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Basic Science

Structural changes of the femoral bone with age

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Besides bone mineral content (BMC), structural changes are important for the understanding of the metabolism and biomechanics of bone. Measurements of BMC of the femoral neck and shaft were made with dual photon absorptiometry in 113 normal women and 46 normal men with ages from 20 to 90 years. In normal women, BMC of the femoral neck deceased significantly and almost linearly with age, while BMC of the femoral shaft decreased significantly only after 60 years of age. In normal men, BMC neither of the femoral neck nor of the femoral shaft showed significant change during age. Because the femoral neck and femoral shaft represent mainly trabecular and cortical bone, respectively (1), it appears that the ratio between trabecular and cortical bone decreases with age especially in women. During scanning of the femoral shaft, it is possible to measure the external diameter (D) and in most cases also the internal diameter (d) with a precision of about 2 and 5 percent, respectively, and to calculate the cortical width (1/2 [D –d]) and the cortical area (n/4 [D^2 –d^2]). In both women and men the external and internal diameters increased significantly with age, but more distinctly in women than in men. The cortical width decreased significantly in women, but not in men,and the cortical area showed a small, but significant increase with age in both women and men. From BMC (g/cm) and the cortical area (cm^2) of the femoral shaft, values for the density of the cortical bone (g/cm^3) can be obtained. It was shown that the cortical density decreased significantly in women, while no significant change was observed in men.

In conclusion, the structural changes demonstrated during remodeling of the femoral bone with age have important implications on the biomechanical properties (2, 3).

Table. Correlations with age

Persons number	Age years	External diameter	Internal diameter	Cortical width	Cortical area	Cortical density
women 113	20–90 52	0.53***	0.63***	–0.21*	0.25**	–0.52***
men 46	20–85 45	0.38**	0.34*	–0.06	0.32*	–0.20

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

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BMC measurements in the proximal tibia following fracture of the ankle

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BMC (bone mineral content) in the proximal part of the tibia was measured using dual photon absorptiometry (1). The measurements were performed just distal to the subchondral plates of the tibial condyles.

Included in this study were 20 patients (13 women and 7 men) who all had a dislocated fracture of the lateral malleolus. The mean age was 42 (18–69) years. All the ankles were operated on using cerclage wire, staples and pins (Cedell 1967), and were placed in a cast for 6 weeks without weight bearing the first 3 weeks. BMC was measured postoperatively, 3 weeks, 6 weeks, 3 months, 6 months, and 1 year after the operation.

Significantly lower values of bone mineral content were found 1 year after the operation.

We conclude that lateral malleolar fracture causes a fall in BMC of the ipsilateral proximal tibia up to 0.5–1 year after the operation.

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The microvascular morphology of normal and arthrotic bone by scanning electron microscopy

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We studied the microvascular structure of normal and arthrotic bone in rabbits by scanning electron microscopy (SEM). Arthrosis was induced in 34 rabbits by splintage of one knee for 5 weeks. Radiography and intraosseous phlebography were performed in 13 rabbits. Intraosseous pressure (IOP) was measured in 12, and 9 were used for SEM. A microvascular cast was produced in the anesthetized living animal by perfusion of the aorta with methyl methacrylate (MMA) at 90 mmHg. Both tibiae were decalcified and macerated. The remaining MMA microvascular cast was then frozen in water and cut for SEM.

All the immobilized tibiae showed moderate arthrotic changes. IOP was 22.4 ± 2.9 mmHg in arthrotic knees and 11.2 ± 4.7 mmHg in control bone ($P < 0.001$). The vascular casts of control tibiae showed the following normal microvascular anatomy: The nutrient artery divides into ascending and descending branches, each giving rise to 4 or 5 smaller arteries to the metaphyses. At intervals these smaller arteries give off thin branches passing to cortical bone through Volkmann's canals. The vessels divide into capillaries and anastomose with venous sinusoids, which are abundant at the fringe of the medulla. The sinusoids coverage upon collecting sinusoids draining into the central vein. In only one of nine normal tibiae a shunting capillary was found bypassing the sinusoids and emptying directly into a collecting sinusoid. Profound changes were observed in immobilized tibiae, including leakage through sinusoid walls, opening of shunting capillaries, fusion of sinusoids, budding of sinusoids, and roughening of collecting sinusoid walls. The significance of these findings in the pathogenesis of arthrotic is uncertain.

