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Cartilage

Markers of early arthrosis in human synovial fluid

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In order to evaluate new pharmacological and surgical treatments for "pre-OA", new markers have to be developed. We have shown (1) that high concentrations of proteoglycan (PG) fragments are present in synovial fluid after knee injury. The present study describes the assay of PG epitope in synovial fluid in patients with developing arthrosis.

Patients and methods: Three major patient groups with knee pain were studied: one control, one with cruciate ligament or meniscus injury > 6 months before sampling, and one without knee injury. Patients were graded for arthrosis using an arbitrary scale of 1–10 based on findings by arthroscopy and/or radiography (2–3). Synovial fluid samples were analyzed for cartilage proteoglycan fragments by immunoassay (4).

Results: With advancing joint changes, there is a decreased concentration of proteoglycan fragments in joint fluid.

Discussion: There is a high PG epitope level in the pre-OA joint. Notably, at the stage of the earliest changes detectable on radiographs, PG levels were already decreased as compared with joints with mild changes by arthroscopy. This suggests that the turnover rate of PG fragments decreases during developing arthrosis and that a correlation exists between the mass of cartilage in the joint and the PG epitope concentration in joint fluid.

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Markers of cartilage degradation in joint fluid in posttraumatic arthrosis

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The identification of new diagnostic and prognostic markers for arthrosis is an essential step in our efforts to facilitate the diagnosis of the early stages of the condition and to monitor the results of new surgical and pharmacologic methods for its treatment. Based on the rapidly growing knowledge of the chemistry and biology of joint cartilage and the availability of sensitive and specific immunoassay methods, we are now able to explore the significance of different markers of cartilage degradation (1).

Patients: Arthrosis is a heterogeneous condition with a multifactorial etiology. In order to simplify the interpretation of our data, we have chosen as our disease model the more homogeneous subgroup of patients with injury to the cruciate ligaments or menisci of the knee. This is a group of patients at high risk for arthrosis and where the time of initiation of the disease process is known.

Methods: Specific fragments of cartilage proteoglycan, matrix proteins, and collagen are determined by immunoassay of knee joint fluid samples, aspirated from patients. In addition, we are now also able to determine the levels of stromelysin, collagenase, and their inhibitors in joint fluid and to relate these to the fragmentation patterns of the cartilage molecules released into the joint fluid from the cartilage.

Results and discussion: Our initial screening study (2) showed that with acute trauma a dramatic release of proteoglycan fragments occurs in the synovial fluid. The concentrations rapidly fall during the first few weeks, but the average level is still 4 years after trauma significantly elevated over that of a matched reference group. This continued, increased concentration of proteoglycan fragments in joint fluid may reflect an increased gradation and/or turnover within the tissue in the injured joint. Subsequent work (3) has shown that late in the disease process, when arthrosis is radiographically apparent, the proteoglycan fragment levels again decrease. Interestingly, current investigations suggest a relation between the levels of stromelysin and proteoglycan fragments in joint fluid. Ongoing longitudinal studies of patients with a knee injury

should enable us to determine the significance of these and other markers for the development, diagnosis, and monitoring of posttraumatic arthrosis.

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Immunolocalization of fibromodulin and second globule in bovine articular cartilage

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In joint cartilage, interactions between collagen II and the large aggregating proteoglycan (PG-LA) form the molecular basis for the tissue's mechanical properties. We have used immunocytochemical ultrastructural techniques to study the distributions of fibromodulin (a matrix protein that may have a specific role in matrix assembly) and PG-LA.

Materials and methods: Bovine joint cartilage was fixed in 0.3 percent glutaraldehyde and 0.3 percent paraformaldehyde for 2 h, embedded at 228 °K in a polar resin, which was polymerized by UV-light. Ultrathin sections were incubated with polyclonal antibodies against fibromodulin or the second globule of the PG-LA core; for detection, protein-A coated with 10-nm colloidal gold was used. Micrographs were taken with a stratified random sampling technique; immunolabeling was estimated semi-quantitatively.

Results: Reactivity for the G2-domain of PG-LA appeared in close proximity to the collagen fibrils. No major difference was noted between labeling in the territorial and in the interterritorial compartments. In contrast, fibromodulin showed a striking lack of immunoreactivity in the juxtacellular, territorial compartments.

Discussion: The co-localization of collagen and the G-2 domain may indicate a specific interaction. Interestingly, this part of the PG-LA core protein is localized between the hyaluronic acid-binding region and the keratan sulfate-rich region, having a rather specific, highly repeating structure.

The in situ-association collagen/fibromodulin corroborates earlier in vitro studies suggesting that this matrix protein may be important for collagen fibrillogenesis. Moreover, the scant labeling close to the chondrocytes may indicate that the molecules form the complex extracellularly.

The chondrone—the functional unit of articular cartilage?

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Articular cartilage is a fiber-reinforced composite; like other load-bearing tissues, cartilage is highly organized—not only on the molecular level, but also on the micrometer/millimeter scale—and this anisotropy is fundamental for the tissue's physiologic function (1).

Materials and methods: Adult articular cartilage from bovine fetlock joints and rabbit knees were processed for light and electron microscopy. Serial and step sections were taken from weight-bearing areas; and from these sets of micrographs, computer-assisted, three-dimensional reconstructions were made.

Results: The matrix is strictly compartmentalized; the fine fibrillary juxtacellular compartment encloses stacks of chondrocytes forming columns, chondrones, which often span the entire height of the cartilage. In the bulk of the cartilage, chondrones run more or less radially, but in the superficial zone, they deviate, flatten, and align parallel to the surface. Consequently, a single histologic section very rarely captures entire chondrones. Moreover, the chondrones tend to align with the predominant direction of collagen fibrils (4).

Discussion: Our demonstration that chondrocytes and matrix form units extends previous light (2) and electron microscopic findings (3, 6). Theoretically, this composite arrangement is mechanically advantageous: the multiple compartments may distribute load, attenuate shear forces, and protect the chondrocytes. It also gives a hypothetical explanation of the poor healing capacity of joint cartilage, although chondrocytes can respond vigorously to noxious stimuli by forming cell clusters and producing new matrix (5), the cells are evidently unable to regroup into functional units.

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Proteoglycan epitope in synovial fluid after tibial osteotomy for medial gonarthrosis

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Increased levels of proteoglycan epitope have been observed in synovial fluid in inflammatory joint disease and after meniscal and ligament lesions of the knee. Does the concentration and total amount of proteoglycan epitope in joint fluid change after tibial osteotomy for medial gonarthrosis?

Patients and methods: Twenty-eight patients (28 knees) were treated with high tibial osteotomy for medial gonarthrosis stage I–III. At surgery, 3 months, 1 and 2 years after surgery, synovial fluid was aspirated from the knee joint. Twenty milliliters of physiologic saline was then injected into the knee and five passive knee flexions were performed. The saline was then aspirated. The content of cartilage proteoglycan epitope was analyzed by ELISA.

Results: The preoperative concentration of proteoglycan epitope varied widely between the individual patients, but was significantly elevated over that found in normal knee joints. There was a tendency towards an increase in both the average concentration of and the total amount of proteoglycan epitope in the synovial fluid from the preoperative to the 3-month follow-up. At 1 and 2 years after surgery, the values again tended to return to the preoperative levels. With more advanced cartilage destruction, as observed by arthroscopy, there was a decrease in the average levels of proteoglycan epitope in synovial fluid obtained preoperatively. No difference in the average concentration of the total amount of proteoglycan epitope in knees treated with a plaster cast or brace postoperatively.

Conclusions: High levels of proteoglycan epitope in synovial fluid persist for 2 years after tibial osteotomy for medial gonarthrosis. This suggests that the actual average mass of remaining cartilage within the knee joint does not change significantly during the observation time, perhaps as a result of the osteotomy. However, a final interpretation of our results will have to await further basic work on the relationship of the concentration of cartilage markers in joint fluid with the actual turnover activity in the joint cartilage tissue.

Does joint cartilage regenerate after proximal tibial valgus osteotomy?

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Proximal tibial valgus osteotomy is known to give gratifying results in medial gonarthrosis with varus angulation. However, little is known about the possible beneficial ef-

fect of the osteotomy on the load-bearing cartilage.

Material and methods: In 19 consecutive patients with medial gonarthrosis, an arthroscopic examination was performed prior to but at the same event as a proximal valgus tibial osteotomy. A transarthroscopic biopsy of the joint cartilage was taken from the load-bearing surface of the medial femoral condyle with a concotome in a standardized procedure. A follow-up biopsy was taken at an average of 26 months after the valgus tibial osteotomy—again with a transarthroscopic standardized procedure—from the load-bearing surface of the medial femoral condyle. The cartilage specimens taken with a concotome were about 5 mm in size. The specimens were fixed in 10 percent neutral buffered formalin, decalcified in EDTA, and embedded in paraffin. The sections were stained with Mayer's hematoxylin-eosin, Safranin-O, and toluidine blue.

Results: In 12 of the 19 patients, there was overt improvement as evident from the microscopic appearance of the cartilage specimens taken after the valgus tibial osteotomy and as compared with specimens taken prior to the operation. In 4 patients the cartilage was judged to be unchanged, and in 3 patients deteriorated. Based on the chi-square test, there was a significant improvement of the cartilage postoperatively ($P < 0.001$).

Conclusions: After tibial osteotomy, the cartilage degeneration is possibly arrested, but there is no convincing evidence of regeneration of hyaline cartilage. However, there is an obvious improvement of the cartilage quality, and obviously a proximal tibial valgus osteotomy has a beneficial effect on the load-bearing cartilage in the medial femoral condyle.

