

Swedish Orthopedic Society

Visby, September 7–9, 1994

Editor: Otte Brosjö

Department of Orthopedics
Karolinska Institute
S-104 01 Stockholm
Sweden

Hip

Gamma nail vs. Compression hip screw for trochanteric fractures—complications and patient outcome

L Ahrengart¹, H Thörnkvist¹, U Lindgren¹, P Fornander², K-G Thorngren², P Wahlström³, L Pasanen⁴, S Honkanen⁵

Departments of Orthopedics, ¹Huddinge University Hospital, ²Lund University Hospital, ³Hudiksvall Hospital, Sweden, ⁴Oulu University Hospital, ⁵Tampere University Hospital, Finland

Introduction: Compression Hip Screw (CHS) is the dominating fixation device for trochanteric fractures. The short Gamma nail is constructed for closed intramedullary nailing of the proximal femoral end.

Patients and methods: A prospective, randomised, multicenter study was performed to compare these two devices in the treatment of trochanteric and subtrochanteric fractures. 548 patients with 548 fractures participated. In 276 cases the Gamma nail had been used and in 272 cases the CHS. Mean age was 79 years and 72% were women. The patients were followed clinically and radiographically for 6 months.

Results: At 6 months 88% of the fractures were healed without any difference between the groups. 69% in the Gamma group had healed in the peroperative position against 58% in the CHS group ($p = 0.02$). 26% of the CHS patients had healed with a secondary dislocation, in most cases through lagscrew sliding, against 16% in the Gamma group ($p = 0.02$). No difference in the incidence of cutout was found. Among the Gamma patients 19% had pain around the greater trochanter at 6 months against 6% among the CHS group ($p < 0.001$). In 17% of the Gamma nail cases peroperative complications were noted: in 11% problems were encountered in putting in the distal locking screws correctly, in 2% an additional fracture in some part of the proximal femur occurred. In the CHS group 6% peroperative complications occurred ($p < 0.001$). No difference in the incidence of reoperations was encountered, however. No difference between the groups was noted regarding peroperative bleeding, stay in hospital, leg length discrepancy or hip

mobility or need for walking support after the operation. The Gamma nail operation did take longer time to perform ($p < 0.01$).

Conclusion: There were no significant differences in fracture healing time, overall clinical outcome or secondary complications between the groups. The Gamma nail seemed to maintain the peroperative fracture position somewhat better than the CHS but entailed more peroperative complications. The Gamma nail operation is more demanding to the surgeon than the CHS system.

Two-way compression along the shaft and the neck of the femur with the Medoff sliding plate in trochanteric and subtrochanteric fractures

Karl Lunsjö, Leif Ceder, Leif Stigsson, Anders Hauggaard

Departments of Orthopedics and Radiology, Helsingborg Hospital, S-251 87 Helsingborg

Introduction: A new concept in compression screw systems for use in high subtrochanteric and unstable intertrochanteric fractures was introduced in 1991 by Medoff. The device allows sliding to occur in the direction of the femoral shaft but also has the option to slide in the direction of the femoral neck. In this series, for the first time, a combined dynamization was permitted.

Patients and methods: The Medoff device was used by 19 different surgeons in a prospective consecutive series consisting of 121 patients, mean age 81 year, followed for 4 months. Patients with undislocated 2-part trochanteric fractures and pathological fractures were excluded. Clinical and radiographical examinations were conducted at day 1 and 7, and at 4 months, postoperatively.

Results: 2 technical failures in 107 trochanteric fractures and no technical failure in 14 subtrochanteric fractures were recorded. One of the 2 technical failures which was a lag screw penetration occurred already at surgery, an "unforced error" by the surgeon. An increased medialisation of the femoral shaft was observed both in trochanteric and sub-

trochanteric fractures but no subsequent complication due to this.

Conclusion: We advise a combined two-way compression in highly unstable and very osteoporotic trochanteric fractures in order to reduce the risk of lag screw penetration. One-way compression along the femoral shaft in subtrochanteric fractures gives a more physiological impaction of the fracture and prevents medialisation of the femoral shaft.

One-way compression along the shaft of the femur with the Medoff sliding plate in trochanteric and subtrochanteric fractures

Leif Ceder, Karl Lunsjö, Leif Stigsson, Anders Hauggaard

Departments of Orthopedics and Radiology, Helsingborgs Hospital, S-251 87 Helsingborg

Introduction: A new concept in compression screw systems for use in high subtrochanteric and unstable intertrochanteric fractures was introduced in 1991 by Medoff. The device allows sliding to occur in the direction of the femoral shaft but also has the option to slide in the direction of the femoral neck. In this series dynamization was permitted only along the femoral shaft.

Patients and methods: The Medoff device was used by 19 different surgeons in a prospective consecutive series consisting of 111 patients, mean age 81 years, with 112 fractures followed for 1 year. Patients with undislocated 2-part trochanteric fractures and pathological fractures were excluded. Clinical and radiographic examinations were conducted at day 1 and 7, at 4 and 12 months, postoperatively.

Results: 8 technical failures in 105 trochanteric fractures, all lag screw penetrations, and no technical failure in 7 subtrochanteric fractures were registered. The total sliding capacity of the plate was consumed before the fracture had healed in all but one of the cases with lag screw penetration.

Conclusion: We advise one-way compression along the femoral shaft in subtrochanteric fractures. It gives a more physiological impaction of the fracture and prevents medialisation of the femoral shaft. A combined two-way compression along the neck and the shaft of the femur may be the best treatment of highly unstable and very osteoporotic trochanteric fractures.

Cause of death 6 months after a hip fracture—a comparison with controls

Ingemar Sernbo¹, Lars Janzon², Olof Johnell¹
and Hans Erik Rosberg³

Departments of Orthopedics¹, Community Health Sciences², Surgery³, Malmö General Hospital, 214 01 Malmö, Sweden

Introduction: Earlier studies have shown an increased mortality within 6 months after a hip fracture as compared with controls. We have investigated patients with hip fractures operated on with internal fixation in Malmö during 1990 and 1991. The cause of death, according to the death certificate, within 6 months postoperatively was obtained in cooperation with the Dept of Community Health Sciences. The deceased hip fracture patients were compared regarding cause of death to a randomly selected material of age- and sexmatched controls.

Material: During 1990 and 1991, 1,169 patients with hip fracture were treated with internal fixation. The mean age was 76 ±11 years for men and 81 ±9 years for women. 77% were women and 52% of the fractures were cervical. During the first 6 months after the operation, 47 men and 127 women died. The mean age of the deceased at the time of the internal fixation was 83 years and 82 years for men and women, respectively. In three cases the cause of death was uncertain.

Results: 174 patients with hip fractures died within 6 months postoperatively and the cause of death was stated as follows in the hip fracture group and the control group, respectively: heart diseases 38%/37%, arterial embolism 8%/4%, infections 15%/15%, CVI 6%/9%, senility 7%/7%, malignant disease 14%/14%, other causes 12%/14%.

Conclusion: We found no significant differences in the cause of death after a hip fracture 6 months postoperatively compared with controls without a hip fracture. Nor did we find any differences when comparing the cause of death in hip fracture patients vs controls within 1 week, 1 month and 3 months postoperatively.

Clinical decision analysis (CDA) on displaced cervical hip fracture—method of operation in a decision tree and its costs

Ingemar Sernbo¹, Olof Johnell¹, Åke Carlsson¹,
Thomas Troëng² and Lars Janzon²

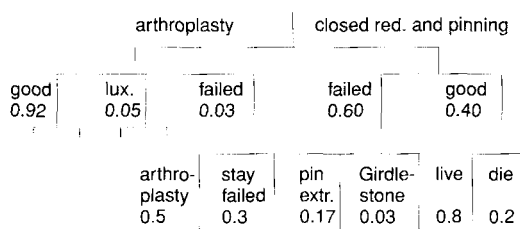
Departments of ¹Orthopedics, ²Community Health Sciences, Malmö General Hospital, 214 01 Malmö, Sweden

Introduction: There is a controversy concerning the method of choice for the treatment of displaced cervical hip fracture—closed reduction and internal fixation or primary arthroplasty. Most agree that certain patients, such as non-displaced fractures should be treated with nailing/pinning while patients with displaced fractures older than 1 week should be treated with a prosthesis. In Scandinavia we have since decades used pinning/nailing as the first method of choice in displaced cervical hip fractures, while other countries have advocated primary arthroplasty.

Method: We have tried to use a CDA focusing on our experience of the probability of outcome within 2 years after each treatment on the decision tree of the CDA. We have also tried to calculate the costs within 2 years that are to be

expected for each branch on the tree and we have found that the initial costs after nailing is SEK 37,000, after primary arthroplasty SEK 55,000 and reoperation with a hip prosthesis SEK 79,500. Including the cost of increased home aid and nursing homes we have also calculated the total cost during the first 2 years and found that primary hip prosthesis costs SEK 182,000 compared with SEK 263,000 if the patient is to be treated with nailing/pinning. You can provide a computer programme with patient facts and background including age, sex, previous fracture, concomitant diseases and, if possible, bone mass. Furthermore, you can describe and include the type and characteristics of the fracture. The CDA can also give the expected remaining life-time in years.

Conclusion: A CDA applied in patients with displaced cervical hip fracture can be used as a tool when you wish to study the best method of operation for your patient. Below: First part of the decision tree.



Metastatic insufficiency of the acetabulum—review of 5 cases reconstructed a.m. K Harrington

Per Fornander² and Ewald Ornstein¹

Departments of Orthopedics ¹Hässleholm Hospital, S-281 25 Hässleholm and ²University Hospital Lund, S-221 84 Lund, Sweden

Introduction: Extensive metastatic destruction of the acetabulum is an uncommon cause for palliative surgery in the malignancy-struck patient. 5 such patients appeared in a county hospital within 2.5 years and were operated upon.

Patients: All patients had a history of progressive unilateral pain on walking and radiographs revealed lytic metastases affecting the roof and/or the medial wall of acetabulum. 3 of the patients were women, all with breast carcinoma. 2 were men, 1 with prostatic and 1 with urothelial cancer. Age at operation varied from 64 to 71 years.

Methods: For the first patient, with a large solitary metastasis destroying the entire supraacetabular bony column, only a total hip replacement including the V-figured rodanchoring cup cementation technique of Harrington seemed appropriate. Encouraged by an excellent clinical result the same procedure with minor alterations was utilized for the following 4 patients.

Results: This reconstruction technique produces consistent results with restitution of painfree ambulation and fair to excellent hip motion. All 5 operations were retrospectively regarded as worthwhile despite the major surgical effort and patient risk. After 3.5 years one patient lives a normal life with a painfree hip and normal walking capacity. 2 lived for one year with a normal function of the hip. 2 patients died 3 months postoperatively, 1 of mors subita and 1 in, a previously undiagnosed, cerebral metastasis; both were painfree in the operated hip. Mean/median operative time was 4 (3.0–5.2) hours and intraoperative hemorrhage averaged 3.6/2.4, (1.9–7.6) L. No major mechanical complication was encountered. 2 significant deep vein thromboses occurred.

Conclusion: The Harrington arthroplastic reconstruction technique offers a valuable solution in handling metastatic insufficiency of the acetabulum.

Charnley versus Spectron—a randomized, prospective study on cemented hip arthroplasty using contemporary technique

Göran Garellick, Henrik Malchau and Peter Herberts

Department of Orthopedics, Sahlgren hospital, 413 45 Göteborg, Sweden

Introduction: Despite the fact that cemented hip arthroplasties have been performed for nearly three decades there are very few reports in the literature of prospective and randomized studies. In 1985 we started a study comparing 2 different hip prostheses. The purpose of the study was to evaluate if differences in the prosthetic design influence the long-term clinical and radiographic outcome.

Patients: 410 hips in 373 patients were randomized to 206 Charnley and 204 Spectron prostheses. Mean age at operation, diagnosis and gender were identical in the 2 groups. The preoperative diagnosis were arthrosis (59%), rheumatoid arthritis (18%), sequele after hip fracture (17%) and miscellaneous (6%). At present 91 patients (102 hips) have died and 2 patients (3 hips) are lost to follow-up. 308 hips have been followed for 5–6 years.

Methods: All patients were followed with clinical and radiographic examination preoperatively, postoperatively and at 1, 3 and 5–6 years postoperatively. The clinical results were evaluated according to the Harris Hip Score (1969). The radiographic findings were classified according to Harris (1982).

