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Experimental orthopedics

Skin test with hydrolyzed biodegradable polymers

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Disadvantages of the use of degradable materials in ordinary surgery are sinus formation in the wounds and late transient fluid accumulation in using resorbable orthopaedic devices.

We introduce a new method to screen the risk patients in the future.

Patients and method: 10 grams of each material was hydrolyzed until total degradation and crushed. All the specimens were then sterilized. The following materials were used:

A: PDLA, Boehringer Ingelheim

B: PGA, Dexon-suture, Davis & Geck

C: PDS, Johnson & Johnson

D: PLLA, CCA Biochem

E: Green colour, Davis & Geck

F: PLLA, Boehringer Ingelheim

G: PLA/PGA, Vicryl-suture (lilac co-polymer), Johnson & Johnson

H: PGA, Dexon-suture (beige), Davis & Geck

14 patients were tested: 7 with allergy preoperatively and 7 with postoperative reactions that arouse suspicions as to the implanted materials. 10 healthy persons with no allergy were tested as controls.

Results: Positive reactions are listed below:

	A	B	C	D	E	F	G	H
Allergic n = 7	7	1	0	1	0	2	4	2
Reaction n = 7	6	3	0	1	0	2	7	2
Control n = 10	8	0	0	1	0	4	1	2

Conclusions: Certain postoperative complications could be related to allergy against the implanted materials.

We recommend that patients with allergy, and patients with previous wound complications, should have a skintest performed preoperatively.

The rat tibia as a fracture model—practical problems

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The influence of the fracture level on the biomechanical properties of healing rat tibial fractures has not been investigated so far, despite the widespread use of rats in fracture healing studies. Fractures were produced in 4 different zones in the right rat tibia and immobilized with a K-wire. A fifth group of rats was not fractured. After 40 days of healing the fractures and the non-fractured bones were tested in three-point bending. A distinct correlation was found between fracture level and mechanical parameters: maximum load, maximum stiffness and maximum stress decreased the more distally the fracture was located. In the non-fractured bones, maximum load and maximum stress were constant in all four zones tested, whereas energy absorption increased in the distal part of the tibia. No influence of the healing fracture was found on the contralateral, non-fractured tibia compared with the animals left undisturbed, and the mechanical properties of the right and left tibia were found to be symmetrical in terms of mean values. 4 different methods of determining the area moment of inertia were investigated, and the simple method of approximating the cross-section to an elliptical annulus was found to correlate well with the area moment of inertia. This was determined from computer tracings of bone slices prepared from the test specimens after the bending test and compensated for the compression caused by the mechanical test.

The effects of growth hormone on secondary fracture healing in rats—a histological description

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Biomechanical studies have indicated that growth hormone has a stimulatory effect on fracture healing. This study was designed to give a histological description of the long-term effects of growth hormone on fracture healing in rats.

Female rats were given either biosynthetic human growth hormone (2.7 mg/kg body weight/day) or saline s.c. in 2 daily injections for up to 20 days after a closed tibial fracture treated with medullary nailing. 5 or 6 rats were killed from each group after 10, 20, 30, 40, 50, and 80 days of healing.

The fracture site was embedded undecalcified in methyl-metacrylate, cut in 8 µm thick, mid-frontal sections and investigated in a normal light microscope after staining with Masson Trichrome. Growth hormone had an initial stimulatory effect on external callus formation. The callus formed was loosely structured and was not removed by the normal modeling and remodeling process. In contrast, the saline treated rats had healed after 40 days with only a small amount of dense callus tissue. The study also revealed that the hemopoietic system was stimulated by growth hormone, with massive invasion of marrow cells into the external fracture callus. Bone marrow cells dominated the intratrabecular space in growth hormone treated animals even after 80 days of healing.

Prevention of bone loss by naproxen in carrageenan-induced juvenile arthritis evaluated by histomorphometry

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Introduction: The dynamics of arthritic bone loss and the effect of treatment with prostaglandin synthesis inhibitors have not been clarified. We studied the structure and dynamics of juxtaarticular bone in carrageenan induced experimental arthritis during naproxen treatment by bone histomorphometry.

Material and methods: During 12 weeks 16 dogs (3 months) matched pairwise by sex, weight and litter received weekly intraarticular injection of 2–3 ml carrageenan 1% into the right knee. One from each pair was randomly treated with p.o. naproxen (dosage initially 5 mg/kg, maintenance 2 mg/kg), the other served as control. Bone was double labelled with ⁴⁵Ca and ³H-tetracycline (15 mg/kg) prior to sacrifice. Histomorphometric

analysis was performed in the center of sagittally oriented sections of distal femoral epiphysis.

Results: Untreated arthritis was associated with 25% reduced trabecular bone volume ($p = 0.01$), an increased fraction of mineralizing surfaces ($p = 0.02$), and an increased mineral appositional rate ($p = 0.04$) as compared with uninflamed control knees. Naproxen treatment reduced the decline in trabecular bone volume following arthritis induction ($p = 0.05$). The increase in the fraction of mineralizing surfaces in arthritis was reduced by naproxen treatment ($p = 0.03$).

Conclusions: Canine carrageenan induced gonarthritis is associated with trabecular bone loss and increased formative capacity in juxtaarticular bone. Naproxen treatment partially prevents the trabecular bone loss and reduces the development of a higher formative capacity in arthritis. These effects might be due to preventive actions of naproxen treatment on either the negative remodeling balance or the accelerated activation frequency in arthritis, but our data cannot distinguish between these effects. However, a reduction in trabecular bone volume in untreated arthritic knees of as much as 25% cannot be explained solely by a change in activation frequency.

The in vivo and in situ perfused tibia—a model for the study of vasomotor effects in the bone vascular bed in the pig

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Introduction: This model was developed to study the role of various substances in bone blood flow regulation.

Material and methods: Danish Landrace breed pigs of both sexes weighing 60–76 kg were used. The brachial artery and vein served for arterial (AP) and central venous pressure (CVP) monitoring, respectively. Intraosseous pressure (IOP) was recorded through an intraosseous Radner bone cannula in the proximal diaphyseal marrow. The nutrient artery of the tibia (NAT) was dissected free. An extracorporeal blood supply was delivered to NAT from the right carotid artery via a peristaltic pump. The bone perfusion rate was selected to produce a flow which produced a perfusion pressure equal to the mean arterial blood pressure.

Results: Mean arterial pressure and central venous pressure were 86 mmHg and 9 mmHg, respectively. The mean perfusion pressure of NAT was 91 mmHg, with a mean perfusion rate of 1 ml/min. The mean IOP was 22 mmHg. After 4 hours perfusion pressure of NAT was 95 mmHg and the concomitant flow was unchanged. The IOP and CVP remained normal.

Conclusion: This model is the first one developed in pigs. We have established an in situ perfused bone model with peristaltic nutrient artery perfusion and IOP and CVP pressure recordings. The model appears suitable as an in vivo screening tool for vasomotor effects in the bone vascular bed.