Early circulatory and metabolic changes after elevation of a myocutaneous island flap in the pig

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Introduction: Free and island flaps are used increasingly to substitute large defects in traumatic and reconstructive surgery. The circulation and, hence, the ultimate survival of these flaps depends on the adequacy of the vascular stalk. Monitoring of the tissue oxygen tension (PO_2) seems promising for continuous surveillance of the patency of vessels in the stalk. In order to differentiate between spontaneous and pathologic events after flap elevation, we investigated the early changes in blood flow and tissue metabolism in relation to PO_2 in a rectus abdominis island flap.

Material and methods: In 7 pigs the superior epigastric vein was cannulated on one side. Baseline venous outflow and arteriovenous differences in oxygen, lactate, and glucose were measured. Temperature and PO_2 were monitored subcutaneously and in muscle bilaterally. An 8 by 15-cm myocutaneous island flap was then elevated and resutured on the side with the cannulated vein, leaving the superior epigastric artery as the only connection. Recordings were obtained at 0, 0.5, 1, 2, 3, 4, and 6 h after flap elevation.

Results: Immediately after flap elevation, the venous outflow decreased to zero. Following resuturing, blood flow increased steadily to 13.8 ± 1.8 mL/min at 0.5 h and 2.7 ±3.7 mL/min at 3 h. Thereafter, the flow was constant. None of the flaps were cyanotic. The weight of the flaps increased by 25 percent. The temperature in the muscle decreased by 4° C immediately after flap elevation ($P < 0.05$). PO_2 showed a tendency to higher values in subcutis than in muscle, and to a greater decrease in muscular values after flap elevation. There were no changes in consumption of oxygen and glucose or release of lactate.

Conclusion: The rectus superior myocutaneous island flap seems to adapt rapidly to the transit from normal conditions to the flap circulation based on the superior epigastric vessels alone. We found no major implications of changes in metabolism and only a tendency to higher blood flow in the flap as a whole. Our results do, however, suggest tissue-specific changes in blood flow after flap elevation.

The relationship between ^{99m}Tc-DPD uptake, blood flow, and microvascular volumes in arthritis

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Introduction: A number of factors governing the bony uptake of ^{99m}Tc-diphosphonate have been listed, including blood flow, vascular surface area, capillary permeability, and mineralization rate. Previous experimental studies in dogs have shown localized changes in uptake of ^{99m}Tc-DPD in response to chronic synovial inflammation. The purpose of this study was to relate these changes to intraosseous hemodynamic parameters.

Materials and methods: Arthritis of the knee was induced in 8 immature dogs by injections of carragheenan into the right knee for 12 weeks. The regional blood flow (RBF, mL/min/100 g) was measured in the anesthetized spelenectomized dogs 2 hours after injection of ^{99m}Tc-DPD using radioactive microspheres. The vascular volume (VV, mL/100 g) was assessed by the tissue distribution of ^{125}I-fibrinogen and ^{51}Cr-erythrocytes, and the mean transit time of blood (MTT, seconds) was calculated by VV/RBF. The uptake of ^{99m}Tc-DPD was expressed as bone/blood ratio.

Results: The table contains representative data as mean values from the noninflamed control limbs and (in brackets) the relative changes in arthritis as ratios between experimental and control limbs.

