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Hip fractures

Difference in etiology of trochanteric and cervical fracture of the proximal femur

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The increased incidence of fractures of the proximal end of the femur has stimulated further studies of etiologic factors.

Patients and Methods: 868 patients who sustained a fracture of the proximal femur during one year were investigated.

Results: There were 623 women and 245 men with 501 cervical, 315 trochanteric and 51 subtrochanteric fractures.

A higher prevalence of risk factors for osteoporosis, other than age and sex, and to falls were found in the fracture patients compared to population studies in Göteborg.

These, well known factors, were shown to be of particular importance to trochanteric fractures, especially in women, i.e. the patients with trochanteric fractures were less ambulatory and used walking aids more often, they had handicap-transport licences and went out more seldom than did the patients with cervical fractures. Previous fractures were more common in the trochanteric group.

The patients with trochanteric fractures were more often confused but had less often sustained a cerebro-vascular insult than the cervical group.

The women with trochanteric fractures were also shorter ($p<0.001$), lighter ($p<0.01$), and had weaker strength of the hand-grip ($p<0.05$) than the women with cervical fracture.

The results could be interpreted as support for a difference in the etiology of cervical and trochanteric fractures. The cervical fractures (cortical) being an effect of normal senile osteoporosis, while the trochanteric fractures (cancellous) are a result of pathologic osteoporosis.

Social activities and drug consumption in hip fractures

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An increasing number of hip fractures have been observed in the eighties. The diminished bone mass in elderly people is most important but other factors contributing to the fall must be taken into consideration.

Methods: 300 consecutive cervical and 300 consecutive trochanteric hip fractures were interviewed at their admittance to the department of orthopaedic surgery in Malmö. Questions concerning their social background, walking aid, smoking, if they could read a paper, do their shopping, drug consumption etc were asked.

An age-matched control group from the city-files in Malmö were asked the same questions. The interviews were made by the same person.

In this study we present hip fractures and a control group living in their own homes.

Result and Conclusions: Women with hip fractures could not go shopping and needed more domestic help compared with the control group. It was more common to take drugs among women with hip fractures.

Compared with men in the control group, men

with hip fractures more often lived alone and had weak eyesight i.e. difficulty in reading a paper. Men with hip fractures took drugs more often than those in the control group.

All differences were statistically significant.

Traumatic hip joint tamponade as a cause of reversible femoral head ischaemia

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It has been proven experimentally and suggested in transient synovitis in the child that hip joint tamponade with the ensuing rise in intracapsular pressure may cause femoral head necrosis. This paper presents four patients with traumatic hip joint tamponade with high intracapsular pressures and femoral head ischaemia reversed by aspiration.

Patients: Four elderly (75–87 y) patients were admitted after hip trauma. None had clinical or radiographic evidence of previous arthropathy.

Methods: Conventional radiographs of the hips and pelvis in AP and lateral views. 99m-Tc-MDP scintimetry pre-and post-aspiration evaluated numerically as an uptake ratio injured/intact femoral head. Computed tomography in a transverse plane. The joint capsule was penetrated with a needle for intracapsular pressure recordings prior to aspiration of the intracapsular haematoma. In one case internal fixation was performed. Post-aspiration scintimetry was performed within 24 hours.

Results: Radiographs were normal in three patients, whereas in one there was an undisplaced cervical fracture. Computed tomography revealed intracapsular haematomas in all four patients. Preaspiration scintimetry showed diminished uptake over the femoral head, ratios being 0.56, 0.78, 0.66 and 0.6 respectively. Intracapsular pressure in neutral position of the hip was 240, 176, 96 and 120 mmHg respectively; 8, 5, 3 and 18 ml of blood was aspirated. Post-aspiration scintimetry revealed restitution of isotope uptake in all patients, ratios increased to 1.01, 1.05, 0.93 and 1.1.

Conclusions: These patients had intracapsular pressures theoretically sufficient to cause disturbance of the vascular supply and have demonstrated a scintimetric femoral head uptake defect reversed after joint aspiration. It is concluded that traumatic hip joint tamponade may cause femoral head ischaemia reversible by aspiration.

Screws or hook pins in femoral neck fracture fixation?

Scintimetric results and short-term follow-up.

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Tc-MDP scintimetry has proven hook-pinning to be less traumatizing to the femoral head vascularisation than nailing in femoral neck fracture. This investigation compares two atraumatic methods of osteosynthesis, cancellous AO bone screws and hook-pins.

Material and Method: In a prospective investigation April 1983 – May 1984 AO screws and hook-pins were used randomly for femoral neck fracture fixation at a central hospital. 110 patients were included, 53 of whom had two AO-screws and 57 two hook-pins. Scintimetry was performed 6–15 days after the operation. The patients were followed up at four months with radiographic and clinical investigation.

Results: There was no difference in scintimetric results between the screw and hook-pin groups in undisplaced or in displaced fractures. Within four months six re-operations were performed because of technical failure in the AO screw group and one in the hook-pin group. However, at the four month control, another seven reoperations were planned, six in the hook-pin group and one in the AO screw group, because of resorption-varisation.

Conclusion: Similar results regarding postoperative femoral head vascularization (scintimetry) and early postoperative reoperations were found after screw and hook-pin fixation of 110 prospectively studied femoral neck fractures.

Improvement of gait during fracture healing in patients with trochanteric fractures

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A consecutive series of 103 patients with trochanteric fractures were analyzed with respect to their walking capacity on an electronic walkway. 41 frac-

tures were stable and 62 unstable, according to Evans grading system. The surgical technique was randomized, the Ender technique was used in 39 cases and the sliding nail in 64.

46 patients (45%) managed to perform the walkway test at both 3 and 6 months postop., while 24 (23%) were unable and 33 dropped out for various reasons.

At the 6 months test 25 patients used walking aids, compared to 14 patients before the accident. 31 of the 46 patients (2/3) put more than 90% of their body weight on the operated leg.

18 patients, 8 of which had been unable to perform the 3 months test, showed an evident improvement of walking capacity at the 6 months follow up. Of these 18 fractures, 14 had been classified as unstable. The 18 patients were almost equally divided between the two surgical methods.

The single limb support phase was normal for 18 patients at the 6 months test.

Thus, improvement of the walking capacity in patients with trochanteric fractures can still be expected three months after operation and seems to be more dependent on the fracture-type than on the surgical method. However, the walking test revealed that only approximately 25% of the patients had a normal gait 6 months postop.

The need for hospital resources during one year after hip fracture in Göteborg, Sweden

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Hip fractures in the elderly have, together with arthroplasties, put an increasing demand on orthopaedic hospital resources. In spite of this hospitalization time at the orthopaedic wards has continously decreased.

The aim of the present investigation was to study the total need for hospitalization and rehabilitation of the hip fracture patients, not only at the orthopaedic clinics.

Patients: The number of hip fracture patients in Göteborg 1982 was 827. A sample of 105 of these comprised the study group. The mean age was 78 years of the women and 74 years of the men.

Results: 72 percent of the patients came from their own home and 28 percent from an institution. These are the same proportions as found in our studies in 1975, 1980 and 1983/84. The average hospitalization time at the orthopaedic wards was 25 days. It varied considerably between different groups of patients, i.e. patients from own home who were discharged to own home; 18 days, from long-term-care to long-term-care; 3.6 days, from own home to rehabilitation home; 28 days, and from own home to long-term-care; 61 days. In addition there was the hospitalization time at the other than orthopaedic clinics.

60 percent of the patients were in their own home after three months and remained there during the studied year. There was a temporary need for additional long-term-care one to three months after the fracture, and the hospitalization time at the orthopaedic clinics is due to a relative lack of early effective rehabilitation resources.

There was an increase of the proportion of patients discharged directly home from 29 percent in 1975 to 47 percent in 1982. These figures correspond well to other studies in Lund and Stockholm, Sweden.

The mortality occured among the institutionalized patients, and was 6.7 percent at one and three months after the fracture, and 18 percent after one year.

This study shows that the orthopaedic hospitalization time can be shortened by more effective rehabilitation of those patients who are discharged to another institution, but who end up at home.

A rehabilitation programme for patients with hip fracture in Göteborg, Sweden

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The incidence of hip fractures has increased in urban areas in the Nordic countries. Epidemiological studies indicate that physical inactivity with muscular atrophy, low body mass and social isolation are risk factors. The aim of the present study is to develop new strategies for a long-term rehabilitation programme for the elderly patient with a hip fracture.

