treatment. One had meanwhile been treated for lung metastases. Of the patients with bone metastases, 8 were alive and 14 had died. The mean survival was 16 months in this group. Two patients with a metastatic bone process had developed a cicatricial recurrence that responded well to radiotherapy. In the group of primary bone tumors, partial or total revision of the endoprosthesis was required in eight instances. In only 1 case did the functional result suffer as a result of this. Loosening occurred once in a patient with a metastatic process. No infections were observed in either group. In the primary tumor group, results according to the Enneking Functional Evaluation System were good in 8, moderate in 14, and poor in 4 cases. Results in the patients with metastatic processes were good in 14 and moderate in 8 cases.

Endoprostheses in patients with bone tumors

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A survey is presented of long-term results of limb-salvaging treatment of patients with primarily malignant and metastatic bone tumors. Between 1978 and 1988, 26 females and 22 males were treated. The pathologic-anatomic diagnoses of the primary tumors were osteosarcoma (18), malignant fibrous histiocytoma (3), and chondrosarcoma (5 cases). The histology of the primary tumor in the patients with metastases was mammary carcinoma (14), pulmonary carcinoma (2), multiple myeloma (2), prostatic carcinoma (2), Grawitz's tumor (1), and malignant melanoma (1). The Enneking staging of the primary bone tumors was IIA (2), IIB (23), and III (1). The metastatic bone processes involved more than 50 percent cortical destruction or a spontaneous fracture. The humerus was affected in 3 patients, the pelvis in 1, the femur in 43, and the proximal tibia in 1.

All the patients with osteosarcomas and malignant fibrous histiocytomas were given prolonged intravenous

Use of modular Kotz endoprostheses to reconstruct joints following tumor resections

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Surgical treatment of primary malignant bone tumors has in recent years shifted from amputation to limb salvage. An oncologically adequate tumor resection can be followed by a joint reconstruction using an uncemented KMFTR (Kotz Modular Femur and Tibia Reconstruction) endoprosthesis. During the period 1984–1989, 25 malignant bone tumors and one benign bone tumor were resected, whereupon this KMFTR endoprosthesis was implanted. The hip joint was replaced in 14 and the knee joint in 12 patients. The mean age of these patients (12 males and 14 females) was 38 (14–76) years. The follow-up averaged 22 (3–65) months. Postoperative complications occurred in 10 patients, the most important being infection (4), patellar tendon rupture (1), and tibial fracture (1). One patient required a revision 2 years after the operation (broken prosthesis stem), and 1 had to undergo amputation of the upper leg in view of infection. No local recurrence was seen. Six patients developed metastases (5 have meanwhile died).

Our preliminary findings show that reconstruction of a joint with the aid of a Kotz endoprosthesis can give a satisfactory result.

Limb-salvaging procedures in the treatment of malignant tumors of the proximal humerus, and experience with the modular Rizolli shoulder prosthesis

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Between February 1970 and October 1987, limb-salvaging operations were performed in 9 female and 11 male patients (aged 4–61 years) suffering from a primary malignant tumor of the proximal humerus (osteosarcoma in 8 cases, giant-cell tumor in 3, chondrosarcoma in 8, and malignant fibrous histiocytoma in 1 case). A proximal humerus resection was performed in 9, and an extraarticular humerus and glenoid resection in 11 cases. *Reconstruction*: shoulder prosthesis in 7 cases, arthrodesis in 4, reconstruction of the proximal humerus with a spacer and autograft in 9 cases. One local recurrence was seen.

The Nijmegen experience with a modular shoulder prosthesis according to Rizolli: palliative results in 5 cases of secondary tumor growth and in 2 cases given treatment designed to be curative have been encouraging. This prosthesis permits reconstruction of the proximal humerus because the length of the humerus-replacing part of the prosthesis can be varied.

Conclusions: Although this procedure nearly always leads to an nonfunctional shoulder regardless of the reconstruction used, a limb-salvaging operation is to be preferred, mainly because the patient is better off with a usable hand and elbow, but also because emotional acceptance is excellent.