Table

	^{99m}Tc-DPD	RBF	VV	MTT
Femoral cortex	8 (1.04)	6 (0.96)	2.5 (1.13)	33 (1.25)
Metaphysis, prox.	11 (1.22*)	5 (1.53*)	9.4 (1.03)	221 (0.71*)
- interm.	23 (0.86)	5 (0.80)	10.1 (1.20)	266 (1.97*)
- growth pl.	72 (0.77*)	37 (0.75*)	7.6 (1.51*)	18 (2.10*)
Epiphysis, center	13 (1.13)	7 (0.89)	6.5 (1.39*)	88 (1.72*)
Epiphysis, margin	17 (1.29*)	11 (1.37*)	6.2 (1.23*)	43 (0.91)
Patella	11 (1.43*)	8 (1.60)	3.8 (1.30*)	39 (0.96)

Conclusion: RBF is an important, but apparently not the only, determinant of the uptake of ^{99m}Tc-DPD and of the changes seen in arthritis. We found no relationship between ^{99m}Tc-DPD uptake and VV or MTT.

Lymphatics of human periosteum: A preliminary study

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Whether lymphatic drainage from bone and periosteum exists is still a matter of contention. The purpose of the present study is an attempt to identify lymphatic capillaries in human periosteum, if any.

Thirteen normal periosteum-bone biopsies from 12 patients operated on in the orthopedic department at Herlev Hospital were investigated. All the specimens were fixated immediately after removal followed by dissection of the periosteum from the bone. Six periosteal biopsies were examined with light microscopy. Adjacent sections were stained by immunoperoxidase technique for Factor VIII, which is a marker for endothelium in both lymphatic and blood capillaries, and for laminin, which is found only in blood capillaries. A vessel that was positive for Factor VIII, but not for laminin, could in this way be identified as a lymphatic capillary. Seven biopsies were examined with conventional transmission electron microscopy. In none of the specimens were lymphatic capillaries detected.

We conclude that either human periosteum is devoid of lymphatic capillaries or lymphatic capillaries are so few and far apart that they cannot be detected with the methods applied.

Early fixation of allogeneic bone graft in titanium and hydroxyapatite-coated implants: An experimental study in dogs

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Introduction: To evaluate allogeneic bone-graft incorporation into noncemented porous-coated implants, we performed an experimental study and compared the fixation of titanium and hydroxyapatite-coated implants with and without a bone graft.

Material and methods: Unilateral osteopenia of the knee was induced in 12 mature dogs by weekly intraarticular injections bilaterally in a 10-mm drill hole in both distal femoral epiphyses. Hydroxyapatite (HA)-coated plugs, 6 mm in diameter, were implanted in the medial condyles and titanium alloy (Ti)- coated plugs in the lateral condyles in 10-mm drill holes. Allogeneic, fresh-frozen (–80°) cancellous bone, milled into a homogeneous graft was packed into the overreamed canal around the implants in 6 dogs (grafted group). In a sex-, age-, and weight-matched group of 6 control dogs, the implants were left in the overreamed canals without a bone graft (overreamed group).

Results: After 6 weeks, the anchorage of grafted Ti- and HA-coated implants was equal; when compared with the Ti-coated implants in the gap, the shear strength was increased by 425 percent ($P < 0.001$). However, HA coating alone (in the absence of a bone graft) was found to enhance the bone-implant interface shear strength to nearly the same degree (by 325 percent) ($P < 0.001$). Minor increments were obtained when a bone graft was used together with hydroxyapatite. No difference in implant fixation was found between osteopenic and control bone. The quantitative histologic evaluation confirmed the results from the mechanical push-out test.

Discussion and conclusion: Our results have demonstrated the enhanced bone-implant fixation using an allogeneic, freshly frozen, cancellous bone transplant in both osteopenic and normal bone, suggesting a normal repair potential of osteopenic bone in the model. However, although a cancellous bone graft enhances the implant fixation, hydroxyapatite coating appears to yield almost the same anchorage by enhancing bone repair in the defect.

Ankle

Total ankle alloplasty: Seven years' experience

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From 1981 through 1987, 52 ankle joints in 43 patients with intractable ankle pain were treated with ankle alloplasty (Kofoed). The diagnosis was arthrosis in 23 cases (25 ankles) and arthritis in 20 cases (27 ankles). The prosthesis used was in the first 26 ankles a cemented two-piece device, whereas the remaining cases were treated with a three-piece device with meniscal bearing. Apart from this the prosthetic construction was unchanged. The patients were assessed preoperatively and at follow-up according to a 100-point scoring system, which gave 50 points for freedom from pain, 30 points from normal function, and 20 points for normal mobility. Each postoperative year, radiographs were taken assessing prosthetic subsidence and progressive cement-bone radiolucency.