Method: Göteborg is divided into five districts according to medical and social care. The study is performed in one of these districts, where the patients belong to the Clinic of Orthopaedic Surgery, Sahlgren's hospital, and the Clinic of Geriatric Medicine, Vasa Hospital. The population is 34 800 persons of whom 2 300 are above 80 years. The maximal caring time for hip fracture patients in the orthopaedic ward is set to a maximum of 21 days. A geriatrician visits the orthopaedic wards each week as a consul-

tant to ensure an adequate level of rehabilitation for each patient. An occupational therapist coordinates social and medial care and performs a home call together with the patient. The majority of the patients can be discharged directly to their own homes without any convalescent care. Most patients will join a rehabilitation programme in a day-care ward 2–3 days a week during a period of three months. An orthopaedic surgeon visits the day-care unit 3 hours a week as a consultant. The patients come back for policlinic control six and twelve months after the fracture. Five beds in the geriatric annexe hospital are reserve beds in case of therapy failure.

Results: About 40 patients have been trained in the day care ward. Several patients who were first admitted to the geriatric care have been discharged to their homes by help of the day care programme.

Comprehensive care of hip fractures. Primary nailing, scintimetry, immediate mobilization and home rehabilitation

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In Sweden the incidence of hip fracture in the elderly will have doubled by the end of the century; these patients now occupy one fourth of our orthopaedic beds; their need for rehabilitative facilities is rapidly increasing. Since 1970 we have improved our methods for primary nailing of cervical fractures, mobilization of the patients in the hospital, and rehabilitation at home rather than at institutions. This program has decreased primary hospitalization by 50% and institutional rehabilitation by 75%.

(1) *All cervical fractures are nailed* and allowed immediate wieght-bearing; radionuclide scintimetry identifies those who will develop necrosis of the femoral head; secondary arthroplasty is performed in symptomatic patients, i.e. in 15% of 500 cervical fractures nailed 1976–1981. Improved primary surgery has now decreased the incidence of vascular impairment; the need for secondary arthroplasty has dropped to below 10%. Acta Orthop Scand Suppl 200, 1983.

(2) An intensive *mobilization program in the hospital* is aimed at rapid restoration of pre-fracture ADL; two weeks postoperatively a simple *functional test* predicts the rehabilitation potential of medico-socially marginal patients. Lancet ii: 1097–98, 1982.

(3) Two thirds of the patients *return directly home for rehabilitation* supervised by primary care personnel. Clin Orthop 152: 173–184, 1980.

Comparison of different communities in Sweden has clearly demonstrated wide margins for improved care of the hip fracture patient resulting in the release of resources for the treatment of other age related diseases, notably arthrosis and rheumatoid arthritis. Our data are based on > 5000 patients, 50% of whom were studied prospectively.

Knee Injuries

Acute knee injury with hemarthrosis. Cause of bleeding and primary care

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Hemarthrosis after an acute knee trauma is often a sign of a severe ligament injury. If these injuries are not diagnosed and treated in time, many patients will suffer from knee instability in the future. The aim of this study was to analyse the cause of hemarthrosis in all patients arthroscoped for acute knee trauma during the period 1982 to 1983 and to discuss primary care.

Results: 199 patients had a diagnostic arthroscopy done because of hemarthrosis. Their mean age was 27 years. 40% were women. Ligament injuries were seen in 156 patients. 107 (69%) had a tear of the anterior cruciate ligament. In 51 of these patients there was a concomitant meniscus tear, 17 of which were unstable, longitudinal peripheral tears, suitable for repair. An isolated tear of the anterior cruciate ligament was seen in 22 patients. 29 patients had an intraarticular bleeding after a traumatic dislocation of the patella and 14 after a contusion without any ligament injuries.

Conclusions: No matter how you decide to treat these patients, there is always a need for a correct diagnosis. Surgery planning could be done more selectively and it is possible to give the conservatively treated patient the right information about the injury. Above all, meniscal tears will be left undiscovered if these knee-injuries are only examined clinically or in anaesthesia. This could lead to an unnecessary delay of the rehabilitation. It is our opinion that patients with hemarthrosis after a knee trauma should have a diagnostic arthroscopy within 1 week.

Results of knee-arthroscopy and percutaneous surgery in a series of 238 consecutive examinations

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Methods: Between January 1983 and December 1984 238 patients were examined with arthroscopy. In acute knee lesions all knees with hemarthrosis and with suspected clinical instability were included in the series. Other indications were suspected meniscus lesion, loose body or early cartilage degeneration. In patellofemoral pain resistant to therapy the possibilities were: a/ synovial plica b/ chondromalacia c/ subluxation of patella. The central approach was used and all structures were probed with a hook. All lesions were registered in a special protocol. Ligament lesions were sutured and meniscus lesions sutured if possible: otherwise partial resection was performed. Patients examined with arthroscopy only or operated with the arthroscope, were treated as outpatients and received a written postoperative training program.

Results: In 137 knees meniscus lesions were diagnosed. The lesions were classified in 5 subgroups. The mean-age was highest in the subgroups with horizontal (41 years) and radial (45 years) lesions. In 121 knees with percutaneous resection 4 recurrences were noted. In 9 knees with meniscectomy via arthrotomy and in 7 where the meniscus was sutured, no recurrence was found. In 48 of the 238 examinations another diagnosis than suspected was found. In another 12 cases the suspected diagnosis was confirmed, but additional lesions were also found. In 203 knees with arthroscopy including percutaneous surgery 4 complications were noticed: 2 deep vein thromboses and in 2 cases pain in the scar. The mean sickleave for the 203 cases was 10 days. Observation time 2–4 months.

Conclusions: 1/ Arthroscopy completes the clinical examination so that the knee lesion becomes clear to the whole of its extent. 2/ Arthroscopy and percutaneous surgery is safe with few complications and short sickleave. 3/ Unnecessary arthrotomy is avoided.

Intra and extra articular tissue responses to synthetic soft tissue devices

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The tissue response to synthetic (alloplastic) implant materials is governed by the material's chemical (low molecular weight impurities, antioxidants, stabilizers, etc.) and mechanical (brittle, ductile, elastomeric-compliance) characteristics as well as size (particles vs. bulk) and shape-surface texture (rough, smooth, fabric, fibers, felt, etc.). The local anatomy of the implant site (hard tissue, soft tissue) and degree of motion (flexing) also play a significant role. All synthetic implants form a fibrous capsule surrounding the implant in either non-flexing or flexing (ligaments and tendons) modes. The fibrous capsule and ingrown tissue (if present) is basically scar or granulation tissue containing approximately 85% type I and 15% type III collagen.

Data were presented to show that the mechanical properties, shape and texture are the most important factors controlling the tissue response when the chemistry of the material is such that it is inert and stable. Brittle, ceramic, fibers (carbon) when fractured induce mechanical trauma in mobile tissue such as ligaments or tendons. Fabrics and braids induce a more cellular response when implanted in mobile tissue. Foreign body giant cells are present around all fabric, braid and porous implants but to a significantly greater degree in the presence of particulate matter, for example, delusterant particles from dacron and small abraided or fractured particles from synthetic materials, including carbon.

The use of dacron ligament as an anterior cruciate prosthesis

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32 selected patients (13 women and 19 men, age range 16–35 years) were operated on because of anterior cruciate insufficiency. All patients initially had a three-month training programme and bracing and only those who still had problems after the program were accepted for operation. The anterior cruciate was replaced by a dacron ligament. A ++ medial instability was also treated in 4 patients. The operation involved careful positioning of the cruciate substitute through drill holes in the anatomic, isometric points by using a new drill guide. The inner ends of the drill holes were beveled. After operation stability was measured on x-ray and with a measuring device immediately and after 4–5 days. Full range of motion exercises were started on the first postoperative day and weightbearing was allowed. Muscle training was guided by Cybex measurements. All patients have been followed for at least one year. There have been 3 graft ruptures all probably due to technical errors. One patient had a low

grade infection around one of the staples without any serious consequence and another a synovial fistula. The remaining patients have all become stable with no drawer sign or pivot shift. Stability measurements showed a mean decrease from 7 mm preop to 0.2 mm postop. Follow up arthroscopy has been done on 8 patients in connexion with staple removal 6–8 months after operation. In these cases the ligament was covered by scar tissue and had excellent tension. Rehabilitation time to initial muscle strength was between 3–8 months. Knee function was assessed before and after operation by a knee function score and a test including a one leg jump running a figure of eight, running up and down stairs and a slope. All test results were improved as well as the knee function score. These preliminary data indicate that the technique may be studied further. It is vital to remember that the dacron ligament is still an experimental device. Not until a 5 year follow up without major complications is achieved can the dacron ligament be recommended for use in special cases.

Partial rupture of the anterior cruciate ligament

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Method: Knee joints with indirect trauma which were stable under general anesthesia but had haemarthrosis were routinely examined with arthroscopy. Out of 95 knee joints 34 had partial anterior cruciate ligament injuries. Twenty-eight of these were followed for six months to five years and examined with regard to stability and using the Lysholm knee score. The original injuries were classified as:

Group I: Interstitial injury but with continuity.