Surgical possibilities in the treatment of malignant primary bone tumors of the pelvis

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A retrospective study was performed of 32 patients with a malignant primary bone tumor of the pelvis treated in Leiden and Amsterdam during the period 1982–1989. The tumors involved were chondrosarcoma (22), Ewing's sarcoma (4), osteosarcoma (3), and 1 each of malignant fibrous histiocytoma, fibrosarcoma, and undifferentiated myxoid sarcoma. Two patients (chondrosarcoma) with metastases were followed without receiving treatment. Three patients received radiotherapy (2 with Ewing's sarcoma and 1 with chondrosarcoma): 1 is disease-free, 1

is stationary (chondrosarcoma), and 1 has died of metastases. Depending on tumor type and staging, the following operative procedures were used: hemipelvectomy (8), sometimes modified, and resection (19) with various forms of reconstruction. Eight patients (2 with osteosarcoma, 2 with chondrosarcoma, 2 with Ewing's sarcoma, 1 each with myxoid sarcoma and malignant fibrous histiocytoma) were treated with hemipelvectomy, in 5 cases modified by salvaging the iliac wing with a view to improve prosthesiologic possibilities. In 19 cases (17 with chondrosarcoma, 1 osteosarcoma, and 1 fibrosarcoma), a resection was performed. Reconstruction was unnecessary in 7 instances. In 3 cases a bone graft was used to restore the pelvic ring. In 4 cases an arthrodesis between the hip and pelvis was achieved. Reconstruction was carried out with a saddle prosthesis in 4 cases. In 1 case the resected pelvis was replaced by an allograft obtained from a bone bank. Of the 19 patients treated with resection, 16 are diseasefree, 2 have a local recurrence, and 1 has died of metastases. The functional results in patients treated with salvage operations depend on the extent of the resection. In those without reconstruction or with only restoration of the pelvic ring, the results are usually good. The results in the other cases are generally moderate, but preferable to those of hemipelvectomy.

The value of hyperthermic isolated regional perfusion, intraarterial infusion, intraoperative radiotherapy, and adjuvant chemotherapy in limb-salvaging treatment of highly malignant soft tissue sarcomas

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Limb-salvaging treatment is determined by such factors as localization, size, and degree of malignancy of a soft tissue tumor of a limb. Given adequate therapy, the local recurrence rate is 50 percent. In the past, therefore, an amputation was performed to prevent local recurrence if no sufficiently wide local resection was possible. The final prognosis depends on histologic diagnosis and tumor staging, as well as on the occurrence of distant metastases. High-dosage postoperative radiotherapy (in excess of 50 Gy) has made it possible to increase the resectability rate of soft tissue sarcomas of the extremities, while on the other hand, the recurrence rate can be reduced to 10 percent. Even with this mode of treatment—surgery and postoperative radiotherapy—some tumors require amputation of the limb involved. To increase the resectability rate in this group of patients, hyperthermic isolated regional perfusion with Melphalan/Dactinomycin was introduced and used in 14 cases of highly malignant soft tissue

sarcoma of an extremity. One patient had a local recurrence after this treatment.

The new mode of treatment combining intraarterial infusion of cisplatin with preoperative and postoperative radiotherapy and surgery was introduced in 1982 for primarily unresectable, highly malignant soft tissue sarcomas. This treatment ensured a resectability rate of 89 percent and a local recurrence rate of no more than 13 percent.

Intraoperative radiotherapy makes it possible during surgery to apply a large dose of radiotherapy to the tumor bed while leaving adjacent healthy tissues intact. Thus, a larger dose of radiotherapy can be given without increasing treatment morbidity; particularly in the case of sarcomas, this form of treatment probably has significant advantages over conventional radiotherapy. The adjuvant chemotherapy generally given has not contributed to an increased resectability rate, a reduced local recurrence rate, or an increased disease-free survival.

Using the combination of surgery, intraoperative radiotherapy, and chemotherapy, it has proved possible to perform limb-salvaging treatments of soft tissue sarcomas of the extremity with a local recurrence rate of only about 10 percent.

The functional results of resection-arthrodesis of the knee joint in view of malignant disease

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Seventeen patients treated with resection-arthrodesis of the knee during the period 1975–1988 were studied in retrospect. They were 10 males and 7 females averaging 27 (15–57) years of age. Tumor localizations were the distal femur (13 cases), the proximal tibia (3), and the synovia (1 case). Diagnoses were osteosarcoma (IIB, 8 cases), chondrosarcoma (IIA in 2 cases, IIB in 2, and III in 1 case), giant-cell tumor (IB in 1 case, III in 1 case), synovial sarcoma (IIB in 1 case), and desmoid tumor (IB in 1 case). The operation involved resection of the malignant process, whereupon continuity between the upper and lower leg was restored with the aid of a medullary nail or plate osteosynthesis with an additional bone graft. The median follow-up was 39 (8–169) months. Sixteen patients were evaluated using the scoring system agreed on at the International Symposium on Limb Salvage in Musculoskeletal Oncology (1985). One patient was excluded because an immediately postoperative infection necessitated amputation. Pain scores were excellent in 13, poor in 2, and fair in 1 case. Stability was excellent in 12, good in 3, and poor in 1 case. Acceptance was excellent in 1, good in 11, and fair

in 4 cases. Complications were excellent in 8, good in 5, fair in 2 (reoperations resulting in leg shortening in 1 case, migrating medullary nail in 1 case), and poor in 1 case (reversal graft in a later stage).

