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Part III

Orthopedic radiometry

Computed tomography in preoperative evaluation of herniated disk in the lumbar spine

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Until October 1983, we used plain radiographs and lumbar myelography as the only preoperative examinations of suspected herniated disks of the lumbar spine. In 1983, a CT GE 800 was installed; and during a learning period, we used both myelography and CT examinations.

Since October 1983, plain radiographs and CT examinations have primarily been used in examining patients with suspected disk herniations. If the result was not conclusive, a myelography was carried out.

Results. During the period October 1983 through December 1985, we performed more than 300 CT examinations for suspected lumbar disk hernias. Disk herniations were seen in more than half of the examinations. In 40 patients the result was not conclusive or there was a discrepancy between the CT findings and the physical examinations. In these cases a myelography was also carried out.

Eighty-one of the patients were operated on. In 55 of the 59 patients with only a CT examination, positive findings of disk disease could be confirmed at surgery. The same was found in 19 of the 22 patients where both CT and myelography had been performed.

Conclusions. 1. The result of CT examination as a primary diagnostic procedure in patients with clinically suspected herniated disk of the lumbar spine is in most cases reliable and sufficient to proceed to surgery provided there is a clinical indication.

2. In inconclusive CT examinations or a discrepancy between the CT findings and the patients' symptoms and signs, myelography is recommended to clarify the pathology of the lumbar spine before surgery.

Primary computed tomography versus secondary myelography in diagnosing lumbar disk herniation

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Computed tomography (CT) of lumbar intervertebral disks is the investigation of choice in patients under suspicion of herniated nucleus pulposus.

In 337 patients examined with CT, 38 were supplemented by myelography. This study was made to determine why secondary myelography was necessary and to discover whether myelography gave further information.

In 23 of 38 patients, CT was sufficient, but the discrepancy between CT and symptoms required myelography. At CT, technical problems were found in seven examined intervertebral disks (L5/S1), in 2 cases of spondylolisthesis, and in 3 cases of obesity. In 23 patients, there were no discrepancy between CT and myelography. CT was normal in 2 cases, whereas myelography showed herniated disks. Eleven CTs were under suspicion of disk herniation, but only seven were confirmed by myelography.

We concluded that if the CT was done without any technical problems and was found normal, it was rare that myelography added any further information. In case of uncertain findings at intervertebral disk L5/S1, a secondary myelography is of great value.

Radioanatomic studies of the cervical spine: Correlations with discography, facet joint injections, and computed tomography

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The development of new or improved surgical techniques for the treatment of cervical spinal disorders and the rapid advances of modern diagnostic imaging modalities such as computed tomography and magnetic resonance imaging, along with interventional diagnostic procedures call for a thorough knowledge of the architecture of the cervical vertebral column and its intricate topographic relationships to the delicate neural and vascular elements.

To some extent, these radiologic techniques also provide information on the in-vivo functional anatomy, demonstrating how the multisegmental movements of the vertebral column affect the neurovascular spinal contents.

The radiographic workup of patients with different types of cervical spine disorders in the hands of a radiologist in a non-academic position included computed tomograph with and without multiplanar image reconstruction, intervertebral disc injections and discography, and diagnostic injections and opacification of the facet joints.

Anatomic studies were conducted on injected and frozen cadaveric specimens, some of which were positioned in functional postures before freezing. A great number of normal and pathologic cases were studied, rendering a large morphologic data base for comprehensive correlative evaluation of the diagnostic images.

In normal cases, typical topographic relationships, dimensions, and movements were studied. The assessment of pathologic changes focused on typical degenerative changes and disclosed a consistent pattern and sequence of degenerative changes in the intervertebral discs and the facet joints, and also elucidated how such changes may affect the spinal cord, nerve roots, and segmental blood vessels, as well as the vertebral artery.

Quantitative CT-scanning of trabecular bone: The relation to mechanical compressive strength parameters, and a clinical examination of the proximal tibia

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The distribution of mechanical strength at the proximal tibia in degenerative disease of the knee joint is of considerable interest in non-hinged total knee replacement (TKR), because the critical fixation and support of the tibial component depend on the trabecular bone resection surface. We have evaluated the relationship between quantitative CT (QCT) and compressive strength and have applied the findings to study candidates for TKR and to the density changes after TKR.

Six cadaver knees were scanned at 140 kV, 70 mA, 3s scan time and a slice thickness of 8 mm. The proximal tibiae were then cut in 8 mm slices, and 8 mm cylinders were removed in a recognizable pattern. The cylinders were rescanned in an acrylic phantom. The relative attenuation coefficient (r_o) was derived from QCT (r_o=1+0.001 H, where H is the CT value in Hounsfield units). Clinical QCT was conducted in 20 patients before and after total knee replacement (maximal follow-up 2 years).

The cadaver study revealed a close relationship between QCT and mechanical strength (QCT to yield strength, r = 0.85; QCT to elastic modulus, r = 0.78). The clinical study showed highly abnormal density patterns at the proximal tibia of candidates for TKR: the patterns were dependent upon the type and degree of malalignment with high density at the loaded condyle and low density at the unloaded condyle. After successful operation, these abnormalities tended to revert towards normal within 6 months, suggesting that an increase in strength occurs at the weak preoperatively unloaded condyle.

QCT gives detailed and fairly accurate information on the distribution of trabecular bone strength at the tibia. Highly abnormal strength patterns are found at the tibiae of degenerated knees, but a process of active remodeling can be expected to provide adequate strength for long term prosthesis survival.

Postreductional remodeling of the hip joint in late discovered CDH

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The hip joints of 11 infants with unilateral late discovered CDH, 5 (3–15) months old at diagnosis, were investigated by ultrasound. Closed reduction was performed in all the patients, and the postreductional position was secured by abduction splintage. The ana-

tomy and remodeling of the hip joints were followed by repeated ultrasonic examinations.

All the hips became stable to manual provocation in 1–4 months. Existing soft tissue interposition between the joint components disappeared completely within 2 months after reduction. The smaller femoral head on the dislocated side regained in size during treatment.

In conclusion, conservative treatment provided a normalization of the anatomic disorders seen in late discovered CDH.

Sonography, arthroscopy and intracapsular pressure in juvenile chronic arthritis of the hip

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The evaluation of synovitis of the hip joint presents diagnostic problems. Conventional radiography offers little information about the presence of synovitis.

Sonography was studied in the preoperative evaluation of the hip joint in 16 hips in 14 patients, aged 7–22 years, with juvenile chronic arthritis (JCA). Arthroscopic examination and intracapsular pressure monitoring was performed as well.

The joint capsule distension found at sonography correlated well with the degree of synovial inflammation found at arthroscopy and with the intracapsular pressure.

Sonography and intracapsular pressure recording can be recommended as tools in the diagnosis of synovitis of the hip joint in JCA.

Femoral neck anteversion measured by ultrasound and radiography

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The angle of anteversion of the femoral neck (AV-angle) is an important parameter in the evaluation of children with an intoe gait. In order to avoid the radiation exposure connected with radiography, the use of new non-ionizing techniques for determining the AV angle is desirable. Real-time ultrasonography has been tested for this application, and the AV-angles compared with those measured by the radiographic method of Rippstein.

Twenty-seven children from 3 to 14 years of age were examined. With the patients in the supine position, an anterior ultrasound scan along the long axis of the femoral neck was obtained. Two modifications of assessing the intercondylar plane were tested. In the children of Group A the knees were flexed 90° over the edge of the table, and both legs strapped. In Group B the knees were extended, and the posterior contour of the femoral condyles was scanned as a reference line. The AV-angles were determined from the proximal scan in Group A and by combining the angles from the two scans in Group B.

The median differences between the AV angles measured by ultrasound versus radiography were 3° on the right and 4° on the left side in group A and 5° and 3° in Group B. Because the accuracy of the method of Rippstein is approximately 5° and that of the ultrasound probably somewhat less, a difference between the values of the two methods of 10° or less appears acceptable. Five out of 32 hips in Group A had a difference in the range 11–21°, whereas a discrepancy greater than 10° was found in only 1 out of 22 hips in Group B (12°). Thus, the AV angles showed a good agreement in most patients.

In conclusion, it appears that ultrasound is appropriate as a screening method for children with rotational disorders of the femur.