Results: The clinical outcome with a mean follow-up 5.6 (5–6) years was good. The mean pain score was 43 (max 44) and the mean Harris Hip Score 87 (max 100) reflecting an old population with high frequency of other disabilities. 92% of the patients were satisfied with the result of the hip replacement after 5–6 years, 4% were uncertain and 4% were unsatisfied. In the Charnley group (22.2 mm head diameter) we had 4 early dislocations, 2 late dislocations and 13 patients with late subluxation episodes. In the Spectron

group (32 mm head diameter) we had no dislocations. 4 patients had a late infection (2 Ch, 2 Sp – 1%). 12 hips (3%) are so far revised – 3 infections, 3 malpositioned components and 6 due to mechanical loosening. In the Charnley group 4 stems (2%) have been revised and the Spectron group 2 cups (1%). The result of the radiographic examination reveals 3 definitively and 1 possibly loose Charnley stems and 4 definitively and 1 possibly loose Spectron cups. A high percentage of the metalbacked Spectron cups have an early radiolucency.

Conclusion: As expected the early results of a randomized study of this type shows no major differences. We found a significantly increased rate of dislocation with a 22.2 mm head. The radiographic results with intermediate follow up indicate mechanical loosening of the Charnley stem and the Spectron cup. The cemented flanged Charnley Ogee cup in combination with a straight, collared cemented stem seems to be the choice for the future.

Hybrid total hip arthroplasty—preliminary report of 190 hips

Göran Garellick, Jonas Thanner, Henrik Malchau and Peter Herberts

Department of Orthopedics, Sahlgren hospital, 413 45 Göteborg, Sweden

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

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

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

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

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

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

Results: 1 patient has been lost to follow-up and one patient has died. Revisions have been performed in 2 hips, in 1 patient due to a femoral fracture and in 1 due to recurrent dislocation. The radiographic examinations have not revealed any probably or definitively loose component. Good or excellent result are reported in 85% of the patients at latest follow up.

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

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

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

Early and continous socket migration causing late revision—a roentgen stereophotogrammetric case report

Ingemar Önsten¹ and Bengt Mjöberg²

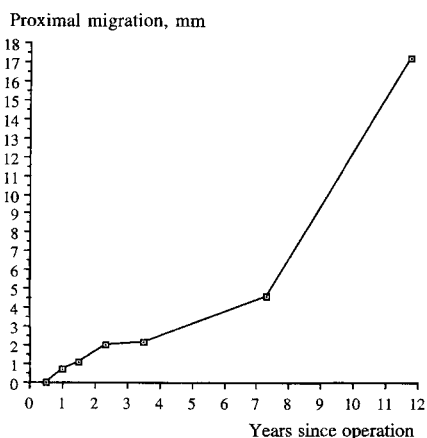
Departments of Orthopedics, ¹Malmö General Hospital, S-214 01 Malmö and ²Uppsala University Hospital, Uppsala Sweden

Introduction: Sufficient data from long-term follow-up roentgen stereophotogrammetric (RSA) studies have accumulated (2, 3) to prove that early micromovements of endoprosthetic hip- and knee joint implants are related to the final outcome. Despite this, the present debate is focused on wear particles as the one and only initiating factor of total joint failure.

Patient and methods: In 1980 a 55-year-old woman underwent a Lubinus THA due to primary arthrosis. Postoperatively her symptoms were never alleviated. In order to evaluate her THA, tantalum markers were implanted after 6 months in the pelvic bone and the proximal femur. Subsequent RSA was performed.

Results: The ESR remained between 7 and 12 mm. Socket migration was evident within 12 months, and progressed continuously thereafter (Fig). She refused a revision procedure for 12 years; by then the socket had migrated 17 mm proximally and the acetabulum had eroded to a large

cavitary defect. The total wear during the 12 years was 1.3 mm.



Discussion: This case clearly demonstrates that failure of the acetabular component might be initiated and promoted by migration, in turn leading to abrasion of the outer surface and cement fragmentation and thereby osteolysis. The annual wear rate of 0.1 mm could not explain this. This case implies that wear particles from the bearing surface is not the sole explanation to acetabular component failure (1).

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Updated information from the Swedish National THR register

Henrik Malchau and Peter Herberts

Department of Orthopedics, Sahlgren University Hospital, S-413 45 Göteborg, Sweden

Introduction: In order to assure quality control for total hip joint implants the National THR Register was started in 1979. All departments performing total hip arthroplasty are reporting to the Register.

Methods: From the participating clinics information about types and numbers of primary implants yearly are known. Complete hospital records of all reoperated THR are collected and data computerized. Patient-related factors

such as age, sex and primary diagnosis and implant-related factors for survival are analyzed.

Material: The database contains information from 18,379 reoperations. In 11,804 cases one or both components were exchanged or extracted at the operation. The remaining reoperations mainly consisted of closed reduction, a procedure that, for various reasons, is under-reported. The mean age at primary intervention was 68 years, at reoperation 77 years. 86% of revised hips had no previous revision. 2.1% were revised more than twice. Among the different factors for survival we found the cementing technique extremely important. The introduction of the modern cementing technique with distal femoral plugging, proximal seal, acetabular compression, vacuum mixing of the cement and high pressure lavage significantly improves the survival rate for the implants. We found significant difference between old, early and modern cementing technique. This difference can be shown already after 3.5 years follow-up.

Conclusion: The information obtained from this study provides an opportunity to improve the indication and implantation technique and identify implants with documented good survival.

Cemented revision total hip replacements in patients younger than 55 years old—a multicenter evaluation of second generation cementing technique

Christer Strömberg and Peter Herberts

Department of Orthopedics, Sahlgrenska University Hospital, 413 45 Göteborg, Sweden

Introduction: The results of cemented revisions have been less than satisfactory, with a high incidence of aseptic loosening. Although second generation cementing technique has resulted in a dramatic decrease in femoral component loosening in primary total hip arthroplasty, to date only a few reports have demonstrated similar benefits in revision surgery.

Material and methods: From the National Swedish Hip Register, the results of first-time revision for aseptic loosening using secondary cementing technique were evaluated in 68 patients (70 hips) younger than 55 years old. At the time of revision the average age was 47 (29–55) years. Average follow-up was 6.7 (3–10) years. 57 stems and 48 cups were revised. 2 patients died during the follow-up.

Results: Overall there were 10 (14%) rerevisions, 9 because of aseptic loosening and one because of a fracture. A separate evaluation of cups and stems showed that 13% of the cups had been rerevised for aseptic loosening and 13% were radiographically loose. Corresponding figures for the stems were 7% rerevisions and 14% loose. 29% had no pain in the revised hip, 32% slight or occasional, 28% moderate and 11% severe. 75% walked with a limp. 80% were satisfied with the results.

Conclusion: The use of secondary cementing technique

in revision total hip arthroplasty has reduced the rerevision rate, especially on the femoral side. The radiographic loosening rate is still unacceptably high. Development in cementing techniques, better education, centralisation and new bonegrafting techniques may further improve the results.

Results of cemented revision hip arthroplasty using second generation cementing technique

Peter Hultmark, Christer Strömberg, Peter Herberts

Department of Orthopedics, Sahlgrenska University Hospital, S-413 45 Göteborg, Sweden

Introduction: Long-term results after revision hip arthroplasty using first generation cementing technique have been disappointing. The purpose of this study was to evaluate the results after revision using second generation cementing technique.

Patients and methods: From 1982 to 1988 we revised 131 hips in 127 patients using second generation cementing technique. Hips revised more than one time were excluded. The remaining 111 hips (107 patients) were followed prospectively with clinical and radiographic evaluation. There were 69 revised cups and 94 stems. The reason for revision was aseptic loosening in 104 hips and infection in 7. Average age at the revision was 70 (28–84) years and average follow-up 5 years. During follow-up 20 patients had died and 1 was lost to follow-up. Bone defects were classified according to Gustilo and Pasternak. On the acetabular side 47% were minor defects (Type I), 53% moderate (Type II or III) and on the femoral side 63% minor and 36% moderate. None had severe defects. Bone transplantations were performed in 2% on femoral side and 30% on the acetabular side.

Results: The mean Harris hip score was 76 after 5 years. 81% of the patients were satisfied with the result, 8% indifferent and 11% unsatisfied. Overall re-revision rate was 9% (10 hips). 3 sockets (4%) have been re-revised, 7 (10%) are definitely loose and 3 (4%) probably loose. 8 (8%) stems have been re-revised and 2 (2%) are probably loose. 3 were Charnley short stems and 5 long stems, which gives a 14% re-revision rate for short stems and 5% for long stems.

Conclusion: Compared with previous reports on revision using classical cementing technique our results using second generation cementing technique are better. In revision surgery long femoral stems seems to do better than short stems.

Penetrating cervical hip fracture screw—report of a complication

Kent Sundgren¹ and Lennart Persson²

Departments of ¹Orthopedics Gävle Hospital, S-801 87 Gävle and ²Surgery Bollnäs Hospital, S-821 01 Bollnäs, Sweden

Introduction: Screw fixation and immediate weight bearing is a standard procedure for cervical hip fractures. Most commonly the screws slide outwards during weight bearing and union of the fracture. Sometimes inward migration and also penetration into acetabulum and pelvis are seen. The incidence of this complication is unknown.

Cases: During a period of 2 years we found 4 cases of inward penetrating cervical hip fracture screws. These 4 cases were completely identical. The penetration occurred in the left hip and it was the calcar screw that penetrated.

Discussion: This complication is rarely reported in the literature. It is important to be aware of its existence though the penetration sometimes occurs without clinical symptoms. One way to prevent penetration would be to develop a cap to attach to the non-threaded end of the screw after placing it in the femoral head.

Cemented revision hip arthroplasty with impaction grafting—histology of 4 cases

Lars R A Weidenhielm¹, Thomas W Bauer²,
Rob G H H Nelissen³, Dennis P LeGovan⁴
and W E Michael Mikhail⁵

Departments of ¹Orthopedic Surgery, S:t Görans Hospital, S-11281 Stockholm, Sweden, ²Pathology and Orthopedic Surgery, The Cleveland Clinic Foundation, Cleveland, Ohio, USA, ³Orthopedic Surgery, University Hospital Leiden, The Netherlands, ⁴Pathology, St. Vincents Hospital, Toledo, Ohio, USA, ⁵Regency Orthopaedics Spec. Inc., 2000 Regency Court #201, Toledo, Ohio, USA

Optimal surgical technique and implant design for revision hip arthroplasty for patients with significant proximal femoral bone loss are controversial. Radiographic studies have suggested that cementing an implant with a polished, tapered stem into a bed of impacted bone allograft may provide adequate joint function and restore proximal femoral bone. Radiographs of cancellous bone graft adjacent to cement are difficult to interpret, however, and the viability and remodeling capability of impacted bone graft adjacent to cement is unclear. To further evaluate this interface, we obtained biopsies of the proximal femur at the time of trochanteric wire removal from 4 cases, 11 to 22 months after cemented revision hip arthroplasty with impaction grafting. 3 relatively well-defined zones could be identified histologically: 1) an inner zone consisting of bone cement, fibrous tissue and partially necrotic trabeculae with evidence of bone remodeling, 2) a middle zone consisting of viable tra-

becular bone and probable "neo-cortex" formation with fewer particles of bone cement, and 3) an outer zone with viable cortex. Fibrous tissue was present around some of the incorporating bone graft fragments, but no continuous fibrous membrane was present. Cement particles were identified, but no polyethylene debris was visible by light microscopy. The results illustrate proximal bone remodeling with a least partial restoration of proximal femoral bone stock using the technique of cemented revision arthroplasty with impaction grafting.

Stability of uncemented hydroxyapatite-coated and cemented hip prostheses evaluated with roentgen stereophotogrammetric analysis

Lennart Sanzén¹, Ingemar Önsten¹, Åke Carlsson¹ and Jack Besjakov²

Departments of ¹Orthopedics, ²Diagnostic Radiology, Malmö General Hospital, 214 01 Malmö, Sweden

Introduction: The validity of early micromotion as measured by roentgen stereophotogrammetric analysis (RSA) of joint implants has now been established (1,2).

Patients and methods: We have evaluated micromotion by RSA at 0, 3, and 12 months postoperatively in patients with hip arthrosis treated with an uncemented hydroxyapatite-coated (HA) or a cemented prosthesis.

Series 1 comprises 13 patients with bilateral simultaneous total hip arthroplasties. A cemented prosthesis or a HA prosthesis was implanted randomly in the right and left hip. Pain was evaluated with a visual analogue scale (VAS).

Series 2 includes 26 patients with unilateral primary or secondary arthrosis managed by implanting HA prosthesis. Stability was compared with RSA data from arthrosis patients with cemented Charnley prostheses.

