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1. A prospective study of preoperative and postoperative sequential MRI and early clinical outcome in automated lumbar percutaneous discectomy

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There is sparse quantitative information about what happens with the disc herniation after percutaneous discectomy and no data about the actual pathology of the herniated disc in the immediate connection with surgery. Comparative studies of MRI and early clinical outcome as assessed by clinical parameters as pain, SLR and neurological findings are also missing.

The aim of this study was to evaluate the size of the disc herniation with MRI pre- and postoperatively in patients undergoing APLD and to correlate the MRI findings with the early clinical outcome.

Patients and methods: This study includes 20 consecutive patients. The indication was a non-resolving unilateral radicular leg pain for at least 6 weeks, positive SLR and neurological deficits. All had a contained lumbar disc herniation. Except the preoperative diagnostic MRI, three sequential MRI were performed: on the day of surgery, immediate pre- and postoperatively and six weeks postoperatively. The clinical outcome was analysed as to the development of the sciatic and low back pain (VAS), SLR and neurological findings. The maximum protrusion of the disc herniation was measured in the axial and sagittal plane and the maximal protrusion was assessed in mm and in per cent of the anterior-posterior diameter of the spinal canal.

Results: There was no significant difference in the maximum protrusion of the disc herniation between the three measurements. There was a significant improvement of the sciatic pain at the first day postoperatively but not at one week or six weeks postoperatively. SLR decreases in a significant way postoperatively, at one week and at six weeks. There was no correlation between the MRI findings and the early clinical outcome as measured in any of the clinical parameters. Seven patients had an early unsatisfactory clinical outcome necessitating open surgery.

Conclusion: The effect of APLD does not seem to be mediated by decreasing the size of the disc herniation. The clinical outcome in the individual patient can not be predicted from early sequential MRI. In this study APLD was ineffective in the treatment of contained lumbar disc herniation.

2. The significance of a positive SLR-test after lumbar discectomy

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Purpose of the study was to determine the clinical significance of a positive SLR-test after lumbar disc surgery.

Method: Prospective and consecutive study of lumbar disc excision (microscopic or loupe magnification). Subjective and objective patient data collected in a standardized protocol preoperatively and at 4, 12 and 24 months postoperatively. SLR-test related to outcome of surgery and reoperation.

Patients: 200 consecutive patients operated on for lumbar disc herniation, aged 42 (20–81) years, 115 men and 85 women. 192 herniations were located on the two lowermost lumbar levels.

Results: Preoperatively the SLR-test was positive in 86% of the patients, for the majority between 0° and 30°. At four months postoperatively 78% had negative SLR-test and the majority of positive tests were between 60° and 90°. The 44 patients with a remaining positive SLR-test at four months postoperatively graded their outcome as excellent in 51, fair in 30, unchanged in 14 and deteriorated in 5% as compared to 90, 7, 2 and 1% in the group with negative SLR-test. These figures remained at 12 and 24 months and the correlation between excellent outcome and the result of the SLR-test was highly significant ($p = 0.0001$). Reoperations before 24 months postoperatively were performed in 20% of those with a positive SLR-test at 4 months postoperatively as compared to 4% of those with a negative SLR-test at 4 months ($p = 0.01$). There was also a female predominance among the patients with a postoperatively positive SLR-test.

Conclusion: A positive SLR-test at 4 months after lumbar

disc surgery is more common in females, and entails an almost 50% risk of a clinical outcome less than excellent and a 20% risk of repeat surgical intervention.

3. Cerebrospinal fluid levels of neurofilament protein and S-100 are increased in patients with lumbar disc herniation

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Markers of nerve tissue injury can be analyzed in the CSF. This allows characterization of the cell types involved, and the degree of disease, in patients with neurological disorders. The aim of this investigation was to determine if nerve root injury caused by disc herniation increases the levels of nerve and glial cell injury markers in the CSF and to assess if these markers were related to clinical parameters.

Methods: 15 patients with sciatica and CT-verified lumbar disc herniation (DH group), admitted for surgery, and seven patients admitted for lower extremity surgery (control group) were included in the study. Concentrations of neurofilament protein (NFL), S-100 protein (S-100), neuron-specific enolase (NSE) and glial fibrillary acidic protein (GFAP) were determined in the cerebrospinal fluid (CSF). NFL and GFAP were analyzed by ELISAs, S-100 and NSE by RIA and LIA methods, respectively. The concentrations of the four markers were related to patient history (heredity, previous symptoms, length of subjective symptoms, sick leave, smoking), clinical findings (motor and/or sensory deficits, positive straight leg raising test) CT-findings (location of the herniation, degree of nerve compression) and postoperative result (back pain, radicular pain, persistent motor and/or sensory deficits) were investigated in the DH group. The Mann-Whitney test was used for statistical comparisons between the groups. Results are given as mean $\pm$ standard error of the mean.

Results: CSF concentrations of NFL and S-100 were increased in the DH group compared to controls (1158 $\pm$ 383 vs. 152 $\pm$ 14 ng/l, $p < 0.01$, and 1963 $\pm$ 231 vs. 1003 $\pm$ 152 ng/l, $p < 0.05$, respectively). There were no differences in NSE and GFAP between the DH group and the controls (350 $\pm$ 20 ng/l vs. 308 $\pm$ 42 ng/l, 484 $\pm$ 61 ng/l vs. 364 $\pm$ 58 ng/l respectively). DH patients with less than 3 months preoperative duration of subjective symptoms had higher NFL levels than patients with longer duration (2318 $\pm$ 746 vs. 384 $\pm$ 100 ng/l, $p < 0.001$). None of the markers were related to preoperative clinical or CT findings. Persistent motor and/or sensory deficits at follow-up 2-3 months postoperatively were related to high levels of NFL preoperatively (2248 $\pm$ 781 vs. 432 $\pm$ 98 ng/l, $p < 0.05$).

Discussion: NFL constitutes a major structural element of neurons. The levels of NFL are higher in the axons than in the cell body and dendrites in most neurons. In the nervous system, S-100 is localized in the cytoplasm of astroglial cells

and Schwann cells. GFAP is exclusively localized in astrocytes, whereas NSE is found mainly in nerve cell bodies. The increase of NFL and S-100 in the CSF in patients with lumbar disc herniation causing sciatica indicates a nerve root injury affecting intrathecally localized axons and Schwann cell myelin sheaths. Since GFAP and NSE levels remain unchanged the integrity of nerve cell bodies and astrocytes seem to be preserved. The finding of higher levels of NFL in patients with short duration of symptoms may be consistent with a massive release of NFL from the damaged nerve root during the acute phase of the disease. The lower level of NFL in patients with long-standing chronic pain may be caused by an atrophy of the nerve root, which then releases less NFL. The relationship between persistent neurological deficit and high NFL levels in CSF indicates that these patients had a more pronounced nerve damage. Investigation of nerve tissue injury markers in CSF are of value to understand pathophysiological mechanisms in sciatica. In addition, the data in the present study indicates that NFL may be a potential diagnostic marker for nerve root injury in patients with disc herniation and sciatica.

4. Cauda equina syndrome as a postoperative complication—a report of 5 patients operated for lumbar disc herniation

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We report on 5 patients (3 women) 31 to 54 years of age, operated for lumbar disc herniation, whom immediately postoperatively developed an acute cauda equina syndrome (CES). In 4 of the patients an acute neuroradiologic investigation was performed, MRI in 3 and myelography-CT in 1. These investigations did not in any case give an explanation as to why the patients had developed a CES. All 5 patients were reoperated within 48 hours. An extended decompression was performed in 3 patients, and a total laminectomy and posterolateral fusion in 2. No obvious cause of the CES could be revealed during the reoperations. The clinical outcome varied; 2 of the patients experienced a total recovery within three months, whereas 3 had some degree of bladder incontinence and weakness in the leg previously affected by the sciatica.

The 5 patients laid open certain common features. All five had varying degrees of preexisting lumbar spinal stenosis on which the herniated disc was superimposed. And, the level affected by the herniation was in no patient the most distal one; there were always stenotic levels on both sides of the herniation.

We therefore postulate the hypothesis that CES after surgery for disk herniation may be caused by a venous congestion. The preexisting spinal stenosis renders the venous drainage vulnerable. The swelling caused by the disk hernia-

tion and the following surgery may be enough to block the drainage in case of a relative obstruction both proximally and distally. A disk herniation at the lumbosacral level, on the other hand, would have an unrestricted venous drainage distally which may be the explanation why postoperative CES was not seen at this level in spite of this being the most common site for disk herniations.

Special attention should be paid to the development of postoperative CES when operating patients with preexisting spinal stenosis for lumbar disk herniation. The risk may be higher if the disk herniation has stenotic levels both above and below. Acute neuroradiological investigation will probably not contribute to determine the cause of the CES. The treatment of choice seems to be extended decompression within 48 hours.

5. Lumbar nerve root compression and intraspinal synovial cysts

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The purpose of the study was to describe the clinical features, diagnostics and surgical treatment of intraspinal synovial cysts from lumbar facet joints.

Patients and methods: Through a five-year period, 8 patients with lumbar nerve root compression due to lumbar synovial cysts demonstrated on neuroradiographic investigation were evaluated. Evaluation was performed by MRI in 7 cases and CT-myelography in one case. All patients were studied prospectively, collecting subjective data and neurologic. All patients underwent surgical decompression.

Results: Two patients had the picture of spinal claudication while the remaining 6 had nerve root compression on either L5 or S1 levels. The straight leg raising test was negative in 2 patients and positive in the remaining 6. Four of the patients had no neurological abnormality. The neuroradiographic evaluation demonstrated in 6 cases single nerve root compression exerted by a synovial cyst, and in the remaining 2 patients there was more diffuse compression of the thecal sac. All synovial cysts could be shown to be emanating from a degenerative facet joint. Surgical decompression was performed without complications. At medium term follow-up, 5 patients were totally painfree regarding sciatica, and the remaining 3 were significantly improved. Low back pain was unchanged or somewhat improved.

Conclusions: Synovial cysts arising from facet joints can exert compression on nerve roots or the thecal sac yielding a picture of central or lateral spinal stenosis. It is readily demonstrated by MRI and surgical excision yields a favorable clinical outcome.

6. Acute spinal epidural abscess without spondylodiscitis

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Spinal epidural abscess (SEA) is a rare disorder, associated with a high risk of neurological sequelae. In many patients SEA occurs together with a spondylodiscitis. MRI performed before and after i.v. injection of gadolinium can diagnose spondylodiscitis and at the same time visualize the spinal canal including the epidural space. The aim of this study was to report our experience with the diagnosis and treatment of patients with an acute SEA without spondylodiscitis.

Patients and methods: A retrospective survey of the clinical records and radiological examinations of 10 patients with SEA without spondylodiscitis, admitted to Danderyd Hospital during 1993–1996, was undertaken. There were 5 women and 5 men. Median age was 71 (27–81) years.

Results: All patients had an acute onset of fever and local or radiating backpain. Pronounced weakness in both arms was found in one patient with a cervical abscess. 3 patients had radicular pain in the lower extremity, one of them also with weakness in one leg. 6 patients were neurologically intact. In none of our patients an epidural abscess was suspected on admission and in only 3 patients there was a suspicion of spondylitis. In all cases the diagnosis and the subsequent regression of the abscess were verified by MRI. Imaging findings included inflammatory changes, not only in the epidural space, but also in the erector musculature, as well as signs of septic arthritis in an adjoining facet joint in all cases. The localisation of the SEA was cervical in 1, thoracic in 2 and lumbar in 7 cases. *Staphylococcus aureus* was isolated in 8 patients. All had positive blood cultures. In the remaining 2 patients no etiological agents could be found, probably due to ongoing antibiotic therapy when cultures were taken. The median duration of symptoms prior to start of i.v. antibiotics was 4 (1–15) days. All patients were treated successfully with antibiotics alone. Complete restitution in all 4 patients with neurological symptoms was seen. Good recovery of back pain occurred within median 2 (1.5–5) months. No patient was operated on, but 2 patients underwent percutaneous drainage of a paraspinal abscess and in one patient the epidural abscess was drained percutaneously.

Conclusion: A hematogenous infection of the epidural space should be suspected when a patient is presented with an acute onset of fever and backpain, with or without neurological symptoms. The diagnosis is easily confirmed by contrast enhanced MRI. Blood cultures will usually reveal the etiological agent. Antibiotic treatment alone seems to be sufficient to assure a good clinical outcome.

7. Does the presence of a personality disorder predict the result of surgery for low back pain

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This study aims at investigating whether the presence of a personality disorder affects the long-term result after surgery for low back pain. The study is part of an extensive follow-up of patients with chronic low back pain treated with fusion surgery at the Department of Orthopedics, University Hospital 1983–1987. The follow-up time was at least 5 years. 75 patients took part in the study, 42 women with a mean age of 48 years and 33 men with a mean age of 47 years. At follow-up all patients met the DSM-III-R criteria for somatoform pain disorder.

The main indication for operation was low back pain with a duration of at least six months and a positive response to external fixation test. The operation performed was an anterior lumbar interbody fusion. The presence of co-existing personality disorders was evaluated by administering the SCID screen questionnaire. Long-term results were evaluated based on the patients reported experience of pain, global change, and working-status at follow-up.

At follow-up 18 patients (24%) worked full-time or part-time. 28 patients (37%) reported important global improvement. Twelve out of 75 patients (16%) fulfilled the diagnostic criteria for at least one personality disorder (approximately 10% in the general population). Five of these had a personality disorder in cluster B (i.e. dramatic, emotional and erratic personality traits), none of them reported important global improvement and none of them were in job at follow-up.

The results of our study indicate that the presence of a personality disorder in cluster B result in a worse long-term outcome after surgery.

8. Hydroxyapatite coating of pedicle screws may give too good fixation

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Loosening of pedicle screws is a frequent problem in spinal instrumentation. Hydroxyapatite (HA) coating has been used to enhance screw fixation but the effects on radiolucent zones or the purchase of the screws have not been described.

Patients and methods: In a pilot study seven patients were operated on in the thoracic or lumbar spine with two-level fusion. A four pedicle screw construct with HA coated screws either at the upper or the lower level was used. In 4 of the patients (3 women), mean age 32 (15–43) years, the im-

plant was removed between 10 and 22 months after surgery. The indication for fusion was postdiscectomy syndrome in 2 patients, spinal stenosis in 1, and fracture in 1.

The insertion and extraction torque was recorded with a torque gauge manometer. Two of the screws were extracted with a cylindrical drill leaving a thin layer of bone on the threads allowing histological examination.

Results: The mean insertion torque was 107 ± 37 Ncm for the HA coated screws and 76 ± 29 Ncm for the standard screws ($p < 0.05$). The extraction force could only be measured in one patient and was 5 and 25 Ncm respectively for the standard screws and 475 and 550 Ncm respectively for the HA screws.