A new method for routine measurement of the rotational deformity of a tibial fracture and the bilateral tibial torsion determined in a hundred normal adults

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A new method for measuring the tibial torsion or, more importantly, the rotational deformity between the fragments of a tibial fracture is presented. The method is simple, fast, and accurate, and can be used when dealing with acute fractures, for instance, in conservative treatment. Plaster of Paris signifies no difficulty. For the measurement, you need only such equipment that can be found in clinics where fractures are treated, which means a C-arm image intensifier equipped with a protractor. The procedure is comfortable for the patient, but demands that the knee can be fully extended. The lines of reference are the tangents to the dorsal contour of the femoral condyles and to the inner surface of the medial malleolus at a defined level. The reproducibility of the method is high. The x-ray dose for the patient and the examiner is negligible.

The above-mentioned method has been used to determine the bilateral tibial torsion in a study of 100 normal adults (18–61 years of age) who had never suffered an injury to the knee, tibia, or ankle. The individually measured tibial torsion varied strongly (12–51 degrees), which is in agreement with other results.

The present study shows that the normal adult can have a difference of tibial torsion of at least 14.5 degrees without noticing any discomfort.

The torsional difference between the right and left sides of the tibia of the same normal adult individual seems also to be distributed according to the standard normal distribution curve (n = 100). Approximately 75 per cent of the individuals are within ± 6 degrees, and the curve maximum lies at about 2 degrees to the right.

Magnetic resonance imaging of osteonecrosis in the knee with interradiologic correlation

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Material. Five cases of spontaneous osteonecrosis in the knee joint were examined with magnetic resonance imaging (MRI). Interradiologic correlation was done with conventional radiographs and bone scintimetry. Comparisons were made with other diseases that cause pain in the knee.

Method. A whole-body MRI-unit (Acutscan, Instrumentarium) was used. The equipment works at a very low field strength, 0.02 Tesla. Images with both T1 and T2-weighing were generated.

Results. The equipment produced images with good contrast separation of the different tissues in the knee region. Both T1 and T2 were lengthened in the bone marrow in substantial parts of the affected condyle in osteonecrosis. The pathologic changes depicted with MRI were obvious and widespread when radiographs still were normal. The areas with lengthened relaxation times coincided with the elevated bone tissue metabolism depicted with bone scintimetry. Also other disease states in the knee rendered lengthened relaxation times of the bone marrow.

Conclusions. Magnetic resonance imaging is a very sensitive method in depicting pathologic changes early in osteonecrosis. The findings are not specific for osteonecrosis. Nevertheless, it gives an image that correlates well with the patients' clinical symptoms while plain radiographs are still normal.

Magnetic resonance imaging of syringohydromyelia and Chiari malformations in myelomeningocele patients with scoliosis

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The brain and spinal cord were examined with magnetic resonance imaging (MRI) in myelomeningocele patients to study the incidence of syringohydromyelia and Chiari malformations, and to correlate these lesions with developmental scoliosis and spontaneously arrested hydrocephalus.

Method: MRI was performed using a 1.0 Tesla (T) superconducting magnet (magnetom, Siemens) operating at 0.35 T and later at 0.5 T, using a spinPecho technique with T1-weighted images (TE 35, 70, TR 300/500 msec).

Material: The skull and spine were studied in 30 myelomeningocele patients, 15 males and 15 females, age 3–32 years. For comparison, scans of the spines of 9 volunteers were obtained. Referral for MRI was on the basis of developmental scoliosis and/or signs and symptoms suggestive of lesions in the brain stem or the spinal cord from levels above the myelomeningocele and/or spontaneously arrested hydrocephalus.

Results: Twelve patients had syringohydromyelia, 4 of whom had widened spinal cords and 8 various degrees of spinal cord atrophy. The Chiari I malformation was present in 2 patients and the Chiari II malformation in 28 patients. Syringohydromyelia was present regardless of type of scoliosis, result of shunting procedures, neurologic levels, and extent of the Chiari malformation. In patients with widened spinal cords, there was a good clinical correlations between the extent of the cavities and the neurologic deficits. The brain stem was deformed and compressed at the foramen magnum due to the Chiari malformation, which caused marked spastic paresis in 3 patients and multiple cranial nerve deficits in 2. The two patients with the most rapid progression of their scoliosis had the most extensive syringohydromyelia. Both had high thoracic scoliosis and low lumbar lesions.

Conclusion: Neurologic deterioration due to syringohydromyelia or the Chiari malformations is probably more common in myelomeningocele patients than previously recognized. These lesions may cause or aggravate scoliosis, loss of ambulation, and impaired upper extremity function. MRI can, in spite of marked scoliosis, visualize these lesions noninvasively in any plane without the use of ionizing radiation or intrathecally administered contrast materials.

Roentgen stereophotogrammetric analysis – RSA – of the LMPCH prosthesis

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In an uncemented total hip prosthesis, there is always the question of how to evaluate fixation. Subsidence and rotation of the femoral component are impossible to measure with any degree of precision on plain radiographs. The aim of the present investigation is to study motion in the femoral canal of the LMPCH (Low Modulus porous Polyethylene Coated Hip) prosthesis with RSA.

The prosthesis is made of titanium alloy, and small tantalum balls were placed in the proximal and distal parts of the stem. Because of the higher radiopacity of tantalum, the balls are detectable on radiographs. The stem is coated with 3 mm thick polyethylene in which six tantalum balls were placed at different levels. During the operation of the 10 patients included in the study, five tantalum balls were inserted in the greater and three in the lesser trochanter. Pairs of radiographs were taken in a fixed set-up with the roentgen tubes at an angle of 45 degrees to each other post-operatively and after 6 weeks and 3, 6, 9, and 12 months.

During the first 3 months when the patients were allowed only touch-down weight-bearing, the subsidence was small (mean value 0.4 mm). In the next 3 months, the subsidence increased by 0.76 mm; but then the rate decreased, and at 1 year the total subsidence was 1.6 (1.1–2.5) mm. Even if the subsidence varied in magnitude between patients, they all followed the same pattern. All the prostheses rotated inwards, with the rate of rotation also decreasing with time. At the 1 year follow-up, the rotation was 4.4 (2.4–7.6) degrees.

We found that RSA makes it possible to register subsidence and internal rotation of the LMPCH prosthesis, information that could not have been obtained by other means. Of importance in this context is that the design of the prosthesis allows attachment of tantalum markers to it. The results show that there is early migration of the prosthesis in the femur at a gradually decreasing rate, the clinical importance of which is uncertain.

Mechanical loosening of total hip prostheses: A radiographic and roentgen stereophotogrammetric study

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Radiographic criteria of mechanical loosening are not well defined. Consequently, the interpretations of radiographic investigations have been conflicting. We studied the pattern of migration of the components in THP with roentgen stereophotogrammetry (RSA) and compared the results with conventional radiography.

Patients and methods: 20 patients with 20 THP were investigated postoperatively for 2 years. Tantalum balls were implanted into the os ilium and into the proximal femur during operation. RAS and radiographic examinations were performed postoperatively, after 4 months, and after 1 and 2 years.

Results: 11 acetabular and three femoral components migrated. After an initial period of rapid migration, most components migrated slowly. Eight of nine stable acetabular components had an incomplete radiolucent zone, but 1 of 11 migrating components had no discernible radiolucency. Seven of seventeen stable femoral components had an incomplete zone adjacent to cortical bone, but 2 of 3 migrating femoral components had no discernible radiolucency adjacent to the cortical bone.

Discussion: The pattern of migration may be explained on the basis of thermal necrosis of bone at polymerization. During the first postoperative months, most necrotic bone will be resorbed, allowing a rapid migration. The more frequent migration of the acetabular component compared with the femoral component is explained by heat abduction by the metal.

Radiographic examination is not well suited for assessing mechanical loosening at an early stage. RSA, however, may reveal migration within 4 months after surgery.

Instability of the anterior cruciate deficient knee

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In order to assess knee instability under reproducible conditions, external transducers or radiographic tech-

niques have been used to register the effect of standardized forces. In the present study, we measured translations and rotations in 17 patients with knee problems (due to a previous rupture of the anterior cruciate ligament) using roentgen stereophotogrammetric analysis. The knees were investigated at about 30° of flexion and with anterior (150 N) and posterior (80 N) traction.