Results: There was no significant difference in micromotion between cemented and uncemented sockets or femoral stems in either series of patients. The average maximum migration and rotation of the sockets at 12 months was 0.2 mm and 0.4°, respectively. Stem migration measured as motion of the femoral head averaged 0.7 mm in all groups and was mainly caused by internal rotation of the stem. Preliminary results from RSA at 24 months were unchanged. VAS pain values in bilaterally operated patients did not differ between the HA and cemented side.

Conclusion: The early RSA results of HA prostheses seem to compare with cemented Charnley hips. Femoral thigh pain was not a clinical problem.

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Bioresorbable vs. titanium screws in acetabular cup fixation—a prospective and randomized study using roentgen stereophotogrammetric analysis

Jonas Thanner¹, Henrik Malchau¹, Johan Kärrholm¹, Lars Wallinder² and Peter Herberts¹

Departments of Orthopedics, ¹Sahlgren and ²Northern University Hospital, Göteborg and Umeå, Sweden.

Introduction: Titanium screws are used to provide stable primary fixation of uncemented cups. Reports of corrosion, fretting and osteolysis have initiated interest in using other fixation materials. The purpose of this study was to document the use of bioresorbable screws in clinical practice and to evaluate the early fixation using roentgen stereophotogrammetric analysis (RSA).

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

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

Results: Cups fixated with PLLA screws rotated in retroversion in contrast to the anteversion seen in the titan group (rotation around the longitudinal axis; $p = 0.02$). The total translation (vectorial sum) did not differ. Neither did the medial-lateral and anterior-posterior translations of the cup center differ ($p > 0.05$). There is an increased proximal migration in the PLLA group but the difference is not significant ($p > 0.05$). We found no clinical or plain radiographic differences between the 2 groups.

Conclusion: During the first postoperative year the pattern of rotation around the longitudinal (proximal-distal) axis differed between the 2 groups. The clinical implication of this finding is unclear and further follow up is needed.

In vivo wear of long-time successful Charnley total hip replacements

Thomas Ilchmann¹, Ljubisa Markovic², Anil Joshi², Kevin Hardinge², Hans Wingstrand¹

¹Department of Orthopedics, University Hospital Lund, Sweden and ²Centre for Hip Surgery, Wrightington Hospital, Wigan, England

Introduction: There is a correlation between aseptic loosening and wear of the acetabular cup after THA. The aim of this study was to get more information about the in vivo wear over a long period of time, not affected by eventual mechanical loosening. We made an accurate analysis with three different methods of wear assessment.

Material: The implants were Charnley total hip arthroplasties. 25 hips from the early operated patients in Wrightington Hospital were selected randomly. No revision of the cup and a good clinical result (5–6 D'Aubigné-Postel) on the latest follow-up were demanded. A maximum demarcation of 1 millimeter in zone 1 (DeLee) and a maximum migration of 5 millimeters on any radiograph were accepted. The mean follow-up time was 22 years, and mean 12 radiographs per patient were analyzed.

Methods: Migration was measured against the teardrop line. Wear was measured with the Charnley-Duo method and with the Wroblewsky method. 20 hips could be analyzed with the computerized EBRA method.

Results: Migration of more than 3 millimeters was measured on only 1 radiograph. The mean wear-rate per year was 0.05 mm (0.06 mm) and 6 (2) cups had no detectable wear as measured with the Charnley-Duo (Wroblewsky) method. There were no changes of the wear rate with time. The EBRA analysis did not provide further information.

Conclusions: Long-time successful cups do not migrate. They have an extremely low wear-rate. In vivo wear is a linear process, the rate is not affected by aging of the prostheses. No wear probably just means no detectable wear. High wear rates impair a long survival of the prostheses and are of high prognostic value.

Reconstruction of the proximal femur with long-stem prostheses after resection for tumors—the Gothenburg experience.

Peter Hultmark, Björn Gunterberg, Örjan Berlin and Bertil Stener

Department of Orthopedics, Sahlgren University Hospital, S-413 45 Gothenburg, Sweden

Two of the authors, (BS and BG) have described a way to reconstruct the proximal femur after tumor resections using a long-stem Moore prosthesis surrounded by a cement spacer substituting the resected part of the bone.

Patients and methods: 23 patients were operated on from 1974 until 1993 with the described technique. Complica-

tions, function (according to Enneking et al. 1993), and survival were assessed. 10 patients were female and 13 male (age range 18–77). Indications for surgery: metastases 12 (5 from hypernephromas), chondrosarcomas 6, giant cell tumors 2, osteosarcoma, myeloma, and fibrous dysplasia 1 each. The type of prostheses used were Moore (16) and Bateman (7).

Results: 3 revisions were performed 1–7 years post-operatively because of suspected but unconfirmed recurrence (1), acetabular wear (1), and pain of unknown cause (1). 1 patient had a hemipelvectomy due to chronic osteitis and subsequent prosthetic failure, and the only local recurrence (metastasis) also had a hemipelvectomy. Eleven of 12 patients with metastases are dead (average survival 14 months). All 6 patients with chondrosarcomas are alive with an average survival of more than 8 (2–17) years and both patients with giant cell tumors are alive 18–20 years postoperatively. Functional score among the 10 living patients with more than one year follow-up was in average 23 (13–29) points, maximum of a 30.

Conclusion: Tumors of the proximal end of the femur can be resected and the femur reconstructed successfully with long-stem prostheses supported with a spacer of acrylic cement. This is a simple and inexpensive method. The procedure is particularly suitable for metastases, and has also proven very successful in locally aggressive lesions and low-grade malignant tumors.

Knee and ankle

No signs of degenerative changes, but impaired knee function 9 years after isolated partial medial collateral ligament rupture

M Lundberg and K Messner

Department of Orthopedics and Sports Medicine, University Hospital, 581 85 Linköping, Sweden

Introduction and method: Many authors have reported excellent short- and medium-term clinical results after partial tears of the medial collateral ligament (MCL) in the knee joint. In a prospective study we followed 38 consecutive patients (mean age 24 years) with an isolated partial MCL rupture. At 4 years most patients had normal knee function and stability, and they had returned to their preinjury activity level. At the instrumented test, using the Genucom Knee Analysis System, no differences in total varus/valgus rotation were shown between injured and healthy knees. A significant decrease of the initial valgus stiffness and, simultaneously, an increase in resistance to tibial rotation for the injured compared to the healthy knee was demonstrated. 9 years after injury all patients were re-examined.

Results: Manual tests showed, similar to the previous examinations, no significant valgus laxity. Standing radiographs did not show signs of arthrosis. Knee function according to the Lysholm score was significantly reduced compared with the 4 year followup. 9 patients had sustained new injuries 2 to 8 years after initial injury (Table 1).

Conclusion: Despite near normal stability at manual and instrumental examination and absence of major signs for arthrosis, MCL ruptures lead in the long term to decreased knee function.

Table 1. Reinjuries

Structure	MCL	ACL	PCL
Ipsilateral	2	1	1
Contralateral	1	4	

Clinical experience with the Leeds-Keio artificial ligament in reconstruction of the ACL—a prospective 2 year follow-up study or until ligament failure

Jan Rading¹ and Lars Peterson²

¹Department of Orthopedic Surgery, Håssleholm Hospital, Håssleholm, Sweden and ²Gothenburg Medical Center, Västra Frölunda, Sweden

Material and methods: A study was performed on 24 consecutive patients with symptomatic chronic ACL rupture who had been reconstructed with the Leeds-Keio artificial ligament. The patients were followed for a minimum of 2 years, or until ligament failure, whichever came first. The evaluation included a clinical examination, Lysholm knee score and testing with an arthrometer KT 1000.

Results: Within 2 years from surgery 3 patients were reoperated because of a rupture of the artificial ligament leading to instability, and another 6 patients had developed significant subjective instability even in ordinary activity. Only 8 patients had a subjectively stable knee. 11 patients scored 84 points or less in the Lysholm knee score, while 13 patients scored 85 points or more. The mean difference of anterior translation between the reconstructed knee and the other knee tested with the arthrometer KT 1000 was 3.7 mm.

Conclusion: The high rate of unstable knees, 9-out of 24, due to insufficiency of the artificial ligament in this 2 year follow-up study, strongly suggests that the Leeds-Keio artificial ligament is not an effective device for the reconstruction of the ACL.

Arthroscopic ACL reconstruction—a follow up of 52 patients

Lennart Magnusson and Jüri Kartus

Departments of Surgery, Köping Hospital, S-731 81
Köping and Orthopedics NÄL County Hospital S-461 85
Trollhättan, Sweden

Introduction: In our hands open ACL surgery led to long hospital stay (mean 8 days) and long sickleave (mean 188 days). We therefore in 1991 changed methods to arthroscopic ACL reconstruction. This paper reports the preliminary results of our first 52 cases.

Patients and methods: From October 1991 to December 1992 52 consecutive patients with unilateral ACL rupture were operated on by the same surgeon (JK), using patellar tendon autograft, the Acufex protrac all endoscopic procedure and interference screw graft fixation. 12 ruptures were operated on less than 2 months after the injury (group A) and 40 later (group B). The mean age was 20 (15–32) years in group A and 25 (16–47) years in group B. The rehabilitation, being equal in both groups, consisted of CPM during hospital stay, 6 weeks of locked brace in full extension when walking and open in full ROM when exercising. 51 patients underwent a clinical examination and interview after 18 (12–28) months by an independent examiner (LM). One patient in group B was excluded due to acute contralateral ACL injury.

Results: The mean hospital stay and sickleave was 3.5 and 104 days respectively in group A compared to 3.7 and 80 days in group B. In both groups meniscal injuries were found in 80% of the patients. The mean Lysholm score of follow up was 85 in group A and 91 in group B. 11 patients in group A and 37 in group B performed competitive sports (Tegnér Level 7–10) before the injury. At follow up the corresponding figures were 8 in group A and 27 in group B. 2 patients in group A and 3 in group B were unable to go back to competitive sports because of the injured knee. Post-operative stability in both groups was examined manually. In group A one patients had 0 Lachmann, 11 had +, in group B 12 had 0, 26 had + and one patients had ++.

Conclusion: Arthroscopic ACL reconstruction in our hands gives shorter hospital stay and sickleave than open surgery. It seems to yield good knee stability and give the patients opportunity to go back to competitive sports after both acute and chronic ACL ruptures. We feel encouraged to continue using the method with the aim of further shorten the rehabilitation time and hospital stay.

MRI of anterior cruciate ligament reconstructions with semitendinosus tendon—a preliminary study

Evald Johansson and Jan Eliasson

Departments of Orthopedics and Radiology,
Mälarsjukhuset, S-631 88 Eskilstuna, Sweden

Reconstruction of the anterior cruciate ligament with a free patellar tendon autograft is a generally accepted procedure. In selected cases another graft material may be preferable (reoperations, extensor-mechanism malalignment, Mb Schlatter). The semitendinosus tendon may be a suitable option in these cases. The appearance of a tendon in a drill-hole has, however, not been fully investigated. MRI has been used to evaluate anterior cruciate ligament reconstructions and at least some authors regard it as a reliable method.

The purpose of this study was to use MRI to evaluate the semitendinosus autograft in the drillholes after an anterior cruciate ligament reconstruction.

Patients and methods: In 8 consecutive patients the anterior cruciate ligament was reconstructed using a double-loop semitendinosus graft. 3 operations were performed early after the trauma, 3 after more than 6 months and 2 were reoperations after earlier failed reconstructions. The grafts were investigated with MRI more than one year after operation using a 1.0 Tesla magnet (Siemens Magnetom SP Impact). 3 or 4 mm thick sections of both T1- and T2-weighted images were obtained in 3 different planes. After injection of contrast material (Magnevist) intravenously a T1-weighted sequence was repeated.

The MRI data of the transosseous pathway of the graft were analyzed in an attempt to answer the following questions: 1) Are the grafts well demonstrated and continuous in the bone tunnel? 2) Do the tendons have a normal signal (compared with patellar tendon or posterior cruciate ligament)? Abnormal signals were graded as slight or pronounced. 3) Is there any fluid around the grafts? 4) Can any accumulation of contrast be detected? This was graded from 1 to 4, where 1 represents scantily visible contrast and 4 a pronounced accumulation of contrast.

Results: 1) All grafts were clearly demonstrated within the bone tunnels. 2) In 8/16 of the tunnels the grafts had a normal signal intensity. 5 showed slightly abnormal signal intensity while 3 were pronounced. 3) We found no fluid accumulation around the grafts. 4) In only 3 tunnels obvious contrast enhancement was detected.