Group II: Obvious fibre injury and discontinuity in the antero-medial (a) and postero-lateral (b) portion.

Results: The follow-up findings were distributed as follows (total number of each group in parenthesis):

	Number of positive Lach-man	Ant draw	Pivot	Stable knees	Lysholm score
Group I (14)	2	6	0	8	95
Group IIa (3)	1	3	0	0	94
Group IIb (10)	9	7	4	1	90

Conclusion: Initially stable knees with partial anterior cruciate ligament injuries tend to become unstable with time, especially those with posterolateral bundle rupture, which may cause symptoms.

Surgical or non-surgical treatment of ligamentous knee injuries. A randomized controlled study – early results

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Method: Two hundred patients with acute ACL, MCL or ACL/MCL injuries were randomized to surgical treatment or plaster fixation only. The first hundred cases have been followed for one year and were evaluated with regard to time of disability, the Lysholm score, stability and muscle force. Two thirds of the patients were men and the average age was 28 years. Seventy-five per cent of the injuries were sports injuries, 57 percent soccer injuries.

Results: The time of disability was six weeks less in the non-operated group as compared with the surgically treated. The patients in the non-operated group were able to return to sports activities three weeks earlier. The operated group was slightly less unstable than the non-operated but the difference was not significant for any quality, nor was there any difference in the Lysholm score between the groups.

Conclusion: The early results of treatment of ligamentous knee injuries do not differ between surgical treatment and non-surgical treatment.

Early treatment of the torn posterior cruciate ligament. A 3–12 year follow up study

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Early repair of a torn posterior cruciate ligament (PCL) is considered to give a good functional result. It has been our experience, however, that a moderate posterior drawer often remains, although knee function is excellent. This fact may jeopardize the result in the long run.

43 patients (32 men and 11 women) were treated within 3 weeks from an injury to the PCL. The majority (67%) were between 15 and 30 years old. 58% were sport- and 26% traffic-injuries. The diagnoses were made on clinical examination under anaesthesia and arthroscopy.

In 9 patients (21%) the ligament was torn off the tibia with a piece of bone. The remainder showed a total (30 patients) or a partial (4 patients) tear of the

ligament itself. In 18 (42%) the PCL tear was the only injury; in the remainder it was combined, most commonly, with a tear of the medial ligament complex (MCL).

A suture repair (Palmer, 1938) was done in 17 patients, primary reconstruction in 4 and nail fixation of an avulsed bone fragment in 8. 14 were treated without repair or reconstruction; 4 of them had partial PCL tears.

Follow-up was done in all patients 3–6 years after the injury. In 23 a second follow-up was done 7–12 years after the injury. The first follow-up included a rating of knee function and activity level and a knee function test (Lysholm & Gillquist, 1982; Tegner et al., 1984), a Cybex-2 test, clinical stability tests, and measurements of sagittal plane laxity in 20° of flexion. At the second follow-up the same examinations were done, but a standing X-ray including patellofemoral axial views was added.

At the first follow-up all but two (one with a bone-fragment-tear and a comminuted fracture of tibia plateau and one with a partial tear and associated grade II–III tear of the MCL) with bone-fragment-tears or treated conservatively because of partial tears showed a stable knee with an excellent function. In patients treated with suture repair or reconstruction 85% showed an excellent or good rating of knee function. 16/21 (77%) showed a slight or moderate posterior drawer sign. In patients with total PCL tears treated conservatively 80% showed an excellent or good knee function. All had a moderate posterior drawer sign. At the second follow-up the patients in general showed deteriorating knee function commonly because of early degenerative joint disease.

Hinged cast following ligamentous knee injuries. A randomized controlled study

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Method: 113 patients, age 15–50, operated on for ligamentous knee injuries were randomized to either a hinged cast or rigid plaster cast fixation.

Results: Patients who had been operated for isolated anterior cruciate ligament injury treated with hinged cast returned to work on average six weeks earlier than those treated with rigid fixation. Also, those treated with a hinged cast returned earlier to their sports activities.

The range of motion returned to normal more rapidly in cases treated with hinged cast. There was no difference in stability between the groups.

Conclusion: A hinged cast after knee ligament operations is no danger to joint stability and has the advantage of an earlier return to physical activity.

Age and sex specific changes in incidence of tibial condyle and patellar fractures over 30 years

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Several reports from Scandinavia indicate an increased age specific incidence in hip fractures. We have shown the same increase in fractures of the distal end of the radius and in women in malleolar fractures.

In the Department of Diagnostic Radiology at Malmö General Hospital all X-ray films have been saved and all films from knee fractures have been re-evaluated from the years 1950–55 and 1980–83 and the type of fracture has been noted.

Results: During the six years in the 1950's 227 (38 per year) tibia condyle fractures and 144 (24 per year) patellar fractures occurred, and from the four years in the 1980's 242 (61 per year) tibia condyle fractures and 238 (60 per year) patellar fractures occurred.

The age specific incidence for tibial condyle fractures shows an insignificant increase in men over 80 years of age but in women the increase in the 1980's was significant above 70 years of age. Patellar fractures followed the same pattern with an increase in elderly men which is not significant, but above the age of 60 there is a significant increase in women.

It seems as if several fragility fractures have increased their age specific incidence now compared with 30 years ago. In women we have a significant increase in the tibial condyle fractures and in elderly women also in the patellar fractures.

A new operative procedure for recurrent dislocation of the patella

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Since 1978 14 knees with recurrent dislocation of the patella have been treated with a new operative procedure originally designed for the external rotation syndrome of the knee and first presented at the meeting for the Swedish Orthopaedic Association at Huddinge 1981.

This operative procedure means that you take a medial parapatellar retinacular strip, about 8–10 mm broad, and cut it proximally at the vastus medialis. With the knee in 30° of flexion and the foot internally rotated you suture the proximal end of the strip under tension round the proximal end of the medial collateral ligament.

There has only been one recurrence of a patellar dislocation and it happened as early as 1979. Three other patients needed minor operations because of remaining anterior knee pain.

The patients were also analyzed with regard to generalized joint laxity and abnormal femoropatellar articulation. Despite of the fact that about 50% of the patients had patella alta and this procedure only strengthens the medial retinaculum, the method seems promising and encourages us to continue with it.

Secondary lowering of the patella after anterior advancement of the tibial tubercle for the patello-femoral pain syndrome

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In a series of 72 patients treated with anterior advancement of the tibial tubercle for patello-femoral pain syndrome, secondary lowering of the patella was noted in eight. In all eight patients the results following surgery were poor, with severe disabling retro- and peripatellar pain and atrophy of the quadriceps muscle. We find it important to describe this complication and to illustrate and discuss the biomechanical consequences.

Methods: The shortening of the patellar ligament and lever arm of the ligament were determined from radiographs of the knee joints before and after surgery. A theoretical analysis was made of the compressive force in the patellofemoral joint in one of these patients.

Results: The Insall-Salvati index decreased from 0.88–1.25 (mean 1.07) preoperatively to 0.54–0.78 (mean 0.70) at follow-up 1.0–2.5 years postoperatively. The lowering of the patella was correlated with a reduction of the lever arm of the patellar ligament in seven patients.

Conclusions: The mechanism behind the lowering of the patella is obscure but the reduced lever arm of the patellar ligament will increase the compressive force in the patellofemoral joint, and might be one explanation of the poor results. Impaired congruity of the patello-femoral joint, increased tension in the patellar ligament and increased pressure against the quadriceps tendon are other possible explanations.

Lower extremity

Three-dimensional electrogoniometric gait recording

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Methods: Gait recordings on 20 healthy subjects and 3 patients with rheumatoid gonarthritis were made by means of a light-weight computerised electrogoniometer. The angular excursions in three planes were recorded simultaneously with regard to hip, knee and ankle joints in both legs. Determination of the mean values and dispersions were then made.

Tests and retests were performed on the healthy subjects in order to establish the reliability of the method. Its valitidy was checked by comparing it to other methods.

The recordings from all healthy women and men, respectively, were combined to 2 "normal graphs" and compared with the measurements from the patients with diseased knee joints.

Results: The reliability and validity of the method was found to be satisfactory. The maximum error of the method was 3.2 degrees in rotation of the hip joint.

Patients with gonarthritis showed decreased angular excursions of the knee joint, especially in flexion during stance phase.

Conclusions: Computerised electrogoniometry was found to be a simple and efficient tool for recording and studying both normal and pathological gait. The errors are small and well defined. It is easy to handle and gives reproducible and accurate results.