All the patients displayed an increased anterior displacement on the injured side (mean = 7.9 ± 2.8 mm). The amount of anterior-posterior displacement could entirely separate the injured knees (mean = 13.4 ± 3.1) from the normal ones (mean = 5.1 ± 1.3). Analysis of rotational movements of the tibia of the anterior loading revealed decreased internal rotation and adduction and with posterior loading increased external rotation on the injured side.

Roentgen stereophotogrammetric analysis provides a complete kinematic analysis of movements occurring during a test situation. The reproducibility of the sagittal translations was sufficiently high for individual analysis.

Bone scintigraphy in orthopedic practice

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Bone scintigraphy with ^{99m}Tc-methylene diphosphonate has been found valuable when clinical and radiographic examinations fail to solve diagnostic problems.

A reviewed 1 year, unselected, consecutive patient material referred to bone scintigraphy from the Department of Orthopedics is reported. The material comprised 55 men and 66 women aged 1–92 (mean 50) years from a catchment area of 140,000 inhabitants. Special interest was paid to what part of the skeleton was of interest, what diagnostic questions indicated the scintigraphy, and what diagnostic value the scintigraphy had for the final diagnosis.

The parts of the skeleton of interest, as a percentage, were whole skeleton 14, trunk 8, upper extremities 11, and lower extremities 67. In most patients, several diagnostic alternatives occurred before scintigraphy. These were reduced after scintigraphy. The reduction was more pronounced (45%) when specific diagnostic questions were asked about, such as osteitis, bone tumor, osteonecrosis, fracture. It was observed that in symptomatic patients with normal radiographs, bone scintigraphy was abnormal in almost 50 per cent. Bone scintigraphy was estimated to be of major value in establishing the final diagnosis in 56 of the 121 patients.

Prognostic precision in early postoperative ^{99m}Tc-MDP scintimetry after femoral fracture fixation

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Introduction: The predictive value of skeletal scintimetry at the time of femoral neck fracture fixation has been proven in smaller materials recently. Deficient femoral head uptake as compared with the intact side (ratio <1.0) predicts healing complications while intact femoral head uptake on the fracture side is correlated with uncomplicated healing. This report aims at determining the predictive value of skeletal scintimetry in a larger patient material.

Patients and methods: Through 3 years, the vast majority of femoral neck fracture patients at our clinic had ^{99m}Tc-MDP scintimetry performed 1–2 weeks after fracture fixation. Of these, 302 were followed for 2 years postoperatively or until healing complications occurred. The patients' age was 78 (18–91) years and female/male ratio 3/1. A numerical isotope uptake evaluation was performed with a dedicated computer system. The isotope uptake per picture element in the femoral head of the fracture side was compared with a corresponding uptake on the intact side.

Results: In all, 196 cases showed an intact femoral head uptake (ratio ≥1.0). Of these, 178 showed no signs of healing complication at 2 years, whereas 18 had developed redisplacement, nonunion, or segmental femoral head collapse. Totally, 106 cases had deficient femoral head uptake (ratio <1.0). Ninety of these had developed healing complications during the first 2 postoperative years, whereas 16 cases showed no signs of radiographic complications at 2 years. This gives a prognostic accuracy of 89 per cent. When looking for femoral head avascularity as a sign of healing complication, the sensitivity of the procedure was 85 per cent and the specificity 91 per cent.

Conclusion: ^{99m}Tc-MDP scintimetry performed within 2 weeks after femoral neck fracture fixation may predict the outcome of the healing course with a prognostic accuracy of 89 per cent.

Intracapsular pressure and caput circulation in undisplaced femoral neck fractures

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Preoperative Tc-MDP-scintimetry and ultrasonography of both hips were performed in 9 patients with undisplaced femoral neck fractures.

The scintimetry ratio and the difference in capsular distension of fractured/intact side were correlated with the intracapsular hip joint pressure of the fractured side recorded peroperatively.

The intracapsular pressure in the straight neutral position of the hip was increased in all cases (mean 73 mmHg). It correlated well with the capsular distension in seven of the nine hip joints.

All the patients with an intracapsular pressure >80 mm Hg had a scintimetric ratio <0.80, indicating an obstruction of the vascular supply to the femoral head.

In conclusion, intracapsular tamponade may contribute to the development of avascular necrosis of the femoral head in patients with undisplaced femoral neck fracture.

Radiographic examination revealed 16 per cent with migration of the acetabular screw ring; in 4 patients we found the migration progressive. Two patients were reoperated on, in 1 we exchanged the screw ring and in the other we extracted the prosthesis. Early signs of stress shielding were evident in the proximal femur in 11 per cent. We still cannot tell how progressive this finding will be. No major local or systemic complication was recorded.

Conclusion: Although our preliminary results are very good, we still consider this kind of reconstructive surgery in young patients as clinical developmental work demanding careful and prospective follow-up and strict indication. A socioeconomic cost- benefit analysis showed that the economic outcome is very favorable for society, as well for the patients. The operative technique is demanding, with a significant learning curve. We now believe it can produce durable results, but the final outcome of the radiographically evident bone remodelling is still not clear.

Posters

Cementless THR in young patients using a porous-coated femoral implant: 2–7 years follow-up

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Since 1979, we have used Lord's cementless hip prosthesis in reconstruction of young patients with degenerative hip disease. The study is prospective and longitudinal with annual clinical and radiographic controls. The purpose of the investigation is to gain experience about suitable indications and to evaluate long-term complications.

Totally, 100 patients have been operated on and the follow-up period is 2–7 years. Age at operation was 47 (25–65) years, and females slightly predominated. The diagnosis was primary arthrosis in 34%, consequences of different types of diseases in childhood, usually CDH in 27 per cent and posttraumatic arthrosis in 14 per cent. Preoperatively, 53 per cent of the patients were sick listed, 16 per cent had a disablement pension.

In evaluating the results, we have used the Charnley-d'Aubigne score. Pain relief was excellent or good in 91 per cent (score 5 or 6). Function was excellent or good in 75 per cent. The motion improved from 3.2 to 5.4, and 87 per cent were excellent or good. An important finding was that 1 year postoperatively 80 per cent of the patients were back in full-time employment.

Protrusio acetabuli in rheumatoid arthritis

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Severe erosion of the bottom of the acetabulum often with a complete bone defect is not uncommon in rheumatoid arthritis of the hip. The development of this protrusio acetabuli is often fairly rapid and can be clinically notified by a progressing shortening of the leg, together with severe pain, and can also be followed radiographically. In reconstruction of the hip, the cup of the prosthesis has to be a) fixed to the acetabular bony ring and b) supported at the bottom of the acetabulum. The force transmitted to the cup must be spread as much as possible over the pelvic bone. A technique of transplantation of cancellous bone to the bottom of the acetabulum in cemented cups, together with a supporting metal netting is described. The amount of cement is reduced by the method. Full-weight bearing is allowed from the first postoperative day. There has been good healing of the bony transplant with a good bony bottom of the acetabulum in 64 out of 65 consecutive transplanted hips. To date, there are no loose cups.

Foreign-body reaction inducing loosening of the Christiansen total hip replacement: A histologic study

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The trunnion-bearing Christiansen total hip replacement (Chr THR) had a socket and a trunnion sleeve made of poloxymethylene (POM) or Delrin®. More than 5,000 Chr THR were implanted in Sweden during the 1970s. Today, more than 1,000 of them have been revised, most often owing to aseptic loosening. Common findings are worn sockets and excessive bone loss in the acetabulum and proximal parts of the femur. These observations have been confirmed at revision and then also masses of caseous debris material were found within the joint cavity. Altogether, these findings are indicating a foreign-body reaction. We have studied the debris, the regenerated synovial membrane, and the bone-cement interface with both conventional light microscopy and transmission electron microscopy (TEM). The intraarticular debris consisted of a necrotic fibrinoid material that also lined the synovial membrane. Polarizing light revealed Delrin particles in the detached intraarticular masses, as well as intracellularly and extracellularly in the joint capsule. Our microscopic findings are similar to those demonstrated by Willert et al. (1977) regarding polyester and the Weber prosthesis. The histologic reaction found here seems to be similar to that demonstrated by Wroblewski (1979) and Webbs (1980) regarding an excessively worn soft-top hip (polyethylene) prosthesis.