Conclusions: Our investigation has demonstrated that MRI can visualize the grafts within the drillholes. According to our criteria the tendons were well incorporated in 8/16 of the osseous tunnels. There was no fluid in the drillholes. Increased vascularity was seen around three grafts. MRI seems to be of value in evaluating anterior cruciate ligament reconstructions.

Arthroscopy under local anesthesia—a quality study

Thomas Dolk and Agust Karason

Department of Orthopedic Surgery, Regional Hospital,
S-70 185 Örebro, Sweden

Introduction: Arthroscopy under local anesthesia has been performed in increasing number of patients at our hospital since 1992. About 2/3 of all patients scheduled for knee arthroscopy were treated this way, creating better resources for other patients. The aim of this study was to evaluate patient reactions and suggestions to improve the operation.

Material: All patients undergoing knee ($n = 216$) and ankle ($n = 4$) arthroscopy under local anesthesia between August and December 1993 were sent a questionnaire in January 1994. 158 of the arthroscopies were therapeutic meniscectomy, synovectomy and loose body removal.

Results: The total response rate was 90%. There were 69 women with 63 answers and 151 men with 132 answers.

Most patients were satisfied with the preoperative planning and information although only 19% of the patients could choose operating day. The nursing care was considered excellent in spite of relatively primitive surroundings.

No premedication was given. 9% of the patients considered the anesthesia injection to be unbearably painful. During operation 3% of the patients experienced pronounced pain. 1/4 complained of not being able to relax on the operating table although most patients thought the operation and information to be very interesting. The postoperative information was considered to be adequate by most patients but there was often not enough time to discuss with the doctor afterwards. A visit 1–2 weeks after the operation was offered to 57%. Suggestions for improvements were made by 25% of the patients.

The crucial question "Would you consider local anesthesia for your other knee?" was answered positively by 77% while 15% were negative and 7% undecided.

Discussion: This study reveals a good patient acceptance of local anesthesia for knee and ankle arthroscopy. Valuable suggestions to improvements are made by the patients. This type of quality control should be one of cornerstones of orthopedic surgery.

Arthroscopy in patients older than 45 years of age

Wolfgang Gammer

Department of Orthopedics, Ludvika Hospital, S-771 81
Ludvika, Sweden

Introduction: Arthroscopy of the knee provides diagnosis and therapy in the same séance. This is especially true regarding meniscal tears and loose intraarticular bodies. In older patients, changes of the articular cartilage or synovia may influence the outcome. To evaluate the results of

arthroscopy in this patient category a retrospective investigation has been performed.

Patients: From 1978 to 1988, 1,344 arthroscopies have been performed. In this series, 304 patients were older than 45 years and 229 of those arthroscopies were performed because of clinically suspected, surgically treatable affections of the knee, such as meniscal tears or loose bodies. The other 75 arthroscopies were performed for diagnostic reasons.

Results: In the treatment group, meniscal tears and/or loose bodies were found in 167 (73%) knees. In 62 (27%) knees, the clinical suspicion of treatable condition was not verified at arthroscopy. 106 knees with positive findings at arthroscopy also had visible arthritic changes. Still 89% of the operated knees were improved after the operation. In the other 61 knees without arthritic changes the improvement rate was 96%. In the diagnostic groups, the procedure was of benefit in only 12 (16%) patients.

Conclusion: Minor arthritic changes in the knees of patients older than 45 years of age do not preclude good clinical results after arthroscopic partial meniscectomy.

The clinical application of MRI in diagnosing meniscal lesions of the knee—a cost analysis

Ulf Sennerby, Peter Fritzell, Monica Magnusson and Bengt-Erik Larsson

Department of Orthopedic Surgery Central Hospital of Falun, S-791 82 Falun, Sweden

Introduction: Several studies have shown a significant covariation between MRI and arthroscopy in diagnosing meniscal lesions. The benefit of using MRI prior to arthroscopy was investigated during clinical conditions at our department. The aim of the investigation was to evaluate whether the use of MRI preoperatively: 1) can reduce the number of cases that otherwise should have had arthroscopy, and 2) reduce the operation time.

Material and methods: During April 1991 through May 1992, 100 patients (29 women and 71 men, aged 13–62 years) were diagnosed clinically to have meniscal lesions. These patients normally would have had an arthroscopy but were instead examined with plain radiography and MRI. According to the results from the MRI, the patients were divided in two groups: Grade 1–2 lesions (group A) and Grade 3 lesions (group B). Only 10 patients in group A underwent arthroscopy to confirm the MRI results, the rest were treated conservatively. All patients in group B had arthroscopy and lesions were treated percutaneously.

Results and conclusion: Of the 100 patients investigated with MRI, 33 were allocated to group A and 67 to group B. At follow up 1.5 years later, 30 patients in group A were clinically examined or interviewed. All but one patient were free from symptoms or had minor problems with their knees. One patient had a bucket handle lesion and was treated per-

cutaneously in the beginning of the investigation. Two patients were lost to follow up. In group B one MRI result was false positive.

It seems that patients with grade 1–2 lesions can be treated conservatively in most cases. If only the 68 patients with grade 3 lesions had arthroscopy, the operation time saved would be 19 hours. The operation time saved in cases with MRI was 8 minutes in average compared to cases that have not had MRI. MRI can be a valuable tool for screening lesions in order to optimize treatment procedures and avoid surgery, but to a somewhat higher cost.

Intra-articular pressures in the human knee joint

Jorma Styf¹ and David Gershuni²

¹Departments of Orthopedics East Hospital, 416 86 Göteborg, Sweden, and ²UCSD, San Diego, Ca 92161, USA

This study investigated the occurrence of compartmentation between the anterior and posterior compartments in a normally hydrated and in a volume loaded human knee by recording intra-articular pressures simultaneously in the anterior and posterior compartments during passive motion.

Methods: 10 subjects (8 men and 2 women) with a mean age of 40 (29–64) years were studied during spinal anesthesia after arthroscopy of the contralateral knee. A fiberoptic transducer-tipped catheter was introduced through an antero-lateral portal into the anterior part of the knee joint. The second catheter was introduced through a postero-medial portal. Continuous passive motion was applied at a rate of one full cycle, (0° to 90° and then back again) in 150 seconds. Pressure were recorded for 3 full cycles. The procedure was repeated after injection of 0.9% saline (1 mL/kg body weight) into the knee.

Results: Intra-articular pressures were subatmospheric in both compartments on insertion of the catheters. In a normally hydrated knee joint pressures in the anterior and posterior compartments at the end of extension and flexion were significantly different. After intra-articular injection of saline, pressures varied between 20 and 125 mmHg depending on the position of the joint. In the volume loaded knee, pressures between compartments differed only at flexion of 80° or more.

Conclusion: Our results indicate that the normally hydrated human knee joint is compartmentalized, but overhydration diminishes this tendency.

Quality of salvaged blood after total knee arthroplasty

Tore Dalén and K Gunnar Engström

Departments of Orthopedics and Histology and Cell Biology, University of Umeå, Sweden

Autotransfusion of blood is an expanding area in clinical orthopedic practice. Shed blood from orthopedic wounds, in contrast to wounds in vascular and cardiac surgery, may be contaminated with bone fragments, fat particles and methyl methacrylate monomer. Because of this, the question has been raised whether the blood should be washed before retransfusion. The purpose of this study was to study the cellular quality of drain blood versus circulating blood within 6–8 hours, which is the limit suggested for retransfusion of drain blood.

Material and methods: 33 patients with a mean age of 70 years operated with a tricompartmental knee prosthesis had a ConstaVac® autotransfusion drainage postoperatively.

Results: The patients had a mean total pre- and postoperative bleeding of 1438 ± 137 mL (mean $\pm$ sem) of which 681 ± 89 mL was retransfused postoperatively. They were also transfused with 1.8 ± 0.3 units of homologous erythrocyte concentrate. At 2 hours ($n = 31$) drain blood had a 6% lower hemoglobin value than circulating blood ($p < 0.05$ paired t-test). Leukocytes and platelets were reduced in the drain by 70% ($p < 0.001$) and 82% ($p < 0.001$). Fibrinogen was consumed within the wound by 98% ($p < 0.001$), and thus no clotting was seen. At room temperature incubated blood glucose is consumed, primarily via anaerobic oxidation, to lactate by red cells. P-glucose in the drain was 16% lower ($p < 0.005$) than in the blood and due to lactate, pH decreased to 7.24 ± 0.01 vs. 7.34 ± 0.01 ($p < 0.001$). Acid pH is known to interfere with the ion channels of the red cell membrane and cause swelling which agreed with the MCV that increased 0.6% ($p < 0.05$). Further, some red cells lysed causing an increase in plasma hemoglobin to 563 ± 52 vs. 30 ± 5 in the blood ($p < 0.001$). At 7 hours ($n=21-25$): Results were similar to above, however, the blood quality was closer to that of circulating blood and hemoglobin was about the same and the leucocyte and platelet counts remained reduced but not as much (both $p < 0.001$), $46.4 \pm 5.5\%$ and $58.5 \pm 6.9\%$ respectively. MCV continued to increase as the pH lowered but not significantly to the 2-hour values. As better quality blood filled the drain container the amount of plasma hemoglobin was reduced ($p < 0.005$).

We conclude that postoperative drain blood after knee replacement surgery differs from circulating blood, especially concerning the leucocytes and platelets, and that incubation at room temperature causes additional changes to the blood. However, the general quality of drain blood appears quite acceptable and, in fact, improves with time from surgery with respect to hemolysis. Further investigations of quality is needed to analyze the significance of the damage to the blood.

Stem vs no stem in uncemented Freeman-Samuelson TKA—stereoradiographic study of 27 tibial components followed for 5 years

Kjell G Nilsson¹, Lars-Gunnar Brobäck², Tomas Movin² and Johan Kärrholm³

Departments of Orthopedics, ¹Umeå, ²Eskilstuna, and ³Sahlgrenska Gothenburg³

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

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

Results: 21 patients (21 knees) could be followed up to 5 years after surgery. 2 patients died (3 knees; 1 stem and 2 no stem) and 3 knees were revised (2 stem and 1 no stem).

RSA revealed that the median maximum migration (MTPM) at 5 years was 2.3 mm for the stemmed components, and 3.4 mm for the non-stemmed ones ($p = 0.180$). From 1 to 5 years postoperatively median varus/valgus tilting was about 0.6° (stemmed) and 2.1° (non-stemmed), respectively ($p < 0.05$). Median anterior/posterior tilting at 5 years was 2.3° (stemmed) and 2.2° (non-stemmed) ($p = 0.950$). In both groups almost all components subsided anteriorly and/or medially. Anterior subsidence did not significantly differ between the groups, whereas medial subsidence was significantly larger in the non stemmed group.

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

Discussion: The addition of a stem to the FS Mk II tibial component reduced varus/valgus tilting, whereas there was no positive effect of the stem on anterior/posterior tilting. However, in both the stemmed and non-stemmed groups the micromotions recorded were larger than has previously been found in other prosthetic designs evaluated with RSA. This,

and the fact that 3 knees had been revised within 5 years questions the efficacy of this prosthetic design when used without cement.

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Wear in PCA total knee arthroplasty—a 5–10-year follow-up

Arne Sahlström¹, Lennart Sanzén¹, C F Gentz²
and Inga Redlund²

Departments of ¹Orthopedics and ²Radiology, Malmö General Hospital, 214 01 Malmö, Sweden

Introduction: The main cause of wear of the polyethylene tibial insert is deterioration of material properties through heat pressing. When the first reports on delamination wear in the heat pressed polyethylene tibial inserts of the PCA total knees (Engh et al, 1992; Jones et al, 1992) appeared it was feared that a major clinical problem was at hand. In our study we aimed at detecting clinically significant wear of tibial insert in a 5–10-year follow-up of a large material of PCA total knee arthroplasty.

Patients: In our department a total of 269 patients (304 knees) were operated on between 1982 and 1987 with PCA total knee arthroplasties due to arthrosis (186) or rheumatoid arthritis (83). In 1992, 83 had deceased and 27 could not participate in a follow up examination, leaving 142 patients (158 knees) to be examined.

Method: Clinically the HSS score was used and radiographically the examination consisted of exposures in provoked varus and valgus. The radiographs were digitized and the height of the tibial inserts was compared to the known insert size, controlling for enlargement factor.

Results: Radiographic signs of wear was found in 33 knees. 5 of this knees had obvious tibial insert fracture, which led to direct revision. One patient (2 knees) declined reoperation. 24 knees had 2 mm wear and were thus considered impending failures meriting further follow up. Prior to our follow up study 17 knees had been revised: 2 due to wear, 9 due to mechanical loosening, 5 due to infection and 1 early revision due to technical error.

