

# Norwegian Orthopedic Society

Drammen, May 23–25 and Oslo, October 25–26, 1991

## Editor: Ludvig Fjeld Solheim

Department of Orthopedics  
Surgical Clinic  
Ullevål University Hospital  
N-0407 Oslo, Norway

## Experimental orthopedics

### Effects of short-term treatment with glucocorticosteroids and indomethacin on bone healing in unstable and stable osteofixation of rat femora

Hans Erik Høgevold, Bjarne Grøgaard and Olav Reikerås

Department of Orthopedics, University Hospital, Oslo, Norway

*Introduction:* Long-term treatment with glucocorticosteroids and indomethacin inhibits fracture healing, but the effects of short-term treatment is unclear.

*Material and methods:* The effects of short-term therapy (3 days) with methylprednisolone (n=9) (0.2 mg/100 g bw im) and indomethacin (n=9) (0.2 mg/100 g bw per os) on bone healing were studied in male Wistar rats submitted to stable or unstable femur osteotomies. Six weeks after the operation the femora were examined macroscopically and tested in cantilever bending.

*Results:* The bending moment and rigidity of femora with unstable osteotomies were significantly lower in rats receiving short-term indomethacin treatment whereas steroid therapy had no effect. Femora with stable osteotomies showed significantly lower bending rigidity as well as a tendency toward a reduced bending moment when the rats had been treated with indomethacin.

*Conclusion:* Short-term therapy with glucocorticosteroids did not influence fracture healing under unstable or stable osteofixation of fractures in rat femora, whereas short-term treatment with indomethacin significantly inhibited healing.

### Muscle contraction doubles the strength of healing tibial fractures in rats

Lars Nordsletten, Sigmund Skjeldal, Ole J Kirkeby and Arne Ekeland

Institute of Surgical Research, Rikshospitalet, Oslo, Norway

The theory behind functional fracture treatment is that the fracture is stabilized during loading by the soft tissues acting together with the brace as a hydraulic cylinder. The aim of this study was to investigate the effect of muscle contraction on the biomechanical properties of healing fractures.

*Material and methods:* 16 male Wistar rats (200 g) were randomized to two groups. The anterior cortex of the right tibia was sectioned with a scalpel 4 mm distal to the tibial tuberosity, and the fracture completed by manual breaking of the posterior cortex, leaving the fibula intact. The fracture was fixed with an intramedullary nail. On day 25 the healing lower legs were tested in quasi-static three point ventral bending during tetanic muscle contraction (group A). Tetanic muscle contraction was induced via an electrode connected to the ischiadic nerve. Group B was tested with relaxed muscles. The left tibia was tested after removal of all soft tissues, and served as reference value. The ratio of the biomechanical values for the right test leg over the left tibia was calculated for each rat.

*Results:* The ratio for the mean ultimate bending moment of the healing fracture compared to the intact tibia was 1.16 tested with muscle contraction (group A), and the ratio was 0.6 tested with relaxed muscles (group B) ( $p < 0.001$ ). The ratio for the mean ultimate energy absorption to failure was 1.96 in group A, and 0.85 in group B ( $p < 0.001$ ). The ratio for the mean bending stiffness was 0.44 in group A, and 0.32 in group B. The ratio for the mean deformation was 2.3 in group A, and 1.6 in group B ( $p = 0.011$ ).

*Conclusion:* Our study showed that muscle contraction doubled the strength of the healing callus. In functional fracture treatment the contribution of active muscle contraction may be more important than the previously described passive hydraulic effect of the soft tissues.

## Regional microcirculation measured by laser Doppler flowmetry in intact and osteotomized, healing tibias of rats

S Skjeldal, L Nordsetten, O J Kirkeby, O Reikerås and I Bjerkreim

Institute of Surgical Research, Rikshospitalet, Oslo and Sophies Minde Orthopedic Hospital, University of Oslo, Oslo, Norway

Measurement of blood flow in bone is of interest in a number of clinical and experimental situations. The aim of this study was to evaluate laser Doppler flowmetry as a method for measurement of blood flow in normal and healing, osteotomized tibias of rats.

**Materials and methods:** Laser Doppler flowmetry was performed with a Periflux 2B (Perimed, Stockholm, Sweden). A masterprobe (PF 318, Perimed, Stockholm, Sweden), was placed directly on the bone surface after local removal of periosteum. The laser Doppler signals were recorded on screen and logged by a Macintosh SE. The output values, or flux were given as perfusion units as recommended by the manufacturer. Two groups of animals were investigated:

1) 18-week-old Wistar rats ( $n = 8$ ) were anesthetized with Dormicum/Hypnorm. The anterior, medial part of tibia was exposed. A small area in the metaphysis and a small corresponding area in the diaphysis were marked with ink, and repeated laser Doppler recordings performed. Five recordings were done in each area. The relative flux between metaphysis and diaphysis was calculated, and the significance of the difference was calculated using two-sided *t*-test.

2) Six-week-old Wistar rats were submitted to osteotomies in the left tibia just proximal to the distal fibula. The osteotomized tibias were fixed by intramedullary nails. Four weeks later, both tibiae were exposed, and laser Doppler flowmetry performed as described. The relative flux between the left and the right tibia was performed for the proximal diaphysis, the callus region and the distal metaphysis. Analysis of variance was used.

**Results:** The measurements revealed a marked spatial variation.

1) A significant difference in flow in diaphysis and metaphysis was found ( $p < 0.05$ ). The relative value was  $1.7 \pm 0.4$ .

2) Flow in the osteotomized tibias was increased compared to the controls. The difference was only significant in the callus region, in which the relative value was  $2.3 \pm 0.5$ .

**Discussion:** The marked spatial variation is well known from laser Doppler flowmetry in other tissues. By using five repeated measurements, we found a reliable value, and an interindividual coefficient of variation comparable to the microsphere technique. Increased circulation in metaphysis versus diaphysis, and in callus versus intact bone is demonstrated in previous studies using other techniques. We therefore conclude that laser Doppler flowmetry is a useful technique for evaluation of regional blood flow in intact and osteotomized tibias of rats.

## Fractures

### Femoral neck fractures treated with the hip compression screw—a follow-up study of 311 cases

Paul N Fuglesang<sup>1</sup>, Tom H Edna<sup>1</sup>, Staal Hatlinghus<sup>2</sup>, Morten Svinsås<sup>1</sup> and Tormod Bjerkeset<sup>1</sup>

<sup>1</sup>Department of Surgery and <sup>2</sup>Department of Radiology, Inherred Hospital, N-7600, Levanger, Norway

**Patients and methods:** In total, 401 patients were treated for femoral neck fracture at Inherred Hospital from April 1979 to December 1985. 311 patients were treated with hip compression screw (HCS) (Richards) and 90 were treated with hemiprosthesis. We studied retrospectively the 311 cases treated with HCS. Median time from admission to operation was eight hours, median operation time was 70 minutes. 176 patients (111 dislocated fractures, 61 undislocated and four unclassified) were accessible for follow-up (103 by questionnaire) until at least three years postoperatively or until failure. The radiographs of the 176 patients in the follow-up study were classified according to Garden and pre- and post-operative measurements of angles, fracture level and screw position were performed.

**Results:** Seven fractures redislocated within three months postoperatively, two developed pseudarthrosis and 53 (41 primary dislocated) developed late segmental collapse (LSC). Totally 54 patients have been reoperated with prosthesis. The LSC rates increased significantly when operation was delayed for more than 12 or 24 hours after the injury. Postoperative anterior angulation beyond 15 degrees had especially high rates of LSC.