Foot and ankle

Hallux valgus treated with chevron osteotomy and biodegradable fixation—a two-year follow-up

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Patients and method: 37 chevron osteotomies fixated with biodegradable implants, self-reinforced polyglycolide pins were performed in 33 patients, all suffering from a painful hallux valgus. The Frederiksberg bandage consisted of sterile foam rubber with the thickest layer medial, medio-plantar and round the first toe, supported by an elastic bandage introduced as an eight-figure around the toe and foot. Finally a canvas shoe with stiff sole was fitted for out-door use. Ambulation was allowed immediately with heel- and lateral support. Normal ambulation in own shoes was allowed after 2 weeks.

All patients were operated on in an out-door procedure. Radiographic and clinical investigation was performed in all patients before surgery, 2 and 6 weeks, 3 months and at the follow-up. The median age was 47 (15–59) years and the median follow-up time was 32 (24–46) months.

Results: The preoperative median first intermetatarsal angle was 14 (10–22) degrees, at follow-up 10 (4–18) degrees. The preoperative median hallux valgus angle was 28 (17–66) degrees, at follow-up 18 (8–58) degrees. All osteotomies were healed 6 weeks postoperatively. There were no cases of avascular necrosis. At follow-up there were no cases of secondary dislocation.

Recurrence of hallux valgus occurred in 2 feet. 1 patient developed osteitis and was treated with long-term antibiotics. 22 patients were painfree, 24 were satisfied with the cosmetic, 26 with the functional result, and 28 with the bandage.

Chevron osteotomy with biodegradable fixation for bunionette (tailor's bunion)

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An assortment of operations for bunionette have been reported. Chevron osteotomy has recently been reported (1) as an effective treatment for symptomatic bunionette.

Material and methods: 3 younger patients, all with bilateral painful bunionette and footwear restrictions, were operated with chevron osteotomy and fixation with a biodegradable implant, self-reinforced polyglycolide pins, (diameter 2 mm and length 25 mm).

Postoperatively the foot was dressed in sterile foam rubber supported by an elastic bandage. Ambulation was allowed

immediately with heel-support. After 2 weeks, normal ambulation in own shoes was allowed. Radiographic and clinical investigations were performed preoperatively, 2 and 6 weeks, 3 months, and at the follow-up in all patients. All patients were operated bilaterally in the same anaesthesia.

Results: The follow-up time was 4, 1.5 and 1 year. Intermetatarsal 4–5 angle, metatarsophalangeal 5 angle and forefoot width improved in all 6 feet. 2 patients were painfree without footwear restrictions. 1 patient 3 years postoperatively experienced intermittent pain from both feet because of the development of hallux valgus bilaterally.

All osteotomies healed without any secondary dislocation or avascular necrosis.

All patients were satisfied with the cosmetic and functional results.

Reference: 1. Kitaoka HB, Holiday AD, Campbell DC. Distal chevron metatarsal osteotomy for bunionette, Foot & ankle 1991; 12;2; 80

Treatment of ruptured lateral ankle ligaments—a 9–13-year follow-up

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The aim was to evaluate long term results of 3 different treatments for acute ruptured lateral ankle ligaments and to clarify the frequency of late complications.

Patients and methods: During the period May 1979 through September 1982, 149 patients with arthrographically verified ruptures were allocated to treatment with either an operation and a walking cast, walking cast alone, or an elastic bandage. At follow-up primo 1992, 79 patients out of 103 possible were examined clinically and radiographically. The mean observation time was 11 (9–13) years, and the patients were evenly distributed in the 3 treatment groups. 1 patient was excluded due to rerupture after a repeat trauma. Fishers exact test and Mann-Whitney test were used, and the significant level was chosen at 5 percent.

Results: Totally 32 parameters concerning interview, clinical and radiographic investigations were statistically analysed comparing the groups, and only one difference was significant: there were fewer complaints of pain on running and/or at sports activity in the operated on group compared to the plaster group. Among the 78 patients at follow-up there were 4 patients with severe pain during different activities; 5 had complaints of severe instability; 4 judged the overall result as poor; 4 had moderate arthrosis and 12 were unstable using the definition: difference in talar tilt ≥ 3 mm, but only 1 using the limit: difference $\geq 6^\circ$.

Conclusion: There was no difference in the 3 treatment groups after an observation period averaging 11 years. The long term complication rate was low.

Early mobilization of operatively treated Achilles tendon ruptures—a clinical and radiographic study

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From experimental studies it is known that an early restricted motion of sutured tendons accelerates the tensile strength of the repair, but the risk is an increased gap between the tendon ends and a possible elongation of the tendon.

Aim: To study if an early restricted motion of sutured Achilles tendons can shorten the period of convalescence and improve the results in the short and the longer term.

Material and method: During a period of 2 years, 71 patients were randomized for postoperative bandaging in either a below-knee plaster with the ankle in equinus position for 6 weeks followed by a plaster cast for walking for 2 weeks, or a dorsal plaster cast for 2 weeks followed by 4 weeks in a modified DONJOY ROM-Walker (Figure). In this bandage, with a dorsally placed elastic band, an active dorsiflexion between -30° and 0° was possible in the 3rd and 4th week of treatment, and free unloaded motion in weeks 5 and 6. During the operation metallic markers were placed in both tendon ends and the distance between these was followed by standardized radiography. All patients were seen after 3 months.



Results: 35 patients were randomized to the plaster cast group, and 36 to the ROM-Walker group. The ROM-Walker group had significantly better ROM in the ankle joint both after removal of the plaster/bandage and at the early follow-up. The patients also had a longer walking distance and less adherences than the plaster group. The plaster group was sick-listed significantly longer than the ROM-Walker group. The calf circumference was identical for both groups. The distance between the markers after 12 weeks was not significant and could not be correlated to ROM, but correlated to the tension in the repair. 2 patients in the plaster group had re-rupture; only 1 in the ROM-Walker group. We have not been able to demonstrate adverse effects of the early mobilization, and especially no sign of "Dorsal shift" in ROM in the ankle joint as an expression of tendon elongation.

Conclusion: The study shows that an early restricted motion of sutured Achilles tendons is possible, and it seems to shorten the period of convalescence and improve the results in the short term. The effect in a longer term is still all in the air. Moreover, the marker separation primarily seems to reflect the tension in the repair.

Removal of internal fixation after malleolar fractures—the effect on patient complaints

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In this study we have evaluated the effect of removal of internal fixation on different categories of subjective complaints in patients with fixated malleolar fractures.

Material and methods: Of 89 patients with removal of material of osteosynthesis after malleolar fractures, 66 were included, 21 men and 45 women, median age 44 (15-77) years. 38 patients were fixated a m Wiberg-Cedell, 26 were fixated a m AO, and 2 were fixated with Rush-pins. Data were obtained from the patient records and from questionnaires administered to the patients. These regarded demographics, types of fractures and fixations, different categories of subjective complaints from implant, cicatrice and fracture and the effect of removal of the internal fixation on these complaints.