Discussion: Our clinical and radiographic 5–10 year follow-up of 158 knees revealed a 6% (9 knees) revision or recommended revision rate due to delaminating wear inherent to the tibial insert of the PCA total knee and 24 more impending failures due to radiographically detected wear. Thus the delaminating wear, in the PCA knee arthroplasties, exceeds any other singular factor causing revision.

Conclusion: Risk of polyethylene wear dramatically increases when heat pressing is used in manufacturing of tibial inserts. Also malalignment, incongruency, low age at operation and overweight are contributing to wear. Wear after 5–10 years exceeds any other singular factor causing

revision. Thus wear should be given due attention in future follow-up observations.

A controlled, randomized, double-blind multicenter trial of intra-articular hyaluronan treatment in osteoarthritis of the knee

L Stefan Lohmander

Department of Orthopedics, University Hospital, S-221 85 Lund, Sweden

Introduction: The results of pharmacological treatment of osteoarthritis (OA) are frequently unsatisfactory, due to insufficient effect on pain or to side effects. We have studied the efficacy of intra-articular injections of hyaluronan (HA) in OA of the knee.

Patient and methods: 240 patients (8 centers) with radiographically verified symptomatic OA of the knee (Ahlbäck stages I–II) were randomized to 5 weekly injections of either 2.5 mL saline or 25 mg HA (Artzal® Seikagaku/Astra). Results were evaluated at 0, 1, 2, 3, 4, 5, 13 and 20 weeks by visual analog scales (pain, function, motion, activity), Lequèsne index of severity of knee disease¹ (pain, walking distance, ADL) and global evaluation by patient and investigator (7 stages from much improved to much worse). At the conclusion of the study 189 patients were valid for efficacy, 51 were not due to baseline VAS pain <11 mm or baseline Lequèsne index <4, age outside 40–75, <12 patients/center, surgery, protocol violations, etc. Statistical significance of differences were evaluated by Wilcoxon 2-sample tests and area under the curve technique. The last valid value was carried forward. P-values <0.05 were considered significant.

Results: No serious side effects were noted. At 20 weeks both groups were improved compared to baseline. There were no differences between the HA or placebo groups with regard to the above mentioned measures of efficacy. Stratifications by age (under/over 60 years) or baseline Lequèsne index (under/over 10) were done prior to code-breaking to yield subgroups of approximately similar size. Evaluations of these subgroups showed significant improvement of HA over placebo treatment for global assessment in the older age group. The older age group with a baseline index of severity of knee disease >10 showed significant improvement with regard to VAS pain, Lequèsne index and global assessment compared to placebo. This difference still remained at 20 weeks. Intention-to-treat analysis confirmed these results.

Conclusions: The results of this controlled, randomized, double-blind multicenter trial in Scandinavia suggest that patients with knee OA over the age of 60 and with an index of severity of knee disease >10 comprise the most likely group to benefit from treatment with intra-articular HA. This concurs with our previous study that failed to show any benefit for a young age group with early-stage knee cartilage changes and moderate symptoms.²

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Prolonged reaction time in patients with chronic lateral instability of the ankle

Richard Löfvenberg¹, Johan Kärrholm¹,
Gunnvei Sundelin² and Olof Ahlgren¹

Departments of ¹Orthopedics, and ²Occupational Medicine, University Hospital of Northern Sweden, S-901 85 Umeå, Sweden

Introduction: Chronic lateral instability (CLI) of the ankle (recurrent sprain and giving way) occurs in 10–20% after severe ankle sprains. The condition is often associated with mechanical instability. Impaired proprioception, peroneal muscle weakness and subtalar instability have been suggested as other etiologic factors. The purpose with the present study was to investigate the reaction time to sudden ankle movement resembling a sprain situation.

Patients and methods: 15 ankles in 13 patients with symptoms of CLI were subjected to sudden angular displacement. The subjects were standing with equal weight on two trapdoors, which were released randomly one at the time. The reaction times in the peroneus longus (PL) and the tibialis anterior (TA) muscles were recorded with EMG and compared with 15 control ankles with no previous history of ankle trauma. Surface electrodes were used. The reaction time was defined from the start of the trapdoor movement indicated by an electrical switch to the first visible response on the EMG recording.

Results: Longer ($p = 0.0001$) ipsilateral reaction time was recorded in the patients (65–68 ms) compared with the controls (49 ms).

It was concluded that delayed proprioceptive response to sudden angular displacement of the ankle can be one of the causes to chronic lateral instability of the ankle.

Spine

Pathoanatomical findings in pedicle screw fixated thoracolumbar breast cancer metastases

Bogi Jónsson¹, Halldór Jónsson Jr.¹, Marianne Petré²,
Mallmin², Inger Andréasson³, Lennart Sjöström¹ and
Wolfgang Rausching¹

Departments of ¹Orthopedic Surgery, ²Diagnostic Radiology and ³Oncology, University Hospital, 751 85 Uppsala, Sweden

Introduction: Breast cancer may have a spinal metastatic involvement as high as 85% at autopsy. Patients with metastatic spinal involvement sometimes need surgical intervention to relief pain or prevent paraplegia. We conducted a study, using The Uppsala Cryosection Technique, to evaluate the long term effect of surgical intervention in thoracolumbar breast cancer metastases.

Material and methods: 11 pedicle screw fixated thoracolumbar spine specimens with breast cancer metastases were removed after freezing in situ, examined with both conventional radiography and high resolution computed tomography and then cryosectioned. The mean survival after surgery was 11 (1–32) months. There were 4 upper thoracic (T1–T6), 4 lower thoracic or thoracolumbar and 3 lumbar specimens. All had been operated on with transpedicular screw fixation. 2 patients had additional anterior surgery. The analysis particularly focused on screw position, loosening zones and deformity.

Results: Screw positioning was generally adequate. In the upper thoracic spine the posterior fixation sometimes failed in preventing progressive kyphosis. At other levels the reduction was maintained. All vertebrae adjacent to bone cement replaced vertebrae had collapsed. Loosening zones were observed around many screws.

Significance: Transpedicular screw fixation seems to prevent further deformity within the lower thoracic and lumbar spine. Maintaining reduction in the upper thoracic spine seems more difficult. Clinical symptoms correlated poorly to loss of reduction or screw loosening.

Intramuscular pressures in the erector spinae muscles during surgery of the lumbar spine

Jan Willén¹ and Jorma Sty²

Departments of Orthopedics, County Hospital, 431 80
¹Mölndal and ²East Hospital, 416 85 Göteborg2, Sweden

Introduction: The effects of 3 different spinal retractors (Codman, Acromed Viking and the Muller McCulloch) on the intramuscular pressures (IMP) in the erector spinae mus-

cles (ESM) were determined during spinal surgery.

Methods: IMP were recorded bilaterally by Myopress catheters in 8 patients, with a mean age of 50 (31–71) years, before, during and after surgery. Decompression, combined with posterior and/or anterior fusion with instrumentation was done in 6 patients, and minor decompressions in 2 patients.

Results: IMP in the anesthetized patients was 6.7 ($SD=1.8$) / 7.4 (1.8) mmHg in the left/right ESM before surgery. During preparation for the surgical procedure IMP varied between 30 and 140 mm Hg. During the surgical procedures, mean IMP was between 63 and 140 mmHg (range 40–180 mmHg) depending on the retractor used during surgery. The mean duration of the surgical procedures in the 6 patients with major surgery was 305 (215–420) minutes. Immediately following surgery IMP was 14/14 mmHg and did not exceed 26 mmHg in any case. In 3 cases followed 1 day after surgery, IMP was 10.3 (3.0) / 13.7 (4.6) mmHg.

Conclusion: IMP in the ESM during surgery on the lumbar spine increased to levels that according to other studies, would impede local muscle blood flow. However, IMP at rest after surgery was elevated to levels that do not create ischemia.

Lumbar spinal stenosis in southern Sweden—incidence and frequency of severe neurologic symptoms

Karl-Erik Johnsson

Department of Orthopedics, S-214 01 Malmö, Sweden

Introduction: Spinal stenosis usually develops slowly and the neurologic signs are often sparse and seldom dramatic. The aim of this retrospective investigation was to find the frequency of severe neurologic symptoms in central spinal stenosis.

Material: Between 1987–1991 spinal stenosis was found in 55 patients (mean age 68 years, 26 were men) at the Department of Orthopedics in Malmö and in 40 patients (mean age 66 years, 23 were men) at the Department of Orthopedics in Växjö. The diagnosis was established by myelography, CT-scanning or MRI. The catchment areas of the two departments were about 240000 and 170000 inhabitants respectively.

Results: See table.

	Peron. palsy	Leg paresis	Bladder dysf.	Cauda eq. syndrome
Malmö (n=55)	12	2	1	1
Växjö (n=40)	2	0	0	0

Annual incidence of severe symptoms in 95 patients: Peroneal palsy 2.5%, leg paresis 0.4%, bladder dysfunction 0.2%, cauda equina syndrome 0.2%.

Annual incidence of spinal stenosis (per 10⁵ inhabitants): Malmö 46, Växjö (County of Kronoberg) 47.

Conclusion: In central spinal stenosis the risk of severe neurologic problems is low. Most patients are operated on because of pain and walking difficulties and very few are emergency cases.

Spinal stenosis and inheritance of strong bone

Jan Åström¹, Margaretha Rödén¹ and Gunnar Sundström²

Departments of ¹Orthopedics and ²Clinical Physiology, Sundsvall Hospital, S-851 86 Sundsvall, Sweden

Arthrosis (OA) of the hip as well as spinal stenosis are associated with elevated bone mineral density (BMD) of the forearm (Roh et al 1974; Johnsson and Nilsson 1984). This high BMD seems to be of genetic origin in OA of the hip (Åström et al 1993). Is this the same in spinal stenosis?

Hypothesis: Children of patients operated for spinal stenosis have an elevated BMD of the forearm.

Material and methods: 55 patients (30 men, 25 women) operated with laminectomy 0–13 years ago for spinal stenosis and 57 of their children were compared to a control group constituted by 46 husbands and wives to the patients and the children. Single photon densitometry was performed on the distal forearm of patients, children and control individuals. The results were expressed in percent of age and sex specific means of BMD in a population based normal material from the city of Linköping.

Results: The mean relative BMD for the control group was 101.8%, for patients it was 109.8% ($p=0.0169$) and for children 107.5% ($p=0.0299$). There were no sex dissimilarities.

Conclusions: Both patients suffering from spinal stenosis and their children have an elevated BMD of the forearm. This supports the theory of a genetic origin that contributes to the development of the disease.

Posterolateral lumbar fusion augmented with biodegradable rods fixating the facet joints—a roentgen stereophotogrammetric analysis

Ragnar Johnsson, Paul Axelsson, Björn Strömqvist

Department of Orthopedics, Lund University Hospital. S-221 85 Lund, Sweden

Purpose: to make a roentgen stereophotogrammetric analysis (RSA) (1) of the stabilizing effect and the healing rate of posterolateral fusion augmented with biodegradable rods fixating the facet joints in lumbar disc/facet joint degeneration.

Patients: 10 consecutive patients, 7 men and 3 women, median age 42 (39–59) years, with lumbar disc/facet joint degeneration in need of surgery had a noninstrumented posterolateral fusion, including application of 0.8 mm metal indicators for the RSA, between L5–S1 in 7 cases and L4–S1 in 3. The patients were instructed to keep the trunk straight with the aid of a lumbosacral support for 5 months postoperatively.

Methods: At the posterolateral fusion cartilage and subchondral cortex of the facet joints were removed. Thereafter, a transarticular biodegradable polyglucolic-acid rod with 2 mm or 3.2 mm diameter was applied in a predrilled canal perpendicular to the surface of each facet joint. All patients were followed with RSA monthly 2–6 months and 1 year postoperatively. At each RSA the patients were examined without orthosis in supine and erect positions. The translatory movements of the vertebrae included in the fusion between these positions were calculated. Conventional radiographs were taken at 6 months and 1 year postoperatively.

Results: 1) All 7 fusions between L5–S1 healed according to RSA and radiography. 4 cases were stable within 3 months as defined by RSA, 2 within 6 months and 1 within 1 year. 2) None of the 3 fusions between L4–S1 fully healed. In all 3 cases consistent 1–3 mm intervertebral translations remained during the whole follow-up period and partial osseous fusion was noted on radiographs. 3) None of the 10 fusions showed any radiographic signs of osteonecrosis around the biodegradable rods.