Physical performance after different types of non-operative treatment of tibial shaft fractures

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Methods: Fiftyseven cases with tibial shaft fractures were studied. Fifteen of them had been treated conservatively in a long leg cast with little or no weight bearing, and 42 had been treated in a functional brace with full weight bearing as soon as possible. Dynamometric measurements by 2 Cybex isokinetic dynamometers were performed as concerns plantar flexion torques, contractional work and range of movement in the ankle.

Results: The maximal dynamic plantar flexion strength was similar in the braced legs compared to the patients uninjured leg, but correspondingly significantly lower in the long leg cast treated extremities. The contractional work as well as the range of movement was significantly smaller on the fractured side in both groups. However, the relative decrease (%) was significantly larger in the long leg cast treated group compared to that treated by funcitonal bracing.

Conclusions: Functional bracing gives less sequelae than treatment with long leg cast.

Surgical reconstruction of chronic lateral ligament injuries of the ankle

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Thirty-one patients with chronic lateral instability of the ankle were treated by a simple reconstructive operation. A subperiostal release was made on the distal part of the lateral malleolus. The released flap, including the insertion of both the anterior fibulotalar and fibulocalcanear ligaments was then sutured in a more proximal position. Preoperatively all ankles were unstable with a positive anterior drawer sign and talar tilt restricting their physical activities. Twenty-nine patients were examined 14–70 months after surgery. In 92 per cent the result was excellent or good. Out of 28 patients with unstable ankles restricting sporting activities before surgery 24 (86 per cent) had no restriction at follow up. It is concluded that this procedure could be recommended as surgical treatment of unstable ankle joints where both anterior fibulotalar and fibulocalcanear ligaments are insufficient.

The pronation capacity of the foot – its implications for axial deformity after tibial shaft fractures

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Ankle problems after tibial shaft fractures are common, especially if there is a varus deformity present. The limit of varus deformity tolerated is considered to be five degrees. The malalignment is compensated as pronation of the foot. If the pronation capacity is smaller than that needed for compensation, the mechanism of ankle problems could be explained. This investigation was made to analyse if the pronation capacity of the foot is of the same magnitude as the varus deformity tolerated.

Ten osteoligamentous preparations were taken from ten adult cadavers. The specimens were placed in a test frame and the maximal pronation capacity was measured in various degrees of plantar flexion. It was found that the average pronation capacity was 9.5 ± 7.0 degrees (range 0.3–20.7). It was also found that the pronation capacity decreased linearly with 0.2 degrees for every degree of plantar flexion ($r = -0.92$).

Thus, the mechanism for ankle complaints after varus deformed tibial shaft fractures is probably a too small pronation capacity. The large intra-individual variation in pronation capacity makes it impossible to set up a tolerance limit for varus deformities. An anterior angulation, compensated as plantar flexion of the foot, further decreases the tolerance for varus deformities.

Only anatomical reduction seems to guarantee abscence of ankle problems due to a lack of pronation capacity of the foot after tibial shaft fractures.

Functional anatomy of the hindfoot with special reference to its torsion transmitting properties

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A leading feature of the hindfoot is its torsion transmitting properties. This has several clinical implica-

tions, for instance balance in one leg, standing and walking on uneven surfaces, as well as an understanding of trauma mechanisms in ankle fractures. The aims of this investigation were to analyse the magnitude of the torsion transmitted and to explain the functional anatomy in a simple model.

Ten osteoligamentous preparations of the lower leg were taken from newly diseased, adult cadavers. Each specimen was placed in a test frame. The amount of tibial torsion for every degree of supination of the foot was measured in various degrees of plantar flexion. In addition, in four of the specimens the motions of the different hindfoot bones were measured in the three cardinal planes. The results were recorded as angular motions of pins inserted into the various bones of the preparations.

The torsion transmitted was in average 0.44 degrees of tibial outward rotation for every degree of foot supination. The hindfoot acts as a modified universal joint. The talus is analogue to the center piece, the talocrural joint is the "proximal fork" and the calcaneus-cuboid-navicular system is the "distal fork" of the universal joint. The distal fork changes its configuration through its range of motion explaining the loss of torsion transmission.

Upper extremity

Functional bracing of fractures of the shaft of humerus

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Thirty patients with fractures of the humeral shaft were treated in 1982–83. All were treated with a functional brace consisting of a plastic sleeve, individually molded or prefabricated, and early functional activity after a few days of immobilisation as suggested by Sarmiento. One operated subacute and one deceased from unrelated cause were excluded from the study.

Results: Of the remaining 28 patients with 28 fractures there were 14 women and 14 men. The mean age was 57 years (19–88). There were 18 fractures on the left and 10 on the right side. 22 fractures were due to low-energy trauma and 6 to high-energy trauma. 26 fractures were closed and 2 open. Three patients had transient nerve palsies all of which resolved spontaneously. Six patients had other major fractures or injuries. The average hospital stay was 11 days (0–91).

21 fractures healed without complications in mean 9 weeks. There were 7 (25%) fractures with delayed union which required 9 operations.

Conclusions: Compared to other studies with conservative treatment the frequency of delayed union in this material is surprisingly and unacceptably high. This could be a result of bad bracing technique and too many doctors involved in the treatment. Further studies will show if a more careful bracing technic will improve our results.

Arthroscopy and stability testing of the shoulder joint

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A consecutive series of 36 patients with shoulder problems were examined with arthroscopy. In half of the patients stability testing during fluoroscopic control was also performed.

In younger patients labral lesions and chondral lesions of the humeral head were common arthroscopic findings. In the older patients ruptures of the supraspinatus and biceps tendons were more frequent.

Stability testing proved more useful than arthroscopy for the subsequent treatment in shoulder instability. Arthroscopy was of some value in choosing treatment in older patients.

A difficulty with shoulder arthroscopy is the variable anatomy and another problem is which degenerative changes should be considered normal.

No doubt shoulder arthroscopy in combination with stability testing will add a new dimension to our knowledge of shoulder problems in the future.

Pressure recording in the subacromial bursa

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Introduction: Knowledge of tolerable hand load and optimal work postures, obtained by biomechanical modelling of the shoulder joint, can be a useful tool in preventing vocational shoulder pain. Validation of such a model requires estimation of forces and moments to be performed in vivo. EMG and intramuscular pressure measurements have previously been applied for this purpose. This study presents the re-

sults of pressure recording in the subacromial bursa at rest and during exercise. The method may also be used for diagnostic purposes in clinical work.

*Methods:*The pressure in the bursa was recorded in 8 healthy volounteers aged 20–40 years (10 shoulders) using the microcapillary infusion (MCI) technique with an infusion rate of 1.5 ml/h. Using a local anaesthetic, a Myopress^{R} catheter was introduced into the bursa and connected to a pressure recording device. The pressure was recorded in a standardized resting position for 40 minutes. The subjects were then asked to flex the shoulder 45 degrees and the elbow 45 degrees. The pressure was measured in this position without hand load and with a hand load of 1 kilogram. The procedure was repeated three times with an injection of a bolus of 0.2, 0.5 and 0.5 milliliters of saline before each cycle respectively.

Results: The pressure at rest during 40 minutes was stable and averaged 8 mmHg at the start of the observation and 6 mmHg at the end. When the arm was lifted, the pressure in the bursa rose to an average of 32 mmHg without hand load and to 56 mmHg with hand load. When the bursa was preloaded with saline, the pressure at rest and during load increased.

Conclusions: The pressure in the subacromial bursa is related to the position of the arm and to the hand load. The infusion rate used does not increase the recorded pressure. Instant volume preloading of the bursa, with a volume as low as 0.2 milliliters, however, increases the pressure at rest and during load. The MCI technique is found suitable in recording pressure in the subacromial bursa.

Carpal tunnel pressure in Colles' fracture

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Carpal tunnel syndrome is a common complication of Colles' fracture. Hematoma, oedema and mechanical pressure from fragments have been considered as causes as well as fixation in extreme volar flexion of the wrist.

The following investigation was conducted in order to analyse the pressures in the carpal tunnel after Colles' fracture. The material consisted of thirteen patients with acute Colles' fractures. The pressure variations due to injection of local anesthetics into the fracture hematoma, and due to different volar flexions of the wrist were recorded. Comparisons were made to a control group of eight healthy volunteers.

The pressure recordings were done using a Wick catheter technique. The patients were measured in neutral position before and after injection of local anesthetics into the fracture hematoma. The pressure was also measured in 30 and 60 degrees of volar flexion of the wrist. The control group was measured in neutral, 30 and 60 degrees of volar flexion.