The HA coated screws were very adherent. In two patients it was not even possible to remove the screws with the torque gauge manometer. Instead they had to be extracted with great force using a universal chuck. In one patient the HA coated screws had to be extracted with a cylindrical drill. The histological examination demonstrated good osseointegration.

Conclusions: HA coating of pedicle screws was so effective in improving the purchase that removal of the screws constituted a problem. HA coating of pedicle screws should be used cautiously; it may be very useful in patients with osteoporosis or in spinal surgery for metastases and other tumors.

9. Mobility after anterior cervical fusion and modum cloward: a radiostereometric and clinical analysis comparing autologous, homologous and heterologous bone grafts

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The heterologous bone graft heals with a fibrous union in contrast to the overbridging bone fusion obtained with the autologous one. The aim of the study was to compare the mobility of segments fused with different bone transplants and relate it to the clinical outcome.

Patients and methods: 33 patients (19 men and 14 women, 36–64 years of age) were operated on with anterior decompression and fusion a m Cloward due to disc protrusion/osteophytes in one level of the lower cervical spine. They were randomized to autologous bone transplant from the iliac crest, homologous bank bone or heterologous bovine transplant (Unilab SurgiboneTM). During the procedure three or four tantalum balls, diameter 0.8 mm, were placed in each of the two vertebrae being fused. Radiostereometric analysis (RSA) in maximal flexion and extension was done six, twelve and at least 24 months after surgery. The patients did pain rating (VAS) and was examined clinically preoperatively and at the same interval postoperatively with an unbiased

observer at the last follow-up.

Results:

Mobile fusions according to RSA

Graft	Total	6 mo.	12 mo.	24 mo.
Autologous	10	3	1	1
Homologous	11	5	5	2
Heterologous	12	5	3	3
All grafts	33	13	9	6

No significant differences between the grafts.

Clinically, the pain rating did not correlate with mobility in the fusion. The pain rating (VAS) did not significantly differ between the groups, but the patients operated with autologous grafts experienced more reduction of the pain radiating into the arm.

Conclusion: In six out of 33 patients, mobility could be demonstrated more than two years after surgery without difference between the types of graft. Three more patients were mobile one year postoperatively indicating that the healing process continues after the first year. The clinical outcome was not influenced by mobility in the fusion.

10. Subaxial cervical spine subluxation in rheumatoid arthritis treated with the Olerud cervical fixation system

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To improve stability and to avoid the need for 360 degrees fixation the Olerud Cervical Fixation System was applied on a series of rheumatoid arthritis patients with subaxial subluxation of the cervical spine (Group A). Comparison was made to a historical series fixed with plates (Group B).

Materials and methods: Group A consisted of 9 patients, 5 women, with a mean age of 72 (62–78) years. Group B consisted of 16 patients, 15 women, with a mean age of 65 (55–77) years. Myelopathy was present in 4/9 patients in Group A and in 13/19 patients in Group B. Treatment consisted of reduction of deformity by peroperative traction, decompression, and fusion. In Group A the new system was applied via a posterior approach. In Group B two patients were operated from posterior, 5 from anterior, and in 9 both approaches were used. Fixation was achieved with plates.

Results: Average operation time was 3:50 hours in Group A and 5:30 hours in Group B ($p=0.0229$). The peroperative blood loss as well as the clinical outcome was equivalent in the two groups.

Conclusions: The new fixation system results in the same clinical outcome as traditional plate fixation. By avoiding 360 degree fixation the operation time can be significantly reduced.

11. Posterior atlantoaxial fusions with the Olerud cervical fixation system for odontoid fractures and C1–C2 instability in rheumatoid arthritis

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The most frequently used methods for treatment of odontoid fractures includes both nonsurgical methods such as Halo vest treatment and surgical methods such as anterior screw fixation, posterior transarticular screw fixation and posterior wiring techniques. However, disadvantages and complications have been demonstrated with all these treatment methods. Problems have also been reported with the existing methods for posterior fusion for C1–C2 instability related to rheumatoid arthritis. The present study presents early results from a 6-month follow-up of a new surgical method using the Olerud cervical fixation system for posterior C1–C2 fusions.

Patients and methods: The study is based on data from all patients who underwent a posterior C1–C2 or C1–C3 fusion using the Olerud cervical fixation system with C1-claws and transpedicular screws in C2 or C3 between 1996 and 1997. 26 patients were included, 14 men and 12 women, with a mean age of 72 (37–93) years. The indication for surgery was odontoid fractures in 19 patients and rheumatoid arthritis (RA) in 7 patients. 2 patients had both an odontoid fracture and RA and 1 had an odontoid fracture and ankylosing spondylitis. The patients have been followed for at least 6 months. Plain radiographs have been obtained pre- and the first week postoperatively and were scheduled to be obtained 3, 6 and 12 months postoperatively. The radiographic findings were graded as healed, no healing disturbances or not healed.

Results: No neurological or vascular complications, related to surgery, were found peri- or postoperatively. One patient was accidentally extubated during a late phase of the surgical procedure after the placement of the transarticular screws, but was reintubated and survived without an established ischemic brain injury.

8 out of 13 patients who have been followed by radiographs at least 6 months, have healed radiographically. The other 5 patients have no radiographic signs of healing disturbances after 6 months. 3 patients have died of other reasons not related to the operation. When they died, there were no signs of complications related to the neck surgery. The remaining 10 patients have not yet attended the radiographic 6 month follow-up.

Discussion: The early results of posterior C1–C2 fusions with the Olerud cervical fixation system seems promising. No serious complications related to the surgical procedure were found. However, these patients needs to be followed for a longer period before any definitive conclusions can be drawn.

12. Posterior lumbar interbody fusion in chronic disabled low back pain patients

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A follow-up study conducted by an independent observer was performed on our first 29 consecutive Posterior Lumbar Interbody Fusions, PLIF, there at least two years had transpired since date of operation.

Patients and method: Patients chosen for operation all had a history of chronic disabling low back pain exceeding 2 years and a sick leave period in excess of 6 month (average 3.4 years).

During 1989–1993, 29 consecutive patients were operated with a PLIF. The level of fusion was chosen depending on radiological changes and results from intradiscal injection provocation test. Data regarding patients' pain and working ability was accumulated preoperatively and thereafter once annually. Bone union was verified on radiography by thin (1mm) CT slices and sagittal reformation and in all but 3 patients by a "second look" at the time of hardware removal. All patients were subsequently evaluated by an independent observer in November, 1995, on average 4.7 years postoperative.

Results: Bone fusion was obtained in 92% (27) of the patients. There was a highly significant reduction in back- and leg-pain measurements. 9 of 29 had excellent results, 6 good, 6 fair and 8 poor results. 18 of 29 had returned to work.

Conclusion: We consider the PLIF operation after pain provocation a method possible for treatment of chronic disabling low back pain.

13. Lumbar back and posterior pelvic pain during pregnancy—a 3-year follow-up

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Back pain is common during pregnancy and includes pain from the lumbar back as well as from the pelvis. This pain can be reduced by structured physiotherapy during pregnancy, and the beneficial effect may last for several years. Some women have residual pain for a long time, but the relative incidence of different pain types and their respective degree of disability has not been reported. Neither has any study presented a physical examination of these women three years post partum with focus on type of pain.

Methods: All women in an intervention group as well as all women in a control group who had experienced back pain during an index pregnancy were interviewed through a mailed questionnaire, three years post partum. All women who had residual back pain filled in an additional questionnaire and were physically examined.

Results: Out of 799 pregnant women 233 had some type of back pain during the index pregnancy, and 41 had residual pain three years later. No significant differences were noted between the intervention group and the control group in relation to incidences of type of back pain. Women with combined pain, lumbar back as well as posterior pelvic were significantly more disabled ($P < 0.05$) and had significantly poorer muscle endurance in the lumbar back and pelvis ($P < 0.01$).

Conclusions: Some five percent of all pregnant women, or 17% of all women with back pain during pregnancy had residual pain three years later. Women with combined pain were more disabled and had lower muscle endurance than women with lumbar back pain or only posterior pelvic pain. The key problem may be poor muscle function in the back and pelvis.

14. Long term follow-up with the uncemented cls stem in total hip arthroplasty

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Patients: During 1986–1992, 137 uncemented CLS stems were implanted in 116 patients. The procedure was done bilateral in 20 patients and one patient was revised to another CLS stem. 116 were primary arthroplasties and 21 were revisions. 64 patients were men and 52 women. The mean age at operation was 50 (26–72) years. The mean follow-up was 8.3 (5.5–12.5) years. The distribution according to the Charnley classification was: A 67; B 39; C 31.

Method: The patients were followed in a consecutive, prospective and longitudinal study including a clinical and radiologic evaluation. Clinically the patients were evaluated pre- and postoperatively according to Merle d'Aubigné as modified by Charnley. Preoperative the patients were classified according to Charnley A, B and C. The latest and the first available postoperative radiographs were analysed with respect to subsidence, stress shielding, cortical hypertrophy, radiolucent lines and ectopic bone formation.

Results: During the follow-up time 12 patients died, thus leaving 104 patients with 124 CLS stems left for evaluation. No patient was lost for follow-up. The preoperative

Merle d'Aubigné score was according to pain 2.6, function 2.7 and ROM 3.7. At the latest follow-up, the corresponding scores were pain 5.7, function 5.6 and ROM 5.0. During the observation time 5 stems were revised due to mechanical loosening. The radiological analysis showed a low frequency of subsidence, cortical hypertrophy, stress shielding and radiolucent lines.

Complications: No deep infection of fatal pulmonary embolism was seen. Four patients showed transient peroneal palsy. Three patients had pulmonary embolism and two had deep venous thrombosis. Three patients had early dislocation of the operated hip (1 patient had 3 dislocations).

Conclusions: The uncemented CLS stem used in relatively young patients gives good clinical results with only a few complications and a low revision rate. Based on the radiological findings the prosthesis seems to be stable, thus indicating a good probability for a good further prognosis for the prosthesis.

15. Migration of the Cone prosthesis—a radiostereometric study

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The Cone prosthesis is a cementless titanium alloy femur implant with a conical shape with a stem slope angle of 5°. It has 8 sharp longitudinal ribs with a varying height of 1–2 mm which is supposed to give the stem rotational stability. The CCD angle is 135°.

Patients and methods: 24 patients (25 hips) with a mean age of 43 (28–58) years were studied during two years using repeated roentgen stereophotogrammetric measurement and Merle d'Aubigné score as clinical outcome. Migration of the centre of the head of the prosthesis was measured at 4 months, 1 year and 2 years.

Results and conclusions: The Merle d'Aubigné scores improved at the control at four months and the improvement remained after one and two years. The precision of the RSA measurement for subsidence was 0.2 mm and in most cases the migration values were inferior to the accuracy of RSA. It is concluded that the Cone prosthesis at two year seems stable, measured with RSA-technique, and so far has a good clinical outcome.

16. Revision total hip arthroplasty using of third-generation cementing technique

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We studied results after revision THR with use of third-generation cementing technique.

Patients and methods: There were 84 consecutive patients (30 male, median-age 70 (31–87) years), revised for the first time, with so-called 3:rd generation cementing-technique because of aseptic loosening (66 hips, 79%), infection (6 hips, 7%) or other miscellaneous reasons. Preoperative bone defects were classified as suggested by Gustilo-Pasternak. Charnley components were used in most cases. Majorly, bone defects were sustained with cement and reinforcement-net. The median follow-up period was 3.6 (1.5–6.3) years.

Cementing-quality was graded as suggested by Raut. Radiological follow-up was performed as suggested by Johnston.

Results and discussion: 76% of the patients stated less pain than preoperatively, 65% improved their walking ability and 73% claimed to be satisfied with the result. 4 of the cups and 4 of the stems required a re-revision. One cup and one stem because of recurrent infection and one cup and one stem because of postoperative infection, the others were revised because of aseptic loosening. One hip out of three, revised because of dislocation, continued to do so. 25 out of 67 (37%) revised stems and 10 out of 54 (18%) revised cups were radiologically loose.

Radiologic cup loosening was associated with poor bone stock but not with malpositioning, incomplete cement mantle or age. Femoral loosening was associated with poor cement mantle, especially in zone 4, but not with poor bone stock or age. Improved cementing-technique, per se, does not appear to dramatically improve short-time results in revision THR when compared to second-generation techniques.

17. The McMinn cup in severe acetabular defects

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The stemmed McMinn cup is used as a salvage revision procedure in patients with severe acetabular bone deficiency.

Patients and method: McMinn revision cups were used in 13 hips (12 patients; 3 men, median-age 59 years, range 33–81 years) with severe acetabular bone loss (Gustilo-Pasternak III/IV). Plain hip radiographs and C-T scans were made post-operatively and after one year. The clinical outcome was assessed by a patient-questionnaire. Two patients were excluded: One because of loosening, the other had an ischemic gangrene not related to surgery.

Results and discussion: Of the remaining 11 patients 7 stated less pain than pre-operatively, 5 improved their walking ability and 6 claimed to be satisfied with the result. On follow-up- radiographs 4 cups had migrated cranially, 3 of these patients had symptoms. C-T scans showed that another cup had rotated laterally but this patient did not have any symptoms. Post-operative radiographs and C-T scans showed that 8 stems had penetrated through the iliac cortex or into the sacro-iliac joint but this was not associated with migration or symptom. On the follow-up both plain radiographs and C-T scans disclosed that all patients had developed radiolucent lines, but only one patient (with a migrated cup) had a continuous zone. The short-term results after the McMinn procedure seem to be reasonable, considering that in some of these patients a Girdlestone procedure was the only alternative. An additional advantage is that it is cementless and that bone grafting may improve the situation if further surgery should become necessary.

18. Patient expectations of revision total hip arthroplasty

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The aim of this study was to investigate expectations versus outcome in patients undergoing revision THR.

Patients and methods: 30 patients (11 male, median-age 69 (33–89) years) answered a pre-operative questionnaire regarding their expectations of the operation. A follow-up questionnaire at one year included questions about e.g degree of fulfilled expectations and satisfaction. The study was performed by an independent observer.

Results: Pre-operatively all the patients expected markedly or rather markedly improved walking ability and pain-relief. The expectations were not associated to gender, age or previous revisions. 40% stated that their expectations derived from the surgeon only, 30% stated that other factors were more important than the surgeon and 20% stated both the surgeon and other factors had contributed. At follow-up 24 of the patients were satisfied, 19 had improved their walking ability and 25 had less pain. Degree of fulfilled expectations regarding both pain and walking ability was associated to the virtual clinical result and patient satisfaction. 7 and 12 patients claimed unfulfilled expectations concerning pain-relief and walkingability respectively.