Results: 59 of the patients had one or more subjective complaints, mostly in the categories reduced mobility of the ankle joint, soreness over cicatrice and pain related to movement. Approximately 75% of the patients reported after removal of internal fixation improvement regarding the majority of the complaints in all categories.

Conclusion: Removal of internal fixation after malleolar fractures still plays an important role in the aftertreatment of these fractures as an answer to different subjective complaints. Significantly more subjective complaints were associated to the AO mode of fixation in comparison with the Wiberg-Cedell mode of fixation. On the basis of this material we cannot unequivocally recommend removal of internal fixation routinely in all patients with malleolar fractures.

Upper extremity

Early vs delayed osteosynthesis a m Rush of Colles' fractures Older type IV

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Introduction: In a retrospective study the results of early vs delayed osteosynthesis of Colles' fractures Older type IV were compared.

Patients and methods: 32 patients (30 women, 2 men) with an average age of 64 (23-80) years with a Colles' fracture Older type IV were included in the investigation and follow-up. In the group osteosynthesized early (within the first day) 16 patients with 17 fractures were operated after attempted reduction. In the other group 16 fractures in 16 patients were reduced and immobilized with a dorsal plaster cast and after 17 (12-30) days osteosynthesized a m Rush because of redisplacement of the fracture. At follow-up 16 (6-41) months after the operation, pain, the degree of arthrosis, range of movement, grip strength and the radiographic results were determined and evaluated by means of the Lucas modification of Sarmiento merit point rating system.

Results: In the group that was operated on early significantly more patients were painfree but there were no significant differences in the range of movement of the wrists, grip strength, degree of arthrosis or Lucas' score.

Discussion: Significantly more patients with an early osteosynthesis were painfree, therefore early osteosynthesis of unstable Colles' fractures Older type IV is recommended.

Elbow synovectomy in rheumatoid arthritis

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Introduction: The elbow joint is involved in approximately 60% of patients suffering from severe rheumatoid arthritis (RA). We present our results in a clinical and radiographic follow-up study of patients undergoing elbow synovectomies.

Methods: 26 elbows in 24 patients with RA were followed median 4 (1-9) years after the operation. 22 of these had resection of the radial head. The examination included the following parameters: Subjective: Pain score, joint swelling, stability, cosmetic result, motion and paresthesiae. Objective: Swelling, crepitation, range of motion and stability. Pre- and postoperative radiographs were evaluated.

Results: 19/26 stated improvement of pain and function. 2 patients reported increased pain and 5 unchanged. Swelling at

follow-up was reported in 8 elbows compared to 23 before the operation. Improvement of motion was seen especially in supination/pronation. Radiographic classification showed progressive changes into the next stage of the disease. Three complications were reported: 1 infection, 1 neuropraxi and 1 hematoma.

Conclusion: Elbow synovectomy produces good results in patients suffering from RA. In spite of this, this operation accounts for only 3-7% of the total amount of operations patients with RA pass through. This study shows that elbow synovectomy should be considered in patients with pain and swelling and failure of medical treatment.

Elbow arthroplasty with interposition of the fascia lata

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Since 1986, 19 interposition arthroplasties have been carried out in 17 patients; in 1 case due to trauma and in 18 cases due to arthritis. 3 were males and 14 females.

Method: Wide opening of the joint laterally. Resection of the caput radii. The lower part of the humerus was ruginated to the medial epicondyle. Excision of exostoses. In cases with prominence of the top of the olecranon and the coronoid process these were smoothed. The articular surfaces were smoothed. Eburneous bone was removed. The lower part of the humerus was covered with a 5 x 8 cm fascia lata strip sutured to drill holes. The lateral capsule was sutured to the drill holes. After 14 days of immobilization in an angular plaster active training was started. The average length of follow-up was 39 (4-64) months.

Results: 2 elbow joints were operated on because of restricted mobility: 1 remained unchanged, and in 1 the hinge movement was improved 55 degrees and supination/pronation 70 degrees. 17 elbow joints were operated on because of pain: 14 were released of pain in every day activities, in 1 there was an improvement, in 2 the pain increased and in 1 of these an elbow arthroplasty had a satisfactory effect.

Elbow mobility in 13 patients at follow-up:

	Improved	Unchanged	Deteriorated
Ext/flex	8 (38°)	0	5 (12°)
Sup/pro	7 (84°)	2	4 (15°)

Radiographic examination of 12 patients at follow-up: 5 had moderate resorption of the trochlea (egg and cup configuration), 3 had light resorption, 4 were without resorption. In 7 an additional joint fissure was seen.

Conclusion: The method has proved suitable for the relief of pain in pronounced arthrosis/arthritis in elbow joints. It is inexpensive. It does not prevent subsequent alloplasty in case satisfactory pain relief is not obtained.

Systematic examination of patients with acute wrist trauma

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Aim: By means of systematic diagnostics to ensure early and correct treatment of acute wrist trauma.

Material and methods: In the period January 15 to June 14 1991, 641 patients with wrist trauma were included in the study. Only patients who had had a radiographic examination were included. All patients were examined according to an algorithm. The following modalities were included in the algorithm: standard radiographs, cinematography, CT, tomography, bone scintigraphy, and arthritis screening. The patients followed the algorithm until a final diagnosis was achieved.

Results: In 326 patients (51%) fractures were diagnosed on standard radiographic examination. All fractures of the scaphoid were diagnosed at the primary examination. A bone scintigraphy was performed in 54 patients (8%), and in 24 patients focal activity was revealed. By using CT and tomography in this group of patients 7 fractures of the distal radius and 11 fractures in the carpal bones were found. 17 patients were referred to arthritis screening but no pathological changes could be found. The distribution of diagnosis in the 641 patients can be seen below.

Diagnosis	Male n 282		Female n 359	
Fracture of the distal forearm	6	2%	5	2%
Fracture of the distal radius	41	15%	91	26%
Fracture of the distal radius and ulna (Colles', Smith)	35	12%	111	31%
Fracture of the scaphoid	26	9%	7	2%
Fracture of the triquetrum	3			
Fracture of the capitate	2			
Fracture of the hamate	2			
Fracture of the hamate and pisiforme	1			
Fracture of the pisiforme	1			
Carpal instability	1			
Distorsion	127	45%	108	30%
Contusion	17	6%	22	6%
Arthrosis/other/unspecified	21	8%	15	4%

Conclusion: More than 50% of the patients had a fracture diagnosed at the primary examination. By using bone scintigraphy the need for more advanced diagnostic examination (CT, MRI) can be reduced significantly. It is recommended that departments of orthopedic surgery use an algorithm adapted to local availability of diagnostic imaging modalities.