Conclusions: In this study osseous posterolateral L5–S1 fusion augmented with biodegradable rods fixating denuded facet joints yielded rapid spinal stabilization and high healing rate maybe due to enhanced initial stabilization and/or increased ossification. No adverse rod effects were noted. The technique eliminates the potential early and late osteosynthetic problems of instrumented fusions. The presented technique might be a good alternative to instrumented fusion in one-level lumbosacral fusions.

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Decreased width of the spinal canal in patients with chronic symptoms after whiplash injury

Kurt Pettersson, Johan Kärrholm, Göran Toolanen and Christer Hildingsson

Department of Orthopedics, University Hospital of Northern Sweden, S-901 85 Umeå, Sweden

Introduction: The sagittal diameter of the cervical spinal canal has been shown to correlate with neurologic deficits in both traumatic and degenerative conditions. The purpose of

this study was to evaluate if the sagittal diameter of the spinal canal had any influence on the risk of developing chronic symptoms after whiplash trauma.

Patients and methods: We evaluated 48 consecutive patients admitted because of a whiplash trauma during car accidents. None of the patients had any preinjury neck symptoms, head injury or unconsciousness. 24 patients (12 men and 12 women, mean age 37 years) had persistent symptoms after 6 months, while 24 (12 men and 12 women, mean age 34) were asymptomatic. All measurements were done from standard lateral radiographs using a graphic digitiser connected to a microcomputer. The initial radiographs were used. The association between sex, remaining symptoms at follow up and recorded values of spinal canal width were evaluated using a multivariate analysis of variance (MANOVA).

Results: The multivariate test showed significant differences between asymptomatic/symptomatic even when considered relative values due to size of the vertebral body (Torg ratio). Symptomatic patients had lower values. The average values for women were also significantly lower than for men.

Conclusion: We conclude that a narrow diameter of the cervical spinal canal seems to be unfavorable in whiplash patients.

MRI and neurological findings in acute whiplash trauma—a prospective investigation of 39 cases

Christer Hildingsson¹, Kurt Pettersson¹, Göran Toolanen¹, Markku Fagerlund² and Jan Björnebrink²

Departments of ¹Orthopedics and ²Diagnostic Radiology, University Hospital of Northern Sweden, S-901 85 Umeå, Sweden

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

Patients and methods: The prospective study included 39 consecutive patients, 20 women and 19 men with a mean age of 32 (18–52) years, treated at our department because of a whiplash injury resulting from car accidents. MRI was performed with a mean of 11 (4–15) days after the injury in a blinded manner by 2 radiologists. At the same day as the MRI was performed a neurological examination was done without knowledge of the MRI findings.

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

Conclusion: Despite many pathologic findings on MRI,

we found no relationship between these lesions and the neurologic deficit in the acute phase. It seems thus not necessary to investigate these cases early after injury with MRI.

Protocol for assessment of results in treatment of back pain

Gunnar Ordeberg, Rolf Nordemar, Richard Stensman, Björn Strömquist and Alf Udén

Departments of Orthopedics, Uppsala, Lund and Malmö, and Departments of Rehabilitation Medicine, Karolinska Institute and Uppsala, Sweden

In a joint project between specialists in Orthopedics and Rehabilitation Medicine we have designed a protocol for the evaluation of outcome in patients treated for back pain. The requirements for the protocol were; the registration should be simple enough to be used in all patients with back pain; the protocol should be applicable in all different types of treatment; the measures of decreased function should be generally applicable to allow comparison to other disorders besides back pain.

The authors have now agreed upon a registration with documentation of a basic medical record and objective findings before treatment, and 3 to 4 months after treatment in a computer-adapted protocol(1). At these time points the patient will also fill a protocol with pain drawings and visual analogue scales, and a protocol reporting disability. The latter protocol was originally developed by Erik Spangfort, and has been validated in patients with back pain, and in patients with other diagnoses. The protocol is to be used prior to treatment and at follow up.

Final follow-up should be performed by the doctor, who originally referred the patient to treatment, or by the patient's GP, 12 months after treatment.

In patients with a long history of painful condition/s/ or longstanding disability, additional protocols have been chosen, measuring quality of life, sleep, depressions, personality and coping strategies. We are using these protocols routinely in our institutions to be able to make comparisons between our Departments, and between different modes of treatment. Computerized programs for registration and preparation of the data in the protocols can now be supplied and probably, service with an optical scanner for processing of patient protocol can be offered in the near future for those who are interested in this service. A possibility to provide central registration of the data will hopefully be offered subsequently.

Reference: 1. Strömquist B. and Jönsson B. (1993) Computerized follow-up after surgery for degenerative lumbar spine diseases. *Acta Orthop Scand Suppl* 251:138-42.

Scoliosis as the first sign of a cystic spinal cord lesion

Lars Samuelsson¹ and Dan Lindell²

Departments of ¹Orthopedics and ²Diagnostic Radiology, Örebro Medical Center Hospital, S-701 85 Örebro, Sweden

Introduction: Cystic spinal cord lesions may have an insidious and varied symptomatology which may be unrecognized or misunderstood, causing pain and unnecessary neurologic deterioration before proper treatment is carried out. Scoliosis may be an early sign of a syrinx regardless of an association with a Chiari malformation or spinal cord tumor.

Patients and methods: We reviewed 10 patients with scoliosis as the first sign of a cystic spinal cord lesion with the aim to identify and study early patient and curve characteristics. All patients were examined with magnetic resonance (MR) imaging of the brain and spinal cord and quantitative sensory thermal testing (QSTT).

Results: The mean Cobb angle was 21° and the curves were right thoracic in 7 patients, left thoracic in 2 and left lumbar in 1 when first seen for scoliosis. In 6 patients the cystic lesion was found when screened for syringomyelia as a routine in congenital or juvenile scoliosis or before an adolescent curve was braced. In 4 patients the diagnosis was delayed up to 17 years before neurologic deterioration warranted MR imaging which revealed 2 Chiari I associated syringes and 2 cystic spinal cord tumors. QSTT disclosed a subclinically decreased sensation in 2 of the patients without clinical findings except scoliosis. It also verified the decreased sensation in all patients in whom neurologic deterioration had complicated the clinical course of their scoliosis.

Conclusion: More frequent spinal MR screening of patients with supposed juvenile or adolescent idiopathic scoliosis even without atypical features is indicated. QSTT documents subclinical as well as overt decreased sensation and is valuable in the serial follow up of these patients to monitor the progress or the response of the cystic lesion to the treatment regimen.

Spinal fractures in patients with ankylosing spondylitis (Mb Bechterew)

A Frost¹, C Olerud¹ and G Forsgren²

Departments of ¹Orthopedics, and ²Diagnostic Radiology, Uppsala University Hospital, S-751 85 Uppsala, Sweden

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

Material: 31 consecutive patients with ankylosing spondylitis and spinal fractures treated in Uppsala from 1985 to 1993 were reviewed. There were 6 women and 25 men with a mean age of 61 (39-83) years. 16 had one level cervical

fractures, 2 had two levels cervical, 13 had thoracolumbar, and 1 had a cervical and a thoracolumbar fracture. 3 trauma mechanisms were identified: high energy trauma, low energy trauma, and insufficiency fracture. 10 of the patients had a severe neurological damage at the time of the injury (Frankel A to C), and 10 had minor neurological compromise (Frankel D). 6 patients deteriorated neurologically pre-operatively during the first 1 to 33 days after the accident. 2 patients with thoracolumbar fractures had deteriorated neurologically due to displacements during surgery at other hospitals.

Methods: All patients were treated operatively except the 2 patients with two levels cervical fractures who were managed in halo vests. In the cervical spine the AO Cervical Spine Locking Plate was used most often anteriorly and ordinary plates posteriorly. In the thoracolumbar spine the Posterior Fixator (Hosptech AB, Sweden) was used most often.

Results: The average operation time was 3.7 (0.5–9) hours and the average blood loss was 3.2 (0–16.5) L. Complications were common. 2 patients with severe neurological injuries died: one on the operation table from a cardiac arrest, the other 2 weeks after surgery from cardiac failure. 2 patients with cervical fractures deteriorated neurologically due to epidural hematomas during surgery. 2 patients had excessive bleeding. 2 patients developed infections requiring revision. Mechanical failure of the fixation developed in 6 patients. In one a halo loosened repeatedly and had to be repositioned several times. Of the other 5 loosening occurred in spines fixed unilaterally. A gross malalignment requiring reoperation occurred in one patient. All the surviving patients healed their fractures. Of the 27 patients with neurological compromise 6 remained unchanged, and 11 improved. 2 had died, and for 1 patient the present neurological status was unknown.

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

Upper extremity

Primary dislocation of the shoulder—physical activity and 10-year prognosis

Lennart Hovelius and Bengt Malmqvist

Orthopedic Department, Gävle Hospital, 801 87 Gävle

During the time period 1978–1979 we treated 257 patients,

aged 12–40 years, with or without immobilisation in a prospective Swedish multicenter study.

We classified the patients into 4 activity levels based on the risk for recurrence. Patients engaged in contact sports were assigned to group 1, and patients with no reported physical activity at all to group 4. Groups 2 and 3 consisted of patients with activity levels with less risk for recurrence than group 1 but greater than group 4.

247 patients have had a follow-up after 10 years.

The rate of recurrence was the same for all activity levels regardless of treatment and the prognosis after 10 years was mainly related to the patient age when the primary dislocation occurred.

Tension band wiring vs. nonoperative treatment of proximal humerus fractures—a prospective randomized study

Hans Törnkvist¹, Leif Ahrengart¹ and Anders Sperber²

Departments of ¹Orthopedics, Karolinska Institute, Huddinge University Hospital, S-141 86 Huddinge and ²Orthopedics, Mälarsjukhuset, S-631 88 Eskilstuna, Sweden

Introduction: The optimal treatment of proximal humerus fractures among elderly remains controversial. This prospective study aimed to compare surgical treatment (tension band wiring or cerclage wiring) with nonoperative treatment.

Materials: 43 patients (37 women, 7 men) were randomized to surgical treatment with internal fixation of the fracture (n = 22) (tension band wiring (n = 14), cerclage wiring (n = 8) or non-operative treatment (n = 21). The fractures were classified according to the AO-system as follows: Surgical group: A (n = 4), B (n = 13), C (n = 5). Nonoperative group: A (n = 4), B (n = 14), C (n = 3). Surgery was performed by 4 specialists in orthopedic surgery. At 1-year follow-up, the patients were presented to a questionnaire and were assessed clinically and radiographically.

Results: 8 patients were excluded (4 died, 4 refused to return for follow-up). 1 patient was given a hemiprostheses after 4 months. 34 patients (18 op., 16 non-op.) returned for follow-up. Patients in the non-operated group assessed higher scores of over-all shoulder function, ability to sleep on injured side, combing hair, and ability to carry a weight of 5 kg by the injured arm ($p < 0.05$). There was no difference between the groups regarding pain score or range of motion.

6 patients in the operative group suffered from major complications. 2 patients developed deep infection followed by nonunion of the fracture and avascular necrosis (AVN) of the humeral head. AVN of the humeral head was found in 2 patients and non-union of the fracture in 1 patient. 1 patient sustained a postoperative pulmonary embolus. There were no such complications in the non-operative group.

Conclusion: In this study on elderly patients with proximal humerus fractures, surgical treatment with tension band

wiring or cerclage wiring, did not offer any advantage compared to non-operative treatment. On the contrary, the surgical group developed, compared to the non-operative group, several serious complications and also worse functional outcome of the injured shoulder.

Glenoid replacement or not? Early results from a randomized study on shoulder arthroplasty

Ulf Jonsson, Dag Halvorsen, Hassan Abbaszadegan and Björn Salomonsson

Department of Orthopedics, Danderyds Hospital, S-182 88 Danderyd, Sweden

Introduction: A randomized study was performed to find out if there are any relevant functional differences after total shoulder arthroplasty compared to hemiarthroplasty. Early results are presented.

Patients and methods: Among 31 patients entered into the study 3 patients have been excluded before the randomization because of poor bone quality in the glenoid. No bone grafting was performed. Another 2 patients have been excluded from the comparison due to complications unrelated to the operative method. The mean follow up was 12 (4–24) months. In the humeral head replacement group (HH) there were 9 patients with RA and 6 patients with OA. Their mean age was 68 years and their preoperative Constant score (without strength) was 26.5 points. In the total shoulder arthroplasty group (TS) there were 6 RA and 5 OA patients. Their mean age was 60 years and their preoperative Constant score was 24.8.