Discussion and conclusion: Patients undergoing revision THR have surprisingly high expectations. Expectations are, of course, founded on numerous irrational and emotional factors, not always directly related to the medical condition. But they certainly have an impact on the outcome, which in orthopedic surgery is mostly dependent on the patient's subjective opinion.

19. Early migration of the Exeter hip prosthesis—a radiostereometric study

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The purpose was to gain knowledge of early migration of the Exeter hip prosthesis in primary arthroplasty.

Patients and methods: Included in the study were patients younger than 75 years with non-inflammatory hip arthritis not previously operated on and in category A or B according to Charnley's classification. There were 24 hips in 24 patients. The arthroplasties were performed with the surgical technique described by the producer of the Exeter prosthesis. Radiostereometric analysis (RSA) was performed before mobilisation and at 4 and 12 months postoperatively. RSA could be completed for 21 femoral and 22 acetabular components.

Results: All femoral components had migrated 0.4–1.7 (mean 1.0) mm in distal direction at 4 months postoperatively and 6 migrated further 0.3–0.7 mm. At one year the distal migration was 0.5–2.2 (mean 1.2) mm. At one year six femoral components had migrated in lateral direction 0.5–1.0 (mean 0.6) mm, 11 in posterior direction 0.7–2.4 (mean 1.1) mm and one 0.6 mm in anterior direction. At one year one acetabular component had migrated 0.3 mm in medial direction and another 0.2 in cranial direction.

Discussion: All the Exeter femoral components migrated in distal direction, but 4 months postoperatively the migration had stopped in 15 out of 21 components. Both magnitude and incidence of early migration of the femoral component in this study is much higher compared to previous RSA studies with femoral components of other designs. This might be due to the tapered shape of the collarless Exeter stem facilitating a slight subsidence within the cement rather than a sign of loosening. The Exeter acetabular component (plastic) was stable in most cases.

20. Problems and complications in hip revisions with impacted morselized allografts and cement

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The purpose was to study intra- and postoperative problems and complications in hip revisions with impacted morselized allografts and cement up to 2 years postoperatively.

Patients and methods: Due to mechanical loosening 26 consecutive hips were revised (24 stems and 25 sockets) for the first time using the technique described by the Exeter group in 1993.

Results: In 3 hips the femur was perforated during surgery (2 supplied with cerclages and 1 with a Dall-Miles plate and wires). A fourth perforation was not noticed until postoperatively. In 1 hip the drill was caught in the femoral canal during cement extraction and a cortical window had to be made (supplied with a Dall-Miles plate and wires). In 1 femur a skeletal fragment (2x4 cm) was avulsed from the trochanter minor area and was fixed with a cerclage. In 1 femur an anterior crack occurred in the proximal femur which was supplied with cerclages. In 2 femurs an undislocated crack at the distal tip of the stem was not noticed until postoperatively. Femoral fatigue fractures occurred in 3 of the above 9 hips 1–4 months postoperatively (the 2 supplied with a Dall-Miles plate and wires and 1 of the perforations supplied with cerclages). All healed after reoperation with open reduction and fixation with an AO-plate with 12–14 screws. In 5 femurs occurred intraoperative accidental detachment of the greater trochanter which all were supplied with cerclage and healed uneventfully.

In 3 hips the acetabular ream had to be reinforced with a reconstruction plate. Two sockets loosened during prepara-

tion of the femur and had to be recemented.

4 femoral components dislocated postoperatively, 1 three times, 2 twice and 1 once, all stabilised after treatment with orthosis for 3 months.

Conclusion: Minor intraoperative problems occurred frequently illustrating the difficulties in hip revisions with impacted morselized allografts and cement. Complications during cement extraction and postoperative dislocations were as frequent as reported in previous studies. Postoperative fatigue fractures were seen in femurs supplied with cerclages or wires, which might have been avoided by initial use of a longer stem or a plate secured with screws.

21. Preoperative treatment in patients with hip fractures

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In Sweden patients with hip fractures are usually treated with traction, while awaiting surgery, in order to reduce pain. Some surgeons also believe that traction improves the position of the fracture and makes the reduction and osteosynthesis easier. The aim with this study was to perform a randomised trial to evaluate the value of preoperative skin traction in patients with hip fractures.

Patients and methods: A series of 120 patients with hip fractures were randomised to be nursed free in bed or to receive skin traction with the leg placed on a sled awaiting surgery. Four groups with 30 patients each were established: 1) cervical hip fracture nursed free in bed (21 women and 9 men, mean age 81 (56–94) years), 2) cervical hip fracture that received skin traction (20 women and 10 men, mean age 81 (61–96) years), 3) trochanteric hip fracture nursed free in bed (25 women and 5 men, mean age 77 (50–89) years), and 4) trochanteric hip fracture that received skin traction (25 women and 5 men, mean age 81 (59–95) years). The time for the injury, start of the “preoperative treatment” and operation were registered. We recorded the pain score using a Visual Analogue Scale (VAS) 15 minutes before “preoperative treatment” as well as after 1, 4 and 12 hours. The use of supplementary analgesics was registered and the patients were followed with clinical and radiological assessment after 4 months.

Results: The average time period between the index injury and “preoperatively treatment” was 11 (3.3–56) hours for the patients nursed free in bed and 11 (1.5–135) hours for those who received skin traction. The average time period between “preoperatively treatment” and the operation was 17 (2–45) hours respectively 19 (2.6–215) hours.

No significant differences were found between the groups in terms of pain during the preoperative period, supplementary analgesic requirements or the frequency of complications.

Conclusion: We conclude that skin traction as preoperative treatment in patients with hip fractures has no benefit.

22. A randomized multicenter trial of the Medoff sliding plate versus standard screw-plate systems in subtrochanteric fractures

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The Medoff sliding plate (MSP) differs from standard screw-plate systems by its compression capacity along the femoral shaft. This greater load sharing ability for the MSP should, in theory, result in increased fracture stability with decreased rate of fixation failure. The purpose of the study was to test this hypothesis by comparing the efficacy of the MSP versus three other standard screw-plate systems in the fixation of subtrochanteric fractures.

Patients and methods: From March 1993 through June 1995, 107 patients with a subtrochanteric fracture were after randomization treated with either the MSP (n=55), or with one of three different screw-plate systems according to the preference of the surgeon (dynamic hip screw, DHS, n=32, dynamic condylar screw, DCS, n=12, dynamic hip screw with a trochanteric stabilizing plate, DHS/TPS, n=8). The patients were prospectively followed for an average of 16 months (10–41). The endpoint for the follow-up was a healed fracture or revision surgery. The protocols and radiographs of the patients from the eight participating hospitals were sent for independent review and evaluation to a center, which was not involved in the surgical treatment of the patients.

Results: The condition such as age (mean 80 years), walking ability, and domestic situation was similar in all four device groups before the injury. Significantly ($p=0.04$) more patients in the MSP-group (78% vs 60%) were allowed immediate postoperative weight-bearing compared to the other groups. During the follow-up period, 9 patients in the MSP group and 7 patients in the other groups had died. At one year postoperatively, 47% of the patients in the MSP group walked without aids versus 35% in the other groups ($p=0.38$). There were 3 fixation failures with the DHS, 3 with the DCS, 2 with the DHS/TPS, and 1 with the MSP. The difference between the MSP and the other devices (1 vs 8) was significant ($p=0.01$).

Conclusions: This study supports the use of a load sharing device in extramedullary fixation of subtrochanteric fractures in elderly patients.

23. Quality of life after cervical hip fracture

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Hip fracture is associated with a high incidence of complications resulting in a considerable morbidity and costs. How about quality of life?

Material: 90 cervical hip fracture patients (age 80 (66–92); 27% men, 73% dislocated) were studied. The inclusion criteria were: no severe cognitive dysfunction (Pfeiffer >3), independent living and ambulation. 88 patients had internal fixation, one a primary THR and one a hemiatroplasty. Quality of life (EuroQol), ADL (Katz) and function were assessed in the ward, at 4 months and after 12 months, when also clinical and radio-graphic examinations were done.

Results: 67 (74%) patients were followed-up; 18 were deceased and 5 refused. 47 of the fractures healed, 11 patients were reoperated. Another 9 patients developed a pseudoarthrosis, 4 of them were scheduled for surgery. 22 patients had local pain because of the screw-heads. 29 patients were ADL-dependent compared with 5 prior to the fracture. The corresponding figures for home assistance were 47 and 26 and for living in a institution 8 and 0. Quality of life according to EuroQol was significantly lower at follow-up compared to at the time of the injury.

Discussion: The estimated change in quality of life was larger than one might have expected. However, many elderly are not apt to complain; rather they often adapt to an unnecessarily low functional level. In most centers today orthopaedic surgeons treat hip fracture patients on a consultant basis; routine controls have largely been abandoned. This practice prevents progress and is therefore unjustifiable both from an humanitarian and from an economic point of view.

24. Nutritional status in elderly women with hip fracture

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Protein-energy malnutrition (PEM) is associated with loss of subcutaneous fat and muscle mass enhancing the risk for falls and fractures. We evaluated nutritional status and its relation to indices of muscle strength, quality of life and cognitive function in hip fracture patients.

Material: 42 women, mean age 80 (65–95) with a cervical hip fracture were assessed; 7 patients lived in an institution, 4 were non-ambulatory and 7 had a cognitive dysfunction (Pfeiffer <4). Nutritional status (Body Mass Index – BMI, Triceps skin fold – TSF, arm muscle circumference – AMC,

grip strength measure, IGF-1 and, IGF-binding protein-1), quality of life (Nottingham Heath Profile – NHP), and ADL status (Katz) were studied.

Results: A low BMI (< 21) was found in 50% of the patients, TSF and AMC were low in 70% and 10% of the cases. Mean IGF-1 was 75 (SD=34.0); 71% had a IGF1 less than 100 and 76% had the ratio IGF-1/IGFBP-1 less than 5 indicating a low anabolic activity. 20% of the patients described loss of appetite and 12% difficulties to eat. BMI was correlated to grip strength and to cognitive function. Patients with a low BMI had decreased Katz and NHP scores.

Discussion: Half of the women with hip fracture showed signs of PEM. A low BMI was associated with a lower muscle strength, cognitive function and quality of life. Poor nutritional status may have a negative influence on.

25. Outcome measurements in total hip replacement surgery—a validation study on the Swedish National Hip Arthroplasty Register

P Söderman, H Malchau, P Herberts

The purpose of the study was to validate the Swedish National Hip Arthroplasty Register, which was initiated in 1979, including 148,359 primary and 11,198 revision THR, and to study the outcome after total hip replacement (THR).

Methods: From the Swedish National Board of Health Welfare Register 2732 patients operated with an THR between 1986–1995 were randomly selected. The patients received a questionnaire addressing Charnley category, pain, satisfaction and revision. 1367 received a disease specific (WOMAC osteoarthritis index) and two general health questionnaires (SF-36, NHP). Finally a cohort of 390 were evaluated by clinical and radiographic examinations.

Results and conclusions: The results using clinical and radiographic failure end-point definitions will be compared with the currently used failure end-point (revision). This will hopefully give an indication of the sensitivity of the currently used failure end-point (revision) in the analysis from the register.

26. Follow-up of patients operated with a total hip arthroplasty—the surgeon's responsibility?

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The major concern after total hip replacement (THR) today is wear – periprosthetic bone loss and consequently loosening – failure. Diffuse bone loss (radiolucent lines) or local (osteolysis-granuloma) is mostly, at least at an early stage, a silent process. Extensive bone loss might lead to revisions with technically demanding surgery with bone grafting and is also a risk factor for periprosthetic fracture. The long-term

results of revision surgery with major bone deficiencies or periprosthetic fractures are in general poor. The ultimate goal is to avoid such an unreliable surgery by periodically radiographic monitoring of all THR patients. To revise early may lead to an easier revision procedure with better long-term result, decreased costs for the society and less suffering and better quality of life for the patient.

Our experiences with randomized and prospective trials, in which the study protocols include longitudinal radiographic examinations, are that we are able to diagnose periprosthetic bone loss early, when the patient have no symptoms of an impending loosening. Examples of such trials are the 12-year old ongoing randomized studies of 410 cemented THR (Charnley versus Spectron), and 171 uncemented THR (HG I versus PCA). Furthermore, the Scandinavian PCA multi-center study and analyses concerning revision rates and periprosthetic fractures in the national hip registry.

Follow-up routines differ considerably between the orthopaedic departments in Sweden. One extreme is the prospective and randomized trial and the other is no follow-up at all. Have we as orthopaedic surgeons the time for and can the health-care system afford regular follow-ups of all patients with a THR? Would such a clinical follow-up routine be cost-effective? We claim that this issue is of major concern for orthopaedic surgeons in the joint replacement field.

A nation-wide standardized follow-up routine (the follow-up intervals should be different depending patient and implant related risk factors) should not only be a quality insurance of a costly health-care technology but also, as a spin-off effect, give an opportunity to further validate and increase the scientific and clinical value of the national hip registry. With earlier well-known disasters in the "THR history book", regularly follow-ups, especially when new implants is used, should not be regarded as an optional requirement; failure to do so is unethical.

27. The validity and reliability of Harris Hip score

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1969 Harris introduced a new rating scale and although Harris Hip score (HHS) has been frequently used only a few validity tests and no reliability test have been published. The purpose of this study is to perform an extensive test of Harris Hip Score including validity and reliability.

Methods: 58 patients operated with THA 2–10 years ago answered WOMAC and SF-36. The patients were within one week examined by an orthopedic surgeon and an experienced physiotherapist. Content validity, convergent and divergent construct validity, criterion validity, test-retest reliability, internal consistency reliability and inter-observer-reliability (between physicians and physiotherapists) of Harris hip score compared to a disease-specific test (WOMAC) and a generic questionnaire (SF-36) were tested.

Results: SF-36, WOMAC and HHS have high validity and reliability. The disease specific tests had higher convergent, divergent validity and internal consistency reliability than SF-36. Test-retest reliability is higher in the not self-administrated test (HHS).

28. Experiences in nailing of the humerus with the True Flex Nail

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Aims of the study was to evaluate our experiences of 32 patients treated with a True Flex nail. This nail represents a different way to archive rotational stability without locking screws

Material and methods: Our indication for nailing of humerus fractures were: pathological fracture; multiple traumatised patients and patients not suited for conservative treatment (gross dislocation, skin problems, incurable pain); fractures located in the caput humeri and fractures involving the distal 8 cm of the shaft were excluded. 32 patients were treated during this period, 16 men and 16 women. Six of the patients had pathological fractures. 12 fractures were of high energy type and 14 low. The dominating fracture pattern was A3 according to AO-classification. 7 patients had multiple injuries. The patients were followed with clinical examination and radiography until dead, healed or reoperated.