**Conclusion:** With the reservation that many patients had a primary prosthesis, we find the method satisfying as regards rates of primary union. The LSC rates are, however, high. Increased rates of LSC when operation was delayed is one good reason to recommend early operation in dislocated femoral neck fractures.

### Early loss of fixation of cervical hip fractures

Jørgen Ingwersen, Arne Skoglund and Sverre Syversen

Orthopedic section, Gjøvik Fylkessykehus, Gjøvik, Norway

**Introduction:** During 1990, a prospective, randomized study was carried out, comparing the Olmed and Richard fixation methods in cervical hip fractures.

**Patients and methods:** 100 patients participated, 26 of whom were excluded (nine wrong indication, twelve died, five could not be followed-up). The remaining 74 were comparable concerning sex distribution and age. Fracture reduction was evaluated according to Garden's criteria 1971, and the two Olmed screws (shank 6 mm) and two Richard screws (shank 5 mm) according to Rehnberg 1988. The dis-

placed fractures were then divided into groups depending on satisfactory/non-satisfactory reduction combined with satisfactory/non-satisfactory screw placement. After 3 (2–6) months, we examined early loss of fixation by radiographs and it was defined as redislocation beyond 10° varus/valgus tilt in the AP view and more than  $\pm 5^\circ$  in the lateral view. All reoperations were total- or hemiarthroplasties. There were no deep infections.

**Results:** We found no early loss of fixation among non-displaced fractures. The dislocated fractures showed the same marked tendency in all the groups and were totally distributed as follows.

	No	Redislocation	Reoperation
Olmed	29	14	5
Richard	31	23	10

**Conclusion:** The high numbers of early loss of fixation are a consequence of our strict definition of redislocation. We have found significantly more patients with early loss of fixation in the Richard group ( $p < 0.03$ , chi square test) but no significant difference concerning reoperations.

## Early loss of retention in fractures of the femoral neck—which patients should undergo a primary prosthesis operation?

Jan G. Benterud and Antti Alho

Orthopedic department, Ullevaal Hospital, University of Oslo, Oslo, Norway

This study presents 149 patients with 136 dislocated and 13 undislocated femoral neck fractures operated within three days from fracture in the period. It includes 110 women and 39 men, median age 80 (63–97) years. 59 patients were operated with a Richards® 2-hole HCS + one cancellous screw, 90 were operated with two Olmed® screws. 45 patients (30%) had early loss of retention. This term was defined as >10 mm varus translation of the head or >5° change of the angle between the pins (28 cases), backing of the screws by >20 mm (17 cases) or secondary perforation of the head (one case) within three months. Factors that we suspected to be potential predictors of early failure were registered and analyzed in a stepwise logistic regression.

Variable	Odds ratio	Confidence interval (95%)	N	Early loss of retention n (%)
Age/10 years	1.84	1.02–3.32		
Imperfect reduction	2.96	1.27–6.82	60	24 (40)
>30° varus	6.46	1.52–27.67	11	7 (64)
Remaining head size*	3.02	1.33–6.87	46	22 (48)
Comminution of calcar	3.82	1.72–8.50	53	27 (51)

\*Perpendicular distance from center of the femoral head to fracture line <15 mm

The method of osteosynthesis, the time from injury to operation, the angulation and parallel placement of the screws or their positioning in collum/caput were not significant parameters.

**Conclusion:** A number of patients will benefit having a primary endoprosthesis. We do not consider high age as an indication for a prosthesis operation because the increased risk of primary failure per year is very small and high age corresponds to greater surgical risk. High degree of varus deformation, small size of the remaining femoral head fragment and comminution of the calcar are prognostic factors which should lead to consideration of a primary prosthesis operation. This is also true for the imperfect fracture reduction, a result which should not be tolerated.

## Gamma nail versus CHS in intertrochanteric and subtrochanteric femoral fractures—a preliminary report of a prospective randomized study

P. Benum, T. Grøntvedt, M. Bråten, A. Walløe, A. Ekeland, S. Raugstad and O. Fasting

Orthopedic Department, Trondheim University Hospital, Bergen University Hospital Haukeland, Oslo University Hospital Ullevål, Rogaland Central Hospital, Oslo University Hospital Aker, Norway

The paper presents the preliminary results of a study performed from October 1989. So far 460 patients have entered the study, 226 treated with gamma nail, 234 with CHS. 322 have been followed for six months.

No significant differences have been found between the two groups as to length of operation, blood loss, deep venous thrombosis, pulmonary emboli, wound infection, length of stay in hospital, walking function and postoperative deaths.

An unfavourable position of the lag screw was more frequent in the fractures treated with a gamma nail. Perioperative problems and complications occurred in 23 fractures treated with gamma nailing, versus seven in the CHS group. Problems with the insertion of the distal interlocking screws were experienced in eleven cases treated with gamma nailing. Four complicating diaphyseal fractures occurred during the operation in the gamma group. There was no significant differences in fracture healing, tendency to malunions or lag screw penetrations.

The number of reoperations were significantly higher in the gamma nail group (16/226) compared to 3/234 in the CHS group). In the gamma group six patients had to be reoperated for complicating diaphyseal fractures, five of these fractures occurred several months after the primary operation. Five fractures treated with gamma nailing had to be reoperated due to redislocation of the fracture, versus two in the CHS group. One gamma nail had to be removed after fracture healing due to severe thigh pain.

It is concluded that gamma nailing cannot be recommended as a routine procedure in the treatment of intertrochanteric and subtrochanteric fractures of the femur.

### Modified Grosse-Kempf locked nail in combined diaphyseal/trochanteric femur fracture

Bjarne Grøgaard, Antti Alho, Knut Strømsøe and Arne Ekeland

Orthopedic Department, Surgical Clinic, Ullevål University Hospital, Oslo, Norway

*Introduction:* After introduction of the Gamma nail we have been confronted with trochanteric fractures under healing combined with a secondary femoral shaft fracture distal to the Gamma nail.

*Materials:* Five patients, four of whom female, median age 84 (74–92) years suffered a fracture distal (0–15 cm) to the Gamma nail 4–70 days after the primary operation. Reoperation was performed using a modified Grosse-Kempf nail where the proximal cylindrical end was modified to fit two hip screws (Ullevål hip screw) to be introduced into the neck and head of the femur. This was achieved through an aiming device. Depending on the age of the trochanteric fracture, different degree of weight bearing was advised.

*Results:* In four patients the fractures healed uneventfully. In one patient the observation period was too short. No complications were observed. Follow-up times varied from 2–6 months.

*Discussion:* The Grosse-Kempf intramedullary interlocking nail has been modified to be used in combined trochanteric and diaphyseal femur fractures. The experience has so far been good.

### Nonunion of tibial shaft fracture treated with locked nailing without bone grafting

A. Alho, A. Ekeland, K. Strømsøe, J. G. Benterud

Orthopedic Department, Ullevål Hospital, Oslo, Norway

We treated 25 nonunions after fractured tibia with locked Grosse-Kempf nail in 20 men and five women 0.5–4.5 years after the fracture. Eleven fractures had been open and ten had been Müller type B or C. No bone graftings were made in connection with nailing. For better alignment, the nonunion site was opened eleven times and the fibula resected or osteotomized twelve times. Static locking was used in eight cases. There were eight infections before the index operation, seven of which were pin tract infections. There were three infections after nailing. One of them was a recurrence after originally six pin tract infections. In one patient

repeated nailing and bone grafting was necessary after fracture of the nail. In one patient an external rotatory malalignment was corrected by an osteotomy. In the follow-up at 2 (1–6) years, all non-unions had healed and static nailing did not seem to impede consolidation. There was periodical drainage in two cases. Shortening of 2–3 cm occurred in three cases. In no case was the function of the ankle or foot impaired compared with the preoperative state. We conclude that locked nailing of tibial non-union provides a means of treatment with a rare need for bone grafting and with an early restitution of function. Due to primarily open fractures and several previous procedures, including external fixation, the risk of infection is increased.

