Scandinavian Foot Society

2. Total ankle joint replacement—a clinical follow-up

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Materials and methods: From 1982 to 1991 43 total ankle replacements using the Thompson prosthesis were performed in 39 patients at Diakonhjemmet Hospital. The results presented are based on medical files and follow-up evaluations. Five patients are dead, these have been excluded. The indications for arthroplasty in the surviving 34 (32 women and 2 men, 38 ankles) were rheumatoid arthritis, 29; other chronic disease with joint involvement, 4; posttraumatic arthrosis, 2; mean age 63 (40–84) years. All patients suffered from disabling pain and had pronounced radiographic changes.

Result: Radiographs taken a few days postoperatively showed satisfactory positioning of the prosthesis in more than 90% of the cases. Peroperative malleolar fracture occurred in 6 ankles, all healed uneventfully. At the follow-up examination,mean observation time was 58 (11–127) months. Five ankles had been reoperated, 4 with replacement of the prosthesis, the fifth was converted to an arthrodesis. The patients reported a considerable reduction in pain following arthroplasty, though most of them had some pain on weight bearing. Mean range of motion was 30 degrees (5 dorsi- and 25 plantarflexion). 80% of the patients expressed that the operation had been "worth the effort".

Conclusion: Total ankle replacement seems beneficial in our group of patients. It reduces pain and function is improved in this group of patients whose ability to walk is restricted by several affected joints.

3. Ankle joint replacement—a clinical folllow-up

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Introduction: The reported success rate of ankle joint replacement has been 40–100% in rheumatoid arthritis (RA) and 50–62% i osteoarthrosis (OA).

Material and method: 30 ankles in 25 patients were replaced using Richard's TPR total ankle joint prosthesis. 23 ankles (21 RA and 2 OA) in 18 patients, mean age 62 (37–77) years, were followed. Average follow-up was 5 (3–7.5) years. Preoperative status was evaluated retrospectively by interview at follow-up, review of case records and examination of radiographs. At follow-up all patients were clinically and radiographically examined and interviewed.

Results: 5 tibial components were loose with radiolucent zones >2 mm and 5 had 1–2 mm zones. 2 tibial and 1 talar component showed migration. Average walking distance increased from 260 to 975 m. 9 were totally relieved of pain, 7 had significant, 5 some and 2 no relief of pain.

Discussion: The results, with total pain relief in only 39% and anticipated loosening in 52%, are disappointing when compared with the results of ankle arthrodesis where total pain relief is reported in more than 60%.

4. Comparisons between methods for evaluation of club foot treatment

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Introduction: Of 70 treated club feet (follow up 4–14 years) we found good results in 60%, fair in 24% and poor in 16% of the feet, when assessed by the system of Laaveg and Ponseti (1980). A further investigation was conducted to see how the evaluation methods per se behave when they are applied simultaneously in the same objects.

Patients and methods: Enough data were collected to compute the scores in a variety of available score systems. Each system has a maximal score denoting excellence in correction, while descending scores denote less favorable results. The score of each foot qualifies it for one of the classes: excellent, good, fair, or poor. Functional parameters (active joint motion, endured physical activity, pain, patient satisfaction) contribute 70–80% of the score sums in the Laaveg and Ponseti (1980), Lau et al. (1989), Addison (1983) systems, compared to about 50% in the systems of Magone (1989), McKay (1983), Ghali (1983), Preston and Fell (1983), Green and Lloyd-Roberts (1985), and Turco (1979). Parameters reflecting anatomic appearance and passive joint motion contribute the complementary 20–30 and 50%.

Results: The scores correlated well in both the functional systems ($r = 0.89$) and in the systems less influenced by function ($r = 0.88$). But across these two mainstreams the correlation of the scores fell to $r = 0.68$–0.80. The talo calcaneal (TC) index (Beatson and Pearson 1966) did not discern consistently between good and poor results, as 10 feet with some overcorrection all had a normal TC index. Using a discriminant analysis we were able to select sets of objective observations in the feet that could predict classification in a score systems, e.g., ankle motion, fore foot and hind foot position and long arch could be used to classify correctly 55 of 70 feet in the Turco system.

Conclusion: It is possible to define objective measurements in club feet that can predict the outcome of treatment.

5. Correction of foot deformities with the Ilizarov external fixator

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Introduction: The management of residual foot deformities in patients treated for talipes equinovarus (TEV) by one or several surgical procedures presents a major challange for the orthopedic surgeon.

Material: Since 1990, 10 feet in 7 patients with TEV with an average age of 10 (6–15) years were treated for residual hindfoot and/or forefoot deformities using the IEF at the Department of Orthopedics, University Hospital, Uppsala. The number of surgical procedures performed on each of these 10 feet prior to the application of the IEF was 2 (1–6). Hospital for Joint Diseases Orthopedic Institute functional rating system for clubfoot surgery was used at follow-up 17 (3–34) month after correction.

Technique: Two rings were secured to the tibia by crossed K-wires. One half-ring was fixed to the calcaneus and one to the forefoot, each by two crossed K-wires. The tibial rings and the two half-rings were joined together by threaded rods enabling correction of the deformities by successive distraction. No osteotomy or surgery of soft tissue was performed.

Results: The time in IEF was on average 69 (42–92) days for correcting the foot deformities. THe IEF's were well tolerated. When correction was completed and the IEF's removed, the feet were immobilised in a plaster cast for 6 to 12 weeks. In all cases the feet were brought to a plantigrade position. No serious complications were recorded. All patients were satisfied with the cosmetic outcome and believed that walking ability had improved.

Discussion: Our preliminary experiences with the EIF for correcting foot deformities have been promising. Further studies and longer follow-up will, however, be necessary until more definite results can be presented.

Conclusion: With the IEF the feet could be corrected to a plantigrade and cosmetic acceptable appearence, the range of motion was still limited and the patients were satisfied with the result.

6. McBride's operation for hallux valgus–with or without osteotomy?

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Introduction: With more than 150 known operations for hallux valgus none is the one and only. We have evaluated the results after McBride's soft-tissue operation without or combined with a proximal osteotomy.

Materials: From 1988 to 1993 a total of 39 feet with hallux valgus in 30 patients were operated and later reevaluated. The follow-up time was 30 (6–72) months. There were 29 women and 1 man. The mean age was 39 (18–54) years at the time of operation.

Results: Group with osteotomy (17 patients): Hallux valgus angle (MTP I) before operation average 31° (17°–42°) and after average 20° (4°–36°). Average correction was 10°. Intermetatarsal angle (IM I–II) preoperative 13° (8°–20°) and after 9° (2°–14°). 12 had no longer pain and 2 had less. 11 were completely satisfied with the cosmetic result. 5 were not completely satisfied.

Group without osteotomy (22 patients): MTP I angle before was 27° (16°–32°) and after 26° (14°–38°). IM I–II angle was unchanged 12° as was the range (7°–15°). 15 were now pain free and 3 had less pain. Only 6 in this group were completely satisfied with the cosmetic result. 12 were not completely satisfied.

Conclusion: We found that McBride's operation was very effective against pain, but the best overall result was achieved, when it was combined with an osteotomy.

7. Tailor's bunion operated with a "Reversed Mitchell Osteotomy"

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Introduction: There are many surgical procedures for tailor's bunion of the 5th ray. We have used a reversed Mitchell osteotomy followed by 6 weeks in a forefoot plaster of Paris. We wished to evaluate our results.

Patients and methods: We reviewed 13 procedures performed on 6 women and 3 men a median of 50 (30–64) months previously. Median age at operation was 20 (14–32) years. At review pre- and postoperative symptoms were evaluated with visual analog scales (VAS) and converted to scores between 0 (best imaginable) and 100 (worst imaginable). All feet were painful preoperatively, median VAS 49 (23–95), and all patients had trouble finding comfortable shoes. 7 patients felt the foot was ugly and 8 had reduced their physical activity.

Results: There was one postoperative hematoma which resolved spontaneously. One osteotomy healed only after bone grafting. One patient required re-osteotomy because of persisting symptoms. At review 3 patients complained of hyperesthesia or a burning sensation at the operation site. There were no transfer pressure lesions. Patients graded the final result as VAS 19 (0–70). One patient was doubtful that she would have undergone the operation had she known the result in advance.

Conclusions: Similar or better results have been reported with simpler procedures.

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Trauma

1. Internal fixation of unstable pelvic and acetabular fractures

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Material and methods: Unstable fractures of the pelvic ring and/or acetabulum have previously been considered a difficult surgical problem. Since 1988 we have treated these fractures with internal fixation. 46 patients were treated with internal fixation, 22 men and 24 women. The median age was 27 (12–64) years. The patients were seen with a median follow-up time of 1.7 (1–3) years. The strategy of the treatment was open reduction with anterior and/or posterior plating. In fractures of the sacrum or in sacroiliac joint disruptions, a Mears sacroiliac plate was used posteriorly. Fractures of the anterior pubic rami, symphysis-disruptions and unstable fractures of the iliac bone were stabilized with Letournel plates. Acetabular fractures were treated according to the principles of Letournel.

Results: The patients were operated median 6 days after the accident, and mobilization was started 9 (2–61) days after surgery. No deep infections were seen. Skin necrosis was seen in 4 patients early in this series, occurring over the Mears plate. These cases all healed after revision and secondary closure. There were no cases with loss of reduction, and primary union in anatomical position was obtained in all cases. The functional results was evaluated and was good in all cases except one. 65% of the patients returned to work after median 34 weeks. The pain status was evaluated with Visual-Analogue-Scale. 6 patients required regularly analgesics.

Conclusion: Internal fixation is a good treatment with few and acceptable complications. Early mobilization is allowed and the outcome after median 1.7 years is good.

2. Complex acetabular fractures operated on through an anterior or a posterior incision, or combined—a study of 24 cases

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Operative treatment of complex acetabular fractures, especially when the dome is fractured and displaced, is often difficult because of limitations of the surgical exposure. Various approaches have been advocated, depending on the fracture type; namely anterior or posterior, combined anterior and posterior, or extensile approaches.

Patients and methods: 24 complex acetabular fractures operated on between 1983 and 1988 through an iliofemoral (anterior) or a Kocher-Langenbeck (posterior) incision, or a combination of the two, were evaluated. The fractures were displaced more than 5 mm in the acetabular dome. The average operative delay was 10 (3–24) days. The patients were followed up clinically and radiographically for 6 (4–8) years.

Results: Anatomic reduction (≤ 1 mm displacement) of the acetabular dome was achieved in 11 cases. In 11 there was a remaining step-off of 1 to 3 mm and in 2 cases of 4 to 5 mm. Heterotopic bone formation was the most common complication but was clinically important in only 4 cases. Posttraumatic arthrosis developed in 7 cases, all within 2 years, and was the major reason for an unsatisfactory result. In 1 of these patients anatomic reduction was achieved, but 6 had a remaining step-off of > 1 mm in the dome. At follow-up the clinical outcome was rated excellent or good in 15 patients and fair or poor in 9 patients.

Discussion: The aim of operative treatment of complex acetabular fractures is to obtain reduction of the dome, as congruency correlates with a satisfactory clinical and radiographic long-term result. The fact that full reduction of the dome fragments was achieved in only 11 of 24 cases in the present study may indicate that the anterior or posterior incisions, employed singly or in combination, did not permit sufficient exposure for adequate reduction of the fractures. In conclusion, the approaches used in this study might not be appropriate for surgical treatment of complex fractures with displaced dome fragments.

3. Operative treatment for pelvic instability

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Introduction: Diagnosis and treatment of pelvic instability are often controversial. This study evaluates the selection and results after operative treatment.

Materials and methods: Among 19 patients examined from 1991 to 1993, 9 (aged from 27 to 44 years) were operated on. Everyone underwent a in-depth clinical examination, standard radiographs, MR-scan, scintigraphy, in some cases myelography and the effect of injecting local anesthetic in the sacroiliac joint was evaluated.

Symphysiodesis was performed by plate fixation and bone grafting. Arthrodesis of the sacroiliac joint was achieved through screw fixation. 3 patients had symphysiodesis, 3 unilateral sacroiliac arthrodesis, 1 bilateral, 1 unilateral and symphysiodesis and 1 patient had arthrodesis of all 3 joints. 3 underwent reoperation.

Results: Postoperatively 2 were fully relieved from pain and 7 experienced pain reduction. The use of analgesics was less among 7 patients. Everyone had achieved improvement in walking distance. Today 4 patients walk without any limitations. Walking-aids were no longer required by 8 patients. Before 2 used crutches and 1 was immobilized in a wheelchair.

Conclusion: We experienced that arthrodesis is a good treatment to a selected group suffering from pelvic instability.

4. Operative treatment of osteochondral lesions of the talus

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Purpose: What are the results of operative treatment of osteochondral lesions of the talar dome?

Patient and methods: During 1978–1992, 33 patients were treated for osteochondral lesions of the talus. After 5 (1–12) years, 27 patients (8 women) were available for follow-up. Their age was 27 (13–57) years. Surgical treatment consisted of curettage and/or drilling of the lesion by arthroscopy (10) or osteotomy of the medial malleolus (17). The subjective result and all radiographs were classified according to Loomer, and compared with the operative findings.

Results: The radiographic stage correlated reasonably well with the peroperative findings in stage 3–5. Tomography had no additional value. The subjective result was excellent in 9, good in 12, fair in 2, and bad in 4 patients. Only pain appeared to be correlated to this result. No other correlations or predictive factors could be found.

Conclusion: The final result of operative treatment of osteochondral lesions of the talar dome was unpredictable, but often satisfying. The indication for operation can be based on the history and standard radiographs in stage 3–5.

5. Optimized modified tension band osteosynthesis of the patella

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Introduction: We present a modified tension band osteosynthesis for severe fractures of the patella, which minimizes soft tissue trauma and can also be used for non-severe fractures of the patella.

Materials and methods: Since 1991, we use a modified procedure for the management and operative treatment of severe patellar fractures. Depending on the fracture morphology we use, k-wires which are inserted from the ventral edge and the upper surface of the patella in different directions and angles to stabilize the displaced fragments. Separated small fragments can be stabilized by fixing them to bigger parts. Cerclage wires placed in direct contact with the bone, not touching the quadriceps tendon and the patellar ligament, complete this stabilization procedure. This technique minimizes soft tissue and tendon trauma and protect the proprioceptive function of the tendons. Implant removal is easier and less traumatic.

Results: From 1991 to 1993 we treated 30 patients by this technique. 18 patients could be clinically and radiologically reexamined: 10 male patients with an average age of 35 (20–72) years, 8 female patients with an average age of 45 (21–83) years. 4 transverse, 7 multifragment and 7 complex fractures were treated.

Complications: 1 refracture after osteosynthesis by a new trauma was observed. Out of the 18 reexamined patients, 15 had a normal range of movement of the knee-joint without pain, 3 patients showed a patella baja at radiographic control.

Conclusion: By using the modified patella tension band osteosynthesis, severe fractures of the patella can be stabilized avoiding a patellectomy. The operative procedure is less traumatic than the standard one. K-wires and cerclages are in good biomechanic position directly to the bone with a minimal risk of displacement. Implant removal is easier and less traumatic. Therefore, we use this technique with good results also in uncomplicated fracture cases.

6. The EX-FI-RE external fixator versus locked intramedullary nailing in tibial fractures. Preliminary results from a prospective randomized study

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Introduction: The aim of the study was to compare the EX-FI-RE external fixator and locked intramedullary (IM) nailing in tibial fractures needing operative stabilisation.

Patients and methods: EX-FI-RE is a unilateral, single frame, dynamic axial fixator. The Grosse-Kempf reamed nail was used for the nailings. 52 patients with 53 unstable fractures have entered the study (28 EX-FI-RE, 25 IM nails). Open grade III fractures are not included.

Results: There were no differences in postoperative infections or total number of reoperations, but there was a tendency to more reoperations due to secondary dislocation in the EX-FI-RE group. Time to fracture union and full weight

bearing was identical, but unprotected weight-bearing (no crutches or brace) was achieved earlier in the nailed group (12 vs 18 weeks; $p = 0.007$). At 6 months there were no differences in knee motion, ankle motion, ankle pain, fracture site pain, angular or rotational deformities. 75 per cent of the nailed patients had knee pain at 6 months, whereas this problem was absent in the EX-FI-RE group.

Conclusions: EX-FI-RE and locked intramedullary nailing seems to give comparable results in tibial fractures.

7. Mechanical aspects of current intramedullary tibial nails

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In recent years several intramedullary nails have been introduced, each with its own specific properties, but all with a similar objective; e.g., optimal circumstances for fast and adequate consolidation of the fracture.

In an attempt to compare these nails a model was created, using standard plastic bones (saw-bones) fractured at an identical site using a saw and removing a centimetre of bone to imitate a loss of bone over a distance of one centimetre. Then the various types of intramedullary nails were implanted following the instructions of the supplier in every detail. The bones were then tested for bending, rotational stability and axial loading.

The results show great differences in bending and rotational stability. Reasons for this can be found in the initial design of the nail and its distal fixation.

To compare these results with the in vivo situation some tests were repeated using human cadaver tibias.

8. The natural course of vertebral fracture

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Introduction: The natural course of vertebral fractures including osteoporotic fractures is not well known. The objective of this study was to examine the consequences to the individual and the community as well as the incidence of a repeat vertebral fracture over a 12-year period.

Patients and method: According to the files of the Radiology Department of the Malmö General Hospital 286 individuals over the age of 20 had a vertebral fracture during 1979. Individuals with malignancy and multiple-trauma patients had been excluded. The mean age was 68 years, 196 were women, 91 were still alive in 1991. 70 answered an inquiry and in 55 a new spine radiograph was obtained. These radiographs and the corresponding original radiographs from 1979 were analysed with a digitizing method. Since the definition of a new fracture is uncertain we used and tested several cut offs; 10%, 15% and 20% reduction of ratios or heights as well as 3 SD and 4 SD reduction of ratios.

Results: The mortality in the whole group was 68%. Among women over the age of 50 and with a low energy fracture the mortality was 77%. 50/70 interviewed individuals had had back pain during the last year (71%) and more than 60% had problems in their daily life. The incidence of new vertebral fracture varied between 74% and 43% depending on which fracture definition that was used.

Conclusion: Vertebral fractures seem to occur in a population with a generally increased morbidity. They had significantly more back pain 12 years after the fracture compared with the population at risk. The same was observed for the need of help in daily life. The incidence of new vertebral fractures was high.

Pediatric hip

9. Ultrasonography as the primary imaging method in the diagnosis of congenital hip dysplasia in infants

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The aim of the study was to evaluate to what extent ultrasonography (US) can replace radiography as the primary imaging technique in clinical suspicion of congenital hip dysplasia (HD).

Patients and methods: 566 children in the age range 1-23 months, referred for clinical suspicion of HD, were examined by US. In the youngest infants, the percentage coverage of the cartilaginous femoral head by the bony acetabular roof was measured (femoral head coverage, FHC). When the ossification center had appeared, the coverage was indirectly measured by the distance from the lateral tangent of this center to the lateral bony acetabular rim (lateral head distance, LHD).

Results: By ultrasonography, 95% of the children had normal hip joints. The FHC in normal hips increased with age; the lower normal limit (mean minus 2 SD) was 46% in the youngest infants and 52% at age 4–5 months. LHD also increased with age; the upper normal limit (mean + 2SD) was approximately 3 mm. Radiographs were obtained when ultrasound showed pathologic findings. There was a high correlation coefficient ($r = 0.93$) between ultrasonographic and radiographic measurements of the lateral head distance. All hips with the most severe pathology (subluxation and dislocation) by US had similar findings by radiography.

Conclusion: Ultrasonography, based on measurements of femoral head coverage and lateral head distance, was reliable in the assessment of hip joints in infants. With ultrasound used as the primary imaging method, radiography can be omitted in more than 90% of patients referred for clinical suspicion of HD.

10. Ultrasonographic evaluation of breech presentation as a risk factor for hip dysplasia

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Introduction: It is common knowledge that breech presentation is a risk factor for hip dysplasia (HD). The aim of this study was to see if ultrasonographic evaluation could improve the hip screening of breech babies, with special regard to the need of follow-up and to late-detected HD.

Material and methods: In the 3-year period 1988–1990, 409 newborns were delivered in breech position. Their hips were examined clinically and by ultrasound. The ultrasound method was based on measurements of the femoral head coverage (FHC) (Terjesen et al. 1989). Children with neonatal hip instability (NHI) were treated with a Frejka pillow, whereas treatment was not implemented in those with suspicious clinical or ultrasound findings. All children had a follow-up examination at 3 months, and later if necessary.

Results: The mean FHC was 54%. Neonatal hip instability was present in 26 newborns, who had a mean FHC of 38%. Of the newborns with NHI, 19 (73%) were birth number one and frank breech presentation was present in 16 babies (61%). Newborns with NHI had significantly higher birth weight than breech babies with stable hips. During the follow-up, all hips developed normally, and there were no cases of late detected HD.

Conclusions: Ultrasound in addition to clinical examination improves the neonatal screening and seems to eliminate late-detected HD in infants with breech presentation. No follow-up is necessary in breech babies with normal ultrasound findings at birth.

11. Ultrasound in the diagnosis of hip dysplasia in children above 2 years of age

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Introduction: During the last decade ultrasound has become an important imaging technique in diagnosing hip dysplasia and dislocation (HD) in infants. Terjesen et al. (1991) reported that the method was useful also in older children. The aim of the present study was to establish normal values of ultrasound measurements in children above 2 years of age.

Patients and methods: 132 children with normal hip joints, 64 boys and 68 girls, were examined by ultrasound because of clinical suspicion of HD. Their mean age was 4.7 (2–16) years. With the hip in neutral position, lateral and anterior ultrasound scanning was performed. On the lateral scan, lateralization of the femoral head was assessed by measurement of the distances from the lateral tangents of the bony and cartilaginous femoral head to the lateral acetabular rim (lateral head distance, LHD, and lateral cartilage distance, LCD). On the anterior scan the distance from the anterior tangent of the bony femoral head to the anterior acetabular rim (anterior head distance, AHD) was measured.

Results: The LHD increased significantly with increasing age. The mean LHD was 0.8 mm in children 2–3 years of age, 1.5 mm at age 4–7 years, 2.6 mm at age 8–12 years, and 3.1 mm in the age group 12–16 years. The upper normal limit (mean + 2SD) in the 4 age groups were 3.6 mm, 4.3 mm, 5.9 mm, and 6.7 mm respectively. There were no significant differences in LCD and AHD between the age groups. In 20 children a standard radiograph was taken. The lateral head distance by radiography (LHDR) was in good accordance with the corresponding LHD by ultrasound. The difference between LHD and LHDR was 3 mm or less in 37 (93 %) of the hips.

Conclusion: Ultrasound is recommended as the primary imaging technique in older children referred for clinical suspicion of HD. The limits of normal range of the ultrasound parameters found in the present report should be used to distinguish between normal and pathologic hips. Radiography should be omitted in patients with normal ultrasound findings.

12. Late-detected hip dislocation—treatment and results after the introduction of ultrasound evaluation

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The aim of the present study was to evaluate the results of treatment of late-detected congenital hip dislocation (HD) when ultrasound (US) was used in diagnosis, treatment, and follow-up.

Patients and methods: The material comprises 18 patients (19 hips), 16 girls and 2 boys, with a mean age at diagnosis of 10 (3–26) months. There were 9 hips with complete dislocation and 10 with subluxation. They were treated with traction prior to closed reduction guided by ultrasound under general anesthesia, and immobilization in a hip-spica cast. Ultrasound was used in all follow-up examinations, to assess femoral head coverage with the hip in neutral posi-

tion and varying degrees of abduction and internal rotation, and to measure femoral anteversion angles. Radiography was often omitted when US showed normal findings. The mean period of follow-up was 67 (43–90) months and the age of the patients at the most recent follow-up was 6.5 (4–9) years.

Results: During the primary treatment period, 2 patients underwent surgical treatment (varus derotation femoral osteotomy and open reduction) because of redislocation. During the subsequent course, femoral osteotomy was performed in 3 patients, in one case with additional acetabuloplasty. At the most recent follow-up, good radiographic results (Severin class 1 or 2) was seen in 17 hips (89%), whereas 2 hips had fair results (Severin class 3).

Conclusion: The main advantages of ultrasound are that effects of positioning of the hip on femoral head coverage can be directly observed by dynamic evaluation and that the need of radiography is considerably reduced. This policy involved good results and few complications.

13. Avascular necrosis of the capital femoris epiphysis in patients treated with the Denis Browne abduction harness for congenital dislocation of the hip

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Clinical records and radiographs of infants treated with the Denis Browne harness for unstable hips have been reviewed in order to assess the incidence of avascular necrosis.

Materials and methods: The Denis Browne abduction harness was applied on 173 unstable hips of 133 patients for three months. Diagnosis was made from the clinical examination alone. The ages of the patients at the beginning of treatment were a few days. The hip condition was followed by serial radiographs at 6, 12, and often 24 months. Avascular necrosis to the hip was classified according to Kalamchi and McEwen (1980).

Results: Avascular necrosis was found in 14 hips (8.1 %) including even a "stable" hip. No hips showed group IV changes. There were 101 girls and 32 boys. Hip instability was found to be unilateral in 93 patients (left hip involved in 55 patients) and bilateral in 40 patients. After 2 years only one patient continues to be followed as an outpatient.

Conclusion: We found that early diagnosis does not guarantee treatment success, although application of the Denis Browne abduction harness is an acceptable treatment of the congenitally unstable hip (Elsworth and Walker 1986). Further diagnostics (sonography) is indicated when clinical examination cannot secure hip stability.

References:

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14. Results of treatment in 48 patients with club foot

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The aim of the study was to evaluate whether the quality of club foot treatment at our hospital were acceptable.

Patients and methods: During the period 1978–1989, 52 children with congenital club foot were treated. After a median follow-up of 7 (4–14) years, 48 patients (70 feet) were reviewed clinically and by radiography. The primary treatment had been serial plaster casts in 43 feet and additional neonatal tenotomies of the achilles and posterior tibial tendon in 27 feet (in 15 achillotomy only and in 12 feet both tendons). Operative treatment after the neonatal period was done in 53 feet (75%) at a median age of 10 (2–60) months. These surgical procedures included posterior release in 26 feet, posteromedial release in 22, lenghtening of achilles and posterior tibial tendon in 3, soft tissue release combined with bony procedures in 2 feet. 22 patients (32 feet) had one and 16 patients (21 feet) 2 operations after the neonatal period.

Results: According to the functional rating system of Laaveg and Ponseti (1980) the median rating of the 70 feet was 83 (45–100) points. Satisfactory results (excellent and good, 80–100 points) were obtained in 42 feet (60%), whereas 17 feet (24%) had fair (70–79 points) and 11 feet (16%) had poor results. Anteroposterior and lateral radiographs in 66 feet showed a median talo-calcaneal (TC) index of 44 (20–76). 47 feet (71%) had TC index above the lower normal limit of 40. 30 feet had satisfactory results by both clinical and radiographic evaluation.

Conclusion: Surgical procedures after the neonatal period were necessary in the great majority. The results of treatment were satisfactory in approximately two thirds of the patients.

52 children were born with idiopatic club foot in the period 1978–1989. 70 feet in 48 children were assessed for evaluation of functional and radiographic results of treatment after median 7.7 (4–14) years. The primary treatment was redressing plaster cast in 48 and neonatal percutan achillotomy in 22 feet with resistant equinus position of the heel. Only 6 feet in the latter group did not need further corrective surgery. 7 feet (10%) were treated conservatively only. 48 feet were operated on before 2 years of age. Median 6.5 (1.5–18) months. 34 after conservative treatment and 14 after neonatal achillotomy. 24 feet were operated with posterior release, 14 with posteromedial release, 9 with lenghtening of the achilles and posterior tibial tendon and 1 with tibial osteotomy depending on the residual deformity. 34 feet were operated after 2 years of age. Median 46 (28–78) months. For 6 feet this was the first operation and for two feet after initial achillotomy. The 25 others were reoperations. 10 feet underwent 3 operations.

According to Laaveg/Ponseti functional rating system 54% of the club feet operated on within 2 years of age had

excellent results while none of the feet that primarily were operated after 2 years obtained an excellent result at follow up. Radiographically we measured a TC-index of 40 or more in 47/66 feet. 10/67 feet had deformity of the talus dome or calcaneus.

15. The reliability of radiographic assessment during leg lengthening

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16 patients with a preoperative leg length inequality of on average 6.4 (3.6–13) cm, orthoradiographically determined, underwent leg lengthening with the Orthofix external fixator and callus distraction. At follow-up, 2.3 (1–8) years after the lengthening, leg length inequality, orthoradiographically determined, averaged 2.4 (0.5–7.2) cm. 96 radiographs covering 14 femoral and 2 tibial lengthenings were assessed on a digitizing table with a computer programme (PROFILE) as regards the amount of lengthening and the degree of magnification. The magnification of the tibial lengthening averaged 6%, in the children and adolescents undergoing femoral lengthening 10% and in the adults undergoing femoral lengthening 25%. A radiopaque ruler was placed in the same level as the bone during the radiographic exposure and the distraction gap could be measured avoiding misinterpretation by magnification. In 3 of the 10 patients, who prior to lengthening were skeletally mature, LLI at follow-up was up to 1 cm in excess of the LLI determined with the computerized technique.

16. Peak bone mass and muscle strength during adolescence and early adulthood. A population-based study

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Introduction: Peak bone mass is an important predictor for future fracture risk. It is therefore important to determine when peak bone mass occurs and to identify determinants of peak bone mass such as muscle strength.

Material and methods: From city files 395 individuals, 15–16, 21–22, 26–27, 31–32, 36–37 and 41–42 years old, were randomly selected. Of those invited, 332 (175 men, 157 women) responded (84%). They were all living in a well defined part of the city of Malmö in Sweden, where previous studies have shown that the demographic structure of the population is the same as for the entire city. BMD (g/cm^2) was measured in the spine, hip and for the total body (DPX, Lunar) as well as in the forearm (^{241}Am source, SPA method), where both distal (mostly trabecular bone) and proximal (mostly cortical bone) measurements were made. Muscle strength (leg) was measured using a Biodex (Smith & Nephew).

Results: For both sexes BMD-levels at all measured sites had reached their maximum already in the second age-group (21–22 years), and these values did not change significantly with increasing age, except in the hip. Here the BMD values decreased subsequently for each age-group to become significantly decreased for the group in the early forties compared with those in their early twenties. A statistically significant positive correlation was found between muscle strength and BMD for both sexes, strongest for Total Body BMD ($p < 0.01$).

Conclusion: Peak bone mass is reached already in the early twenties. The BMD level remains unchanged for the following 2 decades, except in the hip where a marked reduction starts already in the early thirties. This might be of importance with regard to future risk of a hip fracture. Muscle strength is positively correlated with BMD, indicating that it might be possible to increase the peak bone mass by being physically active.

17. Muscle function after subtrochanteric and mid-diaphyseal femoral shortening osteotomies—is there a limit for the degree of shortening?

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Shortening osteotomies are done both for leg length inequality [1], and for unaccepted tallness [2]. Kenwright and Albinana found that 7.5 cm shortening of the femur did not leave any permanent loss of function [3], while Kempf et al suggested an upper limit of 4.5 cm [4]. Neither of these authors related the maximum shortening length to the preoperative length of the femur, nor to any objective outcome measurements. In the present follow-up study we examined the relationship between relative femoral shortening length at the subtrochanteric and mid-diaphyseal level with objective isokinetic muscle strength measurements more than two years after the operation.

Material and methods: Relative femoral shortening length (shortening/initial femoral length=RSL) at the subtrochanteric (ST) and mid-diaphyseal (MD) level was compared with isokinetic muscle strength in knee extension and flexion on a Cybex 340 Dynanometer more than two years postoperatively in 14 ST- and in 20 MD-shortenings (21 patients).

Results: For the ST level no upper limit for shortening length could be detected. For the MD osteotomies relative shortening length was negatively correlated to muscle strength (Table).

Table. Correlation coefficients between RSL and muscle strength

	Peak Torque (60°/sec)		Total Work (180°/sec)	
Osteotomy level	Flexion	Extension	Flexion	Extension
ST-RSL (n=14)	–0.18	–0.33	–0.22	–0.18
MD-RSL (n=20)	–0.53*	–0.39	–0.69*	–0.60*

*$p < 0.05$.

There was a significant difference between those shortened more or less than 10% at the MD level, with lower strength in those shortened more than 10%.

Discussion: Shortenings less than 10% may be done at the MD level. For greater shortenings the ST level should be considered since any upper limit for this shortening seems to be very high (largest shortening 15 percent in the present study).

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18. Long term result after infantile Mb Blount

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Introduction: 52 cases of infantile Mb Blount were collected and presented in 1973 (Zayer). The long-term results after Mb Blount are not known, especially the potential development of degenerative changes. To study the further course of the disease the material was reevaluated 20 years later.

Material and methods: Of the 52 patients two had died and two could not be traced. A questionnary was sent to the remaning 48 patients (17 men and 31 women), now 40 (25–74) years old. 11 patients had unilateral disease and 37 bilateral; in total 85 affected knees. 42 patients were examined radiographically. On standing weight-bearing films the degree of arthrosis (Ahlbäck) and the degree of angular deformity of the knee were determined.

Results: All patients answered the questionnary. 12 patients had been operated in the knees after completion of growth; one with knee prosthesis, 3 with osteotomy, 8 with arthroscopy-meniscectomy. 2 patients had hip prosthesis because of arthrosis. At time of follow-up 15 patients had slight or moderate knee pain. The radiographs showed grade I arthrosis in ten knees, except the knee operated with prosthesis. The HKA-angle measured 5 degrees varus.

Conclusion: The majority of patients with infantile Mb Blount have at 40 years of age no knee pain and no arthrosis despite a high rate of meniscal lesions.

Spine

19. Effectiveness of brace treatment in moderate adolescent idiopathic scoliosis

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Inclusion criteria: girls 10–15 y with idiopathic adolescent thoracic and thoracolumbar scoliosis between 25° and 35°. 286 patients were entered into a prospective controlled study. Center preference decided treatment, with 5 centers (131 patients) preferring observation, 3 centers contributing 115 patients preferring brace treatment and one center preferring electrical stimulation (49 patients). By August 30, 1993, 96% have reached 16 years of age.

Failure to complete follow-up occurred in 6% of the observed cases, 20% of the braced and 11% of the electrically stimulated patients, for a total of 15%. A worst case analysis does not prevent firm conclusion as seen from figure 1 in which the result of brace treatment is significantly superior to observation even if all drop-outs were failures. Failure was 6° or more of increase on two consecutive radiographs.

Due to early failure of the electrically stimulated patients that center decided to stop but has continued to follow most of the patients. It is also seen in figure 1 that there is no difference whatsoever between electric stimulation and observation.

This prospective study thus demonstrates that brace treatment has a significant effect on the progression of adolescent idiopathic scoliosis up till 16 years of age.

20. Operative treatment of adolescent idiopathic thoracic scoliosis—Harrington-DTT versus Cotrel-Dubousset Instrumentation

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Radiographic outcome and complications of Harrington-DTT (H) and Cotrel-Dubousset (CD) instrumentation for idiopathic adolescent thoracic scoliosis were compared retrospectively. The patient material consists of 55 consecutive patients in the H-group and 52 consecutive patients in the

CD-group. The mean age at operation was 15±2 (11–19) in both groups. The follow-up interval was 43±18 (17–91) months in the H-group and 28±11 (10–53) months in the CD-group ($p = 0.0001$). The preoperative radiographic measurements (Cobb angle of primary and secondary curve, apical rotation, thoracic kyphosis, lumbar lordosis), carried out by an independent observer, were fully comparable in both groups.

The mean correction of the primary curve at the follow-up evaluation was 47 percent in both groups. Apical rotation of the primary curve remained almost unchanged in both groups. Rotation of the secondary curve increased significantly in the CD-group. Thoracic kyphosis was unchanged in the CD-group but decreased in the H-group. Spinal balance worsened in 29 percent of the H-cases and in 44 percent of the CD-cases. There were no neurologic complications in either of the groups. Intraoperative lamina fractures (4 cases) and postoperative hook dislodgement (5 cases) occurred only in the CD-group. One distraction rod breakage was seen in the H-group. 3 reoperations were performed in the H-group, 9 reoperations in the CD-group.

21. Specific diagnosis in 532 cases of back pain

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Introduction: In an effort to reduce the cost for sick leave a special back clinic was started in Malmö.

Patients and methods: Residents of Malmö <56 years who were sicklisted between 30–60 days due to pain in neck, shoulder or back were included in the project. The patients were examined by an experienced orthopedist, an experienced physiotherapist and interviewed by a social worker. If needed, supplementary radiographs or MRI scans were performed within 2 days. All patients were screened by laboratory tests. The patients completed a questionnaire including Roland's back score, pain drawing etc. Diagnosis was set according to ICD 9.

Results: August 1991 – December 1992, 532 patients were examined. There were 261 men and 271 women. The mean age was 40 (9–58) years. 55 percent of the patients had immigrant background. During the 2 years before the study the work absenteeism was about 3 times higher compared with the general population. MRI was used in 57 cases. One patient had generalized metastases from a breast cancer, one patient had a neurofibroma in the sacrum and was cured by surgery. In 15 patients disc herniations were detected. 6 patients were operated on, whereof 4 improved. Thus 5 patients had benefit from surgery. The remaining 515 patients got a symptom diagnosis. During 18 months removal of disc herniation was performed in 73 cases at the Orthopedic Department, Malmö General Hospital, and nerve root decompression was performed in 30 cases. Thus the routines for somatic diagnosis of the medical service in Malmö are sufficient. In 99% of the patients in our project social and work-related factors were of greater importance to the rehabilitation.

22. Physical signs in lumbar disc hernia

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In a prospective study of 163 consecutive patients with suspected lumbar disc hernia, we investigated whether physical signs could predict degree of hernia (complete hernia, incomplete hernia, bulging disc, and normal disc) found at surgery. Stepwise discriminant analysis showed that there were only two physical signs of diagnostic value: lumbar range of motion (F-statistic 33.732; $p < 0.0001$) and crossed Lasègue sign (F-statistic 10.007; $p < 0.0019$). By these signs 74% of the uncontained hernias and 68% of the contained hernias could be correctly classified. In another data model we discriminated between "low degree lesions" (negative exploration and bulging disc) versus "high degree lesions" (incomplete hernias and complete hernias). Again, lumbar range of motion (F-statistic 39.650; $p < 0.0001$) and crossed Lasègue sign (F-statistic 15.781; $p < 0.0001$) were the only significant parameters, predicting 71% of the "high degree lesions" and 80% of the "low degree lesions". Thus, the most important physical signs in diagnosing lumbar disc hernia are pain-related and therefore dependent on patient feedback. Nevertheless, lumbar range of motion is reliably measurable on a ratio scale, and is along with root tension tests among the few physical spinal signs that have previously been shown to be reliable. These two physical signs are important since degree of hernia is the most important prognostic factor for the outcome of lumbar disc surgery.

Degree of hernia also has an impact on the choice of invasive therapy–open surgery, percutaneous surgery, or enzymatic nucleolysis. Moreover, it is not possible to discriminate between contained and uncontained hernias by current diagnostic imaging, which produces a plethora of information—about one fourth of a symptom-free population has demonstrable disc hernias. Neurological signs were often absent, showed no correlation to degree of hernia, and had also a limited value for predicting the level of hernia, but they are important for differential diagnosis in distinguishing between radicular and referred pain.

23. Pathoanatomical and radiographic findings in spinal breast cancer metastases

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12 spine specimens with breast cancer metastases in different stages were removed after freezing in situ, examined with conventional radiography and high resolution CT and then studied in detail by cryosectioning. In the total of 53.5 vertebrae, lytic metastases were most common, most were in contact with the vertebral wall and the endplates. Endplate depressions were associated with expansion of the discs. All lytic lesions adjacent to endplate defects contained disc material. Among the 29 collapsed vertebrae, only 4 had blowout-type extrusions of the posterior wall. Epidural tumor growth was rare. No thickening of the dura or changes in the spinal blood vessels were observed. Compression of the posterior elements (kissing spines, facet joint subluxation) and pars failure were common.

25. Fusion or conservative treatment in adult spondylolisthesis—a prospective randomised study

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Introduction: Satisfactory results of spinal fusion in spondylolisthesis has been reported in many studies. However, functional outcome and pain have been poorly quantified, and there are no controlled studies published. Furthermore, it is controversial whether instrumentation of lumbar fusions improves outcome. The present study was designed to determine whether surgical treatment is better than physiotherapy and whether instrumentation improves the outcome of posterolateral fusion.

Patients and methods: 37 patients, 18 women and 19 men, with adult isthmic spondylolisthesis with at least one year of low back pain, with or without sciatica were randomised to (1) physiotherapy, (2) posterolateral fusion, and (3) posterolateral fusion with transpedicular instrumentation (C-D). All patients were followed at least 2 years. The mean age was 34 (18–56) years. Pain and functional disability were quantified by visual analog scales.

Results: All functional as well as pain scores were on average better in the fused groups (2+3) than in the conservative group. The differences were statistically significant for 7 out of 12 functional scores and for both pain scores. There were no statistically significant differences between group 2 and 3.

Conclusion: The present randomised controlled study of adult spondylolisthesis with 100% two years follow-up shows that fusion results in a superior functional outcome and less pain compared to conservative treatment. The results indicate that instrumentation does not improve the functional outcome or pain.