The preoperative score was 33 (13–58) points, and at the latest follow-up 83 (65–97). The results for cases of arthrosis and arthritis did not differ significantly, nor did the results of two-piece and three-piece devices after a maximum of 3 years.

Two patients have died from unrelated reasons. Three prostheses have been extracted because of unchanged pain. They were converted to arthrodeses, which healed uneventfully within 5 months. Two prostheses have been revised, one because of a subsequent malleolar fracture, the other because of varus position of the tibial component. No deep infections have been encountered. One patient needed split-skin transplantation because of skin necrosis of the dorsum of the foot. In the entire series, only 1 case of progressive radiolucency has been found. The patient was free of pain and well functioning at the 4 year follow-up.

In conclusion, the present results of ankle alloplasty seems within the period of follow-up an attractive alternative to arthrodesis.

Osteochondritis dissecans of the ankle: Long-term results of surgical treatment

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Osteochondritis dissecans of the ankle occurs most frequently anterolaterally or posteromedially on the talar dome, but central talar lesions have been described, and recently 2 cases of osteochondritis dissecans localized to the tibial articular surface was reported. The role of surgery as well as the long-term results in osteochondritis dissecans of the ankle joint are not clear.

Twenty-four patients of a total of 26 patients with osteochondritis dissecans of the ankle were seen for follow-up 9–15 years after surgery. In all the cases, drilling of the lesion was performed, and in 15 cases a loose fragment was removed. In four ankles the lesion was located in the tibial articular surface, and in 22 in the talar dome. The short-term results of surgery were satisfactory: 20 of the patients were cured or improved. At follow-up only one third of the patients were free of symptoms. Pain upon weight bearing was the most frequent complaint followed by ankle swelling and stiffness. Only 1 patient had snapping or locking sensations at the time of follow-up in contrast to 16 patients prior to surgery. The radiographs at follow-up showed local or universal irregularity or sclerosis of the subchondral bone in all but 5 ankles. Only one ankle showed diminished joint space.

Excision of loose fragments combined with drilling diminishes the symptoms in osteochondritis dissecans of the ankle, but does not secure the development of a normal joint. Progression to arthrosis is infrequent, except when established already at the time of surgery.

Hip

Primary hip arthroplasty with the AML femur prosthesis

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Since March 1986, we have, at our department, performed 192 hip arthroplasties with the uncemented AML femur prosthesis. This is a preliminary report from a prospective study.

Patients and methods: In all the patients, radiographs of the hip and Harris hip score have been obtained preoperatively and 6 months, 1 year, and 2 years postoperatively. From the preoperative radiographs, bone quality was estimated, and from the postoperative radiograph, bone remodeling factors, stem shift, and subsidence of the stem were recorded. At present, our material contains 146 operated on hips with ≥ 6 months of follow-up, 93 hips with ≥ 1 year of follow-up, and 21 hips with ≥ 2 years of follow-up. The average patient age is 55 (21–68) years.

Results: The average preoperative hip score was 48, after 6 months 81, after 1 year 85, and after 2 years 91. The postoperative radiographs were in most patients virtually unchanged except that calcar resorption appeared in 45 percent of the patients 1 year postoperatively. In 2 cases, we found cortical thinning, which could be related to stress-shielding ; also, there were 8 cases of cortical hypertrophy due to stress transfer from the prosthesis to bone.

Conclusion: In this preliminary study of an uncemented femoral implant, the population operated on was younger and

more active with great demand on their prosthesis. We find the results encouraging in the short term, although the increase in hip score is slower compared with cemented hip arthroplasty. We can recommend this arthroplasty as a technical highly reproducible procedure.