### Transpedicular internal stabilization according to Dick in unstable fractures of the lumbar spine

Knut Strømsøe, Antti Alho and Wim Kok

Orthopedic Department, Ullevål Hospital, Oslo, Norway

*Material and methods:* At the orthopaedic department, Ullevål Hospital, 32 patients were treated according to Dick for 34 unstable fractures of the lumbar spine, 22 men and 11 women, median age was 29 (14–56) years. Eleven patients had the fracture in the first, six patients in the second, four in the third, six in the fourth and three in the fifth lumbar vertebra. One patient had fractures in the first and fourth vertebra and one had a fracture in the third and fourth vertebra. Seventeen patients had no other lesions, seven had moderate additional lesions, and five patients had multiple serious additional lesions. Seven patients had marked neurologic deficiency preoperatively including two patients with cauda equina syndrome. Median time from injury to operation was 2 (0–11) days. In 33 fractures transpedicular bone grafting according to Daniaux was performed. Laminectomy was done in one patient and hemilaminectomy in two. Postero-lateral spondylodesis was done in three patients. The median observation time was 23 (3–38) months.

*Results:* Median preoperative height reduction of estimated anterior height of the fractured vertebra was 30 (0–90) percent, postoperatively this figure was 10 (0–20) percent. Median hospitalization time in acute hospital was 21 (10–40) days. Four of seven patients with preoperative neurologic deficiency were restituted ad integrum, whereas one patient still had a disturbance of his bladder function. This patient had an anus praeter naturalis performed due to a perineal penetration. Two patients had persistent neurologic impairment in one leg. Two superficial wound infections were registered. Fatigue fractures of one or more pedicular screws were seen in five patients without any consequences for the fracture healing. Pedicular, but extracorporeal position of two screws, were seen in one patient without consequences for the fracture healing or for the reduction. All patients were mobilized with a three-point brace two or

three days after operation or as soon as the other lesions permitted it.

*Conclusion:* Three years of experience with the transpedicular stabilization of unstable fractures in the lumbar spine according to Dick combined with transpedicular bone grafting to the fractured vertebra has shown the method to be valuable.

## Hip

### Peroperative complications and causes for revisions of total hip replacements

Leif Ivar Havelin, Lars Birger Engesaeter and Norvald Langeland

Department of Orthopedics and Traumatology, Haukeland University Hospital, Bergen, Norway

*Material:* Of 17,444 THRs registered in The Norwegian Hip Registry, 15,094 were primary THRs and 2,350 were revisions.

*Results:* Two deaths, three cardiac arrests and five cardiac infarctions without fatal outcome were reported. Fracture of the femur peroperatively was seen in 2% of the revisions compared to 0.2% of the primary operations. At primary operations, fissures in the proximal femur were seen in 3% when an uncemented femoral component was inserted and in 0.6% with a cemented component. These complications were not related to types of implants.

In revisions, loosening of the acetabular component was the reason for reoperation in 56%, and loosening of femoral component in 64%. Dislocations, infection and fracture of femur was the reason for reoperations in 4% each. When revised, the Christiansen prostheses and the double cups more often had loosening of the acetabular cup than the total material, whereas the Charnley prostheses had loosening of this component less often. The Müller prostheses more often had loosening of the femoral components. Fracture of femoral stem was the reason for revision in 34 and fracture of acetabular cup in four of the patients.

### Acetabular revision with a hydroxyapatite coated screw cup

A. Reigstad, M. Røkkum and K. Bye

Kronprinsesse Märthas Institutt, National Orthopedic Center, Oslo, Norway

The long time results after cemented revisions of loose acetabular prostheses are inferior to the results after primary

total hip replacements. From 1989 we have routinely used a HA-coated screw cup (Landos corail) in revisions of loose acetabular prostheses. The series consists of 42 patients, 31 females and 11 males, with a mean age of 64 (20–83) years. Four hips had had one or multiple revisions before the index operation, in 38 hips the index operation was the first revision. The removed prosthesis was cemented in 26 hips and uncemented in 16. Allogenic and autogenic bone transplantation or a combination of allogenic/autogenic transplantation were carried out in eleven, nine and three hips, respectively.

One patient died of cerebral embolism. The remaining 41 patients were followed-up clinically and radiographically four months, one year and two years postoperatively with a mean follow-up of one and a half years. The mean pain score (d'Aubigné/Postel) rose from 2.7 preoperatively to 5.6 and 5.7, respectively one and two years postoperatively. In one patient the acetabular prosthesis migrated 2 mm medially between the three-week and four-month radiographic examination. At the follow-up one and two years after the operation the prosthesis was stable and the patient was painfree. In the remaining 40 hips the prostheses were radiographically stable. In the cases with bone transplantation the grafts had healed and remodeling of the bone around the prostheses had occurred. No radiolucent lines were seen.

We conclude that the clinical and radiographic results with this hydroxyapatite coated component in revision of loose acetabular prostheses are very promising at a mean follow-up of one and a half years.

## Knee

### Osteochondral lesions and acute ACL injuries

L. Engebretsen, E. Arendt and H. Fritts\*

Department of Orthopedic surgery, University of Minnesota and Center for Diagnostic Imaging\*, St Louis Park, Minnesota, USA

*Introduction:* Injuries to the anterior cruciate ligament (ACL) are often accompanied by lesions in joint capsule, ligaments, menisci and cartilage. Recent studies using MRI have shown a high frequency of subcortical and osteochondral lesions although radiographs are normal. The purpose of this study was to examine the frequency of bony lesions judged by MRI and correlate the findings with the arthroscopic diagnosis in patients with acute ACL injuries.

*Patients and methods:* During the period August 1990 through May 1991, 49 patients were treated surgically due to an acute rupture of the ACL. In 18 patients MRIs were obtained in order to rule out a repairable meniscal injury prior to surgery. The MRIs were read by one radiologist. The arthroscopic diagnosis was established by two surgeons.

**Results:** Except for one tibial avulsion fracture, all the radiographs were normal. All 16 total ruptures of the ACL seen on the MRI were confirmed at arthroscopy. In addition, the arthroscopic examination showed two partial ruptures, one of which was classified as normal, through the MRI. 28 bony lesions were diagnosed in the 18 patients. Only three patients had normal MRIs. 25 of the bony lesions were localized in the lateral femoral or tibial condyle. Five patients showed cartilage injuries in the lateral compartment at arthroscopy.

**Conclusion:** Bony lesions were found at MRI in 85% of the patients with acute ACL ruptures. The lesions could not be detected radiographically or at arthroscopy. Experimental studies suggest that some of the lesions verified on MRI may lead to degenerative changes. This may lead to changes in the evaluation and rehabilitation protocol in patients with acute ACL ruptures.

## Arthroscopic surgery of the knee under local anesthesia

Odd Gunnar Granlund

Akershus Central Hospital, Surgical Department,  
Nordbyhagen, Norway

**Introduction:** The purpose of this report is to present an analysis of the usefulness, the patient acceptance and the results of surgical arthroscopy of the knee under local anesthesia.