Cartilage regeneration after proximal tibial osteotomy for medial gonarthrosis

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Cartilage regeneration has been reported after proximal tibial osteotomy. However, biopsies have been obtained only in a few cases.

Patients and methods: Twenty-eight patients (28 knees) were treated with high tibial osteotomy for medial gonarthrosis stage I–III. Arthroscopy was performed at osteotomy, and a cartilage bone biopsy was obtained. Sixteen patients had a plaster cast and 12 a brace postoperatively for 6 weeks. Two years after surgery, 16 patients accepted a control arthroscopy with a new cartilage-bone biopsy from the medial femoral condyle.

Results: In 9/16 knees, cartilage regeneration was observed on the medial femoral condyle and in 8/16 on the medial tibial condyle. In the two undercorrected knees, no regeneration was observed. In only two knees did the cartilage appear normal at arthroscopy. The main repair

feature was proliferation of fibrocartilage that covered bone and areas of fibrillate cartilage that filled vertical clefts in hyaline cartilage. The hyaline cartilage revealed an increased cellularity, with numerous nests of proliferating chondrocytes.

Conclusions: Two years after surgery, a substantially lower rate of cartilage regeneration was observed than previously reported. Fibrocartilage regeneration was the most common histologic finding. No correlation was found between regeneration and clinical result. Early knee mobilization in a brace had no influence on regeneration.

Treatment of full-thickness cartilage defects in the human knee with autologously isolated and cultured chondrocytes

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Injured articular cartilage has a poor capacity for regeneration. Full-thickness cartilage defects will not heal; and if situated in load-bearing areas giving incongruity in articulation, they are quite troublesome for the patients. It has been demonstrated in rabbits that it is possible to heal cartilage defects in the patella with transplantation of autologously isolated and cultured chondrocytes. We have applied the same technique for treatment of patients with cartilage defects in the knee.

Patients and methods: Seventeen patients (9 women, 8 men) with a mean age of 28 (15–45) years were included in this study. The mean follow-up time was 28 (21–34) months. Defects with a mean size of 2.5 cm², down to, but not through, the subchondral bone plate were treated. Twelve defects were located on the femoral condyles and five on patellar facets. Donor cartilage was taken from an unloaded area in the same knee as the defect. Chondrocytes were isolated enzymatically and cultured in Ham's F-12 medium with the addition of 15 percent of the patient's own serum. After a culture period of 14 days, cells were isolated and transplanted into the defects. Finally, the defects were covered with a periosteal flap. Free movements were allowed, but no weight bearing for 3–4 weeks. Arthroscopic controls were performed after 3 months and after 1 year.

Results: Arthroscopy after 3 months showed a transplanted area with visible borders level with the surrounding articular surface. Transplants were spongy in probing and well attached to subchondral bone. After 1 year, the transplanted area had a similar appearance, but with a more firm consistency. The newly established joint congruity considerably reduced the patients symptoms, as all the patients noticed disappearance of localized pain and locking

phenomena. Three patellar and two condylar transplants showed signs of central cartilage wearing off. One partial loosening of femur transplant after 3 months and one patellar transplant developed chondromalacia. Both were reoperated on. Biopsies for histologic examination and metachromatic staining tests showed tissues of hyaline appearance. Transplantation restored a synovial joint function in 15/17 knees.

Conclusions: The present results suggest that autologously isolated and cultured chondrocytes might be used for the repair of articular cartilage defects and could indicate a new orthopedic way of rescuing damaged joints.

Biological articular resurfacing in the arthrotic knee with carbon fiber implants

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Treatments for patellofemoral arthrosis in the young patient have been disappointing. Subchondral drilling gives rise to an ingrowth of a repair tissue of fibrocartilage character, but not strong enough to fill up the defects to congruity. We describe our experience with carbon fiber implants used as scaffolds for the ingrowing repair tissue in treatment of localized knee arthrosis.

Patients and methods: Thirty patients (18 males, 12 females) with a mean age of 43 (27–53) years were examined 24 (17–36) months postoperatively. Preoperatively and postoperatively, the patients were evaluated using the rating sheet for knee function described by Larson (1972). All the knees were preoperatively rated as "poor." Pads of woven carbon were used for arthrotic lesions on the patellar facets. The carbon pad was pushed into a bur-prepared basin in the cancellous bone of the patellar surface. Condylar defects were treated by carbon rods, pushed into pre-drilled holes in the subchondral bone, end flush with the surface. Postoperatively, CPM was used for 2 days, partial weight bearing for 8 weeks.

Results: The mean total Larson knee score preoperatively was 46.5 and postoperatively 75.2 out of 100 points. Twenty-five of the 30 patients were graded in the category of Good-Excellent (70–100 points). There was a remarkable pain relief, but less functional recovery.

Conclusions: The carbon-fiber implant seems to give satisfying relief of severe, disabling pain in the arthrotic knee and some functional recovery. This method might be able to arrest the development from local to generalized arthrosis and reconstitute a destroyed area of cartilage in a way of armored, fibrocartilage resurfacing.

Spine

Myelography as an outpatient procedure

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Bed rest for 24 hours after myelography is an accepted clinical procedure. Several articles have recently shown that with the use of thinner spinal needles patients can be encouraged to be ambulatory directly after the examination. We have therefore started to use thin 25-gauge spinal needles. The patients are observed for 2 hours and are then allowed to return home.

Patients and methods: Sixty consecutive patients have answered an enquiry 1 week after the myelography.

Results: All the patients could return home after 2 hours. One third complained of moderate/severe headache and/or back pain. The discomfort lasted on an average 2–3 days. No complications or adverse reactions requiring hospital care were seen.

Conclusions: We have shown that myelography can be performed as an outpatient examination. The simplified procedure entails no increased medical risk.

Gadolinium-enhanced MRI for separating disc from scar tissue in postdiscectomy problems

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Ten patients with previous surgery for lumbar disc herniation and with recurrent symptoms were examined with myelography, MRI, and CT before reoperation. MRI was performed with T1–W and T2–W sequences in sagittal and axial projections before and after intravenous gadolinium injection. CT scans were obtained before and during intravenous contrast infusion. Enhancement of scar tissue, but not of disc, was observed on T1–W sequences after gadolinium administration, which allowed separation of these structures. The contrast-enhanced MRI examinations correlated well with the findings at reoperation, and were superior to MRI without contrast, CT before and after contrast, as well as myelography, in discriminating disc from scar tissue.

Does microsurgical technique give superior results compared with the traditional method when operating on a lumbar disk hernia? A prospective study

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Caspar first described the benefits of using microsurgical techniques when operating on lumbar hernias. His good results have been confirmed by several authors. So far, however, no randomized prospective studies with controls have been published.

Patients and methods: Sixty patients were included in the study. They all had a primary lumbar hernia at one level. They were randomized to either traditional surgery or microsurgery. All the operations were performed by 1 surgeon (TT) previously trained in microsurgery. The follow-up was done by the other 2 authors according to a standardized protocol. The patients were seen at regular intervals up to 1 year after the operation.

Results: There were no statistical differences in operating time (microsurgery 65 min and macrosurgery 50 min), bleeding (both 50 mL), or perioperative complications. The mean stay in the hospital was 2.4 days for the micro-surgically and 2.6 days for the macrosurgically operated on patients. The mean sick leave was 10.2 weeks in the micro group and 10.6 weeks in the conventional group.

Surgical treatment of lumbar disc herniation and spinal stenosis—results correlated with duration of preoperative symptoms

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The natural course of lumbar disc herniation and lumbar spinal stenosis is variable, but spontaneous improvement may be seen. In disc herniation a correlation between the duration of preoperative symptoms and the surgical results has been reported, whereas as far as spinal stenosis is concerned, this has not been thoroughly studied. In this study the result 1 year after surgery is correlated with preoperative duration of sciatica in patients with lumbar disc herniation, as well as lumbar spinal stenosis.

Patients and methods: In a prospective study, 100 consecutive patients (mean age 42, 43 females, 57 males) with lumbar disc herniation and 100 (mean age 55, 61 females, 39 males) with spinal stenosis (central or lateral) were included.

The following data were recorded: 1) duration of sciatica and other subjective variables; 2) neurologic findings; 3) radiologic findings; 4) peroperative findings, and

the patients were reexamined 4 and 12 months after surgery. The surgical effect on the sciatic pain was classified, and a neurologic examination was performed.

Chi-square analysis has been used, as well as a significance test in 2×2 tables for the correlation study.

Results: Totally, 98 percent of the patients with a lumbar disc herniation and sciatic symptoms of less than 1 year were improved as compared with 68 percent in the group with sciatica of a longer duration ($P < 0.001$).

In patients with lumbar spinal stenosis, the results were better if the duration of preoperative leg symptoms was less than 3 years.

Conclusions: Our study yielded better results of disc surgery if the preoperative symptom duration was less than 1 year. For spinal stenosis the preoperative duration of symptoms seemed to be of less importance for the outcome after decompressive surgery, although better results were seen with a duration of less than 3 years.

Erythrocyte sedimentation rate after spinal surgery

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Major surgical procedures induce a transient increase in erythrocyte sedimentation rate (ESR). To evaluate the value of ESR determination when infectious complications after spinal surgery are suspected, ESR values after uncomplicated surgery have to be known.

We have studied the ESR at fixed intervals during the first 4 months after lumbar spinal surgery.