26. Development of method and technique for evaluation of lumbar spinal canal stenosis

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Introduction: In lumbar spinal stenosis there is by definition a conflict between the space occupied by the nerve structures and the available space within the spinal canal. A change in posture may have a dramatic effect on the symptoms and signs of the disease. CT and MRT investigations in patients with suspicion of spinal stenosis are commonly performed in a relaxed supine position, which may result in difficulties to evaluate the degree and location of the spinal encroachment.

Materials and methods: Recently a transferrable loading device for use in CT investigations was constructed. In this device the lumbar spine can be exposed to an axial force similar to the force in the upright standing position.

To be able to measure the CSA (cross sectional area) of the dural sac accurately it was necessary to inject low dose contrast intrathecally.

37 patients with suspicion of lumbar spinal stenosis were included in the present study. Each patient was investigated in two positions i.e. psoas relaxed position and axial compression (400 N) in extension.

Results: A statistical study of the measurement error showed that the crosssectional area of the dural sac (CSA) between relaxed and compressed position has to exceed 15 square millimetres to indicate a true difference. Analysis of the patients with CSA less than 100 square millimetres in compression showed that 5 of 7 in LIII–LIV level, 9 of 14 in LIV–LV level and 6 of 10 in LV–SI level decreased more than 15 square millimetres.

Conclusions: It seems necessary to include dynamic investigations in patients with possible lumbar spinal stenosis, especially those who have shown CSA of around 100 square millimetres or less at regular CT investigation.

The CT myelo investigation is sufficient when evaluating the spinal canal in most cases. MR is however superior to CT for evaluation of the soft tissues within the spinal canal and especially the space within the intervertebral foramen. A nonmagnetic device for MRT is ready for use but results are not analysed yet.

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27. Results of fusion in lower lumbar degenerative disease

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The role of surgery in lower lumbar degenerative disease is controversial. The study comprised 32 consecutive patients (median age 53) treated from 1987–1992, all had degenerative segment disease of their lower back. In 19 cases a degenerative spondylolisthesis was found, 4 of these on 2 levels. The rest of the patients had degenerative disc disease and/or facet joint degeneration. Neurologically, 13 had spinal stenosis, 22 had lateral stenosis. 10 patients were operated on before (failed back symptom) 4 of these more than once. All patients were operated on with an extensive root release if any root compromise was found followed by a posterolateral fusion with pedicle screw technique. All fusion healed except 1, and 2 cases were reoperated with removal of the implant and further root release. All patients were seen after 1 year with radiographs. Follow-up was performed by an independent observer after median 27 months with a questionnaire and all patients with continous symptomatology were examined clinically and with new radiographs.

16 patients could be classified excellent, 6 good, 9 fair and 1 poor. 16 patients were at work and 11 could participate in some kind of sports. Except for 1 pseudarthrosis no serious complications were found. This result shows that operation with nerve release and fusion is a worhwhile and relatively safe alternative in a selected group of patients with severe degenerative disease. It further shows that patients classified as failed backs could have benefits from further surgery.

28. Complications following transpedicular stabilization of the spine

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163 consecutive transpedicular screw stabilization procedures performed between 1987 and 1991 at our institution were retrospectively investigated with specific regard to peroperative and postoperative complications. The indications for stabilization were trauma (33 cases), metastatic spinal disorder (30), spinal stensosis (33), spondylolisthesis (27), ankylosing spondylitis (6), low back pain (LBP) (22) and miscellaneous (12). Early complications were unusual and none were associated with permanent morbidity. Survival analysis revealed that there is a 15% probability of having the transpedicular implant removed or replaced in the first postoperative year. Stabilizations performed for LBP were associated with a worse result. Age and gender did not influence the clinical survivorship. Survivorship analysis of radiographical outcome showed a 40% risk of failure—defined as loosening or implant fatigue—at 6 months. There was a positive correlation between radiographic failure and increasing age or a diagnosis of spinal stenosis. The outcome was more favourable in cases where anterior vertebral interbody fusion was also performed. The mechanical durability of transpedicular fixators used alone is a cause for concern.

Failure was defined as a radiolucency ≥ 1 mm surrounding one or more screws, implant failure or an increased kyphosis angle $\geq 10°$.

29. Spinal canal encroachment in thoracolumbar burst fractures before and after reduction and pedicle screw fixation.

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Introduction: The most common treatment for burst fractures is reduction and fixation using a posterior approach and a pedicle-screw fixator system. Controversy persists as to whether the spinal canal decompression achieved with this method is sufficient.

Patients and methods: 67 consecutive burst fractures at the thoracolumbar junction (T12–L2) were evaluated with CT pre- and postoperatively. The spinal canal area at the site of maximum obstruction was measured and the encroachment of the estimated original area was calculated in percent. T12 was fractured in 8, L1 in 43 and L2 in 16 patients. 30 patients had neurological deficits. Reduction and fixation were performed with a pedicle screw fixator.

Results: Spinal canal encroachment averaged 49% in patients with neurological deficits and 37% in neurologically intact patients ($p = 0.002$). All L1 fractures with encroachment in excess of 50% were associated with neurological deficits. All spinal canal areas had increased on the postoperative CT. Average pre- and postoperative stenosis at T12, L1 and L2, were 35–12%, 37–17% and 52–35%, respectively. Preoperatively, 27 L1 fractures had canal encroachment in excess of 30%, postoperatively only 7. The most severe remaining encroachment at L1 was 44%. The type of burst fracture and the timing of surgery did not significantly influence the decompression. Almost all patients were treated within four days. Adequate fracture reduction generally resulted in good canal decompression. The releationship between the obstructing fragment and the vertebra above remained unchanged in most cases, indicating that portions of the disc are significant factors for reduction.

Conclusion: Spinal canal decompression obtained by posterior reduction and fixation of burst fractures is sufficient for the vast majority of patients. A postoperative CT should always be performed to evaluate the decompression.

Only occasionally is a secondary anterior decomression indicated.

30. Surgical treatment of spondylitis with ventral reconstruction

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Introduction: Pyogeneous as well as tuberculous spondylitis are rare diseases in the western world. The conventional treatment has been conservative including long lasting antibiotic treatment and a minimum of 3 months immobilisation. Due to the progress in both diagnostic and surgical techniques a more active treatment is now possible.

Aim: To present our results using a surgical approach in a series of 16 patients suffering from acute spondylitis.

Materials and methods: In 1991 through 1993, 5 women and 11 men, mean age 60 (25–78) years were treated operatively for spondylitis in the above department. Localisation—given the agens in brackets—was T4/T7 (*Staph. aureus*), T6/T7 (*Klebsiella pneumoniae*), T7/T8 (*TB*), T7/T9 (combined infection *Staph. aureus* and *Pseudomonas aeroginosa*), T7/T10 (*Salmonella typhimurium*), T8/T9 (*TB*), L1/L3 (*E. Coli*), L2/L3 (3 patients, all *Staph. aureus*), L3/L4 (*E. Coli*), L3/L4 (*Staph. aureus*), L3/L4 (*TB*), L4/L5 (*Staph. epidermidis*), L4/L5 (*Haemophilus paraaphrophilus*), and T10/T12 and S1/S2 (*TB*—treated by surgery and conservatively respectively). The surgical procedure included a radical ventral removal of all infected tissue including decompression of the dura. This was followed by strut-grafting and local application of antibiotics.

Results: In all patients the infectious foci were postoperatively withour active infection judged both clinically and from infection-parameters. Rehabilitation period was shortened. This treatment is safe, efficient and shortens rehabilitation.

31. Anterior fusion in the cervical spine using the CSLP

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Introduction: The cervical spine locking plate (CSLP) was introduced 1985 as a safer and more stable alternative to conventional AO H-plates for anterior stabilization of the cervical spine. The implant system is based on pure titanium plates and screws. The plates have a similar profile to that of H-plates; the screws are either cylindrical with perforations or solid. The screws are locked in the plate holes by expansion bolts.

Patients and methods: During a period of 7 years 162 patients have been operated with this device. 104 had traumatic injuries and 58 non-traumatic disorders. 82 of the patients were neurologically impaired. In 42 cases a posterior stabilization was added to the anterior procedure. Postoperatively the patients wore a Philadelphia collar for about six weeks. The patients were allowed to get out of bed as soon as they could tolerate it. The mean postoperative stay in the hospital was 6 days for the neurologically intact patients.

Results: In 159 patients a successful primary stability without loosening of the implant or deformity was achieved. Early screw loosening with deformity occurred in three patients. One patient died peroperatively and two during the first week (myocardial infarction 2, urosepsis 1). After one month a fourth patient with tetraplegia and cerebral injury died of pneumonia and sepsis. At the late follow up 6 additional patients had died. This late mortality had no relation to the operations. Immediately after the operation two patients were neurologically impaired from a prolapse of disc material and an epidural hematoma. In both cases the conditions were resolved after reoperations.

2 patients developed oesophageal fistulas. The fistulas healed after plate removal. Seven patients complained of hoarseness for 6 to 12 months after surgery.

The average postoperative hospital stay was 6 days for patients without neurological impairment. After a mean follow-up time of 2 years the remaining 152 patients had healed fusions without signs of late instability. However, after combined anterior and posterior fixation the clinical results were less satisfactory with somewhat more pain as well as inferior range of motion.

Conclusion: Anterior stabilization of the cervical spine with CSLP is a rather simple and safe technique. It gives a reliable stability that allows early ambulation. Additional posterior fixation is mostly redundant and should only be performed in exceptional cases.

32. Grisel's syndrome—a 7-year material from Stavanger

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Introduction: Grisel's syndrome is a subluxation of the atlantoaxial joint, often associated with an infectious condition in the neck. The first known description is from 1830, but Grisel gave the syndrome its name in 1930.

Several studies have shown that a vascular plexus around dens drains the upper part of the posterior pharynx; and septic exudates may cause mechanical and chemical damage to the ligaments stabilising dens leading to subluxation. The most common symptoms are torticollis with an acute onset, and neck pain. Most of the patients are children. The management depends on type of dislocation and duration of symptoms. Several principles of management are advocated

in the literature. They include antibiotics, various types of traction, bed rest with a roll under the neck, surgical reduction, and arthrodesis.

Patients and methods: From 1987 to 1993, 9 patients have been admitted in our hospital with the diagnosis Grisel's syndrome or acute torticollis (the catchment area of the hospital includes 250,000 people). The diagnosis was based on clinical findings (acute onset of irreducible torticollis) and radiographic findings.

There were 5 boys and 4 girls; the average age was 9 (4–27) years, and the duration of symptoms was 1.3 (0–4) days. One of the patients was under treatment of scarlet fever, 4 had or had recently been through a common cold and had enlarged neck lymph glands. 3 patients had no evidence of infection, but got torticollis after hyperextention while falling or playing. One patient had no evidence of inflammation nor any history of injury, but had influenza symptoms one month prior to the acute torticollis. All our patients were treated with bedrest with a hyperextended neck without traction. This was arranged by placing the patient in supine position on a double mattress, with the upper mattress slightly shorter at the head end allowing the head of the patient to hang down and rest on the lower mattress.

Results: Even if one might imagine that the described resting position might be uncomfortable all patients accepted it. In fact, they realised that it was the position which gave relief from pain. In 6 patients 1 or 2 days of treatment were enough. The average length of admission was 2.3 (1–5) days. All the patients had their torticollis reduced when discharged from the hospital. 5 patients continued with a soft neck collar for 1 to 3 weeks.

33. MRI and neurological findings in acute Whiplash trauma—a prospective investigation of 39 cases

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Introduction: The purpose of the present investigation was to study the initial clinical symptoms and signs in relation to the early magnetic resonance findings after acute whiplash injury.

Patients and methods: The present prospective study includes 39 consecutive patients, 20 women and 19 men with a mean age of 32 (18–52) years, treated at our department because of a whiplash injury resulting from car accidents. MRI was performed with a mean of 11 (4–15) days after the injury in a blinded manner by two radiologists. At the same day as the MRI was performed a neurological examination was done without knowledge of the MRI findings.

Results: Altogether 26 patients showed changes on MRI. Disc lesions were seen in 25 patients. 10 had disc herniation, 3 with medullary and 7 with dura impingement. 26 patients had neurological deficits at physical examination. 7 of the 10 patients with disc herniation and foraminal stenosis showed neurological signs. In 3 of these cases the clinical findings were in agreement with the MRI findings.

Conclusion: Despite many pathologic findings on MRI, we found no relationship between these lesions and the neurologic deficit in the acute phase. Thus it seems unnecessary to investigate these cases early after injury with MRI.

34. Surgery in unstable cervical spine injuries in Iceland 1975-1991

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Introduction: All cervical spine injuries in Iceland needing operative intervention have since 1974 been treated at only one hospital i e Reykjavik City Hospital. This has made a retrospective study of these injuries possible.

Method: The medical records and radiographs of patients with unstable cervical spine injuries were rewiewed. Patients with and without neurological injury were included. Only patients treated opertively were included. Patients treated with traction devices or Halo vest were not included. For each case age at time of injury, mechanism of trauma, neurological injury, Abbreviated injury score (AIS), and Injury severity score (ISS) was noted. Cervical spinal column injuries were classified according to level, type of injury and deformity. The radiographic reduction was noted. Postoperative complications were analyzed and any changes in neurological status.

Results: In the years 1975 to 1991, 46 patients were treated operatively for unstable cervical spine injuries. 36 were males and 8 female. The mean age was 33 (14–60) years. 74% were caused by motor vehicle accidents and 22% by fall from height. 20% were under the influence of alcohol. 20% were neurologically intact, 25% had incomplete spinal cord injury, 22% had complete spinal cord injury and 33% had single cervical spinal nerve root injury. 70% had no other injuries. Thoracic, facial and closed head injuries were the most common concomitant injuries. The mean AIS was 3.5 and ISS 15.5. There was one C1 fracture, one C4/C5 fracture dislocation, 18 C5/C6 fracture dislocation, 14 C6/C7 fracture dislocation and 1 C7/T1 fracture dislocation. 11 were compression fractures. 20 patients were fixated with cerclage wire and 10 were fused posteriorly. 26 patients underwent an anterior fusion (modified Smith-Robinsson) without internal fixation. 5 patients had postoperative complications. 2 patients deteroriated neurologically (both with nerve root lesions) and 2 had immediate loosening of the internal fixation with loss of correction. There was no postoperative mortality.

35. Halo-pelvic traction—a 20-year follow-up

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Halo-Pelvic Traction (HPT) was used on a large scale as a tool in the management of severe spinal deformities at the Duchess'of Kent Children's Hospital in Hong Kong during the early 1970's. Osteonecrosis of the odontoid has previously been reported to occur frequently after HPT. The aim of this study was to assess the clinical and radiographical long-term outcome of the cervical spine after HPT.

Patients and methods: 75 patients follow-up who had had HPT were summoned for a clinical and radiographical follow-up; one third of the patients (17 women and 8 men) attended the re-examination. The mean age of the patients at the time of application of HPT was 15 (8–22) years and at follow-up 37 (28–44) years. The average duration of HPT-treatment was 30 (3–55) weeks. The index diagnoses were paralytic scoliosis in 12, tuberculosis of the spine in 5, idiopathic scoliosis in 7, and hemivertebra in one case. At follow-up, pain was assessed using a visual analogue scale (VAS, 0–100, where 0 equals pain-free). The mobility of the neck was estimated clinically. Plain radiographs of the cervical spine, including flexion-extension films, were obtained in every case; in cases with any abnormality, axial and coronal computerized tomography (CT) of the upper cervical spine was obtained as well.

Results: All but 3 patients were completely free from pain, 2 had a mild to moderate pain (VAS equalled 21 and 25, respectively), whereas one had severe radicular pain (VAS = 84) with some muscular wasting. 7 patients had a mild or moderate restriction of their neck motion. Initial radiographs were normal in 20 patients whereas at final review only one had a normal radiograph. Degenerative changes were observed in 14, loss of lordosis in extension in 13 and bony fusion in 2 cases. The dens axis was abnormal in 13 cases and indistinct in three cases, all of which were examined by axial and coronal CT-scans. Among the 16 CTs performed, 12 had an abnormal peg and 4 were normal. CT demonstrated bone cysts of the atlas in 5 cases and apparent degenerative changes of the neuro-central joints in 6 cases.

Conclusion: Radiographic changes of the cervical spine are common after halo-pelvic traction which however, do not correlate well with the good clinical outcome observed after 20 years of follow-up.

36. Spinal fractures in patients with ankylosing spondylitis (Mb Bechterew)

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Introduction: Fractures in the ankylosed spine are challenging. The bone is often osteoporotic and the spine is stiff. Thus, any internal fixation is threatened by long lever arms

Material: 31 consecutive patients with ankylosing spondylitis and spinal fractures treated in Uppsala from 1985 to 1993 were reviewed. There were 6 women and 25 men with a mean age of 61 (39–83) years. 18 had cervical and 13 thoracolumbar fractures. 3 trauma mechanisms were identified: high energy trauma, low energy trauma, and insufficiency fracture. 11 of the patients had a severe neurological damage at the time of the injury (Frankel A to C), and 6 had minor neurological compromise (Frankel D). A further 6 patients deteriorated neurologically preoperatively during the first 1 to 33 days after the accident. 2 patients with thoracolumbar fractures had deteriorated neurologically due to displacements during surgery at other hospitals.

Methods: In the cervical spine anterior and/or posterior approaches were employed. 2 patients with multiple level cervical fractures were managed in halo vests. In the thoracolumbar spine the majority of the patients were initially treated with posterior approach only. In the cervical spine the AO Cervical Spine Locking Plate was used most often anteriorly and ordinary plates posteriorly. In the thoracolumbar spine the Posterior Fixator (Hosptech AB, Sweden) was used most often.

Results: The average operation time was 3.5 (0.5–8.5) hours and the average blood loss was 2.8 (0–16.5) litres. Complications were common. 2 patients died; one on the operation table from cardiac arrest, and one 2 weeks after surgery from cardiac failure. 2 patients with cervical fractures deteriorated neurologically due to epidural hematomas during surgery. 2 patients had excessive bleeding. 2 patients developed infections requiring revision. Mechanical failure of the fixation developed in 6 patients. In one a halo kept coming loose and had to be repositioned several times. Of the other 5 loosenings 4 occurred in spines fixed on one side only. A gross malalignment requiring reoperation occurred in one patient. All the surviving patients healed their fractures. Of the 25 patients with neurological compromise 6 remained unchanged, 12 improved 1, and 3 improved 2 Frankel grades. 2 had died and for 2 patients the present neurological status was unknown.

Conclusions: Even minor trauma can cause fracture in an ankylosed spine. A high proportion of patients with spinal fractures and ankylosing spondylitis has neurological damage. The risk of late neurological deterioration is substantial. The treatment of these patients is demanding and associated with a very high risk of complications. A combined approach that stabilises the spine from both sides is probably beneficial.

Knee

37. Pull-out test after reinsertion of meniscus bucket-handle lesions with suture versus Biofix® tacks—an experimental study

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Introduction: Several arthroscopic meniscus suture techniques are available. Most are time consuming and neurovascular structures are at risk. An all-inside reinsertion technique using Biofix® tacks has therefore been developed. Pull-out tests with Biofix tacks and suture were performed.

Materials and methods: 24 fresh medial cow menisci were randomly divided into 3 groups. A vertical longitudinal lesion was made 3 mm from the peripheral rim. 8 menisci were repaired with a horizontal Maxon-0 suture by means of an Acufex® double barrel (I). 8 lesions were repaired with Biofix tacks (II). The remaining 8 menisci, repaired with Biofix tacks too, were tested after 24 hours incubation in isotonic NACL (III). Sutures and tacks were inserted 4 mm from the lesion. After total vertical separation of the menisci, a pull-out test was performed with a speed of 5 mm/min with a 5 kN weigth-cell on a Nene M5 maschine.

Results: In group I the suture fixation failed at a median load of 49 (47–77) N. In group II the tacks were pulled out at a median of 53 (42–65) N and in group III the median force used was 61 (35–74) N.

Conclusion: Bucket-handle fixation with Biofix tacks seems to be at least as strong as Maxon sutures using the Acufex double barrel.

38. Biofix®-meniscus tacks versus inside-out suturing technique in the treatment of bucket-handle lesions—a randomized study

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Introduction: Meniscus repair using sutures either as an open procedure or arthroscopically assisted are well established procedures. These procedures have a high rate of complications and are time comsuming too. An all inside arthroscopic procedure using absorbable tacks has been developed. In a prospective, randomized study we compare absorbable tacks to inside-out suturing technique.

Materials and methods: Patients with arthroscopically verified bucket-handle lesions less than 6 mm from the capsule were randomized to suturing or fixation with Biofix-meniscus tacks after informed consent was achieved prior to arthroscopy. A dynamic brace with limited ROM was used postoperatively. All patients were re-arthroscoped 3-4 months later. Total healing, defined as healing in full length of the former rupture as well as partial healing defined as a residual stable rupture < 5 mm and not healed lesions were recorded. Documentation was secured on videotape in all patients.

Results: So far 55 patients have been included in the study. 38 patients were rearthroscoped by January 1994, 19 in each group. 3 patients were excluded. They had no symptoms and did not want to have another arthroscopy. In the tack-group 17 patients were clinically assessed as healed, 15 were healed at re-arthroscopy, 2 were not. In the suture-group 13 patients were clinically assessed as healed, 10 were healed at rearthroscopy, 3 were not. Concomitant ACL-lesions ± simultaneous reconstruction was equally frequent in the two groups. Median procedure time in the two groups was 40 (20–90) minutes in the tack-group and 65 (35–120) minutes in the suture-group.

Conclusions: Arthroscopic fixation of meniscus lesions with absorbable tacks is possible as an all-inside arthroscopic procedure. Healing rate is comparable to that of sutures. Operating time is shorter with tacks.

39. A new concept in the treatment of chondromalacia patellae

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The purpose of this clinical study is the examination of the effects after intraosseous drilling of the patella on patients with chondromalacia patellae, within the framework of a prospective study. Our previous examinations on a total of 51 patients showed statistically significant that retropatellar cartilage degeneration is related to an increased intrapatellar pressure. Based on these results and following preoperative pressure measurements we carried out an intraosseous drilling on 40 patients with chondromalacia of the patella. The aim was to examine if intraarticular, intraosseous drilling is able to reduce intraosseous pressure permanently and to demonstrate the effects on the overall symptoms of the patients. A diagnostic arthroscopy was performed prior to drilling in order to eliminate other possible causes for pain and for grading any possible cartilage damage.

The drilling which was carried out via the Hoffa fat body from distal, resulted in all cases in an distinct alleviation of symptoms in most cases, even in a complete absence of pain. This phenomenon was objectified by a pressure-check-up after 6 weeks, 6 months and 1 year following the drilling.

In all 40 cases so far examined a decrease of between 40–70% of the original pressure level was achieved. 35 patients have so far served as control group. In the control group, 5 patients were cured spontaneously whereas the remaining 30 patients showed more or less persisting symptoms.

Artificial increase of the intraosseous pressure by injection of saline solution at the preoperative stage, resulted in the typical pain in all cases.

Patients with the clinical diagnosis of chondromalacia patellae are now routinely subjected to an intrapatellar pressure registration in our clinic. If the pressure level is above 25 mmHg we consider it an indication for patellar drilling.

We therefore have a relatively minor operation at our diposal for the treatment of chondromalacia patellae enabling us to achieve an impressive therapeutical success, where treatment was neither causal nor successful till now.

40. Surgical treatment of jumper's knee related to muscle strength and ultrasonographic findings

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Introduction: The treatment of jumper's knee is usually successful with conservative efforts, but surgical treatment might be necessary. The aim of the study was to see the outcome of patients operated for jumper's knee, and to see if muscle strenght measurements and ultrasonographic examination could give additional information in the follow-up of these patients.

Material and methods: From September 1988 to April 1992, 57 patients were operated for jumper's knee in the patellar tendon. 48 patients participated in the study, 5 patients had bilateral surgery, giving a total of 53 knees. There were 13 women and 35 men aged 26 (15–46) years. The observation time was 21 (9–48) months. All patients were classified clinically as Roels grade 3. All had A-P radiography of the knee, some patients had a preoperative ultrasonographic examination. The follow-up included clinical examination, questionnaire for self-assessment, muscle strenght measurements with a BIODEX isokinetic device and ultrasound examination of the patellar tendon.

Results: By self-assessment 21 knees were excellent, 18 good, 10 fair and 4 poor. 39 patients had muscle strenght test and ultrasound examination. 9 patients had quad total work on the operated side less than 80% of the unoperated side. The mean thickness of the operated patellar tendon by ultrasound was 5.4 mm and 4.4 mm of the unoperated tendon, 13 patients had echoic changes in the proximal part of the tendon. Of the 9 patients with quad total work less than 80% of the unoperated side, 7 had major echoic changes by ultrasound. All were in the lower part of the scale by self-assessment.

Conclusions: Surgical treatment of jumper's knee grade 3 seems to be a good alternative. For patients with continous symptoms after the operation, it seems as muscle strenght measurements and ultrasound examination can give additional information which might influence the outcome of the patients.

41. Reflex muscle contraction latency in the lower leg of normal and anterior cruciate ligament deficient subjects

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Introduction: It has been suggested that tear of the anterior cruciate ligament (ACL) results in changes of the closed loop efferent reflex pathway of the musculature around the knee joint (1,2). This may decrease the ability to produce sufficient reflex contraction causing inhibition of the normal stiffening effect of the muscles on the knee joint and thus allowing for knee joint subluxation. The aim was to measure the reflex pathway by means of muscle contraction latency for the vastus lateralis, biceps femoris and gastrocnemius muscles in subjects with normal knees and those with a unilateral ACL tear.

Materials and methods: 5 healthy sports active subjects with normal knees (mean age 28) and 5 with chronic unilateral ACL tears (mean age 27) were investigated. The subjects stood on a platform that produced randomly prescribed anterior (n=10) or posterior (n=10) directed translations (speed 18cm/sec, distance 18 cm). The muscle activity of the three muscles was measured by EMG. The latency of muscle contraction was defined as the time from the start of platform movement to the first significant change in the EMG signal.

Results: The method was proven to be accurate and repeatable. Latency of muscle contractions for normal and ACL deficient subjects, mean (SD) are shown below.

Table 1. Latency of muscle contractions for normal and ACL deficient subjects, mean msec *SD*

	normal subjects		ACL deficient subjects	
muscle	left leg	right leg	injured leg	healthy leg
gastroc	109 *15*	104 *6*	112 *12*	106 *11*
biceps	133 *9*	134 *12*	128 *17*	130 *17*
vastus lat	137 *21*	125 *15*	124 *11*	123 *6*

Differences not significant

Conclusion: Tear of the ACL did not necessarily affect the muscle contraction latency.

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42. Results following treatment of infectious arthritis with arthroscopic synovectomy

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Introduction: Antibiotic therapy and immediate drainage of the infected joint are established practice in the treatment of septic arthritis. The method of drainage remains controversial.

Materials and methods: From January 1990 to April 1993 14 patients (7 women and 7 men) with infectious arthritis were treated with a combination of systemic or orally administrated antibiotics and arthroscopic synovectomy. The median age was 75 (22–98) years. 11 patients had involvement of the knee, 1 of the ankle, 1 of the shoulder and 1 of the hip joint. 3 patients had a chronic inflammatory arthritic disease, and 5 patients had other chronic systemic diseases. In 7 patients, arthroscopic synovectomy was performed due to inadequate response to conservative therapy. These patients had received systemic administration of antibiotics for 27 (10–55) days. After arthroscopic synovectomy, body temperature normalised in 2 (1–32) days. They left hospital at day 39 (11–107). In 7 patients, arthroscopic synovectomy was performed without prior conservative therapy. In this group, body temperature normalised in 3 (1–13 days). They left hospital at day 20 (12–55).

Results: In subsequent follow-up 22 (1–47) months, 9 patients had reached a full recovery, with joint movements of "normal range". 3 patients had slightly reduced mobility and reported minor "joint pain/discomfort in activity". One patient had severely reduced joint mobility and reported major "joint pain/discomfort". None of the patients developed osteomyelitis. There were no relapses of infectious arthritis and no mortality related to the joint infection.

Conclusion: Arthroscopic synovectomy is effective in patients with infectious arthritis not responding to conservative treatment. Moreover, this procedure appears to shorten the duration of rehabilitation, and reduce morbidity during this period. Early intervention with arthroscopic synovectomy results in a shorter duration of the disease, and follow-up studies show a better prognosis than would be expected in this group of patients.

Bio-degradable materials

43. Absorbable implants in the fixation of fractures, osteotomies, arthrodeses and ligaments

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This is a presentation of our clinical experience when using totally absorbable implants in orthopedics and traumatology. Totally absorbable fixation devices were clinically introduced by us in the treatment of fractures in the extremities in the mid 1980's. Prior to and parallel with clinical trials and use of the absorbable fracture fixation implants, over 4300 animals were operated on in our experimental studies to investigate eg strength, strength retention, degradation, bone changes, healing of fractures, and the fixation properties of the implants.

At the authors' department over 2500 operations were performed using fracture or ligament fixation implants made of self-reinforced (matrix and fibers of same polymers) absorbable alpha-hydroxy polyesters (since November) 1984.

The total number of operations performed using totally absorbable implants at the Department of Orthopedics and Traumatology, Helsinki University Central Hospital from November 5 1984 to February 3 1994 was 2522.

The causes of the operations with absorbable implants at our department from November 5, 1984 to November 5, 1993 have been trauma in 1895, orthopedic disease in 516, not yet analyzed in 20 and totally in 2431 operations.

Table 1. Utilization of totally absorbable implants at our department from November 1984 to December 1993

Implant (mainly used)	n	Implant (mainly used)	n
PGA-PLA rod	53	PLLA expansion plug	53
PGA rod	933	PLLA wire	3
PGA screw	521	At least two different	
PLLA rod	136	kind of implant	335
PLLA screw	150	Not yet analyzed	112
PLLA tack	135	Total	2 431

PGA = polyglycolide PLLA = poly-l-lactide

Table 2. The most common indication for application of absorbable rods, screws and tacks in orthopaedic surgery.

• Fresh fracture of	Ankle
Condyles of humerus	Tarsal and metatarsal bones
Olecranon	• Orthopaedic diseases
Radial head	Osteochondritis dissecans
Carpal and metacarpal bones	Chevron osteotomy for hallux valgus
Patella	• Rupture of the ulnar collateral ligament of the thumb
Distal femur or proximal tibia	

The postoperative clinical course was uneventful in over 90% of the patients. There was wound infection in 3% and failure of fixation in 3%. A non-infectious foreign-body reaction was encountered two to three months postoperatively in 2.3% of the patients operated on the last years with polyglycolide implants but only occasionally in patients operated with polylactide implants. These inflammatory tissue responses required only needle aspiration or minor surgical procedures but did not influence the ultimate functional or radiographic result of fracture treatment.

Due to the biodegradability of the developed fixation devices implant removal procedures were avoided. Consequently, these facilities could be directed to other operations on the waiting list. Avoidance of removal procedures results in financial benefits and psychological advantages.

44. Absorbable polyglycolide membranes. Behaviour and effect on bone

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Self-reinforced polyglycolide (SR-PGA) devices are absorbable; biocompatible and are in clinical use nowadays. SR-PGA membrane is a new member of this family and is being studied here for its behaviour and effect on osseous tissues in rats.

Materials and methods: SR-PGA membrane, 0.15 mm thick, was implanted in 122 Wistar rats. The membranes were applied around femoral diaphyses or metaphyses, either over the periosteum or directly over the bone, after periosteal stripping. In another group of fifty-eight rats, no membrane was applied, but the femoral periosteum was stripped away. The rats were killed after 1, 3, 6, 12, 24 and 30 weeks. Radiology, histology, oxytetracycline fluorescence, microradiography and planimetry were used. SR-PGA membranes were also immersed in distilled water at 37 °C, or implanted in the subcutis and around the femoral bone of other 24 rats for strength retention measurments.

Results: A fibrous tissue capsule around the membrane formed and extended into the implant and ultimately replaced the implant. More new bone formation was associated with the membrane application. Periosteal thickening occurred whether SR-PGA membrane was used or not. PGA fibers decreased in number and diameter continuously until they vanished by 30 weeks. The SR-PGA membranes lost their strength in vitro by 6 weeks, while they retained it for 15 weeks in vivo due to the fibrous tissue encapsulation of the implant.

Conclusion: SR-PGA membrane is considered biocompatible and applicable in the treatment of bone lesions.

45. An absorbable expansion plug for the fixation of fractures of the medial malleolus

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Introduction: The great potential of biodegradable polymers as materials for the internal fixation of fractures and osteotomies has been gradually recognized. Secondary operations for implant removal always cause certain inconvenience for the patient and necessitate considerable resource allocation for the hospital. To avoid these disadvantages related to the metallic implants, biodegradable devices of different physical appearances are being developed for the fixation of various fractures and osteotomies.

Patients and methods: In a prospective study, 26 patients with a displaced fracture of the medial malleolus were treated by open reduction and internal fixation using an absorbable self-reinforced poly-L-lactide expansion plug measuring 4.5 mm in diameter and 30–35 mm in length. Twenty-one patients could be followed regularly for at least six months. The follow-up time ranged from six to 18 months.

Results: No redisplacements occurred, and the consolidation of the fractures was uneventful. There were no signs of inflammatory foreign-body reactions. No severe limitations in the range of motion of the ankle joint occurred, but in nine patients a mild restriction of five to 15 degrees of the dorsiflexion range was found at the follow-up examination.

Conclusion: This preliminary study showed the capacity of self-reinforced polylactide expansion plug for the internal fixation of cancellous bone fractures. The short-term biocompatibility of the implant was excellent. Further clinical applications are being planned.

46. Self-reinforced absorbable vs. metallic fixation in the treatment of ankle fractures

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Introduction: Anatomic reduction of a displaced ankle fracture is the basis of the treatment to avoid secondary arthrosis of ankle joint. From our department have been reported good results in the treatment of ankle fractures by using absorbable implants as fixation devices (1,2,3). To analyze more exactly the advantages of absorbable screws in the treatment of ankle fractures we compared the method with the conventional AO-method, although this comparison has been published earlier in ankle fractures (3), and in extra-articular subtalar arthrodesis in children (3).

Patients and methods: In this study we used a pair comparison method, and 136 patients treated with open reduc-

tion and fixation by metallic devices were compared with 136 patients treated by using self-reinforced absorbable polyglycolide (SR-PGA) screws as fixation devices. In the group of metallic fixation the operation technique was based on AO-principles by using metallic plates and screws, while in the group of absorbable fixation was usually only one screw for one malleolus used. The scheme of postoperative treatment was similar in both groups and we used plaster cast immobilization. Clinical and radiographic results, sick-leave, operation time and complications were recovered in both groups. Clinical results were scored as good, fair or poor, and radiographic results exact, good (secondary displacement <2mm) and poor (displacement >2 mm). For statistical analysis X^2 -test was used for non-numerical parameteres and t-test for numerical parameters.

Results: The groups in this study did not differ significantly when analysing the severity of the fracture ($p = 0.62$), the displacement of the fracture, 6.2 (1–36) mm in average in absorbable group and 5.6 (1–30) mm in metallic group in average ($p = 0.17$), age, 36 (15–63) years in metallic and 37 (16–71) years in absorbable ($p = 0.52$), weight, 75 (50–118) kg in absorbable and 74.2 (45–120) kg in metallic ($p = 0.68$). Clinical results: in absorbable fixation there was 130 good and 6 fair and in metallic fixation 116 good and 20 fair ($p = 0.003$), and radiographical results: in absorbable fixation 100 exact, 29 insignificant displacement, 7 poor and in metallic fixation 82 exact, 40 insignificant displacement and 14 poor ($p = 0.053$). The sick-leave following primary surgery was 86 (3–379) days in the patients treated with metallic fixation and 70 (1–366) days of the patients treated with absorbable screws and in the metallic group the patients needed 12 (0–99) days sickleave on average after removal procedure, while the patients in absorbable group needed because of late complications a new sick-leave 0.6 (7–32) days on average. Also the total sick leave was after absorbable fixation 70 days on average and after metallic fixation 99 days on average ($p < 0.0001$). The operation time was shorter in absorbable fixations [37 (9–125) min compared with 60 (15–210) min in metallic fixations ($p < 0.0001$)]. The complications in the series were 26 in absorbable group including 2 failures, 5 infections, 2 deep venous thrombosis, 11 transient tissue reactions and in metallic group alltogether 33 including 8 failures, 15 infections, 2 delayed unions, 2 deep venous thrombosis. 93 out of 136 patients (69%, whose fracture was fixed with metallic devices complained some kind of pain or discomfort because of fixation devices.

Discussion and conclusion: The avoidance of metallic fixation devices offers capacity to other orthopedic surgery. The difference in sick-leave was approximately one month. Sick-leave is expensive to the society and insurance system and to the patients themselves. The main reason for shorter operation time of absorbable fixations may be easier operative technique. This study was not a randomly allocated prospective study, but by using a pair comparison it was able to find very comparable fractures and patients. The advantages of the use of self-reinforced absorbable implants will be emphasized when treating ankle fractures of well cooperating people, because the postoperative plaster cast immobilization is not mandatory (2).

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46A. Activation of the complement system observed by use of biodegradable pins of polylactic acid (Biofix®) in osteochondritis dissecans

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Introduction: Biodegradable pins of polyglycolic acid (PGA) or polylactic acid (PLA) have been used in the treatment of fractures and osteotomies during the past five years. Adverse effects reported have included swelling at the implantation site and sinus formation considered to represent typical nonspecific foreign-body reactions. Recent reports, however, have shown severe reactions after intraarticular fracture fixation. Reactions in two patients treated with polylactic pins for osteochondritis dissecans (OCD) in our hospital prompted the present clinical investigation and further evaluation of the complement-activating potential of polylactic pins.

Patients and methods: Ten knees underwent arthroscopic fixation of an OCD-lesion with Biofix (PLA) pins. Clinical follow-ups were carried out at 2, 6 and 12 weeks and at 6 and 12 months. Blood samples were collected from five patients 9–24 months post-operatively for biocompability tests. Quantification of human C5a des Arg was performed with a recently developed sandwich ELISA technique using neoepitope-specific monoclonal antibodies.

Results: Six knees developed diffuse swelling and a prolonged postoperative course. Two patients had a particularly prolonged course which could not be attributed to infection. Levels of C5a des Arg in plasma incubated in the presence of polylactic acid were significantly higher compared to plasma incubated in the absence of PLA.

Conclusions: The high frequency of long term postoperative inflammatory signs in these knees treated for OCD and the demonstration of a complement activation potential of PLA pins warrant further studies on the biocompability of this material. Until more information is available, we do not recommend intraarticular use of PLA pins.

Knee prostheses

47. Roentgen stereophotogrammetric analysis of the Miller-Galante II and Freeman-Samuelson hydroxyapatite knee prostheses

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This prospective and randomised study compare two prostheses with rather similar geometry, but with two different tibial component surfaces. The Miller-Galante II (MG II) (Zimmer, Warsaw) which has a titanium fiber mesh for ingrowth and the Freeman-Samuelson hydroxyapatite coated (F/S-HA) (Protek, Bern) prostheses. The aims of the study were to compare the two systems clinically and to analyse the stability of the tibial components by roentgenstereophotogrammetry (RSA).

Patients and methods: 45 patients were operated for gonarthrosis in 51 knees with either M-G II or F/S-HA uncemented total knee arthroplasty. Mean age at operation was 67 (56–73) years. At one week, 2, 6, and 12 months postoperatively, radiographs were taken for RSA. The accuracy of RSA at the knee is 0.1 for rotation and 0.2 mm for translation.

Results: Clinically, there were no significant differences between the two groups. The RSA results showed significant differences between the two prostheses in two directions, lateral and central subsidence. The lateral part of the tibial tray subsided more for the Miller-Galante prosthesis compared to the Freeman hydroxyapatite prosthesis. The central subsidence was larger for the Miller-Galante prosthesis. MTPM was 0.5, 0.6, and 0.8 at 2, 6 and 12 months for the M-G II prosthesis and 0.4, 0.5, 0.6 for the F/S-HA prosthesis.

Conclusion: The low magnitude of migration of both prostheses in this study may be compatible with bone ingrowth and bone apposition.

48. Does a tibial stem improve uncemented fixation of the Freeman-Samuelson TKA? Stereoradiographic study of 27 tibial components followed for 5 years

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Introduction: Poor fixation of uncemented metal-backed tibial components initiated the addition of a stem to the Freeman-Samuelson (FS Mk II) prosthesis. One previous stereoradiographic study has indicated that this measure had the desired effect in terms of improved early fixation (Albrektsson 1990), however, these results could not be verified by us using the same technique (Nilsson 1989). This report concerns the 5-year results of our patients randomized to fixation with or without a stem on the tibial base plate.

Patients and methods: 27 FS Mk II knee prostheses were inserted in 26 consecutive patients(18 women, 8 men, mean age 68 years). At the operation the knees were randomly allocated to a metal-backed tibial component with or without a 110 mm stem. 13 knees (7 OA, 6 RA) received a stemmed tibial component and 14 (5 OA, 9 RA) a tibial base plate without a stem. The two groups of patients were comparable as regards age, weight, preoperative pain and range of motion. Roentgen stereophotogrammetric analysis (RSA) was done postoperatively, and at 6 months, 1, 2, and 5 years after operation.