**Material and methods:** During a 17-month period, 297 outpatient arthroscopies were performed on 294 patients using 50–60 ml 1% Lidocaine with 1:200 000 epinephrine, 20 ml instilled into the joint. 181 patients with ruptured menisci and seven knees with loose bodies were treated surgically, 163 (87%) of whom during the same arthroscopic procedure and local anesthesia. 133 patients answered a questionnaire.

**Results:** 115 patients, i.e. 86%, would accept arthroscopic surgery under local anesthesia to be performed again. 75 patients (54%) were very satisfied with the result of surgery, and 47 patients (34%) were satisfied, while 16 patients (12%) claimed they were not satisfied, half of them (6%) being unchanged. 54% had a Lysholm score of 90 or better, 73% had 80 or better. Two patients had serious complications, one fatal and one non fatal pulmonary embolism, no infections.

**Conclusions:** Arthroscopic surgery under local anesthesia is a useful procedure that is well tolerated by the patients and the results are good. Tromboembolic prophylaxis should be considered.

## Thigh muscle strength following anterior cruciate ligament repair—a retrospective study

I. Holm<sup>1</sup>, M. A. Risberg<sup>2</sup>, H. Steen<sup>1</sup>, O. Granlund<sup>1</sup>,  
A. Ekeland<sup>2</sup>, O. Fasting<sup>3</sup>, G. Uppheim<sup>4</sup>, P. Lereim<sup>1</sup>  
and I. Bjerkreim<sup>1</sup>

<sup>1</sup>Sophies Minde, Orthopedic Hospital, University of Oslo,

<sup>2</sup>Surgical Clinic, Ullevaal Hospital, University of Oslo,

<sup>3</sup>Orthopedic Department, Aker Hospital, University of

Oslo and <sup>4</sup>Menighetsoesterhjemmet Hospital, Oslo,  
Norway

**Introduction:** Previous studies show imbalance in thigh muscle function after knee injuries and after anterior cruciate ligament (ACL) repair. The quadriceps muscle loses more strength than the hamstrings. The purpose of this study was to analyze the thigh muscle strength 1–5 years postoperatively.

**Materials and methods:** 24 patients from four different hospitals were operated for fresh ACL rupture (0–14 days after the injury). Several surgical techniques were used. All the patients had finished their rehabilitation program. The activity level was assessed by Tegner's activity score and Lysholm's knee scoring system. Four functional tests were used to evaluate active knee function. A Cybex 340 isokinetic dynamometer measured quadriceps and hamstrings muscle strength in both legs at speeds of 60° and 240°/second. The non-operated leg was used as a control. The patient's own evaluation was recorded on a visual analog scale. Stability was determined by manual tests and a KT-1000 knee arthrometer. All tests were performed by two independent persons, not the operating surgeon.

**Results:** Tegner's activity score showed that 14 patients were back to the same activity level as prior to the ACL repair. The average preoperative score was 7.6 and postoperative 6.2. The mean Lysholm score was 94.1 (76–100). The visual analog scale recorded a mean value of 84.5 (53–100). A significant difference was observed between the involved and uninvolved leg in two of the functional tests. There was no significant difference in hamstrings muscle strength between the operated and the control leg. The quadriceps muscle showed highly significant difference between the two legs. The mean strength reduction was 11–15% in the various muscle strength parameters.

**Conclusions:** Long-term evaluation of ACL repair showed a highly significant reduction in quadriceps muscle strength although Lysholm knee score, Tegner's activity score and the patients own evaluation showed good to excellent results.

## Upper extremity

### Long-term results of anterior dislocations of the shoulder operated with Bankart operation/subscapularis shortening

Torstein Husby, Magne Røkkum, Arne Rugtveit, Astor Reigstad and Merete Brandt

Kronprinsesse Märthas Institutt, Oslo, Norway

**Introduction:** The preliminary results of a retrospective study of patients operated for anterior dislocations of the shoulder are presented.

**Patients and methods:** The study includes 32 shoulders operated in 28 patients (23 male, five female). Eight patients had heavy work, age at operation was 28 (16–59) years. Hill-Sach's lesion was present in 25 shoulders. Two patients had moderate arthrosis preoperatively. Bankart's lesion was found in 18 shoulders, all operated a m Bankart. In addition, all patients got a shortening of the subscapularis tendon a m Putti-Platt (23) or a m Magnuson-Stack (9). All patients were re-examined 13 (10–17) years after operation.

**Results:** Postoperative sick-leave was 8 (4–12) weeks. 25 patients continued in their former occupation, two heavy workers changed to light work. Four redislocations were observed, two were reoperated with Bankart's repair, one is stable, one still dislocates. 26 shoulders had negative apprehension tests. Nine shoulders developed moderate arthrosis, unrelated to the type of operation. External rotation postoperatively was 30 (5–80) degrees. No patients had complaints related to the reduction of external rotation. The patient assessments were excellent/good in 28 shoulders, fair in one and poor in three cases. Carter Rowe scores were excellent/good in 27, fair in one and poor in four shoulders.

**Conclusion:** Anterior dislocations of the shoulder operated with Bankart's procedure combined with shortening of the subscapularis tendon yielded stable shoulders and good long term results in most of the cases.

### Acromio-clavicular separation treated with the Phemister operation

Terje Kleven<sup>1</sup>, Sturla Storø<sup>2</sup>, Kjell Arne Kvistad<sup>3</sup> and Vilhjalmar Finsen<sup>1</sup>

<sup>1</sup>Departments of Orthopaedics, <sup>2</sup>Physical medicine and rehabilitation, <sup>3</sup>Radiology, Trondheim University Hospital, N-7006 Trondheim, Norway

**Introduction:** We routinely operate complete (Allmann type III) acute acromio-clavicular (AC) dislocations with the Phemister procedure. Excellent results of conservative treatment have recently been reported in the literature. We wished to evaluate our own results.

**Patients and methods:** During the years 1982–88 we operated 32 patients in our hospital for AC separation, all

with Phemister's operation. We studied 20 men who had sustained the injury at an age of 26 (19–60) years 4 (2–6) years postoperatively. We excluded 11 patients who lived far from our hospital and one woman. All patients were examined clinically and also completed a pro forma with visual analog scales which were converted to a point scale from 0 (worst imaginable) to 10 (best imaginable). Values over 8.5 were arbitrarily selected to indicate an excellent result. A-P radiographs were made with and without 5 kg weights fastened to the wrists. Muscle power in extension, flexion, horizontal abduction and adduction, and external and internal rotation at 60 and 180 degrees per second was tested with a Cybex II+ isokinetic dynamometer in 13 of the patients.

**Results:** The clinical evaluation revealed a prominent lateral clavicle in seven, joint tenderness in four and an ugly scar in three cases. The active and passive ranges of shoulder movement were normal in all patients. Of the 20 patients, 19 regarded the results as excellent concerning shoulder function, 14 concerning cosmetics and 17 concerning the overall result of the operation. Radiographs showed four AC joints to be subluxated. There was, however, less than 2 mm translatory movement in all joints on loading. In 14 cases there was calcification in the region of the coracoclavicular ligament, but this did not influence shoulder joint mobility. The median values for peak torque and work performed in the injured extremity were in all directions of motion within 10% of the median values on the contralateral side.

**Conclusion:** In our hands the results of the Phemister operation for complete acute separation of the acromio-clavicular joint have been gratifying.