Traumatic shoulder instability—a comparison between MRI and arthroscopy

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Introduction: Conventional Magnetic Resonance Imaging (MRI) is a well established modality to evaluate rotator cuff tears. Other abnormalities, such as lesions involving the capsule and glenoid labrum, have received less attention.

Aim: To compare how well intraarticular abnormalities can be determined with arthroscopy and a new MRI modality, Fast Field Gradient Echo (FFE).

Patients and methods: 20 cases were studied, including 12 patients with primary traumatic instability, and normal asymptomatic individuals. Mean age 27 (18–55) years. FFE MRI allows thin slice contiguous imaging (1–1.5 mm). All FFE MRIs were compared to conventional MRI. Correlation with arthroscopic and/or intraoperative findings were performed in 9 cases. In 2 cases the symptoms resolved spontaneously and 1 patient refused surgery.

Results: FFE MRI provided excellent visualization of the glenoid labrum and demonstrated 9 tears. Arthroscopy demonstrated 6 tears of the labrum and 3 were inconclusive. Only 5 labral tears could be visualized by conventional MRI. The MRI diagnosis was confirmed at open surgery in the 3 cases where arthroscopy failed to demonstrate the lesion.

Conclusion: Fast Field Gradient Echo is a promising new technique for detection of intraarticular pathologic conditions that would not have been found with conventional MRI or arthroscopy.

Spine

Results of spondylodesis surgery as judged by the Dallas Pain Questionnaire (DPQ)

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Introduction: The Dallas Pain Questionnaire has been developed as an aid for judging the influence of chronic back pain on patients' lives by 4 parameters: daily activities, work-leisure activities, mental stability and social interest. 23 patients who had a posterolateral spondylodesis performed were given a Danish version of the DPQ in order to evaluate its clinical usefulness.

Material and methods: Of 12 men and 11 women (median age 41, range 14-62 years), eighteen were operated by Steffee (n = 7) or Cotrel-Dubousset (n = 11) procedures, while 5 patients had postsurgical orthosis treatment for at least 3 months. All patients filled out the PDQ prior to surgery and 1 year after.

Results: For all patients the DPQ pain score showed significant improvement for daily and work-leisure activities one year after surgery ($P = 0.001$ and $P = 0.0002$) while there was a non-significant improvement for mental stability and social activity. Most patients showed very good radiographic healing, with only 3 showing "doubtful healing" (2 with instrumentation and 1 without) and none "no healing".

Conclusion: In view of the increasing demands for treatment documentation and quality assurance this Danish version of the DPQ was found to be a good supplement to routine clinical evaluation for chronic low back pain patients.

Changes in regional blood flow in the spinal cord, nerve roots, and the dural sac during exercise

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Introduction: The pathophysiology of motor and sensory dysfunction associated with spinal stenosis and nerve root entrapment syndromes has been related to activity induced ischemia or a decrease in regional blood flow in cauda equina or nerve roots. However, normal hemodynamic reactions of the spinal cord and associated structures during physical activity are unknown. The aim of the present study was to determine the blood flow response of the spinal cord, nerve roots, and the dural sac during exercise.

Material and methods: The material comprised 10 Göttingen minipigs 18 months old, weighing 38-43 kg, and 2 bacon pigs of similar weight as pilots. The pigs were trained daily for 6 months on a treadmill. Chronic catheterization of the left cardiac ventricle and the descending aorta was established for blood flow measurement with microspheres. Both catheters were introduced through the right carotid artery and were tunneled subcutaneously to the back. Catheters were flushed 3 times daily with heparinized saline. Blood flow was measured 3-4 days after catheterization at rest, after 15 min exercise at 3 km/hour, and rest again 30 min post exercise using three different microsphere labels and reference sampling from aorta. The entire spine was removed segmentally, frozen in liquid nitrogen, and meticulously separated in white and grey matter. Nerve roots, cauda equina, and the dural sac were also collected. Regional blood flow data (RBF, ml/min/100g) were analyzed using ANOVA and paired t-test.

4 minipigs were excluded: 1 resisted training, 3 were lost due to complications secondary to chronic instrumentation.

Results: Selected RBF values (mean, SEM, n 6) are shown below. Grey matter had approximately 8 times higher RBF than white matter ($p < 0.001$). The spinal cord blood flow distribution exhibited a characteristic pattern with higher flow values in motoractive segments at the cervico-thoracic and lumbosacral levels (ANOVA, $p < 0.001$). Blood flow increased significantly in both grey matter ($p < 0.05$), white matter ($p < 0.01$), and the total spine ($p < 0.01$) during exercise, most markedly in motoractive segments, but the characteristic RBF pattern along the spinal cord and the RBF gradient between grey and white matter prevailed. No blood flow changes were found during exercise in nerve roots (including cauda equina) or the dural sac. All blood flow values returned to baseline post exercise.

Discussion: From this study it may be suggested that the motor active segments of the spinal cord are more susceptible to ischemia because of higher nutritional demands during exercise. Nutrition of nerve roots might not be directly dependent on RBF during exercise. Nerve roots may in part be nourished by diffusion (1), which might represent a considerable nutritional buffering capacity during conditions with increased demands.

	Rest	Exercise	Post Exercise
Total spine	17.0 (0.7)	22.7 (1.3) **	17.9 (0.8)
White matter	7.7 (0.5)	9.8 (0.3) **	8.3 (0.4)
Grey matter	40.6 (1.9)	55.5 (3.8) *	42.5 (2.1)
Nerve roots	10.1 (1.4)	9.3 (1.3)	7.9 (0.5)
Dural sac	1.3 (0.1)	1.4 (0.2)	1.4 (0.2)

Reference: (1) Høy K, Hansen E S, He S Z, Hjortdal V, Kjølseth D, Søballe K and Bünger C. Microcirculatory patterns of the spinal cord, lumbar nerve roots, and the dural sac, Trans Orthop Res Soc 1991; 16: 633

Experimental lumbar spinal stenosis—a new model in pigs for the study of neurogenic claudication

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Introduction: Spinal stenosis has recently been investigated in different experimental models on 1 level stenosis in dogs (1,2). In order to investigate the etiology of neurogenic claudication, a new model of a 2 level spinal stenosis was developed with normal neural function at rest.

Material and methods: The material comprised of 6 pigs, 3 months old, weighing between 29-33 kg. The stenosis was induced in the 2 spine segments L5 and L7 by an ASD band,

aiming at 25 per cent reduction of dural cross sectional area, which previously has been demonstrated to be compatible with normal neural function in other species for 1 level stenosis (1,2). To prevent paraplegia, somatosensory evoked potentials (SEP) were recorded bilaterally by stimulation of the tibial nerve before and after induction of the stenosis. Motor evoked potentials (MEP) were recorded before, during and after induction of the stenosis. Postoperative cross sectional areas at stenosis levels were determined by MRI. The animals were terminated after an observation period of 2 weeks.