Results: In the HH group the mean Constant score was 45.5 and differed significantly from the 56.5 points in the TS group ($p < 0.05$). The active elevation in the HH group was 100° and 117° in the TS group. Active outward rotation was 46.0° and 60.5° , respectively. None of these latter differences was significant.

Conclusion: This study shows some advantages of shoulder arthroplasties performed with glenoid replacement compared to just humeral head replacements. The material is small and with mixed diagnoses and the follow up is short.

Improved shoulder function after rotator cuff repair

Margareta Kronberg, Lars-Åke Broström, Olle Ahlgren, Per Wahlström

Departments of Orthopedics, Karolinska Hospital, S-104 01 Stockholm, and University Hospital, S-901 85 Umeå, Sweden

Introduction: Many patients with impingement syndrom

have a concomitant rotator-cuff rupture. These patients with shoulder pain also often have a muscle weakness and a decreased range of shoulder motion (ROM). There are different opinions how to treat these rotator cuff tears.

Patients: 40 consecutive patients with impingement syndrom and rotator-cuff ruptures have been operated on with anterior acromioplasty and rotator-cuff repair. The series consists of 38 men and 2 women. Mean age was 57 years. All patients have been followed for at least 1 year.

Methods: All patients have been operated on with open acromioplasty without detachment of the deltoid muscle, and with release of the coracoacromial ligament. Rotator-cuff repair was performed using osteosutures after soft-tissue mobilisation. The shoulder joint was immobilised for 5 weeks in internal rotation and adducted position using a sling. Passive training was performed the first postoperative day. Active exercise was started after 5 weeks.

All patients have been reviewed 6 weeks, 3 months and 1 year after surgery. ROM was measured in standing position using a goniometer. Muscle strength was measured with the Isobex 2.0 apparatus. Muscle endurance with the ability (time in sec) to keep a weight (2 kg) in the hand with the arm extended in 90° abducted position. Pain was graded using a VAS scale.

Results: Pain was decreased in all patients. ROM and in particular muscle strength were increased in all patients.

Conclusion: In patients with impingement syndrom and rotator cuff tears shoulder function will improve after acromioplasty and rotatorcuff repair. Rotator cuff repair can be recommended in these patients independent of age of the patient.

ECRL tendon arthroplasty in the treatment of trapeziometacarpal arthrosis

Jan Rading, Isam Atroshi

Department of Orthopedics Håssleholm Hospital, S-281 25 Håssleholm, Sweden

Purpose: A prospective study to evaluate the results of trapezial resection and extensor carpi radialis longus (ECRL) tendon arthroplasty in the treatment of primary trapeziometacarpal arthrosis.

Patients: 19 ECRL tendon arthroplasties were performed in 17 women, aged 57 (50–65) years. Surgery involved the dominant hand in 11 cases. Preoperatively 10 patients were employed. Preoperative symptoms included pain during thumb use in 19 cases, pain at rest in 17 and night pain in 15. Duration of symptoms was 3 (1–10) years. Preoperative radiographs were graded according to Eaton's classification: 8 thumbs were stage II, 10 were stage III and 1 was stage IV.

Methods: The trapezium was resected and the base of the first metacarpal was trapped between the APL and FCR tendons by a distally based ECRL tendon strip. Postoperative thumb cast was applied for 5 weeks. Pre- and postoperative evaluation was performed by a hand therapist. Mean follow-

up was 37 (14–56) months.

Results: 9 cases were painfree, 5 had pain on heavy duty and 5 on light duty. Patients still reporting pain after surgery showed a significant decrease in pain on the visual analog scale at final follow-up. Mean preoperative ADL scores for 11 different activities had improved significantly at final examination. 11 cases were "very satisfied", 7 were "satisfied" and 1 was not satisfied.

The mean pulp and key pinch strengths were 107% and 110% of the preoperative value, 86% and 89% of the contralateral hand and 81% and 77% of estimated normal respectively. Mean thumb radial abduction was 54 and mean palmar abduction was 49. 17 thumbs were able to touch the base of the little finger. Radiographically the distance between the base of the first metacarpal and the scaphoid was 4.5 (2–6) mm, decreasing under stress to 3 (0.5–5) mm. There was no significant subluxation of the metacarpal in any case. Tomography showed arthrosis of the scaphoid-trapezoid joint in 8 cases. Neither of these radiographic findings correlated to the degree of pain relief. 6 patients returned to their preoperative occupation, 1 to a less demanding work, and 3 had early retirement.

Conclusion: Trapezial excision and ECRL tendon arthroplasty achieved pain relief or improvement and patient satisfaction in 18 of 19 cases with primary trapeziometacarpal arthrosis.

Radial tunnel release—review of 37 consecutive cases with 1–5 years follow-up

Ragnar Johnsson², Isam Atroshi¹, Ewald Omstein¹ and Jan Rading¹

Departments of Orthopedics, ¹Hässleholm Hospital, S-281 25 Hässleholm and ²University Hospital Lund2, S-221 84 Lund, Sweden

Introduction: Entrapment of the posterior interosseous nerve (PIN) has been suggested as a cause of resistant lateral elbow and forearm pain. Reported success rates after surgical release vary from 50% to over 90%. In this study 37 consecutive radial tunnel releases were retrospectively reviewed in order to evaluate the efficacy of PIN decompression in patients with symptoms and signs of radial tunnel syndrome.

Patients: 37 forearms were operated in 19 women and 17 men, aged 43 (22–59) years. Preoperatively, all patients reported lateral elbow and proximal-radial forearm pain with arm use, 127 reported pain at rest and 17 had night pain. The mean duration of symptoms was 31 (6–120) months. All had maximum tenderness over the radial tunnel, 22 had tenderness over the lateral epicondyle, 31 had pain during resisted supination and 12 during resisted middle finger extension.

Methods: The radial tunnel was released through a posterior approach and a free fat transplant was used. All patients were evaluated by an independent examiner through review

of patients charts and questionnaires answered by the patients. Mean follow-up was 43 (14–60) months.

Results: 8 of 37 cases reported complete symptom relief and 5 marked improvement within 1–6 months postoperatively. 17 cases reported minor or no improvement, 3 worsening of symptoms and 4 recurrence of symptoms after temporary improvement. In the 24 cases with substantial residual symptoms after surgery, 13 continued to have pain even at rest, 10 had pain on light duty and 1 on heavy duty. 16 of 35 patients returned to their preoperative employment. 19 patients had to change employment or could not return to work due to persistent symptoms. 15 of 37 cases were satisfied with the surgical results while 22 were not satisfied. There were 2 postoperative radial parestheses. No correlation was found between symptom relief postoperatively and preoperative findings.

Conclusion: Radial tunnel release achieved significant symptom relief in only 13 of 37 cases. Results of PIN decompression in patients with symptoms and signs of radial tunnel syndrome are unpredictable and there is a significant number of patients with residual symptoms after surgery.

Endoscopic carpal tunnel release—results of 149 consecutive cases

Ewald Ornstein, Isam Atroshi and Ragnar Johnsson

Departments of Orthopedics, Hässleholm Hospital, S-281 25 Hässleholm, and Lund University Hospital, S-221 85 Lund, Sweden

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

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

Results: Complete symptom relief was achieved in 80% of the cases at 3 months and 89% at 6 months postoperatively. Night symptoms were reported in 2% and daytime paresthesias in 8% at 6 months. Mild scar pain was reported in 25% and moderate scar pain in 3% of the cases at 3 months postoperatively, decreasing to 2% and 1% respectively at 6 months. Abnormal preoperative sensory tests (two-point discrimination and Semmes-Weinstein monofilament) improved significantly in all cases. The pulp and key pinch strength returned to preoperative level at 3 months and the grip strength at 6 months postoperatively. Preoperative distal motor latencies measured by the electroneurometer in 114 cases were abnormal (>4.4 msec) in 58%, all had normalized or improved at 3 months postoperatively. Overall

patient satisfaction rate was 91%. 13 out of 15 patients with prior open release in the other hand preferred the endoscopic release. There were 5 postoperative digital neurapraxias, all occurred under general or regional anesthesia. 3 recovered completely and 2 improved. There was one reoperation and one possible recurrence.

The mean time to return to work was 17 (0–52) days.

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

Pediatric orthopedics

Effect of one seance surgical multiple soft tissue releases in cerebral palsy

Karin Thews, Elisabeth Olsson, Eva Brogren and Helena Saraste

Department of Orthopedics Karolinska Hospital, 171 76 Stockholm, Sweden

In Sweden, 150–200 children with cerebral palsy are born yearly. The numbers of mainly spastic para- and hemiplegia are increasing. Orthopedic surgery which aims to decrease expressions of spasticity can enable further training of motor skills. The optimal age for and the magnitude of this kind of surgery are discussed and the praxis is varying. The aim of this study was to analyze the effect of surgical procedures with respect to range of joint motion (ROM), walking capacity and pattern, ability to other motor skills, and radiographic hip status; to compare the postoperatively achieved ROM with the expected one; and to correlate the age at surgery to treatment results.

In this prospective study, 26 children in the age of 1.5 to 18 years, median 4 years, living in Stockholm with spastic di- and tetraplegia, surgically treated for spastic contractures in lower extremities with multiple soft tissue releases in 1 seance during January 1989 – June 1992 and who volunteered were included. Cases in which the surgery aimed only to improve nursing were excluded. Clinical examination, goniometric measurement of ROM, a qualitative assessment of function level and motor skills, walking analysis, and hip radiography were made preoperatively and 6 months and 2 years postoperatively.

There were significant improvements in ROM of hip, knee and ankle, in function level walking ability, and hip radiography. The function level document used was compared with a more detailed Canadian document (Russel et al 1989): Gross Motor Function Measure. The treatment dependent differences became more obvious with GMFM-test. The best results were reached in the youngest age group, 5 years or less. In the age group over 12 years, the postoperative improvement was more restricted.

Sonography and intracapsular pressure in Legg-Calvé-Perthes' disease

Göran Eckerwall¹, Hans Wingstrand¹, Peter Hochbergs², and Niels Egund³

Departments of ¹Orthopedics and ²Radiology, University Hospital, Lund, Sweden and ³Radiology, University Hospital, Odense, Denmark

Patients: 39 children with Legg-Calvé-Perthes disease (LCPD) and with a radiographically unsatisfactory development. 35 were boys. 5 had bilateral disease. The mean age at the time of the investigation was 7 (5–12) years. 30 hips were classified as Catterall group 4, 9 hips were classified as Catterall group 3. 9 hips were in the condensation stage of the disease and 30 were in the fragmentation stage.

Methods: The children were examined with sonography regarding synovitis and with intracapsular pressure recording and aspiration in conjunction with arthrography performed 15 (2–36) months after the onset of symptoms.

Results: The mean anterior sonographic capsular distension was 3.0 mm (1.0–7.0, SD=1.6) mm as compared to the contralateral, non-symptomatic hip. The mean intracapsular pressure was 4.5 (0–12) kPa with the hips in extension and neutral rotation, 9.7 (1.3–27) kPa with the hips in extension and inward rotation and 0.9 (–0.8–4.7) kPa in 45° of flexion. There was a tendency towards a decrease in sonographic capsular distension of the joint capsule with the duration of time since onset of symptoms ($p = 0.056$) and a decrease in intracapsular pressure in extension and neutral rotation with the duration of time ($p = 0.058$).

Discussion: We conclude that these children have a significant synovitis as diagnosed sonographically. This synovitis is most likely a symptomatically and prognostically important factor in LCPD due to increased intracapsular pressure, pain, a decreased range of motion and, potentially, joint contracture.

Comparison of classifications of neurological lesion level in myelomeningocele patients

Åsa Bartonek¹, Elisabeth Olsson², Helena Saraste²

¹Omsorgsnämnden, Stockholm, 194 27 Upplands Väsby, Sweden, and ²Department of Orthopedics, Karolinska Hospital, 171 76 Stockholm, Sweden

Different ways to define the neurological level of lesion makes it difficult to compare prognostic factors and treatment results.

The classifications of the neurological deficits described by Sharrard, Hoffer, Lindseth, Ferrari and McDonald were compared in 12 myelomeningocele patients.

In no patient all the classifications were equal. In 10 patients the classification according to Sharrard agreed with that of Ferrari. In 3 patients the classifications according to

Hoffer and Lindseth agreed. 3 patients were classified as a lumbar level according to Sharrard, Hoffer and Ferrari, whereas 9 patients were classified as a lumbar level according to Lindseth. According to McDonalds prediction of future ambulation, 11 patients should become community walkers.

Ambulation in the myelomeningocele patient is dependent both on neurological and orthopedic factors. The classification according to Ferrari is based on an analysis of neurological deficits and their associated deformities of locomotor system. Thus, it gives a good practical base for the judgement of orthotic and surgical treatment.