Arthroscopy of the hip joint

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Arthroscopy of the hip is a rare procedure, and publications on the issue are few. To demonstrate the use of hip arthroplasty, we have reviewed the 14 cases investigated at the divisions of orthopedic surgery in the University Hospital in Århus between January 1985 and May 1988. Included were 10 women and 4 men, with an age ranging from 12 to 76 years. General anesthesia and a traction table were used in all the cases. A 5-mm arthroscope was inserted through an anterior approach, and second portals for lavage and instruments were placed lateral to the arthroscope or horizontally above the greater trochanter. The diagnoses at admittance were aseptic necrosis of the femoral head (3), loose bodies (1), juvenile rheumatoid arthritis (1), long-standing pain (5), and snapping hip (4). The diagnosis was verified in 5 cases including arthroscopic removal of a loose body in 1 and resection of a plica bridging the space between the femoral head and the acetabular roof in 2 patients. The diagnosis was rejected in 3 cases. Five joint examinations revealed no pathologic changes. One arthroscopy was inconclusive because of a narrow field of vision in a dysplastic hip. No serious complications occurred. Hip arthroscopy is useful in diagnostics and surgical treatment of selected hip disorders and rehabilitation time is short. Hip arthroscopy is, however, a technically demanding procedure.

Fractures of the femoral neck treated with Hasting's hemiarthroplasty

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The purpose of this study was to evaluate the results after cemented bipolar hemiarthroplasty for displaced femoral neck fractures by clinical and radiographic examination 3 years after the operation. Fifty-two patients with 53 prostheses were available for a follow-up examination 36 months postoperatively (mean age 81 (56–93) years. Three patients were excluded from the follow-up examination because they had undergone revision to a total hip arthroplasty. Sixty-three patients operated on during the same time period had died before the follow-up examination. All 53 prostheses were assessed by clinical (d'Aubigné and Postel's scoring system) and radiographic examination at follow-up. The hospital records and EDP records of all the patients who died before the follow-up were examined to record complications in these cases.

Seven of 59 prosthetic replacements were classified as failures. Two prostheses dislocated, four prostheses had loose femoral stems, one prosthesis was revised to a total hip arthroplasty because of pain. No patients developed acetabular erosion or deep infection. The average mobility score before the femoral neck fracture was 4.9, and at follow-up the mobility score average 3.8. The average pain score at follow-up was 5.6, and the average overall hip mobility was 160°.

We believe that the low failure rate, which compares favorably with the best results after internal fixation, is caused by the right selection of patients (high age and low activity level), the use of bone cement, and the bipolar design of the prosthesis.

Knee

Fractures of the intercondylar eminence of the tibia: An evaluation of knee stability

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The objective of this study was to assess long-term results after cruciate ligament avulsion fractures of the intercondylar eminence of the tibia with respect to knee stability and function.

Patients and methods: Fifty-two out of 59 patients with tibial spine fractures treated during the period 1972 to 1987 were available for follow-up (17 were children and 35 adults, at the time of injury). There were nine posterior (PCL) and 43 anterior cruciate ligament (ACL) avulsions. Fractures with minimal or no displacement were treated conservatively (18), 22 were treated operatively. Follow-up examinations included manual stability tests and measurements of anterior-posterior knee laxity (Stryker Knee Laxity Tester). The average follow-up was 7 (1–14) years. Knee score (Lysholm) and activity level (Tegner) were also recorded.

Results: In 12 of the children and 17 of the adults treated for ACL avulsion, significant anterior instability was found at follow-up. Anatomic reduction did not prevent abnormal laxity. Slight posterior instability was found in 3 patients treated for PCL avulsions. The majority of patients had knee scores in the good or excellent range, however, in general, patients with knee instability had a low level of activity.

Conclusion. Anterior cruciate ligament avulsion fractures in both children and adults frequently results in chronic instability with an associated, decreased level of activity.

Altered muscle coordination in ACL-deficient patients

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Introduction: Recent studies have indicated the hamstring muscles to be essential antagonists in ACL-deficient patients. In the present study, muscle coordination under physiologic conditions was studied electromyographically.