Patients and methods: A prospective, consecutive study was initiated in September 1989. Patients with lumbar spine operations had ESR determinations preoperatively, and 2 and 4 days, 1, 2, 6, and 16 weeks postoperatively.

To date, 51 patients operated on with decompressive surgery and 24 with posterolateral fusion have been included and followed up. No infection has been noted.

Results: A rapid increase was seen with peak value usually obtained on Day 4 (Figures 1 and 2). Generally, higher values were seen after fusion than after decompression.

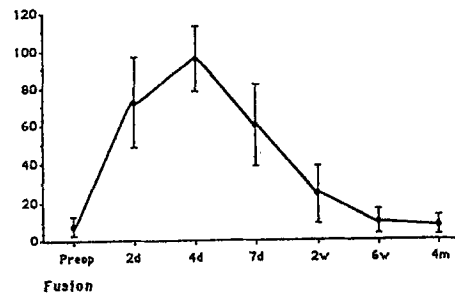
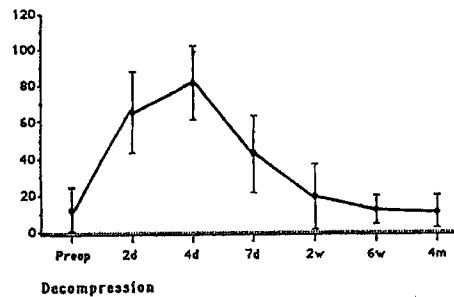
The mean ESR on Day 4 after fusion was 96 (58–125) and after decompression 82 (19–115). After 2 weeks, the values were 24 (3–53) and 19 (3–85), and after 6 weeks 10 (2–24) and 12 (2–32).

Discussion: Spinal surgery may yield very high ESR values during the first postoperative week. At 2 weeks, the values are almost normalized for the majority of patients.

Five patients with a deep infection diagnosed during 1986–89 were used for comparison. Three patients had discitis. Their individual ESR values at diagnosis were 80 (2 weeks postoperatively), 66 (5 weeks postoperatively), and

42 in 1 case not diagnosed until 4 months after operation.

Two patients with spondylitis diagnosed at 6–8 weeks had 80 and 60, respectively. Thus, all 5 patients with an infection had ESR values exceeding a mean + 2 SD at the time of diagnosis.



Reliability of sacroiliac joint tests: An inter-examiner and intra-examiner trial

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The clinical investigation is the rational basis of further investigations and therapy in patients with low-back pain. The aim of this study was to evaluate the reliability of different recommended sacroiliac joint tests.

Patients and methods: Outpatients, 32 women (19–45 years of age) and 5 men (18–45 years of age), were referred to a group especially interested in sacroiliac problems. The patients were examined initially at the outpatient clinic by the orthopedic surgeon according to a structured formula. Fourteen days later, 3–4 patients at each time were examined by the orthopedic surgeon again,

1 chiropractor, and 2 especially interested physiotherapists, independently. A comparative analysis between two examiners in 23 different tests was performed. Totally, 159 comparisons of position, motion, and pain provocation tests were analyzed by kappa statistics.

Results: Position analysis showed a good intraobserver reliability, but a poor interobserver agreement. Motion analysis showed good agreement only in 7/54 comparisons, but pain provocation tests in 60/84 comparisons were statistically significant with good kappa values.

Conclusions: Position and motion tests cannot be used as diagnostic tools because the agreement is less than chance. Pain provocation tests showed a good reliability and can be used as a measurement for therapy.

Internal fixation using the Hartshill rectangle in lumbar spinal stenosis—a pilot study

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There is no consensus today on the need for vertebral fusion in combination with decompression for spinal stenosis. However, the occurrence of postoperative instability seems to jeopardize a good result (1). Thus, a stabilization seems reasonable. We have used the Hartshill system of segmental spinal instrumentation developed by Dove (2).

Patients and methods: The technique was applied in 10 patients (2 men) with spinal stenosis. The indication for surgery was severe pain and neurogenic claudication. All the patients had a lumbar myelography, and the AP diameter of the dural sac was below 11 mm in all the cases. The mean age was 70 years and the mean follow-up 12 (3–34) months. The mean operation time was 215 minutes and the mean bleeding 2,500 mL. The patients were mobilized on the second postoperative day with a brace that should be worn for 4 months. The mean hospital stay was 28 days.

Results: At follow-up, the radiographic examination showed no signs of postoperative slipping in any case and no signs of broken wires or rectangles. Good results were found in 9 patients (no or only moderate pain). One patient experienced unchanged pain.

Conclusions: We consider the Hartshill technique for spinal fusion useful in lumbar spinal stenosis. It is a simple and inexpensive method that can be used outside a spinal center as well.

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Prognostic factors and clinical outcome after a whiplash injury of the cervical spine

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The aim of the present prospective investigation was to statistically analyze factors such as type and force of impact, initial symptoms, and radiographic findings in relation to the final recovery.

Patients and methods: The present prospective study included 93 patients, 40 males and 53 females, with a mean age of 31 (17–67) years, treated at the orthopedic department at University Hospital in Umeå for a whiplash injury of the cervical spine resulting from car accidents. At the initial consultation and at follow-up, a physical examination was made and a detailed form was completed that recorded personal data, details of the accident, symptoms, and behavioral variables. The follow-up was done on an average of 25 months after the accident. Seventeen factors were studied.

Results: The most frequent acute symptoms after injury were aching and stiffness in the neck and headache, followed by dizziness and shoulder pain.

Symptomatic recovery without residual problems related to the injury occurred in 42 percent, while 15 percent reported some minor discomfort. Forty-three percent had major complaints, and of these 18 percent had changed jobs, worked part-time, or were applying for other jobs and 10 percent were retraining. One patient was pensioned and 14 percent were reported sick.

Neck pain and stiffness were the most frequent complaints at follow-up, and nearly one fifth of the cases complained of continuous shoulder and interscapular pain. Twenty-seven percent of the patients complained of low back pain related to the injury.

Conclusion: We could not show any significant relationship between the 17 analyzed parameters and the prognosis.

Oculomotor test for prognostication after whiplash injuries

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Recently, oculomotor dysfunction was reported in patients with chronic and disabling symptoms after whiplash injury of the cervical spine (Hildingsson et al. 1989). The purpose of the present investigation was to prospectively study the oculomotor function in relation to the clinical symptoms in patients with acute whiplash injury and thus evaluate the oculomotor test as a prognostic indication.

Patients and methods: A prospective study was carried out in 40 patients with a whiplash injury of the cervical

spine due to a car accident. The first test was performed on an average 1.7 months after the accident and the follow-up and a second oculomotor test on an average 15 months after the accident.

The oculomotor test was performed according to the method described by Bergenius.

Results: At the initial examination 8 patients showed pathologic oculomotor values.

At follow-up the 8 patients with oculomotor dysfunction initially remained pathologic. Besides, 5 additional patients had changed from normal to pathologic test results. All of these 13 patients with oculomotor dysfunction had disabling symptoms.

Twenty-five patients showed normal test values. Twenty of these had recovered with no, or only minor, discomfort. The remaining 5 patients with normal test results all had persisting symptoms influencing their working ability. Two cases with normal test results initially did not return for follow-up. Thus, 13 of the 18 cases with persisting symptoms in the present study had pathologic oculomotor test results.

Conclusion: It seems that a pathologic oculomotor test, early after the accident or later, is accompanied by persisting symptoms in patients with a previous whiplash injury of the cervical spine.

Fractures

Functional results 10 years after a hip fracture

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Most reports on results after a hip fracture are concerned with short-term problems such as immediate social and medical rehabilitation along with development of complications that require surgical intervention. In this study the fate of hip fracture patients is studied and the functional status of the survivors analyzed.

Material and methods: From operating records, the patients operated on for a hip fracture during 1977 were identified. Survivors were offered a follow-up interview and a radiograph of the hip.

Results: Totally, 362 patients were treated for a hip fracture, 8 of whom had suffered bilateral fractures during that year. Seventy-two patients (20 percent) were alive 10 years postoperatively, 58 of whom were examined. The mean age at follow-up was 75 years. Seventy-two percent were still living in their own homes and 17 percent were living in nursing homes. The mortality rate was higher in the trochanteric group, but the difference was not significant. Sixty percent needed no home aid, 53 percent could do their own shopping, and 48 percent used no walking aids. Over 70 percent were free of pain from their hips. Of

the 35 survivors with a cervical hip fracture, 18 had been reoperated on with a hip replacement and another 4 had segmental collapse of the femoral head. No significant differences were found between sexes or fracture type concerning daily activities.

Discussion: The survival rate in this study is similar to other recent Swedish reports. Patients living in their own homes were surprisingly mobile and had had successful rehabilitation immediately postoperatively, except for those with healing complications after cervical fractures. This study indicates poor long-term results after nailing of cervical hip fractures

Prediction of failure after internal fixation of cervical hip fracture from radiographs

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During 1984–85, 410 patients with a cervical hip fracture were randomized between two methods of internal fixation: a single nail (Rydell) and two LIH hook-pins (LIH). The patients were followed prospectively for at least 2 years. Radiographs were taken postoperatively, after 1 week, and after 1, 3, 6, 12, and 24 months.

Methods: The radiographs of those alive 2 years postoperatively were examined by one of the authors. The sliding of the nails and the diversion in the anterior-posterior projection and the diversion in the lateral projection were measured.

Results: In the failure group (nonunion, late segmental collapse), the greatest sliding was noted within 1 month postoperatively. The diversion increased up to 3 months. Significant differences between failure and nonfailure can be seen already after 1 month. Nonunion increased sliding and diversion continuously up to 1 year, whereas the increase in late segmental collapse is weakening after 3 months.