Results: During the first 12 months 12 patients died. 12 patients were followed up during 12 month or more. Post operative 23 patients had no malalignment but 6 patients dislocated slightly during the first month. After 12 month 10 out of 12 had full range of motion but 2 had 50° of flexion-abduction or less. The operation time varied between 30 and 160 minutes with a median of 70 minutes. The proximal locking screw lost its grip in two patients and caused reoperations. Two pseudarthrosis were found and re operated.

Conclusions: The True Flex nail represents a new concept to create rotational stability. However, it is a demanding procedure with some specific problems. In spite of too many surgeons involved and the aged population, which explains the low rate of follow up, we think that our results are acceptable.

29. Retrograde nailing of the tibia an alternative treatment for stabilisation of the ankle or distal tibia

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Aims of the study was to study if retrograde nailing of the

tibia can be an alternative when previous surgery has failed or other methods of treatment seems unlikely to succeed.

Patients and method: 6 patients (3 women, 3 men) with a median age of 55 (41–43) years were operated on with a retrograde tibia nail, between May 1995 and January 1998. The diagnosis were: necrosis of the talus (diabetic neuropathy); rheumatoid arthritis with advanced dislocation and osteoporosis; secondary ankle osteo-arthritis (reoperation after former attempt for arthrodesis); talus fracture; open distal tibia fracture with ankle involvement (3B); and complete talus luxation (unspecific neuropathy).

After preoperative evaluation and planning a solid tibia nail of titanium alloy (AIM) was used. The most proximal part of the nail (proximal to the locking holes) was cut off before the operation. Retrograde nailing through the sole of the foot, the subtalar- and talocrural joint was performed. In some cases an arthrodesis through a posterior incision was added. In one case a medial osteotomy was also performed. No plaster was used in the postoperative period and all the patients were allowed for partial weight bearing.

The patients has been followed with clinical and radiological examination.

Results: No implant failures were noted. One patient died from other causes in the postoperative period. Clinical and radiological consolidation has been noted in four of the cases. Two patients had superficial wound infections that healed after antibiotal treatment. No reoperations were performed.

Conclusion: Taking in point of view this very complicated group of patients we consider our results to be that good that retrograde tibia nailing through the foot sole could be an alternative for special cases.

30. Decreased chondrogenesis with increasing age influence fracture repair

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The influence of age on fracture repair remains poorly understood. Clinical experience suggests that fracture repair rate decreases with increasing age. In a previous study in a rat femur fracture model, we have reported decreased fracture healing rate with increasing age, evaluated by radiology, fracture callus strength and histology. The aim of this study was to determine the underlying mechanism of impaired fracture healing in older animals using the same fracture model.

Methods: 76 rats at 1 month of age and 78 rats at 6 months of age were included. Unilateral femur fractures were created by the method of Bonnarens and Einhorn. The 1 and 6 month old rats were divided into subgroups (n=12–16) and sacrificed at different timepoints after fracture (2, 4, 7, 10 and 15 days). Histological sections of the fracture callus

were studied. Expression of cartilage and bone related genes (type I and II collagens, osteocalcin and aggrecan) were evaluated by immunostaining and/or RT-PCR and compared between the two agegroups at all timepoints. Immunostaining for sox-9, an early marker for chondrocyte cell differentiation, was evaluated to assess the distribution of chondrocyte progenitor cells in the fracture callus.

Results: The histological evaluation of the fracture callus showed marked differences between the two age groups studied. The calluses in the 6 month old animals were larger but contained less cartilage and more fibrous tissue when compared with the 1 month old animals. Both cartilage formation and endochondral bone formation were delayed and proceeded at a lower rate in the older animals. No marked differences was seen regarding intramembranous ossification between the two agegroups.

In the young animals, positive immunostaining for type II collagen, a cartilage matrix protein, was not seen at day 2, was weak in a small number of cells at day 4, was markedly positive at days 7 and 10 and decreased by day 15. In the older animals, positive type II collagen staining could not be detected until day 7, and was present only weakly at days 10 to 15. Furthermore, overall staining was present in smaller areas of the formed callus in the old when compared to the younger animals. Immunostaining of aggrecan, another cartilage matrix marker, also produced a difference between 1 and 6 month old animals similar to that observed with immunostaining for collagen type II.

mRNA levels of type II collagen were decreased in the older animals. The type II collagen mRNA expression peaked at day 7 in the younger animals and at day 10 in the older animals. In both age groups the mRNA levels of type II collagen decreased 15 days after fracture. Aggrecan mRNA also showed decreased and delayed peak levels of expression in 6 month old animals. mRNA levels of type I collagen and osteocalcin were slightly higher in the 1 month animals compared to the 6 month old animals, but the differences were not significant. In addition, immunostaining for sox-9 was delayed and attenuated in the adult animals.

Discussion: The analyses of cellular activity on histology demonstrates less cartilage and fewer chondrocyte in the older age group. This may be due to reduced chondrogenesis, as evidenced by lower levels of mRNA for type II collagen and aggrecan.

The observation of delayed and attenuated immunostaining of sox-9 in the fracture callus in the older animals further supports an early difference between the two studied age groups. The decrease of fracture repair rate with increasing animal age, thus, may be caused by a reduced rate of chondrogenesis. More detailed studies need to be undertaken to further explore the underlying mechanisms of the observed reduction of chondrogenesis which age during fracture healing.

31. Limited bone loss in the proximal femur and the calcaneus after diaphyseal fractures of the tibia treated with intramedullary fixation and early weight-bearing

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Post traumatic reduction in bone mineral density, BMD, up to 50% have been described after tibial shaft fractures. A reduced BMD will decrease the strength of the bone and thereby enhance the future fracture risk. The type of fracture treatment might influence the bone stock.

Patient and methods: We performed a prospective study on 31 consecutive patients, 37 (16–73) years of age with a closed or open grade I unilateral tibial shaft fracture. All patients were treated within the first three days with a closed reduction followed by intramedullary reaming and nailing with a locked AO Universal Nail. Immediate postoperative mobilisation and early weight-bearing was an essential part of the treatment regime. Dual energy x-ray absorptiometry at the proximal femur, DXA and quantitative ultrasound, QUS, at the heel were performed bilaterally during the first postoperative days and at 3, 6 and 12 months.

Results: At 3 months there was a significant reduction of BMD in the trochanteric region in the injured limb of about 3% ($p < 0.003$), a reduction that was still present at 12 months. The stiffness index and speed of sound, SOS, at the calcaneus on the injured side both decreased significantly ($p < 0.02$ and $p < 0.002$) during the first 3 months. At 12 months there was no significant difference in either the stiffness index nor the SOS when compared with the baseline values obtained after the accident. This finding indicates a faster restoration of the bone properties in the calcaneus compared with the trochanteric region. No significant changes could be observed at the proximal femur or the os calcis of the uninjured limb.

Conclusion: Treatment of tibial shaft fractures with an intramedullary nail followed by immediate mobilisation and early weight-bearing caused very limited loss of quantitative bone properties of the proximal femur and os calcis of the fracture-affected limb.

32. The Kessel inverted shoulder arthroplasty—a 12–15-year follow-up study

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Between 1982 and 1985, 23 Kessel total shoulder arthroplasties were performed on 22 patients (21 rheumatoid arthritis, 1 osteoarthritis). A clinical and radiological 5-year review was published 1992 (Clin Orthop 277: 155–160). We have now undertaken a 12–15-year evaluation of the same patients. The long-term follow-up results are of interest be-

cause the Kessel prosthesis is constrained and has inverted anatomy.

Patients and methods: Of the 22 patients 11 have died and are not included in this study. One patient (osteoarthritis) had her prosthesis extracted 2 months after surgery and 1 patient was revised after two years. One patient is seriously ill and could not participate which leaves 8 patients for evaluation. Mean age was 61 (49–77) years. Shoulder function was subjectively evaluated by a questionnaire, The Simple Shoulder Test (Matsen et al.: Practical Evaluation and management of the Shoulder, 1994) and pain was assessed using a VAS-scale. New radiographs were taken.

Results: In general the patients had a low functional level but they were able to sleep on the operated side and to manage daily hygiene. Five patients were pain free and the worst recorded pain in any patient was 35 mm on the VAS-scale. Two patients had their scapular component cemented at primary surgery. The radiographs showed no radiolucent zones around these components at follow up. The other six scapular components had radiolucent zones of 1–2 mm. No radiolucent zones were detected around the humeral components.

Conclusion: The 5-year experience published in 1992 showed quite poor results with 3 prostheses removed and 3 revised. However, at this 12–15-year follow up it is evident that some of the prostheses have survived surprisingly well and work acceptably for these rheumatoid patients. This observation is of value since inverted anatomy designs in shoulder arthroplasty have gained new interest.

33. Locked superior dislocation after Bi-polar shoulder hemiarthroplasty

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The Bi-polar shoulder prosthesis was designed for use in rotator cuff deficient shoulders including rheumatoid arthritis and rotator cuff arthropathy. Previous papers have reported functional results comparable to other prosthetic designs and no case of postoperative prosthesis dislocation has been recorded.

Material and results: During 1977, 11 patients were operated including 7 RA, 3 osteoarthritis and 1 cuff arthropathy. All patients had a deficient or ruptured cuff. In 2 cases, a superior locked dislocation of the Bi-polar shell above the superior glenoid rim was recorded at 1 week and 6 weeks respectively.

In the first patient, revision surgery was carried out at 6 weeks with a conversion to a conventional hemi-arthroplasty using a large solid head. The postoperative course was uneventful, the patient is pain free at 9 months follow-up but has a considerable joint stiffness.

In the second patient, attempts to closed and open reduction failed and a revision arthroplasty with conversion to a solid head was performed successfully after 9 months. Long

term results after surgery are not yet available.

Conclusion: In spite of using the largest Bi-polar shell available, these arthroplasties dislocated superiorly which we believe was caused by the deficient cranial support from the cuff in combination with the inherent mobility of the Bi-polar shell. This complication has not been reported previously but should cause awareness of the surgeon to this specific instability.

34. Absorbable implants for open shoulder stabilization—a clinical and serial radiographic evaluation

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The aim of this prospective study was to evaluate the clinical and radiographic results in patients with recurrent unidirectional, post-traumatic shoulder instability (dislocations/subluxations). All the patients had a Bankart lesion and were operated on by one experienced surgeon using an open Bankart reconstruction involving absorbable 3.7 mm TAG* suture anchors.

Patients and methods: 18 consecutive patients, 13 male and 5 female (11 dominant, 7 non-dominant shoulders), were included. 3 patients had recurrent subluxations. The median time period between the first dislocation and the reconstruction was 60 (11–192) months. The median number of dislocations before the reconstruction was 5 (0–45). The median age of the patients was 29 (16–50) years. The final clinical examination was performed by an independent observer after a median of 31 (25–38) months. The follow-up was based on the Rowe and Constant scores, assessments of stability using the apprehension test, measurements of range of motion (ROM) and assessments of isometric muscular strength. Age-, gender- and activity- matched, healthy shoulders (n=26) were used as a control for the ROM and strength measurements. Standard radiographs in three projections were taken preoperatively, as well as at 7 (4–18) months and 33 (26–46) months after the preoperative evaluation. An independent radiologist evaluated all the radiographs. Special attention was paid to the appearance of the drill holes, as well as the development of degenerative changes with time. The drill holes were classified as invisible, hardly visible, visible and visible with cystic changes.

Results: There were no re-dislocations. Two patients were re-operated on during the follow-up period. One underwent an arthroscopy and forceful manipulation due to severe restriction of ROM and one underwent a subsequent arthroscopic upper labrum fixation due to persistent pain in external rotation (Andrew lesion). The Rowe and Constant scores were 86 (61–98) and 89 (73–99) points respectively. No patient experienced a positive apprehension test. The strength measurements revealed 8.6 (3.8–15) kg in 90° abduction

compared with 9.3 (2.2–16.5) kg in the control group (n.s.). The external rotation in abduction was 65° (20–90) compared with 91° (80–105) in the control group (p=0.0001). Signs of minor or moderate degeneration were found in 10/18 patients on the preoperative radiographs, in 15/18 at 7 months and in 16/18 at 33 months (p<0.05 preop v 33 months). From the preoperative examination to the 7-month control, 7/18 patients showed an increase in degenerative changes and, from the 7-month to the 33-month control, an increase was found in 8/18 (p=0.008, preop v 7 months; p=0.005, 7 months v 33 months). At the 7-month control, 8/18 patients had invisible/hardly-visible drill holes and 10/18 had visible/cystic drill holes. At the 33-month control, 10/18 patients had invisible/hardly-visible drill holes and 8/18 had visible/cystic drill holes (n.s. 7 months v 33 months).

Conclusions: The open Bankart procedure using absorbable 3.7 mm TAG* suture anchors resulted in stable shoulders, but with a restriction in external rotation as compared with the control shoulders. The radiographs revealed that degenerative changes were present in the majority of patients and increased with time. Visible drill holes and drill holes with cystic changes were present in a significant number of patients at the 7-month and 33-month controls and did not appear to change with time.

35. A comparison of arthroscopic and open stabilization in patients with recurrent anterior shoulder dislocations

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The aim of this study was to compare the results in patients who had recurrent unidirectional, posttraumatic shoulder instability with a Bankart lesion and were reconstructed using either an open or an arthroscopic technique.

Patients and methods: 51 consecutive patients (53 shoulders) were allocated into two treatment groups, which were matched in terms of age, gender and number of dislocations (minimization procedure). The reconstructions were made by one surgeon with a special interest in shoulder surgery. Group A comprised 26 shoulders (6 female and 20 male) which underwent a standard open Bankart procedure using suture anchors. Group B comprised 27 shoulders (7 female and 20 male) which underwent an arthroscopic procedure using 8 mm Suretac fixators (9 extra-articular (a.m. Resch) and 18 intra-articular procedures). The number of dislocations prior to the reconstruction was a median of 8 (2–60) in Group A and 6 (1–50) in Group B (n.s.). The median age of the patients was 25 (16–45) in Group A and 27 (15–62) in Group B (n.s.). The follow-up examination was performed by an independent observer after a median of 32 (22–72) months in Group A and 26 (21–63) months in Group B. The follow-up was based on the Rowe and Constant scores, as-

assessments of stability using the apprehension test, measurements of range of motion (ROM) and assessments of isometric muscular strength using the Isobex dynamometer.