TEM demonstrated multiple large multinucleated activated macrophages resembling osteoclasts. Their cytoplasm was filled with vesicles that were surrounded by Delrin particles.

Conclusion: Plastic wear followed by macrophage activation and subsequent bone resorption is probably a major mechanism in loosening of Chr THR.

A controlled study of DVT prevention with preoperative dextran and graduated compressive stockings in total hip arthroplasty

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Patients: Totally, 150 patients who were subjected to THA were randomly allocated into three groups with standard dextran administration separately or in combination with either preoperative dextran or graduated compressive stockings.

Methods: DVT was diagnosed with ^{125}I-fibrinogen uptake in the nonoperated leg and in the calf of the operated on side, as well as with ascending venography of the operated on thigh.

Results: DVT was considerably lower in the patient group with stockings than in the other two groups regarding the operated on calf, as well as the overall rate. The difference from the group with preoperative dextran was significant. The DVT rate was also considerably lower in the nonoperated on leg of patients with stockings. The difference was significant from both of the other groups. However, DVT of the operated on leg diagnosed with venography did not differ between the three groups.

The peroperative blood loss was on an average 400 ml less in the compressive-stocking group than in the other two groups ($P < 0.01$).

Conclusion: Bilaterally graded compressive stockings can be recommended as a complement to pharmacologic thromboprophylaxis.

Total condylar knee replacement in rheumatoid arthritis: Four to six years' follow-up

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Between February 1979 and January 1982, 119 consecutive total condylar knee arthroplasties were performed in 82 patients as primary intervention for rheumatoid arthritis. The 4–6-year results are reported.

Twelve patients (17 knees) died in the follow-up period; two knees in 2 patients had an arthrodesis due to a knee infection. One patient had a hip exarticulation due to an infection in a total hip prosthesis. Eight knees in 6 patients were lost to follow-up. The remaining 91 arthroplasties were carried out in 61 patients, 12 men and 49 women, aged 55 (24–79) years at operation. Thirty patients had both knees replaced in the period. The mean follow-up time was 59 (49–75) months. All the patients were evaluated preoperatively and postoperatively using the New York Hospital for Special Surgery Knee-Rating Scale.

Excellent or good results were found in 89 per cent according to the total score. Walking pain was present preoperatively in 92 per cent. On the contrary, 95 per

cent had none or slight walking pain at follow-up. Pain at rest was found in 71 per cent preoperatively changing to 93 per cent with no pain at follow-up. A walking distance >500 meters was present preoperatively in 5 per cent and in 56 per cent at follow-up. In 58 per cent a lack of extension of more than 10° was found preoperatively; at follow-up, 88 per cent had no extension lag. Normal tibiofemoral alignment (3°-11°) was present preoperatively in 25 per cent and in 85 per cent at follow-up. In 11 patients a total of 16 complications were recorded, making the overall complication rate 13 per cent. Three complications were serious, all deep-knee infections. The remaining complications except two were early, deep thrombophlebitis being the most common (5%). Total condylar knee replacement in rheumatoid arthritis was found to relieve pain effectively in most patients and at the same time increase the walking distance. The overall complication rate was low.

Early results and complications of the Oxford Knee Endoprosthesis in unicompartment gonarthrosis

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Introduction: The Oxford Knee Endoprosthesis, with a free- mobile, high-density polyethylene meniscus, has been in clinical use since 1978. Few clinical reports are available. The concept has theoretic advantages as regards knee mobility and stress distribution, but it is not without controversy. At our department, we have used the Oxford Knee for unicompartmental replacement since 1983 and report our experience of the first 48 knees in 47 patients, 23 males and 24 females, aged 64 (42–85) years.

The indications for operation have been unicompartmental gonarthrosis Grades I-III according to Ahlbäck; 43 knees with medial and five knees with lateral arthrosis have been operated on.

The patients were examined at 6 weeks, 3 and 6 months, and 1 year after the operation. Nineteen patients have been followed more than 1 year. The clinical parameters recorded were pain, knee flexion, and stability.

Radiographic examination has been performed postoperatively, at 3 months and after 1 year.

Results: Of 46 knees examined at 3 months postoperatively, all were improved and 33 were painless. Twenty-five patients did not use a walking support, and 34 of the 46 patients had a knee flexion exceeding 90 degrees. Radiographic examination revealed in 1 patient a minimal zone of resorption. One year after operation, 14 of 19 patients had no pain. Seventeen of 19 had a knee flexion exceeding 90 degrees. All were stable. In 3 patients a minimal zone was recognized beneath the tibial component. Superficial wound complications were seen in 4 patients, and there were two complications related to the endoprosthesis: one luxation of the meniscus and one loosening of the tibial component that was probably due to a deep infection.

Conclusion: In 48 knees operated on with the Oxford Endoprosthesis, the peroperative and early postoperative complication rate showed no difference from other series reported. The early clinical outcome has been good and encouraging.

Modality of management of the fibula in high tibial osteotomy: Union times and complications

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The modality of management of the fibula was examined in a retrospective study comprising 300 tibial osteotomies performed in 285 patients.

It was shown that osteotomies of the fibula united later than those of the tibia, the most serious complications being neurovascular disorders. No complications arose when the inferomedial portion of proximal fibula was resected and the syndesmosis was detached, nor in valgus osteotomies when the fibula remained intact. Most complications in curved osteotomy were found at fibular osteotomy performed 15 cm below the fibular head and in wedge osteotomy in connection with loosening of staples used for fixation.

In conclusion, clinical and radiographic complications tend to increase when the fibula is osteotomized 10–15 cm below the fibular head, whereas complications at level above showed the lowest number. The union time of the tibial osteotomy was not associated with the site of fibular osteotomy, but the union time of osteotomies where staples were used was best for both the tibia and the fibula.

Changes of the incidence of ankle fractures during 30 years

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Epidemiologic studies of other fractures, i.e., hip, distal end of the radius, have shown an increased incidence in elderly persons. It is therefore interesting to study ankle fractures in this aspect.

Material and methods: All the radiographs of ankle fractures from 1950 to 1954 and 1980 to 1984 were reexamined and classified according to Lauge-Hansen (1942). Age- and sex-specific incidences for the main types of fractures were calculated using the population census figures of the city's files.

Results: Altogether, 1,784 fractures were found. In the 5-year sample from the 1950s, there were 324 men and 281 women and from the 1980s, 580 men and 629 women. In the 1950s, 61 per cent of the ankle fractures in women and 57 per cent of those in men were of the supination-eversion type (SE). In the 1980s, supination-eversion fractures contributed 68 per cent of the ankle fractures in women and 67 per cent in men.

The age- and sex-specific incidence: In SE II injuries, there was a significant increase in middle-aged and old women in the 1980s as compared with the 1950s. In men there was a significant increase in the young and middle-aged men. SE IV fractures had increased in old and middle-aged women; there was also some increase in men. Pronation injuries had increased slightly in men during the last 30 years. Even if both SE II and SE IV injuries have increased in women, the ratio has changed during the 30 years under study. A much larger portion today is the more severe SE IV injury.

The ankle fracture is now demonstating a fragility fracture pattern in women.

Thirty-year follow-up of conservatively treated ankle fractures

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Totally, 143 patients who were treated by closed methods for an ankle fracture were followed up after 29 (25–34) years. The patients were interviewed in a standardized way regarding subjective symptoms; a clinical and a radiographic examination with three standard projections were also undertaken.

At follow-up, 83 per cent of the patients had no subjective complaints, and 82 per cent had no radiographic signs of arthrosis. Patients with the most common type of ankle fracture, the isolated lateral malleolar fracture, supination-eversion Stage II, showed minimal signs of arthrosis in but 1 patient. Only 3 of 49 patients had any subjective complaint. When the Lauge-Hansen classification was applied to the fractures, it reflected the prognosis well, with more posttraumatic arthrosis among more severe stages. The Weber classification did not correlate as well with the prognosis of the fracture.

The idea that all ankle fractures must be perfectly reduced is not supported by the findings of the present study. SE II fractures did not develop arthrosis in spite of a high frequency of residual displacement of the lateral malleolus.

Hallux rigidus

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I treated 138 patients, 89 women (65%) and 49 men for hallux rigidus and hallux valgus with arthrosis. The mean age at the debut of symptoms was 47 and 46 years for the men and women, respectively.