Conclusion: Radiographs can be a good aid in predicting failure as early as 1–3 months after internal fixation of a cervical hip fracture.

The Svalebo program: A rehabilitation program for hip fracture patients

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The aims of the Svalebo program are improved rehabilitation, earlier and increased rate of discharge of hip fracture

patients to their own homes. The program includes patients from Sahlgren Hospital, Gothenburg, Sweden, and started in 1984.

The program provides a continuous plan for the patients from the orthopedic department, through rehabilitation, to the patients own homes. A team consisting of geriatricians, an orthopedic surgeon, physiotherapists, and social workers informs the patients of the program soon after admittance to the orthopedic clinic. The patients are then either discharged to their own homes, with day-care rehabilitation at the Svalebo nursing home or are discharged to the nursing home for a maximum of 3 weeks and thereafter to their own homes.

Results: The length of stay at the orthopedic department has decreased by about 30 percent, and is now about 2 weeks. The use of "convalescent homes" was half of that of the other orthopedic hospital in Gothenburg. A 1-year follow-up was performed on 110 patients. A decrease in newly recruited institutionalized patients was found, from 19 to 10 percent of those coming from their own homes. A more effective use of the day-care facility, a decrease of all forms of institutionalized care, and a better individual care of the patients are results of the program. The need of post-operative radiographs was reduced to those with clinical signs of nonunion, AVN, etc. as evaluated by the orthopedic surgeon.

Conclusion: The Svalebo program provides a useful, cost-effective model for the cross-disciplinary rehabilitation of hip fracture patients.

"Rikshöft": Experience from Gothenburg

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"Rikshöft" /National hip/ is a Swedish program for clinical follow-up of hip fracture patients. All 441 patients that sustained a hip fracture during 1 year and that were treated at Sahlgren Hospital in Gothenburg, Sweden, were included in the program. There were 336 women and 105 men, with mean ages of 80 (± 9.9) and 77 (± 12) years, respectively.

Results: The table shows the place of admittance and discharge of the 336 women in percentages. The men showed a similar pattern. The mortality at 4 months was 14.7 percent, which is more than usual. The relatively high proportion of patients that were discharged to nursing homes was due to the "Svalebo program." This program has reduced the length of stay at the orthopedic department by 30 percent, and has increased the proportion of patients and increased the proportion from 81 percent in 1982 to 90 percent (of those coming from their own homes). A temporary increase in nursing home care was an effect, however.

The ADL follow-up showed that the hip fracture pa-

tients needs a prolonged rehabilitation period.

	Own home	Rehabil. care	Service home	Nursing home/ Geriatric hosp.	Acute clinic Other
Admitted from	69	-	11	13	7
Discharged to	16	10	-	66	8
At 4 months	62	-	4	32	2

Conclusions: The Rikshöft program is a good tool to get a clear picture of the hip fracture care. The resources needed, rehabilitation demand, and functional result of the patients can be evaluated using this instrument.

Reduced hip fracture risk in mothers of patients with coxarthrosis

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The etiology of primary coxarthrosis (CA) is partly hereditary. The condition provides strong reduction of the risk of sustaining a hip fracture. The aim of this study is to evaluate the hypothesis that close kinship to patients with primary CA is associated with reduced risk of hip fracture.

Material: 1) A cohort of 282 mothers of patients operated for primary CA at Sundsvall Hospital. The mothers' data on residency, date of birth and death were provided by the patients and counterchecked with parish registration offices. All the mothers had since the age of 60 been permanent residents of Medelpad County. The mean year of birth was 1887 (1862-1922). All except 7 were dead at the time of the study.

2) A computer register of all Medelpad residents treated at the county's only hospital in Sundsvall 1943-1989 for hip fracture sustained after the age of 60.

3) Data on Medelpad population's size and composition 1943-1989 acquired from SCB (Statistical Central Bureau).

Methods: Year- and age-specific risk for Medelpad women to be admitted to Sundsvall Hospital on account of hip fracture was calculated at 5 year intervals. The accumulated risk for admittance after the age of 60 and since 1943 was calculated for the entire cohort to 37.3 first hip fractures. The number of individuals in the cohort, actually treated for hip fracture, was obtained from the computer register.

Results: Of the 282 mothers, 20 had been treated for hip fracture. $RR\ 20/37.3 = 0.54$. The difference between calculated and actual risk is significant at a 5 percent level.

Conclusion: Mothers of children operated on for primary CA appear to have a significantly reduced risk of sustaining a hip fracture.

Pertrochanteric fractures of the femur: A critical evaluation of elastic versus rigid osteosynthesis

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A prospective randomized study comparing the results of elastic osteosynthesis with Ender's nails compared with rigid osteosynthesis with an AO plate in the elderly was performed over a 3-year period in 412 patients.

Early mobilization and walking with crutches was begun as soon as possible, generally 1–3 days postoperatively, independently of the type of fracture and the quality of the reduction.

The incidence of complications, loss of reduction, migration of the nails, and reoperation rate was higher in the Ender-treated group, while immediate postoperative mortality was slightly higher in the AO-plate group. Other variables, such as hospital stay, frequency of infections, venous thrombosis, and nonunions, were similar in both patient groups.

Despite being a more technically demanding procedure, the AO method seems to be safer than Ender nailing in patients whose general condition is relatively good.

Reamed intramedullary nailing of acute tibial shaft fractures: An analysis of complications

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The merits of treating tibial shaft fractures with reamed intramedullary nails are well recognized. However, complications, such as infection, compartment syndrome, and malunion, although infrequent, continue to compromise results. The purpose of this study is to evaluate the complications that occurred in the management of 70 acute tibial shaft fractures.

Material and methods: From April 1981 through December 1985, 70 tibial shaft fractures were treated by reamed intramedullary nailing at Hennepin County Medical Center in Minneapolis. Thirty-nine of the fractures were located in the middle one third of the tibia, 27 in the distal third, and four in the proximal third. Sixteen of the 70 patients sustained multiple injuries. There were 25 open fractures. Sixty-one AO nails and nine Grosse-Kempf nails were used. Nine fractures were treated with interlocking nails.

Results: Follow-up evaluation was performed in 67 of the 70 fractures. Sixty-two of the fractures united uneventfully. Malunion occurred in 3 patients, and five infections occurred. The infection rate in open fractures treated by reamed intramedullary nailing was as follows: type I fractures, 1/12; type II, 2/12; type III, 0/1. Compartment syndromes occurred in 4 patients. All 4 were treated within the first 24 hours after the injury.

Conclusions: Although 64 of 67 tibial fractures progressed to union, we are attempting to reduce our complications of infection, malunion, and compartment syndrome by the following practices: 1) Avoid reamed nailing of open tibial shaft fractures at an early stage. 2) Use interlocking nails for unstable fracture patterns. 3) Delay reamed nailing of isolated tibial fractures until the acute swelling has subsided.

Difference in fracture patterns between an urban and a rural population

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A difference in the incidence of hip fractures between a rural and an urban area has previously been observed. A study of fractures in urban and rural populations was performed.

Material and methods: In a population-based study between the municipality of Sjöbo and the city of Malmö, all the fractures, intensity of trauma, and age at fracture were recorded. Included in the study were men and women born in 1908, 1918, 1928, 1938, and women born in 1948. The probands in Sjöbo were randomly selected from the National Population Records. In Malmö age- and sex-matched controls were selected from the city files.

Results: Totally, 782 individuals were invited to the study in Malmö. Of these, 570 (73 percent) participated. In Sjöbo 391 (80 percent) of 486 invited individuals participated. Significantly fewer persons had suffered a fracture in the rural group of all those invited, 17 percent compared with 28 percent in the urban group, and there were significantly fewer fractures per individual that had a history of fracture in the rural group (1.2) compared with the suburban group (1.6). When dividing fractures into fragility and nonfragility, the former type dominated in women above aged 70 years, with significantly more fractures in the urban population. The most common first fragility fracture was at the distal end of the radius in all the groups.

Conclusion: The larger number of fractures in the urban population and the lesser traumatic energy suggest a higher degree of osteoporosis in this group, and probably a greater falling tendency.

Is posttraumatic osteopenia followed by an increased risk of sustaining fractures?

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It is not known whether posttraumatic osteopenia is permanent. If so, this should be reflected in a continuously increased incidence of new fractures in the once fractured extremity. In order to try to solve this question, a retrospective cohort study was performed.

Between 1955 and 1965, 767 patients with tibial shaft fractures were treated at the orthopedic department in Malmö. All the patients with fractures in the lower extremities before the tibial shaft fracture, all those with multifractures at the time of accident, and all patients living outside the city of Malmö at the time of the fracture were excluded. The study group thus comprised 270 patients who were still living in Malmö or had died there after 1982.

Because there is only one department of diagnostic radiology in Malmö and because all the radiographs have been saved, we were able to study all the other fractures that this group have sustained to date. Data were compared with an age- and sex-matched control group as regards the location and type of fractures. A comparison was also made between the fracture incidence for the previously fractured and nonfractured side.

The group with a former tibial shaft fracture continued to have an increased incidence of other fractures, both in the upper and in the lower extremities as compared with the controls. When comparing the risk of sustaining new fractures in the once fractured extremity with the uninjured side, we found only a tendency of more fractures. When fractures in the upper extremities were compared, this tendency was statistically significant. We therefore conclude that remaining posttraumatic osteopenia is of minor clinical interest as regards the future fracture risk after a tibial shaft fracture.