The pressure was significantly higher in the fracture group than in the control group (36.4 and 5.5 mmHg respectively, $p < 0.001$). The pressure increased with on average 9.6 mmHg in the fracture group after injection of local anesthetics into the fracture hematoma ($p < 0.001$). The pressure also increased with increasing volar flexion in the fracture group. The pressure was on average 60 mmHg in 30 degrees, and 79 mmHg in 60 degrees of volar flexion ($p < 0.001$). In the control group the pressure also increased significantly in volar flexion. It was 14.5 mmHg in 30 degrees and 26 mmHg in 60 degrees of volar flexion ($p < 0.001$).

Thus, the carpal tunnel pressure is increased in Colles' fractures. It increases further when local anesthetics is injected into the fracture hematoma. It reaches values where the nerve can be damaged if the wrist is volar flexed to 30 degrees or more.

The treatment of lunatomalacia? What is "Accepted procedure"?

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A great number of suggestions exist for the treatment of lunatomalacia. They range from short time plaster immobilization, removal of the bone, replacement by the patients own tissue or by commercialized artificial products, levelling operations of many different kinds and, finally, the choice between nothing and arthrodesis. A small inquiry has shown that the knowledge in this field can be improved in the interest of the patients. Efficient follow-up studies can tell what to do.

Pediatric Orthopaedics

Hip joint instability in newborns

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During 1982 about 1100 newborns were registrered with diagnosis "Hip joint dislocation" or "Preluxation of the hip (instability)".

The records from the consultative orthopaedic department have been studied and the problems concerning treatment and clinical and radiographic follow-up were reported.

Pitfalls in abduction treatment of late discovered CDH

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The importance of the position of the infant during abduction treatment for late discovered congenital dislocation of the hip (CDH) was investigated.

Four infants, two, six, eight and fifteen months of age, with unilateral late discovered CDH were studied. The patients were treated with abduction splintage according to von Rosen. The stability of the splinted hip joints was investigated by ultrasound (7,5 MHz-scanner). An anterior approach was used producing sonograms equivalent to lateral radiographs of the hip with the leg in the Lauenstein position.

It was clearly demonstrated that the femoral head could leave the acetabular socket even when the thigh was held by the splint in full abduction and 90° of flexion. The hip was reluxated by the muscular activity of the child. Stability of the hip joint was only achieved when the amount of flexion in the joint exceeded 100°.

To prevent reluxation of the reduced joint in late discovered CDH the position of the thigh is of crucial importance. The hip must be splinted in a position of full abduction combined with flexion well exceeding 100°.

Diagnostic accuracy of ultrasound compared to radiographic assessment of the hip joint in CDH

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Ultrasound for evaluation of the hip joint was compared to conventional radiographs, arthrography and computerized tomography (CT).

Five children, two to sixteen months of age, with unilateral late discovered congenital dislocation of the hip (CDH), were investigated under general anaesthesia with ultrasound, conventional radiographs, CT and arthrography. For the ultrasonic investigation (7,5 MHz-scanner) the child was investigated in the "frog" position. An anterior approach was used producing sonograms equivalent to lateral radiographs of the hip. During the sonographic examination and during the arthrography the hips were provoked according to Barlow. The arthrography included a lateral projection corresponding to the sonogram.

The ultrasonic investigation provided information of the size and position of the femoral head, the degree of instability of the joint, the size of the acetabulum and the presence of interposing structures in the interspace between the femoral head and acetabulum. The sonographic projection used did not visualize the steep acetabular roof seen in the conventional radiographs. The CT-examination demonstrated that the interposing soft tissue in the acetabulum consisted of fat. Except for this information CT and arthrography did not add any information to what already was given by the sonographic examination and conventional radiographs.

In infants, conventional radiographs and ultrasonic investigation are important complements for evaluation of the hip joint in late discovered CDH. The value of CT and arthrography must be questioned as the techniques seemed not to add information of value in the treatment of the disease.

Treatment of slipped capital femoral epiphysis

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Since 1975 all cases of slipped capital femoral epiphysis have been treated in the same way. This includes preoperative closed reduction when slipping is greater than 10 millimeters. Fixation of the epiphysis is accomplished by three to five K-wires. These are fixed by a small lateral plate to prevent lateral displacement. The contralateral hip is not operated upon routinely, only in case of radiographic or clinical signs of slipping. 25 patients, 8 to 17 years of

age, were included in this study. All patients were followed until the epiphysis was closed. Seven patients showed marked displacement of the epiphysis and were treated in preoperative tibial traction with internal rotation of the femur. Four of the five cases with suspected traumatic origin were in this group. Four patients showed improved position after closed reduction. Five patients showed slipping of the contralateral hip, one to two months after primary treatment, and were operated upon. All patients in which acceptable position of the epiphysis was accomplished (27 hips), showed postoperative excellent results. They all regained normal function of the hip and no difference in leg length was noted. In two of the three patients where reduction was unsuccessful, probably due to remodelling of the epiphysis, the results were not satisfactory. In no case were there problems with displacement of the wires. The final displacement of the epiphysis is of great importance to the future function of the hip. It is therefore necessary to quickly diagnose these cases and treat them adequately. This method of internal fixation is easy to perform, produces good stability to the epiphysis and is not marred by any obvious complications.

Spinal Problems

The Hartshill system for the internal fixation of the spine

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Traditionally, general orthopaedic surgeons have not supplemented spinal fusions for pain syndromes with internal fixation. Scoliosis surgeons however know that in order to achieve a reliable fusion, the facet joints should be excised and the spine internally fixed. Those internal fixation systems that have been available are somewhat complicated and expensive, and not suitable for internal fixation of short segments of the spine.

The Hartshill System is a simple, secure, cheap and adaptable means of internal fixation of the spine. It consists of a 316 L stainless steel rod bent into the form of a rectangle and welded, with the addition of a "roof" to conform with the lamina. The rectangle is secured to the spine by wires passed around the appropriate laminae. We have developed a sacral jig to make drilling of holes in the top of the sacrum safe, but otherwise no special instrumentation is necessary.

We have now used the system in a total of 236 patients. If spinal deformity and fractures are excluded, the system has been used in 156 cases of spinal pain syndromes. The commonest application of the system is for stabilisation of the lumbo-sacral spine after excision of the lower facet joints. We now have a total of more than 50 patients with a more than two year follow-up. The overall results are excellent with an average return to light work at 7.5 weeks following surgery and to heavy work at an average 13 weeks following surgery. The results depend however on very strict selection criteria.

Internal fixation of the sacro-iliac joint

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A dislocated sacro-iliac joint is part of a Malgain-type of pelvic injury.

A dislocation of the SI-joint means a complete rupture of the anterior as well as the posterior ligaments. Intact anterior and posterior ligaments are a necessity for stability of the joint. In cases with a complete rupture of the posterior ligaments, external fixation with, for example, the trapezoid frame system (Slätis) is not indicated as the dislocation then has a tendency to increase.

In these cases open reduction and internal fixation of the dislocated SI-joint, through an anterior exposure is recommended. The joint is fixed with a specialy constructed compression plate.

In a series of 7 cases with a complete luxation of the SI-joint, all the joints were exactly reduced and the corresponding fracture of the pelvic ring was also reduced and fixed. In four cases an associated component was a fracture through the acetabulum.

Six cases were followed more than 6 months after the initial trauma. These pelvic ring fractures were all sufficiently healed. One case with primary extensive damage to nerves and muscles still has a minor handicap. The others are functioning well.

Cervical spine fractures treated at a Swedish county hospital during 1978–1983

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A review of traumatic cervical spinal fractures during the 5½ year period between april 1978 – septem-

ber 1983 was made at the county hospital of Eksjö-Nässjö which serves a population of 115000.

The subjects in the study comes from the general population without any selection.

The patient data, type of injury, the treatment and the incidence, were compared with the Swedish Health statistics and the other publications.

In the period under review 30 patients with cervical fractures were treated at the hospital. (The average being 1:21000 pr year which is less than the Swedish national average of 1:12000 per year).

Out of the 30 cases reviewed 7 were upper cervical spine fractures (at the level C_1–C_2). The other cases involved the lower cervical spine (C_3–C_7).

In the group of lower cervical spine fractures, 10 patients had an unstable fracture with a high risk of progressive neurological damage. These patients were subjected to surgery and the cervical spine was stabilized by internal fixation. 8 out of 10 patients with unstable lower cervical fractures were treated with anterior cervical interbody fusion (Cloward procedure). These patients did not recieve any other form of cervical spine support and were mobilized early during the postoperative period.

There were no surgical complications after this procedure of internal fixation, in contrast to the earlier Swedish recommendation of external fixation with HaloVest treatment.