### Physiological and methodological aspects regarding early diagnosis of the carpal tunnel syndrome (CTS)—preliminary results from surgical treatment in a randomized prospective study

Jan Roar Orlin<sup>1</sup>, Imre Gabor<sup>1</sup>, Karl Erik Slagvold<sup>2</sup> and Einar Stranden<sup>2</sup>

<sup>1</sup>Sophies Minde Orthopaedic Hospital and <sup>2</sup>Circ. Phys. Lab., Aker Hospital, Oslo, Norway

Pressure measurements in the carpal tunnel have suggested that symptoms occur at low pressures while conduction time is unaffected. Yet the indication for decompression of the median nerve still depends on a prolonged conduction time.

Most CTS-patients experience that moist and cold fingers turn warm and dry after decompression. Mechanical irritation of the autonomous median nerve fibres probably has caused reduced skin capillary perfusion during compression. In order to test this hypothesis perfusion in the finger tips was measured with photo-plethysmography in 18 electro-negative CTS-patients, with laser-doppler in five patients, and in a control group, before and after a work test. Perfusion was then found insignificantly reduced, and the

flow values did not correlate to symptom aggravation. By exclusion, increased perspiration rather than reduced perfusion causes temperature reduction.

In contrast, thermography in eleven electro-negative patients and a control group confirmed a  $0.4^{\circ}$ – $1.0^{\circ}$  significant reduction which correlated with symptoms. Decompression, according to randomization, was then successfully performed in 16 hands (eleven patients) without complications, (VAS-scale averaged 77%)

*Conclusion:* A study of functions controlled by autonomous fibres of the median nerve has been performed in electro-negative CTS-patients before and after a provocative working test. Whilst perfusion was not significantly reduced, thermography confirmed a reduction of skin temperature which correlated with symptoms, and which served to indicate treatment for CTS at an earlier stage.

## Wrist arthroscopy

Kjell Bye, Torstein Husby, Jan Haugstvedt  
and Astor Reigstad

Kronprinsesse Märthas Institutt, Oslo, Norway

*Patients and methods:* The patient is placed supine, the upper arm fixed to the table. Traction is applied through fingertraps from an overhead device. A tourniquet is inflated. The primary radiocarpal, the "6R", the midcarpal radial and the midcarpal ulnar portals give access to all parts of the radiocarpal and midcarpal joints. We use a 2.7 mm/30° arthroscope. Wrist arthroscopy has been performed since 1990 in eight patients, age 26 (14–39) years. All symptoms started with a trauma and the patients had pain and disability for 1 (0.5–16) years. Popping was present in four, Terry-Thomas sign in one, the rest had negative radiographs including stress views.

*Results:* Two patients had injuries to the triangular fibrocartilage, one treated with debridement. Three patients had osteochondral fractures in the carpus, one treated with triscaphoid arthrodesis, two with brace. Two patients had isolated chondral lesions in the radioscapoid joint treated with debridement. One patient had a disruption of the scapholunar ligament treated with a triscaphoid arthrodesis. One patient had an instability in the hamate-triquetral joint treated with brace.

*Conclusion:* Wrist arthroscopy is used to confirm or rule out suspected TFC disruptions, osteochondral lesions, and to determine cause of carpal instability. Arthroscopy can also be used to verify an unconfirmed diagnosis on radiographs, arthrogram or scintigram, and it may be used to identify the nature of a wrist problem such as pain, popping or locking.

## Thumb replantations/revascularizations

K. R. Hetland, A. Reigstad, K. Bye, S. Waage, M. Røkkum  
and T. Husby

Kronprinsesse Märthas Institutt, Oslo, Norway

It is widely held that the functional and esthetical results from a successful thumb replantation are superior to those from reconstructive procedures. Reconstruction of an amputated thumb should therefore begin with an attempted replantation.

Between 1984 and 1990 we replanted the thumb in 78 patients. There were nine females and 69 males and their mean age was 36 (1.5–70) years. 39 patients had a total thumb amputation and in 39 patients the thumb was amputated subtotally. The subtotally amputated thumbs were all without arterial circulation. They were connected to the proximal part by a skin bridge often able to carry the venous return from the thumb.

The overall survival rate was 56/78 (72%). Totally amputated thumbs had a survival rate of 19/39. A higher failure rate was seen in patients with avulsion and severe crush injuries. All thumbs amputated by guillotine injuries healed.

We graded the overall function of the 56 revascularized thumbs according to the Tamai score (J Hand Surg 1983; 8:730–2) for finger replantation. Excellent results were seen in 27, good in 13, fair in 13 and poor in three patients.

After removal of the 22 necrotic replants, ten were treated by transfer of the second toe to the thumb stump and three had deepening of the first web space by a Z-plasty. Five patients had an amputation level through the IP-joint with sufficient thumb length. Four patients with metacarpal amputation level refused any reconstructive procedures. Three of these were above 60 years of age.

We conclude that replantation may restore a satisfactory thumb function and appearance in most of the cases.

## Spine and pelvis

### Preoperative evaluation of patients with degenerative back disease

Lars B. Skogland

Martina Hansens Hospital, N-1300 Sandvika, Norway

Which is the most reliable method for detection of segmental instability—the flexion/extension method or the compression/traction method?

*Patients and methods:* 37 patients with 44 suspected unstable segments were consecutively examined by both methods. A translatory instability of 1.0 (1.0–7.5) mm was found in 26 patients with 31 segments. The diagnoses were: isthmus spondylolisthesis in six cases, degenerative spondy-

lolisthesis in 13 cases, retrolisthesis in eleven cases and in one case a fracture.

**Results:** Regarding the mean displacement for the total series, no difference was found between the two groups. However, when looking at the different diagnostic groups it appeared that the compression/traction radiography gave the largest displacements in isthmic spondylolisthesis whereas the flexion/extension method provoked larger displacements in degenerative spondylolisthesis and in retrolisthesis.

**Conclusion:** It does not seem appropriate to recommend the compression/traction radiography as the method of choice when examining lumbar instability, the flexion/extension method may be better in cases of instability due to pure degeneration.

## Prospective follow-up of operations for lumbar disc herniation

Arild Ulvestad

Department of Orthopedics, Central Hospital (SSSF), N-6800 Førde, Norway

**Introduction:** At SSSF there was continuous registration of lumbar discectomy with criteria for result of surgery as described by Ebeling et al (Acta Neurochir 81, 45–52, 1986). The main method was partial laminectomy, medial facetectomy and discectomy (bilateral disc emptying by wide bulging).

**Material and methods:** From October 1985 through February 1991, 136 patients, 74 male and 62 female, mean age 41 (19–72) years, were operated on because of sciatica. The material involved L3-L4 disc in three patients, L4-L5 disc in 65 patients, L5-S1 disc in 64 patients and L4-5 and L5-S1 in four patients. Follow-up was carried out at six weeks, three months, one, two and five years.

**Results:** These are the preliminary results by September 1991, mean follow-up time 26 months. Result 1 = excellent, 90 patients (66%), result 2 = good, 27 patients (20%), result 3 = satisfactory, 11 patients (8%), result 4 = moderate, five patients (4%), and result 5 = poor, three patients (2%). The patients' own opinion of their results showed 90% content and 10% not content. At follow-up 86% had normal working capability in previous or comparable activity, 8% had reduced working capability and 6% were incapable of working. Reoperation rate was found to be six patients (4%) after 19 (1–48) months; recurrent herniation at a new level in two patients. Therefore the true recurrence rate was four patients (3%). The complication rate was 12 patients (9%), no fatal.