Results: During the follow-up period, there were two (8%) recurrences in Group A and three (11%) in Group B (n.s.). One patient in each group was unable to participate in the follow-up due to a recent re-reconstruction. The Rowe score was 88 (55–98) and 93 (71–98) points in Group A and B respectively ($p=0.10$). The Constant score was 89 (72–99) and 96 (80–100) points in Group A and B respectively ($p=0.06$). In Group A, 14/25 shoulders and, in Group B, 14/26 experienced mild discomfort and one shoulder in each group experienced a subluxation when the apprehension test was performed (n.s.). The strength measurements using the Isobex dynamometer revealed 9.7 (3.8–12.3) kilograms in 90° abduction for Group A and 9.8 (3.2–17.6) kilograms for Group B (n.s.). The external rotation in abduction revealed 75° (35–100) in Group A and 80° (50–105) in Group B (n.s.).

Conclusions: In this study involving only patients with unidirectional, post-traumatic luxation with a Bankart lesion, the arthroscopic procedure using Suretac fixators rendered comparable results with the open Bankart technique using suture anchors in terms of functional scores, ROM, strength and recurrence rate.

36. Absorbable tacks for the arthroscopic treatment of recurrent anterior shoulder dislocation

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The aim of this study was to evaluate the clinical outcome in patients with recurrent unidirectional, post-traumatic shoulder instability. All the patients had a

Bankart lesion and were operated on by one of four experienced surgeons using an arthroscopic Bankart reconstruction involving absorbable 8.0 mm Suretac fixators.

Patients and methods: 78 consecutive patients (82 shoulders), 56 men and 22 women, were included in this study. Eleven patients had recurrent subluxations only. The median time period between the first dislocation and the reconstruction was 24 (1–360) months. The median number of dislocations before the reconstruction was 5 (0–50). The median age of the patients was 27 (18–63) years. The final clinical examination was performed by an independent observer after a median of 27 (21–63) months. The follow-up was based on the Rowe and Constant scores, assessments of stability using the apprehension test, measurements of range of motion (ROM) and assessments of isometric muscular strength using an Isobex dynamometer. Age-, gender- and activity-matched, healthy shoulders ($n=59$) from the same cohort were used as a control for the ROM and strength measurements.

Results: The recurrence rate was 8/82 (9.8%). Five patients were re-operated on during the follow-up period for reasons other than re-dislocations. One patient who underwent a subsequent arthroscopy due to pain after eight weeks had a loose intra-articular head of a Suretac fixator, but a healed Bankart lesion. Four patients had marked pain during the early phase of the rehabilitation and two had an increased body temperature one to two weeks postoperatively. Winging of the scapula, which resolved within 12 months postoperatively, was registered in one patient. The median Rowe and Constant scores were 93 (37–100) and 90 (34–100) points, respectively. The median Constant score for the control group was 93 (80–100) points ($p=0.03$). Five (6%) patients experienced a positive apprehension test at the final follow-up. The strength measurements revealed 8.3 (2.3–17.6) kg in 90° abduction compared with 8.4 (12.2–16.5) kg in the control group (n.s.). The external rotation in abduction was 93° (50–135) compared with 105° (75–145) in the control group ($p=0.0018$).

Conclusions: In this study arthroscopic shoulder stabilization using absorbable Suretac fixators appeared to produce reliable results in terms of ROM and recurrence rate, if used in patients with recurrent post-traumatic shoulder instability and a Bankart lesion.

37. Arthroscopic versus open Bankart operation —2-year results in a prospective randomized study

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Between 1993 and 1996 a multicenter study was conducted on the operative treatment of patients with post-traumatic recurrent anterior shoulder dislocations. 60 patients, 43 men and 17 women, 26 (18–51) years of age, were evaluated with a shoulder arthroscopy and if a Bankart lesion was present, the patients were randomised between a percutaneous Bankart procedure with bioabsorbable tacs (Suretac) or an open Bankart procedure using suture anchors. The postoperative training protocol was identical in both groups. In all patients, ROM, stability and Constant score was evaluated at 3, 12 and 24 months postoperatively.

Results: 31 patients were operated with the arthroscopic technique and 29 patients with the open technique. In the arthroscopic group, there were 8/31 recurrences (26%) at 12 (5–21) months after surgery. All the stable patients had a negative apprehension-test. In the open group, there were 5/29 recurrences (17%) at 10 (2–23) months after surgery. In the arthroscopic group, 2 patients had new traumatic redislocations while 1 patient redislocated during an epileptic seizure. In the open group, there were 2 traumatic redislocations. 1 patients in the open group was stable at 1 year follow up but had not yet had the final 2 year examination.

Conclusions: The 2 year results in this study demonstrate a large degree of redislocations after Bankart surgery, even in the open surgery group. Patients non-compliance and predisposing disease may partially explain these results. In the arthroscopic group, there is a higher risk of redislocation which emphasizes the importance of correct patient selection and careful surgical technique in the difficult operative procedure.

38. Indirekt mri arthrography of the unstable shoulder in the aber and the apprehension position—a prospective comparative study of two different shoulder positions during MR imaging using intravenous gadolinium for enhancement of the joint fluid

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The usefulness of MRI for evaluation of shoulder instability can be enhanced by shoulder positions that provokes the stabilizing structures. The ABER position is one such position that is well described in combination with intraarticular gadolinium arthrography. We believe that MRI in the Apprehension Test Position with 90° abduction and maximal tolerable external rotation provides maximum tension on the anterior stabilizing structures and with this technique it is sufficient to use indirect gadolinium arthrography.

The purpose of the study was to make a prospective comparative evaluation of the ABER and the Apprehension Position when using indirect arthrography with intravenous gadolinium administration in unstable shoulders.

Patients and methods: 16 patients with persistent anterior instability after recurrent shoulder dislocations were examined in an open MRI 0.2 T and after 0.1 mmol/kg of intravenous gadolinium. Oblique axial T1-weighted imaging was used for analysis. Operative findings were used for correlation.

Results: Both the ABER and the Apprehension position were useful techniques in detecting capsulolabral pathology and Hill-Sachs lesions.

The Apprehension position produced significantly better gadolinium enhanced joint fluid in region of pathology in both the capsulolabral lesion and the Hill-Sachs lesion. It also visualised the size of the Hill-Sachs lesion better than the ABER position.

Conclusions: MRI examination of the unstable shoulder in the Apprehension position was more beneficial than examination in the ABER position in detecting capsulolabral and Hill-Sachs lesions when using indirect arthrography.

39. Influence of joint area conformity on the migration of the tibial component in total knee arthroplasty

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Increasing conformity of the tibial joint area in total knee replacement (TKR) will imply that higher forces can be transmitted to the bone-cement interface. This study aimed to evaluate if different designs of the polyethylene insert will have an influence on the postoperative micromovements.

Patients and methods: 86 patients were operated with an AMK (De Puy) TKR because of non-inflammatory arthritis. This report embraces the first 57 patients (18 male, 39 female, median age 69 (50–83) years) with 1-year follow up. Before the operation the patients were divided into two groups depending on the degree of the deformity (Group 1: varus/valgus <5°; Group 2: varus/valgus >5°). The PCL was retained in group 1 and sacrificed in group 2. In group 1 the patients were stratified based on age, gender, walking distance, type of arthritis and previous surgery to receive either a standard (non-constrained) or a constrained configuration of the polyethylene. In group 2 a corresponding stratification between constrained or posterior-stabilised (PS) design was done. In group 1, 17 patients received standard and 16 constrained tibial tray. In group 2, 15 patients received constrained and 9 PS design.

Radiostereometric examinations were done after 3 and 12 months. Rotations, maximum subsidence, maximum lift-off and MTPM were evaluated. The patient expectations, to what extent these were fulfilled and the HSS scores were recorded preoperatively and after 1 year. Mann-Whitney U-test was used.

Results: The median absolute rotations varied between 0.1 and 0.3° (max. 0.9°) without any difference in neither of the 2 groups ($p=0.4-0.9$). The maximum subsidence varied between -0.15 and -0.06 mm (max. -0.6), lift-off between 0.15 and 0.25 mm (max. 1.0) and MTPM between 0.29 and 0.50 mm (max. 1.24) without any significant difference ($p=0.1-0.8$).

The patient satisfaction with the results and the HSS scores at 1 year was not influenced by the choice of joint area. Separate evaluation of all patients with a constrained insert did not reveal any significant differences between the cases in Group 1 and 2.

Conclusions: In the early perspective the choice of geometrical configuration of the polyethylene insert had no effect on the fixation of the tibial component and resulted in similar clinical outcomes. Resection of the PCL in the group of patients with more deformed knees gave the same results as when the PCL was retained in patients with smaller deformities.

40. In vivo kinematics of total joint arthroplasty—standard vs. constrained tibial joint surface

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We have developed a new method to study the kinematics of the knee joint using film-exchanger technique and radiostereometry during weight-bearing. This study aimed to evaluate the influence of the geometric configuration of tibial joint area in patients with non-inflammatory arthrosis and minor preoperative deformity ($<5^\circ$ varus or valgus).

Patients and methods: 21 patients (16 female, 5 male, median age 67 (58–83) years) were operated with an AMK (DePuy) TKR. The PCL was retained in all cases. Preoperatively 6–9 spherical tantalum markers were inserted in the distal femur and proximal tibia respectively. Preoperatively and after 1 year the patients reported their expectations and opinions about the operation. Six patients without any knee abnormalities (median age 26 (24–30) years) were used as controls. The patients were stratified to either standard (non-constrained, NC) or constrained (C) polyethylene insert. The stratification was done based on age, gender, walking distance, medial or lateral arthrosis and previous surgery in the knee. At the examination 1 year after the operation the patients ascended a platform (approximately 1 dm high) corresponding to an extension of the knee from $40\text{--}70^\circ$ of flexion. During the extension two film-exchangers simultaneously exposed serial stereoradiographs with a frame rate of 3 or 4 exposures/s during 3 seconds. **Statistics:** Repeated measure ANOVA and Mann-Whitney U-test.

Results: Both designs tended to obtain a less internally rotated position of the tibia during the extension. In addition the centre of the tibia obtained a more lateral and posterior position of the knee compared to normals ($p<0.0005\text{--}0.07$). The non-constrained design displayed smaller posterior tibial translations than did the constrained design ($p=0.006$).

Femoral roll was evaluated as anterior-posterior translation of a point located at the reconstructed circular center of the posterior condyles. In the normal knees there was minimum movements, whereas in the prosthetic knees a "roll forwards" was recorded ($p<0.0005$) and especially in the constrained design (NC vs C: $p=0.03$).

7–9 of the patients (depending on symptoms or activity) reported that they had improved according to their preoperative expectations, 10–12 only to some extent and 0–4 claimed no improvement (NC vs C: *n.s.*). 14 felt that their knee was almost normal and 7 that it was definitely abnormal (NC vs, C: *n.s.*).

Conclusions: Compared to normal knees both designs showed an abnormal pattern of motion. The choice of the geometric configuration of the tibial insert had small influence on the kinematics of the AMK knee. The most pronounced abnormality was increased A-P translations. Reduced flexion during stair climbing might be one way for the patient to reduce the mechanical effects of abnormal translations with increasing flexion.

41. A prospective randomized clinical trial of two different gentamicin-containing bone cements in TKA using RSA technique—preliminary results after 1 year follow-up

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Palacos® cum gentamicin has for long been the dominating and only available antibiotic-containing bone cement in Sweden, and has furthermore shown an excellent performance. An other well-known and abroad widely used bone cement, CMW®, has recently been licensed for use in Sweden in its gentamicin containing version (CMW-1 with gentamicin). There is no obvious reason why these two gentamicin-containing bone cements would differ in any major circumstance, but just the fact that one is new and planned to come in clinical use, justify a controlled prospective randomized clinical study keeping all other parameters equal. We present the preliminary RSA results after 1 year.

Material and methods: 50 consecutive patients (35 women, 15 men, mean age 71) with osteoarthritis underwent primary total knee arthroplasty. Included were patients with arthrosis stage III–V, age over 60, and body-weight under 100 kg. An AMK® metal backed knee prosthesis was used. The per- and postoperative management were in all cases identical except for the bone cement. At the operation, the patients were randomized, by sealed envelopes to either Palacos cum gentamicin or CMW-1 with gentamicin. RSA was performed postop, at 4 and 12 months postop. Clinical results were assessed with Knee Society Knee Score.

Results: When this abstract was written all patients had been followed 4 months and 26 patients had been followed for 1 year, and 1 year data for all patients will be available in June 1998. There were no statistically significant differences between Palacos (P) and CMW bone cements up to 1 year. Mean maximum migration at 1 year was 0.62 ± 0.48 mm (P) and 0.48 ± 0.18 (CMW), maximum subsidence 0.17 ± 0.21 mm (P) and 0.16 ± 0.19 (CMW), and rotation about the transverse axis $0.31^\circ \pm 0.25$ (P) and $0.30^\circ \pm 0.23$ (CMW). There were no differences in knee score between the two groups at year.

Discussion: When introducing new or modified orthopedic implants/cements clinical testing would be mandatory to early detect and exclude potentially disastrous designs. Boneloc bone cement was launched to the market without such testing, and turned out to be a disaster in both total hips as well as in total knees. In a RSA study comparing Boneloc with Palacos in TKA significant differences were found already within 1 year (Nilsson et al. 1996, NOF). In this study the magnitude and pattern up to 1 year of the migration of tibial components fixed with CMW with gentamicin was identical to that of Palacos cum gentamicin indicating a more favorable prognosis for CMW with gentamicin. The follow-up is planned to continue for at least another year.

42. Depression, anxiety and physical function in patients following surgical treatment of knee arthrosis

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Psychometric evaluation and physical function was measured in patients treated by surgery for knee arthrosis.

Patients and methods: 53 patients with a mean age of 68 (39–81) years were selected at random. They were examined by an unbiased observer before, 4 and 12 months after surgical treatment of knee arthrosis. 50 patients (37 TKA, 9 Uni and 4 tibial osteotomy) completed the study. Pain was estimated by pain drawing and a visual analogue scale. Psychometric analysis included Beck Depression Inventory, State and Trait Anxiety Inventory and Multidimensional Pain Inventory. The physical function was estimated by Disability Rating Index (DRI), Larson's knee score and quadriceps function by a Kin Com ergometer.

Results: 40 patients (mean age 70 years) were contented and 10 patients (mean age 61 years) were discontented. 33 of the TKA patients were contented. Social activities were not significantly different between contented and discontented patients, while DRI and Larson score were lower. 14 of the 50 patients were depressed before surgery, and 11 of the patients were depressed 1 year after. Patients who became discontented 1 year after surgery were significantly more anxious and had more pain before surgery.

Conclusion: This study shows that the damaging effect of longstanding knee pain and impaired function upon important aspects of life quality was reversed in 89% of patients after TKA. Remaining knee pain and impaired function explained most of discontentedness. Patients with younger age, with trait anxiety and those treated by Uni knee arthroplasty were less contented.