Patients and methods: Nine patients with an arthroscopically verified total ACL rupture were compared with 9 sex- and age-matched volunteers. While walking on a treadmill (2.5 or 4.5 km/h, horizontally or 25 percent upward inclination), surface EMG was recorded from the thigh muscles: the medial and lateral vastus, the medial and lateral hamstrings. Activity onset was recorded with respect to heel contact, recorded simultaneously.

Results: Walking on a horizontal level, patients did not differ from controls. At increased knee load, walking upwards, the hamstrings were activated significantly earlier compared with the controls.

Conclusion: The earlier recruitment of the hamstrings in ACL-deficient patients probably is a compensation for the lost ligamentous resistance of the anterior cruciate ligament during extension of the knee before heel contact. The altered muscle coordination in ACL patients may encourage further EMG studies to provide understanding of functional stability in ACL patients. Such studies may guide the development of optimal training programs.

Shoulder

The dislocated shoulder: Diagnostic arthroscopy versus plain radiographs, arthrography, ultrasonography, and CT-scanning

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Introduction: The major aim of the present study was to outline which of the following diagnostic techniques is the superior one for the precise evaluation of lesions in the dislocated shoulder (DS): arthroscopy (AS), plain radiographs (PR), arthrography (AR), ultrasonography (US), or CT-scanning (CS).

Material: 17 patients of both sexes within the range of 18–75 years of age, suffering from DS exclusively were included in the study. A report of the exact mechanism underlying the lesion was obtained. All patients underwent AS, PR, AR, US and CS. The different investigators were ignorant of the results obtained from the prior investigations.

Results: Preliminery results are basis for the following remarks:

- Plain radiographs: Osseous fractures and major displacements are revealed.
- Arthrography: Unspecific lesions of rotator cuff and capsule may be visualized. It has not, however, been possible to correlate the size of lesions to the amount of dye in the bursal area and extraarticular area.
- Ultrasonography: Rotator cuff and biceps tendon tears, bony contours of the humeral head and glenoid and effusions into the subacromial and subdeltoid areas may be visualized.
- CT-scanning: Minor osseous lesions are visualized. Chondral lesions are invisible. Soft tissue lesions may be visulized.
- Arthroscopy: Synovitis, precise localization and range of lesions in soft tissue, chondral- and osseous defects are visualized.

Conclusion: The preliminery results indicate that US or AR is valuable as a screening test for soft tissue lesions. However, AS must be preferred if exact mapping of intraarticular lesions is wanted.

Spine

Idiopathic scoliosis treated with the Boston brace

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In 1978, the Boston brace became the standard treatment of idiopathic scoliosis in our department. In the light of the oncoming electro-spinal orthosis treatment, we wanted to evaluate the results of the Boston-brace treatment. Until now, 33 patients (30 females and 3 males) have finished the Boston-brace treatment. Two patients were not able to attend the follow-up examination. The mean age when brace treatment was started was 14 (10–16) years; the average time of brace treatment was 33 (5–72) months; and the average follow-up time was 33 (4–72) months.

Before brace treatment, 17 patients had curves between 20° and 39°. Application of the brace reduced the curves by an average of 10° (5–20°). During the brace treatment, we found an average increase of 1° (–11° to + 10°). At the follow-up the average increase was 2° (–8° to + 11°). Six curves progressed by at least 5°, but no curve measured more than 40°.

Fourteen curves were more than 40°(40–60°) at admittance. Brace application reduced these curves by an average of 15°(3–32°). During the treatment the curves progressed on an average of 5°(–12°to+32°). Six curves (four thoracic and two double major curves) progressed to 56°and 71°,and these patients were treated with spinal fusion.

Conclusion: The Boston brace yielded satisfying results in patients with curves between 20° and 39° when compared with the natural history. When dealing with curves exceeding 40°at the beginning of treatment, the failure rate was high (six out of 14), but the time for spinal fusion was probably postponed.