Results: 21 patients (21 knees) could be followed up to 5 years after surgery. Two patients died (3 knees, 1 stem, 2 no stem) and 3 knees were revised (2 stem, 1 no stem). RSA showed median maximum migration (MTPM) at 5 years was 2.3 mm for the stemmed components, and 3.4 mm for the non-stemmed ones ($p = 0.180$). From 1 to 5 years postoperatively median varus/valgus tilting was about 0.6° (stemmed) and 2.1° (non-stemmed), respectively ($p < 0.05$). Median anterior/posterior tilting at 5 years was 2.3° (stemmed) and 2.2° (non-stemmed) ($p = 0.950$). Median liftoff of the tibial component at 5 years was 0.4 mm (stemmed) and 0.9 mm (non-stemmed), respectively ($p = 0.410$), and median maximum subsidence of the periphery of the tibial component was 1.8 mm (stemmed) and 2.7 mm (non-stemmed), respectively ($p = 0.230$).

The reasons for revision were clinical loosening (2 stemmed components) and unexplained pain (1 non-stemmed component). RSA before revision in the 2 clinically loose components revealed maximum migration (9 mm) and subsidence (8 mm) 3 times as large as the median results for the stemmed group as a whole, whereas the component with unexplained pain showed migration close to the median values for the unstemmed group.

Discussion: The addition of a stem to the FS Mk II tibial component reduced varus/valgus tilting, whereas there was no effect of the stem on anterior/posterior tilting. However, in both the stemmed and non-stemmed groups the recorded micromotions were larger than has previously been found in other prosthetic designs evaluated with RSA. This, and the fact that 3 knees had been revised within 5 years questions the efficacy of this prosthetic design when used without cement.

References:

Nilsson et al. Acta Orthop Scand (Suppl 231) 1989: 34.
Albrektsson et al. J Bone Joint Surg (Br) 1990; 72B.

49. Bilateral knee arthroplasty in one stage—survey of 121 cases with 242 joints

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Material and methods: During 8 years (1986–1993) 121 of 817 (14.8%) patients underwent bilateral knee arthroplasties in one stage, 83 women and 38 men. Age at operation was 70 (39–84) years, same in both sexes. At follow-up 8 patients had died and 3 were not available. The remaining 111 (91%) patients were evaluated at a clinical and radiographic examination on the average 3.5 (0.5–7) years after operation. Of the 242 knees 204 had arthrosis and 38 had rheumatoid arthritis. 117 of the patients had either a unicompartmental (29) or a bicompartmental (88) arthroplasty of both knees; 4 patients had a UCA on one side and a TKA on the other. The operations were performed in epidural anestesia and a tourniquet was used. Antibiotic and anticoagulation prophylaxis was used routinely for 2 and 5 days respectively. In the initial period the operations were performed simultaneously by two surgeons but after the first 16 cases sequentially, as a rule by one surgeon.

Results: The patients generally did very well postoperatively although the bilateral procedures often placed greater demands on nursing care and physiotherapy compared to unilateral operations. Average hospital stay was 21 (10–39) days. 79 (65%) patients were discharged directly to their homes and 42 were referred to rehabilitation units. Average operation time was 155 (90–235) minutes and average total blood loss was 1304 (325–3920) mL. 71 (59%) patients received on the average 3 (1–7) units of blood postoperatively. On the HSS knee score 196 (89%) of the knees rated good or excellent. Primary complications included 1 fatal pulmonary embolus, 2 cerebral infarcts, 2 transient peroneal palsies, 2 deep infections and 3 minor wound complications.

Conclusions: When both knees are severely deranged and symptomatic arthroplasty of both knees is required to achieve the essential goal of surgery i e improved walking capacity, the advantages of a one stage procedure include a single period of pain and suffering for the patient, shorter combined hospital stay and rehabilitation period and finally a lower cost in time and money. No significant difference in the rate of complications was found in this series compared to unilateral operations during the same period. Our opinion is that if operation is at all deemed feasible this type of patient should have the option of a one stage bilateral procedure.

50. PCA uni-compartmental knee prosthesis in arthrosis—a 3–9-year follow-up

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Materials: In the Department of Orthopedics, Malmö General Hospital, 108 PCA uni-compartmental arthroplasties were performed in 98 patients with medial or lateral gonarthrosis during 7 years (1984–1990). In 1993 a 3-9 year follow-up examination was undertaken. Of the 108 knees operated on during 1984–1990, 90 knees (83%, 17 men, 64 women) remained for follow-up.

Results: Of those remaining 26 (29%) were rated as excellent, 29 (32%) as good, 8 (9%) as fair and 27 (30%) as poor. The number of revisions was 25 (28%) and in another 2 (2%) there was an indication for a revision making a total of 27 (30%). In 2 patients the revision was bilateral. Average time to revision was 39 (11–80) months post-operatively. In 14 revisions the femoral components were loose, severe wear of the polyethylene of the tibial component was observed in 14 revisions. The average HSS score preoperatively was 66, after 1 year 85 (80 in the revised group) and after 5 years 78 (only 9 of the revisions were included in the estimation of the HSS score after 5 years as the other 16 patients had already been operated on). Light to moderate wear of the polyethylene was observed radiographically in another 18 (20%) of the patients but only one of these had severe wear indicating an immediate re-operation. First step pain as a sign of prosthetic loosening was observed in 12 (18%) of the patients after 5 years. These patients also had radiographical as well as clinical signs of prosthetic loosening.

Conclusion: There was a remarkable deterioration of the results and HSS score after 5 years compared with the first year postoperatively. This is obviously due to the common complication of femoral components coming loose and the excessive wear of the polyethylene of the tibial component causing a high rate of knee revisions. Our recommendation is to generously revise patients with symptoms from their PCA-unicompartmental prosthesis.

51. Migration of uncemented press-fit cups fixed with screws in hip revision arthroplasty—a stereoradiographic 2 year follow up of 56 hips

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Press-fit acetabular cups fixed with screws have displayed small early migration in primary hip arthroplasty. In revision surgery cemented fixation of the cup has been associat-

ed with high early migration. The purpose of this study was to evaluate the primary stability of press-fit cups (Harris-Galante) used in revisions.

Patients and methods: 56 acetabular revisions were performed in 56 patients with a mean age of 65 years. 41 were first time revisions and 12 were revised for the second time. There were 20 hips with a minimum bone loss (type 1), 23 with cavitary defects (type 2) and 10 with acetabular penetration (type 3). Morselized bone graft was used in 48 and bulk allograft in 8 hips. There were 3 luxations and one infection but none of the patients were re-revised. At operation tantalum markers were inserted into the pelvis and to the polyethylene insert. Stereoradiographic examinations were done postoperatively and at 6, 12 and 24 months.

Results: Migration above the significance level was recorded in 32 hips. Most cups migrated proximally, whereas the migration in the medial-lateral and anterior-posterior directions were more equally distributed. The proximal migration increased from 0.22 mm (-0.02–0.72) six months after the operation to 0.32 mm (0.01–1.18), at the last follow-up. The vektorial sum of the migration in the three directions reached 0.69 mm (0.05–1.91) at two years. Linear regression analysis revealed that use of bulk allograft resulted in slightly increased migration whereas patient factors, type of loosening, prosthetic size and number of screws had no influence.

Conclusion: Uncemented press fit cups displayed a small early migration which was of the same magnitude as previously reported with the same implant in primary surgery.

52. Subtotal revision for aseptic complications after knee arthroplasty

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Introduction: Modular components make sub-total revision an option in TKR revision for polyethylene wear and aseptic loosening.

Materials and methods: 32 total knees with metal backed polyethylene in 30 patients were revised because of loosening/subsidence of noncemented components in 23 knees (14 P, 4 T, 4 TP, 1 FTP), and polyethylene wear in 9 knees (9 PT), diagnosed clinically and with the use of plain radiography, arthrography and arthroscopy.

Results: After a mean observation time of 25 (2–96) months, the clinical outcome was graded as good with normal status and function in 18, fair in 9 and poor in 5 cases. The main reasons for less than good results were extensor mechanism problems in 7 cases, of which 4 were after removal only of a loose patellar component, and remaining pain of uncertain etiology in 6 cases. One patient sustained a patellar tendon rupture one month post exchange of a worn patellar and tibial component.

Conclusion: Sub-total revision for aseptic complications means a conservative approach with less risk for bone loss. However, a full-size arthrotomy is important in order to gain full access to the tibial plateau. Repeated surgical trauma to the patellar tendon can lead to fibrosis and shortening. It is sometimes difficult to estimate the fixation of the tibial component, if in doubt, it is better to revise than to risk a second revision. Simple removal of a loose or worn patellar component leaves the patient with a weak extensor mechanism and considerable impairment.

Hip prostheses, cemented

53. Impacted femoral cancellous grafting in cemented revision hip arthroplasty

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Ling and Gie (Gie et al 1993) have developed a new technique of cemented femoral revision using the Exeter hip prosthesis with impaction cancellous bonegrafting (X-Change technique). This technique allows revision also in cases with severe bone stock deficiency and early results have been encouraging.

Since December 1991 we have performed 42 X-change revisions in 40 patients. One patient has been operated bilaterally, and one patient needed revision at 5 months. We report our operative experience and early results.

24 patients were men and 18 women. The median age was 59 (26–89) years. Right and left hips were operated in 20 and 22 cases respectively. There were 27 primary femoral revisions, 14 second and 1 third. The median interval from the previous procedure was 9 (1/2–15) years.

Bone stock deficiency according to the Endo-Klinik classification was grade I in 4, grade II in 18, grade III in 16 and grade IV in 4 cases.

Four cases were operated on as two-stage procedures with a three-week interval because of suspected infection, which was confirmed by growth of bacteria in three.

Femoral operative procedures included stabilisation of femoral fractures in 10 cases (3 occurring intraoperatively), reconstruction of proximal femoral defects in 8, closure of femoral shaft defects in 20 (including most fractures), cerclage wiring of femoral fissures in 5, prophylactic cerclage wiring in 3 and refixation of a trochanteric pseudarthrosis in 1 case.

We had one case of early postoperative prosthetic dislocation with no recurrence for a year following closed reduction. One case with a subtrochanteric fracture and bone stock deficiency grade III was followed by early failure and needed renewed X-change revision at five months. Several of 12 cases followed for one year or more have shown signs of cortical bone repair and/or remodelling of the bone graft. Subsidence of the prosthesis was a median of 3 mm (0–4) at follow-up.

In conclusion our early experience with the X-change-technique has been encouraging, and even severe cases with grave bone stock deficiency and/or coexisting femoral fractures may be adressed with satisfactory results.

Reference: Gie GA, Ling RSM, Timperley AJ, Linder L, Simon J-P, Sloof TJJH. Impacted cancellous allografts and cement for revision total hip arthroplasty. J Bone Joint Surg (Br) 1993; 75-B: 14–21.

54. Early micromotions of cemented femoral stems subsequently revised due to pain or osteolysis

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Roentgen stereophotogrammetric analysis (RSA) has been used to measure the early micromovements of numerous designs of hip prostheses. The aim of this study was to investigate the clinical significance of early micromotions of cemented femoral stems.

Patients and methods: During the period 1984–1988, 84 cemented hip arthroplasties (Lubinus SP, W Link, Germany) were included in prospective studies in order to measure the migration of the femoral head centre using RSA. There were 33 men and 48 women with a median age of 68 (41–83) years. 58 hips were primary and 26 revision arthroplasties. The patients were studied within 2, after 6, 12, 24 and 5–8 years after surgery. At the latest follow-up 13 patients had deceased. 62 prostheses were still in situ (control group). One primary hip and seven revised hips had been revised or rerevised because of pain (revision group). One primary hip had been revised because of progressive osteolysis.

Results: During the 2 postoperative years increased subsidence, medial and posterior migration was recorded in the revision group ($p < 0.001$). Two years after surgery the subsidence was 10 times higher in the group which subsequently was revised because of pain. In the case revised because of osteolysis small but significant micromotions were recorded. In the revision group subsidence, medial and posterior migration was recorded in all hips before the revision. During a follow-up period of 8 years the hip which developed osteolysis had subsided 0.35 mm.

Logistic regression analysis revealed that the amount of subsidence and the vectorial sum of the migration 6 months postoperatively could be used to correctly classify all but two cases. The amount of subsidence at 2 years had alone the same predictability and resulted in a more accurate mathematical model than the 6 months data.

Conclusion: Early migration of cemented femoral components increases the risk for revision within 5–8 years after surgery confirming that information about early micromotions has clinical relevance. Subsidence of 0.3 mm and a total migration of 1 mm or more at six months or a subsidence of 1 mm or more at 2 years dramatically increased the risk for intermediate-term failure.

55. New instrument for bone transplantation and early results of graft impaction in cemented hip revision

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Introduction: Loosening of a cemented hip prosthesis often leads to a poor bone quality and bone osteolysis which creates a troublesome situation for fixation of a new prosthesis.The preliminary results of stem and cup revisions using a new device for massive impaction of cancellous bone allograft and cementing a new prosthesis on the graft bed are presented.

Patients and method: 20 total hip arthroplasties with mechanical loosening and bone resorption (Endoclinic classification grade 2 and 3) were revised from March 1992 through September 1993. The surgical procedure included cleaning and roughening of the sclerotic endosteal surface. Milled allograft was packed in acetabulum with a trial cup and later with a special instrument. In femur firm graft impaction on top of a stable plug was managed with a distal impactor over a centraliser. A side impactor with qualities for blood and fat evacuation, and finally a proximal impactor shaped a "neo-femoral canal". After retrograde cement filling a standard stem was inserted. One or two days after surgery the patients were mobilized with crutches with minimal weight bearing for three months.

Results: 19 hips in 19 patients aged 53 to 77 years have been followed for 8–26 months (one dead); 17 patients were totally pain free and 2 had slight hip pain. Ten had bilateral hip disease or a knee disease and two of those used one crutch. Radiographic evaluation revealed no bone resorption in any case. Four femoral stems migrated 3–8 mm during the first months. Four out of 14 cases followed for more than 12 months showed trabecular remodelling of the femoral transplants.

Conclusions: The surgical procedure with this device works very well. The short term results are good.

56. Titan (THP)—10 years clinical experience to assert basic principles

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Like "low friction" Charnley prosthesis or "self locking" Müller prosthesis, TITAN (THP) is now a reference for

cemented femoral stems.

The excellence of clinical and radiological results after 10 years allows us to confirm the following basic principles:

- forged titanium alloy (TA6V) for high mecanical strength, low elasticity modulus and better biocompatibility.
- smooth and polished anodised surface for good care of surrounding cement mantle, avoiding shearing forces and fretting corrosion.
- original design with fluted shape: bidirectionnal enlargment on a straight stem for ensuring metaphyseal stability, before cementation.
- modularity with a large range of femoral shifts—standard and lateralised—with or without collar, universal taper cone for different head sizes and neck lenghs, very useful to obtain (after adequate programmation) the restauration of individual anatomic architecture.

The quality of clinical and radiological results with more than 10 years follow up allows us to confirm the value of basic principles—pointing out the fact that it is a quality whole.

All the elements—material, surface and design—are to be taken together—because they are relied—interdependent.

If you made a decision to use titanium alloy for Charnley stem, do not be surprised if it does not work.

If you changed the surface of EXETER prosthesis for a mat and rough one, do not be amazed if loosenings occurred.

TITAN (THP) did not change from the beginning—widely implanted in Europe and accepted by American FDA.

Hip prostheses, uncemented

57. Bioresorbable vs titanium screws in acetabular cup fixation—a prospective randomized evaluation using roentgenstereophotogrammetric analysis

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Introduction: Titanium screws are used to provide stable primary fixation of uncemented cups. Reports of corrosion, fretting and osteolysis have initiated interest in using other fixation materials. Bioresorbable pins and screws have been used in internal fixation. The literature reports on problems with local fluid accumulations probably due to fast degradation of the material. High molecular weigth poly-L-lactic acid (PLLA) has good tensile, flexural and shear strength and it has been efficient for primary fixation of acetabular cups in the canine. The purpose of this study is to document the use of PLLA screws in clinical practice and to evaluate the early fixation using roentgen stereophotogrammetric analysis (RSA).

Patients: The study includes 42 patients operated upon with a hybrid total arthroplasty due to disabling arthrosis. A press-fit acetabular cup (Harris-Galante II, Zimmer Inc) and a cemented chrome-cobalt femoral stem (Spectron EF or Lubinus SP II) were used. The patients were randomized to additional fixation of the cup with 6.5 mm titanium screws (20) or PLLA screws (22) supplied by Zimmer Inc. The study was approved by the local ethical committees in Gothenburg and Umeå, Sweden.

Table 1. Preoperative status, 42 patients

	Harris hip score	VAS (mm)	Age (mean)	Women (n)	Men (n)
Titan	55	68	58	12	8
PLLA	54	71	59	13	9

Method: The acetabulum was underreamed 1 mm. 2–4 screws were inserted. The screws were tightened to 14 ins/lbs using a torque-wrench. Tantalum markers (0.8 mm) were inserted in the polyethylene liner and in the pelvis. RSA examinations were performed postoperatively and 3, 6 and 12 months after surgery. Migrations in terms of rotations and cup center translations were recorded. The precision of RSA measurements (2.7 SD) was 0.3 mm for migration along the transversal or longitudinal axis and 1.1 degree for rotation. Statistics: Repeated measurements ANOVA (MANOVA).

Results: Cups fixated with PLLA screws rotated in retroversion in contrast to the anteversion seen in the titan group (rotation around the longitudinal axis; $p = 0.02$). The total translation (vectorial sum) did not differ. Neither did the medial-lateral and anteror-posterior translations of the cup center significantly differ ($p > 0.05$). There is an increased proximal migration in the PLLA group but the difference is not statistically significant ($p > 0.05$). We found no clinical or plain radiographic differences between the two groups.

Conclusion: During the first postoperative year the pattern of rotation around the longitudinal (proximal-distal) axis differed between the two groups but the difference was small. The (not significantly) increased proximal migration in the PLLA group can be an ominous sign. The clinical implication of these findings is unclear and further follow up is needed.

58. Dual-energy x-ray absorptiometry measurement of bone mineral density (BMD) around proximal porous-coated Taperloc® femoral implants

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Purpose: 1) Estimation of BMD changes around cementless Taperloc® femur stems 4.5–6 year after implantation. 2) Comparison of radius and lumbar spine BMD with periprosthetic bone mineral changes. 3) Precision study of the used Hologic QDR-2000 bone densitometer.

Materials: DXA measurements of lumbar spine, non-dominant radius and both hips were performed on 25 patients, unilaterally operated with a cementless Taperloc® femur stem. Estimation of BMD changes around the hip implant, were obtained by comparing BMD of seven Gruen zones in the operated with the non-operated hip. Thirteen patients were scanned twice on the prosthesis side.

Results: Average BMD in the 7 hip zones was lower on the operated side. The greatest decrease in BMD (22%) occurred in the calcar area. There were relatively large variations of the BMD changes between the patients. No association between skeleton BMD and the size of hip mineral differences were found. The average precision was 2.2-4.9% for the 13 patients.

Conclusion: DXA is a reliable method for measuring BMD around hip joint implants. There was a severe loss of bone mineral around the implants. BMD of the lumbar and radius could not predict the BMD differences between the two femoral bones.

59. Dual-energy x-ray absorptiometry (DEXA) analysis of the femoral bone remodeling after implantation of a HAC coated prosthesis

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Introduction: It is now well established that early modifications of bone frame are infra-radiological and analysing bone density variations seem to be a very promising method. DEXA is probably the most simple and reproductive technique.

Material and methods: Our study analyses 52 patients with unilateral HAC-THA (CORAIL prosthesis), implanted in 1986, scored 18.00 in the PMA hip scale,without any bone remodeling signs on the conventional radiographs.

Results: Bone loss appears very early (3rd month) and seems to slow down between the 12th month and the 5th year. But nothing allows us to say that the stability is reached at this time. We tried to establish a correlation with different factors (age, sex, prosthetic design, femur morphology).

Conclusions: The teachings of this work should be moderated because of the small sample and because of the great number of parameters having an influence on bone remodeling. However, DEXA analysis will perhaps allow us to draw a border line between a physiological process of bone saving and a pathological phenomenum of bone loss.

60. The non-cemented hemispheric Harris-Galante acetabular cup—evaluation after 1–8 years in 1028 replacements

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Introduction: Uncemented porous coated hemispherical acetabular cups have been used with increasing frequency in THA to improve the results. This is a retrospective evaluation of all primary THA with the Harris-Galante I cup (HGC), carried out in our department from 1985 to 1992.

Materials and methods: All patient files and radiographs of 1028 hip replacements with HGC in 922 patients were examined after a minimum of one year of observation. Supplemental mailed questionnaires about the function of the hip, were sent to all patients alive (831 cases), and with a THA not recorded as a failure. 95% were returned. Patients with pain problems (84 hips) were offered a radiographic examination.

Results: At follow-up 42 cups (4%) had been or were planned to be revised; 14 due to recurrent dislocations, 10 due to deep infection, 6 due to displacement of the cup, 7 due to aseptic loosening of the cup, and other reasons in 5 hips. Out of 56 hips with pain, we suspected loosening of the cup in 2 THA.

Conclusion: We find the results of this evaluation of THA with Harris-Galante I cup satisfying, although it is still possible to improve the results.

Hip prostheses

61. Migration of press-fit acetabular cups fixed with screws—stereoradiographic 5-year follow-up and retrieval analysis

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Cementless press-fit cups fixed with screws have been used especially in hybrid THA, because of concerns of long-term failure of cemented cups. In this study the micromotions of press-fit cups were measured for 5 years to enable early detection of fixation failure.

Patients and methods: A consecutive series of 21 patients (22 hips) with a mean age of 58 (44–69) years were studied. 17 had idiopathic coxarthrosis, 2 dysplasia and 2 osteonecrosis of unknown etiology. Press-fit acetabular cups fixed with screws (Harris-Galante I, Zimmer, Warsaw, USA) and cemented SP II (13 hips) or cementless smooth ribbed (8 hips) femoral components were used. Stereoradiographic examinations were done within 10 days, 1.5, 3, 6, 12, 24 and

60 months (20 hips) postoperatively. One patient deceased due to an abdominal cancer 3 years after surgery. The implant was available for retrieval analysis.

Results: None of the cups had been revised at the last examination. Most of the migration occurred during the first postoperative year and especially during the first 6 weeks. Between the 2 and 5 years no significant increase was found. Migration (vectorial sum, TPM) more than 1 mm (1.0–1.6) was recorded in 7 cups including the retrieved implant. Analysis of this implant revealed a thin layer of connective tissue surrounding the entire porous surface, but close contact between the bone and the screws. According to conventional radiographs acetabular granulomatas had not developed in any of the cases. The clinical results did not differ in terms of Harris hip score between the 2 and 5-year follow up.

Discussion: Small early migration followed by several years of a more stable fixation suggests favourable long-term results. Absence of acetabular granulomatas and detectable wear is also encouraging, but the early migration detected in most of the implants suggests various amounts or even complete fibrous fixation as documented in one of the cups. These findings indicate that the efficacy of the press-fit cups cannot be definitely established until long-term results are available.

62. Cemented vs uncemented socket in THA—a roentgen stereophotogrammetric study of 82 hips

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We compared the fixation of the cemented Charnley socket (CH) with the porous, uncemented Harris-Galante type I socket (HG) by using roentgen stereophotogrammetric analysis (RSA). A cemented Charnley stem was used in all cases.

Patients and methods: Series I was 21 patients with bilateral primary arthrosis (OA) that underwent one stage bilateral simultaneous THA. An HG socket was randomly allocated to either side; a CH socket was used in the contralateral hip. Tantalum markers were inserted into the pelvis and the sockets for subsequent RSA. The follow-up time was 27 (23–49) months. Series II was 60 patients with OA that underwent unilateral, primary THA. A random assignation to either a CH or an HG socket was made. Tantalum markers were implanted and subsequent RSA performed. The follow-up time was 24 months.

Results: No hip in either series has so far been revised. The clinical performance was equal in the two prosthetic groups. The RSA did not reveal any difference in the migration between the two prosthetic designs. The polyethylene liner of one of the HG sockets in series II proved to have rotated 18° within its metallic shell.

Conclusion: The early fixation of the HG sockets seems to compare with that of the CH sockets.

63. A technique for bone transplantation with impacted cancellous allograft in the proximal femur associated with uncemented revision

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Insufficient fixation with a high risk of further failure after simple re-cementation of the femoral component at revision has been clearly demonstrated in both experimental, radiographic and clinical studies. This has motivated uncemented revisions combined with bone transplantation in the proximal femur. An essential issue associated with this revision concept has been difficulties in achieving a stable initial fixation of the component. Lately a techique of impacting cancellous bone grafts associated with re-cementation of a short femoral component has been introduced with excellent short term result (1). This technique provides a very solid transplantation in the proximal femur demonstrated through a very rigid initial stability of the reamer before cementation of the component. Based on the assumption that recementation implies reproducing an essential element in the process of aseptic loosening, we have modified this grafting tecnique and developed a set of instruments to be used in association with uncemented revision with long stem prostheses.

The aims of this technique are

1) to avoid re-cementation in a femur that has previously demonstrated mechanical loosening with osteolysis after primary cementation.
2) to ensure an initial stability not only based on distal fixation in the isthmus and curvation of the stem, but also on a rigid grafting of proximal defects.
3) to benefit from overbridging weak parts of the femur with long stem prostheses, typically at the tip of the primary prosthesis.
4) to make grafting of defects in the diaphysis possible.
5) to restore bonestock as it has been demonstrated with the original technique associated with re-cementation.

Reference: Gie G A, Linder L, Ling R S M, Simon J-P, Slooff T J J H, Timperley A J. Impacted cancellous allografts and cement for revision total hip arthroplasty. J Bone Joint Surg (Br) 1993; 75(1): 15-21

64. Cementless hip revision arthroplasty A prospective five year follow-up

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Introduction: As a consequence of the relatively poor results of cemented hip revision arthroplasty we introduced the cementless AML Porous Coated femur stem for revision arthroplasty in 1986. Simultanously we started a prospective evaluation of the clinical and radiographic outcome of operations with this prosthesis. The five year follow-up evaluation is presented here.

Patients: 45 consecutive revision arthroplasties in 43 patients, 8 women and 35 men, were evaluated. The age at the time of surgery was 38–81 years, median 66. The type of the revised prosthesis were cemented Müller Straight Stem in 37 hips, cemented Charnley in 4, cemented Stanmore in 3 and cemented Lubinus in 1 hip. In 40 operations it was the first revision, in 4 the second and in 1 hip it was the third revision. In 19 operations the acetabular cup were revised as well as the femur stem in 26 operations only the femur stem were revised.

Methods: The clinical evaluation was performed according to the Harris Hip Score (HHS) system preoperatively, 6 and 12 months postoperatively and once a year there after. At each control anteroposterior radiographs were taken for evaluation of the adaptive bone remodeling. Radiographic loosening was defined by the presence of migration of more than 5 mm and by continuous radiolucent lines of more than 2 mm around the implant.

Results: At the five year follow-up 28 patients operated on in 30 hips were evaluable. 3 patients had died during the follow-up period, 4 patients were lost to follow-up and 8 femur stems were revised (1 due to peroperative fracture, 2 due to infection and 5 due to aseptic loosening). The median HHS was 82 at the 5 year follow-up. The result was good or excellent (HHS 80–100) in 17 hips (57%). 7 femur stems were definitely loose and of these 1 was scheduled for revision.

Conclusion: Our results of hip revision arthroplasty with the cementless AML Porous Coated femur stem are neither better nor worse than the majority of the reports of cemented hip revision arthroplasties.

65. Uncemented femoral revision combined with bone transplantation with impacted cancellous allografts

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From February 1991 to February 1994, 111 uncemented revisions of femoral components were performed using the Bi-Metric revision femoral components (long stem, 200–300 mm, titanium). The causes of revision were in most cases aseptic loosening (81) or deep infection (22). 80 revised components were cemented and 31 components uncemented. There were 77 first revisions, 21 second revisions and 13 third or more revisions. Quality of bone was graded according to Engh. 23 were grade 1, 48 grade 2 and 40 grade 3. In 18 of 23 cases of grade 1 bone grafting was performed using impacted cancellous allografts. Bone grafting was performed in all cases of grade 2 and grade 3.

Results: Furher revisions: 6 hips were revised again, two because of re-infection, one because of loose acetabular component, one because of fracture of the femoral shaft and two because of recurrent aseptic loosening of the femoral component. Clinical outcome after one year (36 hips): 23 were without pain, 5 sustained slight or mild occasional pain, 5 moderate pain and 3 severe pain. Average Harris Hip Score was 79 (59–100).

Clinical outcome after two years (14 hips): 8 were without pain, 5 sustained sligth or mild occasional pain, one severe pain. Average Harris Hip Score was 80 (38-100). Radiographic outcome after one year (36 hips): 30 were stable without subsidence, 6 had subsided 4–12 mm, one of which was estimated loose. Radiographic outcome after two years (14 hips): 3 had subsided 4–6 mm since one year control, 13 were stable.

Conclusion: These are early results and we cannot base any definite conclusions concerning the optimal concept of revision surgery on these findings, but we find that these preliminary results are satisfactory and that continued use of this revision procedure is justified.

65A. Clinical results after cemented and uncemented arthroplasty for coxarthrosis Prospective randomized comparison of 120 cases for 8–9 years

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The best means of fixation of the femoral and acetabular component are still a matter of controversy. The purpose of this study was to compare the results of a cemented and an uncemented THA.

Material and methods: Between January 1985 and April 1986 a prospective randomized study on the cemented Landos Titane and the uncemented Zweymüller/Endler polyethylene THA was carried out on 120 hips with arthrosis in the age group 56–72 years. Women/men ratio, age, body weight, right/left ratio, and clinical and radiographic assessment of the hip were similar in the two groups. All prostheses were inserted via the direct lateral approach by the same surgical team. The follow-up was carried out independently of the surgeons at 2–3 weeks, 4 months, 12 months and at subsequent annual visits.

Results: The mean operating time was significantly shorter in the uncemented group, whereas the operative blood losses were similar. One hip dislocated and one transient fibular paresis were seen in the cemented group. Two undisplaced proximal femoral fractures which had no consequence for the final result, were seen in the uncemented group. No deep infection occurred. The cemented group had better Merle d'Aubigné scores for pain and walking ability

than the uncemented group at all follow-ups. The difference reached a statistically significant level the first 2–3 years postoperatively. Midthigh pain was reported by 3 patients with uncemented prosthesis after 8 years. No femoral prosthesis in either group and no cemented acetabular prosthesis showed radiographic signs of loosening and none of these components have been exchanged. 10 uncemented acetabular prostheses had migrated after 8 years, 5 of them were reoperated and replaced by an uncemented hemispheric HA coated screw cup on average 67 (50–96) months after the primary operation. The femoral bone remodeling was reported in a previous study (Acta Orthop Scand 1993; 64 (4): 411–6).

Discussion: The clinical results with the two types of prosthesis are comparable after 8–9 years, but the revision rate of the uncemented polyethylene Endler acetabular prosthesis is unacceptably high and the cup can not be recommended. Both the cemented Landos Titane and the uncemented Zweymüller femoral prosthesis have excellent radiographic results 8–9 years after the operation.

Hip fractures

66. Epidemiology of hip fractures in Göteborg, Sweden 1940–1991

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The frequency of hip fractures has increased in the Western societies. This is in part due to an increase of the elderly in the populations, but also due to an increased risk. In the literature, some studies have shown a continous increase of the risk, while others have failed to do so (1).

Material: The fractures have been registered in manual operation room registers. The same source has been used during the studied years. The population data was provided for all years by the city authorities of Göteborg. The calculation of the age-specific risk was performed according to a Poisson model where the annual incidence was assumed to be a continous function of age and calendar time.

Results: The number of hip fractures in Göteborg, population 440,000, has increased from 104 fractures in 1940, 443 in 1965, 979 in 1985, 1057 in 1989, to 1041 in 1991. The incidence (per 1000) of hip fractures in 1991 in the population over 50 years of age was 2.5 in men and 6.2 in women. The test of time trend, or risk, showed a non-monotonous change during the years 1965–1991. Thus, there was an increase of the risk with 5.7% per year for men and 3.1% for women in the period 1965–75. In the period 1975-1985 there was a decrease of 2.1% per year for men and 4.6% for women. Finally, the risk increased with 8.0% per year for men and 4.4% for women during the period 1985–1991.

Conlusions: There is a non-monotonous increase of the incidence of hip fractures in Göteborg, Sweden. The change of the age-specific incidence, or risk, occurs stepwise. It is therefore possible to fail to detect the secular change if too short time periods are studied.

Reference: Obrandt K J, Bengner U, Johnell O, Nilson B E. Is there a secular change in the incidence of hip fractures? Calcif Tiss Int 1988; 44: 175–8.

67. Early outcome predictors in hip fracture

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Introduction: Elderly hip fracture patients use a large part of orthopedic ward resourses and rehabilitation facilities. Modern treatment focuses on shortening of length of stay in the acute orthopedic department and creating paths for early discharge to rehabilitation facilities.

Patients and methods: In 223 hip fracture patients over 64 years admitted from independent living, we assessed 3 explanatory variables (prefracture general medical condition (1), ADL-index (2), and cognitive state (3)) for each of the response variables (discharge to independent living, total hospital stay one year postfracture, and independent living at 1 year after the fracture).

Results: We found three prognostic groups based on the initial assessments:

Group	I	II	III
	Good/fair medical condition, lucid, and and being able to dress	Medical condition affecting rehabilitation, unable to dress, and cognitively impaired	All remaining patients
Fraction (%)	42	9	49
Mean age	79	85	81
Discharge to own home (%)	99	60	86
Stay in acute hospital (d)	12	21	19
Total hospital. 1 year (d)	23	194	83
Independent living at 1 year (%)	94	30	75

Conclusion: Stepwise discriminant analysis showed that ADL was a strong predictor and ADL-index has apparent face value. Age has a strong impact only in patients over 75. Therefore, the traditional definition of elderly at 65, used by, i e, Medicare and the DRG-system seems to be obsolete.

This algorithm can be used for creating treatment programs designed for optimal resourse allocation. It will make it possible to change the basis for reimbursment within the DRG-system. It also provides care givers with realistic goals for individual rehabilitation.

References:
1) Ceder L, Thorngren K G, Wallden B. Prognostic indicators and early home rehabilitation in elderly patients with hip fractures. Clin Orthop 1980: 173–184.
2) Katz S, Ford A B, Moskowitz R W, Jackson B A, Jaffe M W. Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychological function. J Am Med Ass 1963; 185: 94–99.
3) Pfeiffer E A. A short portable mental state questionnaire for the assessment of organic brain deficit in elderly patients. JAGS 1975; 23: 433–441.

68. The Swedish multicenter hip fracture study–influence of age

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A multicenter study of hip fractures in the elderly has been introduced in Sweden to compare different methods of surgery, mobilization and rehabilitation. Data concerning the hospital stay are, prospectively, registered on printed forms by the operating department. There is also a patient enquiry, which gives follow-up functional parameters at four months after the operation. Data are reported on disks through a special program for personal computers. The project started in 1988 and now covers two thirds of the Swedish hospitals. The data base now includes more than 30,000 cases.

Three fourths of the patients were women. Mean age at fracture was 78 years and half of the patients were living alone. Patients aged 60–69 years were in 86% living in own home and 4% in old people's home, whereas among patients aged 90–99 years 41% were living in own home and 43% in old peoples home. Thus, even at high age the majority of the patients were living in some type of independent living before the fracture.

The mean (median) hospitalization time for these two age groups was 14 (10) days and 21 (14) days, respectively, with a successive increase. However, patients aged 50–59 years had a mean (median) hospital time of 18 (9) days, indicating influence of other concomitant diseases. Of patients coming from own home aged 60–69 years 69% returned directly home from the operating department. For the age group 90–99 years the direct return home was 29%. For those coming from old people's home the direct return there was 57% and 53%, for these age groups, respectively.

The special graph showing daily changes in habitat for all patients showed a stabilized pattern around 30 days after the fracture for the age group 60–69 years. Then most patients had returned to their original habitat. For the age group 90–99 years this was found after around 60 days. The mortality after 4 months was considerably higher for those older patients, just over 20% versus 5%, and they consumed considerably more bed-days in the operating department. Economic calculations have been performed for the different age groups concerning costs for total treatment up to 4 months after the fracture.

69. Is there a relationship between bone mineral and fixation failure in femoral neck fractures?

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Introduction: Osteoporosis may have a role in early fixation failures of femoral neck fractures.

Patients and methods: 40 women and 9 men (median age 79 (61–97) years) were treated with closed reduction and randomized internal fixation (21 Richard's Hip Compression Screws and a parallel cancellous screw, or 28 double Olmed screws) for a recent femoral neck fracture and followed up for 3 months. 8 fractures were nondisplaced, 41 were displaced. Fracture reduction was graded as good, fair, or poor. 2-3 days post-injury, a single energy quantitative CT of the femoral condylar area was performed using a Philips Tomoscan 350 (Høiseth et al. 1991). The mean (SD) bone density was 212 (39) HU. The mean (SD) bone mass was 3815 (1684) HU x cm^3. The outcome was defined as normal (34 cases) or any type of disturbed healing (15 cases).

Results: In a discriminant analysis, the fracture type (p = 0.019), fracture reduction (p = 0.28), and type of screw (p = 0.023; two separate screws were superior) had prognostic importance, while the bone mineral had not.

Discussion: In a previous study (Alho et al. 1992), age was a negative factor in fracture healing suggesting a role for osteoporosis. The present material is too small to exclude such a role. However, it seems to be less than that of fracture type, fracture reduction, or type of implant.

References: Alho A et al. Acta Orthop Scand 1992; 63(6): 639. Høiseth A et al. Acta Radiol 1991; 32: 1.

70. Functional outcome after osteosynthesis or hemiarthroplasty for hip fracture—a prospective comparison

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The number of hip fractures in the elderly increases in many countries. It is important to optimize the treatment. These

patients consume great resources. Within a prospective multicenter study a total of 1 115 hip fracture patients were registered in Rotterdam (The Netherlands), Sundsvall and Lund (Sweden). The aim was to compare the effect of treatment on the outcome.

For cervical fracture hemiarthroplasty was the predominating treatment in Rotterdam (n=169), whereas osteosynthesis was used in Sundsvall (screws n =135) and Lund (hook pins n=148). The patients operated with these methods had similar background parameters with a mean age of 80 years, about half of them living alone and 80 percent coming from independent living. The mean (median) hospitalization time was 32 (20) days in Rotterdam, 16 (12) days in Sundsvall, and 17 (10) days in Lund. Discharge to independent living varied from 53 percent in Lund to 72 percent in Sundsvall. Functional outcome (walking ability and ADL capacity) was at 4 months similar in all groups, but at 2 weeks lower in Rotterdam. Mortality at 2 weeks/1 month/4 months was in Rotterdam 4/9/20, in Sundsvall 2/4/13, and in Lund 0/3/10 percent.

Trochanteric fractures were treated by screw-plate in Rotterdam (n=146) and Lund (n=78), and by Ender nails in Sundsvall (n=117). These patients had again similar background parameters. Mean (median) hospitalization time was in Rotterdam 39 (29) days, in Sundsvall 24 (15) days and in Lund 19 (11) days. Discharge to independent living varied from 41 percent in Lund to 57 percent in Sundsvall. Functional outcome was similar between the groups. Mortality at 2 weeks/1 month/4 months was in Rotterdam 2/6/14, in Sundsvall 6/12/19 and in Lund 12/12/18 percent.

Stepwise regression analysis recognized for various outcome parameters several significant predictors: prefracture functional status, city, rehabilitation policy and operation type being important ones.

The rehabilitation results are shown with special graphs giving the pattern of living in different types of habitat up to 4 months after the fracture. These are linked to economic calculations of the entire chain of treatment.

71. 300 cervical hip fractures treated with internal fixation and followed prospectively for 10 years

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In 1982–1983 we analyzed 300 cervical hip fractures with regard to their background factors. The mean age of the men was 76±11 years (n=84) and of the women 78±10 years (n=216). The fractures were treated with a single nail or three screws and re-examined regularly including roentgenograms after 1 week, 1, 3, 12, 24 months and finally after 10 years. Thirteen men and 51 women were alive after 10 years and their mean age at the time of the fracture was 68±10 and 70±10 years, respectively. The patients' ability to walk outdoors, need of home aid, walking aid, ability to climb stairs, standing on one leg, rising from a chair and mental status were compared with the preoperative status and after 1, 2 and 10 years. We also analyzed the pain at rest and the pain in motion of the affected hip. After 10 years 23/300 (8%) of the patients had had their implantat extracted. 62/300 (21%) had been reoperated on with a hip prosthesis and 109/300 were classified as failures (re-operation with prosthesis or late segmental collapse on the roentgenogram). Of the surviving patients (n=64) 10 years postoperatively, 19% had had their implants extracted, 36% were reoperated on with a prosthesis and 52% were failures. 46/64 who were initially classified as displaced cervical hip fractures and had survived for 10 years postoperatively had a failure rate of 29/46 (63%). 21/29 (72%) were classified as failures within 2 years postoperatively.

This study indicates again the need of an individual preoperative analysis with regard to the treatment of choice in displaced cervical hip fractures.