The valgus position was recorded clinically in 198 big toes. Forty toes had a valgus position of 10 degrees or more, with a mean of 18 degrees. In the remaining 158 toes, the average valgus was 4 degrees.

Ninety-five patients were operated on ad modum Keller, with 77 excellent, 12 fair, and 6 poor results.

Preoperatively, the mean passive dorsiflexion was 27 degrees and postoperatively, 47 degrees.

In hallux rigidus the radiographs showed an unusual flattening of the metatarsal head in both frontal and side views. This observation and the clinical findings indicate that a special configuration of the metatarsophalangeal joint may be an etiologic factor disposing to arthrosis in this joint.

Internal fixation of pathologic fractures of the odontoid process through an anterior approach

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Five patients, aged 54–71 years, with pathologic fractures of their odontoid process were treated. Three were admitted because of neck pain upon and during movement, and 2 had neck pain after minor trauma. None of them had neurologic deficits. In all the cases, the tumor was resected through an anterior approach. The odontoid process was fixated internally with one or two bone screws. Two image intensifier C-frames were used. The screws were deliberately chosen too long; the heads of the screws were placed in the cavity after the resected

tumor. The cavity was then filled with methylmethacrylate. The system was anteriorly stabilized by an H-plate and screws.

All the patients obtained immediate pain relief; 4 were mobilized on the first or second postoperative day and 1 was mobilized on the eleventh day.

In one case a posterior fusion at C1-C2 was performed 2 months after the anterior fusion because of destructions in the pedicles of the second cervical vertebra. This patient returned to work 4 months after surgery and is still working 4 years later. One patient died 2 months after surgery of generalized metastatic disease.

Conclusion: By resection of the tumor and anterior fusion by internal rigid fixation, it is possible to obtain immediate pain relief, early mobilization, and to regain nearly a normal range of movement in the cervical spine.

Short or long plaster of Paris bandage for fractures of the four ulnar metacarpals

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A few years ago metacarpal fractures were immobilized with the MP and PIP joints flexed a.m. Jahss. In the now common ulnar plaster bandage, the MP joints are often immobilized in extension, although the safe position is aimed at. The need of immobilization of the fingers in hands with metacarpal fractures has been analyzed in fractures of the four ulnar metacarpals treated in 1985.

Totally, 230 fractures have been treated with a short ulnar plaster bandage from the middle of the forearm to the MP joints permitting free movements in the fingers. This short case is molded over felt pads over the fractures to provide a three-point fixation. Finally, 130 fractures were treated with the usual ulnar plaster bandage running to the finger tips with the joints in the safe position. Both groups were immobilized for 3 weeks, and the patients were seen after 1 and 3 weeks and at follow-up at 3 months. In the group treated with a short plaster bandage, the restoration of function was achieved earlier and the bony anatomy was not inferior.

Missed injuries in an orthopedic department

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In order to analyze factors predisposing to diagnostic failures associated with injuries, all the patients visiting the emergency room or admitted to the orthopedic department were registered during a period of 6 months (July-December 1985).

A missed injury was defined as an injury not diagnosed in the emergency room at the first clinical and radiographic assessment or during the first day of observation in the orthopedic department.

The emergency room was consulted by 15,637 patients during the period of registration. In that group, 87 injuries were missed at the original examination by the physicians on duty.

In all, 952 patients were admitted to the orthopedic department, among whom 17 injuries were missed during the first day of observation.

All the patients and radiographs were examined by senior staff surgeons and radiologists. During this examination, nine injuries were missed. Four of these injuries required supplementary radiographs for a valid diagnosis.

In conclusion, the overall rate of missing an injury during the first assessment was 0.63 per cent.

Measurement of skin perfusion pressure: an aid to amputation level selection

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The ratio below-knee (BK) to above-knee (AK) amputations remains at 2:3 in Denmark and England, with a failure rate of about 15 per cent when the level is selected by means of clinical evaluation alone. When amputation for occlusive arterial disease is inevitable, it is of the utmost importance to save the knee on the assumption that stump healing can be expected. This aim has stimulated interest in methods for determining objectively the level of amputations. The present paper presents the outcome of 246 lower leg amputations performed after introduction of the photoelectric technique for preoperative measurement of skin perfusion pressure (SPP) for assessment of proper amputation level.

Among 246 amputated legs, 169 were selected for BK and 77 for AK amputation. Ten patients died before their stumps could be assessed healed or not; thus, 236 amputations comprise the analysis, 165 (70%) BK and 71 (30%) AK. Out of 12 BK amputations with an SPP $\leq$30 mmHg at the amputation level, five stumps failed to heal (42%). Among 49 BK amputations with an SPP of 31–40 mmHg, eight stumps failed (16%) and of 104 BKs with an SPP >40 mmHg, 13 stumps failed (12%).

The difference in failure rate with an SPP ≤30 mmHg compared with patients with an SPP >31 mmHg was significant (P <0.02). Among 12 AK amputations with an SPP ≤30 mmHg, six failed (50%). Out of 27 AK with an SPP of 31–40 mmHg, three failed (11%); and among 32 AK with an SPP >40 mmHg, one failed (3%). The difference in failure rate was significant between the various SPP groups for AK amputations (P <0.001). The overall failure rate for BK and AK was respectively 16 per cent and 13 per cent.

In conclusion, SPP measurement is predictive for healing of an amputation. An SPP ≤30 mmHg gives a chance for healing of 54 per cent; an SPP between 31 and 40 mmHg gives a chance of 85% healing; and an SPP above 40 mmHg gives a chance of healing of 90 per cent irrespective of measuring level. Using SPP measurements, our study shows that the amputation level can be lowered from AK to BK by 25 per cent with the same failure rate.

Low-frequency transcutaneous electrical nerve stimulation (TENS) after major amputations

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Forty-nine patients undergoing major amputations of the lower limb were postoperatively randomized to one of three groups. Group A: Sham TENS and chlorpromazine 10 mg x 3. Group B: Sham TENS. Group C: Low-frequency TENS to the ipsilateral femoral and sciatic nerves. TENS and sham TENS were comparable with regard to age, sex, amputation level, and number of diabetics.

The average weekly analgesic consumption during the second and third postoperative week was significantly lower in Groups A + C than in Group B (P <0.05). No patients in Group C complained of phantom pains 4 months postoperatively, whereas 50 per cent of the patients in Groups A + B did (P <0.05). All the patients in Group C felt TENS was of value, whereas 50 per cent of those who had received sham TENS felt it had relieved pain.

There were fewer reamputations in Group C than in Groups A + B. The stump healed sooner in patients in Group C than in patients in Group A (P <0.05).

Conclusions: Low-frequency TENS reduces the incidence of long-term phantom pain. It also, to some degree, reduces pain and promotes healing.

Orthopedic anatomy and pathology on laser videodisc

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In recent years a great number of elaborate orthopedic-surgical procedures have been developed (joint replacements, ligament reconstruction, arthroscopic surgery, microsurgery).

Advanced computerized imaging modalities, such as CT and MRI, are increasingly implemented to diagnose orthopedic disorders; they depict the topographic anatomy in a sectional (segmental) display.

The need for an improved and accurate anatomic reference material is reflected by the great number of atlases on segmental anatomy published during the past decade. For a clinically useful anatomic material, it is indispensable that the undistorted topographic relationships between the bony skeleton and the contiguous soft tissues are preserved.

Using the Uppsala technique of cryoplaning of freshly frozen cadaveric specimens, a large number of spine and joint specimens were studied. Every specimen rendered hundreds of perfectly recorded images of superb resolution.

A new electronic medium was explored to determine whether a large number of pictures could be stored while maintaining image quality.

Several thousand color transparencies were transferred to an optical reflective laser videodisc. This medium poses specific requirements for formatting of the material, with meticulous care in preserving the recording and color fidelity.

The playback of the anatomic images with the laser videodisc offers a host of display facilities that cannot be shown by other media.

Still images can be viewed indefinitely, sequences of images played at optional speeds, rendering an animated, cinemorphologic and three-dimensional perception.

Using a computer, segments and particular images are shown in a program that is expected to have a high educational impact.

Arthroscopic resection of the acromion

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Arthroscopic resection of the acromion has not been reported previously. In an experimental study on 20

cadaver shoulders, arthroscopy of the subacromial/subdeltoid bursa was followed by percutaneous, arthroscopically controlled resection of the acromion.