43. A randomized multicenter study of traumatic primary anterior shoulder dislocation, treated with acute arthroscopic lavage or non operatively

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Traumatic primary anterior shoulder dislocations have got a very high recurrency rate among patients up to 30 years of age. This motivates a development of alternative methods of treatment. The object of this randomized multicenter study was to test the hypothesis that acute arthroscopic lavage may result in a lowered recurrency rate and a better functional outcome compared with traditional non-operative treatment.

Method: 60 previously shoulder healthy patients aging 16–30 years, with traumatic primary anterior shoulder dislocation, and without fracture of the great tubercle or joint laxity were randomized in two groups.

One group underwent arthroscopic lavage within 10 days, using a pressure regulated pump and 150–400 mL of isotone saline solution.

The other group was used as control and treated non-operatively. Apart from the lavage, both groups had identical rehabilitation with optional sling for a week followed by free mobilization.

Results: The lavage group had a significantly reduced recurrency rate of 4/30 (13%) compared with 13/30 (43%) of the patients in the control group (Fisher; $p = 0.01$).

Rowe shoulder score revealed a significant better functional outcome for the patients in the lavage group ($p < 0.01$).

Conclusions: Arthroscopic lavage showed to be beneficial in treatment of young patients with traumatic primary anterior shoulder dislocation compared with traditional non-operative regime, at the 1 year follow-up.

45. Nonunion of the clavicle—result after plate fixation and bone grafting

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Many surgical methods previously used to treat non-union of the clavicle have met moderate success, with persistent pain and shoulder dysfunction. The disappointing results have led several shoulder surgeons to recommend conservative treatment of non-unions of the clavicle. The aim of this study was to report our results after rigid plate fixation and bone grafting in manifest clavicular non-unions.

Patients and methods: We report the results of 31 patients (17 male and 14 female) who were treated with plate osteosynthesis and autologous cancellous bone graft due to non-union of the clavicle. The average age at the time of the injury was 36 (18–66) years. Nineteen fractures were from high-velocity trauma and 9 patients had associated injuries. Twenty fractures were located in the middle third of the clavicle, 9 in the lateral third and 4 in the medial third. One or more intermediate fragments were present in 10 patients. The operations were performed at a mean of 28 (3–231) months after the injury. The AO dynamic compression plate was used in 16 patients, the AO reconstruction plate in 11 and the AO 1/3 round plate in three patients. In one patient the operation was interrupted.

The patients were followed between 5 and 133 months after the operations with clinical and radiological examinations.

Results: Two major intraoperative complications occurred, one perforation of the subclavian vein (treated with

suture) and one perforation of the subclavian artery (treated with vessel reconstruction and the operation was interrupted). Four woundinfections were registered, one plate broke and in two patients the screws become loose. In five patients the plate was removed. All non-union except two healed, however, three patients were reoperated due to failure to heal after the first operation. All subsequently healed.

Conclusion: Plate osteosynthesis and autologous cancellous bone graft due to non-union of the clavicle is a demanding surgery and the risk for complication is high. However, the majority of the non-union in this study healed.

46. The treatment of chronic groin pain—a prospective, randomised study on soccer players

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The purpose of this study was to compare surgery and conservative treatment of chronic groin pain in soccer players.

Material and methods: 59 male soccer players aged 16–36 years with chronic groin pain and verified pathology of incipient hernia at herniography and/or positive nerve blocking test of the ilioinguinal nerve, were randomised to 4 groups: The patients in *group 1* were operated by hernioplasty ad modum Bassini, Shouldice or McVay + neurectomy of the ilioinguinal nerve. The patients in groups 2 and 3 received conservative treatment. Those in *group 2* were given physiotherapy, NSAID and initial rest from soccer. Those in *group 3* were given individual strength training exercises of the lower abdominal muscles. The patients in *group 4* served as controls.

All patients were evaluated initially and after 3 and 6 months by Visual Analogue Scale concerning pain at coughing, stair climbing, jogging, sprinting, shooting, sit-ups and straight leg raises. The patients in groups 2–4 (those who were not operated on), were offered cross-over to surgery after 3–6 months if their symptoms persisted.

Results: The controls had persistent problems during the F.U. period.

The patients who received training had less pain ($p < 0.05$) during jogging and stair climbing at the examination at 3 months, but remaining symptoms at sprinting and shooting. At 6 months there was no difference between the patients who received training and the controls. The patients in the surgery group had a significant relief of symptoms ($p < 0.001$) both at 3 and 6 months post.op.

Crossover was done for 23 of 45 patients in groups 2–4. At comparison between conservative treatment and surgery for these patients, surgery turned out to be more effective ($p < 0.001$)

Conclusion: Surgery seems to be more effective than conservative treatment in soccer players with chronic groin pain and a pathological herniography.

47. A comparison of results after arthroscopic anterior cruciate ligament reconstruction in female and male competitive athletes—a 2–5 year follow-up of 429 patients

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The aim was to compare the results in female and male competitive athletes (preinjury Tegner activity level ≈ 7) after arthroscopic anterior cruciate ligament (ACL) reconstruction. At the follow-up special emphasis was put on subjective evaluation of the outcome, level of activity, and the presence of anterior knee pain. Furthermore a comparison of concomitant meniscal injuries prior to or at the time of the index operation was made.

Patients and methods: 133 female and 296 male patients were followed 38 (21–68) months after the index operation (95% of all patients operated during the study period were included). All patients were operated on using patellar tendon autografts and interference screw fixation. The age of the female group (Group A) at the index operation was 23 (16–45) years and the age of the male group (Group B) was 26 (16–47) years. The ACL reconstruction was performed 15 (2–141) and 17 (2–203) months after the injury in Group A and Group B respectively. The patients were re-examined by independent observers. The following evaluation tools were used; KT-1000, knee-walking ability, subjective outcome evaluation, as well as the Lysholm, Tegner and IKDC scores.

Results: At the follow-up the median Lysholm score was 89 (38–100) points in Group A and 90 (22–100) points in Group B. The IKDC evaluation system, subjective anterior knee pain, subjective outcome evaluation and the knee-walking test revealed no differences between the groups. The median preinjury Tegner activity level was 8 (7–10) in Group A and 9 (7–10) in Group B ($p = 0.003$). The mean decrease of the Tegner activity level pre-injury versus at follow-up was 1.9 ± 1.9 in Group A and 1.6 ± 1.7 in Group B (n.s.). The difference between the performed and the desired level of activity at the follow-up was mean 1.1 ± 1.6 in Group A and 0.9 ± 1.5 in Group B (n.s.). The median total KT-1000 side-to-side difference was 2.0 (minus 5–10) mm in Group A and 1.5 (–4 to 13) mm in Group B (n.s.). The median one-leg-hop test was 93 (0–116)% in Group A and 96 (0–130)% in Group B ($p = 0.006$). Concomitant meniscal injuries prior to or at the index operation were found in 64/133 (47%) in Group A and 185/296 (64%) in Group B ($p < 0.01$).

Conclusion: The main findings of this study were, that the overall results at the follow-up 2–5 years after the ACL reconstruction were comparable in both groups. The females had not lowered their activity level more than the males. Concomitant meniscal injuries were more frequent in the male group.

48. A comparison of arthroscopic one-incision and two-incision techniques for reconstruction of the anterior cruciate ligament

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The purpose of this study was to assess the outcome of arthroscopic anterior cruciate ligament (ACL) reconstruction performed using either the "all-inside" one-incision technique or the "rear-entry" two-incision technique.

Patients and methods: A series of 221 consecutive patients who underwent ACL reconstruction was reviewed retrospectively. Group A consisted of 118 patients who underwent reconstruction using the one-incision "all-inside" technique and Group B consisted of 103 patients who underwent reconstruction using the two-incision "rear-entry" technique. The groups were comparable in terms of age, gender and pre-injury activity level. The follow-up was performed by independent observers after 47 (40–68) months in Group A and 55 (40–68) months in Group B.

Results: The median Lysholm score at the follow-up was 90 (38–100) points in Group A, and 94 points (34–100) in Group B ($p=0.002$). The median KT-1000 total side-to-side difference in Group A was 1.5 (–6 to 7.5) mm, and 2.0 (–3.5 to 9) mm in Group B (n.s.). No difference between the groups was found when the IKDC evaluation system was used. Four intra-operative complications, such as graft damage and posterior cortex fracture in the femoral drill hole were registered in Group A and none in Group B ($p=0.06$). No significant difference was found in terms of the anterior knee pain, one-leg hop-quotient and Tegner activity level at the follow-up.

Conclusion: This study revealed that the two methods yielded similar results. The final outcome appears to be satisfactory in most patients, irrespective of which method is chosen. Serious intraoperative complications appeared to be more frequent when the "all-inside" method was used.

49. A comparison of results in middle-aged and young patients after anterior cruciate ligament reconstruction

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The aim of this study was to compare the results after arthroscopic anterior cruciate ligament (ACL) reconstruction, in middle-aged and young patients.

Patients and methods: From our database [including 604 patients] we extracted all patients over 40 years of age

(Group A, $n=30$) and compared them with a group of patients, from the same material, between 20–24 years of age (Group B, $n=37$). The groups were comparable in terms of the male:female ratio and surgical techniques. The follow-up was performed by independent observers. Median (range) values are presented.

Result: The follow-up period was 31 (22–60) months in Group A and 38 (24–60) months in Group B ($p=0.014$). Pre-injury the Tegner activity level was 6 (4–9) in Group A and 9 (4–9) in Group B ($p<0.001$). At the follow-up the Tegner activity level was 5 (3–9) in Group A and 6 (3–9) in Group B ($p=0.032$). At the follow-up there was no difference in terms of the Lysholm score, 91 (37–100) and 89 (38–100) points in Group A and Group B respectively. Using the IKDC evaluation system, 10 (33%) were classified as normal, 12 (40%) as nearly normal, 6 (20%) as abnormal, and 2 (7%) as severely abnormal in Group A, compared with 8 (22%) as normal, 18 (49%) as nearly normal, 10 (27%) as abnormal, and 1 (3%) as severely abnormal in Group B (n.s.). The one-leg hop-quotient was 90 (52–167)% in Group A and 93 (70–118)% in Group B ($p=0.056$). The KT-1000 measurements revealed a total side-to-side difference of 2.0 (–4 to 8.5) mm in Group A and 2.0 (–2.5 to 8.0) in Group B (n.s.). The middle-aged patients were subjectively more pleased with the results than the young patients. There were neither differences in early nor late complications between the groups. At the index operation 11/30 (37%) patients in Group A and 1/37 (3%) in Group B showed cartilage lesions or degenerative changes ($p<0.001$).

Conclusion: Age does not appear to disqualify middle-aged people with symptomatic ACL tear from reconstruction. Cartilage lesions were more frequent in the middle-aged group.

50. Early versus delayed reconstruction of the anterior cruciate ligament in the competitive athlete

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The objective of this study was to compare the function and activity level in patients with anterior cruciate ligament (ACL) rupture who prior to the injury, participated in competitive sports (Tegner activity level ≈ 7) and underwent a reconstruction either early (0–3 months, Group I), or late (12–24 months, Group II) after the injury.

Patients and methods: The patients in Group I ($n=97$) were matched with the patients in Group II ($n=103$) in terms of gender, age, pre-injury activity level and technique of reconstruction. The follow-up examination was performed by independent observers 2–5.5 years after the index operation.

Results: The Lysholm score, IKDC evaluation system and one-leg hop-test revealed no differences between the groups.

Also in terms of the patients subjective evaluation and expectations no differences were found. The Tegner activity level at follow-up was 8 (2–10) in Group I and 6 (2–9) in Group II ($p=0.0001$). The desired Tegner activity level was 9 (4–9) in Group I and 7 (3–10) in Group II ($p=0.0002$). The KT-1000 laxitymeter revealed a total side-to-side difference of 1.5 (–3.5 to 8.5) mm in Group I and 1.5 (–3.5 to 7) in Group II (n.s.). Associated meniscal surgery prior to or at the index operation was performed in 37/97 (38%) of the patients in Group I and 59/103 (57%) in Group II ($p<0.01$). Re-arthroscopy during the follow-up period due to extension deficits was performed in 13/97 (13%) of the patients in Group I and 4/103 (4%) of the patients in Group II ($p=0.03$).

Conclusions: This study showed that competitive athletes who underwent reconstruction at an early stage after the ACL injury had a higher activity level 2–5.5 years after the index operation, as well as a higher desired level of activity than athletes who had the reconstruction delayed by 12–24 months. Meniscal surgery prior to, or at the index operation was more frequent if the reconstruction was delayed, and re-arthroscopy during the follow-up period due to extension deficits was more frequent if the reconstruction was performed early.

51. A technique to protect the infrapatellar nerves and paratenon while harvesting bone-patellar tendon-bone autografts—a dissection study

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The aim of this dissection study was to investigate whether it is possible to harvest the bone-patellar tendon-bone autograft through two small vertical incisions, leaving the infrapatellar nerve undamaged and the major part of the paratenon intact.

Materials and methods: The study consisted of two parts. The first part determined the position of the infrapatellar nerve in relation to the tibial tubercle and the apex of the patella in 38 cadaveric and two amputated lower extremities. In the second part, a bone-patellar tendon-bone autograft was harvested through two 25 mm vertical incisions in 20 cadaveric lower extremities. After the harvesting procedure, the two incisions were conjoined and the injury to the infrapatellar nerve and the paratenon was determined.

Results: The infrapatellar nerve passed through the area between the apex of the patella and the tibial tubercle as one branch in 15/60 specimens, as two branches in 37/60, as three in 6/60 and as four in 1/60. The nerve did not pass through this area in 1/60 specimens. The mean distance from the apex of the patella to the infrapatellar nerve or the uppermost branch of the nerve was 30 ± 27 mm. The mean distance from the tibial tubercle to the infrapatellar nerve or

the lowermost branch of the nerve was 27 ± 27 mm. In one specimen the infrapatellar nerve passed 10 mm distal to the tibial tubercle. In 4/60 specimens a branch of the infrapatellar nerve passed just above the tibial tubercle and in 2/60 a branch passed just above the apex of the patella. In the second part of the study, the distance from the distal edge of the upper skin incision to the infrapatellar nerve or the uppermost nerve branch was 29 ± 33 mm. The distance from the proximal edge of the lower skin incision to the infrapatellar nerve or the lowermost nerve branch was 21 ± 20 mm. In 19/20 specimens, the infrapatellar nerve or the nerve branches were undamaged by the harvesting procedure. The mean length of the undamaged paratenon was 27 ± 23 mm. In 2/20 extremities, the paratenon was completely split by the harvesting procedure.

Conclusion: This study showed that it was possible to leave the infrapatellar nerve undamaged and the paratenon partially intact in the majority of the specimens when harvesting bone-patellar tendon-bone autografts through two vertical 25 mm incisions.