Results and discussion: The pigs were ambulant from 6 hours to 6 days postoperatively in spite of no SEP amplitude change and less than 10% increase of the mean latency after induction of stenosis. In all pigs bowel and bladder function remained normal. The model seems valuable rendering a large segment of lumbar neural structures susceptible for pathophysiological changes. The model thus provides a large substrate of neural structures for investigation in awake nonmedicated pigs.

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Hip

Clinical value of early postoperative Tc-scintimetry after femoral neck fractures—a prospective consecutive trial

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Introduction: The clinical applicability of postoperative scintimetry in relation to healing complications is described.

Materials: 13 men and 33 women, median age 74 (52-95), with 8 undisplaced and 38 displaced fractures were treated with internal fixation (DHS).

Methods: Tc-scintimetry was performed 7 to 21 days postoperatively, and at 2 and 12 months. Uptake ratio of fractured/intact side was calculated, and a visual assessment was done.

Results: 13 patients developed healing complications: 9 redisplacement and 4 avascular necrosis. A significant difference between uptake ratios at postoperative and two-months scintimetry were detected. At early scintimetry an uptake ratio < 1.0 revealed a prognostic accuracy of 0.63, and visual assessment an accuracy of 0.74.

Conclusion: Postoperative scintimetry had a prognostic value, and a normal uptake excluded healing complication.

Evans' classification of the trochanteric fracture—an assessment of the reproducibility in 52 cases

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Material: 52 consecutive sets of preoperative radiographs of trochanteric fractures in patients older than 18 years were available for the study.

Methods: There were 4 observers, all orthopedic surgeons; 2 senior registrars, 1 registrar and 1 in training. All observers were familiar with the Evans classification. Each observer was asked to classify the fractures according to the Evans system. The observers worked independently of one another and by comparing the results of the 4 observers, interobserver variation could be assessed. 6 weeks later the same radiographs were presented again to the 4 observers, but in a new and random order. A new classification was made, and by comparing the first and second assessment of each observer, intraobserver variation could be assessed.

Results: The interobserver variation was large; only 23 of 52 radiographs were classified identically by all 4 observers, and there was pairwise agreement in 30-39 fractures. When assessing stability (i.e. type 1+2 versus type 3+4+5) the 4 observers agreed in 34 radiographs and there was pairwise agreement in 38-46 fractures (kappa: 0.41-0.77). The intraobserver agreement ranged from 35-44 when assessing type and from 45-57 when assessing stability (kappa: 0.69-0.81), but intraobserver variation is generally less clinical important than interobserver variation.

Conclusion: The Evans classification of trochanteric fractures is hardly valuable for determining the proper method of osteosynthesis.

The incidence of hip fractures in the county of Funen 1979-1990

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In 1983, 2 models for estimation of the future number of hip fractures were described (Frandsen and Kruse, 1983). The purpose of the study was to evaluate the precision of the 2 models.

Materials and methods: The study included all hip fractures in patients age 40 years and above which occurred in the county of Funen from July 1979 through June 1990. A hip fracture was defined as a fracture of the femoral neck, a peritrochanteric fracture or a subtrochanteric fracture. Isolated fractures of the greater or lesser trochanter were excluded. A number of control procedures were performed which excluded about one third of the patients. This group of patients included patients who were readmitted to the hospital, patients in whom

Table 1. Overall incidence per year

	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90
Men	0.713	0.512	0.753	0.602	0.669	0.834	0.836	0.807	0.797	0.942	0.869
Women	1.981	1.920	1.979	2.104	2.150	2.326	2.407	2.279	2.500	2.626	2.429

Table 2. Predicted and observed number of hip fractures

Year	Method 1		Method 2	
	Expected	Observed	Expected	Observed
1985				
Men	138	187	210	187
Women	467	535	656	535
1990				
Men	141	197	280	197
Women	503	565	864	565

Method 1: The average observed age- and sex specific incidence rates applied to the predicted population.

Method 2: Maximum likelihood estimates of incidence rates applied to the predicted population.

re-operations were performed on patients who were transferred from other departments.

Results: 75% of the 7,568 hip fractures in the 11 year period were in women (Table 1). Predicted and observed number of hip fractures evaluated by the 2 models are presented in Table 2.

Conclusion: None of the 2 models were able to predict the number of hip fractures efficiently. The observed number of hip fractures turned out to be placed in the interval between estimates given by the 2 models. A revision of the 2 models should be carried out based on the results of the present study.

Threaded cups in total hip replacement

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The use of screw cups in total hip reconstruction is disputed. Several authors have found loosening in 10–35%. The aim of this study was to evaluate complications and frequency of re-operation in our department. 3 types of cups have been used: UNILOC, JENSEN-ST and ARNOLDI.

The study is retrospective with radiographs obtained from 1 year after operation. The material consisted of 236 hips, mean time of observation 2.7, 1.4 and 1.8 years respectively. Demographics were of normal type, although it is notable that the JENSEN-ST cups were used for advanced surgery in 47% of the cases.

The results were good. There was only loosening of cups in 1 case. The UNILOC-cups were found to have a cup-related incidence of dislocation of 10% and of re-operation of 10%. The JENSEN-ST cup was superior to the others with dislocation in 3% and cup-related re-operations in 2%.

Conclusion: In our department a plasmasprayed, hemispherical screw cup was suitable for total hip replacement, even in case of advanced surgery with massive bone transplantation.

Total hip replacement in juvenile rheumatoid arthritis

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Acetabular protrusion in juvenile rheumatoid arthritis is not only a challenge to the surgeon but also a major cause for early and late failure in total hip replacement.

During the years 1987–1992 the authors developed a technique for prevention of progressive acetabular protrusion using massive acetabular filling with cancellous bone and low temperature curing cement combined with a special acetabular cup.

From a series of patients with total hip replacement operated by the authors, all patients below the age of 40 were extracted. The material consisted of 16 patients (23 hips), median age 28 (17–39). 6 hips were inserted in patients below the age of 20.

In short-time follow-up the results were encouraging. There was no loosening of sockets and no evidence of further acetabular protrusion. No deep infection was found.

Closed suction drainage following total hip arthroplasty

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In a prospective study following primary total hip arthroplasty we analysed the drainage postoperatively, the contamination of the wound, the drain tip, and the drain track.

Patients and methods: A total of 81 primary total hip arthroplasties in 78 patients were included in the study. The patients received prophylactic antibiotics until the draintrack was dry. The drain was removed when the drained volume from midnight to the following morning was 20 ml or less. A culture was taken from the wound, and at removal of the drain the tip was incubated, and a culture was taken from the drain track.

Results: There was a strong correlation between the duration of the operation and the perioperative blood loss. The median drain period was 1.8 (1-4) days; 68 of the drains were removed within 2 days postoperatively. In cases where the period of the drainage was 24 hours, the drainage during the first 12 hours postoperatively, and in total were reduced compared to cases where the duration was 48 and 72 hours. The perioperative blood loss and the duration of the operations had no influence on the drainage. 4 patients had a positive culture from the wound, 5 from the tip of the drain, and 6 from the drain track. The most frequent microorganisms were coagulase-negative staphylococci. The positive cultures were not correlated to the duration of the drain period. None of the patients had infection. 2 patients developed subcutaneous haematoma, but had no wound complications.