Pelvic injuries

Epidemiology of pelvic fractures

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Patients with pelvic fractures most often need hospital care, but the severity of the injury varies widely. We have performed an epidemiologic study of pelvic fractures in a defined population.

Patients and methods: The material consists of all hospitalized patients with pelvic fractures in Skaraborg

County (270,000 inhabitants), Sweden, during the period 1976–1985. They were identified through the computerized register of the hospital in the county. Incidence, age and sex distribution, degree of trauma, type of fracture, associated injuries and duration of hospitalization were recorded.

Results: During the 10-year period, 541 patients with pelvic fractures were treated. They constituted 2.7 percent of all patients hospitalized for fractures. The incidence was 2.0/10,000 (1.3 for men and 2.7 for women). The incidence increased with age in both sexes. In ages over 50 years, the mean incidence for men was 2.6/10,000 and for women 6.5/10,000. Totally, 286 (53 percent) patients, mean age 79 years, were injured by moderate trauma. In all 255 (47 percent) patients, mean age 59 years, were injured by severe trauma. Eighty-eight percent of the pelvic fractures were stable and 12 percent were unstable fractures and/or acetabular fractures. Totally, 113 (21 percent) patients had associated injuries, mainly other fractures, of whom 84 (74 percent) patients were injured by severe trauma. Length of hospitalization was 21 days/patient in fractures caused by moderate trauma (20.6 days without and 25.2 days with associate injuries) and 22.5 days/patient for severe trauma (18 days without and 31.9 days with associated injuries).

Conclusions: The incidence of pelvic fractures increased with age especially among women. In older patients the majority of fractures were caused by moderate trauma and stable, but demanded as long or longer hospitalization than fractures caused by severe trauma in younger patients.

Acetabular fractures exposed through the triradiate incision

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Operative treatment of complex acetabular fractures with internal fixation is often demanding; a wide surgical exposure is necessary to achieve anatomic reduction of the articular surface. A variety of extensive acetabular approaches have been designed to meet this problem. For 2 years, we have used the triradiate incision proposed by Mears and Rubash (1983).

Patients and methods: Twenty-three patients with more than 5-mm-displaced acetabular fractures were operated on from December 1987 to December 1989 through the triradiate incision. The lateral aspect of the ilium and acetabular joint are visualized as well as the anterior and posterior columns through an osteotomy of the greater trochanter and subperiosteal elevation of the gluteal muscles. The capsule is incised and the articular surface of the acetabulum is visualized. All the patients received antibiotic

prophylaxis, and 14 patients were administered indomethacin for 6 weeks postoperatively to prevent ectopic bone formation.

Results: There were no cases of infection or skin problems. One patient had a subcutaneous hematoma evacuated after 1 week. Of the 14 patients with indomethacin prophylaxis, 10 had no ectopic bone formation, 2 had grade I and 2 had grade II ectopic bone formation (Brooker 1973), whereas of the 9 patients without indomethacin prophylaxis, 6 had grade II, 2 had grade III, and 1 had grade IV ectopic bone formation ($P = 0.0001$, Mann-Whitney *U*-test). Of the 23 patients that have been followed for 6–24 months, 9 were graded excellent, 7 good, 3 fair, and 4 poor. One patient had a Trendelenburg limp due to tensor muscle insufficiency.

Conclusions: The triradiate incision facilitates repositioning of even grossly displaced dome fractures and has few complications. When using indomethacin prophylaxis, we have had no problems with ectopic bone formation.

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Unstable fractures of the pelvis treated by external fixation

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Unstable vertical pelvic fractures are rather uncommon. They are associated with high mortality and high frequency of neurologic and other complications. The management of these fractures nowadays consists mainly of closed reduction and external fixation or internal fixation after open reduction. The aim of the study was to evaluate the results after treatment of unstable pelvic fractures with external fixation during the last 10 years in Gothenburg.

Patients and methods: Twenty consecutive patients, 11 men and 9 women, treated between 1978 and 1988 were evaluated. The mean age at injury was 36 (17–78) years. The cause of injury was a traffic accident in 13 patients, a fall from a height in 6 patients, and being pressed under a weight in 1 patient. Associated injuries were recorded in 17 patients, mainly other fractures. All the patients were treated with closed reduction and an external trapezoidal compression frame as described by Slätis. Fourteen patients were followed for 5 (1–10) years. Five patients died within 15 (4–25) days. One patient died 1 year after the accident of an unrelated cause.

Results: All the fractures healed. Six patients had no or minor residual symptoms. Eight patients had more severe residual symptoms, such as persistent back pain, posterior pelvic pain, and difficulties when walking.

Discussion: The results of treatment after external fixation show that this method is a simple and effective way to minimize bleeding, and to achieve relief of pain, early weight bearing, and good healing. However, the functional and radiographic results are not so good.

Anterior square-plate fixation of sacroiliac joint dislocation

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The sacroiliac joint is dislocated in approximately 25 percent of unstable pelvic ring injuries. The injury is a result of high-energy trauma, usually a road-traffic accident or a fall. The injury always indicates a severe instability of the pelvic ring, because all the major ligaments between the ilium and the sacrum are torn. The results after conservative treatment are disappointing with a high frequency of residual deformity, instability, and disability. We present a series of 19 patients treated at the University Hospital in Uppsala between July 1984 and May 1987. There were 7 women and 12 men. The mean age was 27 ± 9 (SD) years. The causes were road-traffic accident in 13 cases, fall from a height in 3, injury from a falling object in 2, and a skiing accident in 1. The sacroiliac joint dislocation was part of a major pelvic injury in all the cases. An acetabular fracture was present in 7 cases. Two patients had bilateral sacroiliac joint dislocations. Twenty-one associated injuries were found in 14 of the patients. Seven of the patients had associated neurologic damage. The sacroiliac joint dislocation was treated with open reduction and internal fixation with a square plate through an anterior approach. The procedure was successful in achieving fusion of the joint in good alignment. The patients could be mobilized as planned. The overall long-term result was good. Residual disability was correlated with associated injuries, such as permanent neurologic deficit.

Ileum in ilium, small bowel entrapment in a pelvic fracture: A case report

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Pelvic and acetabular fractures are most often caused by a high-energy trauma. The patient is frequently multiple traumatized, leading to diagnostic difficulties. Associated intraabdominal injuries are common, but direct trauma to the bowel is rare. To diagnose a mechanical bowel obstruction is difficult because paralytic ileus is common in these patients. An early diagnosis is imperative because of the previously reported high mortality rate in this group of patients (≈ 50 percent)

Case report: A 23-year-old man was injured in a motorcycle accident. Radiographs showed a right-side acetabular fracture, ipsilateral posterior column and ilium fractures, and dislocation of the symphysis. On the 5th day, mechanical ileus was suspected and verified by contrast medium leakage. At laparotomy, 5 cm of the proximal ileum was found to be entrapped in the ilium fracture and perforated. Resection and end-to-end anastomosis was performed. The fracture was treated nonoperatively and considered to be infected. Long-term antibiotic treatment was given.

Discussion: Mechanical obstruction of the bowel in combination with a pelvic fracture is uncommon, less than 1 percent in large series, but is associated with potentially lethal complications. The obstruction is usually obscured by the initial paralytic ileus, which, however, only lasts for an average of 2.6 days. A more prolonged ileus combined with increasing bowel sounds, fever, nausea, etc. suggests a mechanical cause.

When reviewing the radiographic material in this case, the skeletal and abdominal films could not detect the bowel entrapment. However, CT scan showed how mesenteric fat and a bowel loop entered the fracture complex. This was unfortunately overlooked primarily, but it indicates that CT scans may be helpful in detecting direct bowel injury during the primary evaluation of these patients.

Arthroplasty

Subsidence, tip and hump micromovements of noncoated ribbed femoral prostheses

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Stress shielding reported after implantation of fully coated implants has initiated reduction of the porous area and re-

generated the interest in smooth implants. We studied the micromovements of 18 consecutive noncoated ribbed femoral prostheses during the postoperative 2 years.

Patients and methods: Nine men and 8 women with a mean age of 48 (35–67) years were operated on. Repeated roentgen stereophotogrammetric examinations were used to record distal migration of the center of the prostheses, and movements of the prosthetic hump and tip.

Results: During the observation time, an increasing number of prostheses displayed significant migration that started earliest and tended to be most pronounced when measured at the tip. One year after the operation, 13 prostheses had subsided (0.88 mm, 0.33–1.72), 11 displayed hump and all but one tip migration. One prosthesis was revised because of pain probably caused by migration of the acetabular component. Two years postoperatively, 14 of 17 patients felt slight discomfort to moderate groin or thigh pain. Measurements on conventional radiographs disclosed correlation between area of tip sclerosis and distal tip migration. Age, the Engh index, prosthetic positioning, and contact prosthesis-cortical bone, did not seem to influence the prosthetic migration at 1 year.

Discussion: Initial stable fixation during the first postoperative months followed by increasing frequency of migrating prostheses causes doubt as to the ability of the noncoated ribbed prosthesis to maintain a durable long-term fixation. Especially tip migration seems to be difficult to prevent. Prosthetic movements during the postoperative period may be a source of midhigh pain and raise concerns about increased risk of fretting corrosion in the long run.

The cemented total hip arthroplasty with contemporary technique: A randomized prospective study

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Despite the fact that cemented total hip arthroplasty has been performed for more than two decades, there are very few reports in the literature of prospective randomized studies. In 1985, we started a prospective randomized study comparing the Charnley and the Spectron total hip prostheses. The purpose of the study has been to evaluate if differences in the prosthetic design influence the long-term clinical and radiographic outcome.