52. Reconstruction of the anterior cruciate ligament in athletes, using a fascia lata graft—a prospective, longitudinal study with 9–11 years follow-up

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The aim of this prospective and longitudinal study was to present the long-term results of 44 athletes who underwent intraarticular reconstruction of the ACL with a fascia lata graft.

Material and methods: The patients have been examined by independent observers at 1, 2, 5 and 10 years postoperatively. The 10 year follow-up included 37 patients. Evaluation pre- and postoperatively included Lysholm's subjective function score, the Tegner activity level scale, measurement sagittal laxity with a Stryker Laxity Tester, and measurement of horizontal one-leg-jump. At 5 and 10 years, subjective knee function was also analysed with IKDC score. At 10 years. At the 10 years follow-up, radiographs of the knee joints were taken and joint degeneration was evaluated according to Fairbanks and Ahlback.

Results: Sagittall stability increased significantly after reconstruction. The stability remained on the increased level throughout the follow-up period. Function and activity level were also significantly improved after reconstruction. A decrease can be seen after ten years, but this may well be explained by the natural decrease caused by ageing of patients. Eighteen of 37 patients (48%) had some kind of radiographic changes at 10 years follow-up. Of these 18, 12 patients had osteophytes, sclerosis or flattening of the femoral condyle (Fairbank signs), while 6 patients (12%) had a narrowing of the joint line as well (Ahlback grade I or II). There was no correlation between the roentgenological signs and clinical symptoms.

Conclusion: Reconstruction of the ACL with a fascia lata graft seems to be a possible alternative to the gold standard, reconstruction with a patellar tendon graft.

53. Biomechanical effects of arm suspension in assembly line work

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Arm suspension has been recommended for assembly line workers who have elevated unsupported arm positions, to prevent shoulder and neck problems. This study evaluates the biomechanical effects.

Material and methods: 12 healthy female subjects performed simulated assembly line work in three positions with and without forearm support of a balancer, a so called "K-block", that hung from a fixed horizontal bar. For motion registration a 3-D recording system (Selspot) was used and EMG of the deltoideus pars ant., deltoideus pars lat., trapezius pars descendens and extensor carpi radialis longus was recorded. The loading moment of force on the bilateral movement axes for the shoulder and elbow was calculated using fully dynamic calculation.

Results: The balancer gave a significant reduction ($p < 0.05$) of the muscular activity in the m. deltoideus ant. for all tasks. There was also a tendency to reduction of the muscular activity in the deltoideus lat. and trapezius muscles, Figure 1. Use of the balancer significantly decreased the trunk inclination and increased shoulder flexion. The loading moment of force was significantly decreased for all working situation when the balancer was used ($p < 0.001$).

Conclusion: The results show that the use of a balancer greatly reduce the mechanical load on the shoulder and elbow joints. It also has the ability to reduce muscular activity. A balancer also creates changes in the working position and allows a more upright trunk posture because the arm can be held more stretched at a lower biomechanical cost than without support.

54. The effects of patient selection and employment status on the results of rehabilitation

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We have compared the results of two methods for patient selection and evaluated the effects of employment status on the results of rehabilitation of patients with chronic musculo-skeletal pain.

Methods: We studied 53 patients who had been on sick leave for more than 90 days. The first group (25 patients) was selected to participate in one out of four treatment models by randomization. During the same time period the second group (28 patients) was selected from the same population by the same social insurance office (FK) and by the same officials. Patients in both groups were treated at the same rehabilitation center (ÖIS Rehab) by the same treatment model and the same staff. A fitness test according to Åstrand and pain analysis were performed before and after rehabilitation. Also, the outcome of 26 employed patients in both groups were compared with 27 unemployed patients.

Results: 6 months after rehabilitation 48% of randomized patients and 64% of non-randomized patients returned to work. The non-randomized patients had significantly less pain and significantly better scores on a fitness test compared to the patients in the randomized study. 92% of employed patients returned to work. One patient (4%) quit the rehab program. Among unemployed patients 56% ended their sick leave and applied for a job. 22% quit the rehab program and 11% were still on sick leave. Employed patients had significantly less pain and better physical fitness.

Discussion: This study illustrates that the method of patient selection and employment status is important for the short term results of musculo-skeletal rehabilitation. Patients motivation and professional skill of the staff at the social security office (FK) to select appropriate patients for a certain type of rehabilitation program may explain the superior results among non-randomized patients.

55. Does psychosocial support influence rehabilitation after orthopaedic injury?

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Previous studies have suggested that psychosocial and psychiatric problems are factors affecting the outcome after an orthopaedic injury. This study aimed to investigate if psychosocial support does have any beneficial effect on the outcome in terms of sick-leave, return to activity and quality of life.

Material: 151 patients with orthopaedic injuries (mean age 41, range 15–64) were randomized to an Intervention group (I-group) and a Control group (C-group). The groups did not significantly differ regarding psychosocial and injury characteristics. I-group was offered a support program during the early phase of rehabilitation. All patients were assessed regarding signs of depression (Beck's Depression Inventory), pain (VAS), quality of life (SF-36) and function. Follow-up was carried out after 6 and 12 months. Data regarding length of sick-leave was collected.

Results: 88 % of the patients (68 of I-group and 65 of C-group, respectively) completed the follow-up. No significant

differences between the groups could be detected regarding clinical outcome (65% good, 30% fair, and 5% poor clinical result). The groups did not differ regarding signs of depression or pain. The I-group scored higher in 2 of the SF-36 subscores ($p < 0.01$). The mean length of sick-leave was 115 and 97 days respectively (n.s.).

Discussion: The results of this study suggest that psychosocial support post-injury may have a beneficial effect on health related quality of life, but do not affect return to work or clinical outcome.

56. Magnetic resonance imaging of the patellar tendon after harvesting its central third—a comparison between one-incision and two-incision harvesting techniques

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The aim of this study was to compare the two-year results after anterior cruciate ligament reconstruction using patellar tendon autografts harvested through a paratenon-splitting, one-incision technique (Group A) with the results of a two-incision, paratenon-protecting technique (Group B). Special emphasis was placed on the evaluation of the donor-site.

Patients and methods: 72 consecutive patients were included in the study. Group A comprised 35 patients and Group B 37 patients. Magnetic Resonance Imaging (MRI) of the patellar tendon was performed in order to evaluate the reconstitution after harvesting of its central third. The median age of the patients at the time of the index operation was 26 (14–44) years in Group A and 27 (14–50) years in Group B (n.s.). The median time between the injury and the index operation was 15 (1–168) months in Group A and 12 (2–192) months in Group B (n.s.). The median preinjury Tegner level of activity was 9 (4–9) in Group A and 9 (5–9) in Group B (n.s.). An independent observer performed all the follow-up examinations after 24 (22–29) months in Group A and 25 (23–29) months in Group B. The follow-up examination was based on evaluation of the knee-walking ability, anterior knee sensitivity (the function of the infrapatellar nerve), the KT-1000 side-to-side difference, the Tegner activity level, the Lysholm score and the IKDC system.

Results: The Tegner activity level, Lysholm score and IKDC classification revealed no significant difference between the patients in Group A and Group B. The same was found in terms of the subjective patello-femoral pain and the total side-to-side laxity difference as measured with the KT-1000. The median loss of anterior knee sensitivity was 16 (0–200) cm² in Group A and 0 (0–285) cm² in Group B ($p = 0.20$). After excluding patients with concomitant or previous incisions in the anterior knee region, 7/35 patients in Group A and 19/33 patients in Group B had no loss of sensitivity ($p < 0.01$). MRI revealed that the donor-site gap (area

corresponding to non-tendinous-like tissue signal) was 5 (0–9) mm in Group A and 2 (0–5) mm in Group B ($p < 0.0001$). No difference was found between the groups in terms of the kneeling and knee-walking test. The correlation between the loss of anterior knee sensitivity and the inability to kneel and knee-walk was significant in Group A ($p = 0.01$, $Rho = 0.4$) and non-significant in Group B.

Conclusions: At the two-year follow-up, the two-incision, graft-harvesting technique resulted in decreased loss of anterior knee sensitivity and a smaller donor-site gap as compared with the one-incision technique.

57. Fracture of the carpal scaphoid—a prospective randomized long-term follow-up study comparing operative and non-operative treatment

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Treatment of carpal scaphoid fractures is usually non-operative in a cast until radiographic and clinical healing occurs at approximately 3 months. As a consequence of the long treatment period the patient often will not be able to work nor participate in sports. Primary screw-osteosynthesis with just a short period of treatment in a cast has gained popularity during the last 15 years. Good short-term results have been reported but long-term outcome is as yet unknown.

Materials and methods: A prospective randomized study was started at the Dep. of Orthopaedics, Stockholm Söder Hospital in 1984. The objective was to compare classic non-operative treatment with acute open internal fixation with a Herbert bone screw. There were 32 fractures in the group treated with a screw and 30 fractures in the non-operative group. All the patients were followed for 11.7 (10.2–12.8) years. The follow-up comprised subjective scoring by the patients (51 fractures), examination of wrist function (48 fractures) and radiological assessment including standard radiographs and CT.

Results: The operative group was treated with a cast for average 2.1 weeks compared to 11.6 weeks for the non-operative group. The operative group was on sick-leave for 5.9 weeks, the cast-treated group for 14.7 weeks. There were no major complications in any of the groups. At the follow-up there was no difference between the groups regarding fracture healing, subjective scoring, range of motion in the wrist or grip strength of the hand. There was an relative increase of radiological arthritis in the ST-joint in the operative group whereas the radio-carpal joint showed no difference between the groups.

Conclusion: Cast treatment of fractures of the carpal scaphoid is a safe method tolerated by most patients. There are however patients, who for different reasons do not accept a long period of cast fixation. For these patients acute screw-fixation may be an option. Internal fixation facilitates early

return to work and reduces ADL-related problems during the healing period. The functional outcome is excellent.

58. CMC 1 arthritis, a prospective randomised study of two operative procedures—preliminary results

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The treatment of arthritis of the cmc1 joint is controversial. This prospective controlled randomised study was initiated in an attempt to evaluate the outcome of two operative procedures (APL arthroplasty versus Burton ligamentous reconstruction and tendon interposition arthroplasty) focusing on pain relief and strength (pinch, key and grasp).

Material and method: The patients were preoperatively evaluated by the occupational therapist and one orthopaedic surgeon. Operated by one of two other surgeons, re-evaluated after 6–12 months and after 2 years. Radiographs were taken preoperatively and at the two controls. So far, 62 patients have been included in the study, and 16 have passed the final control.

Results: The results tends to show a larger reduction of pain at rest and at work after the Burton arthroplasty. Strength tends to improve in both groups.

59. The hybrid hip screw, an implant eliminating migration

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Migration of hip screws used in the treatment of cervical fractures of the femur is a frequent problem. The usual reason for this failure is an insufficient grip of the screw threads in the caput femoris in combination with instability in the fracture area. Motion here causes wobbling of implant, and loads to the threads of the screw implant cause migration of the screw.

A special hip screw has been developed to prevent these complications. This screw has a thread length of 22 mm and a thread diameter of 8 mm. The screw is cannulated and holds a pin with a sharp barb 10 mm in length. As soon as the screw is in the right position in the caput femoris the central pin is pushed forward, emerging in the lower part of the threaded area of the screw. The protruding barb will prevent rotation of the screw thus eliminating migration.

Preliminary tests have been performed to compare different hip screws concerning the rotation force needed to turn them after insertion into femoral heads (removed for hip replacement after cervical fractures). Experiments have also been done with screws inserted in artificial bone with different density. The hip screw with a barb showed a 25% in-

crease in rotation resistance in the experiments with the artificial bone, less in material with a higher density.

60. External tissue extension, etc, for secondary wound closure after fasciotomy

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Our purpose was to evaluate intramuscular pressure (IMP) during secondary wound closure with two types of ETE.

Methods: 7 (4–16) days after acute fasciotomy, IMP was measured in 14 legs and two forearms. IMP and wound diastasis were measured before and after the ETE was applied. The friction of these rubberbands was 2.5 Newton in group A (6 patients) and 3.5 Newton in group B (10 patients).

Results: IMP was 6.9 mm Hg (SD=3.8) before secondary wound closure. It increased to 12.3 (SD=1.4) in group A and to 24.8 (SD=7.6) in group B after ETE application. In group A the wound diastasis was reduced by 51.4% (SD=7.9) and in group B 54.5% (SD=7.5) after ETE was applied. In 11 of 16 patients the wounds were completely closed after 3.5 days (SD=2.0) of ETE treatment. In two elderly patients with low perfusion pressure and diabetes the wounds could not be adequately closed.

Discussion: We conclude that a tensile force of 3.5 Newton seems to be safe for secondary wound closure by the ETE. No IMP values exceeded 33 mm Hg. On the other hand ETE should be used with guardedness in elderly patients with cardiovascular diseases. Patients with reduced perfusion pressure in the extremities have a higher risk for skin necrosis. ETE can be recommended for secondary wound closure after fasciotomy.

61. Abnormally increased intramuscular pressure (IMP) in human legs—comparison of two experimental models

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The purpose was to compare a venous stasis model of a casted leg to external compression by a segmental air splint. The effects of abnormally increased IMP in the anterior compartment on mean arterial pressure in the leg (MAPleg), blood perfusion pressure, neuro-muscular function and the clinical symptoms were compared.

Subjects and methods: IMP in the anterior compartment was measured with a microcapillary infusion technique in ten healthy subjects (mean age 35 years). Venous return of a casted leg was obstructed during 30 minutes by a thigh tourniquet inflated to 60 mmHg. A 20 cm wide segmental cylindrical air splint was applied to the contralateral leg. Mean

arterial pressures were taken in the left arm and proximal to the ankle joints.

Results: IMP increased to 40 mmHg with both methods. MAPleg was 90 mm Hg before, during and after the experiments. It was not affected by venous stasis nor by external compression by the air splint. Blood perfusion pressure in the anterior compartment decreased to 25 mmHg in both legs during limb elevation. After 20 minutes subjects experienced loss of sensation, muscular weakness decreased muscle contraction pressure and impaired nerve conduction velocity only in the leg and foot of the casted obstructed leg.

Conclusion: Venous stasis of a casted leg in healthy subjects is an alternative model to induce abnormally increased IMP and neuro-muscular dysfunction seen in patients with obstructed venous return (thrombosis, pelvic fractures). The model simulates a different pathogenesis of imminent acute compartment syndrome and may be useful to study the pathophysiology of the syndrome, and the effects of counter-measures.

62. The relation among intramuscular pressure, distraction and joint movement during acute limb lengthening

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Limb lengthening through callus distraction is an established method to correct limb length discrepancy. The method is, though successful, associated with complications. A well-known complication is acute compartment syndrome. Our purpose was to study how intramuscular pressure (IMP) was affected by the limb lengthening procedure.