Medullary compression in rheumatoid atlanto-axial subluxation evaluated by computerized tomography

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CT-examination of rheumatoid dislocation in the C1–C2 region was performed in twenty patients with advanced disease. The patients were classified in three grades according to the degree of medullary compression caused by the odontoid process in an extended position of the neck. Five patients showed no dural or medullary compression (grade I), nine dural compression (grade II) and six medullary compression (grade III). CT-grading was found to correlate best with long tract symptoms. These were present in 4/6 grade III and in 0/5 grade I patients while 3/9 grade II patients had long tract symptoms. Tissue attenuation values over the anterior atlanto-axial joint indicated interposing firm connective tissue in non reducable cases.

Dens resection in a case of vertical impression of the dens in the foramen magnum

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Superior migration of the dens is sometimes seen in patients with severe RA. The condition tends to be progressive and can cause grave neurological deficits. A 72-year old woman with disabling RA who for half a year had had paresthesias and numbness of arms and legs experienced increasing muscular weakness with difficulty in walking and eating. She also had occipital headache. X-ray showed a superior migration of the dens into the foramen magnum. On CT the medulla could be seen to be sagitally deformed. A resection of the dens through the anterior approach of Riley was combined with stabilizing with an Oroscoplate and acrylic cement. The patient became painfree immediately postoperatively and the neurological deficits gradually improved. This was objectively verified with a gradual improvement in SEP (sensory evoked potentials).

Somatosensory evoked potentials in rheumatoid cervical subluxation

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Rheumatoid arthritis often affects the cervical spine and this may result in spinal cord compression. Patients developing a rheumatoid cervical myelopathy are usually already severely disabled by arthritis and the neurological examination is often difficult. The presenting features in rheumatoid myelopathy are often sensory symptoms.

Methods: Somatosensory potentials (SSEPs) were recorded bilaterally from the median and tibial nerves in 30 patients with severe rheumatoid arthritis. Fifteen patients had atlanto-axial subluxation and 15 patients without subluxation served as a control group. Median nerves were stimulated at the wrist and SSEPs were recorded at Erb's point, in the neck (C2 level) and in the scalp over contralateral somatosensory cortex. Tibial nerves were stimulated at the ankle and cortical SSEPs were recorded in the vertex region.

Results: Of the 15 patients with subluxation, 4 had pathological SSEP: in 3 cases the SSEP latency was prolonged from median as well as tibial nerves, whereas one patient had slightly increased latency from one tibial nerve. In this group the conduction block is best explained by compression of spinal cord in the upper cervical region. However, we found 4 patients in the control group with delayed SSEPs: in 3 cases there was marked SSEP latency increased bilaterally from tibial nerves, in 1 case slight increase in latency from one tibial nerve. SSEPs from median nerves showed normal latencies in these patients. Hence the conduction block was probably in these cases located in the lower spinal regions, i.e. thoracic or lumbal levels. We have no specific explanation for the delayed SSEP in these cases.

Conclusions: The SSEP method can be useful in providing objective evidence for spinal cord lesions in patients with rheumatoid arthritis. This could be an aid in judging the severity and necessity of surgery in these patients.

Neck and shoulder complaints among sewing-machine operators

A preliminary report of a multidisciplinary epidemiologic study

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During 1984 a multidisciplinary investigation was carried out at four textile factories with 223 sewing-machine operators. A questionnaire was sent out to all the sewing-machine operators concerning socio-psychological factors and general health conditions. In addition to these a questionnaire drawn up by the Nordic Council was used to study complaints from the neck and shoulder. 199 sewing-machine operators answered the questionnaire. 133 of 150 women with complaints from the neck and shoulder region during the last twelve months participated in a clinical investigation.

The incidence of neck and shoulder complaints during the last year was 75 per cent and the weekly prevalence was 39 per cent. However, only 21 per cent had a limitation of their spare time activities and 17 per cent considered that their working capacity was decreased. 30 per cent were sicklisted because of neck and shoulder disease during the last year. 68 per cent of the sewing-machine operators regarded their complaints to be linked with their working conditions.

Aching and the feeling of stiffness in the neck-shoulder angle was the most common subjective complaint and muscle tenderness was the most frequent finding; in levator scapulae in 50 percent and in the trapezius muscle in 39 per cent. According to the diagnostic criterias proposed by Waris et al. the following diagnoses could be established: tension neck syndrome (42 per cent), cervical syndrome (degenerative osteoarthritis) (24 per cent), humeral tendinitis (12 per cent), acromioclavicular syndrome (5 per cent). In 16 per cent no specific diagnosis was made.

Pain drawing for analysis of back problem in industry

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Pain drawing was used to analyse the pattern of pain among industrial workers with known pain in the neck or back. The mean age was 47 years, 50% being 43–56 years. There were 8 males and 17 females. Using 6 symbols for different types of pain, the workers could localize their pain on a drawing of a man's or woman's body. On a separate drawing they indicated the area of the most intense pain. As a comparison group we used subjects from the general population with known neck or back problems. The mean age was 47 years (36–59). There were 21 males and 30 females. The group of workers had more frequent and dominating neck and shoulder pain as compared with the general population where low back pain was more frequent and severe. Analysis of the workers showed that this difference was due to a group of workers who frequently worked with elevated arms (TT).

	N	Neck pain	Dominating neck pain
TT	10	10	7
Other workers	15	5	4
		$p < 0.001$	$p < 0.05$

This study shows that pain drawing is a simple way

to analyse neck and back pain and identify works which gives a certain type of back problem.

Self-help for low back pain and sciatica when connected with spinal instability

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Instability of a lumbar disc may permit pathologic rotation from the normally neutral contact position of the adjacent vertebrae, de-rotation. Neither instability nor derotation must per se cause pain, but a de-rotation may cause pressure on nerve elements between the disc or the lower part of the upper vertebra and the joint apophysis of the lower vertebra and thus evoke low-back pain and sciatica. If there is distinct side localisation of the pain the patient often has observed that some positions and rotatory movements will increase the sufferings. When the medical examination has not disclosed contraindications the logical symtomatic therapy is rotation in the opposite direction here called re-rotation. The results have shown to be immediate.

Recurrences however are common. Because the patient is the first to feel these it is desirable to teach the patient how to perform the rerotation by his own movements. He can then prevent and preclude the recurrence.

This therapy may be called Auto-active rerotation and has the advantage of using repeated gentle movements made by the patient himself.

Bone reconstruction

Healing of segmental ulnar defects in dogs under the influence of bone morphogenetic protein, BMP

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Methods: Segmental ulnar defects were created bilaterally in 19 adult mongrel dogs as described by Heiple et al. in 1967. The defects were created at the junction between the middle and distal thirds of the ulna. An area twice the diameter of the bone including periosteum was resected. This method has been widely used to evaluate bone grafts since the defect invariably proceeds to non-union if left untreated. On one side the defect was treated with 50 mg of partially purified Bone Morphogenetic Protein (BMP). On the contralateral side two control procedures were applied. In nine dogs the defect was filled with autogenous cortical bone chips and in ten dogs with 50 mg of bovine serum albumin (BSA). The dogs were sacrificed 1 to 3 months after surgery. Healing was analyzed by histology and by monthly radiographic examinations.

Results: The BSA treated defects proceeded to non-union. All 19 BMP treated defects showed solid bony union within 1 to 3 months, generally with an abundance of callus. By 3 months remodelling and colonization by red bone marrow was apparent. The defects treated with cortical bone chips healed by 3 months but showed considerably less callus and a slower rate of new bone formation than the BMP treated defects.

Conclusions: Bovine BMP induces a rapid response of bone formation of the host when transplanted to an orthotopic site rich in target cells for this substance i.e. perivascular mesenchymal cells. These cells are readily transformed to bone forming cells, a process known as osteoinduction. Utilizing the osteoinductive property of bovine BMP in dogs the healing of large diaphyseal defects is even more rapid and complete than in defects treated with autogenous cortical bone chips.

Structural properties of autoclaved bone

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Structural properties of autoclaved diaphyseal bone in the rabbit were investigated by torsional testing providing data on maximum strength, stiffness and deformation changes.

The study included 108 (54 pairs) diaphyseal bones autoclaved to provide the same degree of sterilization although with variations of time and temperature. Autoclaving was found to cause clear, but moderate changes in structural properties of diaphyseal bone. The greatest decrease (35 per cent) in torsional strength was noted for specimens autoclaved at 110 degrees for 255 min and the least decrease (9 per cent) for those autoclaved at 131 degrees for 2 min, whereas the decrease for specimens subjected to a

standard autoclaving program i.e. 121 degrees for 20 min was 23 per cent. Furthermore, heat propagation into diaphyseal bone during autoclaving was studied by means of thermocouples. Heat propagation proved to be very rapid, indicating that uniform sterilization of whole bones may be performed to an accurate, predetermined degree.

Autoclaving clearly affects structural properties of bone. However, by appropriate adjustment of time and temperature the physical effect may be minimized within limits consistent with normal mechanical loads, without compromizing safe devitalization of bone. Provided incorporation can be achieved, bone with a pathological lesion may be resected, devitalized by autoclaving and then reinserted offering a simple means for reconstruction of large cortical defects.