Etiology of nerve root compression in spondylolysis and spondylolisthesis

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Lateral spinal stenosis has been suggested to be responsible for nerve root symptoms in spondylolysis and spondylolisthesis (1). To test this hypothesis, I examined 39 vertebrae with a total of 67 spondylolytic defects. All the vertebrae were from skeletons of Eskimo origin. The shape of the spondylolysis showed considerable variations. In 28 the bone was atrophic, in 28 the defect was merely a crack in the arch, while in 9 cases the spondylolysis resembled a hypertrophic pseudoarthrosis with abundant callus formation. In 2 cases, classification was impossible due to bone destruction.

No case was found of definite lateral spinal stenosis (> 3 mm, < 5 mm). In the remaining 67 cases, both the lateral recess and the root canal measured more than 5 mm. These findings do no support the theory that lateral spinal stenosis is an important cause of nerve root symptoms in spondylolysis.

In L5/S1 spondylolisthesis, the fifth lumbar nerve root frequently is affected. It has been suggested that the nerve root is placed under traction by a hook-like protrusion formed by the remaining part of the pars interarticularis of the slipping vertebra. This theory is supported by the present study, where a very definite "hook," larger than 5 mm, was found in half of the spondylolytic vertebrae.

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Fractures

Fixation of experimental osteotomies of the human patella with biodegradable material versus tension band a.m. AO

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Biodegradable material has since 1985 been used with success in the fixation of fractures of the malleoli and osteotomies of the first metatarsal bone. We wanted to study the initial tensile strength in patellar fractures fixed with biodegradable PGA (polyglycolic acid) rods in cadavers before applying the method in vivo because of the considerable traction force exerted by the quadriceps muscles.

Experimental osteotomies on 12 pairs of human cadaver patellae (median age 81 (55–89) years) were fixed with two crossing PGA (Biofix®) rods on one side and a tension band a. m. AO on the other side. Dual photon absorptiometry was applied on all the specimens, and BMC and BMD were recorded. The tensile strength was tested in an Instron Universal Test Machine. The median tensile strength until the beginning of dislocation was 48 (20–125) N for the PGA method, $P < 0.01$. The median tensile strength until a dislocation gap of 1 mm was 120 (45–250) N for the AO method and 123 (60–385) N for the PGA method, $P > 0.1$. We found no correlation between the tensile strengths and the BMC and BMD.

The present study shows that the intinial tensile strength of patellar osteotomies fixed with biodegradable PGA rods was as high as or even higher than that of osteotomies fixed with tension band a.m. AO.

Arthrosis after Colles' fracture

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The purpose of the present study was to investigated the occurrence of arthrosis following displaced Colles' fracture in a long-term follow-up. Fifty-six patients, 51 women and 5 men, with an average age of 71 years at follow-up, were examined on an average 7 years after fracture. The fractures were classified according to Older and the functional evaluation included recording deformity, subjective symptoms, range of motion, grip strength, and late complications. Arthrosis was grade according to Lidström as slight, moderate, or severe.

Slight arthrotic changes (minute osteophytes) were seen in 17 patients, moderate changes (sclerosis, narrowing of the joint space) in 7 and one patient had severe arthrosis (large cysts, obliteration of the joint) at follow-up. Thirty-one pa-

tients had no arthrosis. The most important determinants for the occurrence of arthrosis were the age of the patient and the initial displacement of the fracture ($P < 0.01$). The severity of the arthrosis showed a high correlation with the functional score in the oldest patients with visible deformity ($P < 0.0001$). Arthrosis was not correlated with the residual dorsal angulation or the length of the radial styloid. Neither pain nor laxity of the distal radioulnar joint correlated with arthrosis.

We concluded that radiographic arthrosis could be demonstrated in almost half of the patients with displaced Colles' fractures 7 years after the accident, that arthrosis was closely correlated with the initial displacement of the fracture and the age of the patient, and that arthrosis significantly influenced the function of the wrist.

Biodegradable fixation of displaced ankle fractures

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Recently, biodegradable implants have been introduced in the treatment of displaced malleolar fractures. Twelve patients, mean age 46 years, with displaced ankle fractures (uni-bi-, and trimalleolar) were fixed with 3.2 x 50-mm or 4.7x70-mm- cylindric polydioxanone-coated polyglycolide rods (Biofix®). Patients with a limited ability to cooperate (chronic alcoholism or severe psychiatric disorders) and patients with open epiphyses were excluded from the study.