**Conclusion:** With 86% excellent and good results and 90% content patients after conventional disc surgery, the results are acceptable. Knowledge of one's own results enables preoperative information to patients facing surgery.

## The piriformis syndrome—results after 12 operations

Jan Roar Orlin and Paul Lereim

Sophies Minde Orthopedic Hospital, Oslo, Norway

A material of ten patients, five men and five women with mean age 39 (21–60) years, were operated due to piriformis syndrome between 1982 and 1990. Mean observation time was 3 (1/3–8) years. Their pain, which had lasted 1–15 years, increased with activity although all patients experienced pain at rest, and sleep was disturbed in eight of them. The point of maximum pain was localized behind the trochanter, while radiating pain to the lower extremity and gluteal pain was present in seven patients. In addition, lumbar pain was present in two persons.

Injection of a local anaesthetic was tried in two patients, injection of cortisone in three, and other pharmaca were given to one patient. Stretching was tried in five patients and two were treated by a chiropractor without effect.

Operative treatment was performed bilaterally in two patients and unilaterally in eight. Tenotomy of the piriformis tendon was done in eight hips and an elongation of 2 cm was done in four hips.

At follow-up examination, two patients were almost and five were totally free of pain, including both the patients with bilateral operations. The pain was reduced in one patient and unchanged in two. The latter patients were later diagnosed as having a subluxated snapping hip and a sacro-iliac joint inflammation with an asymptomatic spondylolisthesis L5–S1 of 0.5 cm.

**Conclusion:** The piriformis syndrome is diagnosed by exclusion criteria, and is mainly based on case history, pain pattern and functional examination. Characteristically, the pain is localized behind the trochanter, radiating into the lower extremity as in ischialgia, and the pain persists both in activity and at rest. Of 12 operated hips in ten patients, ten hips were normalized or much better. Two hips which remained unchanged suffered from other diseases of the hip and sacro-iliac joint. The piriformis syndrome is a differential diagnosis when pain is present in the hip region, close to the sacro-iliac joint and the lumbar area.

## A retrospective study of patients operated with fixation of the sacro-iliac joints

Jan Roar Orlin, Roger Sørensen, Imre Gabor, Johan Emil Lange and Ingjald Bjerkreim

Sophies Minde Orthopedic Hospital, Oslo, Norway

**Introduction:** Patients operated for sacro-iliac joint pain often have diffuse and complex symptoms, with or without neurological or radiographic signs of low back disorder. Our study is a retrospective evaluation to try to clarify the indication for operative treatment.

**Material and methods:** In a 12-year period, 18 women underwent sacro-iliac osteofixation. The average age at surgery was 37 (22–53) years. Mean observation period was six years, minimum two years. In 13 patients arthrodesis was performed without using metal, and none of them had complications. Arthrodesis was carried out in five patients using AO-plates with four screws, and two of these patients developed signs of S1-root affection. In five cases additional surgical procedures, sacro-lumbar fixation or symphyseodesis, were carried out simultaneously, while in eight cases such operations were performed separately.

**Results:** Improved/satisfied: five patients, unchanged: ten patients, and deteriorated: three patients. The two patients with S1-root lesion belonged to the latter group. Three of the five satisfied patients returned to full time jobs and one to part-time work. All the others remained on disability pension due to pain.

**Conclusion:** The results of sacro-iliac joint fixation in this material seem poor. However, the improved patients had the clearest symptoms and signs of sacro-iliac disorder. The need of a thorough preoperative evaluation is underlined by the fact that symptoms related to the sacro-iliac joints in many cases may be caused by other disorders of the lower lumbar region.

## Pediatric orthopedics

### Screening by ultrasonography for hip dysplasia in newborns

Ketil Jarl Holen<sup>1</sup>, Agnar Tegnander<sup>1</sup>, Terje Terjesen<sup>1</sup> and Sturla Eik-Nes<sup>2</sup>

<sup>1</sup>Department of Orthopedics and <sup>2</sup>Department of Gynecology and Obstetrics, Trondheim University Hospital, Trondheim, Norway

**Introduction:** The aims of this report were to assess the reliability of our ultrasound method for hip examination in newborns by an interobserver study, and to correlate ultrasound findings with various perinatal data to see if new risk factors could be detected.

**Material and methods:** The material consists of 4459 children born during the period 1988–1990. The ultrasound method is based on measurement of the lateral acetabular coverage of the femoral head, expressed in percentage coverage (Bony Rim Percentage, BRP). The ultrasound findings were correlated with: sex, hip dysplasia (HD) in the family, birth presentation, weight, length, foot deformities, congenital anomalies, duration of pregnancy, and birth number. In 59 newborns the ultrasound examination was done by two or three examiners to evaluate the interobserver variation.

**Results:** The mean interobserver variation in BRP between examiner one and two was -1.5%, between examiner one and three the difference was -1.1%, and between examiner two and three it was 1.2%. The 95% confidence limit ( $\pm 2$  SD) for interobserver variation was approximately 8%. 55 children (1.2%) had neonatal hip instability both clinically and on ultrasound examination (47 girls and eight boys). The incidence of hip instability was significantly higher in children with breech delivery and in those with a family history of HD, and also for children with higher birthweight.

**Conclusions:** Because the interobserver variation in ultrasound measurement was moderate, our technique seems to be adequate for screening of the hips in newborns. Well-known risk factors for HD were confirmed but no new risk factors were detected.

### Screening for congenital hip dislocation by ultrasonography in children three years of age—preliminary results

Agnar Tegnander<sup>1</sup>, Terje Terjesen<sup>1</sup>, Ketil Jarl Holen<sup>1</sup> and Sturla Eik-Nes<sup>2</sup>

<sup>1</sup>Department of Orthopedics and <sup>2</sup>Department of Gynecology and Obstetrics, Trondheim University Hospital, Trondheim, Norway

**Introduction:** During recent years we have used ultrasonography to detect congenital dislocation of the hip (CDH), not only in newborns and infants, but also in older children. In this report we present our method and preliminary results in 3-year-old children.

**Patients and methods:** Children born in Trondheim in 1988 were examined by ultrasound. On the longitudinal, lateral scan, the distance from the lateral tangent of the ossification center of the femoral head to the lateral bony acetabular rim was measured (lateral head distance, LHD). The anterior scan was performed with the transducer along the long axis of the femoral neck. The distance from the anterior tangent of the ossification center to the anterior acetabular rim (anterior head distance, AHD), was measured. Dysplasia, subluxation and dislocation are detected by increased values of LHD or AHD.

**Results:** 293 children (586 hips) have been examined so far. Mean LHD was 0.4 mm (SD 1.3). We found one subluxated hip with LHD 7.0 mm, and one dysplasia with LHD 5.0 mm. Radiographs confirmed the ultrasound findings in these two girls, who both had been treated for neonatal CDH with a Frejka pillow. We did not detect any new cases with CDH. Regarding AHD, normal values were found in all children.

**Conclusion:** Ultrasound is an adequate method in the diagnosis of CDH also in older children. The technique, when used in screening, could provide reliable data regarding the true incidence of late-diagnosed CDH.

## Ultrasonography in the primary evaluation of patients with Perthe's disease

Terje Terjesen

Department of Orthopedics, Trondheim University Hospital, Trondheim, Norway

*Introduction:* The aim of the study was to evaluate the utility of ultrasonography in the primary evaluation of patients with Perthe's disease.