72. Multicentric randomized study on osteosynthesis of femoral neck fractures

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A meta-analysis of failure rates in femoral neck fractures including 106 studies revealed a failure rate of 33% non unions and 16% late segmental collapse within 3 years in femoral neck fractures treated with internal fixation (Keller et al., AAOOS 1993). These are numbers wich reflect the reallity also in Scandinavia. Several implants have been constructed in order to improve the results. The special feature with the lately developed Ullevaal Hip screw is equal shank and thread diameter of 7 mm. We present a multicentric study comparing internal fixation with 3 Ullevaal screw to 2 Olmed and 2 Tronzo screws.

It is a prospective, randomized study with follow-up at 3 months, 1 year and 2 years. The results are preliminary, the

Implant	Cases	Early healing disturbances	Reoperation within 3 months	Reoperated within 1 year	Reoperated within 2 years
Ullevaal	359	84 (23%)	36 (10%)	95 (27%)	112 (31%)
Olmed	244	72 (30%)	20 (8%)	56 (23%)	62 (25%)
Tronzo	132	28 (21%)	13 (10%)	34 (27%)	40 (30%)

two years follow-up will be completed in April 1994.

Early healing disturbances were defined as lost reduction, backing of screws >2mm, perforation of the head or failure due to infection within the first three months. Late segmental collapse was defined as healed fracture and radiographic signs of collapse of the femoral head. There were 161 men and 573 women, median age 77 (28–97) years, treated within 3 days after injury with internal screw fixation.

Results: The results are not significantly different. There are differences between the hospitals, Huddinge having better results for the Olmed screw and worse for the Ullevaal screw than Rogaland and Ullevaal.

Discussion: Several hip screw systems using 2 or 3 screws give similar results in a study with 2 years follow-up.

73. The Medoff sliding plate for hip fractures

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Introduction: A new concept in compression screw systems for use in high subtrochanteric and unstable intertrochanteric fractures was introduced 1991 by Medoff. His device allows sliding to occur in a direction parallel to the longitudinal axis of the femoral shaft but has also the option to slide in the direction of the femoral neck.

Patients and methods: The Medoff device was used in two prospective consecutive series consisting of 112 and 121 patients with a mean age of 81 years. In the first series only sliding along the femoral shaft was allowed and in the second also along the neck. Clinical and radiographic examinations were conducted at day 7, at 4 and 12 months, postoperatively.

Results: Series one: 99 intertrochanteric fractures – 8 technical failures; 13 subtrochanteric fractures – 0 technical failure.

Series two: 77 intertrochanteric fractures – 0 technical failure; 13 subtrochanteric fractures – 0 technical failure; at present 90 patients have been followed for 4 months.

Conclusion: We recommend sliding in both directions in intertrochanteric fractures in order to reduce the risk of screw penetration of the femoral head. Sliding only along the femoral shaft prevents medialisation of the femoral shaft in subtrochanteric fractures.

74. The Medoff sliding plate—a new method of treatment of trochanteric and subtrochanteric non-unions of the hip

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Introduction: Current methods of treatment for non-unions following trochanteric and subtrochanteric fractures of the hip are not always reliable. Fixation with a standard compression screw may compromise results by limiting impaction of the proximal and distal fragments along the non-union site.

Patients and methods: Four patients with symptomatic trochanteric non-unions following fracture were treated with a new technique, which combined fixation with an axial compression screw and a sliding plate along the femoral shaft with peripheral autogenous iliac bone graft. This implant allows vertical impaction of the non-union site both at the time of surgery, as well as dynamically postoperatively. In three patients, the non-union site was not opened, and existing medial offset of the fragments at the fracture site was left unchanged. Early weight-bearing was encouraged.

Results: Dynamic axial loading of the fracture site was observed postoperatively. All non-unions healed.

Conclusion: Based on the results in this limited series, this new technique appears to be a reliable method of treatment for these difficult injuries.

75. Gamma nailing versus CHS in inter- and subtrochanteric femoral fractures—a prospective randomized multicenter study

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Patients and methods: 912 patients were studied, 435 treated with gamma nailing, 477 with CHS. The two groups were comparable as to age, sex, walking function before fracture, risk of anesthesia and fracture types. Various parameters were investigated per- and postoperatively, and at 3 and 6 months follow up. There was a 11% loss of follow up at 3 months, and 21% at 6 months. There was a 16% rate of death during the observation period.

Results: There was no difference between the two groups regarding postoperative Hb, blood transfusions, length of hospitalization, postoperative infections, rate of deep venous thromboses, pulmonary emboli or rate of deaths. Average operative time was slightly longer in gamma nailing (60.9 vs 56.4 min; $p = 0.02$). The position of the sliding screw in the frontal plane was more central in the CHS group ($p = 0.0005$), in the lateral view no difference was seen between the groups. Number of peroperative problems and complications were significantly higher in gamma nailing (48/433 vs 19/472; $p = 0.00009$),the same was true for reoperations (29/429 vs 7/467; $p = 0.00001$). 17 of the reoperations after gamma nailing were due to diaphyseal frac-

tures. Additionally, 3 peroperative fractures had to be fixated. The total rate of complicating femoral fractures was 4.7 percent.

There was no difference between the groups regarding rate of fracture healing and malunions, walking function and need for stay in institutions 3 and 6 months postoperatively. An analysis of the fracture subgroups showed a tendency to a lower rate of healing at 3 months in the CHS-group, (p = 0.07). However at 6 months no difference was seen between the two groups. The rate of reoperations was significantly higher in gamma nailing compared to CHS both in stable intertrochanteric fractures (p = 0.02) and unstable fractures (p = 0.03). Also in subtrochanteric fractures reoperations were more frequent in the gamma nail group. However, only 98 patients with subtrochanteric fractures entered the study, and the difference between the two groups in rate of reoperations was not statistically significant. A comparison of the results in the second half of the study compared the first half showed improvement of the positioning of the sliding screw and reduction of the length of the operation in gamma nailing. However, rate of reoperations was not reduced.

Conclusions: Due to a significantly higher rate of peroperative problems complications and reoperations in particular complicating femoral fractures, gamma nailing can not be recommended as a standard procedure in intertrochanteric fractures. In subtrochanteric fractures gamma nailing may be an useful alternative to CHS. However, also in subtrochanteric fractures there is a risk of complicating femoral fractures following gamma nailing.

75A. The influence of hemarthros on the development of avascular necrosis after femoral neck fractures

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Introduction: Early aspiration of intracapsular hematoma has been said to increase intraosseous blood flow at the femoral head, preventing bone necrosis after femoral neck fractures. We analyzed the influence of the amount and the delay in aspiration of the hemarthros on the hemodynamics of the femoral blood flow and the development of femoral head necrosis.

Patients and methods: A consecutive series of 34 patients with femoral neck fractures (11 Garden I–II and 23 Garden III–IV) was included in a prospective study. Twenty patients were operated on within the first week after trauma and 14 within the second. The delay of surgery after trauma ranged from 4 to 18 days. Prior to surgery (mean 3 days after trauma), ^{99m}Tc-MDP scintimetry was performed in order to evaluate the status of vascularization of the femoral head. At the time of sugery, ICP was recorded before and after aspiration of the hemarthros. Results from scintimetry were evaluated with the head-to-head ratio. Patients were followed during 6 years for detection of avascular necrosis.

Results: The mean ICP in the antialgic physiologic position before and after aspiration was 44.4 mmHg and 37.4 mmHg respectively. The average amount of hemarthrosis aspirate was 1.3 (0–6) mL. The amount of aspirate and the subsequent decrease in ICP were higher in unstable than in stable fractures (1.7 vs 0.5 mL aspirated and 8.9 vs 3.2 mmHg ICP). There was a close correlation between the amount of aspirate and the decrease in ICP. The amount of aspirate was independent of the delay of aspiration, but the average decrease in ICP was significantly higher in cases aspirated within the second week after surgery. Segmental collapse of the femoral head due to avascular necrosis was detected in 6 cases, 3 with aspiration of the hemarthrosis in the first week and other 3 in the second week after trauma. The average preoperative ICP was higher in patients who developed femoral head necrosis (59.5 vs 41.3 mmHg). In these patients, the decrease in ICP after aspiration was significantly higher as compared to patients who did not develop necrosis (25.3 vs 3.1 mmHg). Patients with femoral head necrosis disclosed in the preoperative scintimetry a mean head-to-head ratio under risk values (0.67 vs 1.25). Preoperative scintimetry values were related to the intensity of the decrease in ICP after aspiration.

Conclusion: The severity of the postraumatic hemarthrosis and the delay in aspiration do not seem to influence the development of head necrosis after femoral neck fractures. Aspiration of the hemarthrosis induces a significant decrease in ICP only in cases with impaired vascularity of the femoral head according to the scintimetry assessment, and may be indicated only in these cases.

Anterior cruciate ligament

76. Mechanical properties of a reconstructed human anterior cruciate ligament eight months after insertion

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Introduction: The central third of the patellar tendon is used as af free graft to reconstruct the anterior cruciate ligament (ACL), but in animal studies the strength of the reconstructed ligament one year after insertion is only 20–60% of the contralateral ligament. Corresponding studies in humans have not been reported previously.

Material and methods: A reconstructed ACL and the contra-lateral normal ACL was evaluated mechanically in knee

preparations from a 37 year old male who died in an accident eight months after the operation. The knee preparations were mounted in a special fixture and the anterior-posterior displacement between the limits of ± 150 N was determined. Thereafter the reconstructed and the intact ACL was tested along the long axis of the ACL to failure.

Results: The anterior-posterior tibiofemoral displacements of the reconstructed knee was 86%, 69% and 26% greater than those of the normal joint at 10°, 30° and 60° of knee flexion respectively. The ultimate tensile strength of the reconstructed ACL was 87% and the linear stiffness was 90% of the contralateral normal ACL.

Conclusion: The strength of this reconstructed human ACL tested eight months after insertion was considerably higher than expected from data of corresponding animal experiments.

77. Laxity 3 years after reconstruction of the anterior cruciate ligament—a roentgen stereophotogrammetric analysis of 20 patients

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Introduction: It is generally agreed upon that long-term follow-up is required to assess the sagittal stability after anterior cruciate ligament reconstruction. We have used RSA to assess this stability after 3 years.

Methods: 20 consecutive patients with chronic anterior cruciate ligament deficiency were assessed before, 1 year and 3 years after ligament reconstruction with a free bone-tendon-bone graft from the patellar tendon. Roentgen stereophotogrammetric analysis (RSA) with tantalum markers implanted in the femur and in the tibia was used for assessment. The precision in measurements of total anterior-posterior displacement (±2 SD of differences between repeated measurements) was 2.2 mm.

Results: An increased displacement with increasing load was found before reconstruction but there were no differences between 50, 100 and 150 N stress load at measurements after 1 and 3 years. A decrease in total anterior-posterior displacement from 12.7 mm before reconstruction to 5.1 mm 1 year and 5.5 mm 3 years postoperatively, using a stress load of 150 N was found.

Discussion: The study showed that a definite end-point could be identified postoperatively. It is suggested that the preclusion of soft tissue deformation as a source of measurement errors may have added to analysis consistency. Moreover, the sagittal stability did not increase between the 1- and the 3-year follow-ups suggesting good function over prolonged periods of time.

78. What happens to the patellar ligament after anterior cruciate ligament reconstruction?

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Arthroscopic anterior cruciate ligament reconstruction, using the central part of the patellar ligament as a free (bone-ligament-bone) graft is a well established method. Although this method has been much used, little is known about what happens to the patellar ligament after the operation. The aim of this study was to evaluate the healing of the patellar ligament after anterior cruciate ligament reconstruction in a prospective, randomized, double-blind study with an unbiased observer.

Material and method: This study includes 37 patients, 22 men and 15 women, with a mean age of 25 (17–32) years. All patients were operated with arthroscopic anterior cruciate ligament reconstruction, using a two-incision method (outside-in technique) and interference screws at both ends. The patients were randomized into two groups. (I) suture of the defect in the patellar ligament and bone transplantation to the patella (n=17), and (II) no suture or bone transplantation (n=20). Evaluation of the patellar ligament, including healing of the defect in the ligament was performed one year post-operatively using ultrasonography.

Results: Patients in both groups had hypertrophy of the residual patellar ligament one year after the operation, the remaining parts of the ligament had increased in thickness as a compensatory response after the grafting procedure. In group I there were signs of complete healing of the patellar ligament in 10/17, partial healing in 2/17 and diastasis (no healing) in 5/17 patients. In group II there were signs of complete healing in 7/20, partial healing in 10/20 and diastasis (no healing) in 3/20 patients. No complications, such as total rupture of the patellar ligament were seen.

Conclusion: Almost all patients showed signs of hypertrophy of the residual patellar ligament at one year after the operation, regardless of suture of the defect in the ligament or not. In patients, where suture of the ligament had been performed complete healing was found in 10/17, and in patients where no suture of the defect had been performed there was complete healing of the ligament in 7/20. This study did not reveal any significant differences between these two groups.

79. Anterior cruciate ligament strength during quadriceps contraction—an in vivo study in the rat

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Introduction: The quadriceps-patellar tendon force can be resolved into two components, a normal component that is perpendicular to the tibial plateau and a shear component that is parallel to the tibial plateau1. The aim of this study was to determine their contribution to the separation strength of the anterior cruciate ligament (ACL).

Methods: 20 Wistar rats of median 436 (388–490) g b.w. were used. In both knees the joint capsule and ligaments except the ACL were divided and the menisci resected using a stereomicroscope. In 10 of the rats the ACL of the right knee was loaded in tension to failure by femorotibial distraction. In the other 10 it was loaded during anterior tibial translation. The loading rate was 2.5 mm/sec. (60%/sec). At the instant of loading, quadriceps contraction was induced by electrical stimulation of the femoral nerve. The ACL of the left knees was loaded correspondingly with unstimulated muscles as control. The knee flexion angle was 60 degrees.

Results: All the ACLs failed in the ligament substance. During testing in tension by femorotibial distraction, the ultimate tensile load during muscle contraction was 140% higher than tested with relaxed muscles 374% more energy was absorbed until failure of the ACL during muscle contraction. Both the linear stiffness and the deformation increased by 59%. During testing by anterior tibial translation with and without quadriceps contraction, no differences in the structural ACL properties were found.

Conclusion: At 60° of knee flexion quadriceps contraction increased the structural strength of the ACL during loading in tension but not during anterior tibial translation.

Reference: O'Connor J, Shercliff T, FitzPatrick D, Biden E, Goodfellow J. Mechanics of the knee. In: Knee ligaments: Structure, function, injury and repair (Eds. D M Daniel, W H Akeson and J J O'Connor). Raven Press, New York 1990: 201-237.

80. Anterior cruciate ligament strength Can it be estimated by non-destructive tests?

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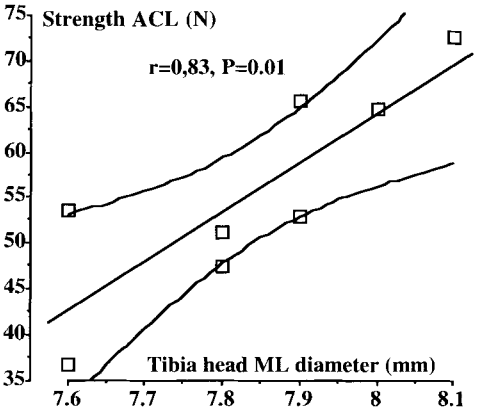
Rupture of the anterior cruciate ligament (ACL) constitutes 15% of all injuries in alpine skiing. For structural and material bone strength non-destructive tests exist, while no such tests have been developed for ligaments. In alpine skiing it is possible that release bindings protecting the ACL can be developed, in which case it is important to be able to estimate the strength of the ACL, and thereby the release setting. In this study two different methods have been evaluated for estimation of rupture strength of the ACL.

Materials and methods: ACL was tested in tension to rupture with the knee held in 60° flexion in 8 male Wistar rats (423 g ±7). Loading rate was 2.5 mm/s. Tibial head diameter in frontal (ML) and sagittal planes (AP) was measured with calipers, and bone mineral content (BMC-g) of the entire tibia was measured by "dual energy x-ray absorptiometry" (DXA). Comparisons were made by simple linear regression analysis.

Results: We observed ligamentous mode of failure in all tested knees. The correlation between ACL strength and tibial head diameters was $r = 0.83$ (ML) (Fig) and $r = 0.76$ (AP)($p < 0.03$). Calculating the tibial head area as an ellipse gave $r = 0.93$ ($p < 0.01$).The correlation between ACL strength and BMC was $r = 0.65$ ($p = 0.08$). ACL strength was not correlated to body weight ($r = 0.24$).



Discussion: Frontal tibia head diameter (ML) is used for setting of alpine release bindings as it is known that it correlates with fracture strength of the tibia (1). This can also become a method for estimating the ACL strength, but needs verification in human specimen.

Conclusion: ACL strength is highly correlated to the tibial head diameter.

Reference: Asang E. Experimental biomechanics of the human leg. Orth Clin North Am 1976; 7: 63–73.

Scandinavian Orthopedic Research Society

81. Hydroxyapatite particles stimulate interleukin 1ß production in mononuclear cells from postmenopausal women

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Hydroxyapatite (HA) ceramic coating looks promising for uncemented fixation of prostheses [1]. In vitro studies have found that HA is relatively inert [2], but a foreign body reaction to HA particles has been found in vivo [3]. In the present study mononuclear cells from postmenopausal women were cultured in the presence of HA particles.

Material and methods: Mononuclear cells were purified from the peripheral blood of 20 postmenopausal women and cultured in a serumfree medium with or without HA particles (size: 1–50µm). After 48 hours, the cultured cells were examined microscopically, and supernatants were analyzed for IL-1ß content by ELISA.

Results: The adherent monocytes in HA-treated cultures were elongated and spindle- shaped, while untreated monocytes were round and smaller. Cells adhered to the HA particles, and HA was also found intracellularly in monocytes. IL-1ß concentration was 5.6±5.2 ng/mL in controls compared to 22.3±15.1 ng/mL in HA cultures ($p < 0.0001$).

Discussion: A previous study with mixed lymphocytes found HA to be relatively inert [2], but the particles used were larger than 15 µm and no HA was found intracellularly. We found that monocytes were able to phagocytose the smaller particles, and judged by their morphological appearance and IL-1ß production, they were activated by the HA. Since HA may be degraded by the cells, it is possible that such a stimulatory effect is a transient phenomenon in contrast to stimulation by other types of prosthetic debris.

Conclusion: HA particles stimulated mononuclear cells in vitro, demonstrated by a 4-fold increase of IL-1ß production and an altered monocyte morphology.

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82. The plasminogen activation system in loosening of total hip prostheses

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The biological factors in aseptic loosening of total hip replacements (THR) include cells of the monocyte/macrophage line and fibroblasts, mediators such as cytokines and prostaglandins and collagenase, gelatinase and other proteinases (1, 2). Proteinases directly responsible for the tissue destruction have been localized in the periprosthetic tissues. Proteinases are secreted inactive, and need activation. The activation of proteinases and focalization of the tissue destruction is not clearly understood. In the present study we have investigated the presence of plasminogen activators (uPA and tPA) and PA inhibitors (PAI-1 and 2) as well as uPA receptor. The uPA/uPAR/PAI systems are thought to constitute the main activator and focalizator system of extracellular matrix degradation in vivo.

Material and methods: Interface membranes and pseudocapsules from eleven loose THRs (eleven patients) were used for tissue extract analyses (ELISA), and from six of these patients the immunolocalization was determined. Control samples, for tissue extracts, were taken from the synovium during arthroscopy of eight knees with meniscal rupture or no visible pathology.

Results: uPA antigen level in the periprosthetic tissues was 18.1 ng/mL in the interface and 15.3 ng/mL in the pseudocapsule compared to 4.9 ng/mL in the controls ($p < 0.001$). tPA concentration was 66 ng/mL in the controls compared to 22.2 ng/mL in the interfaces and 28.7 ng/mL in the pseudocapsules ($p < 0.001$). PAI-1 was not detected in the controls, compared to 77.5 ng/mL in the interfaces and 81.1 ng/mL in the pseudocapsules ($p < 0.001$). PAI-2 was 4.5 ng/ml in the periprosthetic tissues, not significantly different from the 3 ng/mL in the controls. Immunohistochemical localization in periprosthetic tissues of uPA, uPAR and tPA disclosed localization in CD68 positive macrophage rich areas in cells with phagocytozed metal, polyethylene and/or cement particles. uPA staining was also found in connection with pieces of necrotic bone. PAI-1 staining was found in the same areas that stained for uPA or tPA, but PAI-1 positive staining was also found outside this areas.

Discussion: These findings are compatible with the hypothesis that the plasminogen activation system is responsible for activation and focalization of extracellular matrix degradation in periprosthetic tissues. The level of PAs and PAI-1 were significantly different from control

samples, and the differences in uPA/tPA/PAI-1 content were similar to those found between other highly destructive tissues (carcinomas) and their normal counterparts. The expression of uPA, uPAR, tPA and PAI-1 by macrophage-like cells containing phagocytozed material suggests undegradable microdebris as possible initiating and perpetuating stimulus for a proteolytic activation cascade leading to loosening of the prosthesis.

83. Calcitonin gene-related peptide is a potent vasodilator in bone

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Calcitonin gene-related peptide (CGRP) acts as a neuropeptide in both the central and the peripheral sensory nervous system. Nerves containing CGRP have been demonstrated in bone most abundantly at the osteochondral junction of epiphyseal growth plates (1), but CGRP has also a certain calcitonin-like effect on bone resorption.

Purpose: The purpose of this investigation was to study the in vivo hemodynamic effects of CGRP alone and in combination with the sympathetic nerve transmitters noradrenaline (NA) and neuropeptide Y (NPY) in bone by intra-arterial infusion into the tibial nutrient artery (TNA).

Materials and methods: Sixteen landrace pigs, 55–62 kg. TNA of one tibia was catheterized and supplied with blood at constant rate from the left carotid artery. Tibial bone perfusion pressure (BPP), intraosseous pressure (IOP), and central pressures were recorded (2).

Calcitonin gene-related peptide. The vasoactive effect of CGRP (range 10^{-10}–10^{-6} M) was determined by stepwise infusion into the TNA (n=9).

Interaction between CGRP and sympathetic transmitters. Increasing concentrations of CGRP were added cumulatively (range 10^{-9}–10^{-6} M) to the tibial bone vascular bed preconstricted by continuous infusion into the TNA of 10^{-6} M NA or 10^{-7} M NPY in random sequence (n=7). Data were analyzed with ANOVA and paired t-tests.

Results: The intraosseous vascular system at basal tone and preconstricted with either NA or NPY exhibited dose-dependent vasorelaxation to CGRP infusion, since the tibial BPP decreased significantly in all three experiments by increasing concentrations of CGRP (ANOVA, $p < 0.001$). BPP decreased significantly at a threshold level of 10^{-9} M CGRP in bone with basal vascular tone ($p < 0.01$) as well as in the experiments employing preconstriction with NA ($p < 0.01$) and NPY ($p < 0.01$). The maximal relaxing effect of CGRP was observed in all studies at 10^{-6} M, at which concentration the increase in BPP elicited by NA and NPY infusion was completely abolished. However, the relative vasodilation obtained with CGRP in experiments with preconstriction did not differ from that observed with basal vascular tone.

Conclusion and discussion: CGRP induced concentration dependent vasodilation in porcine bone in vivo. Intraarterial infusion of CGRP abolished the vasoconstriction elicited by infusion of NA and NPY in bone, which suggests an important role of CGRP in neurogenic vasoregulation of the bone vascular bed. It is tempting to speculate that local neurosecretion of CGRP plays an integrating role coordinating osteoclast activity and vascular function in bone.

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84. Bone mineral mass as a predictor of hip fracture and the following complications

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Introduction: Earlier retrospective bone mass studies have shown small differences between hip fracture patients and normals. These studies are biased in that some patients already have died at the time of measurement. Other studies have shown a good predictive value of bone mineral measurements for fractures. To avoid selection bias we measured our patients within 10 days after the fracture. We followed the group in order to see if postoperative mortality or postoperative complications, could be predicted by early bone mass measurements.

Material: Included in the study were 102 consecutive hip fracture patients, 31 men, mean age 74 (27–89) and 71 women, mean age 79 (57–97). All patients were operated on within 3 days. The follow-up included dual x-ray absorptiometry (DEXA) measuring bone mineral density and body composition, clinical and radiographic examination. The follow-up was undertaken within 10 days after the fracture and after 4, 12 and 24 months. Data were compared with 190 controls, 85 men and 105 women matched for age.

Results: We found lower bone mass and lower body weight in both men and women when comparing hip fracture patients with controls. Women with trochanteric hip fractures had lower bone mass in their spine and hip as compared to those with cervical fractures. Women with trochanteric fractures also had lower bone mass in the fractured hip as compared to the uninjured side. No such difference was found in men. When comparing healed fractures vs failed (late segmental collaps or nonunion) we found among the failures lower weight in men and lower lean body mass in women. Women with failures also lost more fat and more

bone mass in the cortical area in the femoral neck. Men who died within 2 years lost more lean body mass, and women lost more bone mass and fat.

Conclusions: It seems possible that bone mass measurements together with a clinical evaluation may predict hip fractures, postoperative complications and mortality following a fracture.

85. Determinants of bone mass in women

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The purpose of this population-based study was to evaluate the influence of muscle strength and other function variables on bone mass and to examine the influence of age.

Material and methods: During one year a population-based study was carried out simultaneously in the city of Malmö (an urban area) and the municipality of Sjöbo (a rural area with lower fracture incidence). Invited were women of Scandinavian ethnic background, born in 1908, 1918, 1928, 1938 and in 1948. Bone mineral content (BMC) of both forearms was measured with single photon absorptiometry (SPA) at a distance of 1 cm (BMC 1) and 6 cm (BMC 6) from the tip of the styloid process of the ulna. The muscle strength was measured with the Cybex II machine testing knee flexion and extension force. Balance, walking speed, forced expiratory volume, weight and lean body mass were also recorded.

Results: The results for both study populations were pooled and divided into quartiles for each age group and the mean BMC was calculated for each quartile and the lowest quartiles were compared with the highest. There was a significant positive relationship between knee flexion and extension force and BMC in women 70 and 80 years old. Flexion and extension force were positively correlated with balance in the elderly. Weight and lean body mass correlated with BMC in those 60 and 70 years old.

Discussion: Muscle strength seems to have an important influence on two factors in fracture etiology - balance and bone mass. Maybe public awareness of this fact will lead to an increased physical activity throughout life.

86. What happens with physically acquired high bone mass after reduced activity?

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Introduction: We have earlier found that competitional weight lifters have a significant increase of their bone mineral density compared with controls. Ten years after cessation of exercise a significant bone mineral difference remained. These findings raised the question whether an increased bone mineral density attained by exercise during the first part of life persists also at an old age.

Material: Included in this retrospective cross-sectional study were 48 former nationally or internationally ranked male weight lifters with mean age 64 (50–79) years. Fifty-three age and sex-matched non-weight lifters served as controls. The former weight lifters had when they were young been on an exercise programme for on an average 13 (1–34) years. The time elapsed from cessation of the intense active exercise to the follow-up examination was on an average 30 (7–50) years. Bone mass, lean body mass and fat content were measured with a Lunar DEXA technique (dual x-ray absorptiometry).

Results: There was less bone mass with increasing age in all regions in both ex-lifters and controls. Former weight lifters, <65 years of age, had higher BMD in the spine and total body compared with their controls. In former lifters >65 years of age this bone mass difference had disappeared. No difference was found comparing lean body mass or fat content. We found no bone mass difference only in one region, the skull. This is virtually the only region not affected by weight bearing activity. This indicates that the higher bone mass in active and younger ex-lifters is due to higher physical activity and not to a genetically acquired higher bone mass in the group of weight lifters.

Conclusions: We have in this cross-sectional study shown that an increase of peak bone mass due to high physical activity does not necessarily lead to a life long persistance of supernormal bone mineral density.

87. Vertebral deformation and spinal bone mass

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The European Vertebral Osteoporosis Study includes thousands of population-based subjects studied by a life-style interview, a fracture follow-up and a spine roentgen study. The data are so far not released for publication but some methodological observations in our own sample, 600 population based men and women from Malmö over the age of 50, may be presented.

Methods: The spine configuration was estimated by visual analysis by an experienced radiologist and measurements of deformation based on the corner and end-plate midpoints. The bone mineral content of the spine was measured by the method of Lunar DPX absorbation technique in total body, trunk, spine, pelvis, legs, head and arms plus whole body fat and lean content.

Results and conclusion: Only if the deformation was considerable, deviated >4 SD from normal, was the detection rate the same as for the radiologist, i.e., a considerable radiological deformation of the spine might occur before it is

detected. Scheuermann deformity was fairly common and interferred with roentgen morphometric measurements but only if the less severe criteria were used.

The bone mineral measurement values were correlated with deformation—more deformation, less bone mineral mass in the spine. When correcting for age, the relationship was, however, less obvious and hardly significant. Of the total variation of spine deformation in women, the bone mineral content variation could explain about 20%. Women with vertebral deformation had—even after age correction—low total body fat.

88. Can bone mineral bone mineral density predict fractures in different age groups and measuring sites?

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The outcome of some studies is that bone mineral density (BMD) predicts the risk of fracture in women ≥ age 75. In the Study of Osteoporotic Fractures 9,704 women ≥ age 65 were recruited. In the base-line examination bone mineral content (BMC) and BMD were measured distally and proximally in the radius and the calcaneus using single photon absorptiometry. BMC and BMD of the hip and AP spine were measured in 8,134 women using dual roentgen absorptiometry. The participants were followed for on an average 4.9 years after the measurements of appendicular bone density and 2.6 years after measurement of hip and spine density. Reported fractures were confirmed by obtaining copies of roentgen reports and—for hip fractures—copies of the radiograms. History of falls, strength, balance and gait were assessed at baseline.

Results: The risk of fracture with a 1 SD decrease in BMD was determined using proportional hazard analysis, adjusting for age, falls, strength, balance and gait. There was a total of 1,552 non-spine fractures. For all non-spine fractures the risk associated with each 1 SD decrease in bone mass was approximately the same for all measuring sites and in all ages—1.4–1.6. For proximal femur fracture the BMD at the hip had a higher relative risk (2.1–3.0) in all age groups.

Conclusion: BMD is a strong predictor of all non-spine fractures, particularly wrist, proximal humerus and hip fractures in women of all age groups, with no apparent decrease in relative risk in the oldest women. The results were similar for other combinations of fracture and BMD measuring sites. Preservation of bone mass in women ≥ 75 may be an effective approach to prevention of fractures in this age group.

89. Bone remodelling in the proximal tibia following uncemented total knee arthroplasty

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In 25 patients treated by unilateral uncemented TKA (PCA Modular) because of primary osteoarthrosis of the knee, BMD-measurement (DPA, Gammatec GT-50) in the proximal tibia was performed postoperatively and with follow-up after 1/2, 1 and 2 years. 3 areas of interest around the medial and 3 areas around the lateral fixation peg were selected for BMD-measurements. The patients were divided into subgroups based on pre- and postoperative alignment of the knee. The patients (n=12) with varus malalignment preoperatively corrected to valgus or neutral alignment showed a progressive fall in BMD in all medial areas; significant after 1/2 year and reaching 19–39% after 2 years. In the areas below and lateral to the lateral peg a significant increase in BMD of 10–15% after 1/2 year was found, but after 1 year BMD was back to the initial value. After 2 years the BMD-value lateral to the peg had decreased, while the value below the peg was unchanged.

When the results from all patients with a change in knee alignment (n=23) were calculated, we found the same pattern of bone remodelling with a decrease in BMD in the tibial condyle less loaded post-operatively and a temporary increase in BMD in the condyle where load was increased. Realignment of the knee joint during TKA causes significant bone remodelling in the proximal tibia closely related to the change in knee alignment.

90. Bone remodelling in the proximal tibia following partial and total medial meniscectomy

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Introduction: Following a medial meniscectomy the area of load-bearing is reduced and the stress acting across the medial part of the knee joint is increased.

Material and methods: 33 patients totally (n=19) or partially (n=14) meniscectomized (medial) by open joint surgery 12 years earlier were included in the study. Bone mineral density (BMD) was measured by dual photon absorptiometry in the proximal tibia of the meniscectomized legs and the healthy contralateral legs. The two areas of maximal density medially and laterally in the compact bone of the subchrondral plates and two areas centrally in the medial and lateral part of the subchrondral trabecular bone were selected for the BMD-measurements.

Results: The table shows the percentage difference between BMD in the meniscectomized legs and the healthy legs. P-values are given in brackets (nonparametric test a.m. Wilcoxon).

	Total meniscectomy		Partial meniscect.	
Trabecular bone				
BMD(medial)	1.0%	(0.59)	7.7%	(0.01)
BMD(lateral)	−6.5%	(0.002)	−2.7%	(0.12)
Cortical bone				
BMD(medial)	7.3%	(0.002)	6.7%	(0.04)
BMD(lateral)	−2.3%	(0.43)	−2.6%	(0.20)

Conclusion: The bone remodelling seen in the proximal tibia following medial meniscectomy was basicly identical in total and partial meniscectomy and thus indicating that following a partial meniscectomy normal knee function could not be restored.

91. Prediction of fragility fractures in women using forearm bone densitometry. A longitudinal study over 17 years

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Introduction: A previous longitudinal study of forearm BMC fracture prediction has now been extended to cover 17 years.

Material and methods: In 1970–1976, forearm BMC was measured in 1,076 women using 245Am single photon absorptiometry. A predominantly trabecular area was measured in the wrist and a cortical in the shafts. In 1975–1991, all fractures in these subjects were recorded.

Results: 427 women <70 years at the entry measurements were still living in the city—153 had sustained a fragility fracture. The fracture group had a significantly lower initial BMC compared with those who did not have a fracture. In the age group 30–39 the fracture group had significantly lower values in the cortical site, in age group 40–49 in the trabecular site, in age group 50–59 in both cortical and trabecular sites and in age group 60–69 only in the cortical site. The odds ratio in the age group 50–59 between the lowest and the highest quartiles was 3.9 for the trabecular site and 3.3 for the cortical site. No significant differences between quartiles were found in other age groups. Those in the lower quartile in age group 50–59 had a fourfold risk of sustaining a vertebral fracture and in age group 60–69 a more than sevenfold risk to sustain a hip fracture.

Conclusion: In this 17-year longitudinal study, BMC had a predictive value for fragility fractures even premenopausally. A bone mass measurement in the age group 50–59 gave a good prediction of future fragility fracture risk in the postmenopausal decades whereas a measurement in age group 60–69 has a lower predictive power, supporting our previous suggestion that screening should be undertaken close to menopause.

92. Survival of reinfused shed erythrocytes after knee arthroplasty

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Introduction: Evaluation of the clinical effect of autologous transfusions (AT) is often based only on the need for supplementary homologous transfusions (HT). The need, if any, for (HT) is however multifactorially dependant and gives no information about the quality of the autotransfused red blood cells (RBCs). To assess whether the life span of RBCs, collected from surgical drains following surgery of the knee, was affected by the procedure of AT, we determined the long-term survival of ^{51}Cr-labeled autologous RBCs.

Materials and methods: Ten patients with primary arthrosis of the knee had unilateral, non-cemented, total knee arthroplasty (AGC 2000) and were postoperatively connected to the Constavac TM-autotransfusion unit (Stryker Instruments), which is a closed, autologous blood recovery system, that allows postoperative collection, filtering and reinfusion of unwashed shed blood. Shed blood was collected for six hours postoperatively and reinfused within the following two hours. Immediately before reinfusion, 18mL of the shed blood were aspirated from the system and radiolabeled with ^{51}Cr. AT of the shed blood was performed and the ^{51}Cr-labeled RBCs were reinfused towards the end of the autotransfusion. Subsequent venous blood samples were drawn after 20 minutes (baseline) and repeated three times weekly until 50% activity of ^{51}Cr was reached, followed by samples drawn weekly until less than 33% activity remained in the blood (minimum 40 days postoperatively). The time until 50% activity of ^{51}Cr in blood (corrected for physical decay, but not for elution) was determined by monoexponential fitting.

Results: The time from 100% activity to 50% activity (T_{50}Cr) was 22 days.

Conclusion: T_{50}Cr for autotransfused erythrocytes from unwashed shed blood is equal to T_{50}Cr for banked autologous blood (1), suggesting equal long-term survival, but both are slightly shorter than the normal values of 25–33 days reported for autologous RBCs(2).

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93. Preoperative autologous donation of 6 units of blood during r-EPO treatment in hip joint replacement

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Thirty patients (53–70 years of age), scheduled for revision hip arthroplasty, were treated with r-Epo (Recormon) s.c. during 2 weeks before the first blood donation, and until the day before operation, 6 weeks in total. Blood was donated twice weekly from the third week, 6 times in total.

The study was designed as a comparison between 2 doses of r-Epo, 180 and 360 U/kg/week s.c. respectively. After the first 20 patients only the lower dose was given. The safety limit for donation was 105 g/L.

Results: Six units could be donated by 28/30 patients, 5 units by 2. The Hb level fell from an initial level of 143 ±13 to 128 ±16 g/L the day before operation (range 106–175). 28/30 patients were operated, and 24 of these were only given homologous blood. In 4 patients allogenic blood was added (range 2–8 units). A mean of 3,4 donated units were utilized (57%)

Conclusion: Epo treatment with 180 U/kg/week s.c. during 6 weeks allows blood donation of 6 units preoperatively for most patients, with a mean Hb decrease of only 15 g/L. Autologous blood only was given to 86% of the patients.

94. Fibrinolysis and fibrinolytic inhibition during scoliosis surgery—a method to reduce blood loss?

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Introduction: Blood loss in scoliosis surgery can be considerable. We analysed coagulation and fibrinolysis factors during and after scoliosis surgery in order to investigate possible disturbances in these systems. As a result of our findings, tranexamic acid (Cyklokapron®) was given in order to decrease blood loss.

Patients: In 14 scoliosis patients, coagulation and fibrinolysis was measured before and at intervals during and after operation with posterior fusion and instrumentation according to Harrington. In accordance with these results, a second group of 14 consecutive patients received tranexamic acid 10 mg/kg body weight i.v. immediately before the operation. The dose was repeated after two and six hours.

Results: Most coagulation factors varied with the pronounced hemodilution during surgery, parallel to the variation in hematocrite. Towards the end of the operation, there was a tendency of increased fibrinolysis with elevations in D-dimeres and fibrinogen degradation products. Fibrinolytic activity was high in blood from the wound and drains.

The total blood loss was 2740 ml in the first 14 patients that had not received profylactic tranexamic acid vs 1960 ml in the tranexam group ($p < 0.02$).

Conclusion: In a study of 28 scoliosis operations there were signs of increased fibrinolysis towards the end of, and the nearest hours after operation. In those patients that received tranexamic acid during operation, the blood loss was 800 mL less than in the controls.

95. Ultrastructural changes in primary osteoarthrosis in guinea-pigs

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We studied articular cartilage in spontaneous osteoarthrosis (OA) in Duncan-Hartley guinea pigs. At one year of age they develop fibrillation and cartilage destruction, resembling the human disease. According to one theory, collagen fatigue is a pathogenetic factor in early OA. We therefore investigated whether the gross and light microscopic changes were accompanied by ultrastructural collagen II changes.

Materials and methods: Articular cartilage from load-bearing areas of the medial and lateral tibial condyles from adult and middle aged (6 and 12 months) male Duncan-Hartley guinea pigs (n=4) were processed for electron microscope. Interterritorial matrix compartments in the upper and lower radial zone were examined and collagen volume density and surface density estimated according to stereological principles. Fibril diameters were measured by an particle size analyser.

Results and discussion: All animals get early OA changes at one year, predominantly on the medial side; the lateral side may therefore serve as an internal control. Collagen volume density decreased in the medial, osteoarthrotic cartilage, but remained unchanged on the lateral side. There were no major differences between OA cartilage and non-OA cartilage in fibril diameters or surface density, but it appears to be a change in fibril diameter distribution with age, with an increased fraction of small-sized fibrils. Data are shown in Table I.

Table 1. Mean *SD*

	6 months		12 months	
Medial condyle				
Volume density	0.86	*0.01*	0.79	*0.03*
Surface density	2.61	*0.13*	2.74	*0.28*
Fibril diameter (nm)	81.9	*12.0*	67.9	*7.4*
Lateral condyle				
Volume density	0.90	*0.02*	0.88	*0.03*
Surface density	2.51	*0.08*	2.70	*0.22*
Fibril diameter (nm)	80.8	*8.5*	70.2	*8.4*

A characteristic feature of late OA is an increase in fibril diameter, but this does not seem to be a conspicuous feature in early OA. Rather, a decreased variation in fibril diameter in the middle aged animals was found. In spite of pronounced light microscopic fibrillation and destruction of the OA-cartilage, there were only moderate changes of volume densities. These figures, however, represent statistical averages from numerous samples—focal changes are diluted. The distension of the collagen network e g, tissue swelling, may be due to changes in molecular interactions, involving matrix proteins not detected by the present method. Further immunocytochemical investigations are therefore warranted.

96. Bone biopsy—a diagnostic tool for evaluation of metabolic bone disease

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Introduction: In the 1960s with the introduction of plastic embedding material and heavy duty microtomes it became possible to examine bone tissue without prior decalcification. Since then histologic examination of bone has become an essential part for precise diagnosis of metabolic bone disease. Iliac creast bone biopsies can be performed in outpatients under local anesthesia. Analysis of undecalcified bone samples is the only way to ascertain whether a patient has osteomalacia or not.