Material: Totally, 411 hips were randomized, and 207 Charnley and 204 Spectron prostheses are included in the study. In all, 373 patients were included. The mean age at operation, gender, and body weight were identical in the two groups. The preoperative diagnoses were for almost 60 percent arthrosis, 17 percent rheumatoid arthritis, 17 percent arthrosis secondary to hip fracture. No major differences in the two groups concerning preoperative diag-

noses were noted. Twenty-seven patients (29 hips) have died, and only 2 patients (three hips) have been lost to follow-up.

Methods: All the patients were followed with a clinical and radiographic examination preoperatively, postoperatively, and at 1 and 3 years. The clinical results were evaluated according to the Harris and the Charnley-d'Aubigné hip score systems. The Charnley prostheses were implanted in accordance with Charnley's original description, but without trochanteric osteotomy. The radiographic findings were classified according to Harris et al (1982).

Results: The clinical outcome was good, with a mean score of 5.6 and 5.7, respectively, at 1 and 3 years' follow-up for the Charnley-d'Aubigné pain score system. The mean Harris hip score at 1 and 3 years' follow-up was 82 and 86, respectively, reflecting a rather old population with a high frequency of other handicaps. In the Charnley group, we had four early dislocations, none in the Spectron group. Eight patients have been reoperated on, of those 5 had revisions. The radiographic interpretation has shown 99 percent stable prostheses, 1 percent possibly loose according to the Harris classification.

Conclusions: As expected, the early results of a randomized study of this type show no major difference between the two systems. The results are preliminary, and no major differences can be detected between the two systems with one exception: the four early dislocations in the Charnley group (22-mm head diameter).

Long-term results of Charnley arthroplasty: A 12-16 years' follow-up study

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A retrospective, long-term study was initiated to analyze the clinical function, failures, and radiographic status in our earliest Charnley total hip arthroplasties performed in Gothenburg in the period 1973-1977.

Patients: From 1973 to 1977, a total of 95 total hip replacements were done (90 patients). In the study only patients with a primary diagnosis of arthrosis are included. At follow-up, 35 patients (37 hips) were dead, 11 hips were revised, leaving 47 hips for follow-up. Four patients (5 hips) were interviewed by telephone and the remaining 42 hips were examined.

Method: The 42 patients were examined clinically, and the results according to the Charnley-d'Aubigné hip score system and the Harris hip score system were recorded. At the radiographic examination the findings were classified according to the system described by Harris et al (1982). A survival analysis according to Dobb was performed, with revision or extraction of one or two of the prosthetic components as end-point failure.

Results: The clinical examination with a mean follow-up of 13.6 years showed an excellent pain relief, with a mean Charnley pain score of 5.7. Ninety-four percent of the patients were satisfied. The survival analysis according to Dobb showed a survival function of 86.4 percent after 10 years and 78.2 percent after 16 years. The radiographic examination of the 42 hips showed that 7 percent were definitely loose, that 5 percent were probably loose, and that the remaining hips were stable. Forty-three percent of the patients showed significant signs of wear of the polyethylene socket.

Discussion and conclusion: The clinical and radiographic outcome are, in spite of an old-fashioned cementing technique, very good in this long-term follow-up study. Modern cementing technique has further decreased the incidence of aseptic loosening of the cemented total hip arthroplasty.

Total hip arthroplasty in patients aged 80 years or older

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The purpose of this study was to analyze function and early complications after total hip arthroplasty (THA) in patients 80 years or older.

Patients and methods: Totally, 157 consecutive patients (162 THA) 80 years or older were followed 1 year after THA. The indication for surgery was degenerative joint disease (DJD) in half of the patients and complications to proximal femoral fractures in the rest. The mean age was 83 years in both groups. Clinical results and complications were recorded.

Results: Complications. In 80 percent of the patients, no complications were recorded during the first year. No patient died peroperatively or in the first two postoperative weeks. Three patients died during the first 3 months, and an additional 4 within the first year. Two deep infections occurred (1.2 percent). The dislocation rate was 9.2 percent (15/162). There was a lower dislocation rate (8/84) in the DJD group compared with the fracture group (11/78). The dislocation rate in THAs operated on by a lateral approach (Hardinge) was 14/123, by a posterior approach 1/26, and by a transtrochanteric approach 0/13. All the recurrent dislocations (9) occurred in the fracture group, and were treated either by trochanteric osteotomy (5) or removal of the prosthesis (4). In the patients operated on by trochanteric osteotomy, no further dislocations occurred.

Function. The mean hospital stay was 13 days. The patients returned to the same type of living as prior to surgery in 97 percent in the degenerative group, and 83 percent in the fracture group. At 1 year, 23 patients were not available for follow-up. Out of the remaining patients, 88 percent (112/127) had good or excellent results.

Conclusions: THA in the elderly is a reasonably safe method and yields good functional results. Dislocations, however, were common in these patients, especially in those operated on for complications from proximal femoral fractures. If the indication for surgery was degenerative joint disease there was a low risk for recurrence, but in patients with THA for femoral fractures, 9/11 of the dislocations recurred. In these patients, trochanteric osteotomy was found to be an effective treatment.

Dislocations after total hip arthroplasty— a matter of registration

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The reported incidence of dislocations after total hip arthroplasty (THA) has varied between 0.4 and 15 percent. However, it was not obvious how these data were obtained.

Material and methods: During 1979–1988, 2,068 primary and 427 revision THAs were carried out at Malmö General Hospital, which is the only hospital treating complications such as hip dislocations. We studied the official hospital register and the national register of hip arthroplasties and compared them with the department's operating register. Later on, all the patient files were scrutinized for unregistered dislocations treated elsewhere in the hospital, but in the operating theater.

Results: Totally, 408 dislocations in 108 hips occurred during the 10-year period, which is an incidence of 4 percent. Less than half of the dislocated hips were found in all three registers, and 14 hips were only found in the operating register, whereas five were traced from the national register. In all, 49/108 hips (percent) were reoperated on because of recurrent dislocations.

Conclusions: Different registers demonstrated a considerable variation regarding the number of dislocations. The true incidence of hip dislocation as a complication to THA can only be obtained by combining the operating register with the patients' files.

	1979	-80	-81	-82	-83	-84	-85	-86	-87	-88
Official hospital register	0	17	26	19	15	7	17	30	29	20
National Register	16	10	16	16	14	10	13	25	24	24
Operating register	24	19	30	18	23	10	22	36	33	47
Patient files (total)	31	33	59	35	35	18	33	47	54	63

Cemented versus cementless tibial component in tricompartmental Miller-Galante knee arthroplasty due to gonarthrosis

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Screws have been introduced to improve the primary fixation of the tibial component. In laboratory experiments, screws have been found to reduce the tilting movements of the tibial plateau. The purpose of this study was to compare the micromotions of screw-fixed tibial components with cemented tibial components.

Patients and methods: Thirty consecutive patients (35 knees) with gonarthrosis were operated on with the Miller-Galante knee prosthesis. At the operation the patients were randomly allocated to cemented or cementless fixation of the tibial component, resulting in 17 knees with cementless and 18 knees with cemented fixation. When cement was used, no screws were inserted. The mean age in both groups was 72 years. One and 6 weeks, 3, 6, and 12 months postoperatively, roentgen stereophotogrammetric examinations (RSA) were performed to measure the migration of the tibial components.

Results: The uncemented prostheses displayed significantly larger micromovements than the cemented ones during the first 6 months. At 12 months, however, there were no significant differences in MTPM (0.8–0.5 mm), distal migration (0.17–0.05 mm), or anterior/posterior tilt (0.55–0.34). However, the uncemented prostheses displayed significant larger varus/valgus tilt at 12 months (0.54°–0.27°, $P < 0.05$). One year postoperatively, the average HSS knee score was 84–81 (NS).

Conclusions: The mean recorded micromotions in this series were lower than previously reported for the PCA, Freeman, and Tricon-M prostheses, except for the varus/valgus tilt of the cementless component. The uncemented design of the Miller-Galante prosthesis did not reduce the varus/valgus tilting, maybe because the threads on the screws were too small to gain enough purchase in the cancellous bone of the proximal tibia.

Osseointegrated total ankle joint replacement: A 2-year follow-up of the first case

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Total ankle joint replacement has a place in the surgical treatment of rheumatoid arthritis, but reliable prostheses are still lacking.

Case history. In 1987, we designed a total ankle joint prosthesis for a 26-year-old woman with severe steroid-requiring rheumatoid arthritis. The procedure was founded on Brånemark's osseointegration principle, which was thus used in orthopedic surgery for the first time. The prosthesis was made from pure titanium with a spherical bearing of TiAlV against UHMWPE. It was implanted in two stages 6 months apart. Tantalum markers were inserted into the bone as well as the plastic component.

Results: The patient has been entirely asymptomatic and has regained full motion in the talocrural joint. Radiographic analysis has shown a bone condensation adjacent to the weight-bearing components and no radiolucency. No migration of either component has been detected.

Conclusions: The clinical and radiographic 2-year results in this first case have been extremely gratifying, especially in the light of the results usually attainable with conventional replacement of the ankle. We hope that the principle of osseointegration will prove its value by bringing about an improved survival rate for this difficult joint replacement.

Acetabular bone quality in patients with arthrosis and rheumatoid arthritis of the hip

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It is of interest to determine factors influencing component loosening after total hip replacement. It is also well known that patients with rheumatoid arthritis have a higher frequency of mechanical loosening than patients with arthrosis. The aim of this study is to compare the local bone quality in patients undergoing total hip replacement because of arthrosis or rheumatoid arthritis.