Reimplanation of autoclaved bone supplemented with allogeneic bone matrix

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Incorporation of reimplanted autoclaved bone supplemented with allogeneic bone matrix was experimentally studied in the rabbit.

The middle third of the humerus was unilaterally resected, autoclaved (20'/121C) and reimplanted with allogeneic bone matrix in 7 adult rabbits. Two intramedullary pins were used for fixation of the implants. The contralateral humerus was left intact serving as a control.

Radiographically all reimplanted specimens were incorporated after 3 months. The internal fixation was removed 6 months postoperatively. Two months later the animals were sacrificed and the humeral specimens collected for torsional testing and autoradiography (45-Ca).

Torsional testing showed that the reconstructed humeri on the average had regained 84 per cent (range = 71–96) of the normal strength as compared to the contralateral untreated humeri.

Autoradiography showed uptake of 45-Ca in the autoclaved reimplanted bones indicating revitalisation of the incorporated specimens.

The present study shows that devitalized reimplanted bone supplemented with allogeneic bone matrix does incorporate. The described method may provide a simple means for skeletal reconstruction. In fact, this type of reconstruction of large skeletal defects appears stable enough to withstand normal mechanical loads. Hence, bone with a pathologic lesion may be resected, autoclaved and reimplanted offering a means for both tissue devitalisation and reconstruction.

Arthroplasties

Uni-compartmental reconstruction in gonarthrosis

Analysis of a prospective series operated 1973–1979

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The consecutive series comprised 90 patients, of whom 13 per cent were bilaterally operated. In total were 102 joints operated. All patients except 15 deceased have been analysed (SL), clinically (score according to Hospital for Special Surgery) and radiographically, in total 86 joints. Early postoperative complications consisted of one infection which healed without revision and one deep venous thrombosis, which was restituted without subjective complaints. Late complications have been one infection resulting in arthrodesis, 4 revisions due to loosening in 2 cases (tabes dorsalis and trauma respectively), instability in 1 case and pain alone in 1 case. Further 2 cases have signs of prosthetic loosening. At clinical evaluation the preoperative score was 43 (mean of 100) and the postoperative score 77, with a somewhat better result for medial compared to lateral reconstruction. The results have not deteriorated under observation up to 12 years.

Long term results after patello femoral replacements

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A prospecitve longitudinal study of total patello-femoral arthroplasties according to Blazina (Richards type II) has been performed.

During the period 1976–1984 31 knee joints in 26 patients have been replaced. There were 10 women and 16 men. The diagnosis was chondromalacia patellae (CH/P) in 11 patients/15 joints, arthrosis (AO) in 15 patients/16 joints. The age at the operation in the CH/P group was 34 (24–44) years and in the OA group 58 (40–78) years. The mean follow up was in both groups 5 (½–8) years.

Results: At follow up 21/31 knee joints were completely or almost completely free from pain. Postoperatively the walking ability was improved in all but 2 cases and normal in 22 cases. 4/9 patients in the CH/P group and 2/6 in the OA group (age ≤ 60 years) were able to return to full time duty after the operation. All but three patients were satisfied with the result of the operation. There were no infections or signs of mechanical loosening of the prosthesis recorded and so far no prosthesis has been removed.

Conclusions: In our opinion there is an indication for patello-femoral arthroplasty in young patients with severe, disabling pains provided that earlier operations have given unsatisfactory results. In elderly patients with patello-femoral osteoarthritis the method gives excellent results and could be recommended.

Loosening of the porous coating in tricompartmental prothesis in patients with chronic arthritis

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There are few published long-term follow-up reports on total knee prostheses from independent centers. Cemented uni- and tricompartmental prostheses have a clinical loosening rate of 5 per cent at five years. New prosthetic designs, new metallurgy or technique should at least be comparable to earlier designs and methods without adding new risks. If a new prosthetic device has certain drawbacks early follow-up reports are indicated.

Material and Methods: Thirty-four knees in 28 patients with a follow-up time of 17 (5–29) months were radiographically examined using an imaging intensifier for tangential view of the cement, prosthesis and bone. All patients have been prospectively followed regarding bone quality (bone biopsies) development of radiographic loosening and measurement of movement between prostheses and bone (stereophotogrammetry) and will be reported shortly. This study has been limited to an analysis of the loosening of the porous coating.

	Bead loosening							
	Femur				Tibia			
	Early	Late	No	Σ	Early	Late	No	Σ
Cement	0	0	15	15	3	2	18	23
Non-cement	3	4	12	19	1	8	2	11
Σ	3	4	27	34	4	10	20	34

In two knees there was bead loosening from both and in 17 knees from one component. In seven components the loosening was found within three months i.e. the loosening probably had occurred at insertion of the prosthesis. For the remaining 14 components the bead loosening had occurred later and was correlated with the radiographic zones. On average three (1–11) loose beads were found and in one fifth of the knees the beads were within the joint.

Conclusion: Porous coating with heat sintering of chromium cobolt beads has not been solved metallurgically for the PCA prostheses. The clinical long-term relevance of our findings is still unclear but alarming. This medical device has not been approved in USA for cementless fixation except for limited clinical investigations. The same limitation should be recommended in Sweden.

Use of image intensifier in the planning and execution of osteotomies

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Performance of corrective osteotomy in long bone has a wide-spread use. It is most frequently performed in treatment of arthrosis to reinstate the mechanical axis, or in correction of mal-united fractures. As the degree of angulation varies considerably with rotation of the limb and the radiographic projection exact per-operative translation of the degree of correction from an X-ray plate to the skeleton becomes of paramount importance in achieving the desired amount of correction. A simple technique is described whereby the aim of exact correction is achieved by the use of pre-operative and per-operative image intensification.

Prevalence of primary coxarthrosis in siblings of patients with primary coxarthrosis

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The prevalence of primary coxarthrosis in 289 siblings of 184 patients – operated on with total hip replacement because of primary coxarthrosis – was examined. Age- and sex-matched persons from the city files of Malmö were selected as controls. The prevalence of presenting symptoms (including a hip radiographic examination) of primary coxarthrosis in the siblings was 8% compared to 3.8% in the controls ($p < 0.05$).

The type and localization of primary coxarthrosis was evenly distributed between the two groups. On the other hand the prevalence of gonarthrosis did not differ between the two groups. The increased prevalence of primary coxarthrosis in the siblings suggests the influence of a hereditary factor in its etiology.

Patient information on hip arthrodesis

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Hip arthrodesis is still an excellent treatment of disabling hip diseases. Several hip authorities are now of the opinion that hip fusion is a better alternative than total hip replacement in a young patient with severe unilateral hip problems. However, most patients are nowadays sceptical and even directly negative when they are recommended a hip arthrodesis. When they have been confronted with a person of their own age with a hip arthrodesis their opinion changes totally in most cases. To facilitate the information of these patients a video tape has been produced. The film shows how patients with a well united hip fusion cope with daily activities.

Epidural analgesia for post-operative pain relief after total hip and knee arthroplasties

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Epidural analgesia (EDA) during the first post-operative night in the common ward was evaluated in 120 cases of total hip and 30 cases of total knee reconstruction. The ward nurses were trained to give epidural injections of 0.5% bupivacain and to estimate the level of analgesia. The dosage and the time interval were set individually for each patient. Blood pressure and analgesic level were determined before and ten minutes after the epidural injections. In case of hypotension the patient was given repeated doses of ephedrine, 5 mg, i.v. The nurses were instructed to contact the anesthetist on call in case of queries.

Results: There were no serious side effects, and no case of catheter perforation of the dura. A period of 3 hrs between top-ups had to be reduced to 2 hrs to keep the patients constantly painfree. The injected volume varied between 4 and 7 ml with no correlation to age or weight. Complete pain relief was achieved in 61%, a satisfactory effect in 21%, a doubtful effect in 10% and no effect in 10% of the patients. Thirteen patients (9%) required ephedrine. EDA was discontinued in 3 patients (0.7%) because of nausea and agitation. The anesthetist was called in 12 cases (8%), predominantly at the beginning of the trial.

Conclusion: EDA can easily be prolonged in the common ward for pain relief. The nurses mastered the technique after a short training. It is, however, important that they can consult the anesthetist in case of doubt. After this first experience we intend to widen the indication for post-operative EDA in the common ward.