The undersurface of the acromion, the coracoacromial ligament, and the acromioclavicular joint were marked with needles to facilitate the identification at the arthroscopy of the bursa.

With Storz surgical and endovision TV arthroscopy equipment, resection and abrasion of the acromion, the coracoacromial ligament, and the undersurface of the acromioclavicular joint could be carried out using Dyonics motorized intraarticular surgical equipment.

This indicates that the percutaneous intrabursal arthroscopic technique is practicable for treatment of the so-called subacromial syndrome. The method is under clinical trial.

Results of Magnusson-Stack and Putti-Platt repair for recurrent anterior dislocation of the shoulder

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The subscapularis tendon is often used to reinforce the anterior capsule at surgery for recurrent anterior shoulder dislocation. In this study, two different techniques of subscapularis tendon raphi were studied.

Patients and methods: 47 patients (aged 27 ± 8 years), 31 men and 16 women, were studied. A general joint laxity was found in 13, more often among those 7 patients with a nontraumatic first dislocation. Follow-up was done 30 ± 12 months after the operation. Results were evaluated in a scoring scale modified from Solonen & Vastamäki. The total score is based on symptoms of pain (20 p), instability (15 p), activity restrictions (11 p), and range of motions (ROM). The maximum score is 60 points.

Results: The operation time was significantly shorter for the Magnusson-Stack compared with the Putti-Platt operation (59 ± 12 and 80 ± min.; $P < 0.001$). The sick leave was similar for both groups (2.5 ± 1.3 months). Three patients had additional surgical procedures before the follow-up; one after the Magnusson-Stack operation for posttraumatic arthrosis after a fracture dislocation, and two after a Putti-Platt operation because of posterior instability. The mean score for the remaining 44 patients was 55 ± 5 points. Two of 27 patients in the Magnusson- Stack group had occasional episodes of subluxation. In the Putti- Platt group, 5 of 17 patients had symptoms of instability; 2 had recurrent luxations, and 3 had subluxations-2 of them occasionally and 1 frequently ($P < 0.05$). The ROM for external rotation was less in the Putti-Platt group when compared with the Magnusson- Stack group ($P < 0.05$). In 3 patients, abduction was restricted to 100°, but besides that, the ROM was normal.

Conclusion: We found a somewhat higher frequency of recurrencies after the Putti-Platt operation, and the restriction of external rotation was greater. The Magnusson-Stack technique seems simpler, reflected by a shorter operation time.

Activity score for the evaluation of orthopedic patients

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When evaluating the results after orthopedic treatments, a number of subjective and objective variables usually are given. In order to control the successfulness of the measure taken, it is not enough to claim that the patient has improved subjectively. Only if the patient has improved subjectively and at the same time at least maintained his level of activity is it possible to claim that the undertaken measure has been successful.

In an earlier scoring system according to Merle-D'Aubigné and Harris, organ-specific parts are included, together with an indication of the activity level. In order to avoid this mixture of variables and scores, we have created a pure activity score.

We have used the score presented by Tegner et al. (1985), which estimates the activity level of knee-injured patients. We have sent questionnaires to almost 200 patients waiting for an operation because of arthrosis of the hip, the knee, or the ankle joint. The questions dealt with various kinds of activities, such as the ability to climb stairs or do garden work. The patients evaluated the various activities in a so-called semantic differential scale and after this they were ranked and the score was constructed. This means that the Tegner score has been modified and completed to cover the various levels of activity ranging from international-level top athletes to bed rest.

Ultraviolet radiation and air contamination during total hip replacement

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Ultraviolet radiation of the operating room was utilized in half of the operations in an open randomized study including 30 total hip procedures. Volumetric air sampling demonstrated that the number of colony-forming units (CFU/m^3) were significantly reduced ($P < 0.001$) both close to the wound and in the periphery of the operating room. Half of the central and all but one of the peripheral observations were below 10 CFU/m^3, the suggested upper limit for ultraclean air. Also, cultures from settling plates demonstrated a significant ($P < 0.001$ reduction of CFU/h×m^2. The distribution of the bacterial species will be discussed.

No adverse effects of the UV irradiation were observed among patients or the staff. In operating rooms fitted with a "zonal" ventilation system and with an air-change rate of about 70 times/hour, the addition of ultraviolet irradiation during surgery might make ultraclean air enclosures superfluous. However, in conventionally ventilated operating rooms, ultraviolet irradiation alone is probably not sufficient to achieve ultraclean air.

The drug-application bone chamber – a titanium implant for local application of biochemical agents to a standardized callus

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Several growth factors are known to stimulate connective tissue cells in vitro. Their effects in vivo are mostly unknown.

A titanium implant is inserted in cortical bone of rabbit tibiae. A canal through the implant will be gradually filled with ingrowing bone. The biochemical agent to be tested can reach the bone ingrowth canal by diffusion through a capillary in the implant. Continuous treatment for several weeks is possible, as well as repeated removal ("harvest") of the treated bone without excising the titanium implant, thus allowing repeated experiments in one site.

The harvested bone was examined by ^{99}Tc-scintimetry, radiographic densitometry, tissue culture in test media, and by Ca-analysis.

The implants were shown to function as intended by local application of ^{3}H-proline that was later found as ^{3}H- hydroxyporline in the collagen of the treated bone, but not elsewhere in the animal.

The drug-application bone chamber enables the study of the effects of various, even short-lived drugs on growing, as well as mature bone applied locally in situ.

Bone matrix and marrow versus cancellous bone in rabbit radius defects

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Demineralized bone matrix of allogenous origin can be used as a transplant instead of bone derived from the patient's own skeleton. Under certain conditions, it can be percutaneously applied. We have measured the bone yield of matrix transplants under conditions simulating clinical practice and compared it with conventional bone transplants.

Cancellous bone from the tuber ischii of the rabbit was transplanted to a preformed radial effect in the same animal. On the opposite side, a similar defect was filled with a mixture of either allogenous or autogenous bone matrix particles and autogenous bone marrow. After 4 weeks, standardized segments of the rabbit's forearms containing the middle of the defect were cut out, ashed, and analyzed for ^{45}Ca (injected intravenously 3 days before). With ^{45}Ca, no side differences were found, whereas the callus ash weight of the matrix-transplanted side was around 60 per cent of that of the cancellous bone side. Nontransplanted defects had very low ash weights and ^{45}Ca values.

Thus, in the rabbit, the effect of bone matrix and marrow is quantitatively comparable to cancellous bone.

Antibiotic diffusion into normal and infected knee joints: Experimental septic arthritis in rabbits

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We investigated the diffusion of penicillin (P), cloxacillin (CC), clindamycin (CM), and netilmicin (N) into synovial fluid and synovial tissue of rabbits. Twenty-four New Zealand white female rabbits (2–2.5 kg) were infected with 1,000 colony-forming units of *Staphylococcus aureus* in the right knee, while the left knee (saline-injected) served as a control. Forty-eight hours later, when purulent arthritis was manifest in the right knee, drug studies were performed. After i.m. injection of single doses (6 rabbits per drug), antibiotic concentrations were determined at various intervals in serum, synovial tissue (ST), and synovial fluid (SF) in both knees.

Antibiotic concentrations achieved in SF relative to those in serum were calculated as the ratios (in %) of the AUC (SF) (area under the concentration curve in SF) to AUC (serum), and were for the infected joints as follows: CM, 81 per cent; N, 54 per cent; P, 52 per cent; and CC, 14, percent, respectively. The corresponding ratios for the noninfected joints were 2–3 times lower overall. Similarly, antibiotic concentrations in ST were measurable only in infected knees. In spite of its relatively low penetrability into SF, CC concentrations were maintained for a longer period in both SF and ST than the other drugs, reflecting its higher protein binding.

The antibiotics tested diffused readily into SF and ST of infected joints resulting in sufficient activity against most common pathogens found in septic arthritis. Parenteral antibiotic treatment obviates the need for local antibiotic instillation.