Conclusion: Resection-arthrodesis of the knee joint—is feasible and in well-motivated patients—is to be preferred to an amputation. Two of the 17 patients developed a complication due to which the envisaged result was not obtained.

Use of intercalary allografts to reconstruct segmental bone defects following tumor resections

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Between 1974 and 1987, the Department of Oncological Orthopedics at Massachusetts General Hospital in Boston (U.S.A.) used 54 intercalary allografts to reconstruct segmental defects of the long bones in 52 patients. Of these, 37 grafts (36 patients) were followed up over a period of at least 12 (mean 62) months. The results were evaluated on the basis of the Mankin Allograft Evaluation System. Good or excellent final results were obtained in 32 of the patients. Seventeen late complications were seen. The graft-specific complications were fractures (5 cases) and delayed union (9 cases). Four of the five fractures were successfully treated without the need of graft removal. In 1 case this was necessary, but a second graft in this case was successful. Six of the 9 cases of nonunion showed good or excellent results after further treatment. Several of these patients needed multiple operations and prolonged protection with crutches and/or braces.

Conclusions: Reconstruction of segmental bone defects can be effected adequately and reliably with the aid of large allografts; this usually leads to rapid and virtually complete recovery. The rate of complications is high, most problems developing within the first 3 years. Graft-specific complications usually respond well to treatment.

Varia

The instantaneous rotation center of the temporomandibular joint

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The development of prostheses to replace the temporomandibular joint is still in an initial phase. To define the functional requirements to be met by such prostheses, the movements of the normal temporomandibular joint should be understood. This is even more so when the prosthesis is to function parallel to a natural joint, as is the case with the temporomandibular joint. Because the basic movements of the mandible—opening and closing of the mouth—take place in a single plane (the sagittal plane), or can be reduced to a single plane, polar tract analysis can be used to study these movements. Twenty subjects were submitted to a movement analysis performed with the aid of the Precision Movement Analysis System (PRIMAS). The principle of this system is based on registration with the aid of a TV camera, of infra-red light reflected by markers fixed to the moving object: the mandible.

The principal conclusions are as follows: 1) The characteristic shape of the polar tract in several consecutive openings and closing of the mouth is a U-shape. In opening the mouth the polar tract begins behind (dorsal to) the mandible and ends in the apical area at maximum opening. 2) During the opening and closing movements of the mandible, rotation and translation of the mandible occur simultaneously. Available temporomandibular joint prostheses can only simulate the rotatory part of the mandibular movement. This limitation may cause damage to the normal contralateral joint.

The information obtained by these analyses will have to be used in designing a new prosthesis capable of simulating both the rotation and the translation of the mandible.

A functional analysis of the ligaments of the human wrist joint

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The ligament system of the human wrist joint consists of an ingenious complex of collagen fibers. To understand the function of this complex and its components, the forces

generated by this system during hand movements have to be studied. The force generated by a ligament can be measured from the elongation of this ligament and its stiffness characteristics. These parameters were determined in two separate *in vitro* studies.

Method: The movements of the carpal bones and the elongations of parts of the carpal ligament system during hand movements were studied by radiostereophotogrammetry (RSP). To determine the stiffness characteristics of the ligaments, bone-ligament-bone (BLB) parts were dissected from the ligament system, and their stiffness and elasticity were measured in traction tests.

Results: The RSP study showed that existing concepts of the recruiting of ligaments of the wrist joint are inaccurate, and that specifically an understanding of the movements of the carpal bones contributes to improved insight into ligament-recruiting patterns. It was found that the RTD ligament (dorsal radio-triquetrum ligament) and the LTP ligament (palmar lunato-triquetrum ligament) are not elongated during any hand movement. The findings also show that none of the tested ligaments is longer during radial deviation and palmar flexion than with the hand in the neutral position. The traction experiments show that not all the ligaments consist of mechanically comparable material. The RTD ligament, which showed no elongation in the RSP study, proved to consist of the stiffest material. Of the ligaments on the palmar side, with a lower elasticity module than the RTD, the RSC ligament (lateral radio-scaphoid ligament) proved most elastic; the other ligament parts have a corresponding elasticity module.