In vitro studies on peroperatively salvaged blood

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Autotransfusion implying salvage of blood shed during surgery, followed by refining and re-infusion has attracted increased interest in recent years. In this study blood has been collected during operations for total hip replacement and elective aortic aneurysm resection. Blood, 500 ml, was suctioned from the operative field to sterile disposable reservoirs (Sorenson Autotransfusion Set, Abbott Scand. AB). Anticoagulation was obtained with citrate-phosphate-dextrose aiming at a final concentration of 1:10. The blood was then treated in a Haemonetics Model 30

Blood Processor using a cell washing harness, including a rotating centrifuge bowl (Haemonetics Scand. AB). Two liters of saline were passed through the cell mass for refining approximately 200 mls of red cells. Samples were withdrawn from the patient before the operation, from the blood collected during the operation and finally from the refined product.

In the suctioned blood there was substantial hemolysis and some bacterial contamination. Excess potassium, cell debris, free hemoglobin and bacteriae were largely removed during the refining procedure. However, in some instances the final product contained activated coagulation factors, mainly factor XII. In this respect there were apparent differences between patients subjected to orthopedic surgery and patients subjected to vascular surgery.

In conclusion, there are obvious risks of activation of the coagulation system with peroperative autotransfusion, and such techniques should not be applied without caution in certain groups of patients.

Mechanical loosening of total hip prostheses

An evaluation of arthrography, scintigraphy and roentgen stereophotogrammetric analysis

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Contrast arthography, radionuclide arthrography and scintigraphy have been used to detect mechanical loosening of THP. The results have been conflicting mainly due to disagreement about the diagnostic criteria. We evaluated these indirect techniques by comparation with roentgenstereophotogrammetric analysis (RSA), which reveals both instability and migration by direct measurement.

Patients and Methods: 14 patients with 14 THP were investigated. RSA was performed after percutaneous implantation of tantalum balls into os ilium and trochanter major. Instability was tested at distraction-compression and at rotation; migration was recorded during 19(8–42) months. Contrast and radionuclide arthrography was performed under fluoroscopic control with a mixture of iodine contrast and 99m-Tc-sulphur colloid. Scintigraphy was performed at another occasion after intravenous administration of 99m-Tc-MDP. Four hips were revised after these investigations.

Results: All prosthetic components unstable by RSA (1 acetabular, 3 femoral), or with abnormal arthrogram (2 acetabular, 4 femoral), or with increased scintigraphic activity (3 acetabular, 10 femoral), or loose at surgery (1 acetabular, 3 femoral) were migrating, but no non-migrating components (9 acetabular, 4 femoral) demonstrated any of these signs of loosening.

Discussion: The definition of mechanical loosening of THP is controversial. Our findings suggest that loosening should be defined as migration; migration includes all prosthetic components that are diagnosed loose by one method or another. Contrast arthrography, radionuclide arthrography and provocational investigations with RSA are insufficient to detect all migrating components. There is, however, a good correlation between migration and increased scintigraphic activity at the tip of the femoral component.

A histological study of Christiansen total hip

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During 1974–1981 337 Christiansen total hip prostheses (Chr THR) were implanted at the Central Hospital of Jönköping. The socket in this kind of prostheses is made of polyoxymethylene (Delrin). The frequence of aseptic loosening requiring reoperation has been high (35% after 4–10 years). 60 patients were reoperated owing to aseptic loosening during 1983–1984.

Method: Tissue samples from the synovial capsule and the bone-cement interface in acetabulum and/or proximal femur were examined histologically in 23 cases.

Results: A large amount of small plastic particles, mainly within macrophages, and a pronounced foreign body reaction was a common finding.

Conclusions: The demonstrated tissue reaction might be of importance in Christiansen total hip prostheses loosening.

Regular controls after Christiansen total hip are indicated

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More than 5 000 Christiansen total hip replacements (Chr THR) have been performed in Sweden. From Jönköping Hospital as well as from other orthopaedic units a high revision rate is reported owing to aseptic loosening. At Jönköping Hospital 337 Chr THR were implanted 1974–1981. The routine follow up included clinical and radiographic controls 3,6 and 12 months postoperatively. At the last control the patients were told to return if any new symptoms from the hip should occur. A clinical and radiographic follow up study was performed 1983–1985 (4–10 years postop).

Method: 113 patients (131 hips) who had not had any further contact with the clinic in connection with the operated hip were called for a follow-up investigation including clinical and radiographic examination.

Results: Among those 113, 42 patients (43 hips) had clinical symptoms and/or radiographic findings requiring revision operation. 3 patients were refused for revision because of cardiac or mental illness.

Conclusion: It is suggested that any clinic where Chr THR have been implanted should actively retrieve these patients for follow up investigations since this particular prosthesis is hazardous. Any patients with a THR should be controlled with X-ray even after one year postop since many patients do not come back even if they get severe symptoms from their operated hips.

Nickel hypersensitivity and metal implants

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Corrosive products are released from orthopaedic metal implants due to corrision and abrasion. Complex bound to proteins they have properties like haptens and active immunocompetent T-lymphocytes. Exposed to their antigen agent, sensitized T-cells release lymphokines. Different in vitro tests utilize this phenomenon i.e. migration- and lymphocyte transformation test. In vitro tests investigate hypersensitive reactions in deep tissues but in contrast to skin tests, these are not sensitizing per se. The aim of this study has been to evaluate whether or not patients with unexplained rest pain or skin manifestations (group B), have identical immunological responses to nickel after insertion of metal implants, as patients without symptoms (group 0).

Material and methods: 15 patients were selected for each group and investigated clinically, radiographically and immunologically. In those cases where implant extraction was considered necessary, samples were taken for bacteriological and histological examination.

Results: Seven patients in group B had a history of allergy and skin eruptions were found in five. No patients in group 0 had such problems. Bone resoption around the implant were found in four cases and in two histological examination showed inflammation and foreign body reaction. These patients belonged to the B group. A significantly higher incidence of hypersensitivity reactions against nickel was seen in group B, using the lymphocyte transformation test.

Conclusions: These results indicate the possible need for individual considerations about metal hypersensitivity prior to the insertion of long term metal implants.

Postural stability in patients with arthrosis of the hip – before and after total hip replacement

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Method: In order to study the postural stability in patients with arthrosis of the hip the postural sway was measured using a computerized force-plate. Our clinical experience has shown that the patients' control of their limb as well as their overall balance improved after total hip replacement. However, in the total hip replacement procedure a capsulectomy and replacement of joint surfaces is performed. As the joint capsule contains numerous proprioceptors serving as afferents from the joint to the CNS, a disturbance of postural stability following surgery would be expected.

Our study represents an attempt to define the role of capsular sensory mechanism in postural stability. Does the THR influence postural stability at all? Our material consisted of 18 patients, 9 male and 9 female, all with unilateral osteoarthritis of the hip. The mean age was 63.5 years (39–81 years). The postural sway with closed eyes was registered during 60 seconds by a computerized force-plate. The postural stability was expressed as mean sway area. The patients' sway was measured before, 6 months and 12 months after THR. The operation was performed using cemented Charnley prostheses in 10 patients and using non-cemented HP-Garches prostheses in 8 patients.

Results: In all 18 patients the postural sway area decreased after surgery. There was no difference between the cemented Charnley group and the non-ce-

mented HP-Garches group. Furthermore there was no difference according to age or sex.

Conclusion: In 18 patients suffering from arthrosis of the hip the postural stability improved following total hip replacement. These results correspond to our clinical experience, and they imply that extracapsular components may be of greater importance to the postural stability than capsular proprioceptors of the hip joint.

Femoral fractures after hip arthroplasty

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The aim of this study was to investigate the incidence, predisposing factors, site of the fracture, treatment and final outcome of femoral fractures after hip arthroplasty. During 1975–83 42 patients were seen with 45 fractures. 27 of these patients had undergone total hip replacement and 15 hemiarthroplasty.

Most of the fractures were caused by minor trauma and predisposing factors, especially prior surgery were common. The fractures were located more distally among the patients that had undergone total hip replacement compared with the patients with hemiarthroplasty.

Two patients underwent early operation, one of them re-arthroplasty. 11 were initially treated only with protected weight-bearing, 10 of which healed. One of them was revised 5 months later due to loosening. 32 patients underwent initial skeletal traction and 21 of these did not require further surgery. 7 of the patients treated with initial skeletal traction were operated early, mainly adaption osteosynthesis due to bad fracture alignment. Three of these fractures healed. Two of the 21 patients treated only with traction subsequently required revision arthroplasty because of loosening of the femoral component. Three patients died and five got a permanent pseudarthrosis or Girdlestone. In all, 37 of the 45 fractures healed and 31 of these 37 were not operated.

Femoral fractures after hip arthroplasty seem to be more frequent among patients who have been hip operated more than once before the arthroplasty. The results indicate that when good fracture alignment is achieved with traction union is not jeopardized by the prosthesis nor the cement. The incidence of prosthesis loosening requiring revision surgery is low.