Standing and walking ability in children with myelomeningocele—comparison of two types of orthoses

Åsa Bartonek¹, Elisabeth Olsson², Helena Saraste²

¹Omsorgsnämnden, Stockholm 194 27 Upplands Väsby, Sweden, and ²Department of Orthopedics Karolinska Hospital, 171 76 Stockholm, Sweden

Standing and walking was assessed in 8 myelomeningocele patients (S2–L5 neurological lesion level according to Ferrari).

All patients were assessed using ankle-foot- or knee-ankle-foot-orthosis of Ferrari type (FAFO/FKAFO). In 4 cases a comparison was made between FAFO/FKAFOs and a traditional hinged ankle-foot-orthosis (AFO).

Stable standing was achieved in all patients with FAFO/FKAFO. With the AFO this was possible only in 2 patients, they, however, were dependent on simultaneous compensating quadriceps activity. All patients assessed stable standing as a desirable goal.

2 patients with L5 lesion level according to Ferrari (i.e. without any muscle strength in hip extensors, hip abductors and below-knee muscles) were able to walk hands-free with FKAFOs. To these patients the FKAFO was of great advantage and can be recommended to this patient group. 2 other patients with L5 lesion level were not able to walk hands-free due to pelvis obliquity and limited hip motion. They were dependent on walking aid with FAFO/FKAFOs as well as with AFOs.

Walking speed was not considered as the most important subjective criterion. Stable standing and walking, improved balance, time for dressing and undressing are factors mentioned by the children when judging quality of orthoses. Despite increased walking speed 2 of the 4 community walkers experienced a decreased ability in climbing hills and running with FAFO/FKAFOs. For this category of patients another type of orthoses might be recommended allowing a compromise between satisfying stable standing and some rocker action in foot.

Treatment of femoral shaft fractures in children by external fixation with the Monotube system

Hanne Hedin¹, Kerstin Hjort², Sigvard Blåder³

Department of Orthopedic Surgery, ¹Central Hospital of Falun, S-791 82 Falun, ²Hospital of Karlstad, S-651 85 Karlstad and ³Borås Hospital, S-5021 82 Borås, Sweden

Introduction: Over the past decade there has been a difference in opinion about the treatment of choice for closed femoral fractures in children. The classical treatment has been traction, either pin traction through the bone or skin traction, with wellknown complications like neurovascular impairment which may occur in the normal as well as the fractured limb. The pin traction may cause pin infection or damage to the epiphyses. Another effective treatment has been cast immobilization with the problems of shortening and angulation. Before 1992 the treatment of choice in our hospitals has been skin or pin traction with continued treatment at home after about 1 weeks of hospitalization, with the advantage of being at home and not having the child and one parent restricted to the hospital away from the rest of the family.

Patients and methods: Since November 1992 we have changed the treatment and instead chosen external fixation with the Monotube system, applied within the first 24 hours. The advantages are: a less invasive method than intramedullary nailing, a better control of the fracture with good stabilization, less pain, early mobilization, shorter hospitalization and faster return to school. The system allows dynamization if needed and the removal of the pins can be offered as an outpatient procedure.

Results: The number of patients treated in all 3 hospitals was 20. Most of the fractures were closed. The age of the children ranged from 3–15 years. The complications were superficial pin-hole infections which disappeared after local treatment and/or antibiotics. None resulted in change of pins, deep or chronic infection. No cases of non-union or malalignment were seen. A temporary stiffness of the knees was seen in some of the patients as long as the system was in place but none was persistent. All fractures healed with less than 10° of angular deviation and full range of associated joint movements. We conclude that external fixation of femoral fractures is a satisfactory method.

Varia

Hyaluronan and its derivatives in orthopedic medicine—basic principles and clinical applications

Charles Weiss

Mount Sinai Medical Center, Miami Beach, Florida USA

The Swedish scientific community has played a prominent role in elucidating the structure, function, and distribution of hyaluronan in the musculoskeletal system. Hyaluronan is the molecule responsible for creating the fluid viscoelastic matrix which permeates and protects connective tissue and surfaces during movement. When these functions are disrupted by disease or trauma, exogenously applied preparations of hyaluronan and its derivatives can provide useful therapeutic tools. In the late 60's and 70's, hyaluronan was found to be an effective treatment for traumatic arthritis in race horses. Additional experiments demonstrated its effectiveness in improving joint movement and preventing scarring. Clinical application in man revealed its effectiveness as a treatment for arthritis and as a viscosurgical tool in ophthalmology. Specific methods were developed during the 1980's to crosslink the natural hyaluronan molecule while retaining its biological non-reactivity and significantly enhancing its viscoelastic properties and tissue residence time. As a result of this matrix engineering new biopolymers derived from hyaluronan, generically termed hylans, were produced and are being used in a variety of applications in orthopedic viscosurgery and in viscosupplementation for the nonsurgical treatment of pathologic conditions. Several double blind clinical studies have shown the effectiveness of this material in the symptomatic treatment of arthritis. Results from clinical applications of this material will be presented, including current usage as well as potential applications under investigation.

Whole blood rheology in orthopedic post-operative autotransfusion

Tore Dalén and K Gunnar Engström

Departments of Orthopedics and Histology and Cell Biology, University of Umeå, Sweden

There is an increasing demand for autologous blood, and postoperative retransfusion of filtered shed blood can be a complement to other methods, of pre- or intraoperatively saved autologous blood. However filtered drainage blood has been questioned for its quality.

Material and methods: We studied blood deformability, in terms of whole blood filtrability, in 12 patients operated with a tricompartmental knee prosthesis. The ConstaVac® autotransfusion system was used and consists of a plastic

container with a constant suction to the wound drainage. The blood is retransfused through a 40 mm filter except for the last 100 mL which is left in the container. The reinfusion is stopped after 8 hours. No anticoagulant is added. We analyzed Hb, EPC, EVF, Ery-MCV, LPC, TPC, P-glucose, P-pH and P-free Hb at 2 hours and 5 hours for both circulating and drain blood. We also studied the 2 hour drain blood after static incubation at room temperature, at 5 hours and 24 hours after the operation ended. In these different blood samples whole blood filtrability was studied using a technique with constant pressure, 600 Pa, EVF 40 and 5 mm pore size, with respect to initial filtration rate and clogging rate.

Results: The changes in the drain blood was similar to our earlier report "Quality of salvaged blood after total knee arthroplasty", and we found a continuous rise in acidity and lowering of glucose after incubation. The filtration index, reflecting the resistance of blood to pass narrow pores, showed that drain blood compared to venous blood had an improved filtrability at 2 hours (27% $p < 0.05$, paired t-test). This correlates with a lower leukocyte count, because these cells are slowly filtered. The clogging rate was also lower in the shed blood (25%, $p < 0.01$), which also correlates to leukocyte depletion. The filtration index and clogging rate in venous blood showed no significant changes between 2 and 5 hours. In incubated drain blood we observed a further decrease in filtration index at 5 hours compared to 2 hours (33%, $p < 0.005$) but no change at 24 hours. The clogging rate did not change between 2, 5 and 24 hours. The earlier observed swelling of the erythrocytes (Ery-MCV) in drain blood at 7 hours was also observed here at 5 hours (0.8%, $p < 0.05$) but did not affect the filtrability in any negative way.

We conclude that the changes in whole blood filtrability in shed blood is probably caused by leukocyte depletion and that the erythrocyte quality measured with filtrability showed only small changes within 24 hours of incubation and did not affect the erythrocytes in a significant negative way.

Quantitative analysis of periosteal callus structure

M Magnusson¹, N Inoue², S Larsson¹, W Kim², H T Aro², E Y S Chao²

¹Department of Orthopedic Surgery, Akademiska Sjukhuset Uppsala, 751 85 Uppsala, Sweden; and

²Orthopedic Biomechanics Laboratory, Department of Orthopedic Surgery, The Johns Hopkins University, Baltimore, MD 21205, USA

Introduction: The structure of the fracture callus changes dramatically over the fracture healing period. A study on the callus structure is important for the understanding of the new bone formation and the remodeling process as well as to estimate the mechanical properties of the callus. In this

study the structure of the periosteal callus was analyzed quantitatively using a dog model.

Materials and method: Standardized transverse mid-diaphyseal tibial osteotomies were performed bilaterally on 44 adult mixed-breed dogs and stabilized with a 2 mm gap using a custom-made unilateral 6 halfpin Orthofix external fixation device. One week after the surgery one fixator on each dog was unlocked to allow axial loading while the contralateral side was kept locked throughout the study. These dogs were killed at 8 days, 2, 4, 9 and 12 weeks after the osteotomy. The histological specimens from 4, 9 and 12 weeks and the Backscattered-Electron Images from 6 weeks were digitalized and analyzed by a two dimensional Fourier analysis to quantify the callus structure.

Results: Comparing the specimens from different times after the initial surgery showed some interesting changes in trabecular orientation. The results from the 4 weeks specimens showed a diffuse orientation from a mean of 0° to 83° . In the 6 weeks specimens the orientation was more organized away from the bone surface and ranged from a mean of 48° to 87° . In the 9 weeks specimens the orientation had changed significantly as compared to the result from the 6 weeks specimens. The orientation was now closer to the axis of the bone with a mean of 3° to 46° . The 12 weeks specimens showed similar tendency toward bone axis orientation with a mean of 0° to 49° . When comparing the dynamized side to the control side within each time period there was a significant difference in the 6 weeks group. The control group had now changed to a more of a bone axis orientation while the dynamized group was still in a more perpendicular orientation. At 9 weeks the difference was still apparent but not significant. At 12 weeks the groups were about the same.

Discussion: These findings might indicate that the callus structure is controlled by the mechanical environment under the Wolff's law in the later period of fracture healing. The analysis of the callus structure may show the mechanical condition of the callus.

Dynamic CT and MR—development of method and technique for evaluation of lumbar spinal canal stenosis

Jan Willén¹, Barbro Danielsson², Arne Gaultitz³, Tomas Nicklasson²

Departments of ¹Orthopedics and ²Radiology, Mölndal Hospital, Sweden

Introduction: CLT and MRT investigations in patients with signs of spinal stenosis are commonly performed in a relaxed supine position, which may result in difficulties to evaluate the degree and location of the spinal encroachment, especially in borderline cases.

Material and methods: A transferable loading device for use in CT-myelography investigation was constructed. In this device the lumbar spine can be exposed to an axial force similar to the force in the upright standing position.

40 patients (80 levels L3–S1) were included in the study. 8 patients were investigated in psoas relaxed position (PRP), extension (E) and axial compression (400N) in extension (ACE); the other 32 patients only in PRP and ACE.

The cross sectional area of the dural sac in disc level (d-CSA) was measured.

Results: A decrease in the d-CSA occurred in E but significantly more in ACE. In ACE 70 out of 80 levels decreased its d-CSA in average 25 (2–85) mm². In 19 out of 34 levels where d-CSA was between 50 and 110 mm² (relative central stenosis) at PRP the decrease in d-CSA at ACE was in average 25 (17–40) mm².

Conclusions: This study showed that the space within the dural sac was significantly decreased in more than 60% of all levels investigated at a simulated upright position of the lumbar spine. It seems necessary to do a dynamic CT myelography in patients with signs of lumbar spinal stenosis, if they have shown a d-CSA of approximately 110 mm or less in some level at regular CT investigation. A nonmagnetic loading device for MRT use is available but the results on patients investigated are not analyzed yet.

Coccygodynia

Mohammed Zayer

Department of Orthopedics, Ängelholm Hospital, S-262 81 Ängelholm, Sweden

Introduction: The word coccyx is derived from the Greek word for cuckoo because of the resemblance to the beak of this bird. The painful coccyx (coccygodynia) was described by Simpson in 1859. It is a symptom rather than a disease, which may be affected by congenital deformity, fracture, infection, sprain, arthritis or tumors (chordoma, teratoma, chondrosarcoma or osteosarcoma, rarely psychoneurotic, and often there is no identifiable cause (idiopathic).

Material and method: Since 1978, 10 coccygectomies were performed, all in women, aged 46 (26–74) years, who had tried conservative treatment. 5 patients had a history of trauma. Radiographs showed forward angulation of the coccyx in 9 cases. The incision was longitudinal with total resection of the coccyx.

Results: All were completely satisfied after the operation except 1 who was deceased at the time of follow-up. 1 patient had an infection, which healed 3 months after the operation after antibiotic treatment.

Conclusion: The material is small but shows that, cases with traumatic or idiopathic coccygodynia may benefit from coccygectomy.