*Patients and methods:* 19 patients, 3–8 years of age, were examined by ultrasound, using a longitudinal, lateral scan and an anterior scan along the long axis of the femoral neck. The bony structure of the femoral head was evaluated. The femoral anteversion (AV) angles were determined and the coverage of the femoral head was measured. Synovitis was diagnosed as an increased distance (side difference above 2.0 mm) between the anterior femoral neck and the joint capsule.

*Results:* Ultrasound was reliable in diagnosing Perthe's disease when the surface of the ossified epiphysis was irregular and when fragmentation had occurred. There was a good correspondence between ultrasound and radiography in the assessment of femoral head coverage. 12 of the 19 patients had synovitis. The AV angle, measured by ultrasound, was significantly greater in the affected hips than in normal hips; the mean side difference was 2.9°.

*Conclusion:* Useful information was provided by ultrasound. Like conventional radiography, ultrasound showed the irregular structure of the bony epiphysis and the lateral coverage of the femoral head. In addition, an accompanying synovitis and the degree of femoral anteversion were obtained.

## Extra-articular subtalar arthrodesis according to Grice in flat feet in nonparalytic children

Olav Reikerås

Sophies Minde Orthopedic Hospital, Oslo, Norway

*Introduction:* Extra-articular subtalar arthrodesis was described by Grice in 1952 to correct paralytic flat feet in children. Since then, this operation also has been used in some cases of flat feet in children without demonstrable pareses.

*Patients and methods:* During the years 1964 to 1979 five non-paralytic children with pronounced flat feet deformity and functional symptoms were operated according to Grice technique. At operation the age of the patients ranged from six to ten years. The patients—3 women and 2 men—were followed-up after 16 to 26 years at age 22 to 34 years. At follow-up, clinical and radiographic examinations were performed, including foot-prints.

*Results:* According to subjective and objective assessments, the result was poor in one case. She had flat and rigid

feet. In the other patients, the feet were corrected, but in two cases the patients felt that the feet were stiff with a tendency towards varus tilting.

*Conclusion:* This study shows that pronounced flat feet can be corrected by Grice arthrodesis, but some patients will experience rather stiff feet with a tendency towards varus tilting.

## Leg length inequality and rotational deformity after femoral shaft fracture in children

Turid Nordbø, Anne E F Isem, Terje Terjesen, Svein Svenningsen and Ivar Rossvoll

Department of Orthopedics, Trondheim University Hospital, Trondheim, Norway

The aim of the study was to evaluate the long-term results after femoral shaft fracture in children

*Patients and methods:* 87 patients with femoral fracture at the age of 7 (2–14) years were reviewed 7 (3–12) years after injury. Three methods of treatment had been used: Bryant skin traction in the youngest children (16 patients) and skeletal traction using either the Weber table (26 patients) or the Braun frame (45 patients). Leg length inequality (LLI) and rotational deformity were measured by ultrasound at follow-up.

*Results:* The mean LLI was 6.2 mm and 30 patients (34%) had LLI exceeding 10 mm (27 overgrowth and three shortening). Patients 4–10 years of age had significantly greater LLI (mean 9.7 mm) than those younger than four years of age and those older than 11 years. Rotational deformity, defined as side difference in femoral anteversion angle of 15° or more, occurred in seven patients (8%), but none of them had any complaints. As opposed to the other methods, Bryant traction involved a trend towards external rotational deformity.

*Conclusion:* In patients younger than 11 years of age, an initial overriding of the fracture fragments of 10 mm should be aimed at. In older children, however, overriding during fracture healing should be avoided. Rotational deformity is rarely associated with any symptoms, provided that the anteversion angle at skeletal maturity is within the normal range.

## Varia

### Correction of combined angular deformity and shortening by external fixation

Terje Terjesen and Pål Benum

Department of Orthopedics, Trondheim University Hospital, Trondheim, Norway

We report our preliminary experience with recently developed equipment to correct combined angular deformity and shortening.

*Patients and method:* Two 17-year-old male patients had developed genu recurvatum after previous femoral shaft fracture treated with skeletal traction by a Kirschner pin through the proximal tibia. Lateral radiographs showed a side difference in the angle between the tibial shaft and the joint surface of the tibial condyles of 25° and 30°, respectively. Both patients had a shortening of the affected leg of 30 mm. We performed a step-cut osteotomy through the proximal tibial metaphysis and external fixation (Orthofix) with a T-shaped correction unit was used for fixation. The recurvatum deformity was initially corrected by gradual distraction of the anterior part of the osteotomy by 1 mm per day. After restoration of a normal angle between the tibial shaft and the joint surface, the angular correction unit was locked and longitudinal distraction of 1 mm per day was started. Callus developed rapidly at the posterior aspect of the osteotomy, whereas it was slower on the anterior side. There were no serious complications and the fixator was removed after 15 weeks and 16 weeks, respectively.

*Conclusion:* External fixation with a special device for correction of combined angular deformity and shortening seems to be a suitable method.

### Femoral elongation by use of an elongable intramedullary device

Per Helland

Department of Orthopedics and Traumatology, Haukeland University Hospital, N-5021 Bergen, Norway

*Introduction:* Femoral elongation by use of external fixation is inconvenient to the patients, takes long time and has a high incidence of problems and complications, according to the literature.

*Patients:* Four patients, 18 to 38 years of age, with a mean leg length discrepancy of 40 mm underwent femoral lengthening.

*Methods:* An elongable intramedullary unit was used. Internal and external rotation of the lower leg and the distal femoral fragment was transmitted by interlocking screws to the inner and distal tube of the device. The design of the unit

produced distraction of the fragments by rotations exceeding 25°. The initial elongation was limited to 15 to 20 mm.

Subsequently further bone length increase was obtained to a varying degree, by unintentional daily activity, in all the patients. When adequate bone length had been obtained, further rotation and distraction was discontinued at a second operation two to seven weeks later. A threaded interlocking screw across the cortical bone and the two titanium tubes was inserted. In addition bone chips were transplanted into the osteotomy.

*Results:* Full weight-bearing and normal knee movement was obtained within ten weeks in all the patients. Solid bony union was found within six months. Distraction and rotation was correct in all cases at follow-up.

*Conclusion:* The results were promising and we continue to use this method in order to gain more experience.

### Muscle strength evaluation following femoral shortening osteotomy

I. Holm, H. Steen, G. Follerås, P. Ludvigsen and I. Bjerkreim

Sophies Minde Orthopedic Hospital, University of Oslo, Norway

*Introduction:* Patients with unequal leg length or unacceptable tallness may undergo femoral shortening osteotomies. The aim of this study was to evaluate possible changes in muscle strength following a shortening osteotomy, and how long it takes before a reduction in strength has regained preoperative values. We also wanted to study the degree of correlation between length reduction and the change in muscle strength.

*Material and methods:* During the period 1989–1990 12 patients with an average age of 22 (16–30) years underwent mid-diaphyseal shortening osteotomies fixed by interlocking nails. Ten patients were operated due to unequal leg length, two patients because of unacceptable tallness. The mean shortening was 42 (27–70) mm. A standardized isokinetic muscle test (Cybex 340) was performed preoperatively and at 3, 6 and 12 months postoperatively. The test protocol consisted of five repetitions at 60°/second, and 25 repetitions at 180°/second. All tests were conducted by an independent person (IH).

*Results one year postoperatively:* Compared with preoperative values extension peak torque and extension and flexion average power showed highly significant differences (about 30% reduction) at high and low velocities ( $p < 0.0001$ – $p < 0.0008$ ). Extension/flexion total work also showed significant difference. Increased ratio between hamstrings and quadriceps indicated that m quadriceps was weak.