Material and method: This is a review of the more than 1,000 bone biopsy analyses performed for clinical reasons at our laboratory. We give figure estimates of not only the bone volume, osteoid tissue, resorption surfaces but also estimations of apposition rate after in vivo labelling with tetracycline.

Results: The partition between osteomalacia and osteoporosis is a continuum. In this clinical material representing suspicion of all kinds of metabolic bone disease, a gross estimate of the percentage of individuals with osteomalacia is about 10%. Apart from identifying cases with osteomalacia, this technique has been helpful in identifying other metabolic bone diseases such as hyperparathyroidism or renal osteodystrophy.

Conclusion: Especially in young individuals with unexplained susceptibility of fragility fractures or low bone mass a bone biopsy is indicated. As the treatment of osteomalacia often is lifelong, objective bone biopsy findings should be of value.

97. Osteoarthrosis and late growth

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In order to examine the hypothesis that late growth of the subchondral bone may be one cause of coxarthrosis, pelvic roentgen films of patients born between 1901 and 1972 taken during 1990-1992 were studied. All the examinations had been performed in a private radiologic department in Malmö using same roentgen equipment with constant exposure techniques. Roentgen films showing osteoarthrosis, hip fractures or other obvious pathology were discarded. Films from 108 women and 100 men in three age groups—18–39, 40–59, and >60—were measured. The center and five radii of each femoral head were determined and also the width of the acetabulum, of the femoral neck and the superior cartilage height. Also external and internal transversal pelvic diameters and a distal sacral width were included deducting senile bone outgrowths and osteophytes.

Results: Most of the measured structures increased significantly with age, the femoral head, the acetabulum, the femoral neck in women, the pelvic diameters, and the sacral width in men. The change in cartilage height was not significant, but men in the age 50–70 had higher cartilage.

Conclusions: The findings suggest that growth of the skeleton and the cartilage may occur in adult people. The occurrence of growth factors in bone tissue in general and the still active subchondral growth zones, especially in elderly, plus the weight bearing might explain why five per cent of the population get coxarthrosis The abnormal growth might cause incongruities between the cartilage and the underlying bone, and cartilage which is growing due to the presence of active growth factors is under risk to be sqeezed or poorly nourished.

98. Indomethacin increases the development of osteoporosis in oophorectomized rats on a low calcium diet

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Introduction: In rats oophorectomy and a low calcium diet leads to development of a cortical and trabecular osteoporosis within seven weeks (1). Prostaglandin E_2 is known to stimulate bone resorption and formation. We have investigated the effects of the prostaglandin-inhibitor, indomethacin, on the development of osteoporosis after oophorectomy.

Material and methods: 29 female Wistar rats were randomized into three groups: two were oophorectomized (Ovx) and one was sham-operated. The Ovx groups were fed a low-Ca diet (Ca 0.01%), and the Sham group got normal rat chow (Ca 1.1%). Group Ovx-I had daily intraperitoneal injections of 3 mg/kg indomethacin and the Ovx-C (control) and Sham-group the same volume saline water subcutaneously. Four days prior to sacrifice 85Strontium

Table. Mean *SD*

Group	Ash weight (mg)	Ca (mmol)	PO_4 (mmol)	Mg (µmol)	^{85}Sr x1000 (C/mg/min)
Ovx-C	269 *20*[a]	2.61 *0.15*[a]	1.77 *0.08*[a]	81.8 *3.8*[a]	51.0 *8.3*[a]
Ovx-I	243 *30*[a,b]	2.47 *0.14*[a]	1.69 *0.21*[a]	81.1 *4.2*[a]	64.7 *21.8*[a,b]
Sham	346 *41*	3.13 *0.31*	2.11 *0.57*	110 *12.5*	23.5 *5.8*

$P < 0.05$ [a]compared to Sham+Ca, [b]compared to Ovx-C

was injected to evaluate bone-mineralization. After nine weeks the rats were killed, and the right tibiae and femoral necks were tested in three point bending until fracture. The left femora were dried and ashed.

Results: The weight gain was significantly larger in the oophorectomized rats than in the sham rats, and the indomethacin-treated group had a significantly lower gain than controls ($p \leq 0.0001$). Tibial and femoral weights were equal in all groups. The ultimate bending moment and energy absorption of the tibia were significantly lower in Ovx-I compared to Ovx-C. In the femoral neck both ultimate moment, energy absorption, and deflection were lowest in the Ovx-I group. The biomechanical parameters were highest in Sham. Ash weight, Ca, PO_4, Mg, and ^{85}Sr in the left femur are presented in the Table.

Discussion and conclusion: The increased weight-gain seen after oophorectomy was significantly decreased in the treated group, and although the tibial and femoral weights were the same in all groups, the Ovx-I rats had weaker tibiae and femoral necks in a three point bending fracture test. The increased strontium incorporation, lower ash weight, and mineral contents show that indomethacin had induced an increased bone turnover that resulted in osteopenia of the femur to an even larger extent than oophorectomy and low calcium diet alone.

Reference: Nordsletten L, Kaastad T S, Obrant K J, Skjeldal S, Kirkeby O J, Stokke O, Ekeland A. Muscle contraction increases the in vivo structural strength to the same degree in osteopenic and normal rat tibiae. J Bone Miner Res 1993; accepted.

99. Reperfusion-injury in skeletal muscle

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Introduction: Parenchymal and microvascular injury during reperfusion is thought to contribute to the ultimate damage of skeletal muscle after transient ischemia (1). The findings in a previous study (2) indicated that no such injury occured during late reperfusion. In the present study staining of intracellular albumin was used as a marker of cell damage to measure a possible early reperfusion-injury.

Materials and methods: Complete ischemia was induced in the left hindlimb of 16 rats. The animals were during ischemia kept in an incubator at 27 °C. After 3 hours and 15 min of ischemia, the animals were randomized into two groups (n=8). In one group (NR) the anterior tibial muscle was dissected out and fixed in formaldehyde withouth reestablishment of the circulation. In the other group (R), the limb was reperfused for 3 hours before the muscle was excised. Transverse blocks from the muscles were embedded in paraffin, and 4-µ-thick sections were cut and stained with antisera against rat albumin (Nordic Immunological Laboratories, Tilburg, The Netherlands). The antigen-antibody reaction was visualized with the APAAP method using fast red as the chromogen. In a previous study (2) it has been showed that histological detectable necrotic areas (72 hours survival) were identical with those obtained from immunostained sections. The areas of positive stained fibers were measured by computerized morphometry. The stained areas were calculated in percent of the total cross sectional area, and the two groups were compared using the Mann-Whitney U-test ($p < 0.05$ was considered significant).

Results: All sections in both groups showed a peripheral zone of unstained, intact fibers and a central part with stained fibers. In the periphery of these affected areas there was a scattered pattern of stained and unstained fibers. The muscles which had not been reperfused showed a fainter colouring, and one section had to be discarded. In all the other sections it was possible to measure areas of stained fibers. These areas varied from 64 to 86% of the total area of the muscle. There was no significant diffrence between the two groups which had a mean area of 74% (SD=7) in the NR group and 75% (SD=7) in the R group.

Discussion: A progression of injury during early reperfusion has been related to toxic reoxygenation effects directly on the parenchymal tissue or to harmful effects on the microvasculature thus preventing or delaying nutritive reperfusion (1). The present study indicate that this effect was negligible, and that the injury occurred during ischemia and not during reperfusion. Acute limb ischemia is a serious clinical problem and intervention or treatment to reduce the damage is desirable. Such interventions have according to our findings to be carried out before or during the ischemia and not during reperfusion.

References:
1. Odeh M. N E J Med 1991.
2. Skjeldal S. Eur Surg Res 1993.

Scandinavian Orthopedic Association—part II

Upper extremity

100. Ten years of replantation—clinical results

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In 1983 the first successful recirculation of a finger was perfomed in our hospital. Later that year even a completely amputated hand was replanted. In 1984 successful replantations of thumb, foot and forearm followed.

Between 1983 and 1993 a total of 450 extremity replantations or recirculations in 323 patients has been carried out. Mean age was 37 (1.5–75) years. Overall replantation survival rate was 79%.

Finger replantations apart, 66 replantations were performed on 64 patients. Primary healing was achieved in 61 replantations (92%) of which 3 replantated parts had to be removed later due to serious infection.

384 finger/thumb replantations were carried out in 259 patients. Survival rate was 76% (92 failures). The trauma mechanism was of vital importance for the outcome. All the 22 guillotine amputations survived, and so did also 49 of the 51 amputations with mild crush. 250 severely crushed amputations had a survival rate of 76%, whereas 61 avulsions had a survival rate of 50%.

200 patients with a successful replantation underwent a follow-up examination. The functional results were classified according to Tamai and Nakamura. There were 39% excellent, 26.5% fair and 8% poor. 6 of the 16 in the last group were reamputated because of stiffness, poor sensation and discomfort.

The Chen classification gave 2/3 excellent/good, about 25% fair and 10% poor.

A survey of complete amputations in Norway between 1989 and 1992 (78 patients) demonstrated that 91% were replanted at Kronprinsesse Märthas Institutt. 109 of 114 amputations were distal to the wrist.

Conclusion: The results of replantation/recirculation are comparable to other replantation centers in Europe. Survival is dependent on the trauma mechanism. The functional result is best in young patients. Just a limited number of replantations are performed in Norway per annum, most often on hands and fingers. The replantation service should therefore be centralized to one hospital.

101. Carpal tunnel syndrome and other wrist/hand symptoms in industry A comparison of male and female car assembly workers

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The validity of the diagnosis of carpal tunnel syndrome (CTS) has been debated, especially in industry (1). High prevalences have been reported in the US. Surgery is performed in many cases in Scandindivia, based on only clinical findings, without neurophysiologic evaluation.

Subjects: 565 car assembly workers were included: 441 men and 124 women; the mean age was 30 years in both groups.

Method: The workers were interviewed and examined at the worksite. A questionnaire interveiw, an orthopedic examination and ergonomic evaluation was performed.

Results: Subjective complaints from the wrist and hand were reported in 57% of the females and 37% of the males. The variation of different types of subjective complaints between work stations was great, 28–84% in women and 0-67% in men. The result of the orthopedic examination was divided into joint, tendon, and nerve problems. The women had more pain during wrist motion 18% and 11% for females and males respectively, especially at the DRU-joint, 11% versus 4.8%. For other joints, there was no sex difference. The prevalence of a ganglion (4.8 and 3.2%) did not show any sex difference. Tendinitis symptoms were more common at the radial side of the wrist. Nerve symptoms showed a greater difference between women and men, e.g. numbness during daytime; 26 and 11%, during night: 14 and 11%, Clinical white fingers: 3.2 and 2.7%, and CTS (positive Phalen+ Tinel+ numbness during daytime+ stiffness); 10 and 1.8%. Neurophysiologic evaluation did not show any delayed nerve-conduction velocity in a subset of 15 examined workers, exept in one female worker with diabetes. The body mass, age and wrist diameter ratio, did not explain the CTS symptoms in this study.

Conclusions: There is a sex difference in the prevalence of CTS by a factor of 6. One hypothesis is that edema, due to tendinitis, and possibly the use of vibrating hand machines, causes CTS symptoms, which, however, is less severe than CTS seen in the elderly, complicating fractures or during pregnancy. Surgery could not be recommended without neurophysiologic evaluation in occupational CTS of this industrial type.

Reference: Nathan A, Keniston R C, Meadows K D. Carpal

tunnel syndrome in the workplace. Hippocrates' Lantern 1993; 2(2):1–5.

102. Endoscopic carpal tunnel release. Results of 149 consecutive cases

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Purpose: A prospective study to evaluate endoscopic carpal tunnel release.

Patients and methods: The Chow two-portal technique was used on 48 hands in 40 men and 101 hands in 86 women. Mean age at surgery was 48 (19–94) years. Preoperatively 95% had night symptoms and 98% daytime paresthesiae. All operations were performed by one surgeon. General or regional anesthesia was used in the first 48 cases, and local anesthesia in the last 101 cases. The patients were evaluated preoperatively and 3 and 6 months postoperatively by an independent hand therapist.

Results: Complete symptom relief was achieved in 80% of the cases at 3 months and 89% at 6 months postoperatively. Night symptoms were reported in 2% and daytime paresthesiae in 8% at 6 months. Mild scar pain was reported in 25% and moderate scar pain in 3% of the cases at 3 months postoperatively, decreasing to 2% and 1% respectively at 6 months. Abnormal preoperative sensory tests (two-point discrimination and Semmes-Weinsein monofilament) improved significantly in all cases. The pulp and key pinch strength returned to preoperative level at 3 months and the grip strength at 6 months postoperatively. Preoperative distal motor latencies measured by the electroneurometer in 114 cases were abnormal (>4.4 msec) in 58%, all had normalized or improved at 3 months postoperatively. Overall patient satisfaction was 91%. 13 out of 15 patients with prior open release in the other hand preferred the endoscopic release. There were 5 postoperative digital neurapraxias, all occurred under general or regional anesthesia. 3 recovered completely and 2 improved. There was one reoperation and one possible recurrence. The mean time to return to work was 17 (0–52) days.

Conclusion: Endoscopic carpal tunnel release can be safe and effective with rapid return to work. The use of local anesthesia seems to be important in avoiding neural complications.

103. Metacarpal lengthening after thumb amputation

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Patients and methods: We lengthened the first metacarpal in nine patients aged 34 (26–67) years who had sustained an amputation of the first ray 24 (5–131) months previously. Four injuries were restricted to the first ray. Seven amputations were through the proximal phalanx and two through the metacarpal. In the first two patients a graft was interposed. Callotasis was employed in the remainder. Distraction was discontinued 66 (28–109) days after osteotomy when a lengthening of 30 (17–36) mm had been achieved. In the seven callotasis patients the external fixators were removed 189 (115–271) days after osteotomy. The adductor pollicis tendon was transferred proximally and the first web deepened except in patients with severely lacerated hands. Fracture or palmar flexion of the callus after fixator removal occurred in 5 cases, but required surgery in only one. Treatment was discontinued 326 (140–489) days after osteotomy.

Results: Full sensibility was retained in the ray. On a scale from 0 (like before reconstruction) to 100 (like an uninjured thumb) the patients scored the final result at 67 (30–85). One patient felt the result did not warrant the long course of treatment.

Conclusions: Metacarpal lengthening takes a long time but is a valuable alternative to more complicated reconstructions.

104. Tendon interpositon arthroplasty for basal joint arthrosis of the thumb

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Patients and methods: During the years 1987–1992 we operated on 40 patients with arthrosis of the CMC joint of the thumb with Burton's tendon interposition arthroplasty. Three patients were lost to follow up and two were excluded because of other surgery to the ray. We thus reviewed 37 hands in 29 women and 6 men with a mean age of 58 (44–78) years at operation 45 (14–83) months after surgery. All patients were examined clinically and completed a pro forma with visual analog scales which were converted to a point scale from 0 (best imaginable) to 100 (worst imaginable). Values under 15 were arbitrarily taken to indicate an excellent result.

Results: There were three pin track infections. Only 3 out of 20 patients could not return to their previous job after a total sick leave of 22 (4–52) weeks. Full effect of the procedure was achieved after 10 (4–24) months. The patients rated the overall result as excellent (VAS < 15) in 27 cases. Pain relief was excellent in 23 hands and the cosmetic result in 33. The ability to perform activities of daily living improved considerably. There was no significant limitation of wrist or thumb motion compared with the contralateral side. In the 22 patients with unoperated contralateral arthrosis mean key pinch and grip strength was very similar in the two hands. Radiographs at follow up showed good alignement of the ray and a mean interposition gap of 6 (2–10)

mm. All but one patient would have submitted to the procedure knowing the result in advance.

Conclusion: In our hands this operation has yielded gratifying results.

105. Neck, shoulder and elbow problems in industry—a comparison of male and female car assembly workers

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There is a debate, as to whether or not the higher incidence of myalgia of the neck in females, is due to different work tasks than the male workers, or due to a difference in sex-related disorder, which is unrelated to work. Neck myalgia has increased in the female population in Sweden from 10 to 30% during the last decade. Tendinitis (Impingement) of the shoulder is more often described in male workers than in female counterparts.

Subjects: 565 car assembly workers were included: 441 men and 124 women, mean age in both groups was 30 years.

Method: All workers that were present in the factory at the day of examination were included. A questionnaire and an orthopedic examination was performed. An ergonomic evaluation of the work tasks and tools was made.

Results: Both questionnaire and examination results differed between work stations and sex. Women and men at the same work stations did the same job. Subjective complaints in the neck were reported in 35% of the females and 32% of the males, whereas in the shoulder/neck area: 55% of females and 37% of males reported complaints. 15% of the females and 12% of the males reported elbow complaints.

The orthopedic examination revealed no difference in neck mobility or pain between the sexes. Myalgia of the neck occurred in 34% of the women and in 17% of the men. Pain/crepitations at the AC-Joint occurred in 0.8 of the women and in 1.6% of the men, shoulder impingement in 8.1 and 8.6%, and lateral epicondylitis 5.6 and 4.5% respectively, without significant difference. The variation was substantial between the 23 work stations, e g impingement varied in men between 0 and 25%.

Conclusions: The proportion of subjective complaints exceeded the corresponding signs in the examination by at least 50%. Great caution should be used when interpreting subjective complaints at a work site. Orthopedic examination revealed the same prevalence of symptoms from the neck, shoulder joint and elbow. The female workers had double prevalence of neck-myalgia compared to the male workers, which cannot be explained by physical loading factors on the job site.

Limb lengthening

106. Lengthening of forearm bones in children

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Introduction: In 1977 Dreyfus described gradual distraction of radius, thus correcting a radial deviation of the wrist caused by osteomyelitis. Since 1988, we have treated 5 children using this principle, lengthening one of the forearm bones to restore elbow, wrist and hand function.

Patients and method: The children were 6 (1–12) years of age at the start of the lengthening. An external fixator, Orthofix in 4 cases, and Hammer in 1 case, was mounted before an osteotomy was done. 1 mm lengthening per day was started 7 days after the osteotomy. Two boys, 8 and 10 years of age, had aldredy been operated with centralization of a radial club hand. The ulna had a radial curvature of 30 degrees and was very short. Correction of the angulation was performed at the time of the osteotomy, and the ulnae were lengthened 15 and 13 mm respectively. The angulation of the ulna at the end of treatment was 0 and 11 degrees respectively. The ulnae were completely healed 6 and 4 months after the osteotomy. One girl, 3.5 years of age, had an enchondroma in the lower end of ulna. Impaired growth of the ulna gave subluxation of the radial head and varus deformity in the elbow. The ulna was lengthened 28 mm, which restored normal valgus in the elbow and good elbow and wrist function. The ulna was healed 6 months after the osteotomy. Two Asian boys, 20 months and 6 years of age presented with radial deviation of the hand after osteomyelitis. The yonger boy had been treated for a Salmonella sepsis and had a very short radius with affection of the distal epiphysis. The radius was lengthened 13 mm, and the ostoetomy healed after 3 months. The wrist function was considerably improved. The older boy presented with an atrophic pseudarthosis of the radius. He had already been operated by grafting a block of iliac bone to restore length. The radius did not heal, the graft was resorbed and the preoperative shortening reappeared. The radius was lengthened gradually, according to the recommendations of Ilizarov, but the pseudarthosis remained atrophic without callus formation. He was reoperated on after 5 months with revision and grafting of bone chips. Two months later the radius healed with satisfactory wrist function.

Results: Both boys with radial aplasia, ended up with satisfactory correction of the deformity and improved grip strength. The girl with the enchondroma also had an easy recovery of normal elbow- and wrist function. Further treatment depends on the growth of the tumor. All osteotomies healed without any problems. The atrophic pseudarthosis did not heal by distraction alone, but responded well to revision and bone grafting.

Conclusion: Gradual lengthening using an external fixator device seems to be a reliable method in correcting defor-

mities of various origin of the forearm bones in children. Atrophic pseudarthosis in one of the forearm bones does not seem to heal by distraction alone.

107. Outcome of epiphysiodesis for equalizing leg lengths

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Introduction: The upper limit of normal variation in leg length inequality (LLI) is approximately 10 mm. The aim of this study was to analyze to which extent epiphysiodesis succeeded in obtaining LLI within normal limits.

Patients and methods: Thirty-nine patients (14 women) who underwent epiphysiodesis a.m. Phemister (1933) were examined after skeletal maturity. Skeletal age had been determined according to Greulich and Pyle (1959) and the timing of epiphysiodesis was calculated from Green-Anderson growth remaining graph (Anderson et al. 1963). Mean age at time of surgery was 13.3 (11–16) years. Mean preoperative LLI was 24.7 (15–40) mm. The follow-up period was 7.3 (3–13) years. The cause of LLI was: femoral fracture 9, tibial fracture 4, idiophatic 8, DDH 3, pes equinovarus 6 and others 9. At follow-up LLI was measured with ultrasonography (Terjesen et al. 1991).

Results: Mean LLI at follow up was 9.6 (1–34) mm. In sixteen patients (41%) LLI was 0–5 mm, in 9 (23%) 6–10 mm, in 9 (23%) 11–15 mm and in 5 patients (13%) 16–35 mm. Of the 14 patients with LLI > 10 mm the operated leg was still the longer in 11 cases, whereas it was the shorter in 3 patients. In LLI caused by fracture 11 of 13 patients had LLI < 10 mm, whereas in LLI from other causes 14 of 26 obtained LLI < 10 mm (p= 0.059).

Conclusion: Epiphysiodesis timed according to Anderson et al. (1963) normalized LLI in 64 % of patients. This method seems adequate for timing of epiphysiodesis for LLI after fractures, but is less reliable in LLI of other ethiology.

107A. Progressive opening wedge osteotomy for the correction of angular deformities of the long bones

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Introduction: In order to avoid the disadvantages of conventional osteotomies and attempting to obtain a progressive gradual correction of the deformity, we developed a new technique for the treatment of angular deformities of the long bones. In the present work we review our clinical experience treating adolescents and young adults.

Patients and methods: From 1987 to 1991, a total of 27 angular deformities of long bone in 17 patients were treated by percutaneous osteotomy and progressive angular correction with a modified Wagner's distractor. Ten patients (20 bone segments) with a mean age of 13 years had adolescent bilateral idiopathic tibia vara (group A). Before surgery, the mean angular deformity of the mechanical axis of the extremity was 12° (10°–16°) varus always due to varus deformity of the proximal tibia. Seven other patients (group B) had non-idiopathic angular deformities located at the distal femur (5 cases) and the distal tibia (2 cases). The etiology of the deformity was posttraumatic in 5 cases, sequels of infection in one case, and post-radiation injury in another case. The mean age of this group was 15 (13–16) years. The greatest deformity corresponded to a postraumatic tibia vara with 26 degr. deviation, and the lightest was a distal femur with 15° valgus (9° valgus deviation of the mechanical axis of the extremity). One of the femoral deformities presented an associated 5.5 cm shortening which was also treated in the same procedure. In group A patients, results were considered satisfactory when the mechanical axis of the extremity after treatment ranged from 0 to 5° valgus (mild hyper correction). In group B patients, normocorrection with ±2° of either hypo- or hypercorrection was judged as a satisfactory result.

Results: In patients with idiopathic tibia vara (group A), the final mean angular correction was 15°, passing from a mean preoperative deformity of 12° varus to 3° valgus postoperatively. In patients of the group B the mean angular correction was 17°. Patients of the group A wore the Wagner device for an average period of 12 (10–13) weeks and group-B patients for 13 (9–27) weeks. The most outstanding complications were transient or mild pin tract infections observed in almost 40% of patients. These infections responded well to antibiotics and rest.

Conclusions: Progressive opening wedge osteotomy is valid alternative to conventional osteotomies for treatment of angular deformities of the long bones. This technique shows in our opinion several advantages such as less invasive surgery, progressive correction, possibility of adjusting accurately the correction throughout the postoperative period and more esthetic scars. If needed, bone lengthening can also be performed by using this technique.

107B. Recurrent club foot in children corrected by the Ilizarov technique

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Introduction: Since 1992 we have used the Ilizarov external fixation technique in the treatment of recurrent club foot in children. By slow traction of bone and soft tissues, correc-

tion of complex three-dimensional deformities can be accomplished as an alternative to extensive release of the mid- and hindfoot or both. This correction procedure can be combined with lengthening of a hypotrophic, short leg which is part of the club foot syndrome.

Material: The patients were 3 girls and 2 boys; 5–8 years of age. Four of them had been treated with primarily by manipulation and plaster of Paris during the first 2 weeks of life and later with elongation of the Achilles tendon and radical soft tissue release. In addition one of the patients had been treated with Evan's operation. At the time of Ilizarov operation the patients had relapse of all deformities (equinus, varus, adduction and supination of the forefoot), dense scar tissue posteriorly and a thin achilles tendon. A girl, 7 years old, had a relapsed club foot combined with a hypoplastic tibia.

Results: The average treatment time in the Ilizarov frame was 99 (70–135) days. After removal of the frame the patients were treated with a cast for 6 weeks and later with a dynamic splint orthosis and orthopedic footwear. Superficial pin track drainage occurred during use of the frame in all patients and was treated with antibiotics. The observation time after removal of the cast was 0–8 weeks. One patient had a moderate recurrence of the forefoot adduction which was treated successfully by manipulation. The final clinical result was good in four patients. A flexion deformity of the big toe occurred in the last patient with the combined lengthening and club foot correction.

Conclusion: The Ilizarov method for external fixation and correction represents a useful alternative in the treatment of recurrent club foot previously operated on. The method allows for a controlled correction of soft tissues contractions with the possibility of simultaneous lengthening of the leg and foot.

Shoulder

108. Open and arthroscopic acromioplasty for impingement syndrome

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Introduction: Neer described the impingement syndrome and the role of rotator cuff lesions in 1972. Anterior acromioplasty was reported by Neer in 1972, arthroscopic subacromial decompression (ASD) by Ellman in 1985. The purpose of this retrospective study is to report a one to 7-year follow-up after open acromioplasty and ASD for impingement syndrome.

Patients and methods: From December 1985 to May 1993 fifty-nine shoulders (49 patients) with impingement were operated on with acromioplasty; 26 with open acromioplasty and 33 with ASD. All patients were available for a follow-up. Indication for surgery was shoulder pain at least half a year, positive impingement sign and positive impingement test. Physiotherapy, antiinflammatory drugs and subacromial steroids were without significant effect. Stability test was performed peroperatively only in patients with ASD as inferior instability. At follow-up, 30 (7–90) months after surgery, the patients evaluated the the result of the operation in five categories: No problem, much better, better, unchanged and worse. A modified UCLA–shoulder rating score was obtained. Open acromioplasty was performed as described by Neer and ASD according to Ellman.

Results: In 42 cases the patients were much better or had no problems; unchanged or worse in 16. Shoulder rating score was excellent and good in 42, fair and poor in 17. Preoperatively 35 patients had a manual work, nine a sedentary work. Three had disability pension while two were pensioners. At follow-up 27 patients had an unchanged occupation, nine had a modified work. Nine were on disability pension, four were pensioners. There was no difference in result between open acromioplasty and ASD, men/women and dominant/non dominant shoulder. Unstable shoulders had a poor result.

Conclusions: Excellent and good result of acromioplasty for impingement syndrome was achieved in 71%. No difference was recorded between open acromioplasty and ASD with an observation time of 30 (7–90) months. Instability was associated with a poor result. In 60% the patients had an unchanged occupation at follow-up.

109. Open versus arthroscopic subacromial decompression—results from prospective, randomized study

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Introduction: We present our results from a prospective, randomized study comparing arthroscopic subacromial decompression with the open Neer procedure.

Patients and methods: 37 patients (16 men, 21 women) with impingement syndrome (Neer grade II) were included. 20 patients were randomized to arthroscopic operation (Group A), 17 to the open technique. Median age was 44 (27–61) years, preoperative sick leave was 25 (0–99) weeks. Painful arch, ROM and Cybex recordings were assessed at preoperatively and at 1, 3, 6 and 12 months postoperatively. Randomization was done after diagnostic shoulder arthroscopy. Closed procedure was performed with a posterior portal for the arthroscope, working portal laterally. After bursectomy, 8–10 mm of the acromial undersurface was removed with burr and the C-A ligament was cut. Open technique was performed with 4 cm skin incision, T-shaped incision in the deltoid muscle, bone removed a.m. Neer and the C-A ligament was cut.

Results: Operation time was 77 (50–120) minutes in Group A, 55 (40–90) in Group B ($p < 0.001$). Median postoperative sick leave was 5.0 and 5.5 weeks respectively in Group A and B. Preoperatively and at 1, 3, 6, and 12 months the UCLA Shoulder Ratings (max score 35) were 13 (7–18), 18 (8–29), 25 (7–34), 29 (15–35) and 31 (20–35), respectively in Group A, and 15 (9–24), 19 (7–29), 26 (18–33), 26 (12–35) and 30 (14–35), respectively in Group B. A Visual Analogue Scale recording the patient's assessment (unsatisfied=0, satisfied=100) at 1, 3, 6 and 12 months showed 71 (6–100), 94 (8–100), 92 (40–100) and 99 (70–100), respectively in Group A and, 75 (37–100), 97 (43–100), 96 (34–100) and 100 (18–100), respectively in Group B (median). Peak Torque (PT) at 60 degrees external rotation/sec preoperatively and at 3, 6 and 12 months gave the following recordings: 22 (5–35), 21 (17–40), 30 (14–43) and 27 (11–43) Nm, respectively in Group A and, 14 (7–45), 22 (18–51), 29 (8–48) and 32 (13–53) Nm, respectively in Group B. Total Work (TW) at 60 degrees external rotation/sec recorded in a similar fashion showed 22 (5–35), 24 (14–43), 33 (15–50) and 33 (11–50) J, respectively in Group A and, 14 (5–55), 26 (16–63), 29 (1–57) and 38 (0–65) J, respectively in Group B. TW and PT at 60 and 180 degrees in- and external rotation/sec, UCLA Score, VAS Score, ROM and painful arch yielded insignificant differences between Group A and B at any time.

Conclusion: Arthroscopic versus open subacromial decompression yields insignificant differences regarding both short and long term morbidity. The choice between the two procedures burns down to a question of cosmesis and personal preference.

110. Impingement syndrome and shoulder arthroplasty—results of arthroscopic treatment

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Impingement syndrome in shoulder arthroplasty is seen secondary to cranial migration of the humeral component. The shoulder function is poor due to pain and restricted mobility. Treatment has been difficult and results disappointing. Arthroscopic subacromial decompression has become an accepted treatment for other patients with impingement syndrome. We have tried this method on patients with a painful, poor functioning hemiarthroplasty of the shoulder where the cause is thought to be impingement.

We observed 7 patients with rheumatoid arthritis or psoriasis arthritis previously treated with a Scan shoulder hemiarthroplasty. Treatment consisted of shoulder arthroscopy, subacromial decompression and cuff debridement. There was significant improvement in pain, motion and function. All patients were satisfied with the procedure. No serious adverse events were observed.

The preliminary results of arthroscopic subacromial decompression seem promising and should be considered in patients in whom secondary impingement seems a likely explaination to a painful shoulder hemiarthroplasty.

111. The influence of cuff pathology on shoulder function after arthroscopic subacromial decompression (ASD)

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Some authors have found that outcome after ASD is related to the pathological findings in the cuff tendons (Adolfson and Lysholm 1993, Ellman et al. 1993) while others have found no correlation between lesion and outcome (Snyder et al. 1991, Earnshaw et al. 1982).

This study was made to investigate if patients with defined differences in rotator cuff pathology differed in functional outcome after ASD.

We clinically reviewed 39 patients with subacromial impingement who all underwent ASD; 13 patients with full thickness cuff rupture < 2 cm, 13 patients with partial thickness cuff tears and 13 with intact cuffs. Selection was based solely on the status of the supraspinatus tendon. No other intraarticular pathology was accepted. Median follow-up was 2.9 (1–4) years.

The clinical evaluation was performed by an independent observer (L P) and included range of motion (ROM), UCLA score and visual analogue pain score (VAS).

The total UCLA score as well as its five separate parameters were identical in all three groups. The VAS values showed no significant difference between the groups, although the partial tear group showed slightly higher score values indicating more pronounced pain. ROM was preoperatively most restricted in the full thickness rupture group ($p = 0.056$) and this group gained most ROM postoperatively. Hence, no differences remained at follow-up.

We conclude that results and functional outcome after ASD are not obviously related to the degree of cuff pathology.

112. Treatment of complete grade III acromioclavicular dislocation

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Introduction: The present study reports on a new surgical procedure used in patients with chronic, complete acromioclavicular dislocation. The patients have all been treated surgically with a bone-tendon transplant technique and a temporary screw fixation of the clavicle.

Material and methods: 18 patients (13 men and 5 women) underwent surgical reconstruction. The mean age at the time of operation was 36 (19–58) years. The median time interval between injury and surgical reconstruction was 25 (3–96) months. The follow-up examination was performed on an average 52 (18–120) months postoperatively. Data collections consisted of a pre- and postoperative questionnaire, clinical examination, function score, radiographic examination including stress weighted views, VAS at rest and work respectively and isokinetic concentric and eccentric strength measurements (Biodex). The operations were all performed by one physician and the evaluation was done by an independent observer.

Results: The function score was significantly improved postoperatively compared to the preoperative status. Subjectively only two of the patients felt that their outcome was sub-optimal. Objective examinations revealed moderate limitation of shoulder motion in 3 shoulders. At radiographic examination 16 patients had exact anatomic position of the clavicle end, 1 patient showed subluxation and 1 dislocation. Biodex testing showed no statistical difference in strength between the injured and the uninjured extremity, except for concentric flexion of the shoulder (p 0.041).

Conclusion: In a 4.5 year follow-up evaluation after reconstruction of chronic, complete acromioclavicular dislocations with a bone-tendon transplant technique the majority of patients had a high function score, activity level, sufficient isokinetic strength and cosmetically good result.

113. Evaluation of intraarticular lesions after acute primary anterior shoulder dislocations in young patients

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Purpose: The evaluation of conventional MRI as a preoperative diagnostic noninvasive method to identify the intraarticular lesions in patients with acute primary anterior shoulder dislocations.

Material and method: Between December 1991 and December 1993, 25 patients who had suffered an acute primary and traumatic anterior shoulder dislocation were examined with MRI and arthroscopy. Criteria for inclusion were no prior history of shoulder dislocations, age between 15 and 39 years, radiographic confirmation of the dislocated shoulder and examination with MRI and arthroscopy within 10 days. Average age was 27 (16–39) years with 18 men and 7 women. MRI was performed with a 1.5-T MR Imager using spinecho technique obtaining proton-density and T2-weighted coronal 5-mm sections with a 0.5-mm intersection gap. This sequence was followed by a gradient-echo sequence with a thin-slice (1.0–1.5) mm contiguous 3-D imaging of the shoulder. TR=60 ms, TE=18 ms and the flip angle was 25°. The MRI evaluation was performed before the arthroscopic examination and the images were described by a experienced MR-radiologist. The arthroscopy was performed by different orthopedic surgeons but all used the same scheme as the radiologist in order to classify the intraarticular findings identically.

No information from the MRI examination was available for the orthopedic surgeons before arthroscopy. The capsulolabral lesions were classified as intralabral (e g rupture, contusion) and extralabral lesions (e g glenolabral-, capsulolabral- or total detachment). Standard of reference for comparison was arthroscopy.

Results:

Table. Correlation between MRI and arthroscopic findings.

	Arthroscopy	MRI	Sens.	Spec.	Accur.
Extralabral lesion	17	12	0.75	1.0	0.79
Intralabral lesion	5	3	0.60	0.75	0.66
Hill Sachs lesion	15	12	0.80	1.0	0.88
Osseous Bankart	1	0			
Partial cuff	1	1			
Total cuff	1	1			
Partial biceps	1	1			

The labral tears were located anteriorly in nineteen cases, superiorly in two cases and posteriorly in one case.

Conclusion: Anterior capsulolabral tears and Hill Sachs lesions appear with a high incidence after an acute anterior primary shoulder dislocation. Conventional MRI is a reliable preoperative method in the evaluation of undifferentiated labral tears and Hill Sachs lesions, but fails to give an accurate differentiated preoperative capsulolabral diagnosis.

114. The diagnosis of labral tears—a comparative study between MRI and arthroscopy

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Purpose: Comparison of MRI and arthroscopy in the diagnosis of labral tears.

Material and method: Between May 1991 and September 1993, 61 patients were examined with MRI and arthroscopy. Thirty-five patients suffered from posttraumatic chronic shoulder pain after a non-dislocating trauma, whereas twenty-six had experienced a primary (18) and secondary traumatic dislocations (8). Average age was 29 (16–55) years. There were 54 men and 7 women. MRI was performed with a 1.5-T MR Imager using spinecho technique obtaining proton-density and T2-weighted coronal 5 mm sections with a 0.5 mm intersection gap. This sequence was followed by a gradient-echo sequence with a thin-slice (1.0–1.5) mm contiguous 3-D imaging of the shoulder. TR=60 ms, TE=18 ms and the flip angle was 25°. The evaluation was performed

before the arthroscopic examination and the images were described by an experienced MR-radiologist.

The arthroscopic examination was performed by different orthopedic surgeons but all used the same scheme as the radiologist in order to classify the labral lesions identically. Standard of reference for comparison was arthroscopy. No information from the result of the MRI examination was available for the orthopedic surgeons before arthroscopy.

Results: Correlation between MRI and arthroscopy in diagnosis of labral tears.

Table. Correlation between MRI and arthroscopic findings.

	Arthroscopy	MRI			
		True +	True –	False +	False –
n	44	39	16	1	15

Sensitivity	0.89
Specificity	0.94
Predictive value of positive test	0.97
Predictive value of negative test	0.76
Accuracy	0.90

Conclusion: Conventional MRI is a reliable method in order to perform a non-differentiated evaluation of labral tears.

Hip prostheses

115. The Scandinavian PCA-multi-center study—clinical and radiographic results with 5–7 years follow-up

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Introduction: The introduction of uncemented technology in total hip replacement has brought forward new and unexpected problems. First generation cementless hip replacement has been widely used in the last decade and thought to be a significant advantage in orthopedics. The proper indication is still unclear and in Scandinavia the cementless implants have not replaced the use of cemented prostheses.

Method: The Scandinavian multi-center PCA-study is a prospective, clinical and radiographic follow-up study. 11 centers in Scandinavia have joined the study. All patients are followed with preoperative, postoperative, 1, 3, 5 and 7-year evaluation.

Material: Between January 1984 and January 1987 542 total hips were operated using the PCA prosthesis. 55% women, 45% men with a mean age of 50 years. 55% had primary osteoarthrosis, 30% secondary arthrosis and the remaining avascular necrosis and inflammatory hip disease. The minimum follow-up is 5 years and 340 patients have been followed for 7 years.

Results: The preoperative Harris score was 43 and at follow-up we had a constant result over time with improvement to a mean of 91 at 7-year follow-up. The radiographic analysis showed an increasing instability problem. At 7-year follow-up we found 8% unstable stems and 4% unstable cups. The radiographic analysis further revealed 10% acetabular granulomas at 7-year follow-up and 22% femoral granulomas. In 50 hips one or both components have been revised. A multi-variate analysis did not identify any clinical risk factor for revision. Survival analysis according to Dobb shows 91% cup survival at 8-year and 93% stem survival.

Conclusion: Instability and revision due to aseptic loosening in combination with polyethylene wear and granuloma are the main problems for the first generation uncemented total hip replacements. The procedure is unpredictable and we still look upon uncemented total hip replacement as an experimental procedure.

116. Reoperations because of infection after 24,346 primary total hip replacements

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Introduction: The effect of different preventive measures on the rate of reoperation because of deep infection after total hip replacement, has been studied in the Norwegian Arthroplasty Register.

Patients and methods: Data on 24,408 primary total hip replacements (THR) followed for 0–5.4 years have been collected in the Norwegian Arthroplasty Register. The reoperation rate because of infection, has been studied by analyzing the effect of systemic antibiotic prophylaxis, antibiotic in bone cement, ventilation of the operating-theatre, operating time, age and sex of the patients. To have comparable groups, only those operated for primary arthrosis (16,418 hips) were included in this analysis. Kaplan-Meier survival analyses and Cox proportional-hazard model were used.

Results: Totally 49 hips have been reoperated because of infection, 0.3% of the THR. Reoperations because of infection were less often when the operations were performed in operating rooms with ordinary ventilation, compared to those with laminar airflow or greenhouse (22 of 10,007 vs 24 of 5,986; $p = 0.03$). No effect on reoperation rate because of infection could be detected by systemic antibiotic prophylaxis (7 of 1,171 without antibiotic and 42 of 15,218 with antibiotic). Antibiotic in bone-cement, however, reduced significantly reoperation for infection compared to those without (5 of 4897 vs 37 of 8972; $p = 0.001$). The Cox model revealed that men had 2 times higher reoperation risk

than women, and that those without antibiotics in the cement had 4 times higher risk than those with. No effect on reoperation-rate for infection was found for operating-time or for patient-age.

Conclusion: Reoperation rate because of infection after primary THR for arthrosis was reduced if cement with antibiotics was used and if the operation was performed in an operating theatre with standard ventilation.