Postoperatively, the ankle was immobilized in a below-the-knee plaster cast for 8 weeks. After 6 weeks, full weight bearing was allowed. The patients were discharged from the hospital after a mean of 8 (3–25) days. Clinical and radiographic follow-up was performed after 8 weeks and 6 months. We found no complications during surgery. No postoperative infection, allergic reaction, or sinus formation was observed. The bony union was uneventful in all the cases.

We find the technique simple and the preliminary results satisfactory. The major advantage of this method is that the need to remove fixation material is abolished. This saving of hospital stay might compensate for the costs of the Biofix rods, and the risks in relation to a secondary operation are avoided.

Infections

Registration of postoperative wound infections in orthopedics

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The importance of minimizing the rate of postoperative wound infections is well documented. Since 1980, continuous registration of all the patients on whom we did open surgery has been performed to survey the incidence of infections. Since 1986, the registration of data was computerized.

The results from continuous computerized registration of 1,326 patient since 1987 and 1988 were presented. The rate of registration in the period was in the beginning 59 percent; but after alerting the staff several times, it is now 70 percent and is still increasing. The overall postoperative rate of infections was 1 (0–3.2) percent with no deep infections. The predominating bacteria were *Staphylococcus aureus* (penicillinase-producing) in 39 percent of the cases, and *Staphylococcus albus* in 22 percent, half of which were nosocomial.

Finally, we defined some basic demands on the registration program such as security codes (easy to operate by non-EDP experts), guarded against erroneous inputs, and standardized print-out report facilities; and we stressed some points important in maximizing the value of registration: To obtain continuity, a single senior surgeon who is fully aware of how to operate the computer system should be in charge. Motivation of the involved staff by information and feedback. Specified paperwork procedures in the registration must be established. Control procedures should be established in order to make the rate of registration close to 100 percent.

The use of continuous surveillance of infection rates in Danish orthopedic departments

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In the summer of 1988, an inquiry was sent to all the Danish orthopedic and surgical departments dealing with orthopedics, investigating the use of infection registrations systems. Totally, 74 percent (54/69) of the departments answered the inquiry, whereas 86 of the orthopedic departments answered. Ninety-four percent were interested in a computer system that could register postoperative wound infections, but the necessary equipment was not available in about half of the departments. A majority, 78 percent, would like to register all the orthopedic operations and 60 percent only wanted local use of

the data. Forty-three percent of the departments had experience with other systems, but the systems were organized differently, and the data registered were heterogeneous.

Two thirds of the departments could not report the actual infection rate, neither the total rate for all the operations, nor the rate for alloplasties alone.

The Danish law concerning registration systems demands a high security for registration programs, and only one department wanted even more security.

The daily registration should be a team work between doctors and secretarial staff.

Against this background, we find that it is important to introduce a simple registration system to be used in a majority of orthopedic departments.

Closed joint lavage for experimental septic arthritis

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The effect of joint lavage in the treatment of septic arthritis was investigated in a known rabbit model (1). Fifteen rabbits with established unilateral *Staphylococcus aureus* knee infection received cloxacillin 50 mg/kg x 2 i.m, and probenecid 250 mg x 1 p.o. from day 3 to day 21. Bilateral closed joint lavage was performed once a day from day 3 to 8 with Ringer's lactate via a 2-mm needle inserted just lateral to the patellar ligament. The water was cultured daily. The animals were killed in groups of 5 on days 24, 38,and 52. All the cultures were, and remained, negative after 2 days of therapy. At killing the infected knees presented moderate synovial inflammation, minor reduction of cellularity, and severe depletion of Safranin staining ability. Minor marginal erosions were observed in 6 rabbits. In the control knees only minor inflammation was seen ($P < 0.00001$). The damage to the joint improved significantly ($P < 0.02$) compared with a prior series treated with antibiotics alone (2).

We concluded that joint lavage seems to be an important and harmless adjuvant to the treatment of septic arthritis.

References

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