Conclusion: 84% of the drains were removed within 48 hours with no risk of developing wound complications. The frequency of contamination of the drain tip and the drain track was not correlated to the duration of the drain period.

Migration of titanium alloy and hydroxyapatite coated femoral components in total hip arthroplasty

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Introduction: Experimental studies on stable unloaded implants have repeatedly documented an osteoconductive effect of hydroxyapatite (HA) coating. The purpose of the present study was to evaluate the effect of HA coating on femoral stem migration in the clinical situation.

Material and methods: 27 patients undergoing 28 primary noncemented total hip arthroplasties (THA) were randomly allocated to receive prosthetic components with a plasma sprayed titanium alloy (Ti) coating (n 13) or hydroxyapatite (HA) coating (n 15) with a collar-less straight stem (Biomet). The femoral components were prepared for roentgen stereophotogrammetric analysis (RSA) by 3 tantalum markers. The patients were allowed weight bearing (15 kg) for the first 6 postoperative weeks. Radiographs were obtained postoperatively, and at 3, 6 and 12 months for assessment of migration of the femoral component using RSA. 11 patients with 11 THA's were excluded because of technical errors with RSA. 1 patient died of unrelated reasons. Thus, 15 patients with 15

THA's (7 with HA and 8 with Ti coating) were followed. Mean age at time of operation was 57 (50-65) years.

Results: All femoral components had migrated at 3 months. From 3 to 12 months, migration of Ti coated components continued whereas HA coated components had stabilized at 3 months. At 12 months the difference in migration (MTPM) was significant ($p < 0.05$). Other parameters from RSA (subsidence, rotation) showed the same trends but no significant differences. Maximum subsidence was 0.2 mm in both groups. Harris hip score and visual analog scale was superior in the HA coated group.

Discussion: The results from the study suggest that HA coating enhances the secondary fixation of the femoral component in THA as compared with Ti porous coating. This effect was present after 3 months, where HA coated femoral stems showed less migration. The improved fixation seems to be mirrored in the superior clinical outcome in the HA coated group. Our previous experimental studies on HA coated implants subjected to micromovements in a range corresponding to the clinical situation resulted in membrane formation consisting of fibrocartilage around HA coated implants whereas fibrous connective tissue was found around Ti implants after 4 weeks. After 4 months however, the fibrocartilaginous membrane around HA coated implants was replaced by bone whereas a fibrous membrane was still present around Ti coated implants. The findings in the present study suggest that both types of prostheses initially were surrounded by a fibrous membrane which was later replaced by bone around the HA coated prostheses whereas a fibrous tissue membrane was still present around Ti coated components.

Metal release in non-cemented total hip arthroplasty

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Introduction: All metallic implants release finite amounts of their metallic constituents into the surrounding tissues and measurable levels of metal have been noted in blood and urine. The release of metal showed the highest levels in implants that have a high-surface-area structured metallic coating. The release was accelerated in association with loosening of implants.

Aim: To determine blood concentration and urinary excretion of titanium, vanadium and aluminium in prospective patients with a non-cemented total hip replacement.

Patients and methods: 16 patients, mean age 59 (49-66) years, with primary coxarthrosis were randomly allocated to a Biomet Titanium alloy (Ti6Al4V) coated prosthesis (8 patients) or a hydroxyapatite (HA) coated prosthesis (8 patients). Samples of urine and blood were collected preoperatively; day 2, 4, 7 and 14 postoperatively; 3rd, 6th and 12th

months postoperatively. Graphite-furnace atomic absorption spectrophotometry was used analysis. Serum creatine was normal in patients.

Results: The serum aluminium level was significantly elevated (58 µg/L) at day 2 postoperatively. A toxic excretion of aluminium was found in 6 patients at the second postoperative day. Excretion was normalized within 14 days in all patients. The concentration of titanium in serum showed a significant peak value (5.7 µg/L) at follow-up after 3 months. The concentration of vanadium was undetectably low in both urine and serum. No differences were detected between serum levels in the 2 groups.

Conclusion: The elevated serum level and excretion of aluminium is probably caused by the coating-process where aluminium-oxide is used. The toxicological importance of the elevated titanium levels in serum has yet to be established.

The effect of antibiotic prophylaxis in total hip arthroplasty a m Charnley

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The aim of this study was to evaluate whether antibiotic prophylaxis had any influence on early or late infections in total hip arthroplasty a m Charnley.

Material and methods: In the period 1978–1983 647 total hip arthroplasties were performed. 313 patients did not receive prophylactic antibiotics. The remaining 334 were treated perioperatively with Meticillin 2 g x 3. The following parameters were compared: diagnosis; previous operations; duration of operation; blood loss; sedimentation rate; postoperative temperature; preoperative infection; postoperative complications, and infections. A follow-up examinations was performed after 10 weeks and 5 years.

Results: There were no significant differences according to operation time, blood loss, sedimentation rate, and temperature. In the group of patients who received antibiotics a trochanteric osteotomy was performed in 40 cases, while 294 had a Hardinge approach. In patients who were given antibiotics 303 had a trochanteric osteotomy and 8 a Hardinge approach. 1 patient was reoperated within 10 weeks because of a deep infection. The patient was given antibiotic prophylaxis. 30 patients were reoperated within 5 years. 6 patients had been given antibiotic prophylaxis. Of these 2 were reoperated because of deep infection, 2 because of loosening, 1 because of dislocation, and 1 for other reasons. 24 patients had not received antibiotic prophylaxis and of these 13 were reoperated because of deep infection, 10 because of loosening, and 1 because of non-union of the trochanter. Apart from 1 case of *S aureus* all infections were *S albus* in the group who received antibiotic prophylaxis. In the group who received antibiotic prophylaxis all of the reoperated patients had been operated earlier either because of infection or fracture. Only 1 patient in

the group who had not received antibiotic prophylaxis had been operated earlier by osteotomy.

Conclusion: Antibiotic prophylaxis is recommended to prevent late infections in total hip arthroplasty a m Charnley.

Knee

The clinical result after reconstruction of the anterior cruciate ligament with the Leeds-Keio ligament

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We report the clinical result after reconstruction of the anterior cruciate ligament with the Leeds-Keio ligament. All patients had cronic instability and pain in the knee due to rupture of ACL.

20 patients were reconstructed from 1986 through 1988. Mean follow-up time was 30 months. 3 patients were excluded, 1 because of congenital hyperlaxity, 2 because of lack of cooperability. The complications were: 3 known ruptures, 1 deep and 1 superficial venous thrombosis. 1 had a brisement forcé due to reduced flexion ability.