117. Seven-year-follow-up on CORAIL HAC-coated stem—results meeting the expectations

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Introduction: Our experience of HAC coating started in 1985. A biomechanical concept (primary stereostability), linked to a refined biotechnology (plasma spray process), permitted the CORAIL stem birth. All the questions are not yet solved, but a 7 year follow-up assessment allows us to look forward with optimism on the CORAIL stem reliability.

Clinical findings: The ARTRO Group implanted more than 4,700 CORAIL prosthesis with a very low rate of specific complications. According to the PMA hip scale, the pre-op score was 11.27, it was 17.01 at 12 months and is 17.21 at the 7th year. The survivorship rate is 0.97.

Radiographic findings: The HAC coating improves the stability (migrations < 2mm in 6.2 % of the cases) and the osteointegration of the implant. Bone remodeling seems to be contained within physiological limits (3 cases of stress shielding grade III) and an absorptiometric analysis is now in process in order to know if there are infraradiological signs with a predictive value.

Histologic findings: Several post mortem explant studies have shown physiological images at the interface living bone/HAC coating: centrifugal and centripetal osteogenesis, new bone architecture according to Wolf's laws, and participation of HA to local bone metabolism.

Conclusions: At this level, no clinical, radiographic or histological signs allow us to suspect a failure in the apparently unnatural union between the living bone and the inert implant.

118. Hybrid total hip arthroplasty Preliminary report of 190 hips

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Introduction: Hybrid arthroplasty with an uncemented acetabular cup and a cemented femoral stem component has turned out to be an attractive surgical procedure for treatment of hip joint arthrosis in the middle aged patient. We report the preliminary results from 190 hips operated upon with a hybrid arthroplasty between 1987 and 1993.

Patients and methods: 190 hips in 176 patients have been operated upon with hybrid arthroplasty (Table 1). A porous coated press-fit cup (Harris-Galante I or II) has been used. The cup has been oversized 1 mm and additionally fixated with 2-4 screws for primary stability. The femoral component has been cemented using third generation cementing technique (Table 2). The patients have been prospectively evaluated with clinical (Harris hip score 1969) and radiographic examinations pre- and postoperatively and 1, 3, and 5 years after operation.

Table 1. Age, gender, diagnosis, Harris hip score (HSS) and Harris pain pre-op (n=190)

Age	(mean)	58
Women	(number)	128
Men	(number)	62
Primary OA	(n)	103
Second.OA	(n)	36
RA	(n)	16
Seq. fracture	(n)	9
Miscellaneous	(n)	26
HSS	(mean)	43
Pain	(mean)	14

Table 2. Acetabular cups and femoral stems (n=190)

HG I	HG II	Spectron	Charnley	Tifit
23	167	147	19	24

Results: One patient has been lost to follow-up and one patient has died. Revisions have been performed in two hips. In one patient due to a femoral fracture and in one due to recurrent dislocation. The radiographic examinations have not revealed any probably or definitively loose component. Good or excellent result are reported in 85% of the patients at latest follow up.

Table 3. Mean (range) Harris hip score 1, 3, and 5 years after operation

Harris hip score		
1 year	3year	5year
134 hips 90 (52–100)	36 hips 88 (38–100)	9 hips 91 (78–100)

Conclusion: The clinical and especially the radiographic results in this material are encouraging and hybrid total hip arthroplasty seems to be an adequate procedure in the surgical treatment of hip disease in this age group. The follow-up is short and the results are preliminary.

119. A prospective study of 100 consecutive HA-coated total hip replacements A 3–5 year follow-up

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The clinical results of uncemented total hip replacement have been reported inferior to the results of cemented prosthesis. Experimental studies have shown that hydroxyapatite coatings provide early and strong fixation to bone. However, the clinical experience with hydroxyapatite coated hip prosthesis is still limited.

Material and methods: Between February 1989 and February 1991, 90 patients (100 hips) underwent primary implantation of the hydroxyapatite coated Landos corail titanium prosthesis. There were 67 women and 23 men. The mean age was 57 (32–78) years. All patients were included in a prospective follow-up study. Each patient was evaluated before surgery, and postoperatively at 3 weeks, 4 months, 12 months and yearly thereafter. Two patients, one of them bilaterally operated, died during the observation period of causes unrelated to surgery, leaving 97 hips with a follow-up of 3–5 years.

Direct lateral approach was used. The acetabular component was a hemispheric, self-tapping screw cup. The femoral stem was fully coated. Primary fixation was achieved by press fit. A non-weightbearing period of 3 months was carried out postoperatively.

Results: No major operative or postoperative complication occured. 2 cases of diaphyseal fissures healed uneventfully. One acetabular cup was exchanged because of loosening after functioning well in 4 years. No other prosthetic component was suspected loose. Hip function, especially pain score, rose to a near-normal level during the first year, and this result was maintained throughout the study. No patient suffered from thigh pain. Postoperatively we often saw a dense, radioopaque line around the cup, representing remnants of the acetabular sclerosis. This was extensively remodeled within one year. No radiolucent lines were seen between the acetabular implant and the bone. In some cases small double-lines developed at the proximal part of the femoral stem, laterally and ventrally. However, the remaining part of the stems were completely integrated. We did not see thickening of the femoral cortex, and neither did we observe any dramatic change in bone stock. No implant migration was found.

Conclusion: Clinical results of this HA-coated THR are very good at short- to medium-term follow-up.

120. Fascia lata plasty in recurrent dislocation after total hip arthroplasties

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Introduction: Dislocation is reported as a frequent complication after total hip arthroplasty. Instability caused by malposition of the femoral or/and the acteabular component is understandable and should likely be solved by a rearthroplasty with correction of the position of the two components. Experience over a period of thirteen years with a soft tissue plasty described by the author in posterior hip prosthesis instability when no malposition is evident, is worthwile to be reported.

Material and method: Since 1981, 21 patients, 7 men and 14 women, with median age of 78 (62–84) years, with hip instability after total hip replacement, were treated. A stabilisation plasty, described by the author, using the fascia lata as a tension band around the hip, was performed. Eigthteen patients had been operated on with a posterolateral, two patiens with a transgluteal and one patient with an anterolateral approach. 17 patients had a posterior instability, three patients an instability in all directions whereas one patient had an anterior instability. The median number of dislocations until plasty from the primary operation was 7 (3–12) months. Median observation time is 56 (6–138) months.

Results: In 16 patients a stable hip could be obtained. In five patients new dislocations occured after two, three, eigth, nine weeks and 4 years respectively. In all but two posterior instabilities stability could be achieved while only one of the global instabilities could be stabilized and no stabilisation was obtained in the anteriorly unstable hip.

Conclusion: Stabilisation of an unstable hip after total arthroplasty concerning posterior instability is a reliable surgical stabilisation method when the prosthesis components are in correct position. Hips unstable in all directions or anteriorly are not suitable for this method. The method should be used in cooperative patients only as postoperative cooperation is mandatory for a successful result.

121. The results of socket wall addition for total hip dislocations

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Introduction: Dislocations are one of the major complications after total hip arthroplasty. Reoperations for prosthetic instability are necessary in about one third of the hips but complications are frequent and the failure rate is high. We report our experience with socket wall addition (SWA) for dislocating total hip.

Method: Medical records and radiographs of all patients who underwent SWA for dislocating total hip from September 1984 through December 1991 were reviewed.

Results: SWA was performed in 20 patients.In 19 the SWA was performed for dislocating total hip and in one patient as an additional procedure in primary total hip replacement (THR) as the surgeon felt, during surgery, that the hip was not stable enough. Nineteen of the SWA were for posterior dislocations and one for an anterior dislocation. SWA were performed on average 16 months after THR with a range of 14 days to 5 years. In 10 patients the THR was for primary osteoarthrosis, one for rheumatoid arthritis, four for revision surgery and four THR's were performed because of fracture sequelae. AP radiographic review revealed lateral angle of 44° (30°–60°) on the average; the cup was considered anteverted on average 4°, ranged from 10° of retroversion to 20° of anteversion. There were no primary complications in 19 patients. One patient developed deep infection two months after SWA. The patient's hip was revised with good results. In 10 hips the results of SWA were good preventing further dislocations. Follow-up time on average 5.4 (1–9) years. In 8 hips the SWA screws broke and 7 of the hips redislocated. In a total of 9 hips dislocations continued after SWA. In 4 revision THR was performed without further complications. Three underwent new SWA's with good results in two; one continued to dislocate but has not dislocated during the last two years. Two who dislocated have not been revised and are not considered candidates for further surgery.

Conclusion: SWA gave good results in half of the patients treated. The SWA procedure can be considered as a supplement, but some form of revision surgery is the treatment of choice if surgical treatment is needed.

121A. Acetabular revision with an HA-coated cup—2–5 year results in 100 consecutive cases

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Long-term results after cemented revision of loose acetabular prosthesis are inferior to the results after primary total hip replacement. The outcome of cementless revisions is still short- to medium-term with varying success rates. Hydroxyapatite coatings provide early and strong fixation to bone. This bioactivity is thought to be of special importance in revision surgery, where sclerotic bone and defects are encountered.

Material and methods: Between February 1989 and June 1991 97 patients (100 hips) underwent acetabular revision by use of the hydroxyapatite coated Landos corail titanium cup. 78 women and 19 men ranged in age from 20 to 89 years; mean 66. All patients were included in a prospective follow-up study. Clinical and radiographical evaluations were performed pre- and postoperatively, at 4 and 12 months and after that annually. One patient died a few days postoperatively, and 3 died later in the observation period. Of the removed prostheses 66 were cemented and 34 cementfree. 39 were double cups.

The hip was exposed through a direct lateral approach. Cement and soft-tissue remnants were meticulously removed, and, if necessary, gentle reaming was performed. Defects of 5 mm or less were allowed to fill in spontaneously. Larger bone deficiencies were filled with allografts, autografts or the two in combination. In most cases a self-tapping screwcup was inserted. When bone defects made screw fixation impossible, a hemispheric cup fixed with separate screws was employed.

Results: One case of partial sciatic nerve palsy resolved subsequently, and one femoral fracture during contemporary femoral revision healed without problems.

One screw cup dislocated some days postoperatively and was exchanged with a hemispheric cup which has functioned satisfactory. At 3.8 years a formerly well integrated prosthesis was revised due to aseptic loosening. An infected cup had to be removed 3.6 years postoperatively, still extensively integrated in spite of the sepsis. The remaining cups functioned well throughout the entire study period.

Pain relief and functional improvement were excellent in this series. One cup migrated before 4 months. However, the patient was completely painless, and radiographs demonstrated intimate fixation within one year postoperatively. No radiolucency was seen later than 4 months postoperatively. In most cases remodeling of sclerotic bone and incorporation of the bone grafts were completed at 1 year. Grafts until 44 mm of width between cup and iliac bone healed with almost complete remodelling. Grafts between cup and pelvic soft tissue underwent extensive resorption consistent with the non-loading condition of this bone.

Conclusion: The results compare favourably with the outcome of other acetabular revisions, both cemented and cementless. Especially encouraging is the favourable bony reaction adjacent to the prosthesis.

122. Total hip replacement after fracture of the acetabulum

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The incidence of radiographic loosening after THR in patients with a history of previous acetabular fracture is claimed to be higher than after THR in a non traumatized acetabulum. Some authors recommend open reduction and internal fixation of dislocated acetabular fractures. However, these operations are technically demanding and a high risk of postoperative complications is frequently reported since these patients often are multitraumatized. The incidence of acetabular fractures is low and few orthopedic surgeons are experienced with this type of fractures.

Patients and methods: In the period of August 1986 March 1993 we have performed THR in 11 patients with

previous acetabular fractures by using cementless acetabular prothesis. Polyethylene Endler/Zweymüller prothesis was implanted in five patients,and Landos Corail HAC prothesis in five patients. In one patient a hybrid of cementless Endler/cemented Landos Titan was used.

In 5 cases primary open reduction and internal fixation had been performed close to the accident. The average time before THR was 5 years. One patient underwent an intermediate THR. Six patients had been treated conservatively. Their average time before the THR was 21 years. Three patients underwent intermediate operations.

Results: No technically operative challenges were met and no major operative or postoperative complications occured. The clinical results were graded according to Merle d'Aubigné/Postel. The mean hip score for pain improved from 2.9 preoperatively to 5.7 after THR during the mean observation period of 5 (1–8) years.

No radiographic or clinical signs of loosening were seen in any hip during the follow-up period.

Discussion: The challenging procedure of open reduction and internal fixation of acetabular fracture may not ensure ideal alignment of the acetabulum or prevent the development of secondary arthrosis. Since our results with THR in fractured acetabuli seem to be the same as the results of THR in ordinary hips, we would recommend conservative treatment of acetabular fractures. Secondary reconstruction with cementless HAC total hip artroplasty is performed when indicated in cases with secondary arthrosis.

123. Anatomic rebuilding acetabular component for severe pelvic damages in hip prosthesis loosenings

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Recurrent failures of acetabular component lead to a triple challenge:

- mechanical: how to obtain stability when close bone structures are destroyed?
- biological: how to restore a bony living bed when bone stock is deeply reduced?
- anatomical: how to place the cup in right position when land marks have disappeared ?

Conventional process (wire netting, support ring, mega-cup) are inadequate while operating and unsure in the long run for such major damages.

We worked out an original strategy with an uncemented modular cup called OCTOPUS including:

- a frame or "spider support": pure titanium ring with a lower hook (inserted in the pelvic foramen) and two iliac pre-oriented plugs, fixed by screws on remainning ileum.
- a hemispherical HAP coated cup interlocked with the support by screws after press-fitting bone grafts, filling the defect.
- a polyethylene insert adjusted to different head sizes with antidislocating process or re-orientated cup.

Clinical cases illustrate the surgical procedure and the 3 years follow up results of this technique which allows bone stock reconstruction and anatomical pelvic rebuilding.

124. An affordable 2D CAD-system for preoperative planning of total hip replacements

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Preoperative planning (PP) of a primary THR by drawing is helpful; it allows to foresee problems in finding the correct pivot point, as to its height and lateralisation, it helps to choose an implant with the right CCD-angle and neck length to establish the correct offset, thus helping to avoid unwanted leglength-discrepancies and poor gait.

PP of a complex revision THR is mandatory, because due to grossly migrated components some of the clinical intraoperative tests i e tension of the capsule and soft tissue cannot be used in order to reconstruct a proper biomechanic situation. Measuring the correct size of the implants is essential not to overream weak bone stock in the acetabulum as well as in the femur. In case of a transfemoral approach, PP gives the accurate data where to start or to end the osteotomy.

The benefits of preoperative planning are various:

1. It gives information that to solve a given problem one might need a special implant, i e extra-small, extra-large, extra-long.
2. The accuracy of the postoperative results is increased in terms of avoiding unwanted leglength-discrepancies, false pivot-points, too short muscle leverarms or tendency of dislocation.
3. Using a CAD system one can vary the scale of a given template in order to match it with the scale of a particular radiographs.
4. After some training in p.p. one will be able in most cases to predict the exact size of the implant, which will fit; this might offer the opportunity to cut down the stock (and costs) by installing a "just in time" delivery system for implants.
5. Time during the operation is very expensive; p.p. is facing you with most of the questions and answers, which are embedded in a given case, without loosing blood down the drain whilst thinking.
6. Problems in hip-surgery may have more than one viable solution; doing p.p. in these cases using a CAD-system will save the more time the more variations have to be done, because of the saved preoperative situation.

125. Total hip arthroplasty following congenital hip dislocation

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Introduction: Osteoarthrosis secondary to severe congenital dislocation of the hip is treated with total hip arthroplasty, but fixation of the acetabular cup poses several problems. We report results from a rather simple technique, placing the acetabular cup as distal to the false acetabulum as possible, but not necessarily in the true acetabulum, without bone grafting and with only slight modifications of the standard Charnley technique.

Patients and methods: The follow-up study included 122 consecutive patients (mean age 50 years) with 169 hips operated on from 1969 to 1990 in the author's institution. Only hips with an Eftekhar stage B, C or D dislocation were included. In situ time, failure and death was recorded to construct a survival table. 159 hips were available for current radiographic examinaion. The number of radiographically loose acetabular components were recorded.

Results: Follow-up time was mean 12 (1–24) years. 30 hips were revised, 5 were revised due to deep infection, 25 were revised due to aseptic loosening. 36 acetabular cups showed definite radiographic loosening at follow-up according to Delee and Charnley.

126. Total hip replacement in congenital high dislocation

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Total joint replacement in congenitally dislocated hips are technically demanding procedures. It is stated that a total lengthening of the limb must not exceed 4 to 5 centimeters to prevent damage to the femoral and sciatic nerves. This is achieved by a subtrochanteric shortening osteotomy of the femur.

Materials and methods: Since 1988, 19 patients, 5 bilaterally, have undergone this procedure. There were 16 women and 3 men. Minimum observation time is 2 years. All had high dislocation, and they were untreated as children. Preoperatively, Schantz osteotomy had been preformed in 4 hips, and 3 had hip prosthesis with the acetabulum located in a high position. The reason for arthoplasty was severe pain and disability on walking. The original acetabulum was easy to identify after a subtrochanteric osteotomy was performed. 16 hips received a noncemented prosthesis, 3 were cemented and 5 received a noncemented acetabulum and a cemented stem. Only 3 hips needed a reinforced roof with a bone graft. The mean resection was 4.3 (1–8) cm. The total lengthening of the limb was mean 3.5 cm. The osteotomy was performed transversally, and the femoral stem acted as a medullary nail without additional fixation. At the osteotomy site cancellous bone was added. Tenotomies of the fascia lata and rectus femoris were needed in most cases.

Complications: Stem loosening occurred in one case with the Bio-Fit prosthesis, 1 was reoperated due to malposition of the acetabulum, 1 loose acetabulum and 1 loose stem were seen. One patient had lesion of the sciatic nerve, and non union was seen in one case.

Results and conclusion: After the operation all patients were painfree and walked without aid. In half of the patients negative Trendelenburg was observed. In total, the results are encouraging. The femoral osteotomy allows an easy entrance to the original acetabulum, and, in our opinion, the good function is due to the nearly anatomic position of the proximal femur.

Trauma

127. Definition and prevention of infections in multiple injuries

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Modern treatment of intensive care patients aims to prevent rather than treat complications. Unnecessary treatment with antibiotics is expensive and predisposes to superinfections. How to define infections in patients with multiple injuries and how to prevent them?

Patients and methods: A series of 34 patients with multiple injuries were examined prospectively to define the earliest signs of infection and the appropriate treatment. Each patient was given a prophylactic antibiotic for 1 to 3 days postinjury. A protocol was developed to define which criteria should be met to claim an infection. If no signs of infection were seen the patient received only the prophylactic antibiotic. When starting treatment with antibiotics the reason for that was registered. The variables included laboratory parameters for the first 14 days, chestradiographs and regular cultures from wounds, urine drains, trachea and blood.

Results: 17 patients with open fractures and 16 patients with only closed injuries were given a prophylactic antibiotic. The mean age of the patients was 44 (13–77) years. For 23 patients the original antibiotic was either not discontinued (3 patients) or another therapeutic, usually broad-spectrum antibiotic was chosen (20 patients). Antibiotic therapy was allowed, if culture from blood or jount fluid was positive or the wound had a secretion of pus, or pneumonia was observed on a chest radiograph film. Antibiotic therapy was

also allowed on combined criteria based on fever, C-reactive protein, thrombocytes, shivering and tachycardia. Two infections were detected with a more than fourfold rise in serum alfa-toxin IgG antibody level.

Conclusion: The definition of infection in patients with multiple injuries needs further assessment in order to define the right indications for and avoid unnecessary treatment with antibiotics.

128. The posterior luxatio coxae with a ventrocaudal fracture of the femoral head (Pipkin fracture)

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The Pipkin fracture is a rare fracture. To our knowledge there have been few reports on Pipkin fracture. In the review of the literature most of the time case reports are described.

Pipkin (1957) published a series of 25 patients. He classified these fractures in four types.

Between 1984 and 1993 we saw 5 patients with a Pipkin fracture.

In most of the publications a long period of immobilisation is described. We report in our 5 patients about the early mobilisation of the Pipkin fracture.

129. A second generation locked intramedullary nail for the treatment of severe proximal and combined femoral fractures

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Introduction: Locked intramedullary nailing is well established in femoral fractures where the trochanters and condyles are intact. We modified the slotted Grosse-Kempf nail to house two 7 mm Ullevaal Hip Screws for the insertion into femoral neck and report our preliminary experience in 20 cases of complex femoral fractures since 1990.

Patients and methods: We used our second generation nail (Howmedica, Kiel) in 8 men and 12 women, median age 73 (25–95) years. We used a 13 mm nail in the first 14 cases and a 14 mm nail in the last 6 cases. The indications were: failed trochanteric osteosynthesis in 1, fracture after previous osteosynthesis in 7, fracture of the shaft and hip in 2, comminuted trochanteric-subtrochanteric fracture in 7, and pathologic fracture in 3.

Results: Complications: break-through of screw in 1, fracture of nail in 2, and shortening of femur by 4 cm in 1. There were 2 reoperations during 22 (1–40) month follow-up. 2 of 3 pathologic fractures are still at risk, all other fractures are healed.

Discussion: Osteosynthesis with plates in multiple femoral fractures is a logical step-by-step solution. An absolute stability of the bone/implant construct is required. The stresses of such constructs may become too high, especially in fragile bone. Locked nailing allows more freedom, the construct may deform temporarily without jeopardy. Further, the fracture healing potential is disturbed less in closed nailing than when using open methods.

130. Segmental bone defects of the tibia treated with bone transport

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Introduction: We have used the Orthofix limb reconstruction system for bone transport in five cases of segmental bone loss of the tibia after grade IIIB fractures.

Patients: There were four men and one woman with a median age of 41 (30–55) years. All had had a high energy injury to the leg. Before transport devitalized bone was resected, soft tissues reconstructed and infection controlled. The length of the tibial defects when transport was started was 5.2 (2.4–10.2) cm. The time from injury to the start of the transport was 14 (7–17) weeks.

Results: The duration of transport was 9 (7–30) weeks. The time from osteotomy to fixator removal was 10 (7–15) months. The length of the regenerated new bone was 5.0 (2.1–12.7) cm. Alignment was well maintained, but one patient required correction of rotation during transport. Two had minor pin tract infections. No nerve or vessel complications occurred. Two fractures healed spontaneously and two after bone grafting. Grafting has recently been performed on the last patient. The functional results were satisfactory.

Conclusions: We have found bone transport rewarding in these very challenging injuries.

131. Early range of motion training after ligament reconstruction of the ankle joint

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Chronic lateral instability of the ankle joint often leads to permanent disability, especially in athletes. The recommended treatment is surgical reconstruction of the lateral ligaments if the patient does not regain satisfactory functional stability after a rehabilitation program. The aim of this study was to evaluate the effects of early range of motion training after anatomical ligament reconstruction for chronic lateral ligament instability of the ankle joint.

Material and method: Forty patients (22 men, 18 women) with a mean age of 24 (17–35) years were all operated on with anatomical reconstruction, i e shortening, imbrication,

and reinsertion of the lateral ankle ligaments. Postoperatively the patients were randomized into two groups. (I) Immobilization for six weeks in a plaster cast. (II) Early range of motion training, using Walker Boot (R). The functional results were assessed using a scoring scale, and the objective stability with standardized stress radiographs, measuring anterior talar translation (ATT) and talar tilt (TT) preoperatively and at follow-up one year postoperatively. The study was prospective, randomized and blinded, with an unbiased observer.

Results: The functional results were satisfactory in 16 of the patients in group I, while 4 were dissatisfied with their ankle function, mostly due to pain. All patients but one in group II had satisfactory functional results. The mean values of ATT and TT were not significantly different between group I and II pre-operatively and did not differ significantly at one year follow-up. The mean time period for sick leave and the mean time for return to sports activity were shorter for patients in group II compared to group I. Two surgical complications were noted, both superficial infections in group I. One of these patients had unsatisfactory functional results due to persistent pain.

Conclusions: The functional results were better after early range of motion training and the mechanical stability was not compromised. Early range of motion is recommended as it will enable earlier return to sports activities and shorter sick leave.

132. The long-term course of clavicular fractures in adults

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The aim of this study was to evaluate the long-term results after non-operated mid-part and lateral clavicular fractures in adults 10–20 years after the injury.

Material and methods: Between 1970 and 1979, 1,665 traumatic fractures of the clavicle were treated at Malmö General Hospital, serving a population of 230,000. 222 mid-part and 93 lateral clavicular fractures sustained in adult patients still living in Malmö were identified and the patients were re-examined. All patients had been conservatively treated with sling immobilisation. There were 71 undisplaced and 151 dislocated mid-clavicular fractures as well as 74 undisplaced and 19 dislocated lateral clavicular fractures. The clinical examination was focused on pain and shoulder function. 260 fractures were roentgenographically examined.

Results: At follow-up 185 patients were rated good, 36 fair and one poor after mid-clavicular fractures and 79 patients were rated good, 14 fair and no poor after lateral clavicular fractures. Roentgenographically there were seven non-unions in the mid-clavicular group and ten non-unions after lateral clavicular fracture. 138/186 fractures had healed with deformation and exuberant bone formation after mid-clavicular and 25/74 after lateral clavicular fractures, significantly more often after displaced fractures. Eleven patients with clavicular non-union were asymptomatic and six patients had moderate pain.No patients had persisting neurological symptoms and no patient wanted surgery at follow-up.

Conclusions: The results of the present study indicate that most clavicular fractures in adults can be conservativley treated. Healing with deformation and non-union is compatible with a favourable outcome in most patients.

133. "Radial Head-Capitellum View" in acute elbow trauma

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Introduction: Evaluation of the "Radial Head-Capitellum View" (RHC) in acute trauma of the elbow.

Material and methods: In a prospective study 386 consecutive patients, who suffered an acute trauma of the elbow with clinically suspicion of fracture, were included. All had radiographs in 3 projections: lateral (LAT) with the elbow in 90° flexion, anterior/posterior (AP) with the elbow fully extended and a 45° oblique lateral (RHC) projection with the elbow in 90° flexion. All radiographs were evaluated by a radiologist.

Results: There were 134 fractures. 106 of the fractures were 2-fragmentary, 26 were comminuted and 2 were epiphysiolyses. 39 were dislocated. The RHC radiographs unveiled 11 fractures not visible in the ordinary radiographs (LAT+AP). They were all 2 fragmentary non-dislocated. 9 of these were localised to the caput (7) or the collum (2) of the radial bone, 1 was localised to the lateral condyle of the humerus and 1 in the olecranon. 10 of the 11 fractures had an effusion on the LAT radiographs. In all 77 cases had effusion on the LAT radiographs. 30 of these had new radiographs taken 10 days later unveiling 3 fractures more (all in the radial caput non-dislocated 2 fragmentary).

Conclusion: The "Radial Head-Capitellum View" is only recommended, as a supplement in acute elbow trauma, when the standard lateral projection shows an effusion in the elbow joint.

134. Intra articular calcaneal fractures in children

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Introduction: The management of fractures of the calcaneum has attracted much interest and controversy over the

years. The majority of the literature relates to adult fractures. Few reports detail the management of intra articular fractures of the calcaneum in children. This paper reviews our experience at Alder Hey Hospital.

Patients: Six children with seven fractures were reviewed personally. The following data was obtained. The age and sex of the patient, mechanism of injury, type of fracture and associated injury was documented. Conservative or operative treatment was recorded. If operative the timing, incision and method of fixation was noted. Any complications were recorded. At clinical review the patients were asked about pain at rest and during activity, the need for analgesia, their walking distance and their ability to negotiate uneven ground. The calf diameter and heel width were measured. The range of movement at the ankle joint, subtalar and mid tarsal joints were recorded. Plain radiographs and CT scans were scrutinised.

Results: There were 5 boys and 1 girl. Their ages ranged from 9 to 13 years. All sustained their injury following a fall from height. All injuries were closed. 2 patients had associated injuries. One patient had conservative treatment. The remaining five had operative intervention 5 to 11 days after injury. The fixation was by way of plate and screws in 3 and k wires alone in 3. 1 fracture was bone grafted. There were no post operative complications. The conservatively treated patient required a subtalar arthrodesis for pain. Using parameters modified from Crosby and Fitzgibbons 4 feet had an excellent result and 2 feet a poor result at a mean follow up of 25 months. In 4 feet Böhlers angle was restored

Conclusion: This small series demonstrates that excellent results without wound problems can be achieved by open reduction in the child.

134A. Monolateral external fixation for femoral-shaft fractures in children A multicentric study

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Introduction: The traditional conservative approach to childhood femoral fractures provides satisfactory results but implies several disadvantages such as long hospitalization, unconfortable nursing and frequent complications (shortening, angular deformities). In recent years, external fixation has gained popularity not only for treatment of complicated fractures or associated with multiple injuries but also for non-complicated femoral-shaft fractures.

Patients and methods: A total of 47 children with femoral-shaft fractures were treated by monolateral external fixation. There were 29 boys and 18 girls with a mean age of 9 (6–16) years. Thirtytwo fractures were located at the midshaft, 12 at the proximal third, and 2 other at the distal third of the femur. There were neither open nor comminutive fractures The Wagner device was used in 20 cases and the Orthofix® in 27. In all cases, the fixator was applied no more than 24 hours after the fracture.

Results: The mean hospitalization time was 10 (3–28) days. As a major complication, pin tract infection occurred in 11 cases. In 3 of these patients, the device had to be removed, requiring a spica cast to complete the treatment. Osteomyelitis was never seen. The average time interval of fixator bearing was 79 (18–180) days. After removal of the device, some degree of knee stiffness was observed during a short period, but full range of motion was usually achieved after a few weeks of exercises at home. Only one patient who wore the fixator for 5 months required forced knee flexion under anesthesia. Refracture of the femur occurred in 3 cases. Internal fixation plus grafting was then performed in these 3 cases. Consolidation was obtained in all cases. In patients followed for more than 18 months, a mean femoral overgrowth of 0.9 (0.5–1.8) cm was detected. Shortening of the fractured side was never found.

Conclusions: In our experience, the main advantages of external fixation over other methods classically recomended for treatment of femoral-shaft fractures in children (traction, cast) includes less hospitalization time and a more confortable nursing. Furthermore, external fixation allows a better control of the bone fragments, providing the adequate stability. Pin tract infection seems to be the major drawback.

Videodisc exhibition

1. Pathoanatomical analysis of spinal metastasis—a videodisc exhibition

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Spine specimens from patients who had succumbed to metastatic cancer disease with different stages of spinal metastases that had been treated by radiation therapy alone or in combination with surgery for decompression and stabilization, were harvested for detailed studies at clinical routine autopsies. The spine portions were removed after freezing in situ, examined with both conventional radiography and high resolution computed tomography and then cryosectioned at submillimeter intervals.

In the non-surgically treated specimens, the metastatic growth in the bony and discoligamentous vertebral elements and any compromise of the contiguous neurovascular spinal elements was studied in great detail. The "surgical" specimens were also examined for adequacy of decompression, positioning of the spinal implants, postoperative and adverse changes, if any.

In the non-surgically treated spines, lytic metastases were most common, most metastases were in contact with the wall of the vertebrae and the endplates. Endplate depressions were associated with expansion of the discs, all lytic lesions adjacent to endplate defects contained disc material. Among the collapsed vertebrae, few showed blowout-type extrusions of the posterior wall. Compression of the posterior elements such as kissing spines, facet joint subluxation and pars failure were common.

Most of the surgically treated spines had been stabilized with (posterior) segmental pedicle screw fixation without ancillary anterior surgery. No patient with a posterior fixation had a secondary anterior vertebrectomy or fusion. Although both CT scans and cryosectional images displayed some migration of the pedicle screws, rendering a lucent zone towards the collapsed metastatic vertebral segment(s), no adverse effects such as deformity or spinal canal compromise were found in any of the specimens. Analysis of surgical complications revealed several penetrations of the pedicle cortex, one cauda equina compression by a fat graft, extracorporeal pedicle screw placement in several instances, one cauda equina tethering, a severe posterior scar tissue compromise and one instance of bone cement extrusion into the spinal canal.

2. A teaching system system for the coming arthroscopic surgeons—a videodisc exhibition

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Learning how to operate delicate instruments in vulnerable joints without doing any damage to either of these is a time-consuming proces, especially if the operating room is fully booked for the day.

For the sake of the patients and to avoid impatient nurses we have developed a simple system for practicing triangulation exersizes outside the joints in a safe manner by the use of Lego®-system. A number of modules for both the beginner and the more experienced arthroscopic surgeon is demonstrated on this video. The possibilities of further developing this system is unlimited.

Finally a very authentic exersize with motorized shavers using oranges instead of joints are demonstrated.

Poster exhibition

1. A comparison of seven bone cement mixing systems

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Introduction: Mechanical loosening of total joint replacements is the most common cause of prosthetic failure. Loosening may orginate from failure of the cement mantle itself. Fatigue fractures of bone cement is most likely to occur at the site of voids. The size and number of voids can be reduced by mixing the bone cement under partial vacuum. Several different mixing systems has been introduced during the last years. We have tested seven of those systems in order evaluate their effectivness to reduce the voids.

Methods: Mitvac, Optivac, Cemvac, Stryker, and Merck vacuum mixing systems were tested using prechilled Palacos® bone cement. As a control, prechilled Palacos R was also mixed at atmospheric pressure. Two systems, Bonelock and Cemex, using the prepacking principle were also tested. After mixing, the bone cement was injected into PVC tubes. Radiographs of the tubes were obtained, and the number of macropores (voids > 1 mm) was counted. A standardized section from each cement bar was then cut and the number of micropores (voids 0.1–1 mm) was counted. The density and remaining unpolymerized PMMA particles were also measured.

Results: The Optivac, Merck and Stryker systems were slightly more efficiant in redusing porosity than the Cemvac and Mitvac. The result of Bonelock and Cemex mixing systems was not comparable to the others as the systems included prepacked bone cement with different viscosity.

Conclusion: Vacuum mixing of bone cement reduces both micro- and macroporosity.

2. The strength of bone cement and the effects of lamination

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Introduction: The fixation of cemented acetabular components remains troublesome. This may be due to insufficient penetration of the cement into the cancellous bone. The pressure needed for adequate cement penetration may reach 0.2–0.3 MPa (1). Such pressure applied to the entire acetabulum will cause the pressure instrument to lift from a counter-force of up to 500 N. Instead each anchoring hole could be cemented individually, which, however, will create laminations in the cement. We have assessed whether such laminations significantly affect the strength of the cement.

Methods: Pre-cooled Palacos® cum Gentamicin was mixed in vacuum. 2, 3 and 4 minutes after mixing, the cement was injected from both ends into plastic tubes (diameter 10 mm). The interface where the injected cement met was either dry, inundated with saline or with blood. After curing, the cement poles were machined to a diameter of 7 mm and tested in an Instron testing machine until rupture using a cross-head speed of 0.5 mm/min.

Results: Preliminary, solid rods broke at a mean of about 50 MPa. Dry lamination decreased the strength by about 10%. Laminations including saline decreased the strength by about 20%. The addition of blood to the interface proved more harmful but only after 3 and especially 4 minutes, at which time the strength had decrease by more than 50% of that of the solid rods.

Discussion: The results of this study correspond to a previous study at corresponding conditions, except that our cement generally was a factor 2 stronger (2). In that study shorter times after mixing than 4 minutes were not tested. These results suggest that sequential cementation of the individual anchoring holes followed by the application of cement to the entire acetabulum may be feasible, provided that the entire procedure is done within 2 to 3 minutes.

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3. Incidence of pigmented villonodular synovitis in Iceland 1984–1988—a retrospective study

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Aim: To estimate the incidence of pigmented villonodular synovitis (PVNS) in Iceland.

Introduction: PVNS typically occurs as a mono-articular proliferative process affecting adults in the third and fourth decades of life.The knee is the most commonly involved site followed by the ankle.Two variants are identified: 1) A localized proliferative process, which tends to be well demarcated from surrounding structures and where the recurrence rate is relatively low. 2) A diffuse variant involving large areas of synovium with a tendency to invade and destroy articular cartilage. Surgical excision is the treatment of choice. A previous population study (Myers et al.1980) estimated the annual incidence at 1.8 cases per one million population.

Patients and methods: All specimens examined in the Department of Pathology, University of Iceland, and Regional Hospital, Akureyri, during the 5-year period 1984–1988 and coded as synovitis,synovial hyperplasia and giant cell tumor were retrieved and examined by one of us (JB).

Results: Review identified twelve patients,eight women and four men, average age 37 (19–72) years. Each patient had involvement of one joint.Ten patients had PVNS of the knee joint (seven localized and three diffuse). Two patients had localized PVNS outside the knee, one in the ankle and another in a metatarsal joint. All patients underwent partial or total synovectomy. In addition, one patient underwent total knee replacement. None of the nine patients with localized PVNS had recurrence. Two of three patients with the diffuse variant of PVNS had recurrence.

Conclusions: Based on this small number of patients, PVNS appears to have an annual incidence rate of 9.6 patients per year per one million population. This incidence rate is five times higher than estimated by Myers et al. The reason for this apparent discrepancy is not obvious. Can the increasing use of arthroscopy play a role?

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4. Gentacoll® for local prophylaxis against postoperative *Staph. aureus* osteomyelitis in rabbits

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Resorbable collagen sponge containing gentamicin (Gentacoll®) may provide a high local concentration without need of secondary removal of the drug carrier. We compared the effect of gentamicin incorporated in collagen with the effect of collagen alone and systemically administered gentamicin in acute osteomyelitis. A total of 28 rabbits (Ssc:CPH) including 6 for local pharmacokinetics were used for the experiment. Under anesthesia, K-wires were placed in four holes drilled in both tibiae. Local application of NaOH and an inoculum of 2 x 10^8 *S. aureus* resulted in acute osteomyelitis. Collagen sponge (N=6) or Gentacoll® (10 mg/kg) placed in the wound (N=12) or gentamicin 10 mg/kg intravenously (N=6) was used for treatment. Infection was quantitated by macroscopic evaluation of inflammation in tissue, bone and bone marrow, and by growth biopsies from the same areas giving a score of 0–8.

Both collagen+gentamicin and systemic gentamicin reduced the infection-rate ($p < 0.01$). The effect of pure collagen was caused by application of collagen+gentamicin in the opposite leg. Peak concentrations in serum was 5–10 µg/mL and 30–40 µg/mL after local and systemic prophylaxis, respectively. The concentration of gentamicin locally showed a peak after 2 hours in the range of 112–3000 µg/mLfor bone and 225–890 µg/mL for tissue.

Gentamicin incorporated in collagen may thus be a valuable adjunct for prophylaxis against postoperative infections.

5. Bone mineral measurements by DPA in the proximal tibia

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Introduction: Evaluation of BMC and BMD in the proximal tibia is of special interest because this part og the skeleton is highly sensitive to immobilisation and altered loading of the knee.

Material and methods: A Gammatec dual photon scanner (Gadolinium-153) was used for the bone mineral measurements. Three in vitro studies were performed using specimens of dogs' bone meal weighed and stored in polycabonate straight side jars (2 different jar diameters and ashed bone meal). The short (1 month) and long term (1 year) precision in vitro were calculated from measurements performed on a calcium-standard. The precision in vivo was calculated from measurements in the coronal plane of the proximal tibia performed in 8 healthy people measured 3 times bilaterally.

Results: The in vitro series showed that the scanner had a lower detection limit for measurement of bone weights below 0.25–1.0 g depending on bone density. BMC (r = 0.997, SEE = 3.2%) and BMD (r = 0.9996, SEE = 1.1%) were highly correlated to ash weight. The precision in vivo were below 1% and 2% for respectively BMC and BMD, and 3.4–5.2% if BMD was measured in small areas at different locations within the proximal tibia.

Conclusion: Measurement of BMC and BMD performed in the proximal tibia by DPA is highly accurate and the precision allows quantitative measurements of local bone remodeling.

6. Absorbable polyglycolide pin fixation of fractures in children

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Introduction: Polyglycolic acid (PGA) has been in wide clinical use as an absorbable suture material since 1970 in pediatric surgical praxis, too. Absorbable implants made of polyglycolide (PGA) and with no need for implant removal operation have been available for internal fixation of fractures as an alternative to conventional metallic pins in our clinic since year 1984. We have used small-diameter polyglycolide pins as a substitute for metallic pins in the fixation of displaced fractures in children since 1987.

Patients and methods: During the period from September 1987 to September 1993, 98 children with a variety of displaced physeal or non-physeal fractures were treated by open reduction and absorbable pin fixation. The indications for surgery were: 1) displaced (>2 mm) fractures of the lateral condyle of the humerus; 2) severe avulsions (>5 mm) of the medial epicondyle of the humerus; 3) displaced physeal fractures Type Salter-Harris III or IV; and 4) supracondylar fractures of the humerus after a failed attempt at closed reduction. As a rule, the patients underwent surgery within 24 hours of admission (mean 19.5 hours). Open reduction under general anesthesia was performed using standard techniques with the exception that absorbable polyglycolide pins were used to fix each fracture. A postoperative plaster cast immobilization was used in all patients for four to six weeks.

Results and conclusion: The patient population consisted of 62 boys and 36 girls with an average age of 10 (2–15) years. The follow-up time averaged 45 months. Uneventful clinical course and functional recovery ensued in 94 cases. One superficial wound infection (1%) and 3 secondary redisplacements were seen. With the exception of the severely displaced supracondylar fractures of the humerus (i.e. 3 redisplacements), the absorbable pin fixation maintained the reduction without evidence of abnormal physeal growth. The functional result was graded as good. Keeping in mind the basic advantage of the absorbable pin fixation with no need for pin removal operation, we therefore recommend absorbable pin fixation as a viable fixation method of displaced physeal and non-physeal small-fragment pediatric fractures.