^{99m}Tc-diphosphonate scintimetry in juvenile nonspecific arthritis, chronic hemarthrosis, and suppurative arthritis

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We investigated bone metabolism in juvenile nonspecific arthritis (NSA), chronic hemarthrosis (HA), and suppurative arthritis of the knee in puppies by means of ^{99m}Tc-diphosphonate scintigraphy, scintimetry, and contact autoradiography. Unilateral NSA was induced by weekly instillations of 1 per cent Carragheenan solution into one knee. HA was achieved by biweekly intraarticular injections of autologous blood. NSA and HA were studied by repeated bone scans every 14 days in an induction phase of 3 months and monthly in a recovery phase of another 3 months. SA developed immediately after a single inoculation of *Staphylococcus aureus* isolated from a human joint, and bone scintigraphy was performed after 2 days.

In NSA and HA, changes in uptake of radionuclide were present after 2 weeks. The induction phase was characterized by a decreased uptake in the juxtaarticular growth plates (ratio between induced and control joint 0.4 and 0.7 in NSA and HA, respectively) and a moderately increased epiphyseal uptake (ratio 1.2 in both NSA and HA). The recovery phase was characterized by a normalization of growth-plate uptake and a marked increase in epiphyseal uptake (ratio 1.8 in NSA and 1.5 in HA). In SA at 2 days, uptake in the growth plates tended to decrease (ratio 0.85), whereas the epiphyseal uptake varied considerably from a near complete circulatory arrest (ratio 0.3) to a marked increase (ratio 1.6). By contact autoradiography, the uptake of tracer in the growth plates could be located in the layer of provisional calcification. Epiphyseal uptake was seen mainly in a narrow subchondral bone layer. In the recovery phase after NSA and HA, epiphyseal uptake was also located around osteophytes, and in NSA around bone cysts. Central epiphyseal bone was osteopenic with a decreased uptake of tracer.

This investigation implies that the overall scintigraphic appearance of juvenile arthritis may be a decreased uptake of ^{99m}Tc-diphosphonate in spite of active disease due to a depression of growth-plate metabolism. In suppurative arthritis, the early scintigraphic changes may vary. Near normal scintigraphic images may be found in spite of fulminant joint infection. Epiphyseal circulatory disturbances may cause photopenic lesions in the epiphyses, and septic affection of bone may lead to a vast increase in uptake of tracer.

The relationship between nondestructive energy-absorptive capacity of trabecular bone and other mechanical properties

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The shock-absorptive capacity of trabecular bone may be of importance for the development of degenerative bone and joint disease, but the significance of this is unknown. The purpose of this investigation was to study the relationship between nondestructive energy absorption and other mechanical properties of human trabecular bone.

Cylindric specimens (N=34) from the proximal tibial epiphyses of human cadavers were tested repetitively (15 cycles, 0.1 Hz frequency) to 50 per cent of predetermined ultimate strength before the final destructive test. The energy absorption was determined at a fixed stress level relative to the real ultimate strength. The energy-absorptive capacity was defined as energy absorption per unit of bone volume. The relationship between the energy-absorptive capacity, the stiffness, ultimate strength, and ultimate strain was analyzed.

The well-known strong linear correlation between the stiffness and ultimate strength was observed ($r = 0.90$, $P < 0.01$). Ultimate strain was nearly constant (0.026 ± 0.003 (99% confidence limits), and was independent of ultimate strength and the energy-absorptive capacity.

Linear and nonlinear curve-fit analysis showed a positive linear correlation between the energy-absorptive capacity and ultimate strength, but the correlation was not strong ($r = 0.46$, $P<0.01$).

These findings indicate that ultimate strain is an independent variable, and it may be the parameter that determines the failure point. The poor correlation between the energy absorptive capacity and the stiffness and ultimate strength suggests that changes of energy-absorptive capacity may occur independent of strength and stiffness changes.

No effect of prostaglandin synthesis inhibition on regulation of epiphyseal blood flow

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Previous studies have shown evidence of metabolic regulation of epiphyseal blood flow. In order to investigate the possible role of prostaglandins in this regulation, the present study was undertaken.

By means of simultaneous intraosseous pressure and regional blood- flow measurements, the regulation of the hemodynamics of the distal femoral epiphysis was investigated during venous tamponade of the knee-joint capsule before and after inhibition of prostaglandin synthesis by administration of indomethacin.

During knee-joint tamponade, a significant increase in intraosseous pressure level and amplitude was seen, while no change in regional blood flow was encountered. Administration of indomethacin did not affect this reaction.

The results indicate that indomethacin has no influence on the ability to maintain a normal epiphyseal blood flow by active regulation during elevation of the joint pressure and that prostaglandins therefore probably have no role in this regulation.

Radiographic comparison of currently used metallic implant materials

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Aim: To compare the bony reaction to four contemporary metallic implant materials, implanted in a standardized experimental model.

Methods: 40 rabbits were used. One reference implant (pure titanium) was inserted into one of the tibiae and one implant of a test material into the other. The test materials were Tivanium®, Vitallium®, and AISI 316 stainless steel. The steel implants had two surface finishes – rough (similar to the titanium implants) and highly polished (similar to a screw or plate used in clinical practice). The observation times were 5 and 11 months, with the reference and test materials being equally distributed in both groups.

When the rabbits were killed, each tibia was radiographed on mammary film. The radiographs were presented to a digital image analyzer, and the density of bone was measured semiquantitatively around each implant. Besides yielding information on bone condensation, this method is highly sensitive in detecting a radiolucent zone around an implant. In this study the analyzer was used primarily in a qualitative sense – to detect or rule out a radiolucent zone.

Results, 5 months (39 implants – one rough stainless steel excluded because of postoperative dislodgement): 29 showed no radiolucent zone. Nine were inconclusive (4 pure titanium, 1 Tivanium®, 2 Vitallium®, and 2 polished steel). One implant showed a definite radiolucent zone (pure titanium).

Results, 11 months (40 implants): 38 showed no radiolucent zone. Two were inconclusive (both pure titanium). No implant showed a definite radiolucent zone.

Conclusions: In this experimental model, it was not possible from the radiographs to detect a systematic deviation in the bone response to the implant materials under study. Histologic studies must be used to provide the true answer. The higher number of inconclusive radiographs at the shorter observation time is most likely due to a less mature (less radiodense) bone at the interface.

Depressive effect of metal ions on bone remodelling in vitro

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The more frequent use of an uncemented joint prosthesis in modern orthopedic surgery to avoid the undesirable effect of bone cement has raised the problem whether metal ions released by corrosion of the prosthesis have any effect on bone.

We have performed in vitro studies in a fetal mouse calvarium system on the effect of cobalt, chrome, nickel,

etc., and investigated metal-ion interaction with cultured human osteoblast-like cells.

A direct inhibitory effects of all the metal ions was found on bone turnover, as well as on enzyme activity.

Surprisingly, we found only a little effect of Cr+++, although this ion has previously been reported to have high toxicity.

Our results thus demonstrate a clear depressive action of all metal ions normally found in the alloys of orthopedic implants, even in cultured human bone.

The external callus in fracture healing

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There are two kinds of callus in displaced experimental fractures, the periendosteal callus formed by osteoprogenitor cells directly into bone and the external callus that develops via cartilage. We have studied how this external callus develops with the aid of monoclonal antibodies against Ia-presenting cells and T-cells and against collagen II and with staining with alkaline phosphatases and toluidine blue.

In rats weighing 100 g, the right tibia was manually broken after intramedullary insertion of a thin flexible steel wire. Groups of rats were killed after different intervals (3–30 days). The fracture and surrounding musculature were dissected out and immediately frozen at -70°. Eight-micron cryostatic sections were made and stained immunohistochemically with hematoxylin as a background.

Results: The formation of periosteal callus begins on the second day with formation of bone trabeculae without an intermediate stage of cartilage and develops further for 8–10 days, but not thereafter. The external callus develops on the outside of the periosteal callus and mainly on the side of the fracture that abuts on the musculature. On the second day, scattered fibroblastic cells producing a metachromatic substance are visible from the free spaces between muscle threads towards the periosteal callus. There are also inflammatory cells as Ia-presenting cells and different T-cells. All of these cells become crowded outside the periosteal callus (the area of pluripotent cells). Cartilage differentiates from these cells from the fifth day starting at the fracture ends of the muscle side of the bone. The cartilage widens over the fracture, backwards and externally. The cartilage is stained by antibodies against collagen II. Toluidine blue stains the cartilage metachromatically, but also stains parts of the pluripotent cells. Mast cells are visible mostly around small vessels. From the tenth day, buds of capillaries extend from the periosteal callus, resorption of the cartilage occurs, and enchondral bone formation starts. At the fifteenth day, the rest of the cartilage has the form of a V.