Material and methods: During 1989, bone biopsies were taken from 42 hips—22 with arthrosis and 20 with rheumatoid arthritis—undergoing total hip replacement. A drill biopsy was acquired from a standardized site in the acetabulum prior to preparation for cementation. The specimen was fixated and dehydrated in alcohol and embedded undecalcified in methyl methacrylate. Stained sections were prepared and histomorphometrically evaluated regarding total trabecular bone volume, osteoid volume, osteoid surface, and resorptive surface.

Results: Patients with rheumatic hip disease were found to have a significantly increased osteoid volume and surface, as well as resorptive surface, compared with patients with arthrosis. The rheumatic patients also had a greater trabecular bone volume.

Conclusions: Thus, rheumatic patients were found to have an increased rate of bone remodeling activity at the acetabular site compared with patients with arthrosis. Al-

though it is not possible to conclude from this material any prognostic information on late prosthetic loosening, a high rate of bone turnover may imply this. The greater trabecular volume is more surprising, but may be due to a more pronounced cortical porosity.

Secondary total hip replacement in treatment of fractures of the femoral neck

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The fracture complication rates encountered following primary internal fixation of femoral neck fractures have made prosthetic replacement an alternative mode of treatment. However, the prosthetic survival rate is significantly decreased in primary total hip replacement for intracapsular femoral neck fracture as compared with that of total hip replacement for coxarthrosis. The failure rate of secondary total hip replacement for femoral neck fracture complication is not known.

Patients: From 1977 through 1983, 1,066 consecutive cervical hip fractures had primary internal fixation. Patients with rheumatoid arthritis were excluded. Secondary total hip replacement has been performed in 84 hips. The age at the time of secondary total hip replacement was 75 (45–93) years. At the time of follow-up, 5–12 years later, 42 patients were dead and five arthroplasties in survivors had failed.

Methods: A clinical and radiographic examination was performed in 35 of 37 surviving hips. The prosthetic failure rate was compared with 799 total hip replacements performed for primary coxarthrosis using Cox's proportional hazards regression model.

Results: Prior to follow-up, prosthetic failure had been diagnosed in 9 hips. Another six hips had radiographic signs of prosthetic loosening at follow-up. Prosthetic failure was 2.5 times more common in secondary total hip replacement for cervical hip fracture complication than in total hip replacement for coxarthrosis.

Conclusions: Prosthetic failure rate in secondary total hip replacement compares favorably with that reported for primary total hip replacement in femoral neck fracture. Greenough and Jones (1988) reported a 5-year revision rate of 50 percent and Taine and Armour (1985) a 12 percent rate in 3.5 years following primary total hip replacement.

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Function of osteosynthesis in femoral neck fracture and of secondary arthroplasty for its complications

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In the elderly, function and health after cervical hip fracture are influenced by many nonfracture-related factors, and the contribution of the fracture is difficult to measure. Thus, technical results or intermediate outcomes are measured rather than the resulting health, giving insufficient or selected information for the decision on primary procedure. We compared function of osteosynthesis following femoral neck fracture with function of secondary total hip replacement for fracture complications 5–12 years after the operation.

Patients: From 1977 through 1983, 1,066 consecutive cervical hip fractures were admitted and treated with internal fixation. Patients with rheumatoid arthritis were excluded. Secondary total hip replacement had been performed in 83 patients. The age at the time of secondary total hip replacement was 75 (45–93) years. At the time of follow-up 5–12 years later, 42 patients were dead. Forty-one survivors with 42 hips had arthroplasty for a cervical hip fracture complication. Totally, 193 patients had not had arthroplasty and were potential matched controls.

Method: The Nottingham Health Profile (NHP) questionnaire (Hunt and Wiklund 1987) was completed by 28 patients with a total hip replacement, and these were matched with 28 patients with osteosynthesis. Age, sex, living alone, as well as heart disease, were considered in the match

Results: The weighted scores (osteosynthesis/sec total hip replacement) of energy (37/20), physical mobility (35/23), pain (25/15), sleep (38/19; $P < 0.05$), emotion (20/11), and social isolation (15/9) all favored internal fixation. A statistical difference was seen only concerning sleep. In the second part of the NHP, concerning daily living, fewer patients in the osteosynthesized group considered holidays (fraction 0.5/0.1), household duties (0.5/0.2), and hobbies (0.4/0.1) to be negatively affected, whereas the difference was not significant in social life (0.3/0.1) and home life (0.2/0).

Conclusions: Perceived health was slightly better after osteosynthesis than after secondary total hip replacement in a pair-matched study. Resulting health or function following various procedures should be considered when deciding on femoral neck fracture treatment.

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Temperatures when cutting bone with liquid cooled saw blades

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Bone cutting gives rise to significant heat generation, which results in bone necrosis (temperatures greater than 44–47 °C). This may have clinical implications, for example, in the context of bony ingrowth into porous-coated prostheses, but may also be one reason for delayed union after osteotomy.

Previous measurements of temperatures during knee prosthetic surgery have shown that the usual "squirt cooling" has no effect. Alteration of the saw-blade geometry has also been shown to be ineffective.

Methods: Temperature measurements using a 3M 122 oscillating saw blade, provided with a thermocouple, was done in a laboratory set-up on ox bone, using a hand-held EM Maxi-Driver power tool.

Cooling of the cutting process was done in four ways: 1) Saline was applied with a syringe manually, as in the usual clinical situation ("squirt cooling"), with an estimated flow of 50–100 mL/min. 2) External cooling with a pump delivering 600 mL/min. 3) A new prototype saw blade was constructed from two standard 3M "122" oscillating saw blades that were adapted to each other (thickness > 2 mm) with canals inside, so that a cooling agent was directed to the saw teeth. This saw blade was connected to an arthroscopy pump with a flow of 80 mL/min. Measurements were performed with the pump delivering 80–10 mL/min in decrements of 10 mL/min. 4) A 1-mm-thick saw blade (Mitab) constructed on the same principle as the prototype was tested with a flow of 80 mL/min and 40 mL/min.

Results: Testing without cooling gave a mean maximum temperature of 101 °C ± 36°. "Squirt cooling" decreased this temperature to 61 °C ± 18°. Cooling by pump yielded a maximum temperature of 42 °C ± 7°. Internal cooling was found to control the temperature in the most satisfactory manner, with mean maximum temperatures of 23–30 °C ± 1–3°. Decreasing the flow of saline resulted in a gradual increase in the temperature, which reach critical levels below 20 mL/min. Testing of the 1-mm internally cooled blade gave mean maximum temperature of 28 °C ± 4° at a flow of 80 mL/min and 32 °C ± 4° at a flow of 40 mL/min.

Discussion: The internally cooled saw blade consistently decreased the cutting temperature to subcritical values. The 1-mm blade proved as effective in this respect as the prototype blade. The cooling effect is achieved by the cooling itself, as well as by removing the chips from the kerf of the saw.

Bone reaming and heat: An in vivo study of temperature elevations during bone reaming in total hip replacement

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The most frequent long-term complication of cemented total hip arthroplasty is loosening at the bone-cement interface. Bone cement acts by interlocking with the prosthetic irregularities and bony trabeculae. In case of failure at these interfaces, micromotion may occur.

Thermal injury caused by the polymerizing of methyl methacrylate is one probable etiology of mechanical loosening. High temperature induced by mechanical preparation of the bone may be another cause of local necrosis in subchondral bone. Drilling in bone is known to produce high temperatures and local tissue necrosis.

In total hip replacement the acetabular bone is prepared by a rotating power reamer. The sclerotic bone is often extremely hard to ream out, and this necessitates a certain pressure and speed of the reamer. The friction in the procedure produces a substantial amount of heat.

Patients and methods: Ten patients with advanced primary coxarthrosis underwent total hip arthroplasty with cemented prosthetic components. With the use of microthermistors, temperature was recorded during the surgical procedures. The thermistors were mounted in drill holes in the bone of the acetabulum. The influence on temperature with water flushing, as well as with different reaming speeds, was studied.

Results: With the use of standard power reamers considerable temperature elevations were recorded in the subchondral acetabular bone. The temperature level was so high and the time of exposure so long that the risk of local thermal injury was considered obvious. Continuous water flushing preserved normal temperature at the bone surface during reaming and restricted temperature elevation during the polymerization of the bone cement.

Patients and methods: From 1956 to 1987 inclusive, 96,841 children were born, and late CDH was diagnosed in 18 children, 1 of whom a boy. The NHI had been screened according to Ortolani and Barlow. The maternity ward records were analyzed with respect to the experience of the examiner, the time between birth and examination, the finding noted, mode of presentation, and birth weight. The radiograph at the time of diagnosis has also been reexamined. The joint laxity according to Carter-Wilkinson was recorded at a reexamination.

Results: Despite unchanged routines, there was an increase in cases with a late diagnosis between 1980 and 1987 (12 out of 19,398 born; 0.6 ‰ compared with 0.07 ‰ between 1965 and 1972). The hips were shown to be dislocated at least in one of the radiographs. Only 2 girls had a bilateral dislocation. None of the children was born in breech presentation. Seven were firstborn. There was no premature birth. The time of the first examination was 22 ± 13 hours after delivery compared with 16 ± 11 hours of 98 children in a comparison group. The most experienced pediatrician had examined 3 out of 12 with a late diagnosis within 24 hours, and 4 other children within 5 days without noting any instability. None of the parents had CDH. One older and 1 younger sister of 17 siblings had NHI. At follow-up, 7 out of 10 had increased joint laxity.