Materials and methods: IMP was measured by intermittent microcapillary infusion technique in the anterior compartment of 4 legs and in the rectus femoris muscle of 2 thighs. Pressures were taken during general anaesthesia, before surgery, after the lengthening device was applied, the corticotomy was performed and during an acute distraction of 10 mm, and then again without distraction. After the operation, seven days without distraction and 10 mm of gradual lengthening, IMP was measured in local anaesthesia. The final measurement was made after the lengthening was completed.

Results: IMP before osteotomy was 8.7 (SD=3.3) mmHg. At passive extension of the muscle, IMP increased to 36 mmHg. Acute limb lengthening of 10 mm increased IMP to at rest 68.7 mmHg, at passive extension 102.6 mmHg. A peak IMP of 160 mmHg was measured in m. tibialis ant. at passive extension. Without distraction IMP at rest decreased to 25.4 mmHg. After 17 days and 10 mm of gradual distraction IMP was 9.9 mmHg at rest and increased to 12.1 mmHg at passive extension. The plantar flexion range had decreased 16° on average. Mean arterial pressure was 86 mmHg.

Discussion: This study shows that IMP increased to abnormal values due to the lengthening procedure. Most obvi-

ous was the increase in pressure caused by the experimental acute lengthening of 10 mm. IMP at rest, after surgery, without limb distraction increased to 25.4 (14–38.3) mmHg, indicating that the local perfusion pressure decreased by 30%.

63. Prognosis and risk factors in 115 synovial sarcomas

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The reported survival rates in synovial sarcoma have continuously improved but it remains unclear whether this is due to a change in the selection of patients or to changes in treatment. Our aim was to identify factors which influence clinical course.

Patients and methods: In a prospective multicenter study, clinical features and results of treatment were analyzed for 123 patients with synovial sarcoma located in the extremities or trunk wall diagnosed between 1986 and 1994. Seven patients had metastasis upon diagnosis and one was not operated, leaving 115 patients for analysis. Only 7 patients, all children, had adjuvant chemotherapy. The median follow-up for survivors was seven years and none were lost to follow-up.

Results and discussion: Among the 115 surgically treated patients, 41 developed metastasis. The overall five and ten years survival rates were 0.74 and 0.60 respectively. By univariate analysis, large tumor size, local recurrence, all surgery performed outside a center, amputation and extra compartmental location were associated with shorter metastasis free survival. Multivariate analysis showed that only large tumor size was an independent risk factor for metastasis. The five year risk of local recurrence was 0.24. The local recurrence rate was 10 % among patients primarily treated at a sarcoma center and 66 % among those treated at other hospitals.

Conclusions: The most important risk factor for development of metastasis following surgery for synovial sarcoma was large tumor size. Patients with small lesions can safely be managed by surgery without adjuvant chemotherapy.

Postersession

P 1. Back pain in relation to pregnancy—a 6-year follow-up

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Pain incidence and intensity during pregnancy can be reduced by physiotherapy, but the development of pain over a period of years after delivery or the long-time effect of physiotherapy among these women has not been described.

Patients and methods: Consecutive pregnant women were randomly assigned to one control group and two intervention groups and followed through pregnancy, after 3 months and again after 6 years.

Results: The study included 362 women. After 3 months 351 women and after 6 years 303 women could be followed. Back pain found among 18 percent of all women before pregnancy and among 71 percent during pregnancy declined to 16 percent after 6 years. Pain intensity was highest in week 36, VAS = 5.4 and declined to VAS = 2.5, six years later. Slow regression of pain after partus correlated to having a back pain history before pregnancy, ($r = 0.30$; $p < 0.05$), to high pain intensity during pregnancy ($r = 0.45$; $p < 0.01$) and, to much residual pain at 3 months after pregnancy ($r = 0.41$; $p < 0.01$). These correlations were not found in the intervention groups. Furthermore, frequency of back pain attacks at 6 years correlated to frequency of attacks during pregnancy ($r = 0.41$; $p < 0.01$) and to a vocational factor ($r = -0.25$; $p < 0.01$). There were no effects on back pain development among women without pain during pregnancy.

Conclusions: Back pain during pregnancy regressed spontaneously soon after delivery. Few women improved later than 6 months post partum. Expected correlations between back pain in relation to pregnancy and back pain 6 years later were not present in the intervention groups, who had attended a physiotherapy and education program during pregnancy. The program had no prophylactic effects on women without back or pelvic pain during pregnancy.

P 2. Excessive use of broad-spectrum antibiotics for urinary tract infections in orthopaedic departments?—a retrospective study of patients with femoral neck fractures in a Swedish hospital

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The aims of the study were to analyze possible predisposing factors for urinary tract infections such as the use of indwelling catheters and to characterise the types of bacteria involved. The most appropriate regime for this group of patients will also be discussed.

Patients and methods: The hospital records of 435 pa-

tients operated on for a femoral neck fracture were studied regarding their mental status, underlying health, laboratory values and other variables that might affect the urinary tract infection rate. 101/435 (23%) had a urinary tract infection. The hospital records of 100/334 of the uninfected patients were randomly chosen and studied as well as the infected patients records concerning the use of urinary catheters, their urine cultures and the choice of antibiotic treatment.

Results: A poor medical condition and female sex were predisposing factors for urinary tract infection but indwelling catheterization, mean duration 3 days, was not.

We did not find a higher mortality rate among patients with a urinary tract infection.

The most common pathogen was *Escherichia Coli*, sensitive for mecillinam in 98% of the cases. The other pathogens were also sensitive for mecillinam in 94%. The most frequently used antimicrobial agent was a fluoroquinolone (norfloxacin), a broad-spectrum antibiotic, which was used in 64% of the cases.

Conclusion: There was no higher incidence of urinary tract infection among patients treated with an indwelling catheter. Possibly due to the short duration of the catheterization. The use of a broad-spectrum antibiotic was frequent, although it is important to be restrictive with the use of antibiotics and specially broad-spectrum agents to avoid development of resistance. The most reasonable treatment choice would have been a non broad-spectrum antimicrobial agent.

P 3. Nonbridging external fixation of unstable distal radius fractures—a pilot study

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External fixation is commonly used in treating unstable distal radius fractures. Wrist immobilization and excessive distraction during the fixation time might contribute to postoperative morbidity. A non-bridging external fixation device has been designed to allow wrist motion by placing pins in the distal radial fragment rather than in the second metacarpal. We have performed a pilot study of non-bridging external fixation.

Patients and methods: 6 women, aged 57–81 (median 69) years, with unstable dorsally displaced distal radius fractures were treated with closed reduction and non-bridging external fixation 0–14 (median 3) days after the injury. Postoperatively, immediate active wrist motion exercises were started. The external fixation device was removed after 5 weeks. The patients were evaluated 10–16 (median 11) weeks postoperatively using the DASH (Disabilities of the Arm, Shoulder and Hand) outcome questionnaire, wrist motion, grip strength and radiological assessment.

Results: 3 patients were free of pain, 2 had mild pain with activities, and 1 had moderate pain with activities. 2 of 3 employed patients had returned to their work. Wrist flexion

was 50–70 (median 60) degrees, and extension 40–65 (median 45) degrees. Forearm pronation was 70–90 (median 85) degrees and supination 65–90 (median 80) degrees. All fractures had healed and the reduction appeared to have been maintained. No complications were observed.

Conclusions: Non-bridging external fixation of unstable distal radius fractures can be effective and safe. We are currently evaluating this method in a randomized study.

P 4. Prevalence of carpal tunnel syndrome in the Swedish general population

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Symptoms of numbness and tingling in the hand are common in clinical practice. Carpal tunnel syndrome (CTS) is one possible cause. We conducted a population-based study to estimate the prevalence of CTS symptoms and their association with slowing of median nerve conduction in the carpal tunnel.

Methods: A sex and age-stratified random sample of 3000 subjects (age, 25–74 years) was selected from the population register of the southern Swedish region of north-eastern Scania (population 170,000).

A questionnaire was devised using validated questions about general health, medical history, symptoms of pain, numbness and tingling (localization, duration, frequency and severity), social status, education, employment, work and leisure activities. The questionnaire was mailed to the subjects.

All responders who reported numbness and/or tingling in the median nerve distribution experienced weekly during the preceding four weeks, and a random sample of non-symptomatic responders were invited to the hospital. A clinical examination was performed by a hand surgeon and nerve conduction studies by blinded EMG technicians. The examining surgeon classified each symptomatic subject as having clinically certain or uncertain CTS. Measurements of median sensory nerve conduction velocity in the carpal tunnel segment were used to classify the symptomatic subjects as having electrophysiologically definite or borderline CTS. Hands with previous carpal tunnel surgery were excluded.

Results: A response rate of 83% was obtained. The prevalence of numbness and/or tingling in the median nerve distribution in the hands among the responders was 14.4 % (95% CI: 13–15.7%). 262 of the symptomatic responders and 125 non-symptomatic responders attended the clinical examination. Based on electrophysiologically and/or clinically diagnosed CTS in the symptomatic subjects, age-standardized population prevalence rates of 3% to 6% were recorded.

Conclusion: CTS is more common in the general population than previously reported.

P 5. Symptoms, disability and quality of life in carpal tunnel syndrome

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We used standardized validated outcome questionnaires to measure symptoms, function and health-related quality of life in 58 patients with carpal tunnel syndrome (CTS).

Methods: The patients completed the CTS questionnaire preoperatively and 6 weeks, 3 months and 6 months postoperatively, and the SF-36 health survey preoperatively and 3 months postoperatively.

Two-point discrimination, monofilament sensibility and grip and pinch strength were measured by independent examiners preoperatively and at 3 and 6 months.

The size of clinical improvement measured by each outcome and physical measure was estimated by the standardized response mean (SRM = mean change / SD of change).

The preoperative and postoperative SF-36 scores were compared to Swedish general population norms derived from 2181 age and sex-matched subjects.

Results: Large improvement was observed for CTS symptom severity (SRM 1.4–1.9) and functional status (SRM 0.8–1.1) at all follow-up evaluations. Improvement in the SF-36 scales was large for pain (SRM 1.0) and moderate for physical role (SRM 0.5), mental health (SRM 0.5) and the physical component summary (PCS) (SRM 0.6). Sensibility and strength measures had small to moderate SRM.

Compared with the SF-36 norms for the Swedish general population, CTS patients had significantly worse scores for physical functioning, physical role, pain, vitality and PCS preoperatively and for physical role and PCS postoperatively.

Conclusion: CTS is associated with worsening in health-related quality of life. Our findings support the superiority of patient-based health status instruments in assessing CTS.

P 6. The exeter stem subsides within the cement both in primary arthroplasties and in revisions using morselized allografts

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The purpose was to evaluate whether the Exeter stem subsides at the stem-cement or/and the cement-femoral bone interface and if there is any difference between primary and revision arthroplasties.

Patients and methods: Subsidence of the stem was analysed with RSA in 2 primary (P) cemented arthroplasties and 3 revisions (R) with morselized allografts and cement.

Results: All five stems subsided within the cement. In 2 revisions there was additional subsidence of the cement relative the femur.

Case	6 w	3 m	6 m	1 y
<i>Stem versus cement (mm)</i>				
P 1	0.7	1.1	1.5	1.8
P 2	0.7	0.9	0.9	1.0
R 3	0.7	1.0	1.5	—
R 4	1.5	1.7	1.8	1.9
R 5	1.3	1.9	2.3	2.7
<i>Stem versus femur</i>				
P 1	0.7	1.0	1.4	1.7
P 2	0.7	0.9	0.9	1.1
R 3	0.8	1.1	1.5	1.9
R 4	1.3	1.7	1.9	2.2
R 5	1.7	2.6	3.0	3.3
<i>Cement versus femur</i>				
P 1	0	0	0	0
P 2	0	0	0	0
R 3	0	0	0	—
R 4	0.3	0.4	0.5	0.5
R 5	0	0	0	0.3

Conclusions: The major part of the stem subsidence occurred within the cement, however in two revisions a slight movement of the cement occurred. Longer follow-up will show whether the subsidence continues and leads to clinical failure.

P 7. The incidence and mortality of hip fractures in two regions of southern Sweden 1992–1997

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Earlier studies have shown that the incidence of hip fractures is lower in rural areas than in urban ones. We have investigated patients with hip fractures operated with internal fixation or arthroplasty in Hässleholm-Kristianstad (HK) (rural) and Malmö (urban) between 1992 and 1997. National board of health of death register provided date of death and reason to death. National central bureau of statistics (SCB) provided population data.

Patients and methods: We included all hip fracture patients over 65 years between 1992 and 1997. The mortality

study included 1992–1996. A total of 5,468 consecutive hip fractures in 5,141 patients were studied. 318 patients have had hip fractures on both sides and three patients three hip fractures. 74% were women with a mean age of 82.6 ± 7 years (Malmö 82.5 ± 7 ; HK 83 ± 7 , $p < 0.03$). The mean age of the men were 80.3 ± 7 years (Malmö 80.7 ± 8 ; HK 80.1 ± 8). Significant difference was found only for women. 49.3% of the hip fractures were cervical.

Results: The annual incidence for the period 1992–1997 in Hässleholm-Kristianstad was 125/10 000 for women and 62/10 000 for men. In Malmö it was 134/10 000 for women and 68/10 000 for men. No significant difference was found. The six-month mortality rate in Hässleholm-Kristianstad was 10.2% for women and 18.9% for men. In Malmö it was 4% higher both for women and men.

Conclusion: We found no differences between (HK) rural and (M) urban regarding the incidence of hip fractures, however, the lower mortality rate indicates a healthier population in rural areas.

P 8. The use of platelet gel in total knee joint replacement

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Platelet gel contains autologous platelets. Thrombostate (bovine thrombin) and CaCl acts as a local hemostaticum.

Patients and methods: The platelets to be used are harvested through preoperative plasmasequestration in patients prepared for surgery. The hemostatic influence of platelet gel was evaluated in 16 patients (2 males, 14 females) that underwent total knee joint replacement (TKR) between 1996–97. Average age was 73 (60–82) years. 18 patients (3 males, 15 females) with an average age of 72 (64–79) years served as controls. Follow-up averaged 4 months.

Results: None of the patients showed signs of postoperative infection. Two patients, both in the gel group, were postoperatively treated due to deep venous thrombosis. The following differences were registered between the two groups (platelet gel group/control group) at follow-up. Respective averages were for; blood loss 583 (50–1050) mL and 902 (325–1650) mL; Hb decrease 35 (28–53) g/L and 36 (16–54) g/L; and blood substitution requirement 0.9 (0–3) units and 1.1 (0–3) units.

Conclusion: There seems to be a reduction of measured blood loss in patients undergoing TKR when platelet gel is used.