At the time of examination 2 patients had not returned to sport, 14 returned to a less strenuous sport and 1 returned to his original sport, but at a lower level. 10 had no change in occupation, 2 had a less strenuous work and 5 were on social welfare. The Lysholm score were 12 excellent-good, 1 fair and 4 poor. Tegner score pretrauma 7.9 and at time of examination 4.7.

We conclude that the disappointing results could be explained by the long immobilisation regimen and by the high number of ruptures, which in turn might increase with time. This is found to match findings in recent literature.

Anterior cruciate ligament reconstruction for chronic deficiency using prosthetic augmented (ABC Tow, Surgicraft) patellar tendon grafts—a two-year follow-up

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In a prospective study, results at 2 year follow-up for patients reconstructed with prosthetic augmented patellar tendon grafts were evaluated.

Patients and methods: 26 consecutive patients with chronic symptomatic anterior cruciate ligament deficiency were included. Median age at reconstruction was 26 (18-36) years and median time from injury to surgery 28 (4-132) months. 25 patients were available for a complete follow-up, 1 had a telephone interview. Isometric reconstruction was performed using autogenous medial one-third patellar tendon grafts (bone-tendon-bone) augmented with an ABC Medium Duty Tow (Surgicraft) rigidly fixed at both ends.

Results: Median Lysholm Knee Score increased from 63 (47-86) pre-reconstruction to 92 (64-99) at two year follow-up. The median increase in activity level post-reconstruction was 2 (range, -1 to +5) using the Tegner Activity Scale. A stable knee joint at two year follow-up was achieved in 18 of the patients (≤ 3 mm paired laxity difference and no pivot shift). 13 of the patients rated their knee function as normal or nearly normal. Using the IKDC (International Knee Documentation Committee) evaluation criteria 18 patients had an excellent or good result at 2 year follow-up. In 1 patient the ABC Tow was removed 3 months post-operatively because of suspected deep infection.

Weight bearing after reconstruction of the anterior cruciate ligament with the ilio-tibial band—a prospective study

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In a prospective randomised study initial full weightbearing following ACL reconstruction (a distally based, near isometrically, 6 cm broad ilio-tibial band transfer) was compared with the traditional rehabilitation with 5 weeks of non-weightbearing, and then a gradual increase to full weightbearing after 9 weeks. The purpose was to investigate whether weightbearing influenced the initial knee stability and function.

29 patients were included (13 with and 16 without weightbearing). The patients were followed prospectively and knee stability and function was evaluated 12 months postoperatively by a blinded observer.

Results: No significant differences were found between the two groups.

Conclusion: Weight bearing has no negative influence on the initial knee stability and function.

Table. Results (median, range) $\pm$ initial weight bearing (WB)

	Initial WB	No WB
Lysholm score	98 (85-100)	95 (87-100)
Tegner score	7 (5-9)	7 (5-9)
Stability	0.5 (-2-1)	1.5 (1-2.5)
Gait + cru.	7 (2-10)	8 (5-16)
Normal gait	10 (5-16)	10 (6-24)
ROM	Normal	Normal

The effect of treatment with naproxene sodium after arthroscopy of the knee

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Introduction: The aim of the present study was to analyse the effect of postoperative treatment with naproxene sodium on the synovial reaction after arthroscopy of the knee.

Patients and methods: The design was randomised, prospective and double-blind, with a placebo control group. Patients with preoperative synovial reaction were excluded. 120 consecutive arthroplasties were performed in 77 men and 43 women with an median age of 34 (18-65) years. General anesthesia was used. 91 arthroscopies were surgical while 29 were diagnostic. Postoperatively the patients received either naproxene sodium 550 mg x 2 or placebo for 10 days. Patients were given paracetamol 500 mg to use if needed. The results were analysed using the Mann-Whitney test and Chi-square test.

Results: No operative complications were registered. All but 2 patients fulfilled the study. 6 patients had slight gastrointestinal adverse symptoms. At 10 days follow-up of the surgical group, effect of naproxene sodium was registered on synovial effusion ($P < 0.01$), range of motion ($P < 0.001$), quadriceps strength ($P < 0.05$), use of crutches ($P < 0.01$) and pain ($P < 0.001$). In the diagnostic group there was effect on pain ($P < 0.01$). At 20 days follow-up of the surgical group, effect of naproxene sodium was registered on synovial effusion ($P < 0.05$), range of motion ($P < 0.01$) and pain ($P < 0.05$). There was no effect in the diagnostic group.

Conclusion: In the group of patients where surgical arthroscopy was performed, naproxene sodium reduced the synovial reaction. The effect is probably to accelerate recovery rather than to increase.

Arthroscopic fixation of longitudinal vertical meniscus lesions with absorbable tacks—presentation of a new method

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The knee menisci are important for shock absorption, weight bearing and joint congruity and recent studies suggest that preservation is superior to resection. Consequently several systems and suture techniques have been developed for meniscus fixation. The potential danger of neurovascular damage however, demands the exposure of the knee joint capsule and an all-inside system would therefore be preferable.

For some years we have been working on an all-inside technique for meniscus fixation based on the use of Biofix®.

Several prototypes have been made ranging from simple barbed rods to staples. Polyglycolide as well as polyactic acid has been tested. A delivery system has been designed.

The final tack is made of self-reinforced polylactic acid, T-shaped with barbs. After predrilling with a small awl, the tack is inserted through a specially designed cannula and "shot" into the meniscus by a piston mounted on a pneumatic device.

We conclude that this system offers a technique which minimizes the risk of neurovascular damage, where application is easy and capsule exposure is superfluous. This new system is presently tested in a randomized study versus conventional inside-out suture technique in our department.

Results of arthroscopic meniscal repair

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The important functions of the meniscus as shock absorber, preserver of joint stability and possible proprioceptive organ have changed the surgical approach in the treatment of capsule related meniscal tears. The present investigation is an attempt to outline the expected clinical course of these patients.

Material and methods: From October 1987 through August 1991 a total of 535 meniscal lesions were diagnosed by arthroscopy. 56 patients were selected for arthroscopic suture (mean age 28, range 6–73) with no regard to age of lesion. 2 patients were lost to follow-up while 10 patients were excluded, 1 because of a concomitant, ipsilateral fracture of the tibial condyle, and 9 because of rerupture of the sutured meniscus. The remaining 44 were scored for knee function (Lysholm) and activity (ESKA consensus 1990) after mean observation time of 23 (8–54) months. 19 had isolated meniscal tears and 25 had associated injuries most commonly of the ACL (18).

Results: 26 of the 44 patients had unchanged or increased activity at follow-up. Significantly more patients with associated lesions declined in level of activity ($p = 0.05$). The majority of patients with isolated meniscal tears had a Lysholm-score above 90 compared to less than half in the group with associated lesions. The mean recovery period was 14 (4–40) weeks. In all 39 patients judged the result as excellent or good. Failure was seen in 14 (9 verified on arthroscopy and 5 with the subjective judgement "poor") of 53 patients.