References: Mäkelä EA, Vainionpää S, Vihtonen K, Mero M, Laiho J, Törmälä P, Rokkanen P. Healing of physeal fracture after fixation with biodegradable self-reinforced polyglycolic acid pins. An experimental study on growing rabbits. Clinical Mater 1990; 5: 1–12.

7. Direct thrombin inhibition with rec-hirudin CGP 39393 as prophylaxis of thromboembolic complications after total hip replacement

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Hirudin is an anticoagulant originally extracted from the leech *Hirudo medicinalis.* Using recombinant DNA technology a new compound, recombinant desulphato hirudin CGP 39393 has now been produced. The aim of this open pilot trial, designed as an ascending dose-finding study, was to determine the maximum tolerated dose in patients undergoing elective hip replacement.

In this study 48 patients undergoing primary total hip replacement were included and the safety of subcutaneous injections of 10, 15, 20 and 40 mg CGP 39393 twice daily, was evaluated. Prophylaxis was started immediately preoperatively and continued for 8 –10 days. A mandatory bilateral phlebography was performed at the end of the prophylactic treatment period and a clinical follow-up was done six weeks after surgery.

A major bleeding event occurred in the first three patients receiving 40 mg CGP 39393 b.i.d. and the prophylaxis regimen at this dosage level was therefore discontinued. Median values of total blood loss and requirements of blood transfusion in the patients receiving 10–20 mg CGP 39393 were similar to those reported in previous studies on total hip replacement performed at the same centre, using other prophylactic drugs. Deep vein thrombosis (DVT) was confirmed by phlebography in five out of 12 patients in the 10 mg group (42%, 95% confidence limits [CL]: 15–72%), one out of 11 patients in the 15 mg group (9%, CL: 0.2–41%) and two out of 20 patients in the 20 mg group (10%, CL: 1.2–32%) during the prophylaxis period.

CGP 39 393 was safe and well tolerated, when administered as subcutaneous injections of 10–20 mg twice daily. The dose level of 40 mg CGP 39393 twice daily resulted in serious disturbance of the hemostasis in patients after hip prosthesis surgery.

8. Does tranexamic acid reduce blood loss in total knee arthroplasty?

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Introduction: At our department, tranexamic acid (Cyklokapron®), has been given during total knee arthroplasties since 1987 in order to decrease blood loss. The drug was administered towards the end of the operation before the tourniquet was released. The aim of the study was to

evaluate the effect of this treatment on blood loss and blood transfusions.

Material: The records of all patients, who had been operated on with primary total knee arthroplasties during 1985–1988 were retrospectically reviewed. 70 patients had received tranexamic acid before the tourniquet was released. 109 patients who had been operated on with the same prosthesis, but not given tranexamic acid, served as controls.

Results: The mean peroperative blood loss did not differ between the two groups. Multiple regression and logistic regression analysis of the factors that differred between patients and controls showed that tranexamic acid administration reduced postoperative blood loss with 340 mL and also greatly reduced the risk for receiving any blood transfusions. The mean postoperative blood loss in the controls was 1260 ±590 mL.

Conclusion: A retrospective study of 179 total knee arthroplasties indicated that tranexamic acid, given during operation, significantly reduces postoperative blood loss and blood transfusions.

9. Is Colour Doppler Ultrasound a sensitive screening method in diagnosing deep vein thrombosis after hip surgery?

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Computerized colour flow duplex is the latest technology in non-invasive vascular evaluation. High expectations has been invested in this technique as an effective screening method in patients after surgery with a high risk of postoperative thromboembolism.

During a period of two and half years, from January 1991 to May 1993, 143 consecutive patients undergoing total hip replacement (63) or hip fracture surgery (80) were surveilled with bilateral ascending phlebography and colour flow duplex imaging technique 7–10 days after surgery. Both limbs were examined (286) and counted separately. Colour Duplex examinations were performed using Acuson 128 computerized colour flow duplex imager with a 5 MHz probe. The technique used was combined compressibility of the vascular lumen and colour doppler flow fenomena. All Colour Duplex examinations were performed by one specialized vascular technician.

The total incidence of phlebographically verified deep vein thrombosis was 28%, 8% proximal (thigh and popliteal region) and 20% distal (below knee region). For proximal venous thrombi Colour Duplex had a sensitivity of 50% (6/12) and a specificity of 99.6% (1/274). For distal vein thrombosis Colour Duplex had a sensitivity of 47.1% (15/32) and a specificity of 97.2 (7/254). In the proximal region false-negative findings with Colour Duplex corresponded to small non-occlusive thrombi phlebographically (6). In the distal region small muscular vein thrombi was the predominant type of thrombus not diagnosed by the Colour Duplex technique (11). Thus 17 of the 23 false negative Color Duplex findings represented small non-occlusive thrombi or thrombi located in muscular veins.

The computerized Colour Duplex imaging offers an improved visualization of the veins, when compared with conventional ultrasound doppler technique and Colour Duplex has shown accurate results in patients with symptomatic deep vein thrombosis. These results could not be not confirmed in this study of asymptomatic surgical patients. In this surveillance study of total hip replacement and hip fracture patients the rate of deep vein thrombosis was high, 28%. The sensitivity of the Color Duplex technique was shown to be too low to be suitable for screening purposes.

10. Effect of transforming growth factor and platelet growth factor on articular cartilage in rats

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Material and methods: The effect of 0.2–0.5 μg r TGF-1 in one to 15 daily injections in the knee joints of young rats was studied after one to 180 days. Other rats were given injections of 0.5 μg of rPDGF-BB. The opposite knee was the control knee, injected with the vehicle only.

Results: The changes caused by TGF were most marked in the patella. An immediate formation of fibrous tissue in the joint and release of immunological cells were results of TGF but not of PDGF. The hypertrophic cells became within 1–2 days indistinct in their contours in hematoxylin stain. The matrix was stronger stained with safranin O due to increased activity of proteoglycans. A bone plate developed, heaviest after five days. Most of the hypertrophic cells disappeared. Injuries to the cartilage were observed. Localized cartilage necroses and regenerative proliferation of cells occurred. PDGF did not cause alterations. After 90 and 180 days three of six cartilages were destroied, the other were partially ossified. PDGF caused but few changes.

Conclusion: Subchondral bone formation, proliferation of chondrocytes, necrotic areas and ossification of the cartilage after TGF-injections (but not after PDGF) are events occurring in osteoarthrosis.The young patella seems to be an excellent bone for non- invasive studies of growth plates.

11. Does thromboprophylaxis influence survival after total hip replacement?

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Aim: To determine the long-term survival and causes of death in elective hip surgery patients in relation to type of perioperatively administered thromboprophylaxis.

Patients: 1369 patients who participated in one of 7 different prospective, randomized prophylaxis studies carried out in Denmark or Sweden between 1984–1991 were included in the present study on an intention-to-treat basis. In the original studies the main end-point was reduction of thromboembolic complications (TEC), DVT or PE, verified by phlebography or lung scan. In case of diagnosis of TEC patients were treated with oral anticoagulation for 3 months. The prophylactic regimens employed were low molecular weight heparin, either sandoparin-DHE (n=112), tinzaparin (n=223), dalteparin (n=174) or enoxaparin (n=119) vs. various controls: placebo (n=271), macrodex (n=287) and unfractionated heparin (n=183). Prophylaxis was started preoperatively and continued for 7–10 days. The median follow-up time for all studies was 4.8 (0.02–8.3) years.

Methods: The probability of survival was estimated by the Kaplan-Meier method and the statistical significance of each comparison was calculated with a logrank test. A Mantel-Haentzsel analysis was made on all causes of death.

Results: There was no difference in survival between patients receiving active thromboprophylaxis, however, there was a general trend towards a better survival in the 3 placebo groups compared with LMWH and a stratified logrank test on these showed significance in favour of placebo ($p = 0.02$). An analysis on all causes of death showed a significant excess of cardiovascular deaths in the LMWH groups ($p = 0.02$).

Conclusion: These findings suggest that active screening for TEC by objective methods and treatment of verified cases after total hip replacement may be the most effective from a survival point of view. On the contrary the risk of late death is increased in patients having short-term preventive methods in spite of screening. Futher studies are needed with mortality as the main end-point. More extensive prophylactic regimens (prolonged administration and/or increased dosages) should be considered if screening is not to be empolyed routinely.

12. Can mechanical strength of a bone/-implant construct in osteosynthesis of an oblique osteotomy in the distal femur be predicted by densitometric bone mineral assessment?

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Introduction: Bone mineral assessed by densitometric methods reflects mechanical strenght of bone. The interesting question is whether densitometric findings are expedient in deciding between different methods of osteofixation in the treatment of fractures.

Material and methods: In a pilot study two pairs of distally osteotomised cadaver femura from elderly individuals were stabilised with two different kinds of osteofixation device (Grosse-Kempf interlocked nail and 950 AO condylar plate), after densitometry by quantified computed tomography. The femura were subjected to static excentric axial load until mechanical failure. The loads at failure were related to the densitometric findings and used to calculate an estimated failure load in 13 other femura which were fixed with the same devices. These 13 specimens were then loaded till mechanical failure.

Results: The calculated failure loads varied inexplicably as regards the demographic data but correlated well with the observed loads in the specimens tested. A correlation coefficient of 0.92 and a variation coefficient of 13 % between estimated and effective observed load at failure was noted.

Conclusion: This study shows that bone mineral assessment by densitometric methods may be used in prediction of mechanical strength of a bone/implant construct.

13. Re-revision after total hip replacement Results from the Swedish National Hip Register

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Introduction: In order to continuously improve and to secure a high level of quality of total joint replacement procedures the National Hip Register is collecting all reoperations after THR in Sweden. All Swedish surgeons performing THR are participating in this ongoing study.

Material and methods: In this presentation are included re-revisions performed between Jan. 1979 and Dec. 1993, although the register still is not completely updated for 1993. Copies of the medical records of patients revised after THR are sent to the National Hip Register. Certain parameters are extracted from the medical records and the information is computerized. 17,276 patients have been reoperated after the primary THR. 11,197 of these operations are revi-

sions with exchange or extraction of the cup/stem. In 1,609 of the revised group of patients further revisions have been performed and this group of re-revisions is focused in this presentation.

Results: In 85% of the patients one previous revision has been performed, in 13% two and in the remaining 2% three or more revisions have been performed. The reason for revision were in 60% aseptic loosening, in 11% primary deep infection, in 9% recurrent dislocation, in 5% bone fracture and in 3% fatigue fracture of the implant. The diagnosis was in 74% primary osteoarthrosis, in 9% secondary arthrosis after hip fracture, in 7% inflammatory hip disease and in 7% secondary arthrosis after childhood diseases. The mean time between primary and revision are 8.7 years. The mean age at the primary THR was 60 years and at the revision THR almost 69 years.

Conclusion: In comparison with the series of first-time revised patients presented earlier (Malchau et al 1993) we find differences in reason for revision. Aseptic loosening is less frequent in the re-revised group and infection, bony and implant fracture and recurrent dislocation more frequent reasons for revision in the re-revised material. The re-revised patients are younger and with an equal sex distribution in contrast to primary and first-time revision materials. Further analysis identifying implant-, patient- and surgical technique-related risk factors will be performed and presented.

14. The Swedish National Register for Knee Arthroplasty

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Initiated by the Swedish Orthopedic Society, the Swedish Knee Arthroplasty project started in 1975. Subsequent arthroplasties were reported for computer filing. The entry form contained information on the condition of the knee, type of replacement and any complications during the hospital stay. The project was intended for registration purposes only and had no authority over the participants. Participating units used their own indications for arthroplasty, choice of prostheses and indication for revision. Each patient was followed at 3, 6 and 10 years after operation by inqueries, and complications or revisions were noted. Each hospital reported complication and revision frequency annually. According to the computer base 34,000 knee arthroplasties had been reported by September 1, 1993.

We summarize the important uses of the register; the demographic data concern diagnosis, choice of prosthesis and prosthetic annual actual and reported incidence.

Survival analysis: Patient related factors, for instance age and gender. Failure at younger age is more common than at an older age. This is especially obvious when comparing younger males with an older females.

Time related factors; we can see a significant improvement with time with a steady decline of complications at the 3 years interval, all aspects taken into consideration as surgery, implant, patient selection etc. We also found that if a knee concept was kept intact in a number of departments over the years, there was still significant improvement in the results over time.

Implant related factors; we show that some recently introduced implants such as the PCA unicompartmental prosthesis and the Oxford meniscal bearing Uni-knee have inferior survival compared to the Marmor knee.

Analysis of revisions procedures; it is clear that revision from a unicompartmental to a unicompartmental prosthesis gives a higher cumulative revision rate compared to revision to a bicompartmental knee.

We conclude that trial and error is needed in the progress of implant surgery. It is, however, important to minimize the risks, and therefore we recommend that multicenter implant bifunction studies should be carried out irrespective of preclinical laboratory test and randomized studies.

15. Survival analyses of the femoral components of 2,907 primary uncemented hip arthroplasties

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Introduction: 13 percent of 24,408 primary total hip replacements in the Norwegian Arthroplasty Register (Norway: 4.2 million inhabitants), had uncemented femoral components. The survival results of the different femoral prostheses were compared.

Patients and methods: 17 different types of uncemented femoral components had been used. The results of the eight types used in more than 100 patients, with a total number of 2,907 prostheses, were assessed. The observation period was 0–5.4 years. No signficant differences were found between the types regarding gender, diagnoses and age. Survival time until revision because of aseptic loosening of the femoral component, was estimated by the Kaplan-Meier method.

Results: The estimated cumulative revision after 4.5 years was 4.5 percent for the total material of uncemented femoral components. Large variations were, however, found for the different types. The probability of revision for the press-fit prosthesis Bio-Fit (Richards) (n=210) was 18.6 percent, and for the Femora (Thackray) components (n=173) with threaded stem, 13.6 percent after 4.5 years. Of the PM prostehesis (Aesculap) and the Harris/Galante (Zimmer) femoral components 5.6 and 3.6 percent had been revised respectively. Less than 2 percent of the other femoral components [LMT (Biomet), Corail (Landos), Profile (DePuy), Zweimüller (Allo Pro)] had been revised. In a Cox

model, with adjustment for gender, age and diagnosis, the patients having the Bio-Fit, Femora, Harris/Galante and PM prosthesis had, compared to the others (Corail, LMT, Profile and Zweimüller), an increased rate of revision by the factors of 36, 30, 8 and 9 respectively. Analyses restricted to patients with primary arthrosis gave similar results as for the total material.

Conclusion: Large variations were found concerning the results of the different systems of uncemented femoral components. The Bio-fit and Femora prostheses had the poorest results.

16. Early failures of 11,288 cemented primary total hip replacements

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Introduction: The early results of the different total hip prostheses used in Norway during the period 1987-92, were analysed by comparing the survivorship of 11 different combinations of cemented acetabular and femoral components.

Material and methods: The material comprised patients in the Norwegian Arthroplasty Register with primary total hip replacement for primary arthrosis where both the acetabular and femoral component were cemented with high viscosity cement (n=11,288). Only combinations of acetabular and femoral prostheses used in more than 100 operations each were included. Survival probabilities were estimated by the Kaplan-Meier method, with survival time defined as the time interval from implantation of a prostheses to its revision.

Results: The estimated four-year survival probability for all prostheses combined was 98 percent. The Spectron-Lubinus SP hybrid (Spectron in acetabulum and Lubinus SP in femur) (n=269) had a failure probability after four years of 6.4 percent, the Müller Type total prosthesis (n=117) of 4.2 percent and the Elite-Charnley hybrid (n=381) of 3.3 percent. The Charnley total hip replacement which was used in 55 percent of all operations (n=6.218), had a four-year failure probability of 2.1 percent. The other combinations (the total hip prostheses Exeter, Landos, Biomet, Lubinus SP, and the hybrids Lubinus SP-Lubinus IP, Spectron-ITH and Spectron-Biofit) (n=4.303) had all failure probabilities lower than 2 percent. Cox regression analyses with adjustment for gender and age gave significantly higher revision rates for the Spectron-Lubinus SP (estimated failure rate ratio of 2.9), for the Müller Type (4.0) and for the Charnley (1.7) prostheses, all compared to a group consisting of the other combinations.

Conclusion: Except for the Spectron-Lubinus SP hybrid and the Müller Type (curved stem) prosthesis, the cemented prostheses had very good short-term results.

17. Vitalstaining of bone in cemented stable retrieved femoral resurface prostheses

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Introduction: In studies of retrieved stable prostheses areas of direct bone to cement contact are usually observed. In this study we used vitalstaining of the bone to detect if bone in direct contact to bone cement is viable.

Materials and methods: Six stable femoral ICLH resurface hip prostheses were retrived at revision surgery due to acetabular loosening. Mean age 53 (38–69) years, insertion time 12 (9–14) years. Preoperatively the patients were given tetracyclin. After revision surgery the resected femoral heads were processed for undecalcified ground sections with the prostheses in situ.

Results: The sections demonstrated a good bone to cement contact. In some areas the bone was resorbed and replaced by soft tissue. The surface of bone in close contact with cement was often covered with giant cells and macrophages. Bone in direct contact with/or close to the cement sometimes demonstrated an abnormal staining. Instead of red as bone it was stained yellow as osteoid, but still with morphology as bone. Areas with flourescence were observed within the femoral heads. There was no flourescence in the abnormally stained bone or the bordering normally stained bone. There were no indications of flourescence in bone in direct contact with cement except for possibly one area. Birefringent particles were observed.

Discussion: The observed results with vitalstaining indicate that the major part of bone at the cement interface is not viable. We conclude that the mechanical stability of cemented resurface hip prostheses is mainly depending on the original bone excisting at the cementation.

18. Charnley versus Spectron—a randomized, prospective study on cemented hip arthroplasty using contemporary technique

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Introduction: Despite the fact that cemented hip arthroplasties have been performed for nearly three decades there are very few reports in the literature of prospective and randomized studies. In 1985 we started a study comparing two different hip prostheses. The purpose of the study was to evaluate if differences in the prosthetic design influence the long-terrn clinical and radiographic outcome.

Patients: 410 hips in 373 patients were randomized to 206 Charnley and 204 Spectron prostheses. Mean age at operation, diagnosis and gender were identical in the two groups. The preoperative diagnosis were 59% osteoarthrosis, 18% rheumatoid arthritis, 17% sequele after hip fracture and 6% miscellaneous. At present 91 patients (102 hips) have died and 2 patients (3 hips) are lost to follow-up. 308 hips have been followed for 5–6 years.

Methods: All patients were followed with clinical and radiographic examination preoperatively, postoperatively and at 1, 3 and 5–6 years postop. The clinical results were evaluated according to Harris Hip Score (1969). The radiographic findings were classified according to Harris (1982).

Results: The clinical outcome with a mean follow-up of 5.6 (5–6) years was good. The mean pain score was 43 (max 44) and the mean Harris Hip Score 87 (max 100) reflecting an old population with high frequency of other disabilities. 92% of the patients were satisfied with the result of the hip replacement after 5–6 years, 4% were uncertain and 4% were unsatisfied. In the Charnley-group (22.2 mm caput diameter) we had 4 early dislocations, 2 late dislocations and 13 patients with late subluxation episodes. In the Spectron-group (32 mm caput diameter) we had no dislocations. 4 patients had a late infection (2 Ch, 2 Sp; 1%). 12 hips (3%) are so far revised; 3 infections, 3 malpositioned components and 6 due to mechanical loosenings. In the Charnley-group 4 stems (2%) are revised and the Spectron-group 2 cups (1%). The results of the radiographic examination reveal 3 definitively and 1 possibly loose Charnley stem and 4 definitively and 1 possibly loose Spectron cup. A high percentage of the metalbacked Spectron cups have an early radiolucency.

Conclusion: As expected the early results of a randomized study of this type shows no major differences. We found significantly increased rate of dislocation with use of 22.2 mm head. The radiographic results with intermediate follow up indicate mechanical loosening of the Charnley stem and the Spectron cup. The cemented flanged Charnley Ogee cup in combination with a straight, collared cemented stem seems to be the choice for the future.

19. Primary total hip replacement with AML femur prosthesis—a prospective 5-year follow-up

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Introduction: In 1986 we introduced the cementless AML Porous Coated femur stem for total hip replacement (THR) in younger patients. Simultanously we started a prospective evaluation of the clinical and radiographic outcome of operations with this prosthesis. The five year follow-up evaluation is presented here.

Patients: A total of 207 consecutive primary THR in 186 patients were evaluated. 63 patients were vomen and 123 were men. The age at the time of surgery was 21 - 73 yers, median 57. The indication for operation was primary coxarthrosis in 164 hips, rheumatoid arthritis in 10, sequels from fracture in 7, sequels from pediatric hip disease in 10, idiopatic necrosis of the head of the femur in 10 and other diagnoses in 6 hips. Charnley Classes of Function were A in 111 hips, B in 77 hips and C in 19 hips. In the first 99 hips the AML stem were combined with the cementless Link V-type Screw-in acetabular cup and the spherical cementless AML Porous Coated acetabular cup in latter 108 hips.

Methods: The clinical evaluation was performed according to the Harris Hip Score (HHS) system preoperatively, 6 and 12 months postoperatively and once a year there after. At each control anteroposterior radiographs were taken for evaluation of the adaptive bone remodeling. Radiographic loosening was defined as definite loose by the presence of migration of more than 5 mm and by continuous radiolucent lines of more than 2 mm around the implant.

Results: At the five year follow-up, 150 patients operated on in 169 hips were evaluable. 13 patients operated on in 15 hips were dead, 21 patients were lost to follow-up (13 outcounty patients) and two femur stems were revised. The median HHS was 92. The result was good or excellent (HHS 80–100) in 146 hips (86 %). One femur stem was definitely loose and was scheduled for revision.

Conclucion: The results of primary THR with the cementless AML Porous Coated femur stem are encouraging and comparable with the best results of cemented prostheses.

20. Deep infection after total hip arthroplasty

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Material: In the period 05.06.1979 – 31.12.1991, 2037 primary total hip arthroplasties were performed, all in ultra-clean air, wearing body-exhaust system suits and all patients recieving Diclosil as prophylactic antibiotic.

Results: The incidence of deep infection was 0.5% and there was no significant difference in the rate of infection in the group of cemented versus the non-cemented arthroplasties. The microorganism most commonly cultured was not surprisingly *Staph. aureus,* and in one hip Listeria was cultured which is extremely rare. In the 10 patients treated for deep infection the overall failure-rate was 30%. Patients with a revision prosthesis in situ had at follow-up an average Harris hip score of 79 and radiographs showed no signs of loosing or persistent infection.

Conclusion: The rate of deep infection and the patient' condition after the revision procedures are comparable to other published materials. No other study has focused on the relations of deep infection in cemented versus non-cemented arthroplasties.

21. Different aspects of total hip replacement in rheumatoid arthritis (RA) and primary coxarthrosis (OA)

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Introduction: RA patients are chronically ill patients with inflammatoric changes in several joint and have often sustained extensive analgetic and anitinflammatoric medication. We have analysed different aspects of total hip replacment in patients with RA and primary OA.

Material and methods: A total of 396 hips were operated on during the period 1983–1992. Type of prosthesis, sex, age, operating time and blood transfusions required were analyzed in both indications.

Results:

Prosthesis	Diagnosis	n	Sex fem. (n)	Age	Oper. time (min)	Blood transf. (units)
Cemented	Prim OA	358	275	74 ±7	96 ±23	2.0 ±2.0
Cemented	RA	87	75	70 ±2	83 ±25	1.7 ±1.5
Uncement.	Prim OA	38	23	58 ±7	95 ±24	3.4 ±2.5
Uncement.	RA	21	19	48 ±11	99 ±21	3.4 ±1.1

Discussion: Differences were found, both concerning gender and age in the two groups of patients. The number of blood transfusions required was clearly higher in the use of non-cemented prosthesis. No difference in number of blood transfusions required, could be found between the RA and OA patients using the same prosthesis. Duration of operation was longer in RA patients in the non-cemented group, while, in contrast, the duration were longer in cemented prosthesis in the OA patients.

22. Two-stage exchange arthroplasty of the infected hip—the use of antibiotic-impregnated cement spacer

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Antibiotic-impregnated cement spacers have been described for the treatment of the infected knee prosthesis. The spacer will keep the soft tissue distracted and curtail the infection. We have used antibiotic-impregnated cement spacer in treatment of infected hip implant in a prospective study.

Patients and methods: 22 consecutrive patients with an infected hip implant were treated with a resection arthroplasty and implantation of spacer. None of the patients had traction postoperatively. After 6.5 (4–13) weeks 19 patients had a second operation with conversion to a hip arthroplasty. 13 patients have been followed for more than one year.

Results: 1 patient died. In 2 patients we had to do a new hip revision. Both had multiresistent bacteria. The remaining patients (19) who had been operated with a two-stage hip arthroplasty were free of infection in the postoperative phase (3 months). None of the 13 patients followed for more than one year have had signs of infection.

Conclusion: Implantation of antibiotic-impregnated cement spacer appears to bee efficient in treating infected hip implants, with the exception of multiresistent bacteria. A spacer is an alternative to postoperative traction after hip resection.

23. High incidence of stem fracture with the Exeter prosthesis

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The Exeter stem is collarless and tapers on all surfaces. This design is intended to allow the stem to sink into the cement mantle and selv-tighten. The stem is believed to retain its stability during the subsidence.

Materials and methods: From January 1983 to May 1985 we performed 39 Exeter total hip replacements in 34 patients. 9 patients died during the study period, and 3 patients refused to return for follow-up. 2 patients had radiographs at their nearest hospital together with telephone evaluation. Hence, 22 patients (26 hips) were available for follow-up 9 to 10 (average 9.8) years postoperatively. There were 20 women and 2 men. Mean age at operation was 67 (53–78) years. The diagnosis were primary osteoarthrosis (18 hips), secondary osteoarthrosis due to dysplasia (5) rheumatoid arthritis (2) and posttraumatic arthrosis (1). The operations were performed through the direct lateral approach. All the stems had a mat surface. High viscosity cement with gentamycin was used.

Results and discussion: Four femoral stem revisions were performed during the observation period. One case of loosening between cement and bone was revised 3.4 years postoperatively. 3 cases of femoral stem fracture were reoperated at 1.7, 9.1 and 9.5 years. At follow-up another 2 stems and one acetabular cup were loose. However, revision was awaited because of high age and tolerable symptoms. The remaining patients had excellent function and no pain.

In the 6 cases of stem failure osteolysis between cement and bone started proximally. Within the first year cement fractures were frequently recognized in the area just beneath the lateral stem angle. Progression of the lucency to envelope the entire sement mantle resulted in subsidence and painful loosening. Slow progression of the osteolysis resulted in trapping of the distal stem into the cement, coinciding with lacking support of the proximal part. Stem fracture followed.

Even though our experience with the Exeter prosthesis is limited, we find the incidence of stem loosening worrying. Especially alarming is the high rate of stem fracture at long-

term follow-up. We suspect the taper design to be the cause of this problem. While the slender and weak distal end is fixed in a thick, strong cement mantle, the proximal part allows just a thin cement layer easily subjected to mechanical disintegration.

24. Femoral revision with an HA-coated stem—2–5 year results in 38 consecutive cases

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Disappointing results have been reported both on cemented and cementfree femoral revision. Most cementless femoral stems have proximal coatings for bone ingrowth and fixation. However, in the case of revision there are frequently significant defects in the proximal femur. Therefore we find it important to achieve fixation in the diaphysis where the bone quality usually is better. For this reason we employ a stem fully coated with hydoxyapatite.

Material and methods: Between 1989 and 1992, 36 patients (38 hips) underwent femoral revision with the entirely HA-coated Landos corail titanium stem. 22 women and 16 men ranged in age from 45 to 81 years; mean 66. All patients were included in a prospective follow-up study. Clinical and radiographic evaluations were performed pre- and postoperatively, at 4 and 12 months and yearly thereafter. 26 of the removed prostheses were cemented and 9 were cementfree. 3 patients had Girdlestone hips due to extraction of infected implants.

The hip was exposed through a direct lateral approach. Cement and soft-tissue were meticulously removed. If possible, gentle reaming was performed in order to break through some of the dead, sclerotic bone. Small defects were allowed to heal spontaneously. Larger bone deficiencies were filled with bone grafts. A femoral stem was inserted, as thick as possible and as long as nessecery to achieve fixation in the remnants of the femoral bone.

Results: 2 peroperative femoral fractures were treated with cerclage wire fixation and healed without problems. Postoperatively one patient complained of persistent pain upon loading. A radiolucency developed from the proximal part of the stem and almost down to the tip. After one year the stem was exchanged. Most probably this failure was caused by a screw in the medullary canal, remaining after a former hip arthrodesis. The screw may have prevented the complete insertion of the stem, so that insufficient contact to the diaphysis was achieved. All the other patients had dramatically improved their hip function. Thigh pain was no longer any problem. Radiographic examination revealed some radiolucencies proximally in zone 1 and 8. No lucencies were found in the diaphysis. In most cases remodeling of sclerotic bone and incorporation of the bone grafts were completed at 1 year. Increased femoral bone density was often noticed, most likely an effect of increased bone loading.

Conclusion: This fully HA-coated femoral stem exhibit very promising clinical results. There is good radiographic evidence that stable bonding in the diaphysis is achieved.

25. A three zone operating room ventilation

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A new concept of HEPA filtrated vertical laminair air flow for operating room ventilation has been introduced. The vertical flow has a central zone (zone 3) of 0.4 m/sek air flow over the patient, surgical team and instrument area, and a peripheral zone of 0.2 m/sek (zone 2) for gowning and glowing. Zone 1, outside the vertical air flow, is used by the anesthesist and circulating nurse and has conventional mixing ventilation.

Method: The bacteriological efficiency of the new concept was tested with three different lengths of walls between zone 1 and 2 (short 0.5 m from the ceiling, medium 1.5 m and long 0.2 m above the floor) and compared with horizontal laminar air flow. The evaluation was performed during ridigly standardized sham operations (n=20) simulating orthopedic surgery with a six membered team fully dressed in disposable nonwoven clothing.

Results: No differences in air contamination with colony forming units (cfu) were found in zone three between the three different lengths of walls used to enclose the vertical air flow (short 1.3 cfu/m^3, medium 1.1 cfu/m^3, and long 0.8 cfu/m^3). The horizontal flow yielded a somewhat higher count in the operating area than the vertical (1.9 cfu/m^3, p = 0,002). On the other hand the horizontal flow reduced the contamination at the instrument area (vertical 1.2–2.3 cfu/m^3, horizontal 0.05 cfu/m^3, $p = 0.01$). Sedimentation of cfu in wound and instrument area were the same in all four systems (32–64 cfu/m^2h). In zone 1 outside the laminar flow 192–1146 cfu/m^2h was recorded.

Conclusion: All systems were equally efficient and provided a very high degree of bacteriological cleanliness. The laminar vertical flow without walls seems promising as an efficient and practical operating room ventilation fullfilling the standards (<10 cfu/m^3) of clean room ventilation.

26. Operative treatment of symptomatic lumbar spondylolysis and mild isthmic spondylolisthesis in young patients—direct repair of the defect or segmental spinal fusion?

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The aims of this retrospective study are to analyze the results after direct repair (secclusion) of the lytic defect in a group of young patients with symptomatic spondylolysis or mild isthmic spondylolisthesis, and to compare the results of direct repair with the outcome of a group of patients treated by segmental spinal fusion.

28 patients who underwent direct repair operation (Scott's procedure; S), and 28 patients who were treated by uninstrumented segmental posterolateral fusion (F) were invited for follow-up examination on average 4.5 (2–8) years after operation. 86% of the patients followed the invitation. The two groups were comparable as to age at operation, follow-up time, gender, and preoperative subjective symptoms. The follow-up assessment, carried out by an independent observer, included interview, Oswestry questionnaire, pain scale drawing, physical examination, plain radiographs (standing lateral view, flexion/extension films), MRI, and functional testing (lumbar spine mobility, static lifting power).

There was no statistical difference in the subjective, clinical, and functional outcome between the two operation groups at follow-up. The results were good or satisfactory in 87% of the S-group, and in 96% of the F-group. Plain radiographs showed a significant loss of disc height in the operated segment in both groups during follow up. In MRI there was no statistical difference in the hydration index of the three lowermost discs between the two groups. There was no correlation between pathologic disc findings in MRI and clinical outcome.

It is concluded that the results are satisfactory in the majority of young patients after direct repair of the defect as well as after segmental fusion. At this point of follow-up it is impossible to answer the question whether secclusion or segmental fusion should be preferred for operative treatment of this condition in young patients. Direct repair does not protect the disc of the lytic/olisthetic segment from further degeneration. Pathologic disc changes in MRI should be interpreted with caution because their clinical relevance is unclear.

27. The mobility of the spine after posterolateral fusion in adult spondylolisthesis A controlled randomised study

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Introduction: The mobility of the spine is of obvious interest after arthrodesis of the lower lumbar spine, and often of major preoperative concern to the patient. In a randomised, controlled study the effect of fusion on the sagittal configuration and the mobility of the lumbar and thoracic spine was determined in adult patients with isthmic spondylolisthesis.

Patients and methods: 37 patients, 18 women and 19 men, with adult isthmic spondylolisthesis or spondylolysis, with at least one year of low back pain with or without sciatica and severely restricted functional abilities were randomised to posterolateral fusion of one motion segment in situ or physiotherapy. All patients were followed at least 2 years. The mean age was 34 (18–56) years. The patients sagittal configuration and mobility (flexion and extension) were measured by Debrunner's kyphometer before treatment, at one and at two years follow up.

Results: In the total material the pretreatment mean lumbar lordosis was 26° and the thoracic kyphosis was 33°. The mobility of the thoracic spine (T2–T12) did not change in either group. In patients treated with fusion as well as physiotherapy the mobility of the lumbar spine (T12-S1) was decreased at 1 year follow up ($p < 0.05$). At 2 years follow up, however, the mobility of the lumbar spine was not significantly changed compared to pretreatment in either group.

Conclusion: One level posterolateral fusion does not alter the mobility of the lumbar spine in adult spondylolisthesis.

28. Lumbar posterolateral spondylodesis with and without rigid fixation—functional outcome

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Introduction: Lumbar spinal disorders affect many aspects of the patients' daily living. When evaluating the results after surgery on these patients it is therefore important not only to measure objective parameters but also to consider the overall consequenses on the patients living. We therefore introduced the Dallas Pain Questionnaire (DPQ) in our department in 1990.

Materials and methods: The DPQ assess four aspects of daily living—daily activities, work-leisure activities, anxiety-depression, and social interest by visual analog scale

measurements, and all patients were evaluated by DPQ before and one year after surgery. In 1990 and 1991 a total of 68 patients underwent a short posterior lumbar or lumbosacral fusion on the following indications: spondylolisthesis, spinal stenosis, degenerated discus, and fracture sequelae. The fusion was performed either without instrumentation or using the Steffee or the Cotrell-Dubousset techniques. Fusion rate by conventional radiography, complications and functional outcome were assessed prospectively independently after one year.

Results and conclusion: For the whole group of 64 patients the Dallas Pain Questionnaire score decreased from preoperative to one year postoperativ in all the four categories. 69% of patients improved in 3 out of 4 categories.

29. Factors predicting progress in moderate adolescent idiopathic scoliosis

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In the SRS Prospective Brace Study altogether 286 patients were enrolled between April 1985 and March 1989. All patients have reached 16 years chronological age. For the 157 untreated patients different multivariate statistical methods have been used to try to distinguish curves which have a high likelihood of progression.

In a multivariate binary logistic regression analysis 11 potential predictor variables were taken into the analysis: Chronological age, Risser, Apex, Imbalance, Menarche, Height increase during the 1st year of observation, Skeletal age, Rib hump, Kyphosis, Nash-Moe, and Cobb degree.

In a univariate analysis the first seven factors were found to be significantly associated with curve progression. In the multivariate analysis Apex, Risser, and Imbalance seemed to be independently prognostic after controlling for all other variables in the logistic regression model.

A model with the three significant factors in the multivariate analysis correctly classified 81% of all patients as either progressive or non-progressive.

The final multivariate analysis predicts with a high level of certainty those patients with thoracic and thoracolumbar adolescent idiopathic scoliosis who are likely to benefit from underarm brace treatment, as well as those where no treatment seems to be necessary.

30. Whiplash injuries in Reykjavík 1974–1993

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Introduction: The incidence of whiplash injuries in traffic accidents has been increasing in Iceland. The annual cost to the insurance companies due to whiplash injuries is now about 15 million dollars not counting the cost to society.

Objective: To study the incidence of whiplash injuries in Reykjavík during the last 20 years.

Methods: Borgarspítalinn is the only trauma center in Reykjavík. The computer trauma registry of the Emergency Department at Reykjavík City Hospital was analyzed for all whiplash injuries among those residing in Reykjavík from 1974 through 1993.

Results: From 1974 through 1985 there was no change in incidence of whiplash injuries for men (1.2/1000) but an increase of 30% for women (1.85/1000) or approximately 3% a year. The period 1974 through 1985 is used for comparison with 1991. The incidence of whiplash injuries reached a peak in 1991 and was 6.51/1000 for men and 8.75/1000 for women, but decreased to 5.26/1000 in 1992-1993 for men and 7.25/1000 for women. The male/female ratio was largely unchanged from 1974 through 1991 or 40% men and 60% women. From 1985 to 1991 there has been a steady increase of whiplash injuries due to traffic accidents but a slight decrease the last two years. During the same period there has been no comparable increase in the incidence of traffic accidents. The increase in age correlated incidence through 1991 was 5.4 times as high for men and 4.7 for women. The main increase was in the 15 to 19 years age group (12.8 as high for men and 6.3 for women). There was almost a threefold increase in whiplash injuries for men due to other injuries than traffic accidents from 0.76/1000 for men in 1974–1976, 1.98/1000 in 1989–1991 but a decrease to 1.78/1000 for men in 1992–1993 . The increase for women was almost fourfold from 1974–1993 or from 0.50/100 to 1.94/100. These types of whiplash injuries before 1980 were more common in men than women but after 1980 the incidence was almost the same for both sexes. Based on the incidence of whiplash injuries in Reykjavík 1993 there is approximately 64% probability that a woman and a 45% probability that a man will sustain a whiplash injury if he or shet reaches the age of 70.

Conclusion: The incidence of whiplash injuries in 1991 had increased fivefold compared with the period 1974–1985 without a comparable increase in traffic accidents during the same time period. The increase cannot be explained by a change in the driving habits or increasing numbers of cars. During the last two years there has been a slight decrease in the incidence of whiplash injuries sustained during traffic accidents.

31. Decreased width of the spinal canal in patients with chronic symptoms after whiplash injury

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Introduction: The sagittal diameter of the cervical spinal canal has been shown to correlate with neurologic deficits in both traumatic and degenerative conditions. The purpose of this study was to evaluate if the sagittal diameter of the spinal canal had any influence on the risk of developing chronic symptoms after whiplash trauma.

Patients and methods: We evaluated 48 consecutive patients admitted because of a whiplash trauma during car accidents. None of the patients had any preinjury neck symptoms, head injury or unconsciousness. 24 patients (12 men and 12 women, mean age 37 years) had persistent symptoms after six months, while 24 (12 men and 12 women, mean age 34) were asymptomatic. All measurements were done from standard lateral radiograms using a graphic digitiser connected to a microcomputer. The initial radiographs were used. The association between sex, remaining symptoms at follow up and recorded values of spinal canal width were evaluated using a multivariate analysis of variance (MANOVA).

Results: The multivariate test showed significant differences between asymptomatics/symptomatics even when considered relative values due to size of the vertebral body (Torg ratio). Symptomatic patients had smaller values. The average values for women were also significantly smaller compared with men.

Conclusion: We conclude that a narrow diameter of the cervical spinal canal seems to be unfavourable in whiplash patients.

32. Anterior fixation for burst-fractures of the thoracic and lumbar spine using an allograft and plates for stabilization

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*Introduc*tion: We want to present a method and results in the treatment of burst fractures of the thoracolumbar spine using solid allograft bone-blocks and plates for anterior stabilization.

Materials and methods: From 1985 to 1993, we operated on 105 patients with burst fractures of the thoracolumbar spine. In instable two- and three-column injuries, surgery with ventral and dorsal stabilization was performed depending on the fracture morphology. For the ventral procedure, we used the phrenicolumbotomy in the technique of Louis to expose the thoracolumbar spine. For stabilization, we used plates and allogenous solid bone-banked blocks.

Results: Of 105 surgically treated patients, 40 patients were stabilized by this method. 34 patients could be reexamined after an average of 17 months. For the neurological follow-up, we used the Frankel-scale and for the radiographic follow-up, the Cobb-angle was measured. For scoring the individual patient's state, we used our own score containing the range of movement and pain. 27 patients showed good and excellent, 7 patients moderate or unsatisfactory results. In one case, an infection occured, the patient was operated twice again and is now well by good condition. One patient died due to his accompanying injuries.

Conclusion: Ventral intracorporal spondylodesis using an allogenous bone-block is a good method for the treatment of complex burst-injuries of the thoracolumbar spine. It allows an early mobilization and rehabilitation of the patient and shows good long-term results. However, problems, which cannot be denied, are the extended operative procedure and the blood-loss which, especially in case of polytraumatized patients, may be a limiting factor in the preoperative planning. Patients who are in an acceptable general condition will have a benefit using this method of spine stabilization.