Discussion: The reason for the increase in cases with a late CDH during the 1980s is not clear. It is not due to an overdiagnosis, because all the hips were shown to be dislocated. Also, the most experienced physician was not able to make an early diagnosis despite the fact that the children were examined within 24 hours.

Perhaps an increased number of cases with a late diagnosis have made the pediatrician examine the newborn more vigorously, thereby creating increased joint laxity and inducing a vicious cycle. Factors such as female sex and joint laxity imply an increased risk, whereas mechanical factors such as breech presentation and the primogeniture effect very likely facilitate an early diagnosis in the screening.

Varia

Infants escaping an early diagnosis of congenital dislocation of the hip (CDH)

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Despite screening for neonatal hip instability (NHI), a late diagnosis of CDH still occurs. In this study, we have analyzed the routines of screening and the patients with a late diagnosis of CDH since the screening was introduced in Malmö in 1956.

Benefits of ultrasonic investigation of neonatal hip instability

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Since we developed the dynamic anterior ultrasonic technique for investigation of the newborns' hip in 1983, the method has routinely been used for diagnostic and follow-up purposes of all newborns with suspected or verified neonatal hip instability (NHI). The technique provided an opportunity to obtain a correct diagnosis and to follow the stability and recovery of all treated infants.

Material and methods: All the infants in our district treated for NHI in 1980 and 1981, i.e., before the use of ultrasound, were compared with infants in whom treatment

was based solely on the ultrasonic investigation (1986–88). The two materials were studied regarding the number of treated infants and duration of treatment.

Results: We found a 55 percent decrease in the number of treated infants. The average time in a splint was reduced from 57 to 32 days. In spite of this, no late CDH was found among the infants with a normal ultrasonic investigation, and thus not treated.

Conclusions: Although not used for screening purposes, the dynamic anterior ultrasonic technique resulted in a considerable reduction of the number of infants treated for NHI without increasing the occurrence of late CDH. Further, the possibility to quantify and follow the stability made it possible to reduce the time in a splint.

Locomotion status in rheumatoid arthritis

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The clinical manifestations of RA were determined in an epidemiologic population. Our total locomotion score (1) was used for numerical evaluation of subjective (pain, ability, and ADL) and objective (joint mobility, stability, and alignment) status and, in addition, Sollerman's test (2) for hand function. The need of reconstructive surgery was ascertained.

Patients: All 82 patients with destructive RA fulfilling ARA criteria 5–8 were identified in a community of 12,707 inhabitants and evaluated by locomotion score. Seventy-seven went through the elaborate hand function test.

Results: Overall locomotion score (max. 100) was 72 (24–96) and the hand score (max. 80) 61 (0–78); both decreasing significantly with increasing disease duration and age of the patient. Total locomotion status and hand function showed a strong correlation ($P < 0.001$), as well as status of the upper and lower extremities. Forty-four percent of the patients had had a total of 108 reconstructive operations (49 orthopedic and 59 hand-surgical). The operated on category had a similar locomotion score as the nonoperated on category. Among all the patients, we found an indication for another 58 joint replacements or synovectomies and 35 hand or foot operations, i.e., in 56 percent of the patients. Their locomotion score was significantly lower than that of those who were not in need of any operation.

Conclusions: The present status of destructive RA defined as to impairment, disability, and handicap and may serve as a reference for future evaluations of new treatment regimes. Our total locomotion score is well suited for clinical assessment of the local as well as overall effects of different kinds of reconstructive surgery. The need is large.

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Cost of rheumatoid arthritis in relation to locomotion status and effect of knee and hip arthroplasty

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Total locomotion score (1) assesses impairment, disability, and handicap. Total costs of the disease were determined in an epidemiologic population and related to score. Function improvement after arthroplasty was determined and related to costs.

Methods: Cost for all 82 RA patients with ARA criteria 5–8 found in a population of 12,707 (total prevalence 0.65 percent) (2) were calculated as direct (medical and social service) and indirect (sick leave, production loss, and pension) costs. Preoperative and postoperative evaluation of locomotion score and quality of life were done in 54 patients at hip (23 cases) and knee (32 cases) arthroplasty.

Results: Total costs for the disease (1987) were 4.9 million SEK, 56 percent direct and 44 percent indirect costs. Cost per patient (60,000 SEK) were four times higher than that of Swedish inhabitants. Score (max. 100) 70–90 increased the costs by the factor 5; score 50–70 by 7 and score ≤ 50 by 14. Degree of postoperative improvement (score) was similar after hip and knee arthroplasty for different ages, as well as for different preoperative status. Knee arthroplasty (about 48,000 SEK) had higher costs than hip arthroplasty (about 40,000 SEK).

Conclusion: Arthroplasty prevents these patients from becoming incapacitated with associated high costs and improves the quality of life.

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Interscalene plexus block for arthroscopy of the humero-scapular joint

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In order to find a simple alternative to general anesthesia by means of endotracheal intubation for outpatient arthroscopy of the humero-scapular joint, the possibility of using the interscalene plexus block was evaluated.

Patients and methods: This study was performed on 9 healthy patients—8 men and 1 woman, aged 21 to 46 years—who suffered from pain ($n = 3$) or instability or recurrent dislocations of the humero-scapular joint ($n = 6$). Anesthesia was provided by the interscalene plexus block according to Winnie.

Results: This anesthesia provided good operating conditions in all the patients. The anesthesia and surgical procedures were well accepted by 8 of the 9 patients. The ninth patient experienced temporary hoarseness, probably due to a block of the recurrent laryngeal nerve. In 2 of the patients, the diagnostic procedure was followed by corrective surgery using the same anesthesia.

Conclusions: We conclude that the interscalene block is a simple, reliable, and safe anesthetic method for outpatient shoulder arthroscopy, providing good conditions for both the patient and the surgeon. This anesthesia is also well suited for open surgery in this region.

The Ilizarov frame as a tool in orthopedic surgery

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The circular frame was developed in the 1950s by Professor Ilizarov in Kurgan, USSR. The primary indication was fracture treatment, but Ilizarov has extended its application to include a large number of orthopedic conditions. In the early 1980s, the technique was adopted in the West, where it has met growing interest during recent years.

At our department, the frame has been used for the last 2 years for femoral lengthening (1), femoral pseudarthrosis (1), delayed union in a distal tibia fracture (1), tibial lengthening (3) tibial lengthening in combination with foot deformities (2), and pes equino varus (1).

Conclusions: 1) To assemble the frame is, at least in the beginning, time-consuming (preconstruction is recommended). 2) The pain experienced by the patient initially is quite pronounced, but the frame is then well accepted

(weight bearing is encouraged). 3) Pins may have to be changed owing to skin problems or nerve function impairment. 4) The possibilities with the frame are great, and the goals of the treatment can usually be reached.

The Ilizarov circular frame has a definite place in the orthopedic arsenal, and it is up to us to find out the indications and limitations of this technique.

Prophylactic knee braces increase intramuscular pressures

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Prophylactic knee braces are widely used by athletes to prevent injury to the knee. However, an increase in the number of injuries to the ankle and foot in these athletes has been reported. One possible reason for this might be increased intramuscular pressure due to external compression by the brace. We have determined the effect of three knee braces on pressures in the anterior tibial muscle at rest and during exercise.

Methods: Pressures were recorded with the microcapillary infusion method in 8 healthy subjects. Muscle contraction frequency varied between 0.5 and 1.0 Hz between individuals, but was kept constant in each of them. Three different knee braces were investigated: I Donjoy, II Omni, III Bell-Horn.

Results: Intramuscular pressure with the subject supine and at rest increased from 4.6 (SD = 4.2) mmHg to 21 (SD = 9.5) mmHg for the three braces ($P < 0.002$). Intramuscular pressures with the subjects standing and at rest increased from 12.5 (SD = 9.5) mmHg to 37 (SD = 13) mmHg with the braces ($P < 0.001$). The muscle relaxation pressure increased approximately to the same level. There was no significant difference in pressure recordings between braces.

Discussion: This study shows that the tested knee braces increase pressures in the anterior tibial muscle at rest, and muscle relaxation pressure during exercise to levels that, according to other studies, decrease muscle blood flow significantly. Pressure increase in the braced leg might, therefore, give rise to faster development of muscle fatigue during exercise. This might explain the increase in injuries to the ankle and foot recorded in athletes.

Nonsurgical treatment of chronic lateral insufficiency of the ankle joint

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Injuries to the lateral ligaments of the ankle are among the most frequent injuries to the lower extremity. Most agree that acute injuries are best treated nonsurgically, with good functional results in 80–90 percent of the cases. This means that 10–20 percent will suffer from chronic functional instability.

Patients and methods: One hundred consecutive patients (66 men and 34 women) with chronic functional instability (more than 6 months) have been treated with functional ROM exercises, peroneus strengthening, and coordination training using tilt boards for 3 months. All the patients were evaluated before and after treatment using a scoring scale. The mechanical stability was evaluated with standardized stress radiographs, measuring both anterior talar translation (ATT) and talar tilt (TT).

Results: Forty-nine patients gained excellent or good results, while the remaining 51 did not. Patients with painful functional instability had better results, while patients with mechanical instability (increased ATT and TT) had the worst results.

Conclusions: Patients with chronic functional instability and low-grade mechanical instability should be treated conservatively, while those with real mechanical instability, i.e., high values of ATT and/or TT, should be treated with early ligamentous reconstruction.