Conclusion: 74% of the patients had good or excellent knee function after a mean follow-up of 23 months. Associated lesions had negative effects on the result.

Ultra-sound examination versus diagnostic arthroscopy in clinical suspicion of lesion of the meniscus

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Arthroscopy is used as the primary examination in clinical suspicion of lesion of the meniscus. It appears that a number of lesions do not require treatment. Therefore a non-invasive diagnostic method of examination is called for.

A consecutive blinded series of 37 men and 14 women (mean 31, range 15–61 years) with a suspected lesion of the menisci were included in the investigation. The patients were initially examined by ultra-sound, followed by arthroscopy of the joint. The ultra-sound examinations were carried out by the same person whereas the arthroscopies were carried out by several surgeons.

The arthroscopy identified a lesion of the meniscus in 28 patients. 23 patients had lesions in the medial meniscus and 5 patients in the lateral meniscus. Compared to the arthroscopy findings, accordance was found in 43 patients by the ultra-sound examination, there were 4 false positive and 4 false negative results.

The sensitivity of the ultra-sound examination compared to the findings of the arthroscopy was calculated to 0.86 and the specificity of the ultra-sound examination was 0.83.

Conclusion: With optimum equipment, examination with ultra-sound can be recommended as the initial examination in a suspected lesion of the meniscus.

Infection

Bifocal distraction-compression osteosynthesis ad modum Ilizarov in the treatment of chronic infected tibial pseudarthrosis

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Introduction: Infected tibial pseudarthrosis after grade III tibial fracture can be difficult to treat. The main problems are bone defect with infection, compromised vascularity of bone and soft tissue, joint stiffness and osteoporosis. Bifocal distraction-compression treatment with an Ilizarov frame may address all associated problems in 1 seance of treatment.

Method: Chronic infected tibial bone was resected no matter what size of the defect created. Osteocutaneous sinuses were debrided, but left open. An Ilizarov frame was mounted. A percutaneous subperiosteal corticotomy was performed

proximal to the bone defect created. After 5–7 days distraction was initiated over the corticotomy at a rate of 1/4 mm 4 times daily. The free bone segment was transported until the tibial defect closed and a similar amount of new bone tissue was generated in the distraction space. The patient was encouraged to weight bearing and joint exercises during the seance of treatment.

Results: The method was applied in 2 patients (13 and 15 years) with chronic infected tibial defects of 6 and 9 cm length after debridement respectively. After 9 and 12 weeks the bone transport was completed, the tibial defect closed and infection eliminated. Both patients stayed in hospital for 6 days and the bone transport was performed by the patients at home.

Conclusion: Ilizarov distraction-compression osteosynthesis is a valuable and probably superior alternative compared to vascularized free bone grafts/autograft/allograft procedures in patients with chronic infected tibial bone defects. The advantage of the method are minimal surgery, no bone grafting, frame stability, early weight-bearing and joint mobility, short rehabilitation time and a well vascularized bone regenerate.

Occurrence of infection when using Ortofix®

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Introduction: The dynamic axial external fixator, Ortofix, was introduced in 1979 by Bastiani. The Ortofix device has been used in our department for open fractures, other fractures unsuited for intramedullary nailing, limb lengthening and corrective osteotomies. Infections were currently registered and classified.

Material: The Ortofix device was used in 76 patients (median age 39, range 8–91). 17 patients were less than 16 years of age and 9 had corrective or elongation osteotomies. Infections were graded I–V. I–II being pin infections, III–V ranging from resisting of pins to osteomyelitis.

Results: 25 patients had minor infections. 4 patients had grade 3 infection, 9 patients had grade 4 and 2 patients had grade 5 infection. The infection rate in children was much lower. Only 1 child had grade 3 infection. Of 7 alcoholics treated with external fixation, 6 had serious (grade 4 and 5) infections.

Conclusion: The infection rate in our study is comparable with that found in other studies. We found no grade 4 or 5 infections in children. Alcoholism is a relative contraindication to treatment with the Ortofix external fixation. Meticulous pin care is essential in avoiding infections and we will henceforward dispense a pin care instruction to all our patients.

Concentration of Dicloxacillin in serum and bone—an experimental model in rats

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Dicloxacillin is an antibiotic frequently used in orthopaedic surgery, where about 80% of the infections are caused by *Staphylococcus aureus*.

The purpose of this investigation was to describe the pharmacokinetics of Dicloxacillin in rats after intraperitoneal injection, in order to establish an animal model to examine the effect of a single dose of antibiotic in bone surgery. The model was investigated by determining concentrations of Dicloxacillin in serum and bone.

Materials and methods: We used 31 Sprague Dawley rats. The rats were given 1 or 2 injections of Dicloxacillin at 60 or 90 mg/kg. The animals were killed by CO₂-narcose at 1/4, 1/2, 1, 2 and 3 hours. Blood samples and the tibia were used for measuring Dicloxacillin-concentration, which was done by "Biological Method".

The results indicate that Dicloxacillin ought to be given in 2 doses at 60 mg/kg at 0 and after 1 hour, to keep the concentration in serum above 2 x MIC in more than 2 hours.

Miscellaneous

Soft-tissue reattachment using Mitek Anchor System—experiences from the first 16 operations

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In September 1990 the Mitek Anchor System was commercially introduced in Denmark.

Since the introduction of the system in our department in October 1991 until April 1992, we have consecutively collected data from all operations in which the anchors have been used.

The registration has included pre-operative history, type of operation and findings pre- as well as postoperatively.

In the above-mentioned period, Mitek anchors have been used in 16 operations:

11 Bankart-repairs, 3 fractures of the major tuberculum of the humerus, 1 reattachment of the ulnar collateral ligament of the thumb and one reattachment of the medial collateral ligament of the knee.

None of the patients operated on for Bankart lesions have had re-dislocations, and none of the anchors were displaced radiographically. The 3 fractures of the major tuberculum of the humerus have all remained in place after fixation. No side-instability was found in the operated on thumb, and the operated on knee was making progress in training.

By presenting the patient data and the temporary postoperative results, we conclude that not only in Bankart operations the anchors seem highly usable.

Rule changes in soccer—a possibility for injury prevention

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A previous study (Jørgensen 1985) revealed that 80% of soccer players injured after the allowed substitution had been used, stayed on the field because of that, thereby sustaining more serious injuries.

Free substitution could therefore be a possibility for injury prevention.

Methods and material: In a one-year prospective study the effect of free substitution in soccer was tested. Injury incidence, type, and duration were registered prospectively by the players themselves. 13 teams were in the test group with free substitution. A comparable group of 15 teams served as control. A total of 395 players (intermediate level) thus were included.

Results: The duration of minor injuries (sprains and strains) was significantly shorter in the group with free substitution. No difference was found with respect to injury frequency or type. Positive reactions from players, coaches and referees were registered.

Conclusion: Free substitution should be introduced in soccer.