Summary: The periosteal and endosteal callus develops from a homogeneous mass of cells without Ia-presenting cells. The external callus develops from a multiform mass of cells, possibly originating from the soft tissue, and is mixed with Ia-presenting cells. The importance of the latter cells is not known.

Nutrition of nerve roots in the pig cauda equina during experimentally graded compression

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The nerve roots of the cauda equina might be subjected to compression either acutely as in disc herniation or more chronically as in spinal stenosis. The nerve tissue needs a continuous supply of oxygen and other nutrients to maintain its normal function. Compression might reduce the transport of these nutrients by interfering with the flow of CSF or with the intrinsic vasculature of the nerve root. The present study 1) presents a model for experimentally graded compression of nerve roots in vivo and 2) studies the effect of such compression on the nutritional supply of the nerve roots.

Material and methods: 18 pigs weighing 25–35 kg were anesthetized with Ketalar® and Hypnodil® and ventilated with a respirator throughout the entire experiments. The spinal canal was opened by a laminectomy between the 5th sacral vertebra and the 3rd coccygeal vertebra. Great care was taken not to traumatize the nerve roots during the procedure. By placing an inflatable plastic tube over the exposed spinal canal between the pedicles of the 1st and 2nd coccygeal vertebrae, the nerve roots (4 pairs) could be compressed against the corresponding disc. The tube was fixed to the vertebral column by two L-shaped pins and a small Plexiglass plate. The tube was inflated by a compressed air system. The model was calibrated regarding pressure transmission to the nerve roots. During the experiment, the temperature was held constant at 38° C. The nerve roots were compressed for 30 min, and during the last 5 min of the compression, ^{3}H-labelled methylglucose was circulating after an intravenous injection. Methylglucose is not metabolized in the nerve tissue. At the end of the compression, the entire preparation was immediately frozen with liquid nitrogen under continuous

compression. Biopsies of the nerve roots at various levels were examined in a scintillation counter and a value of the content of radioactive glucose in each biopsy was obtained.

Results and conclusion: Compression of 55 mmHg for 30 min resulted in a decrease of the content of radioactive glucose at the compression site by approximately 60–70 per cent as compared with control experiments where the plastic tube was applied, but not inflated. There is evidence that this pressure level is relevant in spinal stenosis (*Spine* 9, 604, 1984). Fifty mm Hg does not result in total ischemia of the nerve roots. However, it might result in a reduced supply of nutrients and an accumulation of metabolites. Such mechanisms could contribute to the production of pain and/or neurologic deficit associated with nerve root compression syndromes.

The knee: CT, MRI, arthroscopy, and anatomic correlations as studied by interactive video technique

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The anatomy of the knee joint is complicated and its functional topographic relationships are not well known. Computed tomography has a given role in diagnosing abnormalities of the bone, whereas the soft tissues are less clearly identified. Magnetic resonance imaging, while not showing the cortical bone, displays the soft-tissue articular elements with exquisite clarity and resolution. This modality also can render information on circulatory disorders (osteonecrosis), detect tumors at an early stage, and show inflammatory changes.

Arthroscopy is the prime modality for demonstrating intraarticular pathology and should therefore be used to validate or disprove radiographic diagnoses.

In a prospective study, knee joints with suspected (mainly traumatic) pathology were studied with CT and MRI and subsequently examined arthroscopically.

Six cadaveric knee joints from individuals of various ages were injected to outline the synovial membrane and articular recesses, then frozen in various positions, and sequentially sectioned on a cryomicrotome. Photographs in perfect registration rendered highly detailed anatomic images. In addition, a great number of close-up images were taken.

CT, MRI scans, and anatomic sequences, along with arthroscopic scenes, were formatted for transfer onto an optical reflective laser videodisc. Explanatory slides were created and selected images were extensively labelled.

An interactive program was designed enabling the viewer to choose any image or image sequence at random and to study anatomic structure in the different modalities.

The visitor of the exhibit controls the laser-disc player with a remote control keypad. The interactive laser videodisc provides not only the highest image quality, but also has an unsurpassed educational impact on individual learning, as well as on teaching of large audiences.

The effect of immobilization of the spine of rats

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The spine of rats was fixed with an external fixation device. Fixation caused neutral, distractive, or compressive immobilization between vertebrae L2 and L5. The time of immobilization was 2, 4, 8, 16, 24, and 32 weeks. Totally, there were 143 rats in the series.

Immobilization caused stiffness of the lumbar spine. After 16 weeks of compressive immobilization, no movement was found. Neutral immobilization caused a lack of movement after 32 weeks. Some movement was found after 32 weeks of distractive immobilization.

Immobilization caused changes in the cells and disturbance in the arrangement of growth plates and changes in the structure of intervertebral discs. The quantity of changes was equal in all the types of immobilization.

Immobilization caused loss of lamellar bone. Four weeks' immobilization caused 20-30 per cent bone loss. The immobilization of 8 and 16 weeks diminished the amount of bone 40–50 per cent. After 24 weeks, there were no more changes, and the amount of bone had decreased 45–60 per cent.

Callus as bone transplant

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The osteogenic and inductive properties of 12 days old autogenous callus transplants were studied histologi-

cally and histomorphologically. Control groups consisted of a mere diaphyseal femur defect group and a cortical bone graft group. Sixty young rats were operated on.

Callus transplants seemed to survive and maintain their osteogenic capacity. The inductive new bone formation of the host bone was concentrated to the edges of the defect in both the periosteum and endosteum. In the other series the inductive new bone formation started in the periphery of the host bone and gradually reached the trauma site.

In the histomorphometric analysis the total amount of new bone formation was greatest in the callus group and least in the bone graft group. The bone grafts incorporated in 3 to 6 weeks after transplantation to to the host.

Accessory nerve injury

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Twenty-nine patients with an injury of the accessory nerve in the posterior cervical triangle are presented. There were 8 male and 21 female patients, mean age at injury 36 (1–62) years. In 21 patients the nerve was damaged during a lymph node biopsy, in 4 patients during a large neck operation, in 2 cases there was a sharpPglass injury, and in 2 cases a blunt contusion. Twenty-one patients were operated on. In 14 cases neurolysis, in 3 neurorrhaphy, and in 4 cases reconstruction with a sural nerve graft was performed on an average of 11 months (2 mos.-5 yrs.) after the injury. In neurolysis cases the cause of symptoms was scar tissue compression. In 5 cases, signs of satisfactory recovery were found at the first consultation and operation was deemed unnecessary. In 3 cases too long a time (6–17 yrs) had elapsed after the injury.

The result was good (normal strength and range of motion of the shoulder, no atrophy, no pain) in 7 operative cases and fair (normal range of motion, normal or almost normal strength of the shoulder, atrophy of the trapezius muscle, no or slight pain) in 8 cases. In 1 cases good and in 4 cases fair recovery was achieved without operation. In 9 cases (31%) the result was poor. The mean follow up time was 13 months in operative and 5 years in conservative cases.

The superficial course of the accessory nerve in the posterior cervical triangle makes it susceptible to injury during a lymph node biopsy etc. in this region. When the nerve is damaged during a surgical operation, the patient may immediately notice pain in the shoulder, in the axilla, or in the occipital scalp. Occasionally, pain does not appear until the patient has begun to move about and to resume work. Paresis of the superior portion of the trapezius muscle (lowering of the shoulder, a hollow in the supraclavicular region, inability to abduct the arm above the horizontal level) is a dominant diagnostic sign.

When the diagnosis of the lesion has been ascertained, surgical intervention should be considered. Exploration of the accessory nerve should not be delayed if paralysis of the trapezius muscle has occurred after surgery in the neck region, because neurolysis gives good results. Moreover, neurorrhaphy or reconstruction is easier in the early stage before the formation of large amounts of scar tissue.

Erratum

The abstract "Total condylar knee replacement in gonarthrosis. Four to six years' follow-up," Acta Orthop. Scand. 57, 601, was written by Per Kjaersgaard-Andersen, Ivan Hvid, Jon-Oddvar Wethelund & Otto Sneppen. In the original abstract, Dr. Kjaersgaard-Andersens name was not included, for which we apologize.