33. Surgery in unstable thoraco-lumbar spine injuries in Iceland 1975–1991

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Introduction: All thoraco-lumbar spinal injuries in Iceland needing operative intervention have since 1974 been treated at only one hospital i.e. Reykjavik City Hospital. This a retrospective study of these injuries from 1975 to 1991.

Method: The medical records and radiographs of patients with unstable thoraco-lumbar injuries were reviewed. Patients with and without neurological injury were included. Only patients treated surgically were included. For each case age at time of injury, mechanism of trauma, neurological injury, Abbreviated injury score (AIS) and Injury severity score (ISS) were noted. Radiographs of 47 patients with 50 thoracolumbar spinal injuries were available The preoperative and postoperative radiographic results for these 47 patients are reported. In these 47 patients the spinal column injuries were classified according to anatomical level and severity of compression of vertebral body and gibbus formation and were classified according to the Denis classification. Radiographic reduction of deformity was measured.

Postoperative complications and changes in neurological status were analysed.

Results: In the years 1975 to 1991, 68 patients were treated operatively for thoraco-lumbar spinal injuries. 47 were men and 21 women. The mean age was 31 (15–55) years. All fractures were burst fractures. In the patient subgroup with radiographic follow-up Denis class A numbered 17, B 22, D 2, E 9. The mean preoperative gibbus angle was 15.7°. Nineteen patients (28%) were injured in motor vehicle accidents, twenty seven (41%) after falling from height and seven (10%) by airplane accidents. Thirty five patients (51%) were neurologically intact, 24 patients (35%) had incomplete spinal cord or cauda equina injuries and 8 patients (12%) had complete spinal cord or cauda equina injury. Most of these injuries were localised between Th10 and L2 (39 injuries).

35 patients (51%) had no other injuries. Facial and thoracic injuries were relatively common concomitant injuries. The mean AIS was 3.5 and ISS 16.5 per patient. Thirty five patients (51%) were treated with round ended Harrington distraction rods and 6 patients (9%) with Harrington compression rods and 11 patients (16%) with Williams-Meurig plates. 22 patients (32%) were fused with posterior fusion.

The mean gibbus angle correction was 10.9° from preoperative value. Mean vertebral body compression vas reduced from 38% of adjacent vertebral body height to 18% compression.

Three patients had deep infections which resolved with antibiotic therapy. 9 patients had immediate postoperative failure of internal fixation. Fifty patients (74%) had an unchanged neurological status postoperatively but 6 (9%) patients deteriorated at least temporarily. Two of those 6 patients had no neurological injury preoperatively. There was no postoperative mortality.

Conclusion: Complications were rather common and quality of deformity reduction was unsatisfactory except for reduction of gibbus angle. These methods for reduction and internal fixation for spinal column injuries have now been abandoned.

34. Spinal tumors causing epidural cord compression in children—a 5-year survey

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Introduction: Spinal tumors are unfrequent in children and very rarely cause epidural cord compression. A retrospective multicentric experience dealing with these unusual cases is reported.

Patients and methods: During a 5-year period, 11 of 235 patients (4.6%) operated on by spinal cord decompression due to primary or metastatic spinal tumors were younger than 17 years of age. The histologic diagnosis corresponded to 4 malignant neoplasms (Chondroblastic osteosarcoma, Ewing's sarcoma, neuroblastoma and Wilm's tumor) and 7 benign tumors (3 osteoblastomas and 4 aneurysmal bone cysts). Except for the Ewing's sarcoma, malignant tumors were all metastatic. The lumbar spine was the most affected area in malignant tumors (3 of 4 cases). All four aneurysmal bone cysts were located in the cervical spine.

Results: Before surgery, the period of complains varied from 3 days to 12 months (mean, 5 months). Symptoms of spinal involvement included back and/or radiating pain in 8 cases, progressive paraparesis in 6, and sensory deficits in 5. Symptoms were more severe in metastatic tumors. In 3 of the 7 benign tumors a progressive scoliotic deformity was the sign leading to diagnosis. Treatment consisted of posterior laminectomy and tumor resection, except for three aneurysmal bone cysts at the cervical spine in which vertebral corporectomy and bone grafting was performed. Among patients with malignant tumors, functional outcome was satisfactory in 3 cases, all becoming ambulatory. However, 2 of these patients died 5 and 27 months after surgery. A third case (neuroblastoma) showed no recovery from paraplegia and died 7 days after surgery. Only the patient with Ewing's sarcoma is still alive 5 years after surgery with minor motor deficts. Six of the 7 patients with benign tumors had a satisfactory outcome without neural defictis.

Conclusion: Early surgical treatment for decompression of the spinal cord and tumor resection provide satisfactory results in children with spinal cord disease due to primary or metastatic spinal tumors.

35. Early experience with retrograde supracondylar intramedullary nail

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Introduction: Previously open reduction and internal fixation has been the method of choice for the management of supracondylar fractures of the femur. This procedure, however, results in extensive soft tissue damage and exposure of the fracture. A new intramedullary nail for kneecephale insertion has been introduced. The nail is available in 3 different lenghts (15, 20 and 25 cm) and in two diameters (11 and 12 mm).

Aim: To describe the new method and the early experience with the intramedullary retrograde nail for the management of supracondylar fractures of the femur.

Patients: 14 patients with type A or C supracondylar femur fractures were investigated. The patients were treated acutely and were followed in our ambulatory with clinical and radiographic evaluation.

Results: Mean age 66 (45–95) years. Median duration of surgery 70 (45–115) min. Median blood loss 300 mL. All fractures healed uneventfully. In the follow-up period 3 older patients died. No failure of the nails was detected, but there were some problems with the distal screws in the cancellous part of the femur.

Conclusion: This new method for management of supracondylar fractures of the femur type A and C, are less invasive compared with historic data using condylar plate or dynamic screw-technique. The method seems to have one weak point, the distal loocking screws.

36. Epidemiologic aspects of multiple trauma in a reference hospital—a one-year survey

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Introduction: Multiple trauma continues to be a challenge for emergency units. In our country, multiple trauma surveillances have been incomplete because of inadequate data source. In fact, information about acute care charge, hospital stay and costs induced for multiple injuried patients are lacking. To determine the epidemiologic characteristics, pathologic findings, and care impact of multiple trauma in our reference Trauma Unit, we reviewed all polytraumatized patients treated during 1 year.

Patients and methods: During 1992, 285 patients with multiple injury where treated in our hospital. A group of 27 died before arrival to the emergency unit. There were 78 patients requiring treatment in the intensive care unit (22% of the total number of patient treated in this unit). Of these, 16 died within the first three days after trauma. A total of 180 cases were treated in the Trauma Unit (15% of all patientes treated in this unit) constituing the group of study. Only the period July to August accounted for the 25% of patients treated. There were 133 men and 47 women with a mean age of 33 years.

Results: The etiology of trauma was road traffic accident in 119 cases, pedestrian in 23, fall in 18, motorcycle accident in 15, bicycle accident in 3 and laboral in 2. All patients had multiple musculoskeletal injuries, 76 without other associated lesions. Fractures affected 2 or more bones in 128 patients. There were 85 patients with concomitant TCE, 11 cases with abdominal trauma, 11 with thorathic trauma. The most frequent pattern of associated injuries was the presence of TCE and multiple fractures (75 patients, 42%). Critical injuries involving at least two major cavities and long bone fractures were found in 16 cases (9%). The overall mortality rate was 14%. The mean hospital stay of the whole group was 14 (2–108) days. Patients suffering a traffic accident with thoracic trauma and multiple fractures accounted for the highest mean hospital stay (34 days). Costs only for hospital care were estimated to $ 671,465.

Conclusion: This study shows the trauma care overload induced to a reference hospital by multiple injury patients. A program for better both regional and national surveillance and prevention of multiple trauma is therefore warranted.

37. Poor results with ACL reconstruction a.m. Insall

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Introduction: The aim of this study was to evaluate the clinical outcome of ACL reconstruction using the iliotibial tract.

Materials: 41 consecutive patients operated in our department 1.9.85–31.10.88 for ACL insufficiency, 14 women and 27 men. Mean age at surgery was 28 (18–49) years. Interval between primary injury and reconstruction was 24 (0–60) months. Mean stay at hospital was 10 (5–30) days postop and sick leave was 127 (12–720) days. 33 were sports injuries. 34 were examined at follow up. Two had emigrated and were interviewed by phone and 5 had a re-reconstruction done or planned before follow up, 4 because of unsatisfactory results and one because of rerupture after three years. None was lost to follow up.

Methods: All patients were reconstructed using the anterior distal part of the iliotibial tract with the attached bone from Gerdy's tubercle drawn "over the top" and fixed intra-articulary. The patients used a posterior splint at day time for 6 weeks and then active and passive movements were allowed. Clinical outcome was evaluated by radiographic examination, Tegner and Lysholm score, one leg jump, Stryker laxity tester and subjective evaluation of outcome.

Results: Follow up time was 44 (24–91) months. Eight patients found the result excellent, 18 good and 10 poor. One with good result found that the treatment had not been worth while and three patients with poor results found it worth while all the same. One leg jump was 1.14 (0.18–1.65) m on the operated side and 1.37 (0.35–1.85) m on the nonoperated side. Tegner activity score was preinjury 8 (4–9), preop. 3 (0–7) and at follow up 5 (1–8). Lysholm score at follow up was 80 (31–100). No serious complications and no infections were noted

Conclusion: We find the results worse than reported by other authors having used the same method and not as satisfactory as to be expected from surgery with rather high morbidity. We have stopped using this procedure.

38. Arthroscopy under local anesthesia—increasing productivity and effectiveness

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Introduction: During 1993 local anesthesia was introduced as a method for knee arthroscopy at our hospital. The introduction was successful and in the end of the year two thirds of all knee arthroscopies were performed in local anesthesia.

Methods: The original method described by Wredmark and Lundh 1982 was used including parapatellar incisions,

medial and lateral. 20 mL of prilocain with epinephrine was used and the anesthesia was injected at least 30 minutes before the operation. No premedication was given. Arthroscopy protocols were used.

Results: During 1993, 409 knee arthroscopies out of 736 (56%) were done with local anesthesia. No major complications occurred and in only a few cases further measures were taken for pain. The number of knee arthroscopies rose from 568 1992 to 736 during 1993 (30%) and arthroscopies of other joints from 96 to 155 (65%). Comparing only the last four months of the year when the technique was adopted by most surgeons 71 percent of the knee arthroscopies were done using local anesthesia. The increase in knee arthroscopy rate was from 196 to 307 (57%) and in other arthroscopies from 44 to 85 (93%).

Conclusion: The introduction of local anesthesia for knee arthroscopy greatly increases productivity of all arthroscopies. It is well accepted by the patients and is considered by us to be the standard method in two thirds of all patients. To avoid abuse, the quality of the procedure must be constantly supervised.

39. Effect of postoperative ketoprofen treatment, following arthroscopic subacromial decompression

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The aim was to study if ketoprofen affects the short-term postoperative results, after arthroscopic subacromial decompression (ASD). Although non-steroid anti inflammatory drugs (NSAID), in previous studies, are shown to be effective in relieving pain in patients with tendinitis of the shoulder and patients who have undergone orthopedic surgery, there are no studies on the effect of NSAID medication following ASD.

Material and method: 41 patients were included in a prospective, randomised, double-blind study, comparing the efficacy of ketoprofen to placebo. Ketoprofen 200 mg or placebo was administered once daily for 6 weeks postoperatively. All patients were evaluated pre- and postoperative using a isokinetic muscle testing machine (Biodex®) including concentric and eccentric measuring, and UCLA Shoulder Rating Scale, including an assessment of pain, function, range of motion, strength and patient satisfaction. We also used the criteria set forth by Neer, grading the results as satisfactory or unsatisfactory. In a satisfactory result the patient is satisfied with the operation and has no significant pain. He also has full use of the shoulder (<20° limitation of overhead extension), and at least 75% of normal strength. All patients were evaluated under anesthesia. ASD is an arthroscopic bursectomy and resection of the anterior and inferior part of the acromion (acromioplasty), releasing the insertion of the coracoacromial ligament from the acromion. The arthroscope is introduced using a posterior portal. Motorised instruments were introduced using a lateral portal. The patients were evaluated six weeks after the operation.

Results: There was a significant higher degree of satisfaction in the ketoprofen group (KG) ($p = 0.017$). 85% in the KG compared to 47% in the PG were satisfied with the operation and had no significant pain. Active range of motion was improved in both groups. There was a significant increase in active flexion and abduction in the KG ($p < 0.01$), and active flexion ($p < 0.05$) and abduction ($p < 0.01$) in the PG. The increase in average active range of motion postoperative was significantly greater in the KG. Both groups had a minor nonsignificant increase in strength. The UCLA score was significantly improved in both groups, in the KG ($p < 0.01$) and in the placebo group ($p < 0.05$).

Conclusion: In the present prospective randomised double-blind study ketoprofen medication was found to be efficient following ASD, on patients operated on for impingement. The ketoprofen treated patients showed a higher degree of satisfaction at the follow-up 6 weeks after the operation. They had less pain and a more pronounced increase in average active range of motion and average UCLA score. These short-term results, in the ketoprofen group (84%), were the same as the results reported in long-term follow-up studies (81–88%).

40. Long term results of the Bristow-Latarjet procedure for recurrent dislocation of the shoulder

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Introduction: Long term follow-up is necessary to evaluate the results after recurrent shoulder dislocation. Hovelius has found an osteoarthrosis rate of 20 percent in his 10-year follow-up of primary dislocations (personal communication).

Materials and methods: 39 patients (41 shoulders) were treated for anterior recurrent dislocation by one shoulder surgeon 1981–1987 with the Bristow-Latarjet procedure. Two patients were operated bilaterally and three patients had previous surgery (Putti-Platt). 28 were men and 11 women with a mean age of 28 years (18–57). Every patient were followed-up with a questionnary and hospital records and the mean follow-up time was 9 (6–12) years.

Results: 32 of 39 patients were satisfied or very satisfied with the operation at follow-up. Three patients suffered from recurrency and two of them are reoperated so far. Six patients had complications around the screw with neuralgic pain which necessitated screw removal. After this, one developed recurrent dislocation and all the others feeling of subluxation. At follow-up 13 patients described subluxation, apprehension or sudden pain (dead arm syndrome). Three of them described these symptoms developing as late as 7–10 years postop.

Conclusion: Most patients are satisfied with the Bristow-Latarjet procedure at long term follow-up although the oper-

ation does not adress the subluxtion problem. Late instability seems to increase—the reason for this should be further investigated.

41. Treatment of acute shoulder dislocations with lidocaine—a randomized and prospective study

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Purpose: The purpose of the study was to evaluate local versus intravenous analgesia in the treatment of shoulder dislocations concerning successful reduction, experience of pain and complications.

Method: Patients with primary or secondary traumatic dislocation of the shoulder were included and radomized to either local lidocaine infection or intravenous analgesia with pethidine/diazepam. Patients with atraumatic dislocations, fractures of the humerus or recorded allergy to these drugs were excluded.

The local method was performed with the patient in a sitting position, injection site was below lateral acromial edge using either a lateral or posterior approach under sterile conditions. Injected volume was 20 mL of 1% lidocaine and ten to fifteen minutes was allowed for the local anesthetic to take effect before any manipulation of the shoulder was attempted. The intravenous method was performed with the patient in supine position and a sufficient dosis of pethidine/diazepam was given intravenously. Shortly after attempt to manipulate the dislocated shoulder was done. The patients were observed for any complication during and after the procedure.

Results: After 18 months 139 patients were admitted to our departments and 120 patients were included. 68 had had a primary dislocation whereas 52 had previously experienced secondary dislocations of the same shoulder.

	Successful	Failure	Total
Intravenous analgesia	55	6	61
Intraarticular analgesia	50	9	59
Total	105	15	120

$p = 0.37$

13 patients treated with the intravenous method had respiratory depression and 7 required an antidote (Naloxone), $p < 0.001$. Two of these patients were kept in the hospital for one day. In the lidocaine group no side effects were recorded during and after the procedure and no superficial or deep infection was observed. The VAS score and the subjective evaluation of the used method was comparable between the two groups. No difference concerning successful or failed reduction was found using a lateral or a posterior approach ($p = 0.50$). The rate of success or failure was identical in experienced and unexperienced orthopedic surgeons.

Conclusion: Local analgesia used to reduce dislocation of the shoulder is a new method and local injection with lidocaine appears to be simple and safe, allowing atraumatic reduction of shoulder dislocations. The rate of success or failure is comparable with the intravenous method, but significantly fewer respiratory complications are recorded after local analgesia with lidocaine.

42. Use of Cryo-Cuff® for the control of postoperative pain

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The Cryo-Cuff system incorporates a combination of hydrostatic pressure and cold to reduce post-traumatic pain and edema. This combination should also reduce post-operative pain. Previous studies have also shown that locally administrated anesthetica combined with low-dose opioids can significantly reduce pain after surgery. This study was designed to compare the effectiveness of cold therapy (Cryo-Cuff) and intra-articular bupivacaine/morphine in decreasing post-operative pain following arthroscopic anterior cruciate ligament reconstruction.

Material and method: 40 patients with chronic anterior cruciate ligament insufficiency were operated with arthroscopic reconstruction of the ligament. Only pateints with isolated anterior cruciate ligament insufficiency were included in the study. The patients were randomized into two groups: (I) Cryo-Cuff during the first 24 hours after surgery, and (II) Cryo-Cuff as group I, combined with intra-articular injection of 20 mL 0.375 % bupivacaine and 1 mg morphine at the completion of surgery. Pain was assessed using visual analogue scale (VAS) at 1, 2, 4, 6, 24 and 48 hours. Supplementary analgetic requirements during the first 48 hours were registered.

Results: In group I 16/20 of the patients were satisfied with the with the analgesic effect of the Cryo-Cuff after surgery, while 18/20 patients in group II were satisfied. The pain scores (VAS) in both groups were low through the entire observation period. The pain scores were universally lower in group II. This was, however, significant only at 24 and 48 hours. The supplementary analgesic requirements were lower in group II. No specific complications due to either the Cryo-Cuff or the intra-articular injection were seen in either group.

Conclusion: Cryo-Cuff is a simple, non-harmful and effective method to reduce post-operative pain in patients operated with arthroscopic anterior cruciate ligament reconstruction. The combination of both Cryo-Cuff and intra-articular bupivacaine/ morphine was slightly more effective than Cryo-Cuff alone.

43. Anterior cruciate ligament injuries and soccer—a national survey of incidence and risk factors and a 7–year follow–up

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A rationale for surgical intervention after an anterior cruciate ligament injury is to restore the preinjury activity level. All Swedish male and female soccer players have an obligatory insurance in the same company. From the archives of the insurance company all knee injuries that occurred during one year (1986) in 188,152 organized Swedish soccer players were registered. A total of 3,735 injuries were reported to the insurance company that year and of these 937 (25 %) were knee injuries. All players were contacted by mail and asked to fill in a questionnaire. The response rate of the questionnaire was 83 %. The patient records from the different hospitals were requested. The anterior cruciate injuries represented 37 % of the reported knee injuries.

The relative risk of sustaining an ACL injury was increased in female players, in elite players, and in players in forward position. The injuries occurred at a younger age in females than in males. Fifty percent of the injured players were treated with ACL surgery, predominantly as a reconstructive procedure with use of a patellar tendon transplant. Thirty percent of the players with ACL injury were active in soccer after 3 years compared to 80 % of an uninjured control population of soccer players. Twenty percent of the players with ACL injuries were still active in soccer 7 years later, while the corresponding figure for uninjured players was 50%. None of the elite players were active at the same level after 7 years. A comparison of ACL-injured players treated by surgical reconstruction or not, revealed no difference with regard to the proportion of players still playing soccer after 7 years.

44. Real-time monitoring of trauma patients

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Introduction: Collecting frequent, timed observations during management of trauma is difficult. It is almost impossible to collect good quality data manually for research and audit purposes. This paper describes the development of a computer system to collect real time data throughout the different phases of resuscitation of the trauma patient.

Methods: The computer hardware consists of a personal computer, PROPAQ monitor, pen, and printer. There are two key elements in the data collection. Fistly, the patient's physiological parameters are measured by the use of monitors. These monitors store the data for a period of five hours(as averaged two minute trends). Secondly, the events (clinical observations, investigations ordered and details of all treatments and procedures) are recorded in the grid computer (portable computer). Observations are stored with the description of the event e.g. systolic blood pressure, value as an analogue quality or a digital count e.g. 140 and date and time e.g. 16/12/93 10:57:23. The operator can display and plot recorded observations at will with the help of Excel software program. A comprehensive printout is produced when information collection is finished. The format allowed us to analyse the data using a spread sheet. The relationship between the physiological parameters and the events were analysed.

Results: At North Staffordshire Hospital Emergency Department the prototype system has been used to record the events and physiological changes during the resuscitation, investigation and definitive treatment of 21 trauma patients. The introduction of this new data collection system has allowed the accurate timing of events and the changes in the physiological parameters as management progresses (real time).

Conclusion: We have found the system a valuable data collection tool which is user friendly. The analysis of the accurate data collected we feel will improve the performance of trauma management.

45. Congenital angiodysplastic lesions of the lower extremity in children

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Introduction: The clinical presentation of angiodysplastic lesions varies from hemangiomas to arteriovenous malformations (AVM). Intraarticular and specially intraosseous lesions are very rare. In fact, only 3 cases of intraosseous AVM have been reported. Among patients included in this work, we report a new case of intraaosseous AVM affecting the left tibia and 2 synovial hemangiomas of the knee, one of them inducing growth distrurbances of the knee joint.

Patients and methods: In a 15-year retrospective survey, 10 patients were treated in our department because of congenital angiodysplasia of the lower extremities. There were 7 girls and 3 boys with an average age of 6 (2–14) years at the first hospital visit. In 5 patients the initial complaint was hemihypertrophy associated in one case to a painful soft tissue mass. Three other patients identified a single mass as their initial complaint, being painful in one. In 2 cases a recurent hemarthrosis was the cause for hospital attendance. In addition to conventional radiographs, 5 patients underwent angiography, 3 CT-scan and 2 MRI studies for diagnosis and surgical planning.

Results: Hemangiomas were identified in 6 cases and AVM in 4. Of the 2 cases (2- and 3-year-old children) with synovial lesions of the knee, one had a localized hemangioma and the other had a diffuse hemangioma. This last patient developed a hyperplasic hemosiderinic chronic synovitis requiring synovectomy. After 6 years of follow-up, growth disturbances in the articular surfaces of the knee were observed. The case of intraosseous AVM in the left mid-shaft of the tibia corresponded to a 12-year-old boy. The lesion was intramedullary with partial cortical involvement. Seven patients were surgically treated. Of these, 4 had excision of localized hemangiomas, one had epiphysiodesis, one underwent wide synovectomy, and one had tibial lengthening. Of the 3 children without surgical treatment, one received radiotherapy with a total dosis of 20 Gy and 2 were treated by compressive stockings. Two of the 4 patients who underwent local excisions of the lesion developed recurrences, one of them with necrotic scars at the ankle requiring above-ankle amputation.

Conclusions: In our experience, intraarticular angiodysplastic lesions seems to have a worse prognosis due to their recurrent blood effusions leading to osteo-cartilaginous destruction. Early diagnosis and correct treatment is desiderable in cases affecting the synovium. Limb length discrepancies induced by angiodysplasia should be treated under common accepted criteria.

46. The reliability of radiologic assessment during leg lengthening

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Sixteen patients with a preoperative leg length inequality of on average 6.4 (3.6–13) cm, orthoradiographically determined, underwent leg lengthening with the Orthofix external fixator and callus distraction. At follow-up, 2.3 (1–8) years after the lengthening, leg length inequality, orthoradiographically determined, averaged 2.4 (0.5–7.2) cm. 96 radiographs covering 14 femoral and 2 tibial lengthenings were assessed on a digitizing table with a computer programme (PROFILE®) as regards the amount of lengthening and the degree of magnification. The magnification of the tibial lengthening averaged 6%, in the children and adolescents undergoing femoral lengthening 10% and in the adults undergoing femoral lengthening 25%. A radiopaque ruler was placed in the same level as the bone during the radiographic exposure and the distraction gap could be measured avoiding misinterpretation by magnification. In three of the 10 patients, who prior to lengthening were skeletally mature, LLI at follow-up was up to 1 cm in excess of the LLI determined with the computerized technique.

47. Incidence of congenital clubfoot unchanged in Uppsala County, Sweden, 1962–1991

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Introduction: Great variations in the incidence of congenital clubfoot exist worldwide. This study estimated the incidence of congenital clubfoot in Uppsala County, Sweden during the period 1962–1991. The material was categorized according to incidence, sex and frequency of bi- and unilateral clubfoot involvement.

Material and methods: The material comprised all children born with congenital clubfoot in Uppsala county during the period 1962–1991. The total number of children born during the period was 102,836 and, of these, 130 were born with congenital clubfoot.

Results: The total incidence was 1.3 per thousand. The incidence for boys was 1.4 per thousand and for girls 1.0. The boy/girl ratio was 1.5/1, but it changed from 1/1 during the first 10 year-period to 2/1 during the other 10-year periods. The frequency of bilateral clubfoot was 51 percent. The incidence showed a tendency to decrease but there were no statistically significant changes when regression analysis was applied.

48. Measurements of tibial torsion in congenital clubfoot

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Congenital clubfoot is associated with reduced external torsion of the leg. Clinical measurements of leg torsion is difficult to perform with accuracy. In the present study leg torsion was determined by computed tomography (CT) in children with congenital clubfoot.

Materials and methods: During the years 1992 to 1993, 13 boys and 3 girls were admitted to our hospital for gait problems due to congenital clubfoot. In 9 cases there was a bilateral clubfoot, in 2 cases it was right sided and in 5 cases it was on the left side. The mean age of the children was 6 (4–10) years. All of them were examined in supine position with the hips and knees fully extended. A series of CT scans was obtained through the hip joints, the femoral condyles and the ankle joints. The anteversion (AV) angle of the femoral neck and the torsion of the leg were measured on superimposed tomograms; the tangential line to the dorsal aspects of the femoral condyles was used for reference. External torsion of the leg was measured as the the angle between the reference line and the line from the centre of the medial to the lateral malleolus.

Results: The AV-angle of the femoral neck was 34° ±14° (10°–57°) and 33° ±12° (18°–50°) for the right and left side,

respectively. The external torsion of the leg was 20° ±10° (5°–40°) and 21 °±11° (0°–38°) for the right and left side, respectively. Six of the patients had external leg torsion below the 25 percentile.

Conclusion: This study shows that there is a great variability of leg torsion in children with congenital clubfoot, and many of them have figures within the normal range. In some cases, however, reduced external torsion is an associated problem for their gait function, and measurements of leg torsion by CT give accurate figures for the evaluation of these children.

49. Epidemiology of childhood injuries in Reykjavík from 1974 through 1993

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Introduction: Accidents are common among Icelandic children. The aim of this study was to determine and analyse the incidence of childhood injuries in Reykjavík.

Materials and methods: Computerised registrations from 1974 through 1993 for children in Reykjavík 0-14 years old who came to the Emergency Department (ED) at Borgarspítalinn because of an accident were analysed. The ED at Borgarspítalinn is the only trauma centre in Reykjavík. The twenty years studied were divided in six 3-year periods and one 2-year period.

Results: The whole period the incidence of injuries among children 0–14 years was 294 per 1000 children a year, 338 among boys and 247 among girls. From 1974–1976 through 1980–1982 there was an increase in injury incidence from 275 to 326 but thereafter the incidence decreased and was in 1992–1993 254. Until 1983–1985 the highest injury incidence was among the 0–4 years old but from 1986–1988 it was highest among the 10–14 years old. The decrease in the injury incidence among 0–4 years old since 1977–1979 was due to a decrease in the incidence of home accidents, which were the most common causes of injury. The increase in the injury incidence among 10–14 years old was due to an increased incidence of school- and sport accidents, especially among girls. Injuries were least common among 5–9 years old and there were no major changes in the injury incidence in that age group. The incidence of traffic accidents decreased from 1974–1976 until 1989–1991 but in the last two years it increased again and was then 10 per 1000 a year. The incidence of burns decreased and was 8 per 1000 a year in 1992–1993. The rate of hospitalisation was 8 children per 1000 a year, or 2.7%.

Conclusions: The childhood injury incidence among children in Reykjavík is very high compared with the other Scandinavian countries. We conclude that a major effort is needed to prevent accidents among Icelandic children.

50. Skiing injuries in Akureyri 1989–1993

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Introduction: In the area of Akureyri (population 20,000) in north Iceland alpine skiing is popular. The aim of the study was to estimate incidence and pattern of skiing injuries in the area.

Materials and methods: The cases were identified from the computer files of the department of orthopedics of Akureyri Hospital from January 1989 to June 1993.

Results: The number of injured were 304 (40% men and 60% women). 40% of the injured were between 11 and 15 years old. The injuries were; sprains/dislocations 143, fractures 77, contusions 44, wounds 36 and head injuries 4. Seven patients were hospitalized. The most common injury was ligament strains of the knee and the most serious were head injuries. The cause of the accidents were: fall 61%, collisions 20%, skipoles 8%, ski lifts 5% and other causes 6%.

Conclusion: Skiing injuries in the area of Akureyri are common and many of them have serious consequences. We have started a prospective study to find out factors that lead to the accidents and we hope that results from that study can help us prevent them.

51. Epidemiology of traffic injuries in Reykjavík 1974–1993

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Introduction: Traffic accidents are one of the major causes of trauma morbidity and mortality. Traffic accidents are responsible for approximately half of the total cost of accidents in Iceland. The objective of this research was to study the epidemiology of traffic injuries in Reykjavík, the capital of Iceland.

Methods: Reykjavík City Hospital is the only trauma centre in Reykjavík. The computer trauma registry of the Emergency Department at Reykjavík City Hospital was analysed to find all patients living in Reykjavík injured in traffic accidents from 1974 through 1993. Information on deaths due to traffic injuries in Iceland and the number of cars in Reykjavík was obtained from the Traffic Council of Iceland.

Results: The number of injured due to traffic accidents decreased by 13% for men and 11% for women from the period 1974–1976 to 1983–1985. The incidence for men decreased from 1.34% to 1.17% and for women from 0.98% to 0.87%. During the next years through the period 1989–1991 the incidence increased again to 1.57% or 34% for men and 1.37% or 57% for women. There was no change in incidence during the period 1992–1993. The highest incidence of traffic injuries for both sexes occurs in the 15–19 year age group or 4.33% for men and 3.00% for women fol-

lowed by the 20–24 year age group. There has been a 44% decrease in hospital admissions during the research period to 2.3/10000 for men and 1.6/10000 for women. During the twenty years of the study the number of cars has almost doubled in Reykjavík. In the year 1993 car accidents caused 76% of the injuries, pedestrians accounted for 6%, bicycle accidents 12% and motorcycles 4%. The most common injuries were fractures 10%, wounds 20%, sprains 49%, contusions 18% and abdominal and cranial injuries 3%. There were 499 deaths due to traffic accidents in Iceland during the whole period or on average 25 per year, with a decrease in incidence during the later years.

Conclusion: The total toll of injuries and deaths due to traffic accidents in Reykjavík is still high. Despite much more traffic there has been a major decrease in hospital admissions for traffic injuries but an increase in the number of minor injuries. Most of the injuries are of orthopedic nature.

52. Salvage-procedure for permanently dislocated patella

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Literature gives many alternatives for treatment of maltracking of the patella. In most cases it concerns patients complaining of patellar pain due to unbalanced movements of the patella during flexion of the knee. In case of a permanently dislocated patella the methods mentioned above are often not sufficient and a patellectomy is the only available solution.

Over a six year period we treated seven knees for permanent patellar dislocation.

The operation technic used was first described by Brückner in 1970: In order to maintain the patellar fysiological position, the patellar tendon is split and the medial one third including a bone block is mobilised at its insertion leaving its origo at the patella untouched. After tunnelling the graft it is fixed to the medial condyle of the femur by a screw. In locating the right place for re-attachment the knee is flexed while judging the patella tracking.

At follow up no complaints were heard except for one case, in which a re-dislocation occurred due to a new trauma. The repositioned medial portion of the patella ligament had thorn; a re-operation was performed and the patient is now free of complaints.

The Brückner procedure is a good alternative in patients with a permanent patella dislocation.

53. "Slipped epiphysis" treated with extracapsular intertrochanteric valgisation rotation osteotomy

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Case report: A 27-year-old man from Somalia was referred to the hospital because of pain in his left hip. He walked without helping aids with a limp. Anisomelia of 30 mm was noted and there was a marked reduction in motility of the left hip joint. Radiographs showed a slipped epiphysis with a non union of the growthplate. Although the patient reported having been beaten with a rifle one year earlier the condition was interpretated as an epiphysiolysis sequelae. The patient was treated with an extracapsular intertrochanteric osteotomy with valgisation and rotation. Osteofixation was achieved by a 1100 AO osteotomy plate. The postoperative course was, with exception of a superficial wound hematoma which resorbed uneventfully, without complications. The patient was mobilised without weightbearing on crutches the second day after surgery and started weightbearing after 6 weeks. At the follow up three months after surgery the patient walked, without aids, with full weight bearing and almost without a limp. The radiographs showed that the osteotomy was healed. An anisomelia of only 10 mm was recorded. A 30 % rotational impairment compared with the right side was noted. A year after the operation the patient takes part in all daily activities inclusive sports.

Discussion: Although during the last three decades the endoprothetic surgery of the hip joint has developed rapidly, biomechanical principles ackowledged years ago should not be forgotten (1). When simple operative treatment, without "burning bridges", can be chosen to stop or retard degenerative changes in young adults, the need for endoprothetic surgery may be unnecessary or can be postponed.

This case report shows only a short term result. However, the growthplate is closed and the prognosis for this young patient's hip is certainly better than before the osteotomy.

Litt.: Pauwels F. Gesammelten Abhandlungen zur funktionellen Anatomie des Bewegungsapparates. Springer Verlag, Berlin Heidelberg 1965.

54. Guided tissue regeneration and its possible use for treating radio-ulnar synostosis

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Introduction: The method of guided tissue regeneration implies using a synthetic membrane to hold off unwanted tissue from a healing wound so as to give the slower dividing "normal" tissue a change to fill the wound area.

Animal study: A large diaphyseal defect was produced in both radii of nine rabbits. On one side, the defect was covered by threading a GORE-TEX® vascular graft material over the bone ends. The other side served as control.

Results: Radiographic and histological analysis revealed a striking difference in the healing of the two defects. All the animals except one developed a non-union on the control side but produced bone to a varying degree within the synthetic tubes.

Clinical use: A 54-year-old white men developed a radioulnar synostosis after an open radius and ulna fracture. He was operated 27 months after his accident were we resected the bony bridge and wrapped the ulna with a GORE-TEX® Surgical Membrane.

Result: The patient regained a 100° range of motion after the resection of the synostosis. A CT-scan done at his 6 month follow up showed no signs of bone formation between the ulna and radius.

Conclusion: This study shows that critical sized long bone defects can possibly heal by means of the technique of guided tissue regeneration. This knowledge and technique have a possible role in the treatment of posttraumatic radioulna synostosis.

55. Early phase changes after transphyseal implantation of self-reinforced polyglycolide (SR-PGA) pins An experimental study on growing rats

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Materials and methods: 58 12-week old Wistar male rats were used as experimental animals. A self-reinforced polyglycolic acid (SR-PGA) rod of 1.1 mm in diameter was driven into a drill hole made in the intercondylar region of the right femur across the distal growth plate up to the diaphysis.

In 29 rats an identical rod was placed in the dorsal subcutis. After a follow-up time of 1 to 28 days both femora were taken as a specimen and analyzed using using radiographic and histologic techniques. The implants were tested for mechanical strengths.

Results: No infections or other complications were encountered. The orifice of the implant canal was filled with fibrocartilage and connective tissue by 9 days. The SR-PGA rod was found to be surrounded by a bone moulding by 18 days.

The implant was broken at the plane of the growth plate by 21 days. By 28 days this cleft was filled with regenerated growth cartilage. The implant did not cause any growth disturbance of the femur. After 2 weeks the shear and bending strengths of the implants averaged 38 MPa and 116 MPa, respectively.

Discussion: Small-diameter SR-PGA implants retain their mechanical strength for 2 weeks thus enabling fixation of rapidly healing fractures, eq. physeal fractures. The relatively rapid cracking of the implant at the plane of the growth plate brings about undisturbed growth of the fractured bone.

56. Strength, density and porosity in vacuum and hand mixed bone cement

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Introduction: Vacuum mixing has previously been shown to increase bone cement strength as has prechilling of components before mixing. In the present study, strength, density and air inclusions have been analysed in low, medium and high viscosity cement types. The results are compared to corresponding hand mixed cement.

Material and methods: Cement cylinders (12 x 6 mm Ø) were prepared from CMW 1 (high viscosity), Palacos R (medium viscosity) and CMW 3 (low viscosity) cement after mixing in two vacuum mixing systems (OPTIVAC and CEMVAC) and after hand mixing (SURGEVAC) at both room temperature (22°) and after prechilling of the components (4°). Compressive strength was tested at 24 hours and 30 days according to ISO 58331/1 1979 with an Alwetron material test machine at 20 mm/min crosshead speed. Density of the cement cylinders was calculated after determination of weight and volume. The relative fraction of air inclusion was calculated in cement rods and in whole cement samples by calculation of volume on basis of the largest measured diameter of the inclusions (>1 mm) as visualized by radiographs of the cement specimens (per mill).

Results: Compressive strength: There was no significant difference between CEMVAC and OPTIVAC mixing systems (30 day test, 22 °C, all cement types, $p = 0.26$). Vacuum mixing significantly increased cement strength by 11% ($p = 0.002$) from 110 to 122 MPa (22 °C). Cement strength increased by 23% from day 1 to 30 (vacuum mixing all cements). Prechilling resulted in no significant change in strength.

Density: Cement density was at 1.245 ±0.028 and 1.246 ± 0.032 in OPTIVAC and CEMVAC mixed samples, respectively. Vaccum mixing significantly increased density from 1.197 (hand mixed) to 1.258 ($p = 0.0001$).

Air inclusion: There was no difference between OPTIVAC and CEMVAC systems. Vaccum mixing significantly reduced the the void volume by a factor of

Table. Minutes on scene time and percentages

Case	PM	AM	Onscene time		Complete obs		No treatment	
			PM	AM	PM	AM	PM	AM
Trauma admit	9.6	1.8	18.4	12.2	67	71	42	42
Trauma home	26.6	15.2	13.9	15.0	65	53	65	66
Medical all	28.8	11.2	14.8	12.8	51	71	27	27
Surgical, all	5.6	1.2	9.0	9.0	35	66	71	100

approximately 10 to 50. There was a tendency of higher void volume in higher viscosity cement. The range of median values for all combinations of cement types and mixing systems varied between 1.7 to 0.5 per mill.

Conclusions: Vaccum mixing resulted in superior cement quality compared to hand mixing. There was no significant difference between OPTIVAC and CEMVAC vacuum mixing systems. Prechilling did not significantly increase bone cement strength.

57. Experience with a HA coated shoulder prosthesis in rheumatoid arthritis

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Within the last two decades we have treated 250 rheumatoid patients with shoulder prostheses of different types.

Since May 1991 until 1994 we ahve performed 34 Biomodular shoulder arthroplasties using hydroxyapatite fixation without cement. In just two cases we have used a total shoulder prosthesis with cemented glenoid component.

The mean observation time was 24 (15–34) months. All the patients who was operated on had radiological changes in group IV and V according to the Larsen/Dale/Eek-grading system. In spite of these relatively advanced affections the results have been encouraging with good pain relief and increased range of motion to some amount, which is specially necessary for the rheumatoid patients in their daily living.

All the implanted humeral components with more or less hydroxy-apatit-coating seem stable and the ingrowth of bone seems to be good even in a rheumatoid patient with more or less osteopenia.

58. Audit of 500 ambulance incidents in North Staffordshire

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Introduction: The nearest vehicle is dispatched to incidents but an attempt is made to match potentially critical ill patients with a paramedic crew. This paper examines the case mix, observations recorded, interventions performed, provisional diagnoses made and the on scene times for paramedic (PM) and nonparamedic crews (AM).

Material and methods: 500 ambulance attendances to North Staffordshire Hospital were examined. The type of case wether general medical, general surgical or trauma was recorded. The age, sex, ambulance diagnosis, provisional hospital diagnosis and wether they matched was noted. The call to scene time, on scene time and the scene to hospital time were calculated for each patient. The observations performed, their completeness and appropriateness was recorded. The number and typee of intervention performed was noted.

Results: See Table. Examining the 266 patients (53%) who had sustained an injury, 57 patients required admission. 158 (59%) had no pre hospital treatment including the administration of oxygen. Only 4 had their oxygen saturation recorded. 57 patients (21%) had no pulse rate recorded and 45 patients (17%) had no blood pressure recorded. 9 (15%) of the head injuries had no record of their Glasgow coma scale and 10 had no cervical collar fitted. 8 of the asdmitted patients (14%) had i.v. acces with 5 having fluid.

Conclusion: The majority of the trauma patients did not reieve or require the skill of a paramedic. 20% of the patients had no basic observations recorded.