*Conclusions:* 1) A femoral shortening osteotomy leads to a long-lasting reduction of several objective muscle strength

parameters. 2) There is a good correlation between the magnitude of length reduction and the change in muscle strength ( $r = 0.70-0.81$ ). 3) The reduction in muscle strength one year postoperatively is most pronounced in m quadriceps.

## Occurrence of incapacity for work among patients treated for nonacute orthopedic disorders

Ivar Rossvoll<sup>1</sup>, Pål Benum<sup>1</sup>, Tobis R Bredland<sup>1</sup>, Kjell Solstad<sup>2</sup>, Eystein Arntzen<sup>2</sup> and Stig Jørgensen<sup>2</sup>

<sup>1</sup>Department of Orthopedic Surgery, Trondheim University Hospital and <sup>2</sup>Norwegian Institute for Hospital Research, SINTEF, Trondheim, Norway

*Introduction:* As part of a project to investigate the effect of increasing the capacity for non-acute orthopaedic surgery on the payment of sickness benefits, occurrence of incapacity for work prior to treatment was studied.

*Material and methods:* For all 2,803 patients hospitalized for non-acute orthopaedic disorders, data on employment, sickness certification, waiting time, diagnosis and treatment were collected in a population of 197,354 persons in the Trondheim area between September 1988 and August 1990.

*Results:* 1400 (50%) of the treated patients were employed, their mean age was 41 (16–73) years, 56% were men. 594 (42%) of the employed had been certified sick due to the orthopaedic disorder for some period of the waiting time. Mean duration of the waiting time was 534 days. Sickness benefits from the National Insurance, which were paid from the 15th day of sickness certification, had been received by a total of 463 patients (33%), and were received most frequently among patients treated with spine surgery (69%), total hip prosthesis (55%) and shoulder surgery (46%). 342 patients (24%) were assessed unfit for work due to the disorder and received sickness benefits from the National Insurance at the time they were put on the waiting list. At treatment this number had increased to 403 (29%). The percentage of employed patients receiving sickness benefits during waiting time increased from 26 in the age group 20–29 to 42 in the age group 60–69.

*Conclusion:* As the population was comparable to Norway as a whole, we conclude that about 50% of patients treated surgically for non-acute orthopaedic disorders in Norway are employed, and that about one quarter of the employed persons will be incapacitated for work at the time indication for surgery is present.

## Blood saving in hip and spine surgery

L. P. Kristiansen, S. Skjeldal, H. Steen, J. Grimstad and I. Bjerkreim

Sophies Minde Orthopedic Hospital, University of Oslo, Norway

*Introduction:* Transfusion of blood and blood products represents a risk for transmission of infections (Hepatitis B and C, HIV, Cytomegalia, etc) and adverse immunological reactions. This occurs even if adequate haematologic screening of blood is performed. The transfusion of homologous blood can be reduced by autotransfusion during and after surgery. Since June 1990 autotransfusion (Solcotrans Plus, Solco Basel Ltd, UK) has been used routinely in major hip and spine surgery at our hospital.

*Material and methods:* The results of 40 patients operated with primary, non-cemented total hip arthroplasty and 34 patients operated with Cotrel-Dubousset spine fixation were studied retrospectively. Half of the patients received blood by autotransfusion postoperatively. The following parameters were registered and compared for patients with and without autotransfusion: Pre- and postoperative haemoglobin, preoperative and postoperative blood loss, transfused autologous and homologous blood volume.

*Results—hip arthroplasty:* With respect to haemoglobin and blood loss values no significant difference was found between patients treated with or without autotransfusion. The patients without autotransfusion received in average 1450 (500–3500) mL homologous blood transfusions. Patients with autotransfusion received 1094 (450–2320) mL autologous blood and 350 (0–1500) mL homologous blood; half the patients had no homologous transfusion at all.

*CD fixations:* In 18 patients without autotransfusion the average total blood loss of 2433 (1200–4250) mL was replaced by 1900 (1200–4250) mL homologous blood. In 16 patients with autotransfusion the mean total blood loss of 2100 (1200–3075) mL was replaced by 1290 (440–2175) mL autologous blood and 620 (0–1800) mL homologous blood; six patients did not receive homologous blood.

*Conclusion:* By use of autotransfusion in total hip arthroplasty and in CD fixation we saved about 1000 mL and 1500 mL homologous blood, respectively. Saving was due to autotransfusion and not changes in the value of postoperative haemoglobin or surgical technique. Autotransfusion used in major orthopaedic surgery results in a significant reduction of homologous blood transfusion.

## Comparison of $^{99}\text{Tc}^{\text{m}}$ -plasmin uptake test (TPT) and venography in the detection of asymptomatic deep vein thrombosis after total hip arthroplasty

Ola Einar Dahl<sup>1</sup>, Elisabeth Leistad<sup>2</sup>, Stein Nyhus<sup>2</sup>  
and Øyvind Havig<sup>2</sup>

<sup>1</sup>Department of Surgery and Radiology, Norwegian Lutheran Hospital (Diakonhjemmets sykehus), Oslo and  
<sup>2</sup>Clinical Research Unit, Department of Surgery, Ullevål University Hospital, Oslo, Norway

To evaluate the efficacy of modern thromboprophylactic regimens, exact diagnosis and preferably non-invasive methods are needed in order to find DVT differences in the patient groups.

TPT is a scan method similar to the widely used  $^{125}\text{I}$ -fibrinogen uptake test (FUT), but is faster and easier to handle. We evaluated the TPT as a diagnostic DVT screening tool in patients undergoing hip surgery and compared the results with bilateral ascending venography.

**Material and methods:** 50 legs in 25 consecutive patients undergoing total hip replacement for coxarthrosis were studied with the TPT preoperatively, the first and sixth postoperative day.

**Results:** No clinical symptoms of DVT or lung emboli were noticed. The test results were evaluated according to the criteria proposed by Olsson (1). The table shows correct/false positive and negative results. The majority of the preoperative scan-indications could not be reproduced on the repeated postoperative scans. Calculations from our scan data obtained on the sixth postoperative day compared to venography revealed the following values: sensitivity 75%, specificity 67%, accuracy 66%, positive predictive value 16% and negative predictive value 98%.

Table

	Venography	
	Pos	Neg
TPT	Pos	3
	Neg	1
		16
		30

**Discussion:** Studies on patients with symptomatic DVT have shown a high sensitivity. This contrasts with the present result obtained among asymptomatic hip-operated patients which shows a much lower sensitivity, and an unacceptably low accuracy and a positive predictive value, which corresponds to reported results on TPT and FUT in comparable groups of asymptomatic patients (2-4).

### References:

- 1 Olsson CG et al. Tc-99m-plasmin for rapid detection of deep vein thrombosis. Nucl Med Com 1982; 3: 41-52.
- 2 Kakkar VV. The diagnosis of deep vein thrombosis using the  $^{125}\text{I}$ -fibrinogen test. Arch Surg 1972; 104: 152-9.
- 3 Winter Christensen S. et al. Contact thermography  $^{99\text{m}}\text{Tc}$ -plasmin scintimetry and  $^{99}\text{Tc}$ -plasmin scintigraphy as screening methods for deep venous thrombosis following major surgery. Thromb Haemostas 1987; 58: 831-3.
- 4 Paiment G et al. Surveillance of deep vein thrombosis in asymptomatic total hip replacement patients. Am J Surg 1955: 400-404.