Discussion: In order to gain insight into intraligamentous forces as a function of the position of the hand, the results of RSP and traction tests have to be combined. For this purpose, however, it is necessary to determine the ligament length when the force generated in that ligament is exactly zero Newtons. The insight thus gained can contribute to our knowledge of the functioning of the ligament system.

The intrafascial pressure gradient in the anterior tibial compartment under standard load: An experimental study

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The functional compartment syndrome is characterized by increased pressure in the anterior tibial compartment when exposed to a load. There are several methods to objectify the diagnosis. To determine the dynamic pressure gradient under standard sports-related conditions, the following study was performed.

Subjects and methods: Ten healthy volunteers (aged 15–40 years) were asked to walk at different speeds on a

treadmill. The pressure in the anterior tibial compartment was measured with the aid of a catheter and transmitted to an XY-writer via a millivolt signal, thus permitting on-line measurement. Test subject and XY-writer were simultaneously depicted by a camera at a rate of 25 frames per minute. Single-frame analysis was used to evaluate the results.

Results: Given readily reproducible curve shapes, the quantitative results were increased curve maximum and curve minimum with increasing speed, as well as increased curve amplitude. Qualitative curve analysis showed that the pressure minimum occurs immediately before the heel strike. Upon full ground contact and active stabilization of the ankle joint, a slightly elevated curve plateau becomes visible. A curve maximum occurs when the hallux pushes off.

Conclusions: The measuring method presented gives reliable and reproducible values and pressure gradient curves. The increase in pressure correlates well with the clinical experience that speedwalkers who develop symptoms can reduce these by reducing their speed. The single-frame analysis of the walking movement permits objective testing of preventive measures (e.g., changed style of walking or changed footwear) that can reduce the pressure in the anterior tibial compartment.

A septic arthritis model with *Staphylococcus aureus* in the rat

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In 90 rats (Lewis, 8–14 weeks old), septic arthritis was induced in the right knee by intraarticular injection of 50 μ L PBS containing 500 to 5×10^7 *Staphylococcus aureus*. Another 30 rats received a control injection into the knee of 50 μ L PBS. The rats were followed up for up to 3 weeks and killed 2 hours to 3 weeks after the intraarticular injection. Body weight and leg function were studied. The knees were resected in toto, including the capsule, and studied histologically after fixation and staining (HE, AB-PAS, Safranin-O, Gram). The number of bacteria present was determined by grinding up the resected knees and making a bacterial count. Finally, a number of rat knees were injected with inactive bacterial constituents and followed in the same way.

It proved possible to induce septic arthritis in rats. The clinical symptoms (weight loss, loss of function) were more severe when the number of bacteria injected was larger. Even at low concentrations of bacteria, an inflammatory reaction developed, with histologic destruction after 7–14 days and virtually total destruction of cartilage

after 2–3 weeks. No histologic changes were observed following injection of inactive bacterial constituents. The number of bacteria injected remained constant 1–4 hours after injection, was unaltered after 8 days, but reduced to zero (sterile knees) after 14 days.

The septic arthritis that leads to destruction and loss of function from 1 week on after induction, however, disappears spontaneously. After a few weeks, symptoms are absent and bacteria are no longer demonstrable in the joint. This means that this model is suitable for studies of the effects of various types of bacteria on a joint, and of the treatment of acute septic arthritis, but not for investigations into the pathology and therapy of arthritis.

Xenografting rabbit costal perichondrium to a sheep knee cartilage defect

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The results of cartilage xenografting are good if fresh material without bone fragment is used. Perichondrium has proved capable of producing cartilage, but the results of xenografts are unknown. In 10 sheep a cartilage defect in the knee was covered with costal perichondrium from an adult rabbit. The graft was fixed with Tissicol (R), a fibrin glue, and the knee joint was immobilized for 2 weeks using external pin fixation. A tenotomy of the Achilles tendon was performed to prevent weight bearing temporarily. During the third and the fourth week, the leg was placed in a CPM machine for an average of 8 hours/day. The sheep were then allowed free grazing.

Arthrotomy of the knee was performed 3 months after the operation; macroscopic, histologic, and biochemical aspects of the graft were determined and compared with those of the cartilage in the same knee. A synovial biopsy specimen was taken as well.

Septic arthritis developed in one instance. The other sheep showed a normal walking pattern and a slender knee with full function. The grafts showed considerable macroscopic similarity to the surrounding cartilage. Histologic examination disclosed normal joint cartilage with increased calcium staining of the basal layer. The collagen II concentration of the grafts averaged 75 percent of that of control cartilage. In only one instance was monocyte infiltration seen in the synovial biopsy specimen.

Conclusions: Xenografting of perichondrium resulted in formation of joint cartilage. No evidence of